

การติดตามการเติบโตและอายุขัยของไลเคนในช่วง 10 ปี ในอุทยานแห่งชาติเขาใหญ่

A DECADE OF OBSERVATION ON GROWTH AND LONGEVITY OF LICHEN AT KHAO YAI NATIONAL PARK

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บทคัดย่อ: การศึกษาการเติบโตของไลเคนจาก 5 สภาพป่า ณ อุทยานแห่งชาติเขาใหญ่ เป็นเวลา 10 ปี เริ่มตั้งแต่ พ.ศ. 2542-2552 โดยมีวัตถุประสงค์เพื่อเปรียบเทียบอัตราการเติบโตและอายุขัยของไลเคนในแต่ละสภาพป่า จากไลเคนทั้งหมด 306 ตัวอย่าง แบ่งเป็น ครัสโตส 146 ตัวอย่าง และโฟลิโอส 160 ตัวอย่าง พบไลเคนเหลือรอดเพียง 72 แทลัส คิดเป็นร้อยละ 24 โดยไลเคนครัสโตสมีอัตราการเติบโตเฉลี่ย 1.66 มม./ปี (n=47) ส่วนโฟลิโอสมีค่าเฉลี่ย 4.99 มม./ปี (n=22) ไลเคนครัสโตสมีอัตราการรอดสูงสุดในป่าเต็งรัง รองลงมาคือป่าดิบแล้ง ป่ารุ่มสอง และป่าดิบชื้น คิดเป็น ร้อยละ 58, 44, 31 และ 18 ตามลำดับ ส่วนโฟลิโอส มีอัตราการรอดสูงสุดในป่าเต็งรัง รองลงมา คือป่าดิบเขา ป่ารุ่มสอง และป่าดิบชื้น คิดเป็นร้อยละ 34, 15, 12 และ 10 ตามลำดับ อัตราการเติบโตของไลเคนมีความแตกต่างกันตามสภาพป่า โครงสร้างของแทลัสและชนิดของไลเคน

Abstract: Studies on growth rates of lichens in five forest types at Khao Yai National Park were performed during 1999 to 2009. The aim of this study is to compare growth rates of lichens in various ecosystems. The specimens consisted of sample 306 thalli consisted of 146 crustose and 160 foliose lichens. Only 72 thalli or 24% of total remained survivor, of which crustose thalli had average growth rate of 1.66 mm/year (n=47) and foliose thalli were 4.99 mm/year (n=22). The highest survival among the crustose thalli of 58% was found in the dry dipterocarp forest, and subsequently lower in the dry evergreen, the secondary and the tropical rain forests accounted for 44, 31 and 18% respectively. Foliose lichens had the highest survival in dry dipterocarp forest and subsequently lower in the lower montane forest, secondary forest and tropical rain forest, accounting for 34, 15, 12 and 10%, respectively. Growth rates of lichens varied among ecosystems, structures of thallus and species of lichens.

Introduction: Lichens are very common flora on Earth, which found in a wide range of environment including the surface of rocks, trees. Growth of lichens involves the cell division and expansion of both mycobionts and photobionts. They can be measured from an expansion of thallus in foliose and crustose lichens, whilst the fruticose lichens can determine by increasing thallus length or biomass. Several factors influence growth of lichens such as nature of substrate and climatic condition. A temperate foliose lichen, *Parmelia isidiata*, grows 0.8-1.6 mm/yr [1], while that of the crustose lichens *Diploschistes scruposus* expands 0.04 mm/yr [2]. By contrast, tropical foliose lichen, *Parmotrema praesorediosum* and a crustose lichen *Laurera benguelensis* have growth

rate of 20.4 mm/yr and 2.4 mm/yr respectively during 23 months of observation [3]. Although their annual growth rate could be obtained during short term investigation, however lichens have different growth patterns during their life span [2]. The objective of study was to monitor long term growth and thallus longevity of tropical lichens commonly found in different forest types at Khao Yai National Park.

Methodology: Observation of lichen growth was conducted from the year 1999 up to present time (2009). Three hundred and six lichen thalli were selected from barks and rocks in the five forest types at Khao Yai National Park, including the tropical rain forest (TRF), the dry evergreen forest (DEF), the lower montane forest (LMF), the dry dipterocarp forest (DDF) and the secondary forest (SF). Outlines of lichens samples were drawn on transparency sheets in order to measure the increase in sizes in accordance with marked time intervals. Thallus areas were measured by using AxioVision LE Rel.4.1 (Carl Zeiss) software. The diameters were calculated using the equation $A = \pi r^2$ [4]. The results were then interpreted into lichen growth rates according to Hale [2].

