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Review Topic

Wood-inhabiting Macrofungi of the Experimental Forest of National Ilan University

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Abstract

This paper records the wood-inhabiting macrofungi discovered in the west side area of the Orchid creek of the experimental forest of National Ilan University within the period of December, 2005 to December, 2008. Fruiting bodies were identified on site or collected for further inspection in the laboratory. Some of them were identified to species by comparing their rDNA sequence (ITS and/or D1～D3 Domains of 28S rDNA) with NCBI data base. A total of 90 macrofungi identified to species (75 of Basidiomycota and 15 of Ascomycota) are recorded in this paper. Among the Basidiomycota identified, *Auricularia auricula-judae*, *Auricularia polytricha*, *Microporus affinis*, *Polyporus tenuiculus*, *Schizophyllum commune*, and *Trametes elegans* are the most frequently discovered species; *Ceriporia lacerata*, *Melanotus subcuneiformis*, and *Mycoaciella bispora* recognized by their rDNA sequences could be new for Taiwan. Species of the genus *Xylaria* make up 1/3 of the Ascomycota identified, while *Cookeina insititia* appears most frequently in fall and winter. Twenty-one soil-borne macro-Basidiomycota were also recorded and identified during the survey period, among them *Coprinus disseminatus* and *Multiclavula clara* are the most easily encountered species.

Key words: the experimental forest of National Ilan University, macrofungi, wood-inhabiting fungi.

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宜蘭大學實驗林場之木棲性大型真菌

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摘 要

本文紀錄於 2005 年 12 月至 2008 年 12 月間於宜蘭大學實驗林場蘭花溪西側區域所發現並確認至種名的木棲性大型真菌。子實體於發現地點直接鑑別紀錄，或採集回實驗室後依形態特徵鑑別確認。少數種類之種名由 rDNA 序列(ITS and/or D1～D3 Domains of 28S rDNA)比對確認。結果共有 90 種木棲性大型真菌確認至種名，其中 75 種爲擔子菌，15 種爲子囊菌。在擔子菌中，木耳(*Auricularia auricula-judae*)、毛木耳(*Auricularia polytricha*)、

相鄰小孔菌(*Microporus affinis*)、略薄多孔菌(*Polyporus tenuiculus*)、裂褶菌(*Schizophyllum commune*)及優美栓菌(*Trametes elegans*)爲最常發現的種類；由 rDNA 確認種名中的 *Ceriporia lacerata*、*Melanotus subcuneiformis* 及 *Mycoaciella bispora* 等三種有可能是台灣新紀錄種。炭角菌屬(*Xylaria*)真菌佔所有鑑別至種名的子囊菌種類的三分之一，大孢毛杯菌(*Cookeina insititia*)則爲秋冬季最易發現的大型子囊菌。調查期間所發現並鑑別至種名的 21 種土棲型大型擔子菌亦併在本文中紀錄，其中簇生鬼傘(*Coprinus disseminatus*)及亮多珊瑚菌(*Multiclavula clara*)最爲常見。

關鍵詞：宜蘭大學實驗林場、大型真菌、木棲性真菌

INTRODUCTION

Macrofungi are fungi that produce obvious fruiting bodies. A large number of them belong to Basidiomycota and few others belongs to Ascomycota. In forest ecosystem, a lot of macrofungi are consumers and scavengers and live as parasites and saprobes on standing and/or dead trees and cellulose debris; some others live symbiotically with tree root system to form mycorrhizae. Because of their obvious fruiting bodies, macrofungi have long being used by people as substrates for daily living and subjects of stories and arts.

A three-year survey on wood-inhabiting macrofungi had been started at the end of 2005, during the period, more than 750 macrofungi specimens were discovered and collected and a paper recording the primary results of the survey had been published (Tseng and Lin, 2008). This paper is a wrap up of the survey based on the macrofungi identified to their species. Although a notable percentage of fruiting body collected remain unidentified, we think the present result should be able to give a picture to the wood-inhabiting macrofungi of the experimental forest and to be a valid list of them.

