VIII. BIOGEOGRAPHY OF MALESIAN ORCHIDACEAE

A. SCHUITEMAN

Rijksherbarium/Hortus Botanicus, P.O. Box 9514, 2300 RA Leiden, The Netherlands

INTRODUCTION

The *Orchidaceae* outnumber by far any other plant family in Malesia. At present, however, an accurate estimate of the number of Malesian orchid species is difficult to make. Subtracting the number of established synonyms from the number of names attributed to Malesian orchid species results in the staggering figure of 6414 species, with a retention ratio (ratio of 'accepted' species to heterotypic names) of 0.74. This is undoubtedly a gross overestimate, as most of the 209 Malesian orchid genera have never been revised over their entire range. Extrapolating from available revisions to estimate a more realistic retention ratio is problematic due to the small number of modern revisions and the different nature of the groups treated. If we look for comparison at Malesian species of some recently revised groups, we encounter a wide range of retention ratios:

Bulbophyllum sect. *Uncifera* (Vermeulen, 1993): 0.24
Dendrobium sect. *Oxyglossum* (Reeve & Woods, 1989): 0.24
Mediocalcar (Schuiteman, 1997): 0.29
Pholidota (De Vogel, 1988): 0.29
Bulbophyllum sect. *Pelma* (Vermeulen, 1993): 0.50
Paphiopedilum (Cribb, 1987, modified): 0.57
Dendrobium sect. *Spatulata* (Cribb, 1986, modified): 0.60.

Correspondingly, we find a wide range of estimates for the 'real' number of known Malesian orchid species: from 2050 to 5125.

Another approach would be to look at a single area, and to compute the retention ratio for the orchid flora of that area. If we do this for Java (mainly based on Comber, 1990), Peninsular Malaysia & Singapore (Seidenfaden & Wood, 1992) and Sumatra (J.J. Smith, 1933, modified), we find the following retention ratios:

Peninsular Malaysia: 0.65
Sumatra: 0.80.

These figures are surprisingly high, but it should be realised that they apply to single areas only. There are certainly many species, as yet unrecognised, which are treated under different names in different areas. However, most of the widespread species are by now fairly well known, so this problem should not be overrated. To make an educated guess, I would say that a retention ratio of 0.5 would be a reasonable figure, leading to an estimated number of currently known Malesian orchid species of about 4300. To this should be added at least several hundred as yet undescribed species, therefore the number of extant species may be as high as 4600 to 4900 (how many of these will become extinct before they are even collected and put in an herbarium?).

The data used for this article were extracted from the database ASORCH developed at the National Herbarium of the Netherlands, Leiden, by Dr. E.F. de Vogel and the author. This database incorporates all major publications on Malesian *Orchidaceae* as listed in the references (as well as a checklist of New Guinea *Orchidaceae* prepared by the author, and numerous other publications). In addition, the Royal Botanic Gardens, Kew kindly put their computerised species lists for Peninsular Malaysia, Java, Borneo, and the Solomon Islands at our disposal. It is my pleasure to thank Dr. P. Cribb for making these lists available to us. A checklist of the *Orchidaceae* of Celebes and the Moluccas in preparation by Ms. S. Thomas (K) became available in manuscript when this article had largely been completed and could not be taken into account. Fortunately, no major revisions are necessary. Table 1 (pages 275–281) summarises these data.

It should be kept in mind that the absolute numbers used below are generally too high by about 20 to 30%, especially for the larger genera. Also the percentages of endemism given are generally too high. I have not attempted to deflate those figures, as this would only have introduced an additional element of uncertainty.

This article consists of three parts: in part I an overview is presented of the major distribution patterns of Malesian orchid genera on a world-wide basis. In part II the distribution of genera and species within Malesia is analyzed. Finally, in part III some conclusions are drawn from the preceding analyses.

I. WORLD DISTRIBUTION OF MALESIAN ORCHID GENERA

1. Endemic genera of Malesia

The following 35 genera are not known to occur outside Malesia (those marked with an * are monotypic), and may be assumed to have originated within the region:

**Amesiella* (Philippines); *Bogoria* (Sumatra, Java, Borneo, Philippines, New Guinea); *Bracisepalum* (Celebes); **Ceratocentron* (Philippines); **Ceratochilus* (Java); *Chelonistele* (Peninsular Malaysia, Sumatra, Java, Borneo, Philippines); *Dimorphorchis* (Borneo); **Dossinia* (Borneo); *Dryadorchis* (New Guinea); **Dyakia* (Borneo); **Entomophobia* (Borneo); *Geesinkorchis* (Borneo); **Gynoglottis* (Sumatra); **Jejewoodia* (Borneo); *Kuhlhasseltia* (Malesia excl. Lesser Sunda Islands and Celebes); **Lepidogyne* Blume (Peninsular Malaysia, Sumatra, Java, Borneo, Philippines, New Guinea); **Megalotus* (Philippines); *Nabaluia* (Borneo); **Neoclemensia* (Borneo); *Omoea* (Java, Philippines); **Ophioglossella* (New Guinea); *Orchipedum* (Peninsular Malaysia, Borneo); **Phragmorchis* (Philippines; a published record from the Lesser Sunda Islands is based on a misidentification); *Porphyrodesme* (Sumatra, Borneo, Celebes, New Guinea); **Porphyroglottis* (Peninsular Malaysia, Sumatra, Borneo); *Porrorhachis* (Java, Borneo, Celebes); *Rhynchophreatia* (New Guinea); **Ridleyella* (New Guinea); *Saccoglossum* (New Guinea); *Saccolabium* (Sumatra, Java); *Sarcostoma* (Peninsular Malaysia, Sumatra, Java, Borneo, Celebes); **Silvorchis* (Java); **Spongiola* (Borneo).

