

THE ORCHID FLORA OF EQUATORIAL GUINEA IN RELATION TO THAT OF WEST AFRICA

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The political unit of Equatorial Guinea is composed of three physically disparate parts: the islands of Fernando Póo and Annobón and the small continental segment, Rio Muni. Annobón lies 340 km. from the nearest mainland (Gabon) while Fernando Póo is only 32 km. from the Republic of Cameroun. Thus, the latter island is so near the mainland that, as EXELL remarked (1962), "its flora is in no sense insular," while Annobón is truly an island with a more typically insular flora. Furthermore, Fernando Póo is West African in climate while Rio Muni and Annobón are Equatorial. There is no obvious reason, then, except that of political unity for considering the three in the same paper. I have done so, however, because Annobón and more especially Rio Muni have been so neglected botanically of late that consideration of them might be welcome, even if only fragmentarily and along with a more extensive treatment of Fernando Póo.

The topography of Annobón was well treated by MILDBRAED (1922) and the flora of the island has been most recently reviewed by EXELL in 1944, who reported 115 "significant species" (i. e. total species minus introductions) with 17 (14.8 %) endemics. The percentage of endemism is low enough to suggest: (1) that the species present have arrived relatively recently, and/or, (2) that diversity of habitats has been minimal and selective pressures low. According to the "Flora of West Tropical Africa" (FWTA, SUMMERHAYES, 1968) 11 orchid species in 9 genera are present (See Appendix i.) Of these, 5 (55 %) are distributed in East, Central and West Africa, 1 in East and Central Africa, 4 (44 %) in West Africa, and 1 widely in both Africa and Indo-Malesia. These species, few as they are, appear to reflect logically the position of Annobón just south of West Africa and off the Central African Coast, and to suggest two routes of immigrational dispersal: from the East through Gabon, and from the North (Cameroun) either via the islands of Fernando Póo, S. Tomé and Príncipe or via the Rio Muni mainland.

The topography and climate of Rio Muni have been briefly treated in

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1942 (NAVAL INTEL.) and the vegetation summarized in 1946 (GUINEA LOPEZ). Enumeration of orchids in this area is, however, rudimentary, and it depends almost entirely on my preliminary survey in February 1969, from which a considerable number of determinations awaits the blooming of live plants. The reported species total of 57 in 26 genera (appendix ii) must be viewed as only a sampling, far from definitive. Of these species, 3 are as yet determined only to generic level, so the actual total drops to 54, of which 12 (23 %) are West African in distribution; 24 (45 %) are found in West and Central Africa; 3 (6 %) in Central Africa; 13 (25 %) in West, Central and East Africa; 2 in Central and East Africa. This distribution pattern appears essentially similar to that of the Annobón orchids. Both fragmentary orchid floras, with a few exceptions for Rio Muni, tend to be composed of the species most frequent in adjacent areas. Possible routes of immigration appear to be largely southward from Cameroun and westward from Gabon. A little immigration northward from the Congos also appears likely.

The topography of Fernando Póo has been described by MILDBRAED (1922) and briefly by EXELL (1944), while climate and soils have been considered by NAVA (1953), ADAMS (1957) and THOROLD (1955). Early explorations are recorded by BAIKIE (1856), BURTON (1863), HOOKER (1849), (1864), HOOKER (1962), HUTCHINSON (1861), LANDER (1830), MANN (1862), MILDBRAED (1913, 1922).

The orchid flora of this island is much better known than are the floras of the other two parts of Equatorial Guinea. MILDBRAED (1922) catalogued 39 species in 20 genera (See Appendix II., species marked*.) These included 6 new species of which 5 are in doubtful standing as the types have been lost in Berlin. Subsequently, 20 additional species were listed by the FWTA (6 GUINEA, 7 MELVILLE, 4 WRIGLEY, 2 WESTWOOD, 1 EXELL). Recently (1967, 1969) I have made two trips to the island and added 47 species to the list. This brings the total to about 106 species in 35 genera. These figures are remarkable in demonstrating how so many species remained unrecorded for so long in spite of several botanical surveys of the region.

