

1 **Dry zone forests of Fiji: species composition, life history traits, and conservation**

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3 RUNNING HEAD: Dry zone forests of Fiji

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1 **Abstract** Species composition and life history traits of trees in native forests in the dry zone of
2 Fiji were investigated. Areas receiving less than 2500 mm yr⁻¹ of rain and covered with native forest
3 were identified using maps, aerial photographs, estimated climate (WorldClim) and field reconnaissance.
4 Ten forest remnants were identified and species lists and data on natural history, and disturbance were
5 compiled. Cluster analysis and DECORANA identified two principal forest types, moist forest (MF)
6 and tropical dry forest (TDF), each defined by unique climate, species composition, and tree life history
7 characteristics. TDF (reported for the first time from Fiji) has a pronounced dry season (5 months with
8 < 100mm rainfall each) and several deciduous canopy species. MF lack a pronounced dry season and
9 have few deciduous species. The amount and variability of rainfall seem to influence the type of forest
10 in a particular location and disturbance is negatively correlated with precipitation. TDF are probably
11 Fiji's most endangered ecosystems.

12

13

14 **Keywords** climate; deciduous; mesic forest; moist forest; natural history; sclerophyll; talasiga
15 grasslands; tropical dry forest

16

17 **INTRODUCTION**

18

19 Tropical forests may occur in a broad scale of climatic conditions, ranging from high to low
20 precipitation and no to strong seasonality. Many different schemes to classify these forests have been
21 proposed (Beard 1955; Webb 1959; Holdridge 1971; Gagné & Cuddihy 1990). Here we use the
22 following definitions for the different types of tropical forest. Tropical dry forest (TDF) are at least
23 partially deciduous and have an annual rainfall from 500 to 2000 mm with a dry season of several
24 months of rainfall near or below 60 mm (Mooney et al. 1998). Tropical rain forests are evergreen, have

1 few sclerophyllous leaves, and have an annual rainfall of more than 2000 mm with no dry periods
2 (more than one month with an average rainfall of less than 100 mm) (Walsh 1996). Sclerophyllous
3 leaves are tough and can resist drought and insect attack through thick cell walls and relatively low
4 nitrogen content (Eamus 1999). The term moist forest (MF, after Holdridge 1971) is used for evergreen
5 forests with a strong sclerophyllous component and an annual rainfall of more than 1700 mm with a
6 dry period of up to 4 months and, hence, corresponding to the evergreen seasonal rain forest of Walsh
7 (1996).

8
9 Tropical dry forests (TDF) have a more or less closed and deciduous canopy that is lower and less
10 complex than in lowland tropical rainforests. Species diversity and biomass are also lower and lianas
11 may be common (Murphy & Lugo 1986; Martínez-Yrizar 1998; Menaut et al. 1998). Clumping of tree
12 species is a common phenomenon (Hubbell 1979), as has been found in some rainforest trees (Chave et
13 al. 2003; Hardy & Sonke 2004; Svenning et al. 2004).

14
15 On a global scale, TDF is probably the most endangered tropical forest type but has relatively little
16 protection. This threat is the result of centuries of logging, burning, farming, and grazing. Currently
17 only small fragments of dry forests remain and the existence of pristine patches is very unlikely (Janzen
18 1988; Ler dau et al. 1991; Trejo & Dirzo 2000). The situation is similar in the insular Pacific where
19 protection is generally inadequate or non-existent (Gillespie & Jaffré 2003) and dry zone ecosystems
20 are extremely vulnerable (Rolett & Diamond 2004).

21
22 The Fiji archipelago includes about 500 named islands, between 177°W to 177°E and 15° to 22°S in
23 the subtropical Pacific Ocean. The two largest islands are relatively high (to 1323 m) and large (10388
24 km²) (Fig. 1) and intercept the prevailing south-east tradewinds, creating rain shadows on the leeward
25 side. As a result, a great variety of rainfall regimes exist in Fiji, ranging from about 1800 mm in the

1 coastal regions of the western sides to 3000 mm and more on the south-eastern side (Mataki et al.
2 2006). The wet, windward, south-eastern sides are covered with rainforest, while most of the dry,
3 leeward, western sites are presently covered with grasslands, called “talasiga” (“sunburnt land”) in the
4 native vernacular, and small forest remnants (Parham 1972; Mueller-Dombois & Fosberg 1998). On
5 the drier, leeward side droughts regularly occur. Mean annual rainfall is lowest in the coastal regions
6 and increases inland (Mataki et al. 2006).

