Treasure Of The Four Kings: plant expeditions to the Raja Ampat Islands of West Papua

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Abstract

The Raja Ampat Islands is a group of four large islands and more than 600 smaller islands. The Islands and waters have been known as the most diverse ecosystems on Earth. Despite it being a biologically very rich area, little is known about the Islands' plant diversity. In order to provide important baseline data for conserving the Islands' biodiversity sustainably, an expedition team from Bogor Botanic Gardens had conducted floral collecting trips to Waigeo Island, Salawati Island and Sorong Nature Park. The aims of the expeditions were to collect priority plant species, particularly those of conservation value, and to describe their habitat characteristics in order to understand their ecological preferences for *ex situ* conservation purposes. The exploration and inventory methods used were a combination of random and purposive searchings. Different directions (aspects) were covered in order to comprehensively study the observed forest areas. A total of 719 plant records were collected from the three conservation areas; five species of which are endemic to Waigeo (*Guioa waigeoensis*, *Alstonia beatricis*, *Calophyllum parvifolium*, *Schefflera apiculata* and *Nepenthes danseri*) and all have been regarded as threatened by the IUCN. Sixty one of these species are endemic to New Guinea, while 100 species have been determined as new collections for the Indonesian Botanic Gardens. *Dendrobium* and *Bulbophyllum* were the most diverse orchids both on Waigeo and Salawati.

Keywords

Plant exploration, Raja Ampat Islands, Salawati Island, Waigeo Island.

Introduction

The Raja Ampat Islands is a group of four large islands (namely Waigeo, Batanta, Salawati, and Misool) and more than 600 smaller islands. The Islands are located and scattered off the western tip of the Bird's Head of New Guinea and is administrated by the West Papua Province of Indonesia. The waters around the Islands have been known as the most biodiverse marine area in the world, especially in terms of coral reefs and fish species (Webb, 2005; Pemerintah Kapubaten Raja Ampat & Conservation InternationalI, 2006). However, despite it being a biologically very rich area, little is known about the Islands' plant diversity and terrestrial resources (Bappenas, 2003; Webb, 2005). Detailed plant expeditions and surveys will therefore provide important baseline data for conserving the Islands' biodiversity sustainably (Webb, 2005).

Geologically the Raja Ampat Islands is also very interesting, by having extensive karst ecosystems, alluvium substrates, acid volcanic and ultrabasic rocks (Jepson & Whittaker, 2002; Webb, 2005; Pemkab Raja Ampat & CI, 2006). The flora must be diverse, according to the substrate and biogeographic reasons (Johns, 1997a, 1997b), as well as to the habitat types, which range from submontane forests, via forests on karst and acid volcanics, to sago swamps and mangroves. The ultrabasic scrub of Waigeo Island is unique and widely known for its endemic species (Webb, 2005). On the other hand, the hill forests on volcanic substrates and alluvium lands extensively occur in Salawati Island. Each island has its own characteristics and undoubtedly the Raja Ampat is botanically very important and valuable despite its relatively small size (Johns, 1995, 1997b; Conservation International, 1999; BKSDA Papua II, 2003; Webb, 2005).

The conservation status of the Raja Ampat Islands is also unique, i.e. the population density is very low, the villagers in general are concerned to conserve their lands, and the traditional government system is still highly influential (Webb, 2005). Over the past twenty years, logging has been extensive in a number of areas of the Islands, particularly in the lowlands. However, some of the prior logging was relatively light, searching primarily for large trees of *Intsia bijuga* and *I. palembanica* (Webb, 2005). Hence the potential for the Raja Ampat Islands remains relatively intact. Preventing logging and mining companies from entering and disturbing the Islands' key conservation areas is indeed crucial if we are to sustain their invaluable biodiversity.

Aims

The aims of the expeditions were to collect priority (target) plant species, particularly those of high conservation value (i.e. threatened species, endemics, and ecotypes) from Waigeo and Salawati Islands and to describe their habitat characteristics in order to understand their ecological preferences to enable their *ex situ* conservation purposes.

