

Higher Fungi of Northeast Langkawi

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ABSTRACT The North-East Langkawi is unique with different ecosystems and diverse forest types which are relatively undisturbed. A total of 212 specimens were collected from eight localities in the North-East Langkawi during two sampling periods from 10 – 19 April 2003 and 4 – 9 April 2004. The highest number of macrofungi collected was from Gunung Raya and Sungai Sireh Forest Reserves which are richly forested with predominantly dipterocarp trees. Twenty-two specimens were identified to species and 153 specimens were identified to genus. Macrofungi from the Division Ascomycota and Subdivision Ascomycotina recorded were *Xylaria* spp. (4 specimens) from Xylariaceae and *Phillipsia* sp. (1 specimen) from Sarcoscyphaceae. Further, 71 genera of Basidiomycotina belonging to 8 orders and 25 families were among the identified specimens. The Agaricales was the dominant order documented with 42 genera from eleven families recorded. The frequently recorded genera were *Marasmius* (29 specimens) followed by *Lentinus* (13 specimens) and *Gymnopus* and *Polyporus* (9 specimens each). The *Marasmius* specimens belonged to *Marasmius* sect. *Marasmius* (15 specimens), *Marasmius* sect. *Sicci* (6 specimens), *Marasmius* sect. *Globulares* (1 specimen) and seven unknown.

ABSTRAK Bahagian Timur-Laut Langkawi adalah unik dari segi kelainan ekosistem dan jenis hutan yang pelbagai dan tidak terganggu. Sejumlah 212 spesimen telah dikutip dari lapan kawasan di Timur-Laut Langkawi semasa dua tempoh pesampelan dilakukan iaitu pada 10 – 19 April 2003 dan 4 – 9 April 2004. Bilangan kulat makro paling tinggi di kutip dari Hutan Simpan Gunung Raya dan Sungai Sireh yang didominasi oleh pokok-pokok dipterocarp. Sembilan spesimen telah dicamkan ke peringkat spesies dan 167 spesimen dicamkan ke peringkat genus. Kulat makro dari divisi Ascomycota dan subdivisi Ascomycotina yang direkod ialah *Xylaria* spp. (4 spesimen) dari Xylariaceae dan *Phillipsia* sp. (1 spesimen) dari Sarcoscyphaceae. Tambahan, 71 genera Basidiomycotina yang digolongkan kepada 8 order and 25 famili adalah dikalangan spesimen yang dicamkan. *Agaricales* adalah order yang dominan yang dilaporkan dan terdiri dari 42 genera daripada 11 famili. Genera yang paling lazim dijumpai adalah *Marasmius* (29 spesimens) diikuti dengan *Lentinus* (13 spesimen) dan *Gymnopus* dan *Polyporus* (masing-masing 9 spesimen). Spesimen-spesimen *Marasmius* digolongkan kepada *Marasmius* sect. *Marasmius* (15 spesimen), *Marasmius* sect. *Sicci* (6 spesimen), *Marasmius* sect. *Globulares* (1 spesimen) dan tujuh lagi belum dikenalpasti.

(Macrofungi, biodiversity, checklist, mycobiota, Langkawi)

INTRODUCTION

We come across fungi in nature at every step, without being aware of it. They are ubiquitous, just like bacteria or viruses, but are usually invisible since spores carrying genetic information do not exceed microscopic dimensions. Interest in fungi for most laymen is only aroused by the conspicuous fungal fruit bodies, the sporocarps. However, sporocarps which are large enough to be appreciated with the naked eye, at times with such beauty and divine

appearance, are formed only by a small proportion of fungi. Other fungi are too minute in size to be discernible without an optical instrument.

Fungi are present in all ecosystems, both within and outside forests. They play a role of major importance in the soil. Their mycelium and spores permeate the forest litter, while mycorrhiza often enables woody plants to grow in places where, without the fungi, they could not grow. The most basic importance of fungi rests

in their intensive participation in all decomposition processes and other chemical reactions in the soil. The number of fungi recognized and described is estimated to exceed 100,000, probably reaching 300,000, i.e. approximately at par in number with that of seed plants. If 40-50 percent of seed-plant species are to die out in the near future due to extensive deforestation or other devastating human activities, it is fair to assume that the same number of fungal species will simultaneously disappear from the surface of this planet forever since most of them are dependent on these seed-plants, as mycorrhiza. Many will disappear without ever being discovered, identified, and perhaps also utilized for the benefit of mankind.