Results, Discussions and Conclusions:

Survival of lichens in various forest types: Lichen in the five tropical forests had different number of survivors (Table 1). Only 72 thalli or 24% of the total remained intact. The dry dipterocarp forest supported the highest survival of thallus samples (58% for crustose and 34% foliose). The DDF had direr condition and high temperature than the other forest, which prohibit metabolic activities of lichens, as well as slow down disintegration and decomposition of biological matters, Lichens which had longer longevity in this forest included *Laurera*, *Relicinopsis*, *Canoparmelia*, *Parmotrema* and *Pyxine*. The larger proportion of dead thalli during ten years indicated that tropical lichens had short life span. Thallus senescence was shown at the center of foliose thallus. Causes of death of crustose lichens were the detachment of the bark substrates from the host tree and competition by other lichens or bryophytes. Warm and moist climate in the tropical rain forest seems to favor growth of other organisms, and those competed for habitats with lichens.

Table 1. Survival of tropical lichen thalli during 10 years of observation (1999-2009) in 5 forest types at Khao Yai National Park.

| Crustose | | | | Foliose | | |
|--------------------|-----------|---------|-----------|-----------|-----------|-----------|
| Forest types | No. Start | No. End | %Survival | No. Start | No. End | %Survival |
| LMF | 2 | 0 | 0 | 13 | 2 | 15 |
| TRF | 39 | 7 | 18 | 20 | 2 | 10 |
| DEF | 32 | 14 | 44 | 13 | 0 | 0 |
| DDF | 12 | 7 | 58 | 32 | 11 | 34 |
| SF | 61 | 19 | 31 | 82 | 10 | 12 |
| Total | 146 | 47 | 32 | 160 | 25 | 16 |
| Crustose + Foliose | | | | Start | 306 | |
| | | | | End | 72 (24%) | |
| | | | | Death | 234 (76%) | |

Growth rates of lichens: Lichen growth rates from five ecosystems were shown in Table 2. The highest growth rates among the crustose lichens were found in the tropical rain forest with an average of 7.47 mm/year, recorded from *Letrouitia vulpina*. The foliose lichen *Parmotrema tinctorum* from lower montane forest had the highest average growth rate of 19.32 mm/year. High growth rates could result from the high humidity and low temperature in both forest types. However, crustose grew slowly when comparing to foliose lichens. This was because of foliose lichens' leaf-like structures provided larger surface areas to intercept moisture, light and nutrients. Foliose lichens had looser organization of fungi and algae. The thalli were able to absorb more water, which was necessary for photosynthetic processes and production of organic matters for growth. Contrastingly, crustose lichens were closely attached to substrates by medulla hyphae [5], resulting in less surface areas.

Foliose and crustose had different average growth rates (Table 3). The decreasing growth rates in foliose lichens were due to thallus structures, age and growth phases (juvenile, maturation, and senescence [6]. Foliose lichens showed apparent senescence at thallus centers (Figure 1). This eventually resulted in a decrease in overall areas and growth rates. Crustose lichens had different patterns of thallus development and grew slowly but constantly throughout the 10 years of observation. The thallus center did not disintegrate. However, the major cause of death was due to bark detachment from the trees.

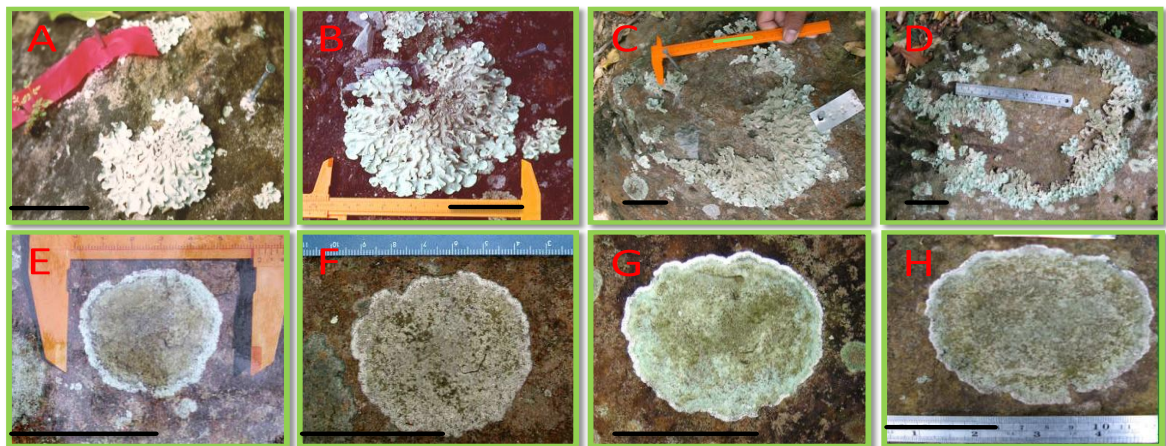


Figure 1 Growth of some lichens from the tropical rain forest at KhaoYai National Park 1999-2009. Upper panels: the same thallus of *Parmotrema tinctorum* photographed in 1999 (A), 2001 (B), 2005 (C) and 2009 (D). Lower panels: the same thallus of *Lecanora* sp.1 photographed in 1999 (E), 2001 (F), 2005(G) and 2009 (H). Scale = 5 cm.

