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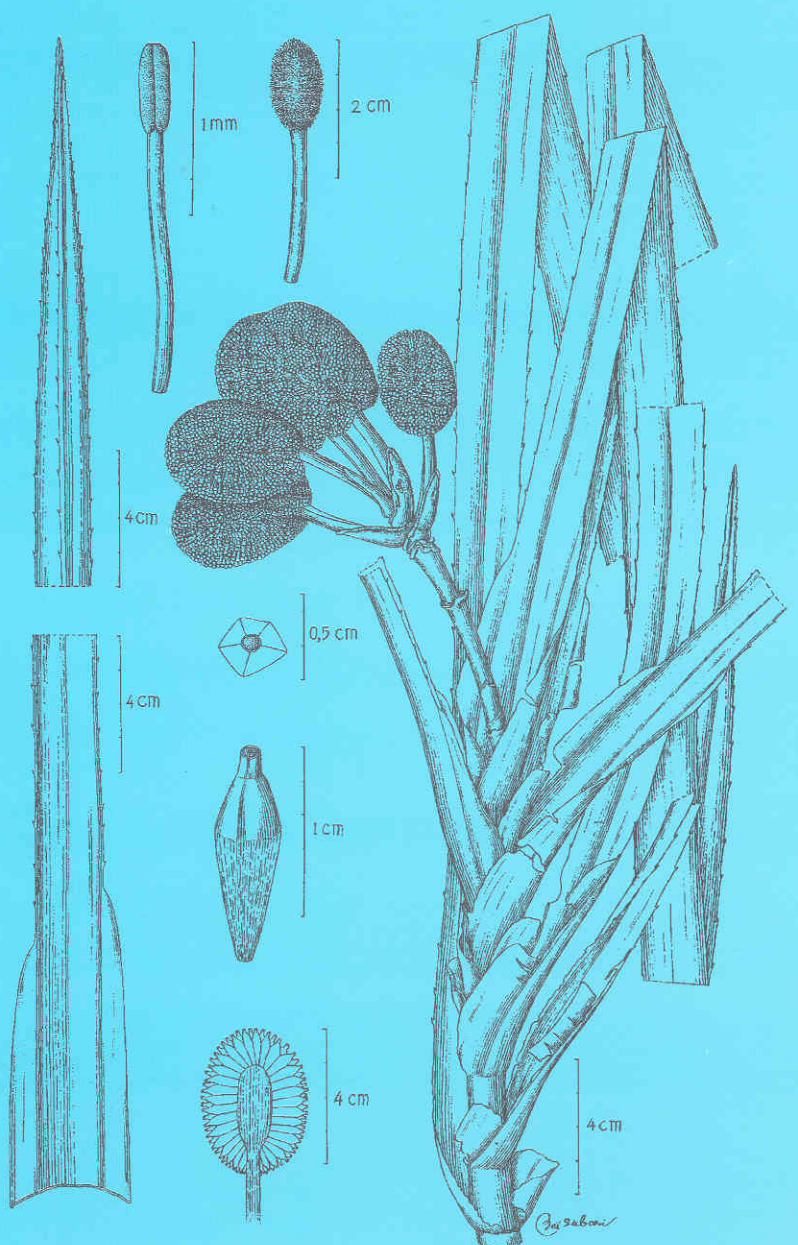

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Correspondence on editorial matters and subscriptions for Reinwardtia should be addressed to:
HERBARIUM BOGORIENSE, BOTANY DIVISION,
RESEARCH CENTER FOR BIOLOGY– LIPI,
CIBINONG 16911, INDONESIA
Email: reinwardtia@mail.lipi.go.id

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THE ECOLOGY AND DISTRIBUTION OF FREYCINETIA GAUD. (PANDANACEAE; FREYCINETOIDEAE) IN THE INDONESIAN NEW GUINEA

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NURHAIDAH IRIANY SINAGA
Post Graduate School, Bogor Agricultural University, Bogor, Indonesia
Forestry Department, Papua University, Jl. Gunung Salju Amban Manokwari, Papua Barat, Indonesia. Email: irianysinaga@yahoo.com.

RITA MEGIA
Biology Department, Bogor Agricultural Institute, Jl. Raya Dramaga Bogor, Indonesia.

ALEX HARTANA
Biology Department, Bogor Agricultural Institute, Jl. Raya Dramaga Bogor, Indonesia.

