生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	黏液繭防止天敵侵襲 (Mucous cocoon protects from predators)
生物系統 LIVING SYSTEM	藍頭綠鸚嘴魚 *Chlorurus sordidus* (Daisy parrotfish)
功能類別 FUNCTIONS	#保護免受動物危害 #Protect from animals
作用機制標題	鸚嘴魚透過腺體分泌圍繞身體的黏液繭，避免寄生蟲的侵襲及遮蔽嗅覺線索 (Glands of the parrotfish protect it from parasites and mask olfactory cues by secreting a mucous cocoon that surrounds the fish.)
生物系統/作用機制示意圖	

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

巨顎水虱科 (Gnathiid) 是一類等足類甲殼動物，其幼體以魚的血液為食。遭感染的鸚嘴魚在白天會尋找清潔魚幫牠清除寄生蟲；然而在晚間，他們比較無法防禦這種寄生蟲的侵擾。於是鸚嘴魚在睡覺前會先分泌包覆身體的黏液繭，以這種類似蚊帳的保護性生物聚合物膜克服此問題。這種繭是從鰓腔中的巨大腺體所分泌，是以焦硫酸鹽鍵結 (pyrosulfate bond) 進行高度交叉鏈接的細小醣蛋白 (glycoprotein) 所組成。這種體外聚合物網可以使小分子滲透但能避免寄生性的巨顎水虱進入。這個行為被認為涉及到阻隔等足類以氣味分子尋找鸚嘴魚和物理性防止寄生蟲接觸到鸚嘴魚的組合機制。夜間分泌黏液的能量消耗只佔鸚嘴魚每天能量總量約 2.5%，是一種非常有效率的生存策略。

Gnathiids are a family of isopod crustaceans whose larvae feed on the blood of fish. During the day, infected parrotfish seek out cleaner fish to consume the parasites; however, at night they are relatively vulnerable to attack. Parrotfish overcome this vulnerability by secreting a mucus cocoon before sleeping which envelopes their bodies with a protective biopolymer that functions similar to a mosquito net. The mucus is secreted from large glands in the gill cavity and is composed of small glycoproteins which are extensively cross-linked through pyrosulfate bonds. This exopolymer net allows small molecules to permeate but prevents the parasitic gnathiids from entering. The process is thought to involve a combination of blocking odorants which the isopods use to target the fish and physically preventing them from approaching the fish. The nightly mucus secretion only

consumes ~2.5% of the daily energy budget of the parrotfish which makes it a very efficient strategy.

文獻引用 (REFERENCES)

「以魚類血液為食的外寄生性巨顎水虱 (Gnathiidae)…珊瑚礁魚類中，主要是一些隆頭魚 (wrasse) 和鸚嘴魚 (parrotfish)，最值得注意的夜間行為之一是在晚上牠們用巨大的黏液繭將自己包裹住…巨顎水虱科的等足類生物襲擊許多珊瑚礁魚類，尤其是在夜晚。於白天，鸚嘴魚不時會尋找清潔魚，只有牠們可以控制巨顎水虱的侵擾，但不清楚鸚嘴魚在晚上如何控制巨顎水虱的侵襲…明顯地，黏液繭被去除後的魚更容易遭受巨顎水虱攻擊 (94.4%)，而黏液繭沒有被去除的魚則較少受害 (10%)。」 (Grutter et al. 2010: 292)

