

## 生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	警戒提供了一個預警系統 (Alerts provide an early warning system)
生物系統 LIVING SYSTEM	黑頂山雀 ( <i>Poecile atricapillus</i> ) (Black-capped chickadee)
功能類別 FUNCTIONS	#生態系統中合作 #保護免受動物危害 #Cooperate within an ecosystem #Protect from animals
作用機制標題	對掠食者特定的警戒透過提供一個預警系統，容許多個物種存活 (Predator-specific alerts allow multiple species to survive by providing an early warning system.)
生物系統/作用機制 示意圖	
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)	
<p>森林中小鳥的聲音就像是混雜的啼嘖聲 (trills)、口哨聲，以及唧唧聲 (chirps)，令人感到混亂。但那其實在進行著大量的溝通。科學家發現鳥類及哺乳類會廣播關於鄰近掠食者的警報，而不同物種（包括哺乳類）能互相明白這些訊息。牠們甚至能夠共享附近掠食者的種類及大小資訊，以及掠食者正在做什麼。</p> <p>黑頂山雀 (black-capped chickadee) 是一種細小、黑白相間的小鳥，生活在森林中。牠們最廣為人知的就是“chickadee dee dee”的鳴叫聲。這些及其它叫聲使牠們能互相保持聯絡，或是讓對方知道哪裡找到食物。較少被人類注意到的是一種非常安靜、高頻率的“seet”叫聲。牠們以這種聲音來警告其他動物有鷹或是貓頭鷹飛近。</p> <p>當山雀看到正在棲息的鷹或貓頭鷹，牠們亦會有另一種叫聲。那是一種比平常更嘈吵及更長版本的“chickadee dee dee”叫聲。這種改變過的聲音能吸引其他鳥類「圍攻」(mob) 掠食者。當掠食者對山雀來說越危險，牠們就會發出越多次的“dee”。例如細小的山鵲鴞 (Northern pygmy owl)，會吃掉非常多的山雀，就會有較多的“dee”。較巨型的大角鴞 (great horned owl) 有較小威脅性，因此山雀會有較少的“dee”。刺耳的“chickadee dee dee”表示山雀看到一隻老鷹或是貓頭鷹，並需要附近其他鳥類一同圍攻掠食者直到其飛走。</p>	

“seet” 叫聲則有著不同目的。因為這種叫聲非常安靜而高頻率，難以被掠食性鳥類所聽到。這代表比起較低沉嘈吵的“chickadee dee dee”，山雀能夠更安全地發出這種“seet” 叫聲。當一隻鷹或貓頭鷹飛近時，這種叫聲能警告其他山雀躲藏起來。就像是一個預警系統，警報能夠從一隻鳥到另一隻鳥而傳播到整個森林，比老鷹飛行的速度還要快。當掠食者飛到時，小鳥們已經安全起躲藏起來了。

其他物種同樣能夠「收聽」到山雀的警報，包括茶腹鵝 (nuthatches)、松鴉 (jays)、松鼠，以及花栗鼠。在其它國家的鳥類同樣能夠對“seet” 叫聲有反應，即使山雀並不生活在該區域。科學家在世界各地播放山雀“seet” 叫聲的錄音，其他鳥類都能明白並找尋掩護。

預警系統不僅是直接地保護鳥類及哺乳類免受掠食者危害。這種合作容許牠們花費更少時間來防範掠食者，並有更多時間尋找牠們維持生活所需的食物。

The sound of birds singing in a woodland can seem like a confusing jumble of trills, whistles, and chirps. But there's a lot of communication going on. Scientists found that birds and mammals broadcast warnings about nearby predators, and different species (including mammals) understand each other's messages. They can even share information on what kind and size of predator is around, and what it's doing.

Black-capped chickadees are tiny black and white birds who live in forests. They're best known for their “chickadee dee dee” calls. These and some other calls keep birds in contact with each other or let each other know where to find food. Less noticed by humans is a very quiet, high-pitched “seet” call. They use this call to warn others that there's a hawk or owl flying nearby.

Chickadees also have another call when they see a perched hawk or owl. It's a louder and longer version of its usual “chickadee dee dee” call. This altered call draws in other birds to “mob” the predator. The more dangerous the predator is to the chickadees, the more times they say “dee”. For example, the tiny northern pygmy-owl, who eats a lot of chickadees, gets more “dee” calls. The bigger great horned owl is less of a threat and so the birds make fewer “dees”. The harsh “chickadee dee dee” means the chickadee sees a hawk or owl and needs other nearby birds to mob the predator until it flies away.

The “seet” call has a different purpose. Because it's so quiet and high-pitched, it's hard for a predatory bird to hear. That means it's a safer call for a chickadee to make compared to the deeper, louder “chickadee dee dee.” The “seet” call warns other chickadees to hide when a hawk or owl is flying nearby. Like an early warning system, the alert can spread through a forest from one bird to another faster than the hawk can fly. By the time the predator arrives, the birds are safely in hiding.

Other species can also ‘listen in’ on the chickadees’ warnings, including nuthatches, jays, squirrels, and chipmunks. Birds in other countries also react to the “seet” call even if chickadees don’t live in the area. Scientists have played a recording of the chickadee’s “seet” call all over the world, and other birds understood it and took cover.

The early warning system goes beyond directly saving birds and mammals from predators. This cooperation allows them to spend less time watching for predators and more time getting the food they need to survive.

### 文獻引用 (REFERENCES)

「除了作為其中一種已發現的最微妙並複雜的訊號系統之外，這個系統不尋常的是組合了兩個層面，分別是指示性及基於風險程度的防掠食者發聲系統 (referential and risk-based antipredator vocalization systems)。為了預示快速移動掠食者的出現（例如，飛行中的猛禽），山雀出發出“seet”警示叫聲。當牠們遇到靜止的掠食者（例如，棲息中的猛禽），牠們會使用“chick-a-dee”的圍攻召集。這兩種發聲行為似乎是功能性地指示遇到的掠食者類型（即是，每種叫聲都預示著遇到特定類型的掠食者）。另外，我們證實了“chick-a-dee”圍攻召集叫聲中微妙的變化，反映了特定掠食者的大小，是一種基於風險的系統之特徵。因此，山雀以兩種等級來傳播關於掠食者的資訊：粗糙等級的信號（“seet”或是“chick-a-dee”）表示掠食者的相遇情況類型，而細微等級的信號（“chick-a-dee”的變化）則是表示遇到的掠食者種類帶來的危險程度。」(Templeton et al. 2005: 1937)

“In addition to being one of the most subtle and sophisticated signaling systems yet discovered, this system is unusual in that it combines aspects of both referential and risk-based antipredator vocalization systems. To denote the presence of a rapidly moving predator (e.g., raptor in flight), chickadees produce a “seet” alarm call. When they encounter a stationary predator (e.g., perched raptor), they use the “chick-a-dee” mobbing call. These two vocalizations appear to be functionally referential to the type of predator encounter (i.e., each denotes a specific type of encounter). In addition, we have shown that subtle variation in the “chick-a-dee” mobbing call reflects the size of a specific predator, a characteristic of a risk-based system. Thus, chickadees convey information about predators at two different levels: A coarse level of encoding (“seet” or “chick-a-dee”) signifies the type of predator encounter, and a fine level of encoding (variants of “chick-a-dee”) signifies the degree of danger presented by that specific predator encounter.” (Templeton et al. 2005: 1937)

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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/Black-capped\\_chickadee](https://en.wikipedia.org/wiki/Black-capped_chickadee)

#### 撰寫/翻譯/編修者與日期

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