

THE VASCULAR PLANT FLORA OF UPPER THOMSON FOREST

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ABSTRACT. — A checklist of vascular plant species was compiled for Upper Thomson Forest, a patch of secondary regrowth forest bounded by Old Upper Thomson Road and Upper Thomson Road on Singapore Island. In 2012, we sampled five 20 × 20 m vegetation plots within the abandoned rubber plantation region of this forest. Within each plot, we recorded all vascular plant species and measured the diameter at breast height (DBH) of all woody stems with a DBH ≥ 5 cm. We recorded 219 species from 80 families. 146 of the recorded species are native, 68 are exotic, and five are cryptogenic. Of the native species, 20 are nationally critically endangered (of which five are likely to have persisted from cultivated rather than native stock), 15 are nationally endangered, and 31 are nationally vulnerable. Among the measured woody stems, Pará rubber, *Hevea brasiliensis* was found to occur most frequently on average. This site has conservation value as a native species refuge and as a buffer to the Central Catchment Nature Reserve.

KEY WORDS. — checklist, conservation, flora, Old Upper Thomson Road, secondary forest

INTRODUCTION

Upper Thomson Forest (01°22'58"N, 103°49'19"E) is a secondary forest that has regenerated on land that was once used for cultivation. It is located in central Singapore, and is bound completely by Old Upper Thomson Road on two sides and Upper Thomson Road on its third side (Figs. 1, 2A, 2B). It lies just outside the boundary of the Central Catchment Nature Reserve as delineated in the Master Plan 2008 of the Urban Redevelopment Authority, Singapore (URA, 2008). Based on Google Earth® satellite images, this forest is estimated to be 56.4 ha in area. As of the Master Plan 2008, Upper Thomson Forest is a “reserve” site (i.e., land held in reserve for future planning and not to be confused with the nature reserves; URA, 2008).



Fig. 1. Upper Thomson Forest and nearby landmarks (Google, 2012). The red outline shows the extent of the forest as at 14 Jun.2012 (date that the satellite image was acquired). The locations of the surveyed vegetation plots are represented by yellow dots labelled UT1–UT5.



Fig. 2. A, Upper Thomson Forest on the right, as seen from the junction of Old Upper Thomson Road and Yio Chu Kang Road; B, Old Upper Thomson Road, with Upper Thomson Forest shown on the left. Signs that point to the land use history of the area can be found within the forest, such as: C, the remains of an old tar road; D, an abandoned building covered by plants and the roots of a large strangler fig (*Ficus* sp.). (Photographs by: Louise Neo).

Upper Thomson Forest was part of a rubber plantation from the 1920s to the 1940s (Surveyor-General, Federated Malay States and Straits Settlements, 1924; Survey Production Centre, South East Asia, 1945). We estimate that the rubber plantation was abandoned during World War II (1941–1945; Lew, 1965; Shepherd & Shepherd, 1968) and not re-established thereafter, and from the 1950s, the vegetation of the area was classified as being under sundry cultivation (Surveyor-General, Malaya, 1953; Chief Surveyor, Singapore, 1969; Ministry of Defence, Singapore, 1975; Singapore Mapping Unit, 1982, 1987, 1992, 2000, 2008). There were also settlements within this area, which belonged to the Hainan Village (The Grassroots Organisations of Nee Soon Constituency, 1987; Figs. 2C, 2D).

Secondary forests can be refuges and resource pools for local biodiversity, despite being disturbed and sometimes degraded (Turner & Corlett, 1996; McShea et al., 2009; Edwards et al., 2011). Forests that have regenerated on abandoned agricultural land may be dominated by exotic species, but they have been shown to support the recolonisation of native species (Lugo & Helmer, 2004). In urban Singapore, secondary forests have been found to support populations of birds, butterflies, and frogs (Koh & Sodhi, 2004; Castelletta et al., 2005; Bickford et al., 2010; K. Y. Chong, S. Teo, and H. T. W. Tan, unpublished data). This paper aims to provide an accessible working checklist of the vascular plant species of Upper Thomson Forest, which may be useful for assessing the conservation value of this patch of forest.

MATERIAL AND METHODS

In the year 2012, we surveyed five vegetation plots, of 20×20 m each, within the abandoned rubber plantation region of Upper Thomson Forest. The extent of the rubber plantation was determined by comparing old topographic maps of Singapore against the latest Google Earth satellite image of the forest (Google, 2012). The five plots were spaced at least 60 m apart from one another for greater independence, and located at least 40 m from the forest edge to minimise the edge effect. The location of each plot was randomly derived using the fTools v. 0.6.1 plugin for the Quantum GIS software v. 1.6.0 (Quantum GIS Development Team, 2010). Within each plot, all species of vascular plants were recorded. Where species could not be identified in the field, specimens were collected for their identities to be further determined in the laboratory or in the Singapore Botanic Gardens Herbarium (SING). To estimate species dominance, stem diameter at breast height (DBH; measured at 1.3 m above the ground) was recorded for all woody stems with DBH

≥5 cm (including lianas). Palms (Arecaceae) were not measured owing to the difficulty in measuring the true stems for some species. To supplement the data from the vegetation plots, we conducted some additional opportunistic explorations of the forest in the year 2014.

A checklist of all the recorded vascular plant species was compiled, with nomenclature and national status categories following or updating those of Chong et al. (2009). We constructed a species accumulation curve from the five sampled plots to determine how the number of recorded vascular plant species increased with sampling effort, using the ‘specaccum’ function implemented in the vegan v. 2.0-2 package of the statistical software R v. 2.14.1 (R Development Core Team, 2011). The approximate total number of species in the species pool of this forest, i.e., including unseen or undetected species, was calculated using the ‘specpool’ function in the vegan v. 2.0-2 package (R Development Core Team, 2011).

RESULTS AND DISCUSSION

A total of 219 vascular plant species from 80 families was recorded. The species and their national conservation status categories are provided in Appendix 1. Based on the vascular flora checklist of Chong et al. (2009), 146 of the recorded species are native, 68 are exotic, and five are cryptogenic (equivalent to the “Weed of Uncertain Origin” category in Chong et al. [2009]). Of the native species, one is nationally extinct, 20 are nationally critically endangered, 15 are nationally endangered, and 31 are nationally vulnerable (Table 1). The nationally extinct species is *Syzygium myrtifolium*, and it is likely to be persisting from escaped individuals of cultivated provenance. Of the 20 critically endangered species, five have known food or ornamental value, and are probably likewise plants of non-Singapore stock persisting from cultivation: *Baccaurea motleyana* (rambai), *Epipremnum pinnatum* (dragon tail plant), *Gnetum gnemon* var. *gnemon* (belinjau), *Nephelium lappaceum* (rambutan), and *Peltophorum pterocarpum* (yellow flame tree).