Materials and methods

Exploration and Study Areas

Mount Nok (Mount Buffelhorn), Waifoi forest (East Waigeo Island Nature Reserve) and Waiyar River (North Salawati Island Nature Reserve) were the main expedition locations. The East Waigeo Island Nature Reserve was established by the decree of the Indonesian Minister of Forestry (no.251/Kpts-II/1996 dated 3 June 1996) comprising a total area of 119,000 hectares, while the North Salawati Island Nature Reserve was established by the decree of the Minister of Agriculture (no.14/Kpts/Um/II/1982) covering a total area of 62,962 hectares. The exploration trip to Mount Nok, Waifoi forest and Sorong Nature Park was conducted from June 11th 2007 to July 9th 2007 while that to Waiyar River was from May 22nd to June 3rd 2008.

The exploration and inventory methods used were a combination of random and purposive searchings (Ludwig & Reynolds, 1988; Krebs, 1989; Cropper, 1993). Waifoi Village of Waigeo Island and Solol Village of Salawati Island were used as the entry points to access the two nature reserves. The camps at Kamtabae River (Waigeo) and Waiyar River (Salawati) were used as the central points to explore the surrounding forests. Different directions (aspects) were covered in order to comprehensively cover the target exploration areas.

Target Species and Habitat Descriptions

The target species to be collected were primarily those of high conservation values, including threatened species, endemics, and ecotypes, but some attractive or promising plants were also collected. The specimens taken were either seedlings, seeds or cuttings. The plant specimens and habitat information were recorded; the records included the scientific and local names, morphological descriptions, abundances, local distribution patterns for selected species (using Ludwig & Reynolds, 1988; Krebs, 1989), phenological events, uses, location coordinates, and habitat characteristics. The habitat characteristic parameters recorded were vegetation types and associations, altitudes, topography/land slopes, soil pH and humidity, as well as air temperature and humidity. The location of each specimen collected was recorded using a Global Positioning System (Garmin MAP 175). Land slopes were measured using a SUUNTO clinometer. Levels of the forest/habitat disturbance were also analysed.

Results and discussions

Waigeo Island and Sorong Nature Park

Records for 554 plants from the East Waigeo Island Nature Reserve and Sorong Nature Park wree made. Five of these species are endemic to the Waigeo Island (*Guioa waigeoensis*, *Alstonia beatricis*, *Calophyllum parvifolium*, *Schefflera apiculata*, and *Nepenthes danseri*) and 42 species

endemic to New Guinea as a whole. The five species endemic to Waigeo have been regarded as 'threatened' by the IUCN (2000). Based on the Indonesian Botanic Gardens' Collection Catalogues (2010), 72 species have been determined as new collections for the Botanic Gardens. Some living seedlings of the palm *Saribus brevifolius* (*see* Bacon & Baker, 2011) were also collected from Bomat Isthmus, Waigeo.

Palms of the karst *Hydriastele costata* and *Livistona brevifolia* were also encountered and collected during the expeditions. *H. costata* and *L. brevifolia* habitat prefer dry karst habitats on particularly ultrabasic rocks. *H. costata* has been regarded as a prominent indicator species of the karst ecosystem. *H. rhopalocarpa*, on the other hand, occurs on inland hill forest on volcanic substrates. Economically potential palms collected were *Sommieria leucophylla, Areca macrocalyx*, *Dransfieldia micrantha*, and *Pinanga rumphianum*. Two variants of *S. leucophylla* have been found showing different leaf colours. This is a taxonomically interesting discovery.

A number of attractive species were also found, including *Maniltoa rosea*, *M. plurijuga*, *Pothos scandens*, and the broadleaf *Dillenia papuana*. Promising species for their potential uses included *Cynometra novoguineensis*, *Piper* spp., and *Raphidophora* spp. Some valuable orchids were also recorded, including *Dendrobium macrophyllum*, *D. lasianthera*, and *D. capituliflorum*. The orchid species that occurred on Mount Nok, Kamtabae River and the surrounding areas were mostly epiphytic (Figure 1). *Dendrobium* and *Bulbophyllum* seemed to be the most diverse genera on Mount Nok and Kamtabae River, indicated by the great number of species (Figure 2). Most orchids occurred on the main part of tree trunks (stems), especially on the upper part (Zone 2) and then followed by the lower part (Zone 1), Figure 3. Johansson (1975) showed a similar occurrence pattern in West African rain forests.

