

# 生物策略表

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|---|---|
| 類別  | 生物策略 (Strategy)   |
| 生物策略<br>STRATEGY  | 提供營養、住處及保護的關係<br>(Relationship provides nutrients, housing, protection)   |
| 生物系統<br>LIVING SYSTEM   | 牛角相思樹 <i>Vachellia cornigera</i><br>(Bullhorn Wattle)   |
| 功能類別<br>FUNCTIONS   | #不同物種之間合作/競爭 #保護免受動物危害<br>#Cooperate/compete between different species #Protect from animals  |
| 作用機制標題  | 牛角相思樹提供營養及住處給螞蟻，作為互利共生關係中螞蟻保護樹木免受草食性生物危害的回饋<br>(Bullhorn acacias provide nutrients and housing for ants in return for protection from herbivores thanks to a mutualistic relationship.) |
| 生物系統/作用機制<br>示意圖  |   |
| 作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)  |   |
| <p>在墨西哥及中美洲的低地，牛角相思樹 (bullhorn acacia tree, 金合歡屬 <i>Vachellia cornigera</i>) 與相思樹蟻 (<i>Pseudomyrmex ferruginea</i>) 這種螞蟻互相幫助而生存。這稱為互利共生關係 (mutualistic relationship)，為兩個物種或多個物種共同合作提供對方所需。相思樹蟻積極地保護牛角相思樹免受草食性昆蟲、鄰近植物，以及致病性微生物的危害。牛角相思樹則提供螞蟻充足的食物以及用作居住並育幼的地方。</p> <p>牛角相思樹有著像牛角的怪異尖刺。細小的相思樹蟻切開小洞作為入口進入尖刺中，那裡就是牠們照顧卵及幼蟲的地方。在三年間，相思樹蟻的族群可以從單獨一隻蟻后產下第一顆卵，增長到一棵樹中充斥著 16,000 隻工蟻。尖刺能防水並能保持濕度，在乾早期能保護卵及幼蟲。它們尖銳的末端能防止鳥類捕食裡面的卵。</p> <p>除了提供住宿之外，牛角相思樹還以特殊腺體分泌蜜液的形式提供食物。蜜液是充滿糖分的濃稠糖漿。但對於相思樹蟻來說更珍貴的，是富含蛋白質、脂肪營養、及維他命的</p> |   |

細小囊泡，這稱為貝氏體 (Beltian bodies) ，生長在牛角相思樹的葉片末端。相思樹蟻會將貝氏體餵給幼蟲。這兩個食物來源提供了相思樹蟻大部分的食物。

所以相思樹蟻又為牛角相思樹做了什麼呢？這些快速而敏捷的工蟻在樹上奔跑並保護樹體免受草食性生物例如昆蟲（包括其他螞蟻）及較大型動物例如齧齒類的危害。發現入侵者的相思樹蟻發出氣味警報 (odor alarm)，使其他螞蟻作出攻擊。相思樹蟻會殺死任何外來的植物，例如觸碰到樹體的藤蔓。牠們亦會積極地殺死任何在樹木基部附近生長的植物。因此，牛角相思樹不需要與其它樹木競爭泥土養分、水分及陽光。最近，科學家亦發現了相思樹蟻也會從腳部散播細菌到牛角相思樹的葉片上。這些細菌能殺滅會感染葉片的真菌及其它致病細菌。

類似這樣的互利共生關係演化了超過百萬個世代。這種關係幫助牛角相思樹以及相思樹蟻渡過例如乾旱的艱難時期。在人類社會中，我們知道透過分享資源及靈感來尋找方法共同合作比起獨自行動更為有效率。牛角相思樹與相思樹蟻也透過剛好的方式達到對方需求而明白了這一點。

In the lowlands of Mexico and Central America, the bullhorn acacia tree and a species of ant (*Pseudomyrmex ferruginea*) help each other to survive. This is known as a mutualistic relationship, where two or more species work together to provide what the other needs. The ant aggressively defends the acacia from plant-eating insects, neighboring plants, and disease-causing microorganisms. The acacia provides the ant with plenty of food and a place to live and raise its young.

The bullhorn acacia has odd-looking thorns that look like bull horns. The tiny ants cut entrance holes into the thorns, and that's where they care for their eggs and larvae. In three years, the population of ants can grow from the lone queen ant laying her first eggs to a tree teeming with 16,000 worker ants. The thorns are waterproof and hold in moisture, which protects the eggs and larvae during dry periods. Their sharp tips keep birds from going after the eggs inside.

In addition to providing housing, the acacia provides food in the form of nectar from special glands. The nectar is a thick syrup full of sugars. Even more valuable to the ants are tiny sacs full of proteins, fatty nutrients, and vitamins called Beltian bodies that grow on the end of acacia leaves. The ants feed these Beltian bodies to their larvae. These two food sources provide most of the food for the ants.