ARY PRIHARDHYANTO KEIM
Herbarium Bogoriense, Research Center for Biology–LIPI. Jl. Raya Jakarta Bogor Km 46 Bogor 16911, Indonesia. Email: arypkeim@yahoo.com

ABSTRACT
SINAGA, N. I., MEGIA, R., HARTANA, A., KEIM, A. P. Ecology and distribution of *Freycinetia* Gaud. (*Pandanaceae; Freycinetoidea*) in Indonesian New Guinea. *Reinwardtia* 13(2): 189–197. — The study mainly concerns with the species of *Freycinetia* that occurs in the Indonesian New Guinea, including the provinces of Papua and Papua Barat. The study indicates that almost all species of *Freycinetia* in the Indonesian New Guinea prefer high humidity and abundantly occur along rivers, except for the members of the group of species with imbricate leaves, which inhabit also secondary forests. Futhermore, the members of this group have never been found within the range of 1700 to 3000 m altitudes. This highest range of altitudes is specifically occupied by the members of the groups of species with semi imbricate and grass-like leaves. The costal forests are inhabited by the groups of species with semi and non imbricate leaves. Indonesian New Guinea shares many species with Papua New Guinea, except for the members of the group of species with semi imbricate leaves, which are more common in Indonesian New Guinea than in Papua New Guinea. On the contrary, the members of the group of species with grass-like leaves are more common in Papua New Guinea and becoming rare toward the Indonesian site and becoming absent in the Vogelklop (Bird's head), except for *F. polyclada* which is commonly found in Sorong. Indonesian New Guinea possesses 34 species exclusively distributed in the area, while Papua New Guinea has 72 species. The two areas share 52 species. Only five species have extra New Guinean distributions, *i.e. F. excelsa*, *F. funicularis*, *F. marginata*, *F. percostata*, and *F. scandens*.

Keywords: ecology, distribution, *Freycinetia, Pandanaceae*, Indonesian New Guinea

ABSTRAK
SINAGA, N. I., MEGIA, R., HARTANA, A., KEIM, A. P. Ekologi dan persebaran *Freycinetia* Gaud. (*Pandanaceae; Freycinetoidea*) di Nugini wilayah Indonesia. *Reinwardtia* 13(2): 189–197. — Studi mengenai ekologi dan persebaran *Freycinetia* di Nugini wilayah Indonesia telah dilakukan. Studi terutama dilakukan terhadap jenis-jenis *Freycinetia* yang ada di Nugini wilayah Indonesia yang meliputi propinsi Papua dan Papua Barat. Hasil penelitian menunjukan bahwa *Freycinetia* lebih senang hidup di tempat yang lembab, dan ditemukan hidup melimpah di dekat sungai. Kecuali beberapa anggota jenis kelompok daun bersirap yang juga dapat hidup di hutan sekunder, akan tetapi untuk jenis dalam kelompok ini tidak pernah ditemukan hidup di pegunungan dalam ketinggian 1700 hingga 3000 m di atas permukaan laut. Tempat seperti ini dihuni oleh *Freycinetia* dari kelompok daun setengah bersirap dan kelompok seperti rumput. Kedua kelompok ini menduduki habitat yang sama akan tetapi kelompok seperti rumput tidak pernah ditemukan hidup di dekat pantai seperti kelompok *Freycinetia* dengan daun setengah bersirap dan tidak bersirap. Nugini wilayah Indonesia dan Papua Nugini (PNG) juga memiliki jenis yang sama akan tetapi khusus untuk kelompok daun setengah bersirap, lebih banyak jenisnya yang ditemukan hidup di Nugini wilayah Indonesia dibanding PNG. Kelompok *Freycinetia* berdaun seperti rumput ditemukan hidup melimpah di PNG dan semakin berkurang ke arah barat hingga tidak terdapat sama sekali di kepala burung, kecuali *F. polyclada* yang banyak ditemukan di daerah Sorong. Ditemukan sebanyak 34 jenis *Freycinetia* yang hanya hidup di Nugini wilayah Indonesia dan sebaliknya 72 jenis *Freycinetia* dari PNG tidak pernah ditemukan di Nugini wilayah Indonesia. Jenis yang ditemukan di kedua

wilayah tersebut sebanyak 52 jenis dan hanya 5 jenis yang memiliki persebaran sangat luas yakni *F. excelsa*, *F. funicularis*, *F. marginata*, *F. percostata* dan *F. scandens*.

Kata kunci: ekologi, persebaran, *Freycinetia, Pandanaceae*, Nugini wilayah Indonesia.

INTRODUCTION

Freycinetia is one of the four genera within the Palaeotropic monocotyledonous family of *Pandanaceae*. The other genera are *Martelliden-dron*, *Pandanus*, and *Sararanga*. Unlike the other three genera, the members of the genus *Freycinetia* are almost all climbers. Prior to this study the genus *Freycinetia* is consisted of 180 to 200 species (Stone, 1973). The genus occurs in the mainland South East Asia, Malesia, Taiwan, Micronesia, northern Australia, New Zealand and the Pacific islands. The centre of distribution is New Guinea, where approximately 60 species are believed to exist (Stone, 1976). The genus is the only member of *Pandanaceae*, occurring in New Zealand.

The island of New Guinean is topographically unique, in the sense that high mountains stretches along the central part of the island from the most western section covering the Vogelkop (Bird Head area) to the most eastern area. It thus constitutes an outstanding North-South dispersal barrier for many species of plant and animals.