Higher fungi are loosely referred to as those which are large enough to be observed without the use of microscopes. Taxonomically, these fall into two fungal divisions, the Ascomycota and Basidiomycota. Sporocarps of these fungi vary in appearance, ranging from patches on wood, through brackets, coral-like tufts, simple clubs and rosettes, to cauliflower-like structures, centrally or laterally stalked fruit bodies. Their texture varies from woody, leathery or fleshy to gelatinous and the surface may be smooth, velvety, hairy or scaly and either dry or glutinous. The fertile underside may be smooth or have spines, pores or gills.

Tropical rainforest boasts its large diversity of life. Likewise, fungal diversity in such forests is also expected to be a lot higher than in other types of vegetation. Langkawi is a group of ninety-nine coastal islands between 22 to 54 kilometers off the coast of Perlis in northern Peninsular Malaysia. The main island covers an area of 939 square kilometers with limestone being the prominent rock type, rising imposingly from the seas, and forms a part of the limestone range in northern Peninsular Malaysia and southern Thailand. Many of these islands are relatively undisturbed and their vegetation is very much influenced by its geology. The granite central and eastern regions are covered with tall dipterocarp primary forests while on the limestone and quartz hills, carbonate-loving species dominate. Other forest types include those bordering the rocky coast and sandy beaches, mangroves along most of the rivers and estuaries, and secondary forests bordering the agriculture land. The climate of these islands resembles that of the northern mainland, with a

distinct and pronounced dry season between November and March, and two indistinct wet seasons from April to May, and August to October.

The Kedawi (Kedah-Perlis-Langkawi) region is floristically different from the rest of Peninsular Malaysia and a number floral species are endemic in Langkawi alone, probably due to its oceanic isolation. Thus a continuous effort in documenting a comprehensive inventory of the flora and fauna, including its mycobiota, of both the terrestrial and marine ecosystems is of high priority for the long-term environmental sustainability of these islands. Kuthubutheen [1] reported 97 fungal specimens from three sites in Langkawi and was undoubtedly the first study on the mycobiota of these group of islands. Eight localities were involved in the present study which aimed at identifying, describing and preparing a checklist of tropical basidiomycete and ascomycete collected, obtaining dry herbarium specimens as well as their pure cultures for biotechnological exploitations.

MATERIALS AND METHODS

Collections were made from eight localities in the North-East region of Langkawi as shown in Fig. 1, during two sampling periods between 10 - 19 April, 2003 and 4 - 9 April, 2004. During the first trip samplings were made at Gunung Raya Forest Reserve (Hutan Lipur Lubuk Semilang), Durian Perangin, Selat Panchor Forest Reserve and Sungai Sireh. During the second trip, samplings were made at Kilim Mangrove Forest (Gua Cherita, Ayer Hangat), Gunung Raya Forest Reserve (Hutan Lipur Lubuk Semilang), Pulau Langgun, Pulau Dendang and Kisap Mangrove Forest. Samples were photographed in the field, collected and the macromorphological characters described. The specimens were then dried at 45 °C in a ventilated portable dryer for microscopic observations and to obtain herbarium specimens. Specimens were stored in insect-tight containers in the Mycological Laboratory, Institute of Biological Sciences, Faculty of Science, University of Malaya. Identifications were based on identification keys [2, 3, 4, 5 and 6] and various field guides available [7, 8 and 9].

RESULTS AND DISCUSSION

The North-East Langkawi can be categorized into three different ecosystems, that is, mangrove

forest, dipterocarp forest and limestone forest. Of the eight localities where sampling was done, Kilim area (Gua Cherita, Ayer Hangat) and Kisap area are considered as mangrove forests while Sungai Sireh, Durian Perangin, Selat Panchor Forest Reserve and Gunung Raya Forest Reserve (Hutan Lipur Lubuk Semilang) are considered as dipterocarp forests and Pulau Langgun and Pulau Dendang are limestone forests. The higher fungi collected from both trips are listed in Table 1. The taxonomic arrangement is based on that proposed by Kirk *et al.* [10]. Some fungi were only observed and not collected are also reported here. The highest number of higher fungi specimens collected or observed in the dipterocarp forests ecosystem is 188 followed by 14 specimens from the limestone forests and 10 specimens from the mangrove forests ecosystem. In the mangrove ecosystem only *Fomes* sp. and *Polyporus* spp. were found growing on dead or decomposing wood. In the dipterocarp and limestone forests, both ectomycorrhizal and

saprophytic fungi were observed. The closed-canopy forests were moist and humid accounting for a diversity of higher fungi.