7
8 Palynological evidence suggests that, before the arrival of people some 3000 years ago, much of the
9 present day talasiga grasslands on Fiji’s largest island, Viti Levu, was covered with forests. Herbaceous
10 vegetation composed of grasses, sedges, and ferns may, however, have occurred in some of the driest
11 places, especially during glacial periods (Southern 1986). The present persistence of fire-resistant
12 species, such as *Cycas seemannii*, in some talasiga grasslands attests to the original woody vegetation
13 (Keppel 2002).

14
15 Rain forest and “dry forest” have been reported to occur in Fiji’s lowlands (Mueller-Dombois &
16 Fosberg 1998). However, the reported “dry forest” is evergreen and dominated by the conifer
17 *Dacrydium nidulum* and the angiosperm *Fagraea gracilepes*, with *Gymnostoma vitiensis*, *Myristica*
18 *castaneifolia*, *Dysoxylum richii*, *Parinari insularum*, *Intsia bijuga*, *Casuarina equisetifolia*, species of
19 *Syzygium*, and the conifer *Podocarpus neriifolius* being other locally common species (Twyford et al.
20 1965; Berry & Howard 1973). As suggested by Mueller-Dombois & Fosberg (1998), this is better
21 referred to as MF. No other native forest type has been reported from the lowland of the leeward site of
22 Fiji.

23
24 In this paper we report the existence of true TDF in Fiji. We then compare it with MF to 1) identify the
25 different species and families that are characteristic of each forest type; 2) delimit the climatic

1 boundaries of both forest types, 3) determine differences in life history traits of tree species in these
2 forests, and 4) assess the anthropogenic impact on TDF and MF.

3

4

5 **METHODS**

6

7 **Climate**

8 The climates of the Suva (18.09° S, 178.27° E) and Nadi (17.75° S, 177.45° E; see Fig. 1) weather
9 stations reflect the climates of rainforests and TDF, with Suva in the wet, south-eastern rain forest zone
10 and Nadi in the drier, western dry forest zone. The climatological observations of these two stations
11 between 1961 and 2003 were detailed by Mataki et al. (2006). While the annual average surface
12 temperature is similar at both stations, Nadi receives considerably less average annual total rainfall
13 (1810 mm) than Suva (3040 mm). In addition, Nadi has a distinct dry season of five consecutive
14 months (May to September), each with less than 100 mm rainfall. Mataki et al. (2006) also pointed out
15 that moderate to strong ENSO events lead to more severe drought conditions.

16

17 Unfortunately, such a long and consistent record does not exist for Fiji's other weather stations. The
18 station at Udu Point (16.13° S, 179.98° E; see Fig. 1), Vanua Levu, is located in the MF zone. It has
19 been recording climatological observations since 1973, but has few years where rainfall records exist
20 for every day. However, the average annual rainfall is about 2400 mm and the average temperature is
21 about 26°C (Keppel et al. 2006).

22

23 **Selection of sample sites**

24 To identify forest remnants in Fiji's dry zone, we used climatic information (Fitzpatrick et al. 1966;
25 Krishna 1980) to find zones with an average annual rainfall of less than 2500 mm, which should

1 include TDF and MF. We then used aerial photographs (Fiji Lands Department survey in 1996) to
2 identify the areas that still have forest cover (rather than talasiga grassland), and eliminated areas that
3 were composed of commercial plantations of *Pinus carribae* using the maps of Chandra & Mason
4 (1998). Having identified places with potentially native vegetation, we visited 21 potential sites and
5 eliminated those that were almost completely covered with the invasive legumes *Samanea saman*,
6 *Albizia lebbek*, and *Leucaena leucocephala*. We found 12 locations that still had several native
7 species, but two of these, Mali Island and Yanuca Island, had only tiny fragments (less than 50 m²) of
8 native trees remaining and were excluded from subsequent analyses. This left us with 10 study sites
9 (Fig. 1), which showed a diversity of rainfall regimes (Table 1). The average rainfall for each study site
10 was estimated using the data available on WorldClim (2006). Unfortunately it is based on an algorithm
11 with high uncertainties on isolated islands, such as those of the Fiji group (Hijmans et al. 2005).
12 However, it provides the only available information about the climate of the study sites.