Decaspermum fruticosum, *Planchonella catartea*, *Garcinia altísima*, and *Rhodamnia cinerea* were the most dominant plant species in Waigeo, while the population of the threatened, endemic species *Guioa waigeoensis* tended to clump (Figure 4). Plant species formation at different elevations on Mount Nok of Waigeo is presented on Table 1. Generally, species formations varied with elevation, but no areas of the Raja Ampat are higher than 1,000 m. Interestingly, pseudomontane vegetation occurred on the tops of hills of 100 m to 200 m in altitude. The proximity of Mount Nok (e.g. the forest edges) to the Pacific Ocean might be the driving force, creating a natural phenomenon called the "Massenerhebung" effect. This is shown by the commonly high-inland species *Casuarina rumphiana*, *Decaspermum fruticosum* and *Livistona rotundifolia* that are able to grow at much lower altitudes of the Island. Mountains surrounded by large ranges will tend to have higher tree lines than more isolated mountains (like Mount Nok), due to heat retention and wind shadowing (MacKinnon *et al*., 1996; Monk *et al*., 1997; Mittermeier *et al*., 1999). The pseudomontane areas of Mount Nok seem to be the most suitable habitats of the Island endemic plant species.

Salawati Island

A total of 165 plant collection records (consisting of seedlings, seeds, and cuttings) were collected from Salawati Island, consisting of 50 orchid collections and 115 non-orchid collections, belonging to 51 plant families. Based on the Indonesian Botanic Gardens' Collection Catalogues (2010), 28 species of thses have been determined as new collections for the Botanic Gardens, while 19 species are endemic to New Guinea. Figure 5 shows the number of orchid species of each genus found in the North Salawati Island Nature Reserve of the Raja Ampat Islands. Similar to Waigeo, *Dendrobium* and *Bulbophyllum* were the most diverse orchid genera on Salawati. Valuable and scientifically interesting species found in Salawati Island include the unique palm *Sommieria leucophylla*, the attractive *Cycas riuminiana*, *Maniltoa rosea*, *Bolbitis heterocrita*, *Leea* spp., *Begonia* spp., and *Pandanus* spp.

In general, the island's soil thickness varied significantly from site to site, from very thick (more than 1.5 m) to shallow (16 cm). The shallow soils commonly occurred on the top of hills. Soil

textures generally consisted of clayed-silt and sandy-silt formations. Detailed results of the soil laboratory analysis were reported separately.

Acknowledgements

I would like to thank Dr. Irawati, Didit Okta Pribadi, Wihermanto, Saripudin, Sudarsono, Supardi, Tatang Daradjat (Bogor Botanic Gardens), Rustandi, Upah (Cibodas Botanic Gardens), Deden Mudiana (Purwodadi Botanic Gardens), I Gede Tirta (Bali Botanic Gardens), Ir. Kurung and Djefri Tibalia (Indonesian Ministry of Forestry) for their assistance and support.

References

Bacon, C.D. & Baker, W.J., 2011. *Saribus resurrected*. Palms: Journal of the International Palm Society 55: 109-116.

Badan Perencanaan Pembangunan Nasional (Bappenas), 2003. *Indonesia Integrated Biodiversity Strategy and Action Plan (IBSAP)*. Jakarta.

Balai Konservasi Sumber Daya Alam Papua II Sorong, 2003. *Beberapa Kawasan Cagar Alam Dalam Lingkungan Seksi Konservasi Wilayah IV Balai KSDA Papua II Sorong*. Sorong.

Conservation International, 1999. *The Irian Jaya Biodiversity Conservation Priority-Setting Workshop: Final Report*. Conservation International. Washington, DC.

Cropper, S.C., 1993. *Management of Endangered Plants*. Jenkin Buxton Printers Pty Ltd, Melbourne.

Dressler, R.L, 1990. *The Orchids Natural History and Classification*. Harvard University Press, Cambridge, Mass., USA.

Indonesian Botanic Gardens, 1999. *An Alphabetical List of Indonesian Orchid Cultivated In Bogor Botanic Gardens*. Bogor, Indonesia.