Fig. 1 Location of the survey regions, survey areas were marked in gray. 1.nursery area, 2.margin of Taiwan Incense cedar stand, 3.area around Chung-Shing building, 4.specimen garden, 5.forest trail(▬·▬) sections, 6.formosan sweet gum stand, 7.trail around water towel, 8.area around the main entrance.

圖 1 實驗林場調查區域位置圖，灰色部分為調查區域。1.苗圃區域，2.肖楠林林緣，3.忠信樓周邊，4.標本園，5.林道(▬·▬)各區段，6.楓香林，7.環水塔步道，8.林場大門附近

MATERIALS AND METHODS

1. The experimental forest

The experimental forest of National Ilan University locates at Chiao-she shiang, Yilan County. The Orchid creek streams through the whole forest from north to south to divide the 173-hectare forest into eastern and western parts. The altitude of the forest is between 125-670 meters. The yearly average temperature and relative humidity of the forest are 22.1℃ and 86%. The yearly accumulated precipitation is over 2,700 mm. Artificial secondary grown forest constructs the major landscape with Chinese Guger-tree (*Schima superba*), Formosan michelia (*Michelia compressa*), Taiwan Incense-cedar (Calocedrus formosan), Taiwan Zelkova (Zelkova serrata), Formosan Ash (Fraxinus griffithii), Taiwan Acacia (Acacia confusa), Wood Oil Tree (Aleurites montana), Formosan Sweet Gum (Liquidambar formosana) and species of Fagaceae as major components.

2. Survey areas

According to the presence of macrofungi from experience in advance, 5 locations and 3 routs on the western part of the forest were selected as periodic survey areas and routs (Fig. 1).

3. Survey and identification

Selected areas and routs were surveyed in a frequency of twice per season from December, 2005 to November, 2006; starting from 2007 till the end of 2008, survey frequency was adjusted to once per season. Fruiting bodies discovered were identified on site when it was possible; if not then specimens were collected and identified later in the laboratory. References apply to fruiting body identification includes Chang *et al.* (2005; 2001; 2000), Chou and Chang (2005), Mao (2000), Huang (1998), Læssøe (1998), Arora (1986) and Phillips (1981). Some of the colonies isolated from the specimens were apply to the method adapted from the methods proposed by Tzen *et al*. (2007) and Tzen and Huang (2009) to extracted their genomes for ITS and 28S rDNA (D1 ～ D3 domains) segments amplification and sequencing. The nucleotide sequences of ITS and 28S rDNA (D1～D3 domains) were compared to the NCBI data base to determine their species names.

4. Data management

Fruiting bodies of a same fungus discovered on a same site or of a distance close around were counted as one. Results of a same season, regardless of the year, were pooled together to reveal the seasonal tendency of kind and number of fruiting body discovery, and to be compared among seasons.

RESULTS AND DISCUSSION

Efforts were made on species identification during the survey period, as usual, there were quite a few of resupinate specimens or easily deliquescent fleshy fruiting bodies remain unidentified. In spite of the difficulty in identifying certain types of fruiting bodies, a total number of 90 wood-inhabiting and 21 soil-inhabiting macrofungi were identified during the period which made it necessary to organize and present the result at this point.

1. Wood-inhabiting macro-Basidiomycota

The 75 identified wood-inhabiting macro-Basidiomycota and their seasonal and total times of discovery within the survey period are listed in Table 1. Seven of the 75 species present total times of discovery over 10 were recognized as frequently encountered species and could be discovered year round. They are *Auricularia auricula-judae*, *Auricularia polytricha*, *Microporus affinis*, *Polyporus tenuiculus*, *Schizophyllum commune*, and *Trametes elegans*.

2. Wood-inhabiting macro-Ascomycota

Fifteen Ascomycota identified to species recorded in this section (Table 2), 7 of them belong to *Hypoxylon* and *Xylaria*. Because of the relatively low number of identified species and times of discovery in comparison to the Basidiomycota stated above, it is inappropriate to make any inference. From the data base referred (Council of Agriculture, 1999) a relatively large number of wood-inhabiting macrofungi belong to Basidiomycota, however, we believe that the low species number and times of discovery of the Ascomycota might be caused by the less attention on these fungi of the surveyor and their relatively not easily to be noticed fruiting bodies. Perhaps a project concentrates on wood-inhabiting macro-Ascomycota may reveal a better picture of these fungi.

