

## 生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	黏性腺毛捕捉昆蟲 (Sticky hairs capture insects)
生物系統 LIVING SYSTEM	南非捕蟲樹 <i>Roridula gorgonias</i>
功能類別 FUNCTIONS	#永久性附著 #獲得、吸收、或過濾生物 #Attach permanently #Capture, absorb, or filter organisms
作用機制標題	南非捕蟲樹葉片腺毛的黏性分泌物透過多步驟黏合捕捉過程，幫助捕捉昆蟲獵物 (Sticky secretions from leaf hairs of <i>Roridula</i> plants help capture insect prey via a multi-step adhesive capture process.)
生物系統/作用機制 示意圖	
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)	
<p>「因為好奇想知道南非捕蟲樹 (<i>Roridula gorgonias</i>) 實際上是如何誘捕獵物，來自馬克斯·普朗克金屬研究所 (Max Planck Institute for Metals Research) 以及德國基爾大學 (Kiel University, Germany) 的 Dagmar Voigt, Elena Gorb 與 Stanislav Gorb 決定仔細研究南非捕蟲樹葉片腺毛 (hairs) 的層級...Voigt 和她的同事假設運氣不好的昆蟲會因一連串的事件而與植株的黏性葉片互相纏結。首先，昆蟲會擦過或被黏在長腺毛 (long hair) 上。隨著牠開始扭動，會接觸到更多長腺毛，被腺毛的黏性分泌物所纏住。然後，牠會接觸到更堅硬、有著中強度黏性的中長度腺毛，最終則是被堅硬而黏性最強的短柄腺毛完全困住。結果掙扎中的昆蟲能量耗盡而動彈不得。」 (Knight 2009: ii)</p> <p>“Curious to find out exactly how <i>R. gorgonias</i> leaves ensnare their prey, Dagmar Voigt and Elena and Stanislav Gorb from the Max Planck Institute for Metals Research and Kiel University, Germany, decided to take a closer look at the hierarchy of hairs on <i>R. gorgonias</i> leaves... Voigt and her colleagues suspect that hapless insects fall foul of the plant's sticky leaves in a cascade of events. First, the insect brushes against, and sticks to, a long hair. As it begins to thrash around, it contacts more of the long hairs, becoming entangled in their sticky secretions. Next, it contacts the stiffer medium length hairs with intermediate strength adhesive and is finally trapped by the rigid short hairs with the strongest glue. Eventually the struggling</p>	

insect runs out of energy and is immobilised.” (Knight 2009: ii)

#### 文獻引用 (REFERENCES)

「南非捕蟲樹這種原始食蟲植物 (protocarnivorous plant) [趙怡姍註：即具有消化獵物但沒有吸收功能的植物] 的捕蠅紙式陷阱 (flypaper trap) 已知能捕捉不同的昆蟲，甚至是那些有著巨大體型的，這是透過不同尺寸腺毛 (glandular trichomes) 使用富有黏性、黏彈性 (visco-elastic) 的樹脂狀 (resinous) 分泌物而做到的。然而，最近的實驗性研究證實了觸手狀長腺毛分泌物的黏性並不如以往假定般有力。可能有人會問，為什麼這種捕蠅紙式陷阱會有這麼高效率。在以往研究中，我們比較了不同尺寸腺毛中分泌物的幾何形狀、靈活度以及黏附特性。我們使用光學及低溫掃描式電子顯微鏡分析植株及其表面的整體形態，並量測不同表面上腺毛的硬度以及其分泌物的黏附特性。在這項研究中呈現出綜合結構性及實驗性的結果，使我們推測南非捕蟲樹代表了三維度的陷阱，由三種功能層級所組成（植株、葉片及腺毛）。根據它們的大小，我們區分了三型在葉片有特別排列的腺毛。最長的腺毛與最短的相比有較大靈活度和較小黏性，短腺毛有 48 倍強的堅硬度及 9 倍高的黏性強度。我們的數據支持作出的假說，即最短腺毛適應於強力而長期地黏住昆蟲獵物，而最長的腺毛則負責起始的捕捉及纏繞功能。(Voigt et al. 2009: 3184)

“The flypaper trap of the protocarnivorous plant *Roridula gorgonias* is known to capture various insects, even those having a considerable body size, by using an adhesive, visco-elastic resinous secretion released by glandular trichomes of different dimensions. However, recent experimental studies have shown that the adhesion of long tentacle-shaped trichome secretion is not as strong as previously assumed. One may then ask why this flypaper trap is so highly effective. In the present study, we compared geometry, flexibility and the adhesive properties of secretion in different sized trichomes. We have analysed the gross morphology of the plant and its surfaces using light and cryo-scanning electron microscopy. Trichomes' stiffness and the adhesive properties of their secretion on different surfaces were measured. A combination of structural and experimental results, presented in this study, let us suggest that *R. gorgonias* represents a three-dimensional trap consisting of three functional hierarchical levels (plant, leaves and trichomes). According to their size, we classified three types of trichomes having a particular arrangement on the leaf. The longest trichomes are more flexible and less adhesive compared with the shortest ones. The latter are 48 times stiffer and their secretion has a 9 times higher adhesive strength. Our data support the hypothesis that the shortest trichomes are adapted to strong, long-term adherence to prey insects, and that the longest trichomes are responsible for initial trapping and entanglement function.” (Voigt et al. 2009: 3184)

#### 參考文獻清單與連結 (REFERENCE LIST)

Knight, K. (2009). Hair hierarchy helps *R. gorgonias* get a grip. *Journal of Experimental Biology* 212: ii. (<https://jeb.biologists.org/content/212/19/ii.2>)

Voigt, D., E. Gorb, and S. Gorb. (2009). Hierarchical organisation of the trap in the

protocarnivorous plant *Roridula gorgonias* (Roridulaceae). *Journal of Experimental Biology* 212: 3184-3191. (<https://jeb.biologists.org/content/212/19/3184>)

#### 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/Roridula\\_gorgonias](https://en.wikipedia.org/wiki/Roridula_gorgonias)

#### 撰寫/翻譯/編修者與日期

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