As the dispersal agents of *Freycinetia* are mostly birds and mammals (such as bats or marsupials) (Cox, 1982, Cox et. al., 1991) as well as insect (such as beetles and ants), the topographic barrier is assumed to be a good barrier for the gen flows in *Freycinetia* as well as in animals. In other words, many of the New Guinean species of *Freycinetia* are believed to inhabit restricted areas or possess limited distribution areas. The aim of the present study is to clarify this assumption.

METHOD

The study was carried out from July 2005 to March 2009. It started by the collecting activities undertaken in several areas in Indonesian New Guinea, including Timika in 2005, Manokwari in 2006, Sarmi in 2006, and Jayapura in 2006 and 2008. It is followed by herbarium study conducted in the Herbarium Bogoriense-Indonesia (BO) in 2006 & 2008, Herbarium Manokwariense, Indonesia (MAN) in 2006, the Lae Herbarium, Papua New Guinea (LAE) in 2006, the National Herbarium of the Netherlands, the Netherlands (L) in 2008 and the Kew Herbarium, UK (K) in 2009.

ECOLOGY OF THE INDONESIAN NEW GUINEAN *FREYCINETIA*

The species of *Freycinetia* can be classified into groups with (1) grass like leaves, (2) imbricate leaves, (3) semi imbricate leaves, and (4) non-imbricate leaves. The members of the grass like leaves group were frequently found in mountains and places with altitudes 1200 to 1300 meters *a.s.l.* (above sea level) (Table 1.) except for *F. angusta* and *F. angustissima*, which were found in much lower altitudes.

During the field study we encountered that *F. angusta* and *F. angustissima* were found along the the river banks of Aikjiwa River in Timika District and Digul River in Merauke District extending from fairly higher altitude down to wetland areas at about 50 meters *a.s.l.* The members of this group so far have never been found on beaches, open areas or secondary forests. Moreover, all members of this group preferred humid areas, such as in riverbanks.

Likewise, most of the members of the semi imbricate leaves group also preferred highlands with altitudes of 1000 up to 3000 meters *a.s.l.* Three species (*F. ayawasa*, *F. nervoauriculata*, and *F. spiroaxilla*), however, where discovered inhabiting primary beach forest on much lower altitudes. Two species of this group, *F. cryptocarpa* and *F. funicularis* were found in both higher and lower altitudes, from montane forests at 1000 meter *a.s.l.* down to hill forests at 600 to 800 meters *a.s.l.* It may be implied that the two species have good ability to adapt to different types of habitats, but when the two species were occupying same habitats, *F. funicularis* was usually found more abundant than *F. cryptocarpa*.

Muller (2005) said that in western New Guinea close to the forest on the 2.200 m above sea level, *Freycinetia* are found while palm disappear. According to the notes of the specimens, these species should be grass and semi imbricate groups.

Unlike the previous two groups, the non imbricate leaves group preferred lower altitudes. The members of this group were abundantly found in humid primary forests at altitude no more than 1700 meters. As the members of the group the semi imbricate leaves were also found within this range, the two members of two different groups were sometimes cohabitants. Our present study indicated that the primary costal forests were exclusively occupied by the members of these two groups.

Table 1. Distribution of the members of the infrageneric groups suggested in this current study (A = secondary forest; B = primary costal forest; B' = primary forest, C = wet land area).

No	The species group	0 to 50 m altitudes			51 to 200 m altitudes		600 to 800 m altitudes		1000 to 1700 m altitudes		1700 to 3000 m altitudes	
		A	B	C	A	B	A	B'	A	B'	A	B'
1	Grass-like leaves	-	-	x	-	x	-	-	-	x	-	x
2	Semi imbricate leaves	-	x	-	-	x	-	x	-	x	-	x
3	Non Imbricate Leaves	-	x	-	-	x	-	x	-	x	-	-
4	Imbricate leaves	x	-	-	-	x	-	x	-	x	-	-

Only members imbricate leaves group were known to inhabit the riverbanks in secondary forests areas, such as *F. andajensis* and *F. macrostachya*. The members of this group were also found to be cohabitants with the members of the non imbricate group.

The members of the grass-like and semi imbricate leaves groups both have ability to inhabit higher altitudes up to 3000 m. On the contrary, the non imbricate and imbricate leaves group preferred much lower altitudes. Following the differences in the altitudinal preference, the morphologies of the grass-like and semi imbricate groups were also noticeably different from the later groups. Mostly species of the first two groups have much smaller dimensions in every part of the structures from stems, leaves, bracts, flowers to fruits. For examples: *Freycinetia angustissima*, a member of the group of grass-like leaves group has a conspicuously slender stem of only 0.2 cm in diameter, leaves of 5 to 10 by 0.5 cm, bract of only 2 by 2 cm, and fruit of 1 to 1.5 by 1 cm. *Freycinetia gibbsiae*, a member of the semi imbricate leaves group has stems of 0.4 to 0.5 cm in diameters, leaf of 15 by 0.5 cm, bract of 4 by 3 cm, and fruit of 3 by 1.5 cm.