We recorded six species which are not listed in the checklist of Chong et al. (2009), and which have not been assessed for their national conservation statuses. They are: *Blechnum pyramidatum*, *Cryptocarya nitens*, *Eleutherococcus trifoliatus*, *Paraderris elliptica*, *Psydrax* sp. 10 of Wong (1989), and *Tectaria incisa*. Two of these are new records for Singapore: *Blechnum pyramidatum* and *Eleutherococcus trifoliatus* (Figs. 3A, 3B). The former is native to South America (McMullen, 1999), while the native distribution of the latter extends from India to South China to the Philippines (Deng, 2008). The other four species are overlooked records. *Cryptocarya nitens* was only recently collected in Singapore from Mandai and Bukit Timah Nature Reserve, with three specimens deposited in SING. *Psydrax* sp. 10 has previously been recorded from the Bukit Timah Nature Reserve (Tan et al., 1995; Turner & Chua, 2011). Several collections of *Paraderris elliptica* from several localities in Singapore, including Changi, Choa Chu Kang, and Kranji, have previously been deposited into SING, and the species has also recently been found in Bukit Batok Nature Park (Neo et al., 2013a). The species is known to have been cultivated for use as an insecticide (Chen & Pedley, 2010). *Tectaria incisa* has been collected from the Singapore Botanic Gardens as an escapee of cultivation (two specimens deposited in SING) and has also recently been found in Bukit Batok Nature Park and Lentor Forest (Neo et al., 2013a; 2013b).

Table 1. Summary of the national status categories of the vascular plants of Upper Thomson Forest.

Nativeness	National Status Category	No. of Species	Percentage of All Species	Percentage of All Native Species
Exotic	Naturalised	22	10.05	–
	Casual	24	10.96	–
	Cultivated only	19	8.68	–
	Not assessed	3	1.37	–
	Total	68	31.05	–
Cryptogenic	Cryptogenic	5	2.28	–
	Total	5	2.28	–
Native	Nationally extinct (persistence from cultivation)	1	0.46	0.68
	Critically endangered (persistence from cultivation)	5	2.28	3.42
	Critically endangered	15	6.85	10.27
	Endangered	15	6.85	10.27
	Vulnerable	31	14.16	21.23
	Common	76	34.70	52.05
	Not assessed	3	1.37	2.05
	Total	146	66.67	–

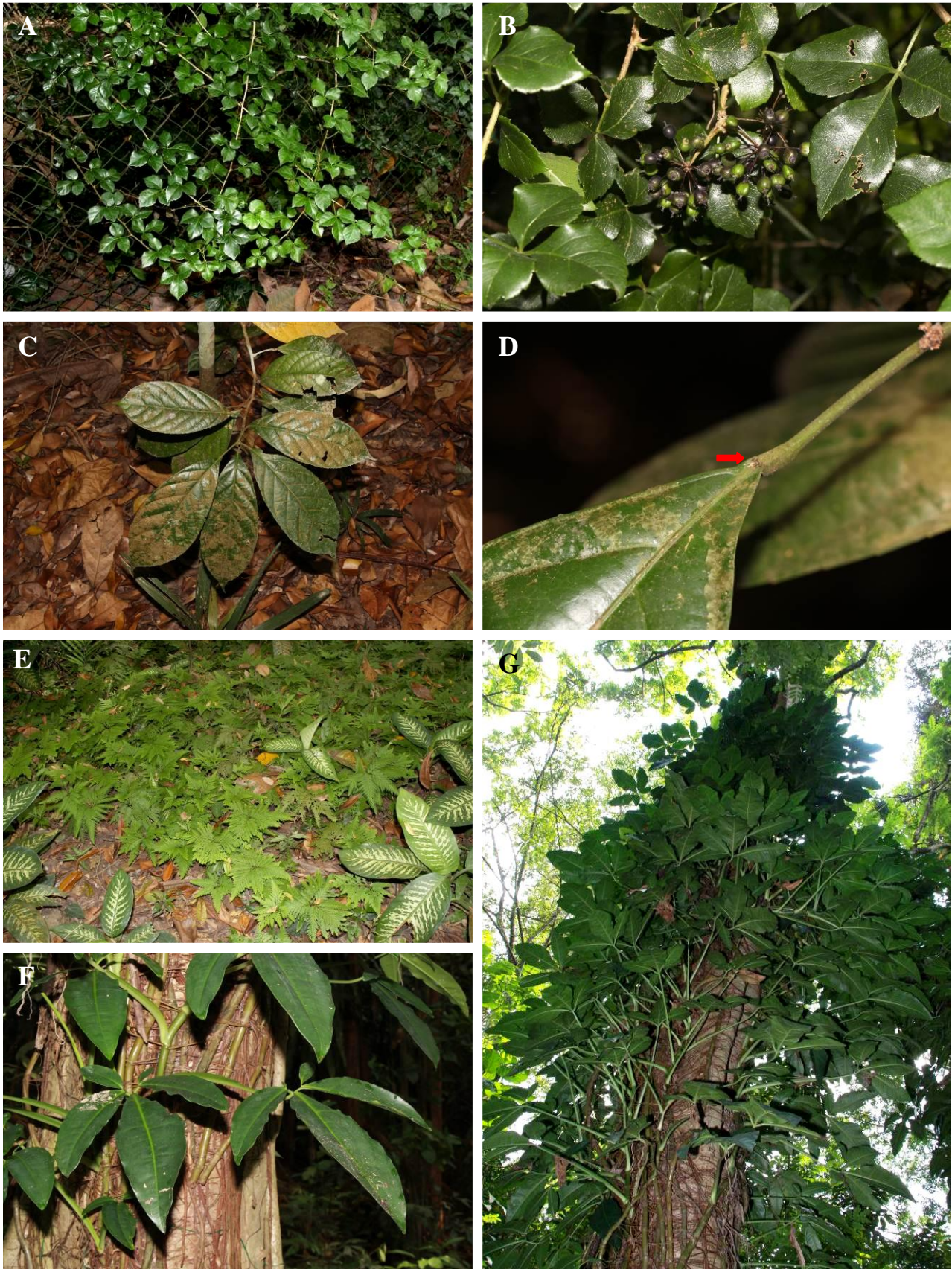


Fig. 3. A, *Eleutherococcus trifoliatus* (habit); B, *Eleutherococcus trifoliatus* (fruits); C, Sapling of *Neoscortechinia sumatrensis* of about 2 cm DBH; D, Leaf of *Neoscortechinia sumatrensis* with paired glands at the base of the leaf blade adjoining the petiole; E, *Selaginella argentea* covering the forest floor; F, G, Variant of *Syngonium podophyllum* var. *podophyllum*, slightly different from the more widespread form in Singapore. (Photographs by: Louise Neo).