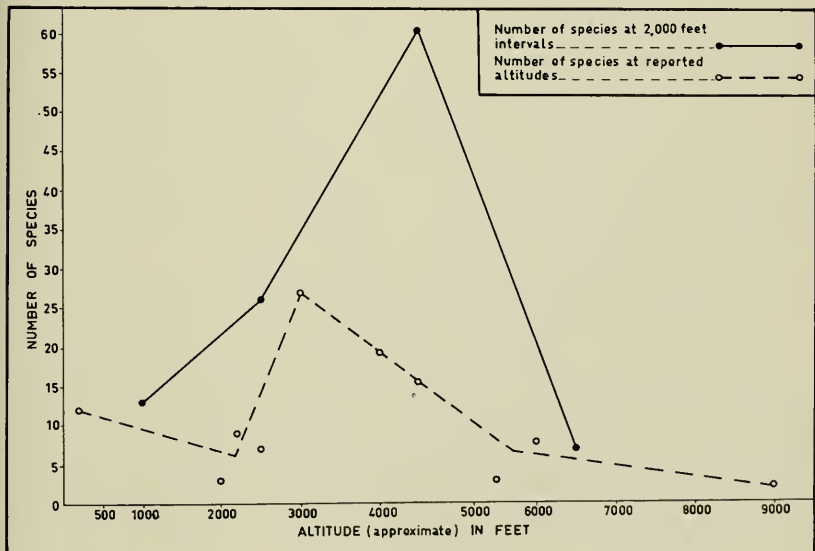
It is now possible to consider the orchids of Fernando Póo in relation to some of the environmental variables of the island. The main variables are altitude, rainfall and atmospheric humidity, and covering vegetation. There are two mountain masses on the island, one terminating in Pico de Santa Isabel (Clarence Peak) reported as 9800 ft. by ADAMS (1957) and 3007.7 m. by the SERVICIO GEOGRAFICO DEL EJERCITO (1959) and the other in Pico de San Joaquim (6600 ft. ADAMS; 2260 m. SERVICIO G.) Rainfall varies from 59 in. (1450 mm.) at Venus on the northernmost coast to 430 in. (11,000 mm.) at Ureka in the extreme south. On the mountains, there is daily cloud by — or shortly after — noon above 4000 ft. except on the Peak of Sta. Isabel which rises clear. The soils show remarkably little diversity (THOROLD, 1955). ADAMS (op. cit.) characterizes six vegetation zones, largely based on altitude and species composition and following MILDBRAED (1922): (1) coastal vegetation; (2) lowland tropical rain forest from sea level

to about 800 m. (2600 ft.); (3) mountain rain forest from 2600 to 4500 ft.; (4) Moka grasslands and southern uplands; (5) *Schefflera* mountain forest from 4500 to 8500 ft. on Pico Sta. Isabel; (6) Ericaceous zone and summit grassland on Pico Sta. Isabel.

BOUGHEY (1955) has suggested a simplified zonation for the mountains of tropical Africa which may be correlated with the classification of Mildbraed and Adams for Fernando Póo:

	BOUGHEY	Near equivalence re. MILDBRAED- ADAMS	
0—2500 ft	Lowland zone	(1), (2)	0— 800 m.
4500	Foothills	(3)	1500
7000	Highlands	(4), (5)	2300
9000	Montane	(6)	3000
13,500	Temperate		4500
Above this	Mountain Desert Zone		