So what does the ant do for the acacia? The fast and agile worker ants race around the tree defending it from plant-eaters such as insects (including other ants) and larger animals like rodents. The ant that finds an invader sends out an odor alarm that causes other ants to attack it. The ants kill any foreign plants, such as vines, that touch the trees. They also aggressively kill

any vegetation growing around the base of the tree. Because of this, the acacia does not have to compete for soil nutrients, water, and sunlight with other trees. Recently, scientists have also discovered that the ants also spread bacteria from their feet onto the acacia leaves. These bacteria can kill fungi and other disease-carrying bacteria that have infected the leaves.

Mutualistic relationships like this evolve over millions of generations. The relationship helps both the tree and ant survive difficult times like droughts. In human societies, we know that acting alone is less effective than finding ways to work together by sharing resources and ideas. The acacia and the ant have it figured out by meeting each other's needs in just the right ways.

### 文獻引用 (REFERENCES)

「我們在這裡調查了經典的螞蟻/植物互利共生演化史：中美洲的螞蟻物種相思樹蟻 (*Pseudomyrmex ferrugineus*) 與尖刺膨大的相思樹 (金合歡屬物種 *Vachellia* species) 的合作。在這個系統中，相思樹蟻獲得了膨大的托葉尖刺作為築巢空間，以及從花外蜜腺還有特化的葉片先端食物體 (貝氏體 Beltian bodies) 獲得食物。相思樹蟻作為回報而保護寄主植物免受草食性生物及競爭性植物所危害，透過積極地巡邏來移除或驅逐入侵者，以及修剪競爭植物...其他金合歡屬的物種並沒有像這些中美洲蟻-金合歡般呈現出互利共生的性狀，包括適宜居住的膨大尖刺、食物體以及增大的花外蜜腺。」(Ward and Branstetter 2017: 1-2)

「部分種類的相思樹演化出特殊構造來支持相思樹蟻群落...在新生葉片尖端的橘色物體只會用來餵養相思樹蟻。相思樹亦會分泌蜜汁作為相思樹蟻的食物，以及長有膨大中空的尖刺作為巢穴位置。作為回報，擁有強力螫針的相思樹蟻會攻擊毛蟲、鹿、以及任何其他嘗試取食相思樹葉片的動物。」

「部分螞蟻-植物的合作關係非常強烈，螞蟻一生只居住在同一種樹上。牛角相思樹長有巨大中空的尖刺，被瘦小、鐵鏽顏色的相思樹蟻所佔據。牛角相思樹不只產生蜜汁，在幼葉尖端還有特殊的富含脂肪及蛋白質之小瘤。這些物質提供了蟻群所需的全部營養。為了使樹體有更多生長機會，相思樹蟻甚至會割除樹木基部的雜草。」(Forsyth 1992: 52)

備註：在其它物種的相思樹也會出現類似共生關係，包括鑷莢金合歡 (*Vachellia drepanolobium*)。

“Here we examine the evolutionary history of a classic ant/plant mutualism: the association of Central American ants in the *Pseudomyrmex ferrugineus* group with swollen-thorn acacias (*Vachellia* species). In this system, the ants receive nesting space in the form of swollen stipular thorns, and food from extra-floral nectaries and specialized leaf-tip food bodies (Beltian bodies). The ants in return protect their host plant from herbivores and competing plants, by patrolling aggressively, removing or repelling intruders and clipping competing vegetation...other species

of *Vachellia* do not display the constellation of mutualism-associated traits—inhabitable swollen thorns, food bodies and enlarged extrafloral nectaries—shown by the Mesoamerican ant-acacias.” (Ward and Branstetter 2017: 1-2)

“Some types of acacia trees have evolved special structures to support acacia ant colonies...The orange bodies on the tips of new leaflets are used only to feed the ants. The trees also excrete nectar for ant food and have swollen hollow thorns that can be used for nest sites. In return, the ants, which are equipped with powerful stingers, attack caterpillars and deer and any other animals that try to eat the acacia leaves.”

“Some ant-plant partnerships are so strong that the ants live their entire lives within one kind of tree. Bulls horn acacia trees have large hollow thorns that are occupied by skinny, rust-coloured acacia ants. The trees produce not only nectar but also special oil- and protein-rich nodules on their young leaf tips. These provide all the nutrition the ant colony will ever need. To allow the tree better growing opportunities, the ants even trim away weeds from its base.” (Forsyth 1992: 52)

Note: Similar relationships occur with other species of acacia, including *Vachellia drepanolobium*.

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#### 延伸閱讀

<https://vimeo.com/95765123>

#### 生物系統延伸資訊連結 (LEARN MORE ABOUT THE LIVING SYSTEM/S)

[https://en.wikipedia.org/wiki/acacia\\_cornigera](https://en.wikipedia.org/wiki/acacia_cornigera)

[https://www.onezoom.org/life/@acacia\\_cornigera](https://www.onezoom.org/life/@acacia_cornigera)

<https://eol.org/pages/642783>

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