13

14 **Data collection**

15 Between May 2002 and July 2004 we prepared a list of all species encountered in each location by
16 walking through the forest for at least 10 person hours. The surveyors (GK & MT) were the same for
17 all localities to ensure comparability of results. We collected specimens of all species that we were not
18 able to identify in the field for identification at the South Pacific Regional Herbarium (SUVA). For all
19 species, forest type (MF or TDF) and life form (climber, epiphyte, herb, shrub/small tree, tree fern, and
20 tree) were recorded (Appendix 1). For a subset of the data, which included only indigenous canopy and
21 subcanopy tree species associated with mature-stage forests (Appendix 2), we determined whether or
22 not a species was annually deciduous (pers. obs. in different TDF during the dry season) or
23 sclerophyllous. Published literature was used to assign floral sexuality (monoecious, dioecious or
24 hermaphrodite; Smith 1979, 1981, 1985, 1988, 1991, 1996) and likely dispersal agents (Guppy 1906;
25 Leenhouts 1956; Carlquist 1974; Wodzicki & Felten 1975; Lock & Marshall 1976; Fujita & Tuttle

1 1991; Mishra & Gautam 1992; Hamann et al. 1999; Setoguchi et al. 1999; Prider & Christophel 2000;
2 Ghazanfar et al. 2001; Webb & Peart 2001; Hodgskison et al. 2003; González-Astorga & Castillo-
3 Campos 2004; McConkey et al. 2004; Thapliyal & Phartyal 2005) for these tree species.

4
5 Species were classified as deciduous or sclerophyllous using broad concepts. Deciduous species
6 included “true” deciduous species that loose their leaves at regular seasonal intervals and drought-
7 deciduous species, which only loose their leaves during prolonged dry periods. We did not distinguish
8 between those and other types of deciduousness (Eamus 1999), because long-term phonological data
9 does not exist for most species. Sclerophylly lacks a precise definition, although sclerophyllous leaves
10 are easily recognised by their small size and relatively thick leaves. These traits are associated with
11 thick cuticles, abundant sclerification, low concentration of nutrients, and high longevity (Turner 1994;
12 Vendramini et al. 2002). Here we considered leaves or leaflets as sclerophyllous if they were less than
13 about 7 cm long and more than about 0.5 mm thick.

14
15 We quantified disturbance by developing an index of anthropogenic disturbance similar to that of
16 Gillespie et al. (2000) to determine the most affected sites. Grazing was ranked as (1) sites with no
17 evidence of goat grazing, (2) sites that previously had goat populations but no recent grazing, (3) sites
18 with frequent and current goat browsing, and (4) sites with extremely high goat browsing that has
19 eliminated all or most of the native understorey. Fire was ranked as (1) sites with no signs or reports of
20 recent fires, (2) sites with recent fires, (3) sites with frequent and recent fires. The effect of invasive
21 species was ranked as (1) sites with no or few invasive species with negligible ecological effect, (2)
22 sites with moderate effect by invasive species, and (3) sites that are dominated by invasive species. The
23 index of anthropogenic disturbance is the sum of all ranks for each site.