In western New Guinea the members of the grass-like leaves group dominate the higher altitudes, especially in the area with elevation more than 3250 m *a.s.l.* The minute habits possessed by the members of this group is in accordance with ecological phenomenon that in places with profoundly high altitudes of 3000 m or higher the most common plants are grasses (46 to 54 %) and the trees are starting to become rare on the altitude of 2700 m (Johns et al., 2007; Muller, 2005). Being mostly of climbing pandans, members of the genus *Freycinetia* undoubtedly need trees to sustain their life style; thus, as the trees become rare at 2700 m altitude, the habit of *Freycinetia* on higher altitudes than 2700 m were adaptively grass-like. We, therefore encountered on the ground, mostly grass like species with many branches like shrub.

Freycinetia angustissima, the highest known New Guinean species has lost the thickness of its leaves in response to the humid environment. This is in contrast to the *F. macrostachya*, which occupies dry areas, thus it possesses succulent leaves in response to the surrounding environment. Few members of the grass-like leaves group followed the water flow from high altitudes down to the flat areas. They could still be found along the banks of steep rivers at the altitudes of 600 to 800 m as long as the area were wet. As the members of the grass-like leaves group have thin leaves (not succulent) they exceedingly need humid environment. In these altitude, the members of the grass-like and semi imbricate leaves groups were more commonly seen living as cohabitants

The members of the semi imbricate leaves group were also found cohabitants with the members of the non imbricate leaves group particularly in the primary costal forests. This finding is supported by the similarity of their leaves anatomy (Sinaga *et. al.*, 2011 in preparation) They both have a layer of long lateral tissue under the epidermal tissue.

DISTRIBUTION OF INDONESIAN NEW GUINEAN SPECIES OF *FREYCINETIA*

The grass-like leaves group possesses a rather disjunct distribution (Figure 1). The members of this group occurred from the highlands of Papua New Guinea in the east to the Indonesian province of Papua in the west, except in Nabire highlands and the Arfak Mountains. The members were found again in the lowlands of Sorong on the most western corner of the mainland New Guinea. *Freycinetia angustissima* was the most widely distributed species in the group. It occured both in the eastern and western parts of New Guinea. The species were also present in Merauke in the

southeastern part of Papua, where *Freycinetia* was previously poorly known. Some species had restricted distribution such as *F. linearis*, *F. polyclada*, and *F. pseudoangustisimma*.

The semi imbricate leaves group had its highest diversity in western Papua as shown on Figure 2. Most species were found with limited distribution. They included *F. ayawasa, F. erythospatha, F. fusiforma, F. gibbsiae, F. hasteta, F. imbristigma, F. lateriflora, F. millikenus, F. nervoauricula, F. pleurantha, F. rhodospatha, F. sterophylla, F. spiroaxilla,* and *F. simpliaxillata*. *Freycinetia ayawasa* and *F. nervoauriculata* which were found only in Sorong. *Freycinetia simpliaxillata* was found nowhere else but at the Yapen Island. *Freycinetia gibbsiae*, *F. lateriflora*, and *F. imbristigma* were exclusively restricted to Baliem valley. *Freycinetia rhodospatha*, *F. pleurantha*, and *F. imbristigma* have been so far collected in Timika. *Freycinetia hasteta* and *F. fusiforma* have been recorded only in the Humbold Bay, Jayapura. Unfortunately the coastal forests in the Humbold Bay have been disappearing and these two species were no longer found in the wild, presumably they are extinct. Thus, *F. hastatus* and *F. fusiforma* were described based on herbarium specimens currently keep only at the National Herbarium of the Netherlands at Leiden. Only three species were found both in eastern and western New Guinea namely *F. funicularis*, *F. cryptocarpa*, and *F. magnoareola*.

Most members of the imbricate leaves group

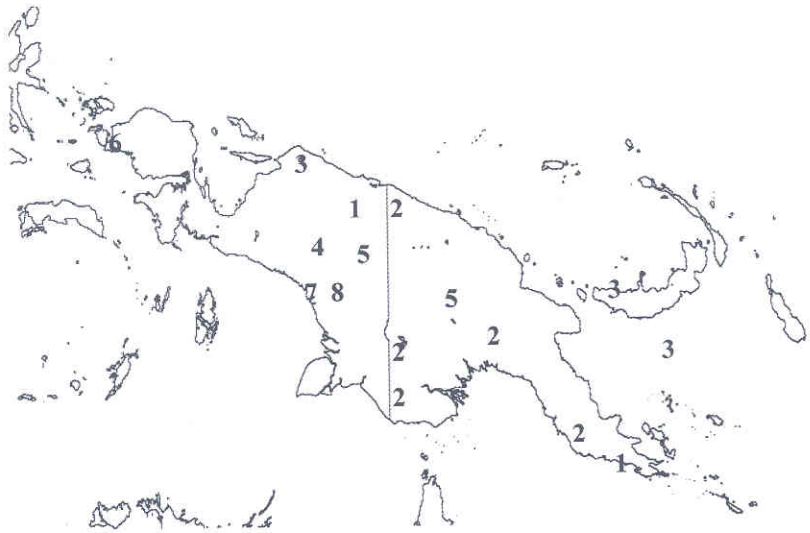

Figure 1. Distribution map of Grass Like Group of *Freycinetia* 1. *F. angusta,* 2. *F. angustissima,* 3. *F. brachyclada,* 4. *F. linearis,* 5. *F. pauciberria,* 6. *F. polyclada,* 7. *F. pseudoangustisimma,* 8. *F. stenophylla*