Wood and litter inhabiting saprophytic species were predominant compared to soil inhabiting species. Species of *Anthracoxyllum*, *Campanella*, *Hemimycena*, *Podoscypha*, *Rhodocollybia*, *Trogia*, *Tetrapyrgos*, *Xeromphalina*, and *Xerula* were not reported in earlier studies of macrofungi in Malaysia [11, 12 and 13]. Putative ectomycorrhizal fungi collected at Sungai Sireh, Durian Perangin and Gunung Raya Forest Reserves were *Amanita*, *Inocybe*, *Boletus*, *Gyroporus*, *Craterellus*, *Hydnum* and *Russula*. Species identification is on-going. There is a possibility that *Gyroporus* sp. and *Melanonotus* sp. will be new records for Malaysia once species identification is verified. These two species have not been reported by earlier studies [14, 15 and 16].

Table 1. The number of specimens of macrofungi collected in North-East Langkawi

	Number of specimens per collecting site							
	A	B	C	D	E	F	G	H
DIVISION : ASCOMYCOTA; SUBDIVISION : ASCOMYCOTINA								
Class : Sordariomycetidae								
Order : Xylariales								
Family : Xylariaceae								
1. <i>Xylaria</i> spp.	-	-	-	-	-	2	-	2
Class : Pezizomycetidae								
Order : Pezizales								
Family : Sarcoscyphaceae								
2. <i>Phillipsia</i> sp.	-	-	-	-	-	-	-	1
DIVISION : BASIDIOMYCOTA; SUBDIVISION : BASIDIOMYCOTINA								
Class : Basidiomycetes								
Order : Agaricales								
Family : Agaricaceae								
3. <i>Agaricus</i> spp.	-	-	-	-	1	-	-	2
4. <i>Leucoagaricus</i> sp.	-	-	-	-	-	-	-	1
5. <i>Leucocoprinus</i> sp.	-	-	-	-	1	-	-	-
Family : Coprinaceae								
6. <i>Coprinus</i> sp.	-	-	-	-	1	-	-	-
7. <i>Psathyrella</i> sp.	-	-	-	-	1	-	-	-
Family : Cortinariaceae								
8. <i>Gymnopilus</i> spp.	-	-	-	-	-	1	-	3
9. <i>Inocybe</i> sp.	-	-	-	-	-	-	-	1
10. <i>Crepidotus</i> spp.	-	-	-	-	-	-	-	7
Family : Entolomataceae								
11. <i>Entoloma</i> sp.	-	-	-	-	-	-	-	1
Family : Hydangiaceae								
12. <i>Laccaria</i> sp.	-	-	-	-	-	1	-	-
Family : Marasmiaceae								
13. <i>Anthracoxyllum nigratum</i> (Lev.) Kalchbr.	-	-	-	-	1	-	-	-
14. <i>Anthracoxyllum</i> sp.	-	-	-	-	1	-	-	1
15. <i>Campanella</i> sp.	-	-	-	-	-	-	-	1
16. <i>Cyptotrampa</i> sp.	-	-	-	-	-	-	-	2
17. <i>Flammulina</i> sp.	-	-	-	-	-	-	-	1
18. <i>Marasmiellus</i> sp.	-	-	-	-	-	-	-	5
19. <i>Marasmius</i> spp.	-	-	-	-	1	1	-	27
20. <i>Oudemansiella</i> sp.	-	-	-	-	-	-	-	1
21. <i>Rhodocollybia</i> sp.	-	-	-	-	-	-	-	1
22. <i>Tetrapyrgos</i>	-	-	-	-	-	-	-	3
23. <i>Xerula</i> sp.	-	-	-	-	-	-	-	3