The numbers of orchid species of Fernando Póo are plotted, in Fig. 1, against the altitude at which they have been reported to occur. If the species are "lumped" into 2000 ft.-interval groups, a peak is shown at 4500 ft, suggesting that the greatest number of species of Fernando Póo are found high in the foothills and low in the highlands. Plotting the species at closer alti-



tude intervals indicates that the greatest number of species is found between 2500 and 4500 ft, with a peak at 3000 ft., (foothills). In connection with this, it is interesting to note that a number of the West African lowland orchids are found only at or above 2000 ft. in Fernando Póo. The most obvious explanation for this is that the island is so intensively cultivated in a regular, plantation style that there is very little natural vegetation — even secondary regrowth — left in the lowlands. Thus, orchids adapted to the lowlands simply do not find habitats. Another explanation is that many species of orchids found in West African lowlands tolerate these conditions but do not find them optimal and so grow much better under moister conditions at higher altitudes. This explanation leads us to another possibility: that much of the flora of tropical Africa is derived from a pluvial flora which developed during periods of lower temperatures and higher humidity, so that foothills and highlands now tend to be relict centres of orchid distribution and radiation.

BOUGHEY (op. cit.) has remarked that in Africa “critical heights” occur at intervals of approximately 2,000 ft. This seems at least partially borne out by the orchids on Fernando Póo as species are not generally distributed over a greater altitude range than 2000 ft. (Exceptions are a few lowland forms which extend above 2000 ft.; *Bulbophyllum bufo*, *B. falcatum* and *Graphorkis lurida*.) Not enough data are available to indicate whether or not many species tend to occur throughout a 2000 ft. range of altitude, but I suspect that many have a considerably narrower range of occurrence.

The closest mainland to Fernando Póo is Cameroun at the region of Douala and Victoria. This area includes Cameroun Mountain which is climatically similar to the Fernando Póo mountains. If an area in this region (just south of Mbanga, including Mt. Cameroun and extending just south and southeast of Douala) roughly comparable to Fernando Póo in size and climate variation is enumerated for orchids, we find here 112 species in 31 genera — figures not significantly different from those for Fernando Póo, even though SHLECHTER's, doubtful types are not included here, so the theoretical total would be higher by 6—7 species. We may conclude, then, that Fernando Póo is neither insular in orchid flora nor depauperate in comparison with the mainland.

This seemingly simple situation becomes somewhat more interesting when we examine overall distribution of the species concerned. Of the 106 Fernando Póo -occurring species, 11 cannot be considered, as they represent either dubious species for which the types have been lost, or determinations only to generic level. Of the remaining 95 species in 34 genera, 51 (45 %) in 23 genera (66 %) do occur in the Cameroun mountain area as delimited above. An additional 6 species in 4 genera are found at sites neighboring this area (i. e. Mbonga, Barombia, Kumba), while 10 species in 8 genera are found further north in West Cameroun (the Bamenda highlands area). This leaves 28 species (30 %) in 18 genera that are not found in Western Cameroun.

Of these 28 species, 13 species in 11 genera are distributed in West and Central Africa; 5 species in 4 genera in West Africa alone; 3 species in 3 genera in West, East and Central Africa; 6 species in 4 genera in East Africa alone or in both East and West Africa; 1 species (*Genyorchis micropetala*) perhaps endemic to Fernando Póo or possibly also found in Congo (Summerhayes, 1968).

That 70 % of the orchid species of Fernando Póo are also found in West Cameroun and that an additional 20 % are found in West Africa indicates clearly that the Fernando Póo orchid flora is basically West African and that immigration into the area has been mainly from the northeast towards the southwest — i. e. from Cameroun to Fernando Póo and also into the Equatorial mainland (East Cameroun, Gabon, Rio Muni, the Congos). The remaining 10 % of the species appear to have moved in an east to west direction from East Africa via either the Equatorial belt or the East Cameroun highland and so crossed into Fernando Póo from either eastern Cameroun or Rio Muni.