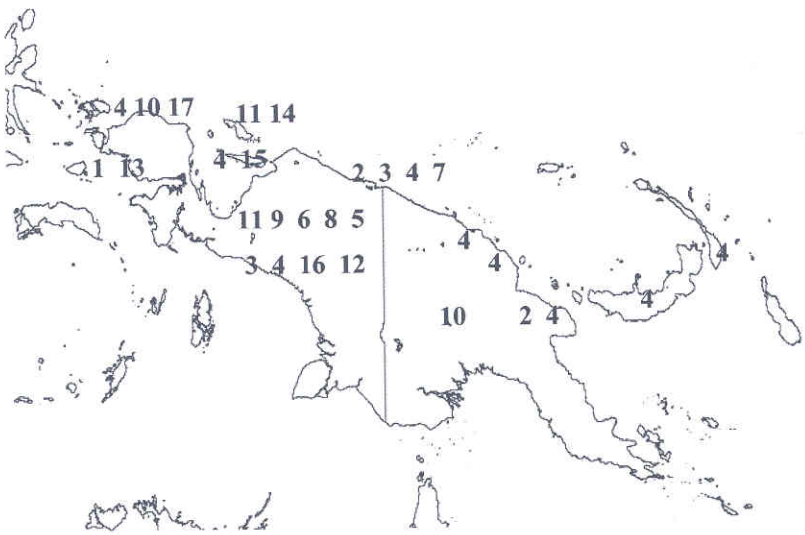

Figure 2. Distribution map of Semi Imbricate Group of *Freycinetia* 1. *F. ayawasa,* 2. *F. cryptocarpa,* 3. *F. erythospatha,* 4. *F. funicularis,* 5. *F. fusiforma* , 6. *F.gibbsiae* , 7. *F. hasteta,* 8. *F. imbristigma,* 9. *F. lateriflora,* 10. *F. magnoareola,* 11. *F. millikenus,* 12. *F. pleurantha,* 13. *F. nervoauricula* 14. *F. spiroaxilla,* 15. *F. simpliaxillata,* 16. *F. rhodospatha,* 17. *F. sterrophylla*

were found in Papua and Papua New Guinea except *F. flavicep*, *F. tenuifolia*, *F. rectangularis*, *F. albaauria*, *F. batantaensis*, *F. folitenella*, *F. gunungmejensis*, *F. broccoariola*, *F. iriana*, *F. manokwariana*, and *F. verstegii* (Figure 3). *Freycinetia albaauria*, *F. manokwariana*, and *F. gunungmejensis* occured only in Manokwari. *Freycinetia batantaensis* was endemic to Batanta Island. *Freycinetia folitenella* was restricted to Jayapura. *Freycinetia broccoariola* was confined to Merauke.

Likewise, the members of the imbricate leaves group were found both in western and Eastern New Guinea, except 11 species. As shown on Figure 4, less widely distributed Papuan species were *F. andajensis*, *F. trachypoda* *F. aculeata*, *F. brevipedicelata*, *F. clavata*, *F. circuita*, *F. concordia*, *F. frutaspiralica*, *F. mandacana*, *F.*

