

การเติบโตและการอยู่รอดของไลเคนบนหิน *Canoparmelia owariensis* ในป่าเต็งรัง ณ อุทยานแห่งชาติ  
เขาใหญ่ ประเทศไทย

## GROWTH AND SURVIVAL OF A SAXICOLOUS LICHEN *CANOPARMELIA OWARIENSIS* IN THE DRY DIPTEROCARP FOREST AT KHAO YAI NATIONAL PARK, THAILAND

เวชศาสตร์ พลเยี่ยม และ กัญชรีย์ บุญประกอบ

Wetchasart Polyiam and Kansri Boonpragob

Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkapi, Bangkok,  
Thailand

Tel: 02 3108395 Fax: 02 3108416, E-mail: wetchsart@hotmail.com

**บทคัดย่อ:** การติดตามการเติบโตของไลเคน *Canoparmelia owariensis* ที่พบบนหินในป่าเต็งรัง ณ อุทยานแห่งชาติเขาใหญ่ มีวัตถุประสงค์เพื่อ 1) ศึกษาอัตราการเติบโตของไลเคน *C. owariensis* ที่พบเด่นบนหินในสภาพป่าเต็งรัง 2) เพื่อสร้าง growth curve ของไลเคนชนิดนี้ โดยศึกษาจากไลเคน 46 แทลัส ที่มีเส้นผ่านศูนย์กลางแกลส 1-15 เซนติเมตร ซึ่งแบ่งออกเป็นกลุ่มแกลสขนาดเล็ก ขนาดกลางและขนาดใหญ่ (เส้นผ่านศูนย์กลาง 1-3, 3-7 และ มากกว่า 7 ซม. ตามลำดับ) การขยายขนาดของแกลสวัดโดยการวาดขอบเขตแกลสในช่วงเวลา 31 เดือน (มิถุนายน 2547-ธันวาคม 2549) ผลการศึกษาพบว่าไลเคนมีการตายไปคิดเป็นร้อยละ 10 ในขณะที่ร้อยละ 39 มีการหลุดร่อนตรงกลางแกลส และพบว่าพวกที่มีขนาดเล็กมีสัดส่วนการตายสูงที่สุด อย่างไรก็ตามมากกว่าครึ่งหนึ่งของแกลสขนาดเล็กเติบโตได้ดี และมากกว่าครึ่งหนึ่งของแกลสขนาดกลางและขนาดใหญ่หลุดร่อนแล้วมีการเจริญขึ้นทดแทน โดยมากกว่า 1 ใน 4 เติบโตได้ดี ข้อมูลดังกล่าวนี้แสดงให้เห็นว่าประชากรของไลเคนชนิดนี้จะอยู่รอดในภาวะแวดล้อมเดิมได้ อัตราการเติบโตสูงสุดพบในไลเคนขนาดใหญ่ และค่อย ๆ ลดลงในไลเคนขนาดกลางและเล็ก มีค่า 0.63 0.53 และ 0.42 มม./เดือน ตามลำดับ อย่างไรก็ตามอัตราการเติบโตสัมพัทธ์สูงสุดพบในไลเคนขนาดเล็ก และลดลงอย่างชัดเจนในแกลสขนาดกลาง และลดลงจนเกือบจะคงที่ในแกลสขนาดใหญ่ รูปแบบการเติบโตของแกลสไลเคนทั้ง 3 ขนาดมีแนวโน้มเพิ่มขึ้น จึงมีความเป็นไปได้ที่จะนำไลเคนชนิดนี้มาไว้ในสภาพที่เหมาะสมเพื่อเพิ่มผลผลิตให้เพียงพอต่อการใช้ประโยชน์และการอนุรักษ์

**Abstract:** The objectives of monitoring growth of the saxicolous lichen *Canoparmelia owariensis* in the dry dipterocarp forest at Khao yai national park were 1) to study the growth rates of the common foliose lichen, *C. owariensis*, growing on rocks in DDF, 2) to construct the growth curves of the species. The study included 46 thalli of 1-15 cm in diameters. These thalli were divided into small (1-3), medium (3-7) and large (> 7) cm in diameters. Thallus expansions were observed by drawing outlines at different time intervals during 31 months (June 2004 to December 2006). The results show that 10 % of the thalli die, whereas 39 % had central thalli disintegrated and fractional regenerated. The small thalli had the highest proportion of death, however, almost half of them had complete growth. More than half of the medium and the large thalli disintegrated and regenerated with more than a quarter of the populations had completed thalli. This information indicates that future population of *C. owariensis* would remain under present conditions. The highest growth rate was found in large thalli; subsequently lower rates were found in medium and small size classes averaged 0.63, 0.53 and 0.42 mm/month respectively. However, the relative growth rates were highest among the small thalli and decline sharply when diameter increased to medium size, and almost stable low at large diameters. Growth curve of the three size class show increasing trends of all. It reveals a promising tendency of manipulating this lichen under appropriate condition to enhance production for sustainable uses and conservation.

**Introduction:** Growth of lichen has long intrigued lichenologists. Lichen growth can be measured from thallus diameters, radius, surface areas and individual lobes [1]. Growth of plane lichens is usually measured by increase in thallus diameters [2, 3]. Crustose lichens have slow growth rates and long life spans. In temperate regions, they can live up to over several thousand years [4]. Therefore, they were commonly used to date rock surfaces. Growth rates of foliose lichens are higher than those of crustose species [1, 4]. Most of the records were made in temperate regions [5, 1] whereas tropic studies are rare. Osathanon [6] recorded the largest lichen thalli of parmelioid species (*Parmotrema tinctorum*) in tropical rain forest. They were observed to grow 1.5 mm/month in average in 20 months. However, most parts of thalli detached from the substrates after 7 years of observation [7]. The lichen *Canoparmelia owariensis* is one of the common tropic foliose lichens inhabiting exposed rock surfaces. This species has medium growth rates. Its growth rates were about 0.6 mm/month in average [6]. The preference of this lichen to rock substrates could be applied in rock surface dating and study of environmental changes of dry dipterocarp forest (DDF). In addition, crude extracts of this lichen were observed to have antifungal activities to cultured plant pathogenic fungi [8]. It is therefore important to learn of the basic factors that control growth and survival of this species in nature so that sustainable utilization and conservation of such valuable natural resource could be properly managed. Objectives of this study were: 1) to study the growth rates of the common foliose lichen, *C. owariensis*, growing on rocks in DDF, 2) to construct the growth curves of the species.

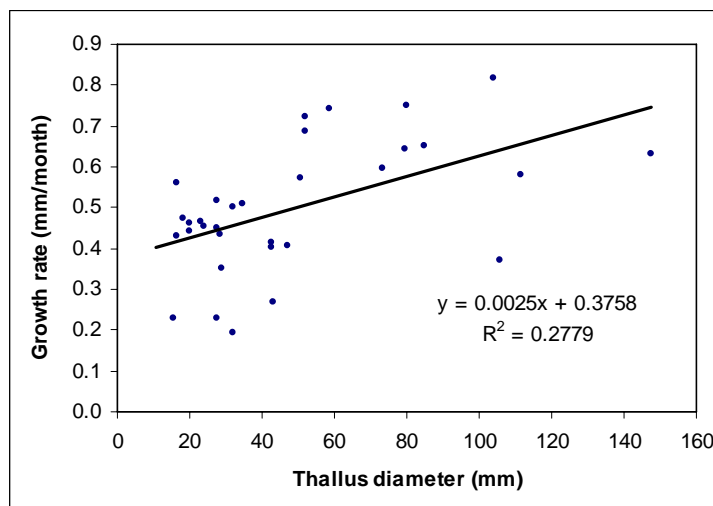
**Methodology:** This observation was performed at Khao Noi in the dry dipterocarp forest (DDF) of Khao Yai National Park. It is situated at 14°13' N latitude, 101°32' E longitude and elevation of 250 m above sea level. This forest is dominated by small *Dipterocarpus* trees (about 5-10 m high) that scattered on exposed rock. Climate is characterized by wet and dry cycles. Light intensity at the canopy where lichens grow exceeds 1600  $\mu\text{mol m}^{-2}\text{s}^{-1}$ . Air temperatures were 25-37 °C. Relative humidity was 30-100 % (mostly dry) [6]. The growth of 46 thalli of *Canoparmelia owariensis* (Asahina) Elix growing on rock surfaces were measured in different seasons from June 2004 to December 2006. Transparent sheets were placed on lichen thalli. Outlines were drawn by permanent pens. Thallus expansions were measured in the laboratory by using software AxioVision AC. Rel. 4.1 and thallus diameters were then calculated. Growth rates were observed through increases in diameters per unit of time. The samples were then classified into different thallus size classes: 1-3 cm as small, 3-7 cm as medium and > 7 cm as large.

**Results, Discussion and Conclusion:** After 31 months, a total of 46 thalli from 10-150 mm in diameters of the lichen *Canoparmelia owariensis* show that dead thalli had the lowest proportion accounted for ten or 22% of all size classes. Thalli with central disintegration and fractional regeneration, and those with completed growth had the same number and the proportion which consisted of eighteen thalli or 39% of the samples (Table 1).

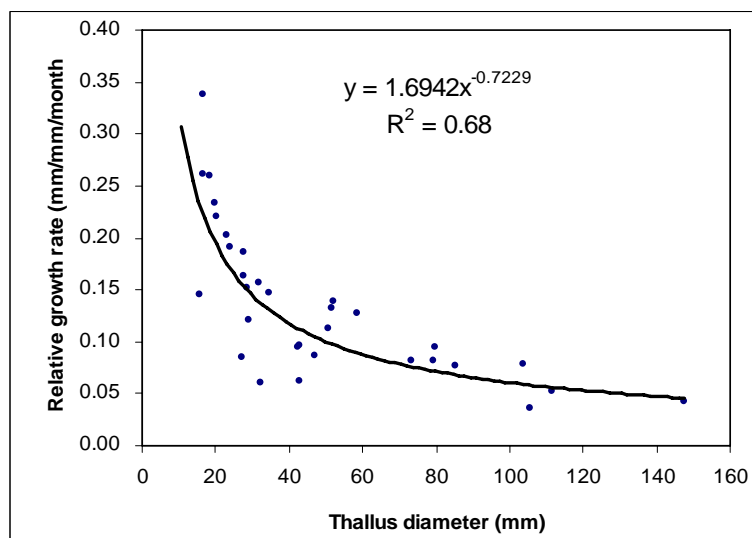
Table 1. Status of 46 thalli of *C. owariensis* growing on rock in dry dipterocarp forest of Khao Yai National Park during June 2004 to January 2007 (31 months).

Size classes (cm)	No.	Death		Regeneration		Complete	
		No.	%	No.	%	No.	%
Small: 1-3	25	7	28	6	24	12	48
Medium: 3-7	10	1	10	6	60	3	30
Large: > 7	11	2	18	6	55	3	27
Total	46	10	22	18	39	18	39

This lichen produces numerous isidia (pustule-like), which enable rapid colonization [9, 10]. The highest proportion of death occurred in the small thalli indicated vulnerability of the juvenile stage to environmental threats of this species. However, the completed thalli shared almost half of its samples with almost a quarter being regenerated guarantee the survival of the population. The large and the medium thalli had lower proportion of death than the former with over half of the populations being disintegrated and regenerated. About one-third of the medium and one-quarter of the large thalli had complete growth. This evidence shows that future population of *C. owariensis* would be existed under present conditions.



**Figure 1** Growth rates from 32 thalli of various diameters of *C. owariensis* during 31 months in the dry dipterocarp forest at KYNP