We would like to highlight new locality records for two species: *Neoscortechinia sumatrensis* and *Selaginella argentea*. We came across a single sapling of *Neoscortechinia sumatrensis* in Upper Thomson Forest (Fig. 3C, D). To our knowledge, this is the first record of this nationally critically endangered species outside of the Central Catchment Nature Reserve, as it was previously only known from the Nee Soon Swamp Forest, Seletar Reservoir, and Bukit Kallang (Ang et al., 2010). *Selaginella argentea* is a nationally critically endangered spikemoss which has only one prior collection record from Singapore (specimen deposited in SING by N. Cantley in 1881). A large mat of this species was found growing in Upper Thomson Forest (Fig. 3E).

We also collected a *Syngonium* species (Fig. 3F, G) with darker green and waxier leaves than the usual form of *Syngonium podophyllum* that is widespread elsewhere in Singapore (Chong et al., 2010). The leaves of the adult climbing form is mostly trisect, with auricles on the lateral leaflets. In comparison, the more commonly-occurring form can have as many as 11, or even 13 leaflets. However, these variations, and other vegetative characteristics such as the length of the petiole, and the proportion of the petiole that is sheathed, are still consistent with *Syngonium podophyllum* var. *podophyllum* as described by Croat (1981). Fertile specimens will be required to draw a more conclusive confirmation about the identity of this population of *Syngonium* species.

When we plotted the number of species recorded only from the surveyed plots against sampling effort, we found that the species accumulation curve did not approach an asymptote, suggesting that more species are to be expected with greater survey effort (Fig. 4). Based on the most conservative estimate (Chao), the vegetation plots sampled 56% of the total number of species in the species pool of Upper Thomson Forest. The estimates of the total number of species range from 154–232 (Table 2). The species for which we measured basal area are presented in Appendix 2 and ordered by the mean number of stems measured per plot, except for species for which only a single individual was measured, which are ordered by basal area instead. The species found to occur most frequently was Pará rubber, *Hevea brasiliensis*, which averaged 9.6 stems per plot and made up 1.9% of the basal area measured in a plot on average. The most dominant species by basal area out of the five plots was found to be *Litsea elliptica*, which comprised 56.3% of the basal area of one plot, but only a single individual occurred in the plots that we sampled. Of the species we measured, one third are exotic species usually cultivated as food or ornamental plants, while the rest are native species typical of the early successional secondary forests in Singapore (Corlett 1991; Boo, 1996; Shono et al., 2006).

Table 2. Approximate true number of species calculated based on data from the five sampled plots, using four commonly used species richness estimators.

Estimator	Chao	Jackknife 1	Jackknife 2	Bootstrap
Predicted number of species	232.02	183.60	213.90	153.82
Proportion of the observed number of species out of the total predicted number of species	0.56	0.71	0.61	0.85

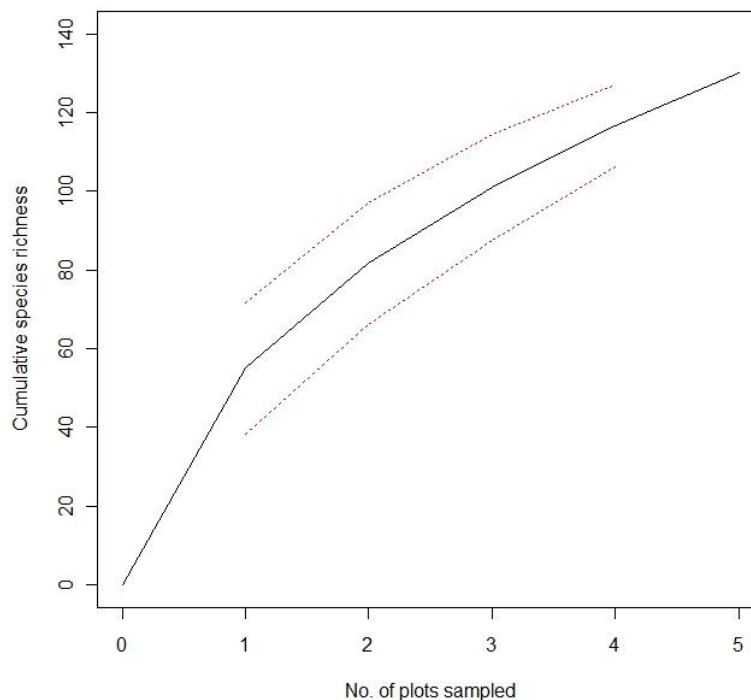


Fig. 4. Species accumulation curve showing the cumulative increase in the number of species recorded from the five sampled plots. The dotted lines represent 95% confidence intervals of the curve.

CONCLUSIONS

The vascular plant species composition of Upper Thomson Forest is a product of the cultivation legacy of the area, and the recent establishment or persistence of native secondary forest species despite the drastic land use change. Of the woody stems measured, Pará rubber trees occurred at the highest frequency, despite the abandonment of the rubber plantations about 60 years ago. Native species were found to make up two-thirds of all the species that we recorded from this forest patch. 31% of the recorded species are nationally threatened. Upper Thomson Forest has conservation value as a refuge for nationally threatened native species, and can function as a buffer to the Central Catchment Nature Reserve, the boundary of which it lies just outside.