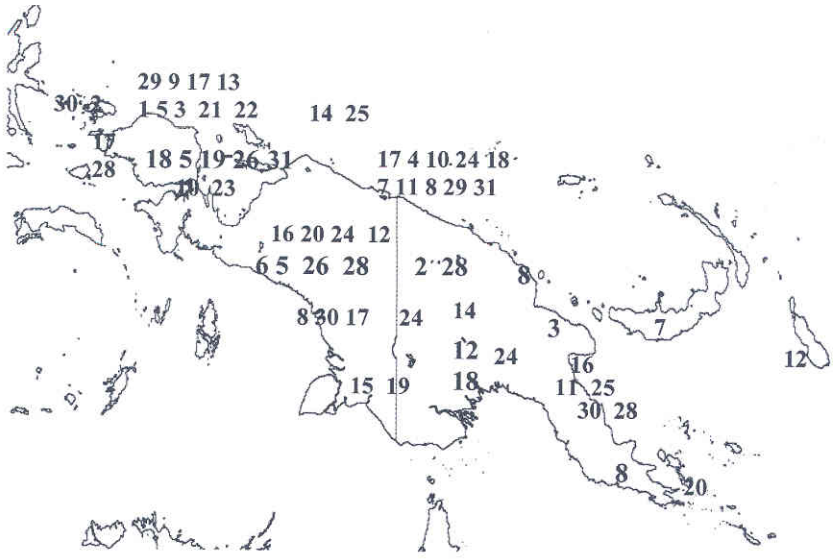

Figure 3. Distribution map of Non Imbricate Group of *Freycinetia:* 1. *F.albaauria,* 2. *F. batantaensis,* 3. *F. biroi,* 4. *F. brasii,* 5. *F. chartacea,* 6. *F. concolor,* 7. *F. desendata,* 8. *F. ellipsoidalis,* 9. *F. flaviceps,* 10. *F. folitenela,* 11. *F. forbesii,* 12. *F. frutasolla,* 13. *F. gunungmejensis,* 14. *F. hagenicola,* 15. *F. broccoareola,* 16. *F. inermis,* 17. *F. iriana,* 18. *F. lalokiensis,* 19. *F. lagenicarpa,* 20. *F. lenifolia,* 21. *F. linearifolia,* 22. *F. marantifolia,* 23. *F. manokwariana,* 24. *F. obtusiacuminata,* 25. *F. oblanceolata,* 26. *F. oreophila,* 27. *F. rectangularis, 28. F. scandens,* 29. *F. tenuifolia,* 30. *F. tenuis,* 31. *F. versteegii*

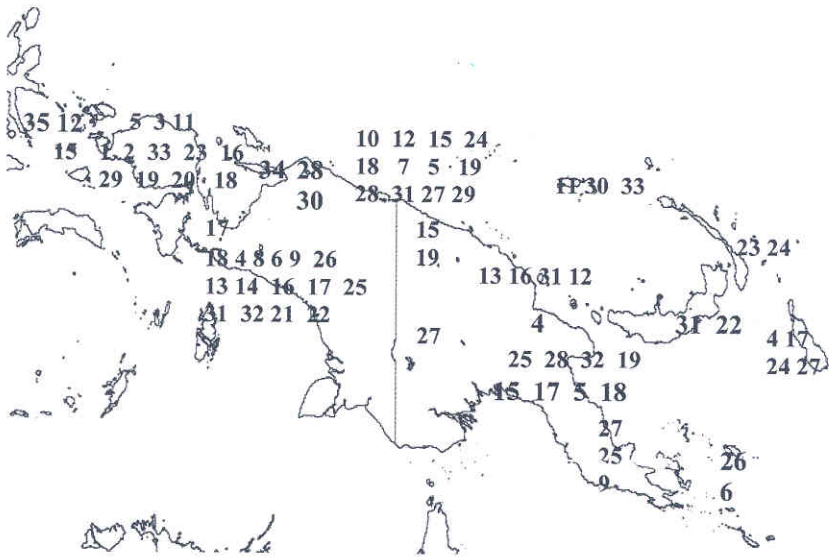

Figure 4. Distribution map of Imbricate *Freycinetia:* 1. *F. aculeatus, 2. F. andajensis,* 3. *F. arfakia,* 4. *F. archboldiana,* 5. *F. aurihasteta,* 6. *F. bicolor,* 7. *F. brevipedicelata, 8. F. clavata,* 9. *F. circuita,* 10. *F. concordia, 11. F. formosula, 12 . F. Fibrosa,* 13. *F. frutaspiralica, 14. F. frutonumerata,* 15. *F. impundens,* 16. *F. klossii, 17. F. lacinulata,* 18. *F. macrostachya,* 19. *F. marginata,* 20. *F. mandacana,* 21. *F. megaauriculata;* 22. *F. palida, 23. F. plana, 24 . F. percostata,* 25. *F. pseudoinsignis,* 26. *F. rosellana,* 27. *F. solomonensis,* 28. *F. stigmabeliata, 29. F. trachypoda,* 30. *F. tessellata,* 31. *F. undulate,* 32. *F. ultrapedicelata,* 33. *F. whitmorei,* 34. *F. yapenina,* 35. *F. exelca.*

megaauriculata, *F. stigmabeliata*, and *F. yapenina*. *Freycinetia aculeata* and *F. mandacana* were found only in Manokwari. *Freycinetia brevipedicelata, F. circuita*, and *F. concordia* were collected only in Jayapura. *Freycinetia frutaspiralica*, *F. clavata* and *F. megaauriculata* occurred only in Timika. *Freycinetia yapenina* has been reported only from the Yapen Island. *Freycinetia arfakiana* has been recorded only in Manokwari and it has never been recollected from the wild, thus to date it has been known only from the type speciment. *Freycinetia andajensis* was extremely rare.

Table 2. Species distribution of *Freycinetia* in Indonesian New Guinea according to the three different location: North, Central Mountains and South of the Indonesian New Guinea (+ = present; - = absent).