A few of the West African species have a disjunct distribution. Five occur here and there in West Africa but skip southern and western Cameroun. All but one of these have been reported from the Calabar-Oban Hills region in southeastern Nigeria or from the Obudu-Ikwette region somewhat north of this area. These species occur in the wet forests of the lowlands and up to the beginning of the foothills at around 2500 ft., environments held in common by the above mentioned regions of Nigeria, the lower slopes of Cameroun Mountain and much of Fernando Póo. Their occurrence at the latter site is not surprising then; it is only surprising that they have not been found in the Cameroun Mountain area. As none of these species are frequent anywhere, it is most likely that collections simply have not yet turned up from Cameroun Mountain — an area so rich floristically in comparison with most of West Africa that the orchids have tended to be overlooked. The remaining one species of this distributional group, *Disperis thomensis*, appears rare in all its habitats and while found in Guinea, Sierra Leone, Liberia, Ghana and Fernando Póo, S. Tomé and Angola, it skips Nigeria and Cameroun. This looks like a disjunction which has come about through elimination of the Dahomey-Togo-Nigeria-Cameroun habitats by a climatic shift towards increased dryness and higher temperatures. This species is thus probably relict at such sites as Moka, at 4600 ft., in Fernando Póo, and may turn up eventually in the ecologically similar Bamenda highlands of Cameroun.

The 10 species of orchids found in Fernando Póo and in the Bamenda highlands of Cameroun but not in the Mt. Cameroun area itself are also of interest. The Bamenda highlands have strong East African vegetational elements and are fundamentally highland savanna rather than forest. Conditions on Mt. Cameroun are not comparable, while conditions of the Moka grasslands in Fernando Póo are. Thus propagules dispersed in an east to west direction from East Africa would find suitable habitats in Bamenda and

then not again until the Fernando Póo highlands. In recent years, clearings above Buea on Mt. Cameroun for extensive cattle grazing have begun to create an environment similar to that of the Bamenda and Moka highlands. It will be interesting to see if highland savanna-type orchids eventually migrate here.

The few highland forest forms (*Angraecum affine*, *Diaphananthe quintassi*, *Polystachya calyptrata*, *P. nyanzensis*) have probably dispersed from East Africa through Equatorial Africa and arrived at Fernando Póo by this route. Further search may disclose some of them in the Crystal Mountains of Gabon.

The overall picture of dispersal and distribution of orchids appears to be along the West Coast from Senegal to Gabon and the Congos; along the Cameroun-Nigerian highlands to Mt. Cameroun and across East Cameroun, Rio Muni, Gabon and the Congos. Eastern orchids, predominantly highland savanna to savanna-woodland forms, may have entered the West Coast area via the Cameroun highlands, while the few forest forms may have come via Congo, Gabon, East Cameroun and Rio Muni. Extension to Annobón has been almost exclusively from Gabon and the associated Congos and Rio Muni, while extension to Fernando Póo has been mainly from the Mt. Cameroun area and, to a lesser extent, from southern Nigeria and eastern Cameroun. This picture is in general agreement with the comments of MORTON (1962) regarding East to West movement of the African flora. The question of how much of the present orchid flora represents relict segments from a formerly more uniform distribution (as suggested by MORTON, 1962, for the West African flora in general, and by SANFORD, 1969, for the Nigerian orchid flora in particular) and how much represents fairly long-range, more recent dispersals is a difficult question. I have recently (SANFORD, 1970) come to the conclusion that successful long-range dispersal of orchid seeds has probably occurred to a much greater extent than orchid specialists have previously considered possible. It now seems likely to me that an appreciable proportion of present-day orchid distribution reflects relatively recent dispersals as well as disjunct relicts from the more remote past. But since there is no way to settle this argument, one had better leave it with only a statement of opinion as to what is possible.

APPENDIX

I. Species of Orchids recorded for Annobón by FWTA (1968)

- Bolusiella talbotii* (RENDLE) SUMMERH.
- Bulbophyllum cocoinum* BATEM ex. LINDL.
- B. melanorrhachis* (RCHB. F.) RCHB. F.
- B. oxypterum* (LINDL.) RCHB. F.
- Calanthe corymbosa* LINDL.
- Diaphananthe pellucida* (LINDL.) SCHLTR.