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LITERATURE CITED

- Ang, W. F., A. F. S. L. Lok, K. Y. Chong & H. T. W. Tan, 2010. Status and distribution in Singapore of *Neoscortechinia sumatrensis* S.Moore (Euphorbiaceae). *Nature in Singapore*, **3**: 333–336.
- Bickford D., T. H. Ng, L. Qie, E. P. Kudavidanage & C. J. A. Bradshaw, 2010. Forest fragment and breeding habitat characteristics explain frog diversity and abundance in Singapore. *Biotropica*, **42**: 119–125.
- Boo, C. M., 1996. *A Study of Secondary Forest in Singapore*. Unpublished Honours Thesis, Department of Botany, National University of Singapore. 97 pp.
- Castelletta, M., J.-M. Thiollay & N. S. Sodhi, 2005. The effects of extreme forest fragmentation on the bird community of Singapore Island. *Biological Conservation*, **121**: 135–155.
- Chen, D. & L. Pedley, 2010. Paraderris. *Flora of China*, **10**: 170–172.
- Chief Surveyor, Singapore, 1969. *1:63,360 Singapore Series I Edition I*. 84 Survey Squadron RE, AD Survey Far East Land Forces.
- Chong, K. Y., H. T. W. Tan & R. T. Corlett, 2009. *A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species*. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore. 273 pp. Uploaded 12 Nov.2009. http://rmbn.nus.edu.sg/raffles_museum_pub/flora_of_singapore_tc.pdf. (Accessed 10 Apr.2013).
- Chong, K. Y., P. T. Ang & H. T. W. Tan, 2010. Identity and spread of an exotic *Syngonium* species in Singapore. *Nature in Singapore*, **3**: 1–5.
- Corlett, R. T., 1991. Plant succession on degraded land in Singapore. *Journal of Tropical Forest Science*, **4**: 151–161.
- Croat, T. B., 1981. A revision of *Syngonium* (Araceae). *Annals of the Missouri Botanical Garden*, **68**: 565–651.
- Deng, Y.-f., 2008. Araliaceae. *Flora of Hong Kong*, **2**: 291–296.
- Edwards, D. P., T. H. Larsen, T. D. S. Docherty, F. A. Ansell, W. W. Hsu, M. A. Derhé, K. C. Hamer & D. S. Wilcove, 2011. Degraded lands worth protecting: The biological importance of Southeast Asia's repeatedly logged forests. *Proceedings of the Royal Society B*, **278**: 82–90.
- Google, 2012. *Google Earth 6.2.2.6613*. Google, California. <http://earth.google.com/>. (Accessed 10 Apr.2013).
- Koh, L. P. & N. S. Sodhi, 2004. Importance of reserves, fragments, and parks for butterfly conservation in a tropical urban landscape. *Ecological Applications*, **14**: 1695–1708.
- Lew, B. T. C., 1965. *The Rubber Industry of Singapore*. Unpublished Honours Thesis. University of Singapore, Singapore. 67 pp.
- Lugo, A. R. & E. Helmer, 2004. Emerging forests on abandoned land: Puerto Rico's new forests. *Forest Ecology and Management*, **190**: 145–161.
- McMullen, C. K., 1999. *Flowering Plants of the Galápagos*. Comstock Pub. Associates, Ithaca, New York. 370 pp.
- McShea, W. J., C. Stewart, L. Peterson, P. Erb, R. Stuebing & B. Gimán, 2009. The importance of secondary forest blocks for terrestrial mammals within an *Acacia*/secondary forest matrix in Sarawak, Malaysia. *Biological Conservation*, **142**: 3108–3119.
- Ministry of Defence, Singapore, 1975. *1:25,000, R.S.O. Metric Grid, Singapore*. Officer Commanding, Mapping Branch, Ministry of Defence, Singapore.
- Neo, L., A. T. K. Yee, K. Y. Chong, Carmen Y. Kee, Reuben C. J. Lim, W. Q. Ng, X. Y. Ng & H. T. W. Tan, 2013a. The vascular plant flora of Bukit Batok, Singapore. *Nature in Singapore*, **6**: 265–287.
- Neo, L., A. T. K. Yee, K. Y. Chong, T. C. Zeng & H. T. W. Tan, 2013b. The vascular plant flora of abandoned plantations in Singapore III: Lentor Forest. *Nature in Singapore*, **6**: 113–124.
- Quantum GIS Development Team, 2010. *Quantum GIS Geographic Information System*. Open Source Geospatial Foundation Project. <http://qgis.osgeo.org>.

- R Development Core Team, 2011. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria. <http://www.R-project.org>.
- Shepherd, E. E. & S. R. Shepherd, 1968. *Bukit Sembawang—A Rubber Estate*. F. W. Chesire Publishing Pty Ltd, Melbourne. 29 pp.
- Shono, K., S. J. Davies & Y. K. Chua, 2006. Regeneration of native plant species in restored forests on degraded lands in Singapore. *Forest Ecology and Management*, **237**: 574–582.
- Singapore Mapping Unit, 1982. *1:25,000 Topographic Map*. Mapping Unit, Ministry of Defence, Singapore.
- Singapore Mapping Unit, 1987. *1:25,000 Topographic Map*. Mapping Unit, Ministry of Defence, Singapore.
- Singapore Mapping Unit, 1992. *1:25,000 Topographic Map*. Mapping Unit, Ministry of Defence, Singapore.
- Singapore Mapping Unit, 2000. *1:25,000 Topographic Map*. Mapping Unit, Ministry of Defence, Singapore.
- Singapore Mapping Unit, 2008. *1:25,000 Topographic Map*. Mapping Unit, Ministry of Defence, Singapore.
- Surveyor-General, Federated Malay States and Straits Settlements, 1924. *1 Mile: 6 Inches Municipal Area, Singapore*. Surveyor-General, Federated Malay States and Straits Settlements.
- Surveyor-General, Malaya, 1953. *1: 25,000 Singapore Provisional Issue*. Survey Department Federation of Malaya, Malaya.
- Survey Production Centre, South East Asia, 1945. *1: 25,000 Topographic Map*. Survey Department, Federation of Malaya.
- Tan, H. T. W., K. S. Chua & I. M. Turner, 1995. Rubiaceae of the Bukit Timah Nature Reserve. *Gardens' Bulletin, Singapore*, Supplement **3**: 29–59.
- The Grassroots Organisations of Nee Soon Constituency, 1987. Rural Economy. In: Lim, H. S. & G. H. Lim (eds.), *A Pictorial History of Nee Soon Community*. National Archives, Singapore. Pp. 59–74.
- Turner, I. M. & K. S. Chua, 2011. *Checklist of the Vascular Plant Species of the Bukit Timah Nature Reserve*. Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore, Singapore. 85 pp. Uploaded 8 Aug.2011. http://rmbr.nus.edu.sg/raffles_museum_pub/btnr_plants_checklist.pdf. (Accessed 27 Feb.2014)
- Turner, I. M. & R. T. Corlett, 1996. The conservation value of small, isolated fragments of lowland tropical rain forest. *Trends in Ecology and Evolution*, **11**: 330–333.
- URA (Urban Redevelopment Authority), 2008. *Master Plan 2008*. URA, Singapore. http://www.ura.gov.sg/uramaps/?config=config_preopen.xml&preopen=Master%20Plan/. (Accessed 12 Nov.2013)
- Wong, K. M., 1989. Rubiaceae. *Tree Flora of Malaya*, **4**: 324–425.