No	Species	Distribution		
		North	Central Mountains	South
	GRASS LIKE GROUP			
1.	*F. angusta*	+	+	+
2.	*F. angustissima*	+	+	+
3.	*F. brachyclada*	+	-	-
4.	*F. linearis*	-	+	-
5.	*F. pauciberria*	-	+	-
6.	*F. polyclada*	+	-	-
7.	*F. pseudoangustisimma*	-	+	-
8.	*F. stenophylla*	-	-	+
	SEMI IMBRICATE			
9.	*F. ayawasa*	+	-	-
10.	*F. cryptocarpa*	+	-	-
11.	*F. erythospatha*	+	+	-
12.	*F. funicularis*	+	+	+
13.	*F. fusiforma*	-	+	-
14.	*F. gibbsiae*	-	+	-
15.	*F. hasteta*	+	-	-
16.	*F. imbristigma*	-	+	-
17.	*F. lateriflora*	-	+	-
18.	*F. magnoareola*	+	-	-
19.	*F. millikenus*	-	+	-
20.	*F. pleurantha*	-	+	-
21.	*F. nervoauricula*	+	-	-
22.	*F. spiroaxilla*	+	-	-
23.	*F. simpliaxillata*	+	-	-
24.	*F. rhodospatha*	-	+	-
25.	*F. sterrophylla*	+	+	+
	NON-IMBRICATE			
26.	*F. albaauria*	+	-	-
27.	*F. batantaensis*	+	-	-
28.	*F. biroi*	+	-	-
29.	*F. broccoareola*	-	-	+
30.	*F. brasii*	+	-	-
31.	*F. chartacea*	+	-	-
32.	*F. concolor*	+	-	-
33	*F. desendata*	+	-	-
34	*F. ellipsoidalis*	+	+	+
35	*F. flaviceps*	+	-	-
36	*F. folitenela*	+	-	-
37	*F. forbesii*	-	-	+
38	*F. frutasolla*	-	-	+
39	*F. gunungmejensis*	+	-	-
40	*F. hagenicola*	+	-	-
41	*F. inermis*	-	+	+
42	*F. iriana*	+	-	+
43	*F. lalokiensis*	+	+	-

No	Species	Distribution		
		North	Central Mountains	South
44	*F. lagenicarpa*	-	+	-
45	*F. lenifolia*	-	-	+
46	*F. linearifolia*	+	+	-
47	*F. marantifolia*	+	-	-
48	*F. manokwariana*	+	-	-
49	*F. obtusiacuminata*	+	+	+
50	*F. oblanceolata*	+	-	-
51	*F. oreophila*	-	-	+
52	*F. rectangularis*	+	-	+
53	*F. scandens*	+	+	+
54	*F. tenuifolia*	-	+	-
55	*F. tenuis*	+	-	+
56.	*F. versteegii*	+	-	-
	IMBRICATE GROUP			
57.	*F. aculeata*	+	-	-
58.	*F. andajensis*	+	-	-
59.	*F. arfakiana*	+	-	-
60.	*F. archboldiana*	-	+	-
61.	*F. aurihasteta*	+	-	-
62.	*F. bicolor*	+	-	-
63.	*F. brevipedicelata*	+	-	-
64.	*F. clavata*	-	+	-
65.	*F. circuita*	-	+	-
66.	*F. concordia*	+	-	-
67.	*F. excelsa*	+	+	-
68.	*F. formosula*	+	-	-
69.	*F. fibrosa*	-	-	+
70.	*F. frutaspiralica*	-	-	+
71.	*F. frutonumerata*	-	-	+
72.	*F. impundens*	+	-	-
73.	*F. klosii*	+	-	+
74.	*F. lacinulata*	-	-	+
75.	*F. macrostachya*	+	+	+
76.	*F. marginata*	+	+	+
77.	*F . mandacana*	+	-	-
78.	*F. megaauriculata*	-	+	+
79.	*F. palida*	-	-	+
80.	*F. plana*	+	-	-
81.	*F. percostata*	+	-	-
82.	*F. pseudoinsignis*	-	+	+
83.	*F. rosellana*	+	-	-
84.	*F. solomonensis*	+	-	-
85.	*F. stigmabeliata*	+	-	-
86.	*F. trachypoda*	+	-	-
87.	*F. tessellata*	+	-	-
88.	*F. undulata*	+	-	-
89.	*F . ultrapedicelata*	-	-	+
90.	*F. whitmorei*	+	+	-
91.	*F. yapenina*	+	-	-

In the present study the northern and southern parts of Papua is delimited by the central mountains range extending, from Sorong at the Bird's Head to Moresbe in Papua New Guinea. The northern and southern parts of Papua contain different species. A total of 38 species occurred strictly in the northern part of Papua, namely *F. polyclada* and *F. brachyclada* (grass like group); *F. ayawasa, F. criptocarpa, F. hasteta, F. magnoareola, F. nervoaur icula, F. spiroaxilla* and *F. simliaxillata* (semi imbricate group); *F. albaauria, F. batantaensis, F. desendata, F. flaviceps, F. folitenela, F. gunungmejensis, F. hagenicola, F. marantifolia, F. oblanceolata* and *F. verstegii* (non imbricate group); *F. aculeata, F. andajensis*, *F. arfakiana*, *F. aurihasteta*, *F.*

bicolor, F. concordia, F. formosula, F. impundens, F. mandacana, F. plana , F. percostata, F. rosellana, F. solomonensis, F. stigmabeliata, F. trachypoda, F. tessellata, F. undulata and *F. yapenina* (imbricate group) .