Epipogium roseum (DON) LINDL.
Liparis nervosa (THUNB.) LINDL.
Platylepis glandulosa (LINDL.) RCHB. F.
Polystachya albescens RIDL. subsp. *albescens* SUMMERH.
Zeuxine elongata ROLFE

II. Species of orchids reported for Fernando Póo (*Reported by MILDBRAED, 1922; others reported by FWTA, 1968, except where followed by WS and collection number — these refer to unpublished collections of W. W. SANFORD, 1967, 1969, at Kew or/and Paris or/and Ite)

Aërangis gravenreuthii (KRAENZL.) SCHLTR.
Ancistrochilus thomsonianus (RCHB. F.) ROLFE WS/4402
**Ancistrorhynchus acrodontum* SCHLTR. MILDBRAED n. sp. 7149
A. capitatus (LINDL.) SUMMERH.
A. serratus SUMMERH.
Angraecopsis ischnopus (SCHLTR.) SCHLTR. WS/4243; WS/4245
**A. tridens* (LINDL.) SCHLTR.
Angraecum affine SCHLTR. WS/4363 A; WS/4364/WS/4368; WS/4365
A. aporoides SUMMERH.
A. birrimense ROLFE WS/4221; WS/4222
A. chevalieri SUMMERH.
A. pungens SCHLTR.
**A. subulatum* LINDL.
**Ansellia africana* LINDL.
Bolusiella talbotii (RENDLE) SUMMERH.
Bolusiella sp. WS/5919; WS/5920
Bulbophyllum bequaertii DEWILD.
B. bufo (LINDL.) RCHB.F.
B. calamarium LINDL. WS/4062; WS/4063
**B. cochleatum* LINDL.
B. comatum LINDL.
B. distans LINDL.
**B. falcatum* (LINDL.) RCHB. F.
**B. fernandopoeanum* SCHLTR. MILDBRAED n. sp. 6892
B. flavidum LINDL.
B. fuerstenbergianum (DEWILD.) DEWILD.
B. fuscoides J. B. PETERSEN
**B. gravidum* LINDL.
**B. insulanum* SCHLTR. MILDBRAED n. sp. 6955
B. intertextum LINDL.
B. mannii HOOK. F.
B. oreonastes RCHB. F.
B. recurvum LINDL.
**B. schultzeanum* SCHLTR. MILDBRAED n. sp. 6951
**B. tenuicaule* LINDL.

B. winkleri SCHLTR. WS/4015

**Calanthe corymbosa* LINDL.

Calypstrochilum emarginatum (Sw.) SCHLTR.

**Chamaeangis vesicata* (LINDL.) SCHLTR.

Chamaeangis ? sp. n. WS/4291

**Cheirostylis lepida* (RCHB. F.) ROLFE

**Corymborkis corymbosa* THOU.

Cynorkis anacamptoides KRAENZL.

C. debilis (HOOK. F.) SUMMERH.

**Cynosorchis calcarata* (RCHB. F.) SCHLTR. TESSMANN 2891

Cyrtorchis ringens (RCHB. F.) SUMMERH. WELLS (WS)/4200; (WS)/4198

Diaphananthe bidens (Sw.) SCHLTR.

D. kamerunensis (SCHLTR.) SCHLTR. WS/4303

D. quintasii (ROLFE) SCHLTR.

**D. subclavata* (ROLFE) SCHLTR. MILDBRAED 6787

**Disperis mildbraedii* SCHLTR. ex SUMMERH.

D. thomensis SUMMERH.

Epipogium roseum (DON) LINDL.

Eulophia bouliawongo (RCHB. F.) REYNAL

**E. horsfallii* (BATEM.) SUMMERH.

**E. milnei* RCHB. F.

Eulophidium saundersianum (RCHB. F.) SUMMERH.