APPENDIX 1

Checklist of the vascular plant flora of Upper Thomson Forest. Nomenclature and conservation status categories follow those of Chong et al. (2009) with some updating based on our observations. “Weed of Uncertain Origin” of Chong et al. (2009) is “Cryptogenic” in this list. Species are grouped by family and arranged in alphabetical order.

S/No.	Species	Nativeness	National Status
ACANTHACEAE			
1.	<i>Asystasia gangetica</i> (L.) T.Anderson subsp. <i>micrantha</i>	Exotic	Naturalised
2.	<i>Blechum pyramidatum</i> (Lam.) Urb.	Exotic	Not assessed
3.	<i>Peristrophe roxburghiana</i> (Roem. & Schult.) Bremek.	Cryptogenic	Cryptogenic
4.	<i>Thunbergia fragrans</i> Roxb.	Exotic	Naturalised
ADIANTACEAE			
5.	<i>Adiantum latifolium</i> Lam.	Exotic	Naturalised
ANACARDIACEAE			
6.	<i>Camptosperma auriculatum</i> (Blume) Hook.f.	Native	Common
7.	<i>Camptosperma squamatum</i> Ridl.	Native	Common
8.	<i>Mangifera indica</i> L.	Exotic	Casual
ANNONACEAE			
9.	<i>Artabotrys maingayi</i> Hook.f. & Thoms.	Native	Critically endangered
10.	<i>Artabotrys suaveolens</i> (Blume) Blume	Native	Endangered
11.	<i>Fissistigma manubriatum</i> (Hook.f. & Thoms.) Merr.	Native	Vulnerable
12.	<i>Mitrella kentii</i> (Blume) Miq.	Native	Common
APOCYNACEAE			
13.	<i>Alstonia angustiloba</i> Miq.	Native	Common
14.	<i>Alstonia scholaris</i> (L.) R.Br.	Exotic	Cultivated only

S/No.	Species	Nativeness	National Status
15.	<i>Cerbera odollam</i> Gaertn.	Native	Vulnerable
16.	<i>Hoya latifolia</i> G.Don	Native	Endangered
ARACEAE			
17.	<i>Aglaonema commutatum</i> Schott	Exotic	Casual
18.	<i>Alocasia longiloba</i> Miq.	Native	Common
19.	<i>Dieffenbachia seguine</i> (Jacq.) Schott var. <i>seguine</i>	Exotic	Casual
20.	<i>Pipremnum aureum</i> (Linden ex André) Bunting	Exotic	Casual
21.	<i>Pipremnum pinnatum</i> (L.) Engl.	Native	Critically endangered (persistence from cultivation)
22.	<i>Philodendron bipinnatifidum</i> Schott ex Endl.	Exotic	Cultivated only
23.	<i>Philodendron hederaceum</i> (Jacq.) Schott	Exotic	Casual
24.	<i>Syngonium podophyllum</i> Schott	Exotic	Naturalised
ARALIACEAE			
25.	<i>Arthropodium diversifolium</i> Blume	Native	Common
26.	<i>Eleutherococcus trifolius</i> (L.) S.Y.Hu	Exotic	Not assessed
ARECACEAE			
27.	<i>Caryota mitis</i> Lour.	Native	Common
28.	<i>Cocos nucifera</i> L.	Exotic	Naturalised
29.	<i>Elaeis guineensis</i> Jacq.	Exotic	Cultivated only
30.	<i>Livistona rotundifolia</i> (Lam.) Mart.	Exotic	Cultivated only
31.	<i>Plectocomia elongata</i> Mart. ex Blume	Native	Vulnerable
32.	<i>Ptychosperma macarthurii</i> (H.Wendl. ex anon.) H.Wendl. ex Hook.f.	Exotic	Naturalised
ASPARAGACEAE			
33.	<i>Cordyline fruticosa</i> (L.) A.Chev.	Exotic	Casual
34.	<i>Dracaena braunii</i> Engl.	Exotic	Cultivated only
35.	<i>Dracaena fragrans</i> (L.) Ker Gawl.	Exotic	Casual
36.	<i>Dracaena porteri</i> Baker	Native	Common
37.	<i>Dracaena sanderiana</i> hort.Sander ex Mast.	Exotic	Cultivated only
38.	<i>Dracaena surculosa</i> Lindl.	Exotic	Cultivated only
ASPLENIACEAE			
39.	<i>Asplenium longissimum</i> Blume	Native	Common
40.	<i>Asplenium nidus</i> L.	Native	Common
ASTERACEAE			
41.	<i>Erechtites valerianifolius</i> (Link ex Spreng.) DC	Exotic	Naturalised
42.	<i>Mikania micrantha</i> Kunth	Exotic	Naturalised
BIGNONIACEAE			
43.	<i>Spathodea campanulata</i> P.Beauv.	Exotic	Naturalised
44.	<i>Tabebuia rosea</i> (Bertol.) DC.	Exotic	Casual
BLECHNACEAE			
45.	<i>Stenochlaena palustris</i> (Burm.f.) Bedd.	Native	Common
CALOPHYLLACEAE			
46.	<i>Calophyllum ferrugineum</i> Ridl.	Native	Common
47.	<i>Calophyllum teysmannii</i> Miq.	Native	Vulnerable
CANNABACEAE			
48.	<i>Girardinia nervosa</i> Planch.	Native	Common
49.	<i>Trema cannabina</i> Lour.	Native	Common
CENTROPLACACEAE			
50.	<i>Bhesa paniculata</i> Arn.	Native	Common
CLUSIACEAE			
51.	<i>Garcinia forbesii</i> King	Native	Critically endangered