Fungal Species	Number of specimens per collecting site							
	A	B	C	D	E	F	G	H
Family : Nidulariaceae								
24. <i>Cyathus</i> sp.	-	-	-	-	1	-	-	-
Family : Pluteaceae								
25. <i>Amanita</i> sp.	-	-	-	-	-	-	-	1
26. <i>Volvariella</i> sp.	-	-	-	-	-	-	-	1
Family : Schizophyllaceae								
27. <i>Schizophyllum commune</i> Fr. : Fr.	-	-	-	-	-	-	-	1
Family : Strophoriaceae								
28. <i>Melanotus</i> sp.	-	-	-	-	-	-	-	1
Family : Tricholomataceae								
29. <i>Callistosporium</i> sp.	-	-	-	1	-	-	-	-
30. <i>Crinipellis</i> spp.	-	-	-	-	-	-	-	3
31. <i>Filoboletus</i> sp.	-	-	-	-	-	-	-	3
32. <i>Gymnopus</i> sp.	-	-	-	-	-	-	-	9
33. <i>Hemimycena</i> sp.	-	-	-	-	-	-	-	2
34. <i>Hygrocybe conica</i> (Schaeff.:Fr.) Kummer	-	-	-	-	2	-	-	-
35. <i>Hygrocybe punicea</i> (Fries) Kummer	-	-	-	-	1	-	-	-
36. <i>Lactocollybia</i> sp.	-	-	-	-	-	-	-	1
37. <i>Lepista subalpina</i> (H. E. Bigelow & A. H. Smith) Harmaja	-	-	-	-	-	-	-	1
38. <i>Mycena</i> spp.	-	-	-	-	-	-	-	7
39. <i>Panellus</i> sp.	-	-	-	-	1	-	-	-
40. <i>Termitomyces</i> sp.	-	-	-	-	-	1	-	1
41. <i>Trogia</i> sp.	-	-	-	-	-	-	-	5
42. <i>Xeromphalina</i> sp.	-	-	-	-	-	-	-	1
Order : Auriculariales								
Family : Auriculariaceae								
43. <i>Auricularia</i> spp.	-	-	1	-	-	-	-	2
Order : Boletales								
Family : Boletaceae								
44. <i>Boletus</i> sp.	-	-	-	-	-	-	-	1
Family : Gyrosporaceae								
45. <i>Gyroporus</i> sp.	-	-	-	-	-	-	-	1
Order : Cantharellales								
Family : Cantharellaceae								
46. <i>Craterellus</i> sp.	-	-	-	-	-	-	1	-
Family : Hydniaceae								
47. <i>Hydnum</i> sp.	-	-	-	-	-	-	-	1
Order : Hymenochaetales								
Family : Hymenochaetaceae								
48. <i>Coltricia</i> sp.	-	-	-	-	-	1	-	-
49. <i>Inonotus</i> sp.	-	-	-	-	1	-	-	-

Fungal Species	Number of specimens per collecting site							
	A	B	C	D	E	F	G	H
Order : Phallales								
Family : Geastraceae								
50. <i>Geastrum</i> sp.	-	-	-	-	1	-	-	-
Family : Phallaceae								
51. <i>Dictyophora cinnabarina</i> Lee	-	-	1	-	-	-	-	-
Order : Polyporales								
Family : Ganodermataceae								
52. <i>Amauroderma</i> sp.	-	-	-	-	-	-	1	-
53. <i>Ganoderma</i> spp.	-	-	1	-	-	-	-	-
Family : Hapalopilaceae								
54. <i>Bjerkandera</i> sp.	-	-	-	-	1	-	-	-
Family : Podoscyphaceae								
55. <i>Cymatoderma</i> sp.	-	-	-	-	1	-	-	-
56. <i>Podoscypha</i> sp.	-	-	-	-	-	-	-	1
Family : Polyporaceae								
57. <i>Fomes</i> sp.	1	-	-	-	-	-	-	-
58. <i>Hexagonia</i> spp.	-	-	-	-	-	-	-	1
59. <i>Lentinus squarrosulus</i> Mont.	-	-	-	-	-	-	-	2
60. <i>L. araucariae</i> Har. & Pat.	-	-	-	-	-	1	-	-
61. <i>L. fasciatus</i> Berk.	-	-	1	-	-	-	-	1
62. <i>L. polychrous</i> Lev.	-	-	-	-	1	-	-	1
63. <i>L. sajor-caju</i> (Fr.) Fr.	-	-	-	-	-	-	-	1
64. <i>L. strigosus</i> (Schwein.) Fr.	-	-	-	-	1	-	-	-
65. <i>L. strigellus</i> Berk.	-	-	-	-	-	-	-	2
66. <i>Neolentinus adhaerens</i> (Fr.) Redhead & Ginn.	-	-	-	-	1	-	-	-
67. <i>Microporus xanthopus</i> (Fr.) Ktz.	-	-	-	-	1	-	-	1
68. <i>Microporus</i> sp.	-	-	1	-	-	-	-	1
69. <i>Polyporus</i> sp.	2	2	2	-	1	-	-	2
70. <i>Pycnoporus</i> sp.	-	-	-	-	1	-	-	-
71. <i>Trametes</i> spp.	-	-	-	-	-	-	-	2
Family : Stecheriaceae								