Most of these genera are oligotypic, if not monotypic. The only larger genus is *Chelonistele* with 14 species, all but one endemic to Borneo (De Vogel, 1986). Not less than 17 of these genera belong to the subtribe *Aeridinae*, of which most are closely

(text continued on page 282)

Table 1. Distribution of orchid genera in Malesia. Numbers between brackets are percentages of endemic species (zero when not given). MALP = Peninsular Malaysia and Singapore; SUM = Sumatra; JAV = Java; BOR = Borneo; LES = Lesser Sunda Islands; SUL = Sulawesi; MOL = Moluccas; NG = New Guinea; PHI = Philippines.

	MALESIA	MALP	SUM	JAV	BOR	LES	SUL	MOL	NG	PHI
Abdominea	1	1	0	1	1	1	0	0	0	1
Acampe	1	1	0	0	0	0	0	0	0	0
Acanthephippium	8(87.5)	1	3(33.3)	2	4(50)	1	1	1	1	1(100)
Acriopsis	6(50)	5(20)	3	3	5(20)	2	1	1	1	2
Adenoncos	16(75)	4	6(50)	1	6(50)	0	3(100)	1(100)	1(100)	0
Aerides	12(91.7)	2	1	1	1	2(100)	3(66.7)	0	1	7(71.4)
Aglossorhyncha	11(90.9)	0	0	0	0	0	0	1	11(90.9)	0
Agrostophyllum	77(96.1)	8(12.5)	14(21.4)	7(14.3)	16(25)	0	3(33.3)	6(50)	43(95.3)	14(71.4)
Amesiella	1(100)	0	0	0	0	0	0	0	0	1(100)
Ania	4(75)	1	1	1	2(50)	0	0	1	1	1(100)
Anoectochilus	18(72.2)	7(28.6)	2	3(33.3)	5(80)	1	1(100)	2(50)	1(100)	0
Aphyllorchis	15(86.7)	3	3(33.3)	1	5(40)	0	1(100)	2(100)	5(100)	3(33.3)
Apostasia	6(50)	5(20)	4	3	5(20)	0	2	2	1	1
Appendicula	135(97.8)	10(30)	33(48.5)	19(15.8)	32(62.5)	7(14.3)	10(60)	3(66.7)	48(97.9)	22(72.7)
Arachnis	7(85.7)	2	2	1	4(50)	1	1(100)	0	2(50)	2
Armodorum	2(100)	0	1	1	1(100)	1	0	0	0	0
Arthrochilus	1(100)	0	0	0	0	0	0	0	1(100)	0
Arundina	1	1	1	1	1	1	1	0	0	0
Ascocentrum	4(75)	1	1	1	1(100)	1	1	1(100)	0	1
Ascochilopsis	2(50)	1	1	0	1(100)	0	0	0	0	0
Ascochilus	5(80)	2(50)	1(100)	1	1	0	0	0	0	2(100)
Ascoglossum	1	0	0	0	0	0	0	1	1	1
Biermannia	6(83.3)	4(75)	1(100)	0	0	1(100)	0	0	0	0
Bogoria	4(100)	0	1(100)	1	1	0	0	0	1(100)	1(100)
Brachypeza	4(100)	1	2(50)	0	3(33.3)	0	1	0	1	1
Bracisepalum	2(100)	0	0	0	0	0	2(100)	0	0	0
Bromheadia	26(84.6)	9(22.5)	4(25)	0	22(68.2)	0	1(100)	1	2(50)	2
Bulbophyllum	1093(95)	135(23.7)	149(43)	85(25.9)	212(48.1)	18(5.6)	51(66.6)	31(35.5)	577(96.3)	137(78.1)

	MALESIA	MALP	SUM	JAV	BOR	LES	SUL	MOL	NG	PHI
Cadetia	44(97.7)	0	0	1	1	1	2(50)	1	41(95.1)	1(100)
Caladenia	1	0	0	1	0	1	1	0	0	0
Calanthe	110(92.7)	21(42.9)	22(36.4)	19(36.8)	20(45)	5(40)	8(50)	8(37.5)	43(88.4)	14(64.3)
Calochilus	1(100)	0	0	0	0	0	0	0	1(100)	0
Calymmanthera	5(100)	0	0	0	0	0	0	1	5(80)	0
Cephalantheropsis	2(50)	1	1	0	0	0	0	0	0	2(50)
Ceratocentron	1(100)	0	0	0	0	0	0	0	0	1(100)
Ceratochilus	1(100)	0	0	1(100)	0	0	0	0	0	0
Ceratostylis	136(97.8)	11(36.4)	24(66.7)	13(61.5)	11(54.5)	3(66.7)	8(87.5)	3(66.7)	72(100)	11(90.9)
Chamaeanthus	1	0	0	1	1	0	0	0	0	1
Cheirostylis	10(60)	3(33.3)	0	3(33.3)	2	1	0	1(100)	2(100)	2(50)
Chelonistele	14(100)	1	1	1	14(92.9)	0	0	0	0	1
Chiloschista	2(100)	1(100)	0	1(100)	0	0	0	0	0	0
Chroniochilus	4(75)	3	1(100)	1	3	0	0	0	0	0
Chrysoglossum	3(66.6)	1	1	1	1(100)	0	1	0	1	0
Claderia	1	1	1	0	1	0	1	0	1	0
Cleisocentron	1(100)	0	0	0	1(100)	0	0	0	0	0
Cleisomeria	1	1	0	0	1	0	0	0	0	0
Cleisostoma	50(78)	15(33.3)	16(18.8)	12(16.7)	22(45.5)	2(50)	2(50)	2(50)	6(100)	7(42.9)
Coelogyne	132(90.9)	28(35.7)	33(48.5)	11(9.1)	62(72.6)	3	10(70)	8(50)	7(71.4)	19(84.2)
Collabium	7(85.7)	1	2	2	2(50)	0	1(100)	0	1	0
Cordiglottis	6(83.3)	4(25)	1	0	4(25)	0	0	0	0	0
Corybas	82(100)	11(72.7)	8(62.5)	8(62.5)	9(66.7)	2(50)	1(100)	1(100)	49(100)	3(100)
Corymborkis	1	1	1	1	1	0	0	1	1	1
Cryptopylos	1	0	1	0	0	0	0	0	0	0
Cryptostylis	18(94.4)	2	3	5(40)	3(33.3)	1	0	0	12(91.7)	2(50)
Cymbidium	17(64.7)	10	10(10)	9	11(27.3)	0	3	2	2	6(16.7)
Cyrtosia	3(33.3)	1	2	1	1	0	2(50)	0	1	0
Cystorchis	19(89.5)	4(25)	6(50)	4(25)	7(57.1)	0	1(100)	1	5(100)	3(33.3)
Dendrobium	872(90.7)	88(22.7)	113(43.4)	67(31.3)	145(56.6)	17(23.5)	51(68.6)	72(60.3)	449(90.4)	84(82.1)
Dendrochilum	268(98.1)	13(15.4)	77(81.8)	14(42.9)	90(90)	5(20)	12(100)	1	1	89(94.4)