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S/No.	Species	Nativeness	National Status
52.	<i>Garcinia mangostana</i> L.	Exotic	Casual
COMBRETACEAE			
53.	<i>Terminalia catappa</i> L.	Native	Common
CONNARACEAE			
54.	<i>Agelaea macrophylla</i> (Zoll.) Leenh.	Native	Critically endangered
CONVOLVULACEAE			
55.	<i>Erycibe tomentosa</i> Blume	Native	Common
COSTACEAE			
56.	<i>Costus speciosus</i> (Koenig) Smith	Native	Common
CUCURBITACEAE			
57.	<i>Coccinia grandis</i> (L.) Voigt	Exotic	Naturalised
CYATHEACEAE			
58.	<i>Cyathea latebrosa</i> (Wall.) Copel.	Native	Vulnerable
CYPERACEAE			
59.	<i>Kyllinga polyphylla</i> Willd. ex Kunth	Exotic	Naturalised
60.	<i>Scleria levis</i> Retz.	Cryptogenic	Cryptogenic
DAVALLIACEAE			
61.	<i>Davallia denticulata</i> (Burm.) Mett.	Native	Common
DILLENIAACEAE			
62.	<i>Dillenia suffruticosa</i> (Griff. ex Hook.f. & Thomson) Martelli	Native	Common
63.	<i>Tetracera fagifolia</i> Blume	Native	Vulnerable
64.	<i>Tetracera indica</i> (Christm. & Panz.) Merr.	Native	Common
DIOSCOREACEAE			
65.	<i>Dioscorea pyriformis</i> Kunth	Native	Common
66.	<i>Dioscorea sansibarensis</i> Pax	Exotic	Naturalised
DRYOPTERIDACEAE			
67.	<i>Pleocnemia irregularis</i> (C.Presl) Holttum	Native	Common
68.	<i>Tectaria incisa</i> Cav.	Exotic	Not assessed
ELAEOCARPACEAE			
69.	<i>Elaeocarpus ferrugineus</i> (Jack) Steud.	Native	Common
70.	<i>Elaeocarpus mastersii</i> King	Native	Common
71.	<i>Elaeocarpus petiolatus</i> (Jack) Wall	Native	Common
EUPHORBIACEAE			
72.	<i>Acalypha hispida</i> Burm.f.	Exotic	Cultivated only
73.	<i>Acalypha siamensis</i> Oliv. ex Gage	Exotic	Casual
74.	<i>Claoxylon indicum</i> (Reinw. ex Blume) Hassk.	Native	Common
75.	<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Müll.Arg.	Exotic	Naturalised
76.	<i>Macaranga bancana</i> (Miq.) Müll.Arg.	Native	Common
77.	<i>Macaranga conifera</i> (Zoll.) Müll.Arg.	Native	Common
78.	<i>Macaranga gigantea</i> (Rchb.f. & Zoll.) Müll.Arg.	Native	Common
79.	<i>Macaranga griffithiana</i> Müll.Arg.	Native	Vulnerable
80.	<i>Macaranga hullettii</i> King ex Hook.f.	Native	Critically endangered
81.	<i>Macaranga hypoleuca</i> (Rchb.f. & Zoll.) Müll.Arg.	Native	Common
82.	<i>Manihot carthagensis</i> (Jack) Müll.Arg. subsp. <i>glaziovii</i> (Müll.Arg.) Allem	Exotic	Naturalised
83.	<i>Manihot esculenta</i> Crantz	Exotic	Naturalised
84.	<i>Neoscortechinia sumatrensis</i> S.Moore	Native	Critically endangered
85.	<i>Triadica cochinchinensis</i> Lour.	Native	Common

S/No.	Species	Nativeness	National Status
FABACEAE			
86.	<i>Acacia auriculiformis</i> A.Cunn. ex Benth.	Exotic	Naturalised
87.	<i>Adenantha pavonina</i> L.	Exotic	Naturalised
88.	<i>Andira inermis</i> (W.Wright) Kunth ex DC.	Exotic	Casual
89.	<i>Archidendron clypearia</i> (Jack) I.C.Nielsen	Native	Common
90.	<i>Archidendron jiringa</i> (Jack) Nielsen	Native	Vulnerable
91.	<i>Baphia nitida</i> Lodd. et al.	Exotic	Casual
92.	<i>Bauhinia semibifida</i> Roxb. var. <i>semibifida</i>	Native	Vulnerable
93.	<i>Clitoria ternatea</i> L.	Exotic	Naturalised
94.	<i>Cynometra cauliflora</i> L.	Exotic	Cultivated only
95.	<i>Entada spiralis</i> Ridl.	Native	Common
96.	<i>Gliricidia sepium</i> (Jacq.) Kunth ex Walp.	Exotic	Casual
97.	<i>Koompassia malaccensis</i> Maingay ex Benth.	Native	Endangered
98.	<i>Kunstleria ridleyi</i> Prain	Native	Endangered
99.	<i>Paraderris elliptica</i> (Wall.) Adema	Native	Not assessed
100.	<i>Peltophorum perocarpum</i> (DC.) Backer ex K.Heyne	Native	Critically endangered (persistence from cultivation)
101.	<i>Pterocarpus indicus</i> Willd.	Exotic	Casual
FLAGELLARIACEAE			
102.	<i>Flagellaria indica</i> L.	Native	Common
GENTIANACEAE			
103.	<i>Cyrtophyllum fragrans</i> (Roxb.) DC.	Native	Common
GNETACEAE			
104.	<i>Gnetum gnemon</i> L. var. <i>gnemon</i>	Native	Critically endangered (persistence from cultivation)
HELICONIACEAE			
105.	<i>Heliconia psittacorum</i> L.f.	Exotic	Cultivated only
HYPERICACEAE			
106.	<i>Cratoxylum formosum</i> (Jack) Dyer	Native	Endangered
HYPOXIDACEAE			
107.	<i>Molineria latifolia</i> (Dryand. ex W.T.Aiton) Herb. ex Kurz var. <i>latifolia</i>	Native	Vulnerable
ICACINACEAE			
108.	<i>Phytocrene bracteata</i> Wall.	Native	Vulnerable
IXONANTHACEAE			
109.	<i>Ixonanthes reticulata</i> Jack	Native	Common
LAMIACEAE			
110.	<i>Callicarpa longifolia</i> Lamk.	Native	Endangered
111.	<i>Clerodendrum laevifolium</i> Blume	Native	Common
112.	<i>Clerodendrum villosum</i> Blume	Native	Vulnerable
113.	<i>Vitex pinnata</i> L.	Native	Common
LAURACEAE			
114.	<i>Cinnamomum iners</i> Reinw.	Native	Common
115.	<i>Cryptocarya nitens</i> (Blume) Koord. & Valeton	Native	Not assessed
116.	<i>Lindera lucida</i> (Blume) Boerl.	Native	Vulnerable
117.	<i>Litsea elliptica</i> (Blume) Nees	Native	Common
118.	<i>Litsea firma</i> Hook.f.	Native	Vulnerable
LINACEAE			
119.	<i>Indorouchera griffithiana</i> (Planch.) Hallier f.	Native	Common
MALVACEAE			
120.	<i>Durio zibethinus</i> L.	Exotic	Casual