24

1 **Data analysis**

2 We excluded species that were sometimes found at the coastal fringes of the forest systems studied but
3 are generally associated with coastal locations (*Abrus prectorius*, *Colubrina asiatica*, *Lumnitzera*
4 *littorea*, *Pandanus tectorius*, *Premna serratifolia*, *Terminalia catappa*, *Terminalia littoralis*, *Thespesia*
5 *populnea*) and species that are non-native and invasive (e.g., *Albizia lebbbeck*, *Leucaena leucocephala*,
6 *Rivina humilis*, *Samanea saman*) or generally restricted to disturbed or regenerating sites sites (e.g.
7 *Commersonia bartramia*, *Culculta straminea*, *Merremia peltata*, *Nephrolepis hirsutula*, *Pureria*
8 *lobata*, *Sphaerostephanos invisus*) from our analysis. This was done to reduce noise by species not
9 genuinely associated with particular vegetation types. Some of the sites had experienced goat grazing
10 for several years, which can be detrimental to the vegetation of island forests (Spatz & Mueller-
11 Dombois 1973; Scowcroft & Hobdy 1987). The island of Monuriki was extremely affected, having
12 almost been entirely denuded of its undergrowth and, as a result, is experiencing severe erosion. To
13 account for this effect, we removed from the analysis all climbers, herbs, shrubs, and small trees (those
14 that do not normally exceed a dbh 5 cm), which are the most vulnerable to grazing (Daubenmire 1972;
15 Gillespie et al. 2000). Vegetation data (species presence/absence; Appendix 2) was analysed using
16 agglomerative clustering with average linkage based on the Jaccard coefficient of the Community
17 Analysis Package (CAP; Henderson & Seaby 2002) to determine the presence of different native forest
18 types. Two distinct clusters, corresponding to MF and TDF, were produced.

19

20 We tested the significance of the two clusters (forest types) by analysis of similarity (ANOSIM) using
21 PRIMER 5 (Clarke & Gorley 2001). One group was three MF sites, the other was seven TDF sites. The
22 hypothesis that there is no difference between MF and TDF was tested by creating a square-root
23 transformed Bray-Curtis similarity matrix and doing an ANOSIM between the samples using all
24 possible (120) permutations. We then tested which species were associated with TDF and MF using

1 Detrended Correspondence Analysis (DCA) for correlation between the sites and plant species (CAP;
2 Henderson & Seaby 2002).

3

4

5 **RESULTS**

6

7 **Vegetation**

8 Two distinct forest types with low similarity are found in Fiji's dry zone (Fig. 2). One comprises all the
9 sites with an estimated annual precipitation less than 2400 mm, has many tree species that are
10 deciduous, such as *Garuga floribunda*, *Gyrocarpus americanus*, *Koelreuteria elegans*, and *Pongamia*
11 *pinnata* (Appendix 2), and therefore is best referred to as tropical dry forest (TDF). The other is
12 dominated by *Gymnostoma vitiense*, *Dacrydium nidulum*, *Fagraea gracilipes*, and *Myristica*
13 *gillespieana*, has mostly evergreen trees (several of which are sclerophyllous), is composed of sites
14 with higher rainfall, and is best classified as moist forest (MF). Gau (estimated total annual rainfall =
15 2439 mm yr⁻¹) is an exception to this pattern, clustering with TDF sites. ANOSIM showed that the two
16 vegetation types are significantly different (Global *R*: 0.984, level of significance: 0.8%). Within the
17 MF, Nautuutu is very different from Lekutu and Nabourewa, the former having several taxa and
18 physiognomic features characteristic of tropical rain forest, the highest rainfall (2458 mm), and has
19 been described as a transitional forest between MF and rainforests (Keppel et al. 2006).

20

21 Several tree species, including *Racosperma richii*, *Buchanania richii*, *Dacrydium nidulum*,
22 *Decaspermum vitiense*, *Fagraea gracilipes*, *Gymnostoma vitiense*, *Palaquium fidjiense*, *Rapanea*
23 *myrtifolia*, *Sarcomelicope petiolaris* were clearly associated with MF in the DECORANA plot (Fig. 3).
24 This also included several tree species that are also common in lowland rain forests, such as *Amaroria*
25 *soulemanooides*, *Dillenia biflora*, *Garcinia pseudoguttifera*, *Myristica* spp., *Parinari insularum*, and

1 *Syzygium fijiense* (cf. Keppel et al. 2005). Trees such as *Antirhea inconspicua*, *Arytera brackendridgei*,
2 *Cynometra falcata*, *Diospyros elliptica*, *Diospyros phlebodes*, *Drypetes vitiensis*, *Excoecaria*
3 *acuminata*, *Gyrocarpus americanus*, *Kingidendron platycarpum*, *Mallotus tiliifolius*, *Pouteria grayana*
4 and *Premna protusa*, show strong affinity to TDF. Some species generally considered to be coastal,
5 such as *Cordia subcordata*, *Erythrina variegata* and *Millettia pinnata* (cf. Ghazanfar et al. 2001), were
6 also part of this group. Species associated with both forest types, MF and TDF, were *Cerbera manghas*,
7 *Cynometra insularis*, *Dysoxylum richii*, *Intsia bijuga*, *Maniltoa* spp., *Pittosporum arborescens*,
8 *Pleiogynium timoriense* and *Vavaea amicorum*.