「藍頭綠鸚鵡魚 (*C.* [*Chlorurus*] *sordidus*) 透過晚上停留在黏液繭中，可以避免受到經常在晚上襲擊魚類的巨顎水虱，以及其他寄生性等足類動物的攻擊，尤其是棲息於珊瑚礁上的寄生蟲種類繁多…繭可能會透過掩蓋巨顎水虱用來尋找魚的嗅覺線索，或充當物理性或化學性屏障，以阻止其侵擾…生產繭的能量消耗，估計佔其每日能量總值的 2.5%…也許可以解釋為什麼魚每晚都可以生產繭，甚至如果需要的話可在同一個晚上生產第二個繭…其它魚類可採用的抵抗寄生蟲行為，包括尋找能幫忙清除寄生蟲的生物、避開傳染性環境和受感染的個體、沿著底物摩擦、減少在淺灘活動，都會耗費較大量能量。然而，黏液繭透過使用適度節能的方式阻止寄生蟲的侵擾…與多種驚人的適應行為和其他動物使用有毒化合物的行為相反，鸚鵡魚透過生理適應來阻止寄生蟲。這涉及位於鰓腔和/或鰓蓋骨下高度特化的巨大腺體，這些腺體分泌一種結構，不僅可以保護整條魚；而且還可以讓魚入睡，這是其他任何動物都未曾發現的組合特質…相比之下，黏液繭更讓人聯想到人類為控制叮咬節肢動物而建造的蚊帳之類的保護屏障。」(Grutter et. 2010: 293)。

黏液繭…是一種有大量雙硫鍵結網絡，大約 21 kDa 表觀分子量 (apparent molecular weight) 的細小醣蛋白所組成。 (Videler et al. 1999: 1124)

“Ectoparasitic gnathiid isopods (Gnathiidae), which feed on the blood of fish…One of the most notable nocturnal behaviours of coral reef fishes, mainly some wrasses and parrotfishes, is the large mucous cocoons that they envelop themselves in at night…Gnathiid isopods attack many coral reef fishes, especially at night. During the day, parrotfish repeatedly seek cleaner fish, which only control gnathiid infestations during the day but it is not clear how parrotfish control gnathiids at night…Significantly, more fish from which the cocoon had been removed (94.4%), compared with fish with cocoons not removed (10%), were attacked by gnathiids.” (Grutter et al. 2010: 292).

“By remaining in a mucous cocoon at night, parrotfish *C.* [*Chlorurus*] *sordidus* may avoid being attacked by gnathiids, which regularly attack fish at night and possibly other parasitic isopods, of which there is a wide range on coral reefs…Cocoons may prevent infestation by masking olfactory cues used by gnathiids to find fish or act as a physical or chemical barrier…The moderate investment in cocoon production, estimated at 2.5 per cent of their daily energy

budget…may explain why fish can produce cocoons nightly and also could produce a second cocoon on the same night if needed…Anti-parasite behaviours fish can engage in, including seeking cleaner organisms, avoiding infectious habitats and infected individuals, chafing along a substrate, reducing activity and shoaling are relatively energetically costly. Using mucous cocoons, however, circumvents this limitation by deterring parasites in a moderately energetically efficient way…In contrast to the astonishingly diverse behavioural adaptations and the use of toxic compounds in other animals, parrotfish use a physiological adaptation to deter parasites. This involves large highly specialized glands in the gill cavity and/or under the operculum, which secrete a structure that not only protects the whole fish but also allows the fish to sleep, a combination of features not known to occur in any other animal…Mucous cocoons, in contrast, are more reminiscent of the barriers, such as mosquito nets, constructed by humans to control biting arthropods." (Grutteret al. 2010: 293).

"The mucous cocoon…is an extensive disulphate bonded network of small glycoproteins of about 21 kDa apparent molecular weight." (Videler et al. 1999: 1124)

參考文獻清單與連結 (REFERENCE LIST)

Grutter, A. S., J. G. Rumney, T. Sinclair-Taylor, P. Waldie, and C. E. Franklin. (2010). Fish mucous cocoons: the 'mosquito nets' of the sea. *Biology Letters* 7: 292-294. (https://doi.org/10.1098/rsbl.2010.0916)

Videler, H., G. J. Geertjes, and J. J. Videler. (2002). Biochemical characteristics and antibiotic properties of the mucous envelope of the queen parrotfish. *Journal of Fish Biology* 54: 1124-1127. (https://doi.org/10.1111/j.1095-8649.1999.tb00864.x)

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/Chlorurus_sordidus
https://www.onezoom.org/life/@Chlorurus_japanensis=419750?img=best_any&anim=flight#x553,y547,w0.2746
https://eol.org/pages/613933

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AskNature 原文連結

https://asknature.org/strategy/mucous-cocoon-protects-from-predators-2/