3. Soil-inhabiting macrofungi

The soil-inhabiting macrofungi that the surveyor came into contact with by chance in the

surveying areas were also recorded and collected. Twenty-one of them were identified to species and are revealed in table 3. All of these 21 species belong to Basidiomycota. According to the times of discovery, *Coprinus disseminatus* and *Multiclavula clara* are the soil-inhabiting macrofungi that are frequently to be met.

Table 1 Total times of discovery by seasons of wood-inhabiting macro-Basidiomycota identified to species during the survey period.

表 1 調查期間鑑定至種的木棲性大型擔子菌於各季節的發現次數總和

Scientific name 學名	Chinese name 中文名	Spr. 春	Sum. 夏	Aut. 秋	Win. 冬	Total 合計
Amauroderma rugosum	假芝	4	3	2		9
Auricularia auricula-judae	木耳	2	5	5	1	13
Auricularia polytricha	毛木耳	6	3	1	2	12
Calocera cornea	膠角耳	1	2	1		4
Calyptella capula	帽形菌		1			1
Campanella junghuhnii	脈紋扇菇		1			1
*Ceriporia lacerata**			1			1
Clavicorona pyxidata	杯珊瑚菌	1				1
Clitopilus hobsonii	荷伯生氏斜蓋傘	1	1			2
Clitopilus prunulus	斜蓋傘		1			1
Coprinus radians	輻毛鬼傘		1			1
Coriolopsis aspera	粗毛擬革蓋菌	1				1
Coriolopsis neaniscus	黃褐革蓋菌	1	1			2
Crepidotus bodioflocosus	褐黃鱗銹耳	1	1	1		3
Crepidotus mollis	軟靴耳	2	2			4
Crepidotus sulphurinus	硫磺色靴耳		1		1	2
Cymatoderma dentriticum	樹枝狀波邊革菌	1		1		2
Cymatoderma elegans	優雅波邊革菌			1		1
Cymatoderma lamellatum	片狀波邊革菌.		1			1
Cyptotrama aspata	粗糙鱗蓋傘		1			1
Dacryopinax spathularia	桂花耳		2	2	1	5
Dictyopanus gloeocystidiatus	小網孔菌	1	4			5
Earliella scabrosa	粗硬春孔菌	1	4	1		6
Echinochaete russiceps	細長刺剛毛狀菌	1	2	1		4
Echinoporia hydnophora			1			1
Elmeruna cladophora	有枝榆孔菌		1			1
Entoloma sericellum	絹狀粉褶菌	1				1
Ganoderma australe	南方靈芝				2	2
Ganoderma tropicum	熱帶靈芝		1	1		2
Ganoderma tsugae	松杉靈芝			1	1	2
Gymnopilus aeruginosus	綠褐裸傘	1		1	1	3
Gyrodontium versicolor	變色原齒菌		1			1
Hohenbuehelia reniformis	腎形亞側耳	1				1
Irpex lacteus	乳白耙菌	1	1	1	2	5
Junghuhnia nitida	明亮松氏孔菌	1	2			3
Laxitextum bicolor	雙色疏革菌	1				1
Lentinus sajor-caju	環柄香菇	1	1			2
Marasmiellus candidus	純白微皮傘		1			1
Marasmiellus coilobasis	白黃微皮傘		1	1		2
Marasmiellus nigripes	黑柄微皮傘		2			2
Marasmius androsaceus	安絡小皮傘		1	1		2
Marasmius capillipes	毛小皮傘		2			2
*Melanotus subcuneiformis**		1	2			3

Table 1 (continued)