	MALESIA	MALP	SUM	JAV	BOR	LES	SUL	MOL	NG	PHI
Didymoplexiella	4(75)	1	1	0	4(75)	0	0	0	0	0
Didymoplexis	11(81.8)	1	2(50)	7(57.1)	3(33.3)	0	0	1	2(50)	2(50)
Diglyphosa	1	1	1	1	0	0	1	1	1	1
Dilochia	7(85.7)	2	2	1	5(40)	0	2(50)	0	1	1(100)
Dimorphorchis	2(100)	0	0	0	2(100)	0	0	0	0	0
Diplocaulobium	85(95.3)	1	1	0	2(50)	0	5(80)	8(62.5)	72(91.7)	1(100)
Dipodium	11(72.7)	4	5(60)	2	4(25)	0	2(100)	0	2(50)	2
Disperis	4(100)	0	0	1(100)	0	1(100)	0	0	1(100)	1(100)
Diuris	1(100)	0	0	0	0	1(100)	0	0	0	0
Doritis	1	1	1	0	1	0	0	0	0	0
Dossinia	1(100)	0	0	0	1(100)	0	0	0	0	0
Dryadorchis	4(100)	0	0	0	0	0	0	0	4(100)	0
Dyakia	1(100)	0	0	0	1(100)	0	0	0	0	0
Entomophobia	1(100)	0	0	0	1(100)	0	0	0	0	0
Epiblastus	22(100)	0	0	0	0	0	1(100)	2(100)	18(100)	1(100)
Epigeneium	21(95.2)	4	7(42.9)	5(60)	10(70)	0	0	0	0	2(100)
Epipogium	1	1	1	1	1	1	1	1	1	1
Eria	285(90.9)	52(19.2)	87(47.1)	40(25)	83(49.4)	9(33.3)	29(62.1)	13(30.8)	52(75)	59(84.7)
Erythrodes	20(90)	2	2	2	3(66.7)	0	0	1(100)	11(90.9)	4(100)
Erythrorchis	2(50)	2	0	1	1	0	0	0	0	1
Eulophia	15(60)	6(16.7)	5	5(20)	5(40)	2	3	3	4(25)	6(50)
Eurycentrum	7(100)	0	0	0	0	0	0	0	7(100)	0
Flickingeria	52(86.5)	10(10)	17(41.2)	14(21.4)	13(46.2)	2	8(62.5)	3(33.3)	10(70)	9(77.8)
Galeola	2(50)	1	1	2(50)	1	0	1	0	1	1
Gastrochilus	4(75)	2(50)	3(33.3)	1	2	0	1	0	0	1
Gastrodia	9(77.7)	2	1	5(60)	2(50)	0	1(100)	0	2(100)	1
Geesinkorchis	2(100)	0	0	0	2(100)	0	0	0	0	0
Geodorum	2	2	1	1	1	1	1	1	1	1
Glomera[1]	127(99.2)	0	1	1	0	0	2(100)	5(80)	119(98.3)	1(100)
Goodyera	39(79.5)	9(22.2)	10(20)	12(25)	11(36.4)	5	4(25)	2(50)	14(64.3)	8(50)