Indonesian Botanic Gardens, 2010. *An Alphabetical List of Plant Species Cultivated in Bogor Botanic Gardens*. Bogor, Indonesia.

International Union for the Conservation of Nature and Natural Resources (IUCN), 2000. *2000 IUCN Red List of Threatened Species* (Compiled by Craig Hilton-Taylor). IUCN Species Survival Commission, Gland, Switzerland and Cambridge, UK.

Jepson, P. & Whittaker, R.J., 2002. *Ecoregions in Context: A critique with special reference to Indonesia*. Conservation Biology 16 (1): 42-57.

Johansson, D.R., 1975. Ecology of Epiphytic Orchids in West African Rain Forests. *American Orchid Society Bulletin* 44: 125-136.

Johns, R.J., 1995. Malesia – An Introduction. *Curtis's Botanical Magazine* 12 (2): 53 – 62.

Johns, R.J., 1997a. *A checklist of the Fern Allies, Ferns and Gymnosperms of the N. E. Kepala Burung (Vogelkop), Irian Jaya, Indonesia*. Royal Botanic Gardens, Kew.

Johns, R.J., 1997b. *Background Papers for the Study of the Flora and Vegetation of the N. E. Kepala Burung, Irian Jaya, Indonesia*. Royal Botanic Gardens, Kew.

Krebs, C.J., 1989. *Ecological Methodology*. Harper & Row Publishers, New York. USA.

Ludwig, J.A. & Reynolds, J.F., 1988. *Statistical Ecology: A primer on methods and computing*. John Wiley & Sons, New York.

MacKinnon, K., Hatta, G., Halim, H., & Mangalik, H., 1996. *The Ecology of Kalimantan*. Periplus Edition, Singapore.

Mittermeier, R.A., Myers, N., & Mittermeier, C.G., 1999. *Hotspots*. Cemex, Conservation International, Mexico.

Monk, K.A., de Fretes, Y., & Reksodiharjo-Lilley, G., 1997. *The Ecology of Nusa Tenggara and Maluku*, Periplus Editions, Singapore.

Pemerintah Kabupaten Raja Ampat & Conservation International Indonesia, 2006. *Atlas Sumberdaya Wilayah Pesisir Kabupaten Raja Ampat, Provinsi Irian Jaya Barat*. Sorong.

Secretariat of the Convention on Biological Diversity, 2003. *Global Strategy for Plant Conservation*. Montreal, Canada.

Webb, C.O., 2005. *Vegetation of the Raja Ampat Islands, Papua, Indonesia*. A Report to the Nature Conservancy, Revision 1.5.

Table 1. Plant species formation (composition) at different elevations on Mount Nok, Waigeo Island, the Raja Ampat Islands.