Table 2 Growth rates of tropical lichen thalli during 10 years in five forest type at Khao Yai National Park.

| Forest types | Growth rate (mm/yr) | | | | | | | |
|--------------|---------------------|---------|---------|------------|----------------|---------|---------|-----------|
| | Crustose lichen | | | | Foliose lichen | | | |
| | No. of thallus | Maximum | Minimum | Average | No. of thallus | Maximum | Minimum | Average |
| LMF | nd. | nd. | nd. | | 2 | 19.32 | 11.52 | 15.44±5.5 |
| TRF | 7 | 7.47 | 1.4 | 3.34±2.20 | 2 | 2.28 | 1.08 | 1.72±0.83 |
| DEF | 14 | 3.79 | 0.15 | 1.19±1.23 | nd. | nd. | nd. | nd. |
| DDF | 7 | 3.48 | 1.46 | 2.40 ±0.66 | 9 | 9.62 | 1.75 | 4.20±2.32 |
| SF | 19 | 4.75 | 0.27 | 1.38±0.30 | 9 | 12.25 | 0.12 | 3.60±3.71 |
| | 47* | | | 1.66 | 22* | | | 4.99 |

Note * = number of area increased thalli, nd = no data collect

Table 3 Lichen average growth rates in the first 3 years comparing with those in ten-year time (1999-2001, 1999-2009) in 5 forest types at Khao Yai National Park.

| Years | Average growth rates (mm/yr) | | | | | |
|-----------|------------------------------|---------|--------------|---------|---------|-------------|
| | Crustose | | | Foliose | | |
| | Minimum | Maximum | Average | Minimum | Maximum | Average |
| 1999-2001 | 0 | 12 | 1.3 (n= 146) | 2.4 | 20.4 | 6.4 (n=160) |
| 1999-2009 | 0.12 | 7.44 | 1.66 (n=47) | 0.12 | 20.52 | 4.99 (n=22) |

Growth curves of lichens: Figure 2 showed the different growth patterns of two complete thalli. Foliose thalli had the highest growth rates during the first eighty months, afterwards, their growth rates decreased. This was different from the uniformed growth pattern of crustose thalli, as shown in the constantly growing curve. According to the curve, it can be concluded that the sizes and growth rates of lichens depended largely on their thallus types (foliose or crustose), growth phases and ages.

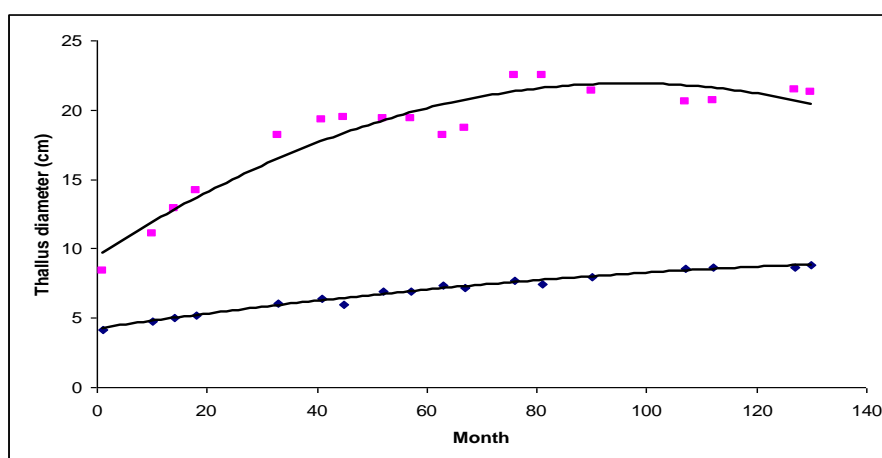


Figure 2 Growth curve of some foliose and crustose thalli selected from the tropical rain forest during 1999-2009 at Khao Yai National Park. Thalli of *Parmotrema tinctorum* (□), *Lecanora* sp.(◇)

Thallus longevity: Ten-years observation enhances our understanding of growth and longevity of the tropical lichens, which are different from those reported from the temperate regions. In the tropic, death and damage of thalli caused by external factors i.e. insect, fallen tree, forest fire. Most of the old foliose thalli show senescence parts at the centers of the thalli. These zones may be regarded as zone of low activity of chlorophyll [7], of which thalli become disintegrated during the observation period. However, many foliose thalli can be regenerated from remnant of the partially degenerated thalli. Thallus life span of tropical foliose may be more than 5 years [8], or up to 20 years for some species. However, Hale [2] summarized that many foliose in temperate region have several year of life span (15-80 years), which also depended on species. The tropical crustose which had completely thalli, and remained expand with slow growth rates can be later recruited to use for lichenometry in the tropic. This type of information is never reported elsewhere. Therefore, long-term monitoring of growth and longevity of lichens in the tropic still need to be continuing for completing data base and the uses of it with confidence.

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Keyword: lichen, growth rate, foliose, crustose

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