1) Including *Glossorhyncha*

	MALESIA	MALP	SUM	JAV	BOR	LES	SUL	MOL	NG	PHI
Grammatophyllum	10(80)	2	2	2	3(33.3)	1	4(25)	3(66.7)	3	5(60)
Grosourdya	8(75)	4(25)	0	3	1	0	3(66.7)	1	0	2(50)
Gunnarella	3(66.7)	0	0	0	0	0	0	0	3(66.7)	0
Gynoglottis	1(100)	0	1(100)	0	0	0	0	0	0	0
Habenaria	94(88.3)	10(10)	9(55.6)	19(68.4)	12(50)	7(71.4)	6(33.3)	7(57.1)	25(88)	23(78.3)
Herminium	1	1	0	1	0	1	1	0	1	1
Herpysma	1	0	1	0	0	0	0	0	0	0
Hetaeria	24(83.3)	9(55.6)	5(40)	3(66.7)	4(25)	0	2	3(66.7)	4(75)	6(83.3)
Hippeophyllum	10(100)	1	1	1	1	0	1(100)	2(100)	5(100)	1(100)
Hylophila	7(85.7)	3	2	1	3	1	1(100)	0	2(100)	2(50)
Hymenorchis	9(100)	0	0	1(100)	0	0	0	0	7(100)	1(100)
Jejewoodia	1(100)	0	0	0	1(100)	0	0	0	0	0
Kingidium	1	1	1	1	1	0	1	1	0	1
Kuhlhasseltia	7(100)	1(100)	1	1	2(50)	0	0	1(100)	1(100)	2(100)
Lecanorchis	6(66.7)	2	2	2	2	0	0	0	4(75)	1
Lepidogyne	1(100)	1	1	1	1	0	0	0	1	1
Liparis	203(93.6)	24(16.7)	46(52.2)	32(34.4)	37(51.4)	6(16.7)	12(50)	12(83.3)	79(92.4)	38(71.1)
Ludisia	1	1	1	0	0	0	0	0	0	1
Luisia	17(70.6)	6(33.3)	3	5(20)	4(25)	1(100)	2(50)	2	2(50)	6(50)
Macodes	8(87.5)	1	1	1	3(66.7)	0	1(100)	0	4(75)	1
Macropodanthus	5(80)	2(50)	1	1	1(100)	0	0	0	0	1(100)
Malaxis	198(95.5)	13(30.8)	22(77.3)	24(70.8)	32(75)	2	4(50)	2	90(96.7)	33(93.9)
Malleola	26(84.6)	6(16.7)	5(40)	7(42.9)	6(50)	1	4(100)	1	4(100)	2(100)
Mediocalcar	15(86.7)	0	0	0	0	0	1	2	15(86.7)	0
Megalotus	1(100)	0	0	0	0	0	0	0	0	1(100)
Micropera	11(90.9)	3	5(40)	2	3	0	1(100)	0	1	3(100)
Microsaccus	13(92.3)	5(20)	6(50)	4(50)	4(50)	0	0	0	0	2(50)
Microtatorchis	43(97.7)	0	0	3(66.7)	1	0	1(100)	1(100)	36(100)	2(50)
Microtis	1	0	0	1	0	1	1	0	0	1
Mischobulbum	5(60)	2(50)	1	0	1(100)	0	1(100)	0	1	0
Moerenhoutia	6(83.3)	0	0	0	0	0	0	2(100)	4(75)	0

	MALESIA	MALP	SUM	JAV	BOR	LES	SUL	MOL	NG	PHI
Myrmechis	10(90)	0	1	2(50)	1(100)	1	2(100)	2(100)	1(100)	3(66.7)
Nabaluia	3(100)	0	0	0	3(100)	0	0	0	0	0
Neoclemensia	1(100)	0	0	0	1(100)	0	0	0	0	0
Nephelaphyllum	11(81.8)	3(33.3)	2	2	8(75)	0	1(100)	0	0	2(50)
Nervilia	23(78.3)	5	5(20)	9(33.3)	5(20)	1	2(50)	3(66.7)	12(58.3)	4
Neuwiedia	6(83.3)	2	2	2(50)	4(75)	0	1	1	1	1
Oberonia	212(91.5)	33(33.3)	24(62.5)	28(42.9)	27(74.1)	3(66.7)	15(73.3)	8(75)	88(97.7)	24(87.5)
Octarrhena[2]	46(97.8)	2	2	2	2	0	3(100)	0	39(97.4)	4(75)
Oeceoclades	1	1	1	1	1	1	1	1	1	1
Omoea	2(100)	0	1	1	0	0	0	0	0	1(100)
Ophioglossella	1(100)	0	0	0	0	0	0	0	1(100)	0
Orchipedum	2(100)	1	1	1	0	0	0	0	0	1(100)
Ornithochilus	1	1	1	0	1	0	0	0	0	0
Pachystoma	1	1	1	1	1	1	1	1	1	1
Paphiopedilum	40(97.5)	4(25)	8(75)	3(33.3)	12(75)	3(33.3)	4(50)	3(33.3)	3(100)	11(100)
Papilionanthe	1	1	1	0	1	0	0	0	0	0
Papuaea	1(100)	0	0	0	0	0	0	0	1(100)	0
Paraphalaenopsis	4(100)	0	0	0	4(100)	0	0	0	0	0
Pecteilis	1	1	1	1	1	1	1	1	0	0
Pedilochilus	34(100)	0	0	0	0	0	1(100)	0	33(100)	0
Pelatantheria	1	1	1	0	0	0	0	0	0	0
Pennilabium	10(90)	3(66.7)	2(50)	1(100)	2(50)	0	0	1(100)	0	2(100)
Peristylus	41(87.8)	7	9(22.2)	9(22.2)	12(58.3)	5(60)	5(40)	4(25)	18(72.2)	5(40)
Phaius	27(81.5)	3	6(33.3)	8(25)	6(66.7)	2	7(42.9)	6(33.3)	5(20)	8(75)
Phalaenopsis	42(88.1)	8(12.5)	8(25)	4(25)	15(46.7)	2(50)	4(50)	3(33.3)	1	19(78.9)
Pholidota	18(83.3)	6(16.7)	10(10)	10(10)	11(54.5)	4	5	1	3	3
Phragmorchis	1(100)	0	0	0	0	0	0	0	0	1(100)
Phreatia	178(96.6)	8(25)	11(45.5)	9(33.3)	7(14.3)	1	10(70)	14(50)	132(97)	16(62.5)
Pilophyllum	1	1	1	1	1	0	0	1	1	1
Platanthera	12(91.7)	1	2	2	6(83.3)	0	0	1(100)	5(80)	1