10 **Flora of dry zone forests**

11 A total of 310 native (and 14 common invasive) species were recorded in forests of the dry zone (Table
12 2). Fern and fern allies represent 12% (19 families, 31 genera, 38 species), gymnosperms 2% (4
13 families, 5 genera, 5 species), dicots 73% (62 families, 160 genera, 227 species), and monocots 13%
14 (12 families, 32 genera, 40 species) of the native flora.

15
16 Plants that are native to Fiji's dry zone represent 96% of the flora. Of this 33% (102 species) are
17 endemic to Fiji (Table 2). MF is richer in species than TDF and has greater percentage endemism (38%
18 cf. 18% of indigenous species). Invasive and/or naturalised taxa comprise 4% of species encountered
19 within the forest and include *Mikania micrantha*, *Spathodea campanulata*, *Coccinea grandis*, *Clidemia*
20 *hirta*, *Albizia labbeck*, *Samanea saman*, *Leucaena leucocephala*, *Passiflora foetida*, and *Lantana*
21 *camara*.

22
23 Overall, about 45% of the indigenous species were trees, 19% shrubs and small trees, 14% herbs, 13%
24 climbers, 7% epiphytes and less than 1% (2 species) tree ferns, the latter being restricted to MF (Table
25 2). Climbing plants were more diverse in TDF, comprising almost 21% of all indigenous species (cf.

1 11% in MF). Epiphytes and herbaceous plants were more diverse in MF, comprising 9% (cf. 3% in
2 TDF) and 16% (cf. 9% in TDF), respectively.

3
4 Rubiaceae is the most diverse family with 15 genera and 26 species of the native flora, followed by
5 Euphorbiaceae with 14 genera and 24 species and Orchidaceae with 10 genera and 14 species.
6 Legumes (Caesalpinaceae, Fabaceae, and Mimosaceae) account for 14 native genera and 16 species.
7 These four groups comprise about 26% of Fiji's indigenous dry zone forest flora. *Ficus* (Moraceae) is
8 the largest genus comprising 8 species of the native flora, followed by *Syzygium* (7 spp.; Myrtaceae),
9 *Psychotria* (6 spp.; Rubiaceae), *Glochidion* (5 species; Euphorbiaceae), and *Garcinia* (4 spp.;
10 Clusiaceae) and *Maesa* (4 spp., Myrsinaceae). These six genera contribute about 11% of the indigenous
11 dry zone flora.

12
13 The diversity within plant families differed greatly between forest types (Table 3). Orchids
14 (Orchidaceae), sedges (Cyperaceae), Myrtaceae, Sapotaceae, grasses (Poaceae), and the Sapotaceae are
15 the most diverse families in MF, while legumes (Caesalpinaceae, Fabaceae, Mimosaceae),
16 Flacourtiaceae, and Sapindaceae were most diverse in TDF. In addition, several families that are
17 usually associated with rain forests and are found in MF were absent from TDF: tree ferns
18 (Cyatheaaceae), filmy ferns (Hymenophyllaceae), gingers (Alpiniaceae), Elaeocarpaceae,
19 Melastomataceae, and Urticaceae.

20

21 **Life history characteristics of trees**

22 Sclerophyllous species make up almost 30% of species in MF and TDF (Table 4). A fifth of the trees in
23 TDF are deciduous, while few trees are deciduous in MF. If only canopy species are considered, more
24 than 30% of the species are deciduous. TDF also differs by having a lower percentage of species
25 dispersed by vertebrates (70% cf. 82%). Both forest types, however, are similar with regard to floral

1 sexