ความหลากหลายทางชีวภาพ การแพร่กระจาย และการจัดจำแนกไลเคนกลุ่มฟรูติโคสเบื้องต้น ณ เขตรักษาพันธุ์สัตว์ป่าภูหลวง จังหวัดเลย

BIODIVERSITY, DISTRIBUTION AND KEYS CHARACTERIZATION OF FRUTICOSE LICHENS AT PHU LUANG WILDELIFE SANCTUARY IN LOEI PROVINCE.

นาถวิดา ดวงผุย, พชร มงคลสุข, ขจรศักดิ์ วงศ์ชีวรัตน์ และกวินนาถ บัวเรือง

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บทคัดย่อ : การศึกษา ชนิดของ ฟรูติโคสไลเคน เบื้องต้น ในเขตรักษาพันธุ์สัตว์ป่าภูหลวง จังหวัดเลย มีรูปแบบการเจริญเติบโตแบบ พุ่มและเส้นสาย โครงสร้างแทลลัส 2 แบบ คือ ส่ว นของราและสาหร่ายแบ่งเป็นชั้น ชัดเจนในแนวรัศมี (radial heteromerous) มีสาหร่ายสีเขียวในสกุล *Trebouxia* เป็นส่วนประกอบ และโครงสร้างแทลลัสแบบไม่แบ่งชั้นอย่างชัดเจน (radial homoiomerous) มีสาหร่ายสีเขียวแกมน้ำเงินในสกุล *Nostoc* เป็นส่วนประกอบ จากการรวบรวมไลเคนระหว่างปี 2551-2552 จำนวน 340 ตัวอย่างใน 5 ระบบนิเวศป่า และจัดจำแนกตามหลักอนุกรมวิธานพบไลเคน 4 วงศ์ 4 สกุล 11 ชนิด ประกอบด้วย *Dendriscocaulon* cf. *intricatulum, Polychidium* cf. *contortum, Ramalina* cf. *farinacea, Ramalina* PL. 1, *Usnea baileyi, U. exaspearata, U. himantodes, U. perhispidella, U. roseola, U. rubicunda* และ *U. undulata* โดย *Dendriscocaulon* cf. *intricatulum* และ *Polychidium* cf. *contortum* เป็นไลเคนที่พบครั้งแรกในประเทศไทย และ *Ramalina* PL. 1 คาดว่าเป็นชนิดใหม่ของโลก

Abstract: This is a preliminary study of fruticose lichen taxa collected at Phu Luang Wildlife Sanctuary(PLWS), Loei province. The fruticose lichens had shrub and pendulous thalline growth forms. Two types of thalli were found: (1) radial herteromerous thalli, consisting of fungal and chlorophyte algal (mostly *Trebouxia*) partners, forming into distinguished layers; (2) radial homoiomerous thalli, consisting of fungal and cyanophyta algal (mostly *Nostoc*) partners, not forming into a well-characterized layers. Three hundred and forty fruticose lichen samples were collected at PLWS from 5 forest types during the year 2008-2009 and were systematically identified into 4 families, 4 genera, and 11 species, including *Dendriscocaulon* cf. *intricatulum, Polychidium* cf. *contortum, Ramalina* cf. *farinacea, Ramalina* PL. 1, *Usnea baileyi, U. exaspearata, U. himantodes, U. perhispidella, U. roseola, U. rubicunda* and *U. undulata.* Two species included *Dendriscocaulon* cf. *intricatulum* and *Polychidium* cf. *contortum* are found for the first time in Thailand and *Ramalina* PL. 1 lichen is expected to be a new species.

Introduction: PLWS is situated at 17° 3′ longitude and 101° 16′ latitude in the north-eastern part of Thailand. It covers an area of about 897 square kilometers with different elevations, 400-1500 meters above sea level. The temperatures were 10-15 ºC throughout the year. There are 7 forest types – bush forest, coniferous forest, dry dipterocarp forest, dry evergreen forest, hill evergreen forest, mixed deciduous forest and tropical rain forest in the area. The environmental conditions promote flora and fauna diversity, particularly in the case of the

orchid Rhododendrons, ferns, mosses, liverworts and lichens. Fruticose lichens are one major morphological groups of lichens with thalli longer than 1 meter for some species. They adhered to soil, rocks or barks by holdfasts. The thalli were irregularly to dichotomously branched. Their stems and branches were round or flatten and may have supporting tissue. The thalli tissue were classified in heteromerous and homoiomerous type covered by outer cortex layer. The objectives of this study were to compile the lichens' genus and species and to construct a local systematic key for fruticose lichens at PLWS.

Methodology: Lichen specimens were collected from 5 forest types: bush forest, coniferous forest, hill evergreen forest, mixed deciduous forest and dry dipterocarp forest and were identified into genus and species according to [1], [2], [3]. Identification of lichen substances by thin layer chromatography were conducted with two standard solvent (A and G) system. Solvent systems were prepared according to [4].

Results, Discussion, and Conclusion: The preliminary study from the 5 forest types in Phu Luang wildlife sanctuary revealed 11 species, belonging to 4 genera and 4 families (Table 1). Taxonomic conclusions and specific keys to all of the species are given below.

Table 1. Eleven species reported in PLWS.

Families	Scientific names
Usneaceae	*Usnea baileyi, U. exaspearata, U. himantodes, U. perhispidella, U. roseola, U. rubicunda* and *U. undulata.*
Ramalinaceae	*Ramalina* cf *farinacea* and *Ramalina* PL. 1**
Lobariaceae	*Dendriscocaulon* cf. *intricatulum**
Placynthiaceae	*Polychidium* cf. *contortum**

*new record, ** expected to new species

Taxonomic conclusions

***Ramalina* cf. *farinacea* (L.) Ach.,** *Lich. univ.*: 606 (1810)

Thallus shrub 4-10 cm. high. Branch flatten, sub-dichotomous branching. Cortex hyaline, double layer, discontinuous. Pseudocyphellae present.

Lichen substance: Containing salazinic acid, sekekamic acid, homosekekamic acid and usnic acid.

***Usnea baileyi* (Stirt.) Zahlbr.,** *Denkschr. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl.* 83: 183 (1909)

Thallus shrub to subpendent. Axis hollow, hyaline. Medulla dense with red pigment subcortical to peri-axial. Isidiate present, soredia absent.

Lichen substance: Containing salazinic acid, norstictic acid, protocetraric acid and usnic acid.

***Usnea exasperate* Mot.,** *Lich. Gen. Usnea Momogr., fasc.* 2, 1937, p. 434 et 440.

Thallus subpendent to pendent 7-15 cm. long, Cortex erode. Axis solid, hyaline to brown or black in older part of thallus. Medulla white, dense. Isidiate present on cortex, soredia absent.

Lichen substance: Containing stictic acid complex and usnic acid

***Usnea himantodes* Stirt.,** *Scott. Natural.* 7: 75 (1883)

Thallus subpendent to pendent 5-12 cm. long, Cortex erode. Axis yellow to yellowish brown. Medulla white, dense. Isidiate present or less, soredia absent.
Lichen substance: Containing stictic acid complex, unknown substance and usnic acid

***Usnea perhispidella* J. Steiner.,** *in Sitzungsber. Kais. Akad. Wiss. Wien, math.-naturw. Classe, vol.* CVI, 1897, p. 210.

Thallus subpendent 5-10 cm. high. Cortex glossy. Axis solid, hyaline. Medulla white, moderately dense. Isidiate on cortex, soredia absent.
Lichen substance: Containing stictic acid complex and usnic acid

***Usnea roseola* Vain.,** *Bot. Mag., Tokyo* 35: 46 (1921)

Thallus subpendent 4-5 cm. high. Cortex dull, hyaline, Axis solid, hyaline. Medulla pale pink, moderately dense. Isidiate on cortex or primary soralium.
Lichen substance: Containing didymic acid and usnic acid

***Usnea rubicunda* Stirt.,** *Scott. Natural.* 6: 102 (1881)

Thallus shrub to subpendent 4-15 cm. high. Cortex matt, red pigment. Axis solid, hyaline. Medulla white, moderately dense. Isidiate on cortex or pseudocyphellae
Lichen substance: Containing stictic acid complex and usnic acid

***Usnea undulata* Stirt.,** *Scott. Natural.* 6: 104 (1881)

Thallus subpendent 5-12 cm. high. Cortex dull, hyaline. Axis solid, hyaline. Medulla white, lax. Isidiate on pseudocyphellae, less on plan cortex
Lichen substance: Containing 2 chemotype 1. stictic acid complex and usnic acid 2. salazinic acid, norstictic acid and usnic acid

***Dendriscocaulon* cf. *intricatulum* (Nyl.) Henssen.,** *Lichenology: Progress and Ploblems (London):* 31 (1976). (see in Figure 1a)

Thallus dwarf fruticose 3-4 cm high., brownish with white spot. Attach on substratum by hold fast, black or pale brown at base. Branch terete, sub-dichotomous to dichotomous branching, black coralloid at tip apices. Not seen isidia and soredia. Homoiomerous tissue. Cortex matt, hyaline, periclinal, *Nostoc* symboint, discontinuous in whole thallus. Medulla white, arachnoid. No supporting tissue. Apothecia not seen.
Lichen substance: psoromic acid

***Polychidium* cf. *contortum* Henssen,** *Symb. bot. upsal.* 18: 108 (1963). (see in Figure 1c)

Thallus dwarf fruticose 3 cm high., black. Attach on substratum by hold fast, black or pale brown at base. Branch terete, subdichotomous to dichotomous branching, coralloid at tip apices. Not seen isidia and soredia. Homoiomerous tissue. Cortex matt, periclinal, *Nostoc* symboint, continuous in whole thallus. Medulla white, arachnoid. No supporting tissue. Apothecia not seen
Lichen substance: no lichen substance

***Ramalina* PL. 1** (see in Figure 1b)

Thallus shrub to subpendent 5 cm. high., greenish to yellowish green. Branch flatten to sub-canaliculated, sub-dichotomous branching, pseudocyphellae present on laminal branch, orbicular to elongate. Cortex hyaline, paraplectenchymatous, continuous. Supporting tissue hyaline, separated into lobule, paraplectenchymatous. Green algae, cluster. Medulla

white, archanoid. Disc apothecia, laminal, ascospore lense shape, 1 septate, 8 ascospore/ascus, I + blue.
Lichen substance: Containing salazinic acid, consalazinic acid, protocetraric acid and usnic acid

Figure 1 Picture of thallus: a) *Dendriscocaulon* cf. *intricatulum* (Nyl.) Henssen. [RU—KNPL0098(RAMK)], b) Ramalina PL. 1, [RU—NDPL0062.09(RAMK)] c) *Polyhidium* cf *contortum* Henssen. [RU—NDPL00072(RAMK)]

Key to fruticose lichen occurring at Phu Luang Wildlife Sanctuary

1a. Thallus containing with blue green algae (Mostly *Nostoc*), colour brown to black, 2-4 cm. high.....2
1b. Thallus containing with green algae (Mostly *Trebouxia*), colour yellowish green to grayish green, 2-30 cm. long..... 3
2a. Thallus colour dark brown to black. Homoiomerous, coralloid at tip of apices..... ..... ***Polychidium* cf. *contortum***
2b. Thallus colour brownish with white spot. Homoiomerous, black caralloid at tip of apices ..... ***Dendriscocaulon* cf. *intricatulum***
3a. Thallus flatten, sub-dichotomous branching. None supporting tissue in center part of the thalli..... 4
3b. Thallus round to angular, branching with sub-dichotomous to irregular, supporting tissue (Axis) in center part of the thalli..... 5
4a. Thallus double layer cortex, continuous in whole thallus, apothecia present..... ..... ***Ramalina* PL. 1**
4b. Thallus double layer cortex, discontinuous in whole thallus, apothecia rare..... ..... ***Ramalina* cf. *farinacea***
5a. Axis (supporting tissue) hollow, hyaline. Salazinic and protocetraric present..... ..... ***Usnea baileyi***
5b. Axis solid, hyaline or pigment present, varies substance..... 6
6a. Thallus subpendent to pendent longer than 30 cm..... 7
6b. Thallus shrub to subpendent up to 20 cm. high..... 8
7a. Axis yellow, isidia not present or less, cortex erode with ridge. Containing stictic acid complex and unknown substance..... ***Usnea himantodes***
7b. Axis hyaline or brown to black, isidia present or less, cortex erode with ridge. Containing stictic acids complex, unknown substance present..... ***Usnea exasperata***
8a. Orange to red pigment in cortex, isidia present on cortex or pseudocyphaellae. Containing stictic acid complex..... ***Usnea rubicunda***
8b. None pigment in cortex, sometime present in other part of thallus..... 9

9a. Pink pigment in medulla, moderately dense, thallus segment. Containing stictic acid complex..... ***Usnea roseola***

9b. None pigment in medulla, moderately dense to lax, containing stictic acid or salazinic present.....10