2) Including *Chitonanthera*

	MALESIA	MALP	SUM	JAV	BOR	LES	SUL	MOL	NG	PHI
Plocoglottis	40(90)	5	5	4(25)	10(50)	0	1(100)	3(33.3)	21(90.5)	7(85.7)
Poaephyllum	6(83.3)	1	1	1	2	0	1(100)	0	3(66.7)	2(50)
Podochilus	55(96.4)	5	17(41.2)	8(12.5)	14(42.9)	2	8(87.5)	3(66.7)	14(92.9)	10(80)
Polystachya	1	1	1	1	1	1	1	1	0	1
Pomatocalpa	18(77.8)	7(28.6)	4(25)	4	6(33.3)	3(33.3)	2	3(33.3)	5(60)	4(25)
Porpax	2(50)	1	0	0	1(100)	0	0	0	0	0
Porphyrodesme	3(100)	0	1	0	2(50)	0	1	0	1	0
Porphyroglottis	1(100)	1	1	0	1	0	0	0	0	0
Porrorhachis	2(100)	0	0	1	1	0	1(100)	0	0	0
Pristiglottis	16(93.8)	2(50)	3	4	5(60)	0	0	1(100)	4(100)	2(100)
Pseuderia	14(100)	0	0	0	0	0	0	1(100)	13(100)	0
Pseudovanilla	6(83.3)	0	0	1(100)	0	0	0	1(100)	3(66.7)	1(100)
Pteroceras	17(70.6)	9(22.2)	7	6	11(36.4)	2	3	2	0	6(33.3)
Pterostylis	4(75)	0	0	0	0	0	0	1	4(50)	0
Renanthera	9(88.9)	2	2	2	4(50)	0	1	1	2	5(60)
Renantherella	1	1	0	0	0	0	0	0	0	0
Rhinerrhiza	1	0	0	0	0	0	0	0	1	0
Rhomboda	12(83.3)	1	1	2(50)	1(100)	1	2(100)	0	4(75)	2(100)
Rhynchogyna	1	1	0	0	0	0	0	0	0	0
Rhynchophreatia	6(100)	0	0	0	0	0	0	0	6(100)	0
Rhynchostylis	2	2	1	1	1	0	0	0	0	1
Ridleyella	1(100)	0	0	0	0	0	0	0	1(100)	0
Robiquetia	24(91.7)	1	2(50)	1	5(80)	0	3(100)	6(83.3)	5(80)	6(83.3)
Saccoglossum	4(100)	0	0	0	0	0	0	0	4(100)	0
Saccolabiopsis	10(70)	0	1	1	0	0	1(100)	0	7(57.1)	1(100)
Saccolabium	4(100)	0	2(50)	3(66.7)	0	0	0	0	0	0
Sarcanthopsis	1	0	0	0	0	0	0	0	1	0
Sarcochilus	4(100)	0	0	0	0	0	0	0	4(100)	0
Sarcoglyphis	5(100)	1(100)	1(100)	1(100)	2(100)	0	0	0	0	0
Sarcophyton	2(100)	0	0	0	0	0	0	0	0	2(100)
Sarcostoma	5(100)	1	1	1	1(100)	0	3(100)	0	0	0

	MALESIA	MALP	SUM	JAV	BOR	LES	SUL	MOL	NG	PHI
Schoenorchis	15(73.3)	3	6(33.3)	4	6(50)	2	2(100)	0	2	2(50)
Silvorchis	1(100)	0	0	1(100)	0	0	0	0	0	0
Smitinandia	2(50)	1	0	0	1	0	1(100)	0	0	0
Spathoglottis	35(91.4)	6	3	3	6(33.3)	1	4(50)	2	20(95)	6(83.3)
Spiranthes	1	1	1	1	1	1	1	1	1	1
Spongiola	1(100)	0	0	0	1(100)	0	0	0	0	0
Stereosandra	1	1	1	1	1	0	0	0	1	1
Stigmatodactylus	6(100)	0	0	1(100)	1(100)	0	1(100)	0	3(100)	0
Taeniophyllum	150(97.3)	16(50)	9(44.4)	19(63.2)	12(33.3)	1	10(90)	4(100)	91(100)	6(100)
Tainia	8(62.5)	4	4(25)	3	6(33.3)	0	0	1	1	0
Thecopus	2(50)	2	0	0	2	0	0	0	0	0
Thecostele	1	1	1	1	1	0	0	0	0	1
Thelasis	22(86.4)	6(16.7)	6(16.7)	7(28.6)	10(40)	3	4(25)	4(25)	9(66.7)	5
Thelymitra	3(100)	0	0	1	0	2(50)	0	0	1(100)	1
Thrixspermum	109(89)	25(52)	36(55.6)	20(45)	22(54.5)	2(50)	7(85.7)	6(50)	11(72.7)	20(75)
Thunia	1	1	0	0	0	0	0	0	0	0
Trias	2(100)	0	0	0	2(100)	0	0	0	0	0
Trichoglottis[3]	64(89.1)	8	16(50)	10(30)	23(56.5)	2	5(40)	3	2(100)	25(84)
Trichotosia	69(92.8)	11	14(42.9)	6	25(52)	2	4(75)	3(100)	25(100)	6(83.3)
Tropidia	18(83.3)	3	2	3	4(50)	3(33.3)	0	2(50)	10(80)	3(100)
Tuberolabium	13(69.2)	1	2	2	1	1(100)	1(100)	2(50)	2	7(71.4)
Vanda	27(88.9)	3(66.7)	5(60)	3	5(60)	3(66.7)	3(100)	3(100)	2	7(71.4)
Vandopsis	2(50)	1	0	0	0	0	1	1	1	1
Vanilla	19(84.2)	5	4(25)	2	8(37.5)	0	1(100)	1(100)	5(100)	2(100)
Ventricularia	1	1	0	0	0	0	0	0	0	0
Vexillabium	1	0	0	0	0	0	0	0	0	1
Vrydagzynea	35(85.7)	3	5(40)	5(40)	15(66.7)	0	2(100)	2(50)	11(72.7)	2(50)
Zeuxine	31(80.6)	10(30)	4	7(14.3)	9(33.3)	2(50)	1	3(33.3)	7(71.4)	8(62.5)
Totals	6414(91.5)	878(22.6)	1095(42.6)	767(30)	1387(54.5)	180(24.4)	435(62.1)	348(49.4)	2668(91.3)	952(74.7)

3) Including *Staurochilus*

related to other, usually more widespread genera. The taxonomic status of several genera in this list is debatable, e.g. *Ceratocentron (~ Hymenorchis), Dyakia (~ Ascocentrum), Jejewoodia (~ Ceratochilus), Rhynchophreatia (~ Thelasis), Saccoglossum (~ Bulbophyllum)*, and others. On the other hand, some are quite distinct, e.g. *Bracisepalum, Orchipedum, Porphyroglottis, Ridleyella,* and *Silvorchis*. The only endemic subtribe is the monotypic *Ridleyellinae*, which is closely related to the *Thelasiinae*.