On the contrary about 12 species were confined to the southern part namely *F. stenophylla* (grass like group); *F. forbesii, F. frutasolla, F. broccoareola, F. lenifolia* , and *F. oreophila* (non imbricate group); *F. fibrosa, F. frutaspiralica, F. frutonumerata, F. lacinulata, F. palida* , and *F. ultrapedicelata.*

Furthermore the species that were restricted to the central mountain range , were mostly of the semi imbricate group namely *F. fusiforma, F. gibbsiae, F. imbristigma, F. lateriflora, F. millikenus, F. pleurantha* and *F. rhodospatha*. Other species of but not restricted to the central mountain range were *F. linearis, F. pauciberria* and *F. stenophylla* (grass like group); *F. lagenicarpa* and *F. tenuifolia* (non imbricate group); *F. archboldiana, F. clavata and F. circuita* (imbricate group).

From above account it is clear that the northern part of western New guinea contain many species of *Freycinetia*, but in the southern New Guinea the number is less. Similarly, the number of species is high in the east and decreases toward the west.

Our study show that western New Guinea shares 52 species with Papua New Guinea. We noted also that 34 species were found only in the western New Guinea and 5 species (*F. excelsa*, *F. funicularis*, *F. marginata*, *F. percostata*, and *F. scandens*) had extra New Guinean distribution. *F. scandens* is well known for being the most wide spread species in the genus; whose distribution covered the entire Malesia and Queensland in northeastern Australia. *F. funicularis* was a wide spread species occurring throughout New Guinea, but was also found in the Moluccas and Celebes. The distribution of the other three species were more restricted than the previous two in which they were found in New Guinea and northern Australia only.

The group distributions (Figure 5) indicated that the grass-like leaves group is confined to New Guinea and adjacent islands except around Sorong. The semi imbricate group has limited distribution areas, concentrating only in the mountains of the western area, except for *F. funicularis* which also extend to Moluccas and Celebes. The imbricate and non imbricate groups have even much wider distribution areas, covering not only the entire Malesian floristic region but also northern Australia and Japan.

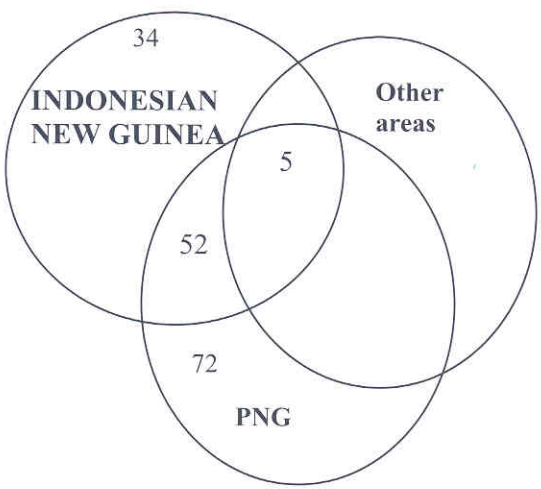

Figure 5. Distribution of New Guinean species of *Freycinetia*. PNG is the standard.

CONCLUSION

The occurrences of *Freycinetia* species in Indonesian New Guinea extends from the costal area to the montane forests zone. Almost all species prefer humid environment and found abundantly along riverbanks. Secondary forests are only inhabited by the members of imbricate group. The members of this group, however are absent at the altitudes of 1700 to 3000 m. This range of altitude is only inhabited by the members the grass -like and semi imbricate group. The grass like group, however, is absent in the costal forests which are dominated by the members of the semi and non imbricate group.

Many newly described western New Guinean

species are locally distributed. The members of the semi imbricate group are more common in western New Guinea than in Papua New Guinea. On the contrary, the members of the grass like group are more commonly found in Papua New Guinea becoming rare in most of Papua and completely absent in the Vogelkop area.

The members of the grass-like group are confined to New Guinea. Only five species are known to have extra New Guinean distributions namely *Freycinetia excelsa*, *F. funicularis*, *F. marginata*, *F. percostata*, and *F. scandens.*

Two third of the total numbers of species in New Guinea are endemic. Thus, New Guinea is regarded in the present study as both centres of diversity and area with the highest level of endemism.

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REINWARDTIA
Vol. 13. No. 2. 2010
CONTENTS
Page

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