Eurychone rothschildiana (O'BRIEN) SCHLTR.

**Genyorchis micropetala* (LINDL.) SCHLTR.

**G. pumila* (Sw.) SCHLTR.

Graphorkis lurida (Sw.) O. KTZE.

**Habenaria attenuata* HOOK. F.

**H. barrina* RIDL.

**H. bracteosa* HOCHST. ex A. RICH.

H. gabonensis RCHB. F.

**H. mannii* HOOK. F.

H. microceras HOOK. F.

**Hetaeria mannii* (RCHB. F.) DUR. and SCHINZ

H. stammleri (SCHLTR.) SUMMERH.

**Liparis nervosa* (THUNB.) LINDL.

L. deistelii SCHLTR.

L. tridens KRAENZL.

Liparis ? sp. n. WS/4084

Malaxis maclaudii (FINET) SUMMERH.

M. prorepens (KRAENZL.) SUMMERH. WS/4384; WS/4391

M. weberbauerana (KRAENZL.) SUMMERH.

Manniella gustavii RCHB. F.

Microcoelia LINDL. sp. WS/4167

Nervilia adolphii SCHLTR. WS/4323

N. reniformis SCHLTR. WS/4032

- **Platylepis glandulosa* (LINDL.) RCHB. F.
- Polystachya albescens* RIDL. subsp. *albescens* SUMMERH.
- **P. alpina* LINDL.
- P. bicalcarata* KRAENZL.
- **P. bifida* LINDL.
- P. calluniflora* KRAENZL. WS/5968; WS/6010
- **P. caloglossa* RCHB. F.
- P. calyprata* KRAENZL. WS/4012; WS/4013; WS/4014
- P. camaridioides* SUMMERH. WS/4362
- P. cultriformis* (THOU.) SPRENG.
- P. elegans* RCHB. F. WS/5977; WS/6008 (Not WS/4013 in FWTA, 1968)
- P. fractiflexa* SUMMERH. WS/4078; WS/4087
- **P. fusiformis* (THOU.) LINDL.
- **P. laxiflora* LINDL.
- P. nyanzensis* RENDLE WS/4025; WS/4026; WS/4027
- **P. odorata* LINDL. var. *odorata*
- **P. oligantha* SCHLTR. MILDBRAED n. sp. 7131
- **P. polychaete* KRAENZL.
- P. rhodoptera* RCHB. F. WS/4094; WS/5965
- P. superposita* RCHB. F.
- **P. tessellata* LINDL.
- Polystachya* sp. WS/5922
- Sarcorhynchus polyanthus* (KRAENZL.) SCHLTR.
- **Satyrium* Sw. sp. TESSMANN 2890
- Tridactyle anthomaniaca* (RCHB. F.) SUMMERH. WS/4399
- T. aff. bicaudata* (LINDL.) SCHLTR. WS/5998
- T. tridactylites* (ROLFE) SCHLTR.
- Tridactyle* sp. WS/4162
- Zeuxine elongata* ROLFE

III. Species of orchids reported for Rio Muni (Those followed by WS and collection number refer to unpublished collections of W. W. SANFORD, 1969; others noted in FWTA, 1968, unless indicated as GUINEA LOPEZ, 1946)

- Aërangis arachnopus* (RCHB. F.) SCHLTR. WS/6064 A Mecomo
- A. calantha* (SCHLTR.) SCHLTR. WS/5757 Niefang
- Ancistrochilus* ROLFE sp. WS/5870 Rio Metem
- Ancistorhynchus ? metteniae* (KRAENZL.) SUMMERH. WS/6072 Mecomo
- Ancistorhynchus* sp. WS/5874 Rio Metem
- Angraecum* aff. *birrimense* ROLFE WS/5846 Rio Metem
- A. chevalieri* SUMMERH. WS/5754 Niefang
- A. aff. chevalieri* SUMMERH. WS/5738 Ebibiyin to Micomesong
- A. distichum* LINDL. WS/5910 Rio Metem
- A. firthii* SCHLTR. WS/5734 Ebibiyin to Micomesong
- Ansellia africana* LINDL. Photograph WS Abumnzok
- Bolusiella batesii* (ROLFE) SCHLTR. WS/5750 Niefang