2. Genera centring in Malesia

Many orchid genera possess their greatest diversity in Malesia, but also occur with a relatively small number of mainly non-endemic species in other regions. These genera probably originated within Malesia and dispersed from there. The number of such genera is fairly large. To give a few examples: *Appendicula* (also in continental Asia and the Pacific as far east as Tonga), *Bromheadia* (also in continental Southeast Asia and Australia, with an isolated occurrence in Sri Lanka), *Dendrochilum* (also in Southeast Asia), *Mediocalcar* (also in the Pacific as far east as Samoa), *Phreatia* (also in tropical Asia, Australia, in the Pacific as far east as the Society Islands), and *Taeniophyllum* (also in Africa [1 sp.], continental Asia, Australia, in the Pacific as far east as Tahiti). These genera mostly belong to phylogenetically advanced tribes.

3. Genera (sub)endemic to continental Asia and Malesia combined

The following genera are examples of those that display a considerable diversity in the region formed by continental Asia (especially the south-eastern part) and Malesia combined, but are (virtually) absent elsewhere: *Epigeneium, Lecanorchis, Neuwiedia, Paphiopedilum* (also 2 (sub)species in the Solomon Islands), *Phalaenopsis* (also 1 non-endemic sp. in Australia), *Pholidota* (also 1 non-endemic sp. in the Pacific), and *Vanda* (also 1 non-endemic sp. in Australia). They include some 'primitive' genera, such as *Neuwiedia* and *Paphiopedilum*, which suggests a great age for this area of endemism. Many oligotypic genera are truly endemic to this region, e.g. *Arundina* (naturalised in parts of the Pacific), *Ascochilus, Cleisomeria, Cyrtosia, Herpysma*, etc. If we extend our criteria slightly by allowing a minor number of endemic species outside continental Asia-Malesia (but without a significant radiation in Australia or New Caledonia), then the majority of Malesian orchid genera fall within this category (e.g. *Coelogyne*).

4. Genera centring in continental Asia

Some genera are well developed in continental Asia, but possess a very limited number of species in Malesia. Often these species are not endemic to Malesia, and it may be assumed that they represent relatively recent arrivals from continental Asia. To this category belong e.g. *Acampe, Cleisocentron, Gastrochilus, Herminium, Papilionanthe, Pecteilis, Pelatantheria, Porpax, Thunia, Trias*, and *Vexillabium*. Only *Gastrochilus, Herminium,* and *Pecteilis* are widespread within Malesia.

5. Genera centring in Australia

The following genera clearly have their origin in Australia: *Arthrochilus, Caladenia, Calochilus, Diuris, Microtis, Pterostylis*, and *Thelymitra*. They are all terrestrials of the

tribe *Diurideae* (Dressler, 1993: 269), which is extremely diverse in Australia, New Caledonia, and New Zealand. In general the influence of the Australian/New Caledonian orchid flora on that of Malesia is very slight. Phylogenetic considerations suggest that *Corybas, Cryptostylis*, and *Stigmatodactylus* belong here as well, even though this is not apparent from the distributional data alone.

6. Asian–Australasian–Pacific genera

Numerous genera, absent from Africa and the Americas, are well represented throughout tropical Asia, Malesia, Australia and the Pacific (including New Caledonia), with endemic species in each of these subregions. Important examples are *Anoectochilus* (as far east as Hawaii), *Corybas, Dendrobium* (the prime example), *Eria, Spathoglottis*, and *Vrydagzynea*. The genus *Oberonia* has a few hundred species in this region, but also a single species in Africa.

7. Widespread Old World genera

A few genera are well developed in Africa and/or Madagascar as well as (Eur)asia and the Pacific, but are lacking in the Americas: *Cheirostylis, Didymoplexis, Disperis, Epipogium, Hetaeria, Nervilia, Phaius*, and *Zeuxine*. They are all terrestrials, and except for *Disperis* and *Nervilia* all possess their greatest diversity in Asia.

8. Widespread genera lacking in tropical Africa

Genera occurring in Malesia as well as the Americas, but which are absent from tropical and southern Africa are few: *Erythrodes, Goodyera, Platanthera, Spiranthes*, and *Tropidia*. Of these, *Goodyera, Platanthera*, and *Spiranthes* (sensu stricto) are absent from South America.

9. Pantropical and (sub)cosmopolitan genera

Some genera are extremely widespread, although they may be restricted to (sub)tropical climate zones: *Bulbophyllum* (pantropical, also in Japan and New Zealand), *Calanthe* (mainly Asian, very few species in Africa and Central America), *Corymborkis* (pantropical), *Eulophia* (pantropical, but very few in the Americas), *Habenaria* (subcosmopolitan), *Liparis* (almost cosmopolitan, but absent from New Zealand), *Malaxis* (same range as *Liparis*), *Polystachya* (predominantly African; in Malesia 1 sp., lacking in New Guinea and the Pacific further east), and *Vanilla* (pantropical). With the exception of *Corymborkis* and *Vanilla* these are all considered to be relatively advanced orchid genera.

II. DISTRIBUTION OF ORCHID GENERA AND SPECIES WITHIN MALESIA

Malesia consists of the following nine subregions: Peninsular Malaysia with Singapore, Sumatra, Java, Borneo, the Lesser Sunda Islands, Celebes, the Moluccas, New Guinea, and the Philippines. I have not included the Solomon Islands, and the Aru Islands are not treated as part of the Moluccas, but as belonging to New Guinea.

