


# 生物策略表

類別	生物策略 (Strategy)
生物策略 STRATEGY	美洲紅樹的扶壁增加穩固性 (Buttresses of red mangrove improve stability)
生物系統 LIVING SYSTEM	美洲紅樹 <i>Rhizophora mangle</i> (Red mangrove)
功能類別 FUNCTIONS	#永久性附著 #保護免受過多液體危害 #保護免受風危害 #Attach permanently #Protect from excess liquids #Protect from wind
作用機制標題	美洲紅樹的扶壁透過有效率地增加支撐面積，容許其生長在淺層土壤中 (Buttresses of the red mangrove enable growth in thin soils by efficiently increasing footprint)
生物系統/作用機制 示意圖	
作用機制摘要說明 (SUMMARY OF FUNCTIONING MECHANISMS)	
<p>美洲紅樹 (red mangrove, <i>Rhizophora mangle</i>) 是一種海岸樹木，生長在熱帶地區的淺水河口 (estuaries)。它們生長的地區常常有海浪及強風，也持續地受到水流及潮汐的力量影響。與此同時，它們生長在淹水的淺層泥沙中，會因為土壤持續地流動而無法像陸地上的樹木般以根部固定植株。不意外地，這些樹種投資了極少的能量在其根系，低至其樹木總生物量的 5% (相比於其它樹種根系佔 15-55% 之間)。相反地，美洲紅樹植株依靠支柱根 (rhizophore)，此為一種特化的支持根 (stilt)，與主幹有一樣的組成材料，能攝取及輸送水分及氧氣，並同時為樹木在困難及變動的表面上 (a difficult shifting surface) 提供支撐。</p> <p>美洲紅樹支持根的作用就像歐洲大教堂 (European cathedrals) 上的飛扶壁 (flying buttress)，或是像一個人使用滑雪杖 (ski pole) 或拐杖 (crutch) 來維持平衡。支持根使生物的底板面積變大，同時亦保持以少量的組織用作穩固植株。美洲紅樹的扶壁比起人造的結構還要有效，它們的支持根分枝多達六次才會進入泥土中。</p> <p>隨著樹木長大，新的支持根持續產生，使樹木能夠對生長環境的變化作出反應，例如朝向最佳光照處生長，而不需要考慮底物 (substrate) 的品質。支持根的固定作用非常有效，使美洲紅樹生長得比紅樹林 (mangrove forest) 中其它樹種還要巨大，並維持主幹</p>	

只以相差幾度垂直於土面，儘管是在具挑戰性的環境條件，以及水流及潮汐不斷拉扯威脅的持續壓力之下。

美洲紅樹獨特的構造及穩固性使它們對於易受破壞的海岸生態系統的保護作用尤其重要，使其不會受到極端天氣 (extreme events)，例如氣旋 (cyclones) 及海嘯 (tsunamis) 所影響。

The red mangrove (*Rhizophora mangle*) is a coastal tree that grows in shallow estuaries throughout tropical regions. They grow in regions where storms and high winds are common and they are continually subjected to water currents and tidal forces. At the same time, they grow in waterlogged and shallow silt that is continually moving and so they are unable to anchor themselves using their roots the way trees growing on land can. Unsurprisingly, these trees invest much less energy in their root system, which can be as low as 5% of the total tree biomass (this compares to between 15-55% for other tree species). Instead, red mangrove trees rely on rhizophores, specialised stilts made from the same material as the main stem that take in and transport water and oxygen and also provide support for the tree on a difficult shifting surface.

Red mangrove rhizophores work like flying buttresses on European cathedrals, or like a person using ski poles or crutches to maintain balance. They make the footplate area of the organism much larger, whilst keeping down the total amount of tissue required for stability. Red mangrove buttresses are even more effective at this than man-made structures, as their rhizophores branch as many as six times before entering the silt.

As the trees grow, new rhizophores are continually produced, enabling the trees to respond to changes in their environment, for example growing towards the best light, regardless of the quality of the substrate. They are remarkably effective at this, growing larger than other trees in the mangrove forests and maintaining main stems that are no more than a few degrees from vertical, despite the challenging conditions and continual pressure from water flow and tides that constantly threaten to push them over.

The unique structure and stability of the red mangrove makes them particularly important for the protection of vulnerable coastal ecosystems from extreme events like cyclones and tsunamis.

#### 文獻引用 (REFERENCES)

#### 參考文獻清單與連結 (REFERENCE LIST)

Méndez-Alonzo, R., C. Moctezuma, V. R. Ordonez, G. Angeles, A. J. Martinez, J. Lopez-Portillo. (2015). Root biomechanics in *Rhizophora mangle*: anatomy, morphology and ecology

of mangrove's flying buttresses. *Annals of Botany* 115: 833-840.

(<https://doi.org/10.1093/aob/mcv002>)

#### 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/rhizophora\\_mangle](https://en.wikipedia.org/wiki/rhizophora_mangle)

[https://www.onezoom.org/life/@rhizophora\\_mangle](https://www.onezoom.org/life/@rhizophora_mangle)

<https://eol.org/pages/2942884>

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<https://asknature.org/strategy/buttresses-of-red-mangrove-improve-stability/>