72. <i>Irpex</i> sp.	-	-	-	-	-	-	-	1
73. <i>Steccherinum</i> sp.	-	-	-	-	-	-	-	1
Order : Russulales								
Family : Russulaceae								
74. <i>Russula virescens</i> (Schaeff.) Fr.	-	-	-	-	-	1	-	-
75. <i>Russula</i> spp.	-	-	-	-	2	1	-	2
76. <i>Stereum</i> spp.	-	-	-	-	-	-	-	1
Number of Unidentified Specimens	3	2	5	1	3	1	-	22
Total Number of Specimens Sighted / Collected	6	4	12	2	27	11	2	148

- indicates absence

Details of Localities :

- A : Kilim Mangrove Forest (Gua Cherita, Ayer Hangat)
- B : Kisap Mangrove Forest
- C : Pulau Langgun
- D : Pulau Dendang
- E : Sungai Sireh
- F : Durian Perangin
- G : Selat Panchor Forest Reserve
- H : Gunung Raya Forest Reserve (Hutan Lipur Lubuk Semilang)

A species of *Gymnopus* KUM 60126 (Plate 1a) was found growing gregariously in soil at Gunung Raya Forest Reserve. This specie could possibly be new as it has not been recorded among the *Gymnopus* of Indonesia [17]. Features include a cap of 3 – 20 mm, conical to convex with umbilicate or papilla. Surface dry, dull, pubescent, dark brown when fresh to hygraphanous to yellowish-brown from disc. Gills adnate, close to crowded, dark brown with 1 – 2 series. Stem 1 x 10 – 26 mm, cylindrical, central, interstitial, dry, dull, glabrous and brown.

The genus *Marasmius* is saprophytic and found on dead leaves, wood, twigs and soil. An unidentified specie of *Marasmius* (KUM 60135) shown in Plate 1b was the biggest *Marasmius* that we have collected so far (Plate 1a). Cap 20 – 58 mm, conical with broadly depressed disc to broadly convex. Surface dry, dull, glabrous at first brownish orange to grayish-orange. Hygraphanous to pinkish brown deep striation from disc to margin. Pileus context thin to light brown. Gills adnate, subdistant, 10-14 lamellae with 1-2 series. Stem 2.0 - 2.5 x 128 -140 mm, cylindrical dry, dull, glabrous, interstitial, light brown.

Possibly a new record of Malaysia, *Rhodocollybia* sp. (KUM60090) was found solitary and gregarious in soil at Gunung Raya (Plate 1c). Cap 17 – 47 mm in diameter conical to convex. Surface dry, dull glabrous with tough surfaces, smooth at first reddish-brown with light brown at disc to brownish, hygraphanous to light

brown from disc. Gills adnate to adnexed, crowded, grayish-brown. Stem 5 – 7 x 95 – 130 mm, cylindrical, central, dry, dull, glabrous, twisted, interstitial and greyish-orange.

Lentinus is the second frequently encountered genus from North-East Langkawi and Plate 1d is *Lentinus strigosus* (Schwein.) Fr. (KUM 80005). Cap 30 mm, funnel-shaped with fibrillose surface and in-rolled margin. Gills decurrent, close, at first white to light-brown. Stem 10 - 15 x 30 - 45 mm fibrillose, cylindrical tapering towards the base, light-brown.

Trogia sp. (KUM 60105) tropical specie is shown in Plate 1e. Cap 17 – 40 mm; centre depressed, circular from the top and hemispherical from the side view. Surface dull and moist. Gills adnate to slightly decurrent and close. Stem 0.5 – 1.0 x 3.5 – 5.0 mm, central, cylindrical solid and hispid.

In the two expeditions, a total of 212 specimens were collected compared to 97 specimens collected by Kuthubutheen, [1] that is, about 2.5 times higher. The higher number of specimens collected could be due to the frequency of sampling, sampling time and number of sampling sites. In this study, sampling was timed to coincide with the wet season [18]. Furthermore, the sites explored were different to the study by Kuthubutheen [1]. To our knowledge, since the study by Kuthubutheen [1], this is the second concerted effort to document the higher fungi of Langkawi in general and the first in the North-East region.