物種多樣性維持機制

▼ 台灣具有很高的生態系多樣性、物種多樣性

- 台灣的地理位置
  - 介於熱帶與亞熱帶
  - 兩大植物區系交會處
  - 鄰近歐亞大陸的島嶼
- 平面
  - 夏、冬雨差異 (西南季風 + 東北季風)
  - 地質多樣化
  - 將近60%的面積為森林
- 立體
  - 錯綜複雜的地形
  - 海拔變異大
- 人為與自然干擾強

▼ 台灣的植物概況

合計共235科 1419屬 4339種 (4077原生種 + 262歸化種)

- **蕨類植物**
  - 37科 (全世界65科) 145屬 630種
- **裸子植物**
  - 8科 (全世界11科) 17屬 28種
- **被子植物**
  - 190科 (全世界291科) 1257屬 3681種
- **台灣特有植物**
  - 台灣的特有種計有1069種，特有率為26.2%。特有種的比率隨著海拔的升高由低海拔地區的17.6% 逐步上升至亞高山帶的59.2%。在緯度上，特有

率則由北部往南部遞增。

參考資料：台灣植物誌第六卷 Flora of Taiwan Vol. 6 (2003年出版)

▼ 台灣的植被多樣性

- 紅樹林
  - 水筆仔 (關渡平原紅樹林)
  - 紅海欖 (台南四草紅樹林，前高雄前鎮潟湖)
  - 消失的細蕊紅樹與紅茄苳
- 海岸林
  - 黃槿、棋盤腳、木麻黃
- 低海拔闊葉林
  - 台灣絕大多數低海拔原生林已經消失，取而代之的是城市、農田與檳榔園
  - 次生林主要樹種：白匏仔、血桐、廣東油桐
  - 榕楠林帶：大葉楠、白榕、茄苳
  - 楠櫧林帶：樟樹、紅楠、香楠、長尾栲、青剛櫟
- 針闊葉混和林 (雲霧林帶)
  - 台灣水青岡 (台灣山毛櫸)、紅檜、台灣扁柏、台灣杉
- 高海拔針葉林
  - 台灣鐵杉、台灣雲杉、台灣冷杉、台灣二葉松
- 台灣的森林界線(？)以上
  - 玉山箭竹、玉山圓柏
- 隨著海拔上升，台灣的植物多樣性**先增加後減少**

▼ 全球陸域生態圈 (biome)

- 熱帶雨林
  - 東南亞熱帶雨林有很驚人的植物多樣性
- 亞熱帶雨林

- 溫帶闊葉林
- 北方針葉林 (boreal forests)
- Latitudinal diversity gradient
    - 不論何種生物類群，在熱帶地區多半都有最高的物種多樣性，隨著緯度增加物種多樣性逐漸下降

▼ 形塑物種多樣性的重要因子

- 物種多樣性會隨取樣量 (sampling effort)增加而增加
    - 個體數量：species-inividual curve
    - 面積：species-area curve
    - 棲地的異質性 (habitat heterogeneity)
- 島嶼生物地理學 (MacArthur and Wilson 1967)
    - 一個島嶼的物種數多寡，與鄰近大陸的距離及島嶼的面積大小有關
    - No. of resident species vs. immigration rate & extinction rate vs. population size
- Triphasic species-area relationships
    - From local to regional to provincial (continental) scale
- Species–Abundance Distribution (SAD)
    - A few abundant species and many rare species
- **Hypotheses for latitudinal diversity gradient**
    - Mid-domain effect
    - Ecological hypothesis: climate and species diversity
    - Historical hypothesis: The time-integrated area hypothesis
    - Evolutionary hypothesis: Rates of diversification

▼ 物種共存機制 (Mechanisms for species coexistence)

- Competitive exclusion: Gause 的草履蟲實驗

- Resource partitioning: MacArthur (1958) 5種warblers的觀察
- The paradox of the plankton (Hutchinson 1961)
- Modern Coexistence Theory (Chesson 2000)
    - Unstable coexistence
        - Species coexist for a long time due to slow rates of competitive exclusion
        - Species will eventually disappear
        - Equalizing mechanisms
            - Reduce fitness difference
            - Hubbell’s neutral theory
    - Stable coexistence
        - Species recover from low density
        - No long-term trends in species density
        - Stabilizing mechanisms
            - Fluctuation independent
            - Niche partitioning
            - Density dependence
            - Fluctuation dependent
            - Storage effect
            - Intermediate Disturbance Hypothesis
- Neutral theory (Hubbell & Foster 1986)
    - Assumptions
        - Zero-sum game: Constant total abundance
        - All individuals & species have an equal probability of colonizing new sites
        - Constant and fixed mortality rates
    - Competition in a local community can be described as a random walk to single-species dominance: Ecological drift

    - High abundance + low mortality: Dominant species take a very long time to out-compete other species
    - Local communities connect with a much larger meta-community
        - Species immigration from the meta-community
        - New species in the meta-community arise via speciation
    - The value of the neutral theory
        - Enormously influential
        - Mathematically elegant and tractable
        - Real communities represent a continuum of niche and neutral interactions
        - Emphasize how dispersal and regional species pool may determine local community structure
- Storage effect (Chesson & Warner 1981)
    - Environmental fluctuations: Resource availability, rainfall, temperature, predation levels
    - Species-specific environmental responses: Asynchronization among species
    - A relatively long-lived life stage
        - Annual plants with long-lived seeds
        - Zooplankton with diapausing (resting) eggs
    - Covariance between environment and competition
        - Intraspecific competition > Interspecific competition
- Intermediate Disturbance Hypothesis (Sousa 1979)