1. West Malesian genera not endemic to a single island

West Malesia is the area consisting of Peninsular Malaysia, Sumatra, Java, Borneo, and the Philippines. Within Malesia the following orchid genera (excluding those globally endemic to a single island or peninsula) are restricted to this area: *Acampe* (a published record from New Guinea is almost certainly based on a cultivated specimen from elsewhere), *Armodorum, Ascochilopsis, Ascochilus, Biermannia, Cephalantheropsis, Chamaeanthus, Chelonistele, Chroniochilus, Cleisocentron, Cleisomeria, Cordiglottis, Cryptopylos, Didymoplexiella, Doritis, Epigeneium, Erythrorchis, Herpysma, Ludisia, Macropodanthus, Microsaccus, Omoea, Orchipedum, Ornithochilus, Papilionanthe, Pelatantheria, Porpax, Porphyroglottis, Renantherella, Rhynchogyna, Rhynchostylis, Saccolabium, Sarcoglyphis, Sarcophyton, Thecopus, Thecostele, Thunia, Trias, Ventricularia.* and *Vexillabium.*

2. East Malesian genera not endemic to a single island

East Malesia is the area consisting of the Lesser Sunda Islands, Celebes, the Moluccas and New Guinea. Within Malesia the following orchid genera (excluding those globally endemic to a single island) are restricted to this area (those marked with an * are within Malesia only known from New Guinea): *Aglossorhyncha, *Arthrochilus, *Calochilus, Calymmanthera, Diuris, Epiblastus, *Eurycentrum, *Gunnarella, Mediocalcar, Moerenhoutia, Pedilochilus, Pseuderia, Pterostylis, *Rhinerrhiza, *Sarcanthopsis*, and *Sarcochilus* (all belonging to a section endemic to New Guinea). There are a few genera of which the overwhelming majority of species occur in East Malesia, but which also possess a small number of species in West Malesia (and except for *Octarrhena* do not extend into continental Asia): *Cadetia, Diplocaulobium, Glomera, Hymenorchis, Microtatorchis* and *Octarrhena* (as far west as Sri Lanka). These are all phylogenetically advanced genera. See also Vermeulen (1993: 47), who concludes that there are distinct West and East Malesian components within the genus *Bulbophyllum.*

3. Genera occurring in all nine subregions of Malesia

The following 44 genera can be found throughout Malesia: *Acriopsis, Appendicula, Bulbophyllum, Calanthe, Ceratostylis, Cleisostoma, Coelogyne, Corybas, Dendrobium, Dendrochilum, Epipogium, Eria, Eulophia, Flickingeria, Geodorum, Goodyera, Grammatophyllum, Habenaria, Liparis, Luisia, Malaxis, Malleola, Nervilia, Oberonia, Oeceoclades, Pachystoma, Paphiopedilum, Peristylus, Phaius, Phalaenopsis, Pholidota, Phreatia, Podochilus, Pomatocalpa, Spathoglottis, Spiranthes, Taeniophyllum, Thelasis, Thrixspermum, Trichoglottis, Trichotosia, Tuberolabium, Vanda*, and *Zeuxine.* In some cases these genera have obvious areas of endemism in (part of) West Malesia, and are represented by non-endemic species elsewhere. For example, *Acriopsis* (Minderhoud & De Vogel, 1986) has 6 species in Malesia, but endemic species occur only in Peninsular Malaysia and Borneo; the two species known from East Malesia are found in West Malesia as well. *Pholidota* is a similar case (De Vogel, 1988). On the other hand, none of the genera listed here has endemic species in East Malesia with non-endemic species only in West Malesia. This seems to imply that most of these genera are of western origin (*Corybas* is probably one of the few exceptions).

4. Species occurring in all nine subregions of Malesia

Seventeen species have been collected in each of the nine subregions of Malesia. These are: *Acriopsis liliifolia* (better known as *A. javanica), Appendicula reflexa, Calanthe triplicata, Epipogium roseum, Eria javanica, Eulophia spectabilis, Geodorum densiflorum, Goodyera rubicunda, Malaxis ophrydis* (better known as *M. latifolia), Nervilia aragoana, Oeceoclades pulchra, Pachystoma pubescens, Peristylus goodyeroides, Phaius tankervilleae, Pholidota imbricata, Spiranthes sinensis*, and *Thelasis carinata.* Except for *Spiranthes sinensis* they are all lowland species, and only five are epiphytes: *Acriopsis, Appendicula, Eria, Pholidota*, and *Thelasis.*

5. Peninsular Malaysia

As the only non-insular subregion of Malesia, Peninsular Malaysia merits a few comments. The Peninsula has a rich orchid flora (878 spp.), but with a relatively low number of endemic species (22.6%), the lowest percentage among the Malesian subregions. Of the non-endemic species c. 401 occur in continental Asia (predominantly in Thailand), and c. 589 elsewhere within Malesia (these categories are not mutually exclusive, of course). Within Malesia the following genera occur only in Peninsular Malaysia: *Acampe, Rhynchogyna, Thunia*, and *Ventricularia.* None of these is endemic.

III. SOME CONCLUSIONS

Looking at the similarity percentages as tabulated in Table 2 (and defined in the legend to that table), one is struck by the very high figure in the entry for Java and the Lesser Sunda Islands: not less than 70% of all orchids known from the Lesser Sunda Islands occur in Java! It is evident that the orchid flora of the Lesser Sunda Islands is a poor one, largely derived from areas to the West of this island group. It would be interesting to make a more detailed analysis, to establish whether there are significant differences between the eastern and western parts of the Lesser Sunda Islands in this respect (I suspect there are). As far as orchids are concerned at least the island of Bali is part of West Malesia rather than East Malesia.

