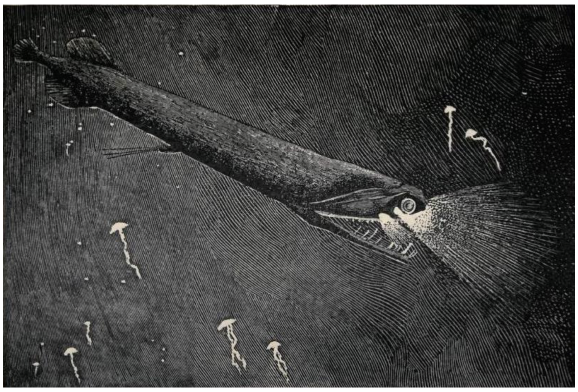
生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	細菌有助於感知遠紅光 (Bacteria help sense far-red light)
生物系統 LIVING SYSTEM	黑柔骨魚 (Lightless loosejaw)
功能類別 FUNCTIONS	#感知來自環境的光（不可見光譜） #Sense Light (Non-visible Spectrum) From the Environment
作用機制標題	松頜龍魚的視網膜透過吸收它們所吃細菌的色素來感知遠紅光。 (Retinas of loosejaw dragonfish sense far-red light by incorporating pigments from bacteria they eat.)
生物系統/作用機制示意圖 (確認版權、註明出處；畫質)	 Holder, Charles Frederick, 1851-1915 / Wikimedia Commons /

作用機制摘要說明 (SUMMARY OF FUNCTIONS MECHANISMS)

「黑色松頜龍魚 (Malacosteus niger) 是一種掠食性深海物種，通常生活在 3,000 至 6,000 英尺（915 至 1,830 公尺）深處近乎黑暗的環境中。他們如何在黑暗中狩獵？透過能夠看到遠紅光。

「所謂可見光譜遠紅端的光具有最長的波長，約為 0.73-0.8 微米。雖然人眼看不見這種光，但包括巨口魚在內的一些動物可以看到這種光。巨口魚的眼睛後面有一對發出藍綠色光的生物發光器官。這個黑暗領域中的大多數其他生物發光生物也發出藍色的光，並且擁有對可見光譜的藍色部分內的波長敏感的眼睛。

「第二對生物發光器官位於龍魚眼睛下方，發出遠紅光，海洋深處幾乎所有其他生物都看不到這種光。這些器官使龍魚比其競爭對手更具優勢，因為它們發出的遠紅光使龍魚能夠照亮潛在的獵物，並在不暴露其存在的情況下與其他同類進行交流。

「但是巨口魚怎麼能看到遠紅光呢？在「吃什麼就是什麼」的奇怪情況下，它可能透過吃被稱為橈足類的微小甲殼類動物來獲得這種能力，而這些甲殼類動物又吃掉了可以吸收遠紅光的細菌。 1998 年，包括布里斯託大學研究員 Ron Douglas 博士在內的英國科學家團隊發現，龍魚的視網膜含有改良版的細菌葉綠素，這種色素可以吸收遠紅光。 （舒克 2001：18-19）

「大多數深海魚類的視覺色素對 460-490 nm 左右的波長最敏感，這是傳統藍色生物發光和暗淡殘留陽光的強度最大值。掠食性深海龍魚 Malacosteus niger，與 Aristostomias sp. 密切相關。 Pachystomias microdon 除了發出藍色生物發光外，還可以從軌道下發光體發出遠紅光，這是其他深海動物看不見的。而馬兜鈴屬 sp。使用對紅色敏感的視覺色素增強其長波長敏感性，我們現在報告說，M. niger 使用葉綠素衍生物作為光敏劑獲得了相同的結果。”

“The black, loose-jawed dragonfish (*Malacosteus niger*) is a predatory deep-sea species that normally lives in near darkness at depths of 3,000 to 6,000 feet (915 to 1,830 m). How can they hunt in the dark? By being able to see far-red light.

“Light at the far-red end of the so-called visible spectrum has the longest wavelength of all, around 0.73-0.8 micrometers. Although invisible to the human eye, this type of light can be seen by some animals, including the dragonfish. Behind the dragonfish’s eyes is a pair of bioluminescent organs that emit blue-green light. The majority of other bioluminescent creatures in this dark realm also emit bluish light, and have eyes that are sensitive to wavelengths within the blue portion of the visible spectrum.

“A second pair of bioluminescent organs, located beneath the dragonfish’s eyes, give off far-red light, which is invisible to nearly all other life in the ocean depths. These organs give the dragonfish an advantage over its competitors, since the far-red light they emit enables the dragonfish to illuminate potential prey and to communicate with others of its own species without betraying its presence.

“But how is the dragonfish able to see far-red-light? In a strange case of ‘you are what you eat,’ it probably obtains this ability by feeding on tiny crustaceans known as copepods, which have in turn eaten bacteria that can absorb far-red light. As revealed in 1998 by a team of scientists in Britain, including Bristol University researcher Dr. Ron Douglas, the retinae of the dragonfish contain modified versions of bacterial chlorophyll, pigments that can absorb far-red light.” (Shuker 2001:18-19)

“Most deep-sea fish have visual pigments that are most sensitive to wavelengths around 460-490 nm, the intensity maxima of both conventional blue bioluminescence and dim residual sunlight. The predatory deep-sea dragon fish *Malacosteus niger*, the closely related *Aristostomias* sp. and *Pachystomias microdon* can, in addition to blue bioluminescence, also emit far-red light from suborbital photophores, which is invisible to other deep-sea animals. Whereas *Aristostomias* sp. enhances its long-wavelength sensitivity using visual pigments that are unusually red sensitive, we now report that *M. niger* attains the same result using a derivative of chlorophyll as a photosensitizer.” (Douglas et al. 1998:423).

文獻引用 (REFERENCES)

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