Elevation (m asl)	Species formation/composition	Dominant species
20 - 100	*Tabernaemontana auricantiaca, Pometia pinnata, Intsia bijuga, Vatica rassak, Artocarpus altilis, Orania regalis, Licuala graminifolia, Pandanus tectorius, Semecarpus macrocarpa, Artocarpus altilis, Syzygium malaccensis, Psychotria tripendumculata, Dillenia papuana*, and *Sommieria leucophylla.* Further inland, *Hydriastele costata* sometimes occurred.	*Tabernaemontana auricantiaca, Pometia pinnata, Intsia bijuga, Vatica rassak, Licuala graminifolia,* and *Orania regalis.*
100-200 Hill tops	*Casuarina rumphiana, Rhodamnia cinerea, Garcinia latissima, Decaspermum fruticosum, Licuala graminifolia, Planchonella catartea, Exocarpus latifolius, Cryptocaria infectoria, Semecarpus macrocarpa, Myrsine rawacensis, Psychotria tripendumculata, Pimeleodendron amboinicum, Intsia bijuga, Artocarpus altilis, Guioa waigeoensis,* and *Livistona rotundifolia* very rarely found.	*Casuarina rumphiana, Rhodamnia cinerea, Decaspermum fruticosum, Planchonella catartea, Exocarpus latifolius,Garcinia latissima.* PSEUDOMONTANE VEGETATION
270	*Calophyllum persemile, C. grandiflorum, Pometia pinnata, Artocarpus integer, Licuala graminifolia, Lasianthus purpureus, Knema* sp.*, Gnetum* sp.*, Actinodaphne* sp.*, Gyrinops* sp.*,* and *Canarium* sp*.*	*Calophyllum persemile, C. grandiflorum, Pometia pinnata, Artocarpus integer,* and *Licuala graminifolia.*
350	*Nagaia wallichii, Schima wallichii, Rhodamnia cinerea, Canarium* sp.*, Gironniera* sp.*, Garcinia* sp.*,* and *Fagraea* sp.	*Nagaia wallichii, Schima wallichii, Rhodamnia cinerea,* and *Canarium* sp.
460	*Castanopsis acuminata, Symplocos fasciculata, Celtis philippinensis, Vatica rassak, Pometia pinnata, Parkia* sp.*, Gironniera,* and *Pandanus tectorius.*	*Castanopsis acuminata, Symplocos fasciculata, Celtis philippinensis, Vatica rassak,* and *Pometia pinnata.*
545	*Celtis philippinensis, Poliosma ilicifolia, Pangium edule, Palaquium* sp.*, Calophyllum persemile, Pandanus* sp.*, Actinodaphne* sp.*, Elaeocarpus* sp.*, Helicia* sp.*, Heritiera javanica, Smilax* sp.*, Inga* sp.*, and Calyptrocalix* sp*.* The orchid *Phalaenopsis amabilis* scattered, small population*.*	*Celtis philippinensis, Poliosma ilicifolia, Pangium edule, Palaquium* sp.*, Calophyllum persemile, Pandanus* sp.*, Actinodaphne* sp.*,* and *Elaeocarpus* sp*.*
560	*Intsia bijuga, Celtis philippinensis, Calophyllum persemile, Castanopsis acuminate,* and *Intsia bijuga.* Some orchid populations abundant, growing on very steep, narrow mount ridges (*Dendrobium macrophyllum, D. amboinensis, Ceratostylis* sp.*, Cadetia* sp.*, Eria javanica, Thelasis* sp.*, and Appendicula* sp.). Begonias grew very well.	*Intsia bijuga, Celtis philippinensis, Calophyllum persemile, Castanopsis acuminate,* and *Intsia bijuga.*
630	*Wendlandia* sp.*, Phytosporum ramiflorum, Heritiera javanica, Intsia bijuga, Oleandra* sp*.* The endemics *Schefflera apiculata* and *Calophyllum parvifolium* found. Rocky habitats, very steep, land slides easily, slope 80-90%. Cliff walls were formed by rock piles, united by plant root systems.	*Wendlandia* sp.*, Phytosporum ramiflorum, Heritiera javanica,* and *Intsia bijuga.*

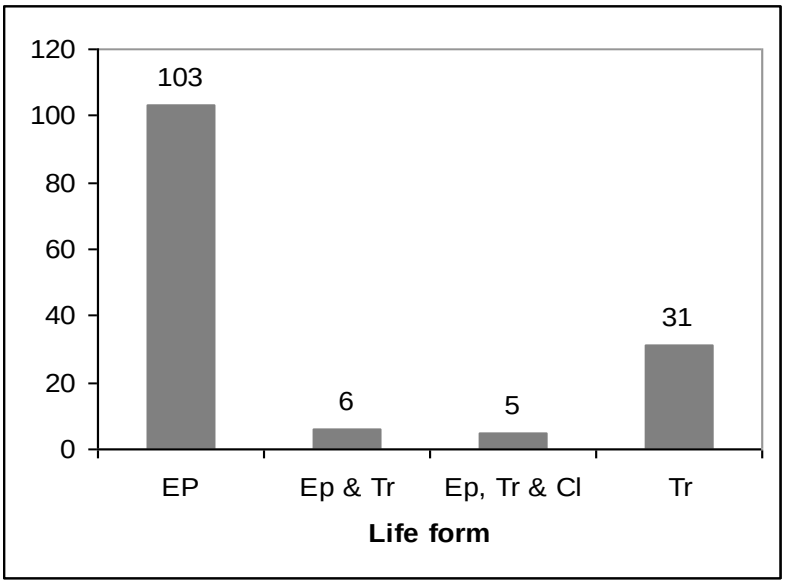

Figure 1. The number of orchid species according to their life forms, found at Mount Nok and Kamtabae River, East Waigeo Island Nature Reserve, the Raja Ampat Islands. Notes: EP (Epiphyte), TR (Terrestrial), and Cl (Climber).

