


# 生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	提供養分的關係 (Relationship provides nutrients)
生物系統 LIVING SYSTEM	山地樹鼯 <i>Tupaia montana</i> (Mountain Tree Shrew)
功能類別 FUNCTIONS	#獲得、吸收、或過濾化學物質 #不同物種之間合作/競爭 #Capture, absorb, or filter chemical entities #Cooperate/compete between different species
作用機制標題	豬籠草及樹鼯以交換養分維持互利共生關係 ( <i>Nepenthes</i> pitcher plants and treeshrews maintain a mutually beneficial relationship by exchanging nutrients.)
生物系統/作用機制 示意圖	 <p>[文中所提的三種與 treeshrew 共生的種類 <i>N. rajah</i>, <i>N. macrophylla</i> 及 <i>N. lowii</i>，趙怡姍補充]  <a href="https://www.newphytologist.org/blog/tricks-traps-tree-shrew-toilets/">https://www.newphytologist.org/blog/tricks-traps-tree-shrew-toilets/</a></p>
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)	
<p>在婆羅洲的熱帶雨林裡，一種大型的食蟲植物 (carnivorous plant)，馬來王豬籠草 (<i>Nepenthes rajah</i>)，以及稱為樹鼯 (treeshrew) 的一種小型哺乳類動物有著良好的關係。豬籠草會以美味的蜜液吸引樹鼯前來。在此同時，這哺乳類動物會放下富含氮素的糞便到捕蟲瓶 (pitcher) 中作為覓食場地的標記。</p> <p>豬籠草有特殊的葉子，能形成一個稱為捕蟲瓶的高身水瓶。它們吸引昆蟲到捕蟲瓶口邊緣的能力最為人類熟悉，尤其是螞蟻。捕蟲瓶口邊緣表面光滑，能使昆蟲失去抓力而掉進</p>	

瓶內。瓶中汁液會消化昆蟲並釋出養分。然而，馬來王豬籠草生活在山中缺乏營養的區域中，並不會有太多的昆蟲。所以吸引而非捕食樹鼯是不錯的方法來獲得額外氮素。與此同時，樹鼯同樣得到食物。氮素對光合作用非常重要，能幫助植物葉片、根部及枝條的生長。

馬來王豬籠草沒有光滑的表面，因為它並不捕食樹鼯。這種植物反而有獨特的把戲從樹鼯中得到它需要的東西。在捕蟲瓶的上方是一個蓋子，猶如馬桶蓋，蓋子朝前在瓶子上方，蜜液位於蓋子的邊緣處。蜜液與捕蟲瓶的開口位置剛好與樹鼯的長度完全一樣。這使得這種動物跨立在瓶口以舔食蓋子上的蜜液，而牠的糞便就剛好落在捕蟲瓶裡。

這個植物-哺乳類動物的故事可以教導我們自利而利人的重要性。因為這對雙方都有益處的關係才有機會繼續下去。

In Borneo's tropical forests, a large, carnivorous pitcher plant, *Nepenthes rajah*, and a small mammal called a treeshrew have a great relationship. The pitcher plant lures the treeshrew in for some delicious nectar. While there, the mammal marks its feeding spot by dropping nitrogen-rich feces into the pitcher.

Pitcher plants have special leaves that form a tall jug, called a pitcher. They are best known for luring insects, especially ants, to the rounded rims of their pitchers. The rim of the pitcher has a slippery surface that causes insects to lose their grip and fall inside. Juices then digest the insects to release nutrients. However, *Nepenthes rajah* lives in a nutrient-poor area in the mountains that doesn't have a lot of insects. So attracting, but not eating, the treeshrew is a good solution for getting additional nitrogen. At the same time, the treeshrew also gets fed. Nitrogen is important for photosynthesis and it helps the plant build leaves, roots, and stems.

*Nepenthes rajah* doesn't have slippery surfaces because it's not going to eat the treeshrew. Instead it has a special trick to get treeshrews do what the plant needs. Over the top of the pitcher is a lid, kind of like a toilet bowl lid (watch video). The lid angles upward over the top of the pitcher, and the nectar is on the edge of the lid. The distance from the nectar to the front of the pitcher's opening is the exact same length as the treeshrew. This forces the animal to straddle the rim as it licks the nectar off the lid, and its feces drop directly into the pitcher.

This plant-mammal story can teach us the importance of meeting our own needs while also helping other people. Because it's good for both parties, the relationship is likely to continue.

## 文獻引用 (REFERENCES)

「肉食性的豬籠草屬植物生長在缺乏營養的基質中，而且會長出瓶子狀的葉片器官（捕蟲瓶），能夠捕捉節肢動物作為氮素及磷素的來源。多種婆羅洲產的豬籠草展示了嶄新的獲取營養能力。尤其是三種巨大的高山物種致力於與山地樹鼯 (*Tupaia montana*) 建立互利共生關係，樹鼯在拜訪時排便到捕蟲瓶中，同時亦會取食捕蟲瓶蓋上分泌的蜜液…在初步的觀察中，我們發現巴魯大家鼠 (*Rattus baluensis*) 同樣會取食馬來王豬籠草捕蟲瓶的糖分分泌液並排便到瓶中，而這種行為似乎是一種習慣。我們發現山地樹鼯與巴魯大家鼠都參與了與馬來王豬籠草的互利共生互動…這項研究是首次證實了食肉植物與多種小型哺乳類動物群落的互利共生關係。另外，新發現的巴魯大家鼠與馬來王豬籠草的共生關係亦是食肉植物與哺乳類動物多向資源共生關係唯二的例子。」 (Greenwood et al. 2011: 1)

“The carnivorous pitcher plant genus *Nepenthes* grows in nutrient-deficient substrates and produce jug-shaped leaf organs (pitchers) that trap arthropods as a source of N [nitrogen] and P [phosphorus]. A number of Bornean *Nepenthes* demonstrate novel nutrient acquisition strategies. Notably, three giant montane species are engaged in a mutualistic association with the mountain treeshrew, *Tupaia montana*, in which the treeshrew defecates into the pitchers while visiting them to feed on nectar secretions on the pitchers’ lids…During initial observations we discovered that the summit rat, *R[attus]. baluensis*, also feeds on sugary exudates of *N. rajah* pitchers and defecates into them, and that this behavior appears to be habitual. We found that both *T. montana* and *R. baluensis* are engaged in a mutualistic interaction with *N. rajah*…This study is the first to demonstrate that a mutualism exists between a carnivorous plant species and multiple members of a small mammal community. Further, the newly discovered mutualism between *R. baluensis* and *N. rajah* represents only the second ever example of a multidirectional resource-based mutualism between a mammal and a carnivorous plant.” (Greenwood et al. 2011: 1)

#### 參考文獻清單與連結 (REFERENCE LIST)

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#### 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/Mountain\\_treeshrew](https://en.wikipedia.org/wiki/Mountain_treeshrew)

[https://www.onezoom.org/life/@tupaia\\_montana](https://www.onezoom.org/life/@tupaia_montana)

<https://eol.org/pages/327856>

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<https://asknature.org/strategy/relationship-provides-nutrients/>