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S/No.	Species	Nativeness	National Status
121.	<i>Grewia laevigata</i> Vahl	Native	Vulnerable
122.	<i>Muntingia calabura</i> L.	Exotic	Naturalised
123.	<i>Scaphium linearicarpum</i> (Mast.) Pierre	Native	Critically endangered
124.	<i>Theobroma cacao</i> L.	Exotic	Cultivated only
MARANTACEAE			
125.	<i>Calathea picturata</i> (Linden) K.Koch & Linden	Exotic	Cultivated only
MARATTIACEAE			
126.	<i>Angiopteris evecta</i> (Forst.) Hoffm.	Native	Vulnerable
MELASTOMATACEAE			
127.	<i>Clidemia hirta</i> (L.) D.Don	Exotic	Naturalised
128.	<i>Dissochaeta viminalis</i> (Jack) Clausing	Native	Critically endangered
129.	<i>Melastoma malabathricum</i> L.	Native	Common
130.	<i>Pternandra caerulescens</i> Jack	Native	Vulnerable
131.	<i>Pternandra echinata</i> Jack	Native	Vulnerable
MELIACEAE			
132.	<i>Aphanamixis polystachya</i> (Wall.) Parker	Native	Endangered
133.	<i>Lansium domesticum</i> Corrêa	Exotic	Cultivated only
MENISPERMACEAE			
134.	<i>Fibraurea tinctoria</i> Lour.	Native	Common
135.	<i>Tinospora crispa</i> (L.) Hook.f. & Thomson	Exotic	Casual
MORACEAE			
136.	<i>Artocarpus heterophyllus</i> Lam.	Exotic	Casual
137.	<i>Artocarpus integer</i> (Thunb.) Merr.	Exotic	Casual
138.	<i>Ficus aurata</i> Miq.	Native	Vulnerable
139.	<i>Ficus elastica</i> Roxb. ex Hornem.	Exotic	Casual
140.	<i>Ficus fistulosa</i> Reinw. ex Blume	Native	Common
141.	<i>Ficus globosa</i> Blume	Native	Endangered
142.	<i>Ficus grossularioides</i> Burm.f. var. <i>grossularioides</i>	Native	Common
143.	<i>Ficus heteropleura</i> Blume	Native	Common
144.	<i>Ficus microcarpa</i> L.f.	Native	Common
145.	<i>Ficus punctata</i> Lam.	Exotic	Cultivated only
146.	<i>Ficus variegata</i> Blume	Native	Common
147.	<i>Ficus vasculosa</i> Wall. ex Miq.	Native	Endangered
148.	<i>Ficus villosa</i> Blume	Native	Critically endangered
MYRISTICACEAE			
149.	<i>Knema malayana</i> Warb.	Native	Endangered
MYRSINACEAE			
150.	<i>Embelia ribes</i> Burm.f.	Native	Common
MYRTACEAE			
151.	<i>Rhodammia cinerea</i> Jack	Native	Common
152.	<i>Syzygium borneense</i> (Miq.) Miq.	Native	Common
153.	<i>Syzygium grande</i> (Wight) Walp.	Native	Common
154.	<i>Syzygium jambos</i> (L.) Alston	Exotic	Casual
155.	<i>Syzygium lineatum</i> (DC.) Merr. & L.M.Perry	Native	Common
156.	<i>Syzygium myrtifolium</i> Walp.	Native	Nationally extinct (escaped from cultivation)
157.	<i>Syzygium polyanthum</i> (Wight) Walp.	Native	Vulnerable
NYCTAGINACEAE			
158.	<i>Bougainvillea glabra</i> Choisy	Exotic	Cultivated only
OCHNACEAE			
159.	<i>Ochna kirkii</i> Oliv.	Exotic	Cultivated only

S/No.	Species	Nativeness	National Status
OLEANDRACEAE			
160.	<i>Nephrolepis auriculata</i> (L.) Trimen	Cryptogenic	Cryptogenic
PANDANACEAE			
161.	<i>Pandanus amaryllifolius</i> Roxb.	Exotic	Casual
PASSIFLORACEAE			
162.	<i>Adenia macrophylla</i> (Blume) Koord. var. <i>singaporeana</i> (Wall. ex G.Don) de Wilde	Native	Vulnerable
PENTAPHYLACACEAE			
163.	<i>Adinandra dumosa</i> Jack	Native	Common
164.	<i>Eurya acuminata</i> DC.	Native	Common
PHYLLANTHACEAE			
165.	<i>Aporosa falcifera</i> Hook.f.	Native	Critically endangered
166.	<i>Aporosa frutescens</i> Blume	Native	Common
167.	<i>Aporosa lucida</i> (Miq.) Airy Shaw var. <i>lucida</i>	Native	Critically endangered
168.	<i>Baccaurea motleyana</i> (Müll.Arg.) Müll.Arg.	Native	Critically endangered (persistence from cultivation)
169.	<i>Breynia coronata</i> Hook.f.	Native	Endangered
170.	<i>Bridelia stipularis</i> (L.) Blume	Native	Vulnerable
171.	<i>Bridelia tomentosa</i> Blume	Native	Common
172.	<i>Sauropus androgynus</i> (L.) Merr.	Native	Common
PIPERACEAE			
173.	<i>Piper betle</i> L.	Exotic	Casual
174.	<i>Piper caninum</i> Blume	Native	Common
175.	<i>Piper sarmentosum</i> Roxb.	Native	Common
POACEAE			
176.	<i>Centotheca lappacea</i> (L.) Desv.	Native	Critically endangered
POLYGALACEAE			
177.	<i>Xanthophyllum flavescens</i> Roxb.	Native	Endangered
POLYGONACEAE			
178.	<i>Antigonon leptopus</i> Hook. & Arn.	Exotic	Casual
PTERIDACEAE			
179.	<i>Pteris ensiformis</i> Burm.f.	Cryptogenic	Cryptogenic
180.	<i>Taenitis blechnoides</i> (Willd.) Sw.	Native	Common
RHIZOPHORACEAE			
181.	<i>Carallia brachiata</i> (Lour.) Merr.	Native	Endangered
182.	<i>Gynotroches axillaris</i> Blume	Native	Common
ROSACEAE			
183.	<i>Prunus polystachya</i> (Hook.f.) Kalkm.	Native	Common
184.	<i>Rubus moluccanus</i> L.	Native	Vulnerable
RUBIACEAE			
185.	<i>Gynochthodes sublancoolata</i> Miq.	Native	Common
186.	<i>Oxyceros longiflorus</i> (Lam.) T.Yamazaki	Native	Vulnerable
187.	<i>Paederia foetida</i> L.	Native	Common
188.	<i>Psychotria ovoidea</i> Wall.	Native	Vulnerable
189.	<i>Psychotria sarmentosa</i> Blume	Native	Critically endangered
190.	<i>Psydrax</i> sp. 10 of Wong (1989)	Native	Not assessed
191.	<i>Timonius wallichianus</i> (Korth.) Valetton	Native	Common
192.	<i>Uncaria longiflora</i> (Poir.) Merr. var. <i>pteropoda</i> (Miq.) Ridsdale	Native	Critically endangered