- B. iridifolia* (ROLFE) SCHLTR. WS/5741 Ebibiyin to Micomesong
Bulbophyllum calyptratum KRAENZL. WS/5745 Niefang
B. aff. fuscum LINDL. WS/5853 Rio Metem
B. intertextum LINDL. WS/5831 Rio Metem
B. magnibracteatum SUMMERH. WS/6090 Mecomo
B. aff. melanorrhachis (RCHB. F.) RCHB. F. WS/5740 Ebibiyin to Micomesong
B. saltatorium LINDL. WS/5806 Rio Metem
B. simonii SUMMERH. WS/5862 Rio Metem
Calypstrochilum emarginatum (Sw.) SCHLTR. WS/5733 Ebibiyin to Micomesong
Chamaeangis odoratissima (RCHB. F.) SCHLTR. WS/5739 Ebibiyin to Micomesong
C. vesicata (LINDL.) SCHLTR. WS/6101 St. Joachim
Cheirostylis divina (GUINEA) SUMMERH.
Cyrtorchis prob. *chailluana* (HOOK. F.) SCHLTR. WS/5751 Niefang
C. monteiroae (RCHB. F.) SCHLTR. WS/5761 Niefang
Cyrtorchis sp. WS/6082 Mecomo
Diaphanantbe bidens (Sw.) SCHLTR. WS/5792 Bata to Rio Benito
D. rutila (RCHB. F.) SUMMERH. WS/5749 Niefang
Dinklageella liberica MAUSF. WS/5744 Niefang
Encheiridion macrorrhynchium WS/5764 Niefang
Eulophia bouliawongo (RCHB. F.) REYNAL WS/5742 Niefang
E. horsfallii (BATEM.) SUMMERH. WS/6043 Abumnzok
E. milnei RCHB. F.
Genyorchis pumila (Sw.) SCHLTR. WS/6071 Mecomo
Graphorkis lurida (Sw.) O. KTZE WS/5753 Niefang
Habenaria gabonensis RCHB. F. WS/5790 Bata to Rio Benito
Listrostachys pertusa (LINDL.) RCHB. F. WS/5872 Rio Metem
Microcoelia caespitosa (ROLFE) SUMMERH. WS/6077 Mecomo
Platylepis A. RICH. sp. WS/5752 Niefang
Polystachya aff. *adansoniae* RCHB. F. WS/5838 Rio Metem
P. albescens RIDL. subsp. *albescens* SUMMERH. WS/5857 Rio Metem
P. prob. coriscensis RCHB. F. WS/5835 Rio Metem
P. aff. dalzielii SUMMERH. WS/5868 Rio Metem
P. laxiflora LINDL. WS/5748 Niefang
P. odorata LINDL. var. *odorata* WS/6066 Mecomo
P. aff. polychaete KRAENZL. WS/5841 Rio Metem
P. ramulosa LINDL. WS/5832 Rio Metem
P. prob. rhodoptera RCHB. F. WS/5897 Rio Metem
P. tessellata LINDL. WS/5732 Ebibiyin to Micomesong
Rangaëris rhipsalisocia (RCHB. F.) SUMMERH. WS/5735 Ebibiyin to Micomesong
Solenangis clavata (ROLFE) SCHLTR. WS/6069 Mecomo
Stolzia elaidum (LINDL.) SUMMERH. WS/5900 Rio Metem
Tridactyle anthomaniaca (RCHB. F.) SUMERH. WS/6075 Mecomo

- Vanilla africana* LINDL.
V. imperialis KRAENZL. (GUINEA LOPEZ, 1946)
V. ramosa ROLFE

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