10a. Isidia on cortex, none pseudocyphellae, papillae and tubercle less. Containing stictic acid complex..... ***Usnea perhispidella***

10b. Isidia on pseudocyphellae, punctiform to elongante. Containing stictic acid or salazinic acid in major substance..... ***Usnea undulata***

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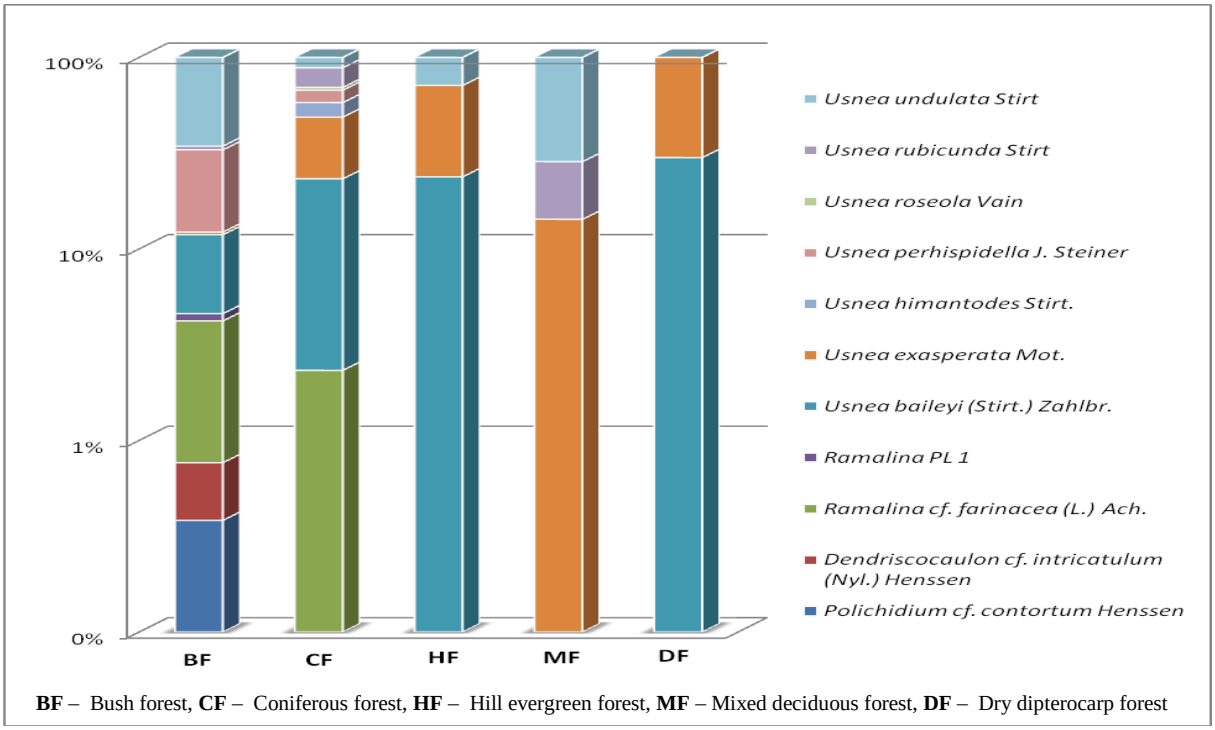

BF – Bush forest, **CF** – Coniferous forest, **HF** – Hill evergreen forest, **MF** – Mixed deciduous forest, **DF** – Dry dipterocarp forest

Figure 2 Percentage of different genus and species of fruticose lichens found in different forest type in PWLS.

The climate conditions, landscapes and altitudes (700-1,400 m) of the study areas varied, hence various types of lichen habitats. In all habitats (Figure 2), *Usnea* and *Ramalina* were dominant in open area. *Dendriscocaulon* and *Polychidium* were found in highly humid area of bush forest. Nevertheless, *Usnea baileyi* and *U. exaspearata* were found only in dry dipterocarp forest. The areas of bush forest had the highest diversity of 35%, coniferous forest 31% , mixed deciduous forest 15% and hill evergreen forests 11%. Dry dipterocarp forest had the lowest species diversity of 8%. In conclusion, altitudes and humidity were the putative key factors which played important roles in determining the diversity and distribution of fruticose lichens in PLWS.

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Keywords: *Usnea, Ramalina, Polychidium, Dendriscocaulon*