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S/No.	Species	Nativeness	National Status
RUTACEAE			
193.	<i>Berbera koenigii</i> L.	Exotic	Casual
194.	<i>Clausena excavata</i> Burm.f.	Native	Common
SAPINDACEAE			
195.	<i>Dimocarpus longan</i> Lour.	Exotic	Cultivated only
196.	<i>Filicium decipiens</i> (Wight & Arn.) Thwaites ex Hook.f.	Exotic	Cultivated only
197.	<i>Guioa pleuropteris</i> (Blume) Radlk.	Native	Vulnerable
198.	<i>Guioa pubescens</i> (Z. & M.) Radlk.	Native	Vulnerable
199.	<i>Nephelium lappaceum</i> L.	Native	Critically endangered (persistence from cultivation)
SAPOTACEAE			
200.	<i>Palaquium obovatum</i> (Griff.) Engl.	Native	Vulnerable
201.	<i>Pouteria obovata</i> (R.Br.) Baehni	Native	Vulnerable
SCHIZAEACEAE			
202.	<i>Lygodium flexuosum</i> (L.) Sw.	Native	Common
203.	<i>Lygodium longifolium</i> (Willd.) Sw.	Native	Vulnerable
204.	<i>Lygodium microphyllum</i> (Cav.) R.Br.	Native	Common
SELAGINELLACEAE			
205.	<i>Selaginella argentea</i> (Wall.) Spring	Native	Critically endangered
SMILACACEAE			
206.	<i>Smilax setosa</i> Miq.	Native	Common
STRELITZIACEAE			
207.	<i>Strelitzia reginae</i> Aiton	Exotic	Cultivated only
SYMPLOCACEAE			
208.	<i>Symplocos fasciculata</i> Zoll.	Native	Vulnerable
THEACEAE			
209.	<i>Gordonia singaporiana</i> Wall. ex Ridl.	Native	Endangered
THELYPTERIDACEAE			
210.	<i>Amphineuron opulentum</i> (Kaulf.) Holttum	Native	Endangered
211.	<i>Christella subpubescens</i> (Blume) Holttum	Native	Common
212.	<i>Pronephrum triphyllum</i> (Sw.) Holttum	Native	Common
213.	<i>Sphaerostephanos heterocarpus</i> (Blume) Holttum	Native	Common
URTICACEAE			
214.	<i>Cecropia pachystachya</i> Trécul	Exotic	Naturalised
215.	<i>Pipturus argenteus</i> (G.Forst.) Wedd.	Exotic	Naturalised
VITACEAE			
216.	<i>Cissus hastata</i> Miq.	Cryptogenic	Cryptogenic
217.	<i>Cissus nodosa</i> Blume	Native	Critically endangered
218.	<i>Leea indica</i> (Burm.f.) Merr.	Native	Common
VITTARIACEAE			
219.	<i>Vittaria elongata</i> Sw.	Native	Common

APPENDIX 2

Mean percentage basal area per plot of sub-canopy and canopy species sampled from Upper Thomson Forest. Species are arranged in descending order of the mean number of stems per plot, except for species with only one individual found out of all the plots, which are arranged in decreasing order of stem size.

S/No.	Species	Mean Percentage Basal Area per Plot \pm Standard Error of the Mean	Mean No. Of Stems per Plot \pm Standard Error of the Mean
1.	<i>Hevea brasiliensis</i>	1.88 \pm 0.42	9.60 \pm 9.11
2.	<i>Cinnamomum iners</i>	0.97 \pm 0.20	4.60 \pm 1.81
3.	<i>Dracaena fragrans</i>	0.87 \pm 0.09	3.20 \pm 2.06
4.	<i>Spathodea campanulata</i>	9.98 \pm 5.82	2.60 \pm 1.94
5.	<i>Nephelium lappaceum</i>	1.76 \pm 0.37	2.20 \pm 0.58
6.	<i>Macaranga bancana</i>	0.35 \pm 0.05	1.20 \pm 1.20
7.	<i>Artocarpus heterophyllus</i>	0.94 \pm 0.32	1.00 \pm 1.00
8.	<i>Andira inermis</i>	4.79 \pm 3.88	1.00 \pm 0.45
9.	<i>Ficus fistulosa</i>	0.56 \pm 0.30	0.80 \pm 0.58
10.	<i>Durio zibethinus</i>	3.34 \pm 1.08	0.80 \pm 0.49
11.	<i>Aporosa frutescens</i>	0.61 \pm 0.17	0.80 \pm 0.37
12.	<i>Cyathea latebrosa</i>	1.88 \pm 0.42	0.60 \pm 0.60
13.	<i>Lansium domesticum</i>	0.88 \pm 0.40	0.60 \pm 0.60
14.	<i>Artocarpus integer</i>	10.74 \pm 0.13	0.40 \pm 0.40
15.	<i>Claoxylon indicum</i>	2.35 \pm 1.21	0.40 \pm 0.40
16.	<i>Gnetum gnemon</i> var. <i>gnemon</i>	0.47 \pm 0.16	0.40 \pm 0.40
17.	<i>Indorouchera griffithiana</i>	11.40 \pm 10.79	0.40 \pm 0.40
18.	<i>Lindera lucida</i>	3.41 \pm 2.33	0.40 \pm 0.40
19.	<i>Macaranga gigantea</i>	0.62	0.40 \pm 0.40
20.	<i>Macaranga griffithiana</i>	1.36 \pm 0.80	0.40 \pm 0.40
21.	<i>Symplocos fasciculata</i>	6.18 \pm 4.91	0.40 \pm 0.40
22.	<i>Macaranga conifera</i>	8.16 \pm 6.41	0.40 \pm 0.24
23.	<i>Litsea elliptica</i>	56.33	0.20 \pm 0.20
24.	<i>Peltophorum pterocarpum</i>	15.90	0.20 \pm 0.20
25.	<i>Vitex pinnata</i>	3.69	0.20 \pm 0.20
26.	<i>Prunus polystachya</i>	0.70	0.20 \pm 0.20
27.	<i>Pipturus argenteus</i>	0.41	0.20 \pm 0.20
28.	<i>Gironniera nervosa</i>	0.29	0.20 \pm 0.20
29.	<i>Bhesa paniculata</i>	0.22	0.20 \pm 0.20
30.	<i>Syzygium lineatum</i>	0.21	0.20 \pm 0.20
31.	<i>Macaranga hullettii</i>	0.15	0.20 \pm 0.20