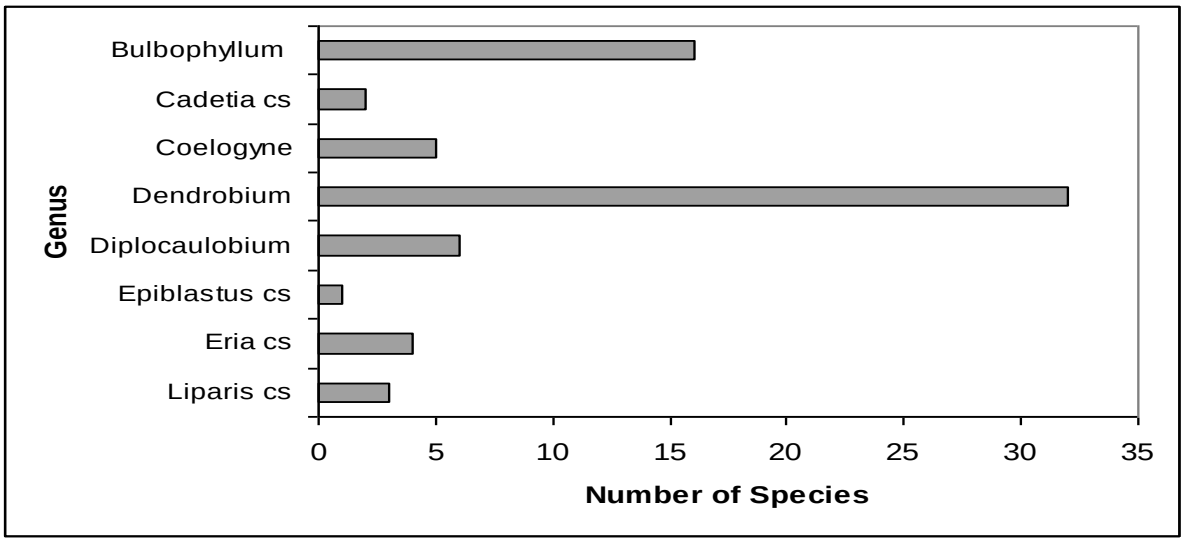

Figure 2. The number of orchid species of each genus found on Mount Nok and Kamtabae River, East Waigeo Island Nature Reserve, the Raja Ampat Islands. Notes: *Liparis* cs (*Liparis, Calanthe, Plocoglottis, Thelasis*), *Eria* cs (*Eria, Flickingeria, Hataeria, Malaxis, Phreatia*), *Cadetia* cs (*Acampe, Agrostophyllum, Appendicula, Ceratostylis, Corymborkis*), *Epiblastus* cs (*Epiblastus, Acriopsis, Brachypeza, Camarotis, Dilochia,*

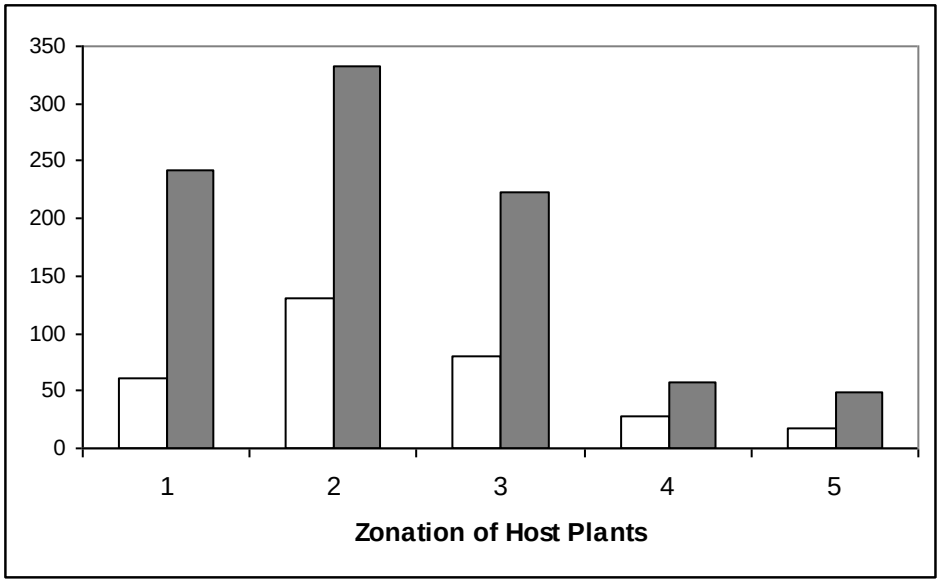

Figure 3. Orchid occurrences (empty bars) and the number of individuals (solid bars) at each zone of the host plants, Mount Nok and Kamtabae River, East Waigeo Island Nature Reserve, the Raja Ampat Islands, West Papua

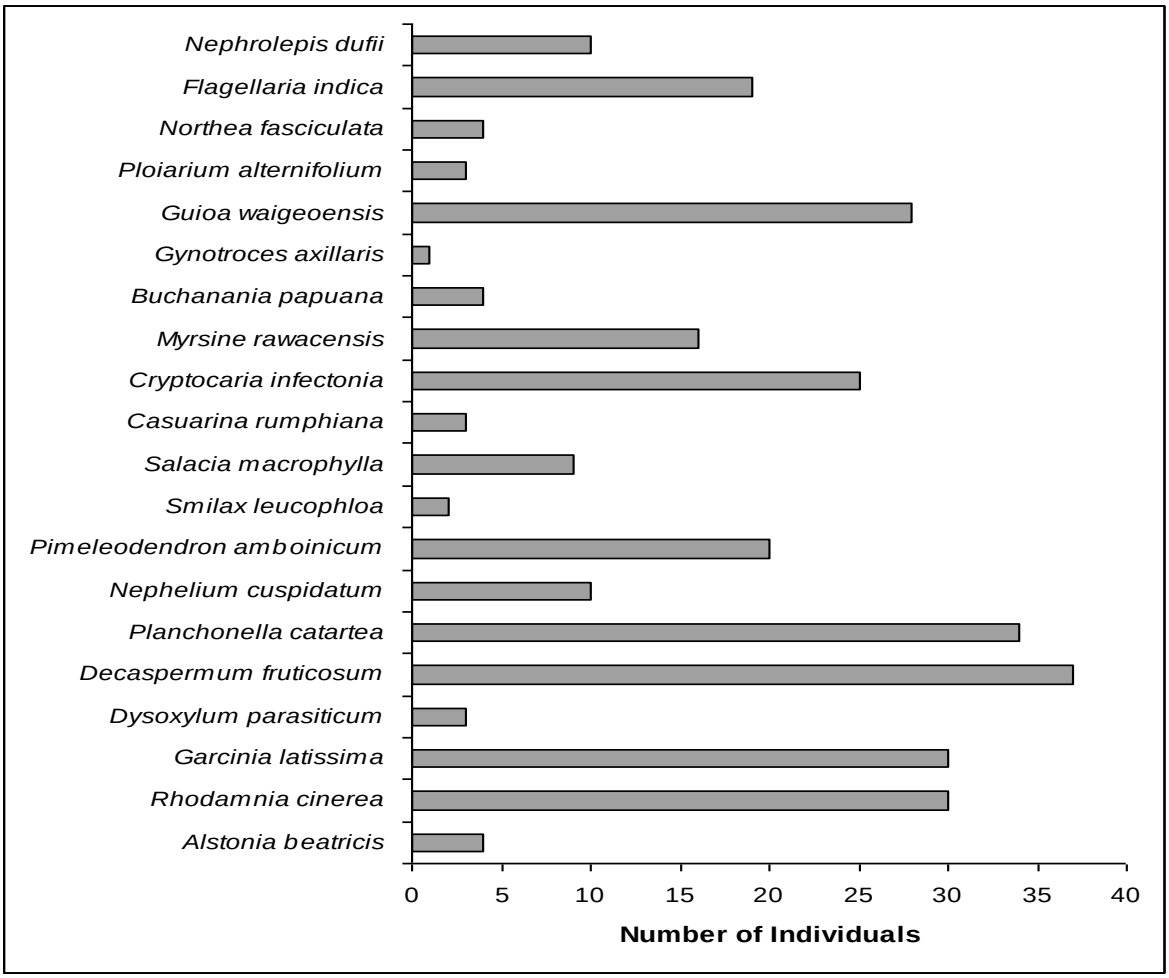

Figure 4. Dominant plant species occurred on hill forests in East Waigeo Nature Reserve (Kamtabae River and the surrounding areas).

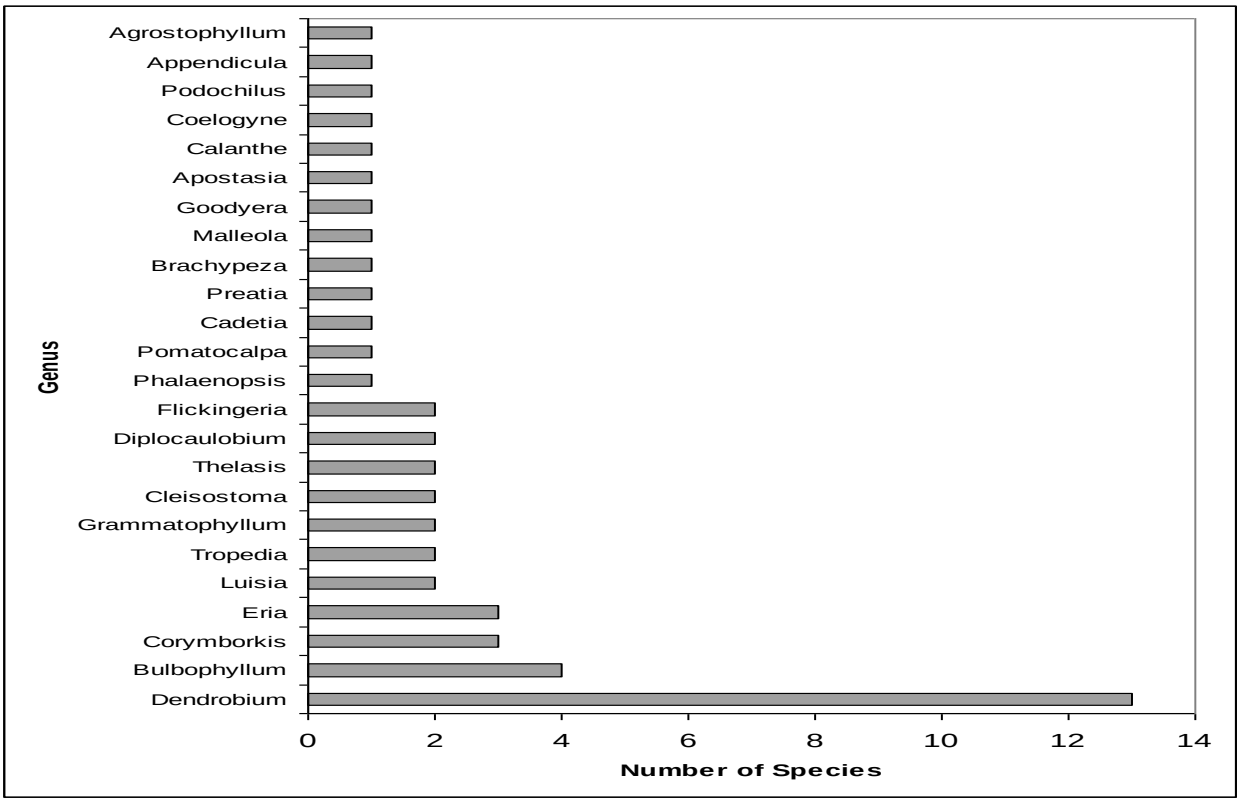

Figure 5. The number of orchid species of each genus found in North Salawati Island Nature Reserve, the Raja Ampat Islands, West Papua