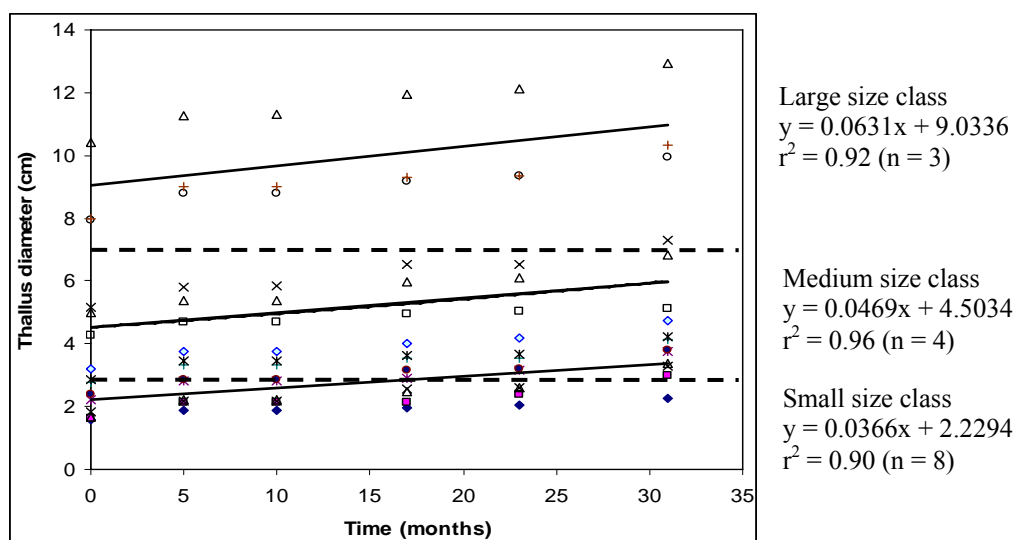


**Figure 2** Relative growth rates from 32 thalli of various diameters of *C. owariensis* during 31 months at KYNP

Growth rate seems to rise with increasing thallus size as shown in Figure 1. The highest and subsequently lower average growth rates were recorded from the large, medium and small size classes (0.63, 0.53 and 0.42 mm/month respectively). The highest growth rate of an individual thallus recorded from the large size class was 0.82 mm/month. This large circular thalli has greater area along the margin, which is active growth zone. Contrastingly, the highest relative growth rate of 0.16 mm/mm/month was averaged from the small size class thalli.

Figure 2 reveals that relative growth rate of *C. owariensis* was distinctively high when thalli were small, and decline sharply when thallus diameters reach medium size (> 3 cm). This rate of the large thalli (> 70 mm diameter) reduced about 6 folds of the small ones (0.05 vs. 0.30 mm/mm/month), which indicate maturity of the thalli. This result coincides with Brodo [5], who reported that small thalli seemed to grow faster than the large ones.

Growth patterns observed in the three thallus size classes (Figure 3) suggesting that the large-class thalli continue to expand at relatively high rate, as well as the medium and the small ones. This information suggested that some thalli of *C. owariensis* is able to grow continuously under appropriate microhabitats, and that provide the possibility to increase biomass production of this lichen for extraction of novel products.



**Figure 3** Growth of 15 completed thalli of *C. owariensis* and its linear regressions of growths during 31 month observations.

Survival of lichen thallus: Thallus growth and survival of the *C. owariensis* is influenced by a combination of several factors on various microhabitats of this forest. Variation of growth rates indicated clearly this situation. Generally, thalli of this lichen broke and detached at the central zones which were the older parts, while expansion of thalli as measuring of growth occur at thallus margins. Hollow rings in the central zones of thallus resulted from senescence [11, 4]. Actual senescence stages of lichen thalli in this study varied. The largest thallus (147 mm in diameter) was already in a senescence stages before the measurements started. Some medium thalli (about 46 mm in diameter) started to show signs of senescence in 17 months. The smallest thallus (10.6 mm in diameter) was recorded to reach senescence stage in 23 months. However, juvenile lobes were also observed within the hollow rings of disintegrating central thallus parts. This extends survival opportunity of this lichen.

This study assumed that the lichen thalli reached maturity when they produce vegetative propagule for distribution. Isidia of *C. owariensis* are most clearly visible on older parts of thalli when the thallus sizes are about 50 mm in diameter. However, the production of vegetative propagules depended also on environmental conditions [9]. By producing isidia, the lichen can easily disperse and quickly regenerate by produce new thalli.

It is reasonable to conclude that *C. owariensis* had fast growing periods when their thallus sizes were smaller than 3 cm. diameter. In contrast, relatively high percentages of death in small thalli indicate that conservation of this lichen should be made early while their thalli were small. In addition high proportion of regeneration from disintegrated thalli, and increasing trend of thallus expansions among the large thalli provides survival opportunity and existence of this lichen.

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**Keywords:** Lichen, growth rate, relative growth rate, dry dipterocarp forest