It seems quite clear from Tables 1 & 2 that the subregions Peninsular Malaysia, Sumatra, Java (with Bali) and Borneo form a single province within Malesia; I have calculated that of the c. 2600 species occurring in this province, c. 240 species are common to all four subregions. Although in the above I have merged the Philippines with this province to form the region called West Malesia, it is not immediately apparent that this is justified. The similarity percentages for the Philippines with Java, Borneo, Celebes, and the Moluccas respectively, do not differ significantly. In absolute numbers, however, the Philippines share many more species and genera with the Western subregions than with the Eastern subregions. The Philippines have numerous endemic species (second only to New Guinea in relative terms), but few and generally unremarkable endemic genera, all belonging to the phylogenetically highly advanced subtribe *Aeridinae.*

The orchid floras of Celebes and the Moluccas are relatively poor (and poorly known), but the endemism at species level is high, especially in Celebes. Celebes has one endemic genus, *Bracisepalum*, which is a distinctive member of the subtribe *Coelogyninae.*

Table 2. Species shared between the major subregions of Malesia. Numbers at and to the left of the main diagonal are absolute numbers, those to the right of the main diagonal (printed in *italics*) are percentages calculated from **100% × Maximum** (S_{ij}/T_i, S_{ij}/T_j) where S_{ij} is the number of species shared between subregions i and j, and T_i is the number of species occurring in subregion i. Please note that the repeated occurrence of the same figures in several places in this table is just a coincidence, not a typing error.

	MALP	SUM	JAV	BOR	PHI	LES	SUL	MOL	NG
MALP	878	*50.3*	*43.8*	*54.2*	*19.5*	*43.9*	*24.8*	*24.4*	*9.9*
SUM	442	1095	*56.1*	*40.4*	*16.8*	*55.6*	*25.7*	*25.3*	*8.0*
JAV	336	430	767	*44.3*	*20.9*	*70.0*	*24.9*	*25.9*	*12.1*
BOR	476	442	340	1387	*19.5*	*48.9*	*27.1*	*25.6*	*6.5*
PHI	171	160	160	186	952	*30.5*	*19.5*	*20.4*	*8.0*
LES	79	100	126	88	55	180	*28.1*	*21.3*	*18.9*
SUL	108	112	108	118	85	50	435	*25.0*	*16.6*
MOL	85	88	90	89	71	38	87	348	*31.0*
NG	87	88	93	90	76	34	72	108	2668

Material of a possible second endemic genus, belonging to the subtribe *Aeridinae*, is present at the National Herbarium of the Netherlands, Leiden University branch. The Moluccas lack endemic genera; in terms of similarity their orchid flora shows strong links with Celebes and in particular with New Guinea. The numbers of species shared by Peninsular Malaysia (MALP) and the Moluccas (MOL), by MALP and New Guinea (NG), by Sumatra (SUM) and MOL, and by SUM and NG, are roughly equal (see Table 2). It is tempting to assume that there is a core of c. 80 species shared by the four subregions. That would be a wrong assumption, for in fact only 43 species are common to MALP, SUM, MOL, and NG.

Both in terms of species number and percentages of endemism, New Guinea is undoubtedly the richest subregion within Malesia, and within the Palaeotropics as a whole. The number of highly distinctive species in genera like *Bulbophyllum* and *Dendrobium* is stunning. These genera, and many others, have given rise to whole sections that are almost confined to New Guinea. The number of truly endemic genera on the other hand is rather small compared to the size of the orchid flora (2668 spp. listed in Table 1; 6 endemic genera), but if we include the genera which almost certainly originated here but dispersed into the surrounding regions, the list becomes more impressive (those marked with an * are endemic): *Aglossorhyncha, Cadetia, Calymmanthera, Diplocaulobium, *Dryadorchis, Epiblastus, Eurycentrum, Glomera* (including *Glossorhyncha), Gunnarella, Hymenorchis, Mediocalcar, Microtatorchis, Octarrhena* (including **Chitonanthera), *Ophioglossella, *Papuaea, Pedilochilus (~ Bulbophyllum), Pseuderia, *Rhynchophreatia (~ Thelasis), *Ridleyella*, and **Saccoglossum (~ Bulbophyllum)*. If, as some authors have proposed, certain sections of *Bulbophyllum, Dendrobium*, and others are raised to genus level this list will become even longer (e.g. *Chilopogon, Codonosiphon, Grastidium, Hapalochilus, *Herpetophytum, *Monosepalum*, etc.). The orchid floras of

the Solomon Islands (Lewis & Cribb, 1991), Vanuatu (Lewis & Cribb, 1989), Fiji (Kores, 1991), and Samoa (Cribb & Whistler, 1996) are largely derivatives of the New Guinea matrix. New Caledonia, on the other hand, has a very distinctive autonomous orchid flora (Hallé, 1977).

It can be assumed that the Malesian orchid flora as a whole is largely derived from Southeast Asian–West Malesian elements, which dispersed towards the East (radiating in several islands along the way). From the Middle Miocene onwards (15 MA ago) the highlands of New Guinea were formed; this resulted in an explosive development of many of the orchid genera occurring or arriving in the terranes being uplifted. Other genera like *Bromheadia, Dendrochilum*, and *Pholidota* probably reached New Guinea much more recently, for they barely radiated at all in New Guinea, even though they have many species elsewhere in Malesia. Elements from the New Guinea orchid flora are gradually finding their way to the West (against the flow as it were), but very few have as yet spread beyond Peninsular Malaysia. The high percentage of orchid species endemic to Malesia (91.5%) and the floristic coherence of its subregions at genus level strongly support treating this region as a distinct phytogeographical unit. As far as the *Orchidaceae* are concerned most of the tropical Pacific Island groups could be included in this unit, with the notable exception of New Caledonia.

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