Scientific name 學名	Chinese name 中文名	Spr. 春	Sum. 夏	Aut. 秋	Win. 冬	Total 合計
Microporus affinis	相鄰小孔菌	3	3	1	3	10
Microporus xanthopus	黃柄小孔菌		1		1	2
Microprons vernicipes	褐扇小孔菌		1			1
Mycoacia copelandii	棉瑚針菌	1	2	1	1	5
*Mycoaciella bispora**		1				1
Naematoloma fasciculare	簇生沿絲傘	1	1			2
Nidula niveo-tomentosa	白絨紅蛋巢菌		1			1
Oligoporus lowei	洛易褐腐乾酪菌				1	1
Oudemansiella radicata	長根小奧德蘑		1			1
Panus fulvus	褐絨革耳	2	1			3
Panus rudis	野生革耳	1				1
Perenniporia tephropra	灰孔多年臥孔菌	1				1
Phellinus lundellii	郎帝木層孔菌				1	1
Polyporus arcularius	漏斗多孔菌	1	2		1	4
Polyporus squamosus	寬鱗多孔菌	1				1
Polyporus tenuiculus	略薄多孔菌	2	4	3	2	11
Psathyrella candollieana	黃蓋小脆柄菇		1			1
Rigidoporus microporus	小孔硬孔菌	1	3	1	1	6
Schizophyllum commune	裂褶菌	3	4	5	2	14
Steccherinum rhois	橙黃齒菌	1		1		2
Stereum cyathoides	杯狀韌革菌	1	2	1		4
Stereum ostrea	蠔韌革菌	3		1	1	5
Stereum spectabile	金絲韌革菌		2			2
Trametes elegans	優美栓菌	4	1	4	4	13
Trametes feei	粉紅栓菌	3	1			4
Trametes hirsuta	毛栓菌	2		3	2	7
Trametes lactinea	大白栓菌	2				2
Trametes versicolor	彩絨栓菌		1	1		2
Tremella foliacea	茶色銀耳				2	2
Tremella fuciformis	銀耳	1		1		2
Trichaptum biforme	囊孔附毛菌	2	2			4
Xylobolus spectabilis	金絲趨木菌	1	1		1	3
	Number of species	44	53	28	22	75
	Times of discovery	70	90	45	34	239

*species considered new for Taiwan

Table 2 Total times of discovery by seasons of wood-inhabiting macro-Ascomycota identified to species during the survey period.

表 2 調查期間鑑定至種的木棲性大型子囊菌於各季節的發現次數總和表 2 調查期間鑑定至種的木棲性大型子囊菌於各季節的發現次數總和

Scientific name 學名	Chinese name 中文名	Spr. 春	Sum. 夏	Aut. 秋	Win. 冬	Total 合計
Biscogniauxia capnodes	平滑炭皮菌	1			1	2
Cookeina insititia	大孢毛杯菌			3	2	5
Daldinia eschscholzii	光輪層炭菌	2	2			4
Dicephalospora rufocornea	紅硬雙頭孢菌		1	3		4
Hypocrea rufa	紅棕肉座菌				1	1
Hypoxylon nitens	刨光炭團菌				1	1
Hypoxylon perforatum	白孔炭團菌				1	1
Sarcasoma javanicum	爪哇肉盤菌			1		1
Orbilia sarraziniana	肉圓盤菌		1			1
Scutellinia scutellata	盾盤菌	1				1
Xylaria allantoidea	蕉座炭角菌	2	1	1		4
Xylaria arbuscula	樹狀炭角菌	1				1
Xylaria cubensis	小蕉座炭角菌		1			1
Xylaria melanaxis	黑柄炭角菌	2		1		3
Xylaria schweinitzii		1				1
	Number of species	7	5	5	5	15
	Times of discovery	10	6	9	6	31

Table 3 Total times of discovery of soil-inhabiting macrofungi identified to species during the survey period.

表 3 調查期間鑑定至種的土棲性大型擔子菌的發現次數總和

Scientific name 學名	Chinese name 中文名	Times of discovery 次數
Calvatia craniiformis	頭狀禿馬勃	1
Clathrus ruber	龍頭菌	1
Conocybe lacteal	乳白錐蓋傘	3
Coprinus atramentarius	墨汁鬼傘	1
Coprinus comatus	毛頭鬼傘	2
Coprinus disseminatus	簇生鬼傘	10
Coprinus micaceus	晶粒鬼傘	1
Coprinus plicatilis	褶紋鬼傘	1
Geastrum saccatum	袋狀地星	1
Hygrophoropsis aurantiaca	錐型濕傘	1
Lepiota atrosquamulosa	暗鱗環柄菇	3
Leucocoprinus birnbaumii	純黃白鬼傘	1
Leucocoprinus fragilissimus	易碎白鬼傘	2
Lycoperdon perlatum	網紋馬勃	1
Multiclavula clara	亮多珊瑚菌	6
Mycena pura	潔小菇	1
Scleroderma areolatum	龜紋硬皮馬勃	2
Scleroderma polyrhizum	多根硬皮馬勃	2
Scleroderma verrucosum	灰疣硬皮馬勃	1
Termitomyces albuminosus	雞肉絲菇	1
Termitomyces microcarpus	小蟻巢傘	1
	Number of species	21
	Times of discovery	43

CONCLUSIONS

One hundred and eleven identified macrofungi discovered from the western part of the experimental forest of National Ilan University are presented in this paper, among them are 75 wood-inhabiting Basidiomycota, 15 wood-inhabiting Ascomycota, and 21 soil-inhabiting species. As was expected, over 90% of the wood-inhabiting species may be discovered in spring and summer; however, there are fruiting bodies, such as of *Ganoderma australe*, *Tremella foliacea*, and *Hypoxylon* spp. appear only in winter. These indicate the diversity of macrofungi of the low elevation secondary forest of Yilan area and although a greater portion of the macrofungi could be discovered in spring and summer, survey should still be carried throughout the year to give a whole picture of the subjects. The development of fruiting bodies may varied by years, the one that was encountered in the year may totally be absent in the next following year. Therefore, to present thorough macrofungi fauna of an area may require a consecutive year round survey for at least a couple or couples of years.

REFERENCES

Arora, D. 1986. Mushrooms Demystified. 958 pp. Ten Speed Press. CA, USA.

Chang, T. T., W. N. Chou, and K. M. Huang. 2005. Guide of Mushrooms. 206 pp. Yuan-Liou Publishing Co. Taipei, Taiwan. (in Chinese)

Chang, T. T., W. N. Chou, Y. Z. Wang, and Y. M. Ju. 2001. The Macrofungi of Taiwan. 542 pp. Council of Agriculture, Executive Yuan. Taipei, Taiwan. (in Chinese)

Chang, T. T., W. N. Chou, N. L. Wu, and Y. Z. Wang. 2000. The Macrofungi of Fu-Shan. 195 pp. Council of Agriculture, Executive Yuan. Taipei, Taiwan. (in Chinese)

Chou, W. N. and T. T. Chang. Mushrooms of Taiwan. 439 pp. Yuan-Liou Publishing Co. Taipei, Taiwan. (in Chinese)

Council of Agriculture, Executive Yuan. 1999. List of the Fungi in Taiwan. 289 pp. Taiwan Forestry Research Institute, Council of Agriculture, Executive Yuan, Taipei.

Huang, N. L. 1998. Colored Illustrations of Macrofungi of China. 293 pp. China Agricultural Press. Beijing, China. (in Chinese)

Læssøe, T. 1998. Mushrooms. 335 pp. Dorling Kindersley Limited. London, UK.

Mao, X. L. 2000. The Macrofungi in China. 719 pp. Henan Science and Technology Press. Henan, China. (in Chinese)

Phillips, R. 1981. Mushrooms and Other Fungi of Great Britain and Europe. 287pp. Pan Books. London, UK.

Tseng, S. H. and Y. L. Lin. 2008. Primary Survey on Macrofungi of the Experimental Forest of National Ilan University. Ilan University Journal of Bioresources 4(1):25-34.

Tzen, S. S., T. W. Huang, and J. L. Yuan. 2007. Atlas of potential fungi pathogens associated with agricultural commodity imported to Taiwan. 194 pp. Bureau of Animal and Plant Health Inspection and Quarantine, Council of Agriculture, Executive Yuan. Taipei. (in Chinese)

Tzen, S. S. and T. W. Huang. 2009. Atlas of potential fungi pathogens associated with agricultural commodity imported to Taiwan II. 168 pp. Bureau of Animal and Plant Health Inspection and Quarantine, Council of Agriculture, Executive Yuan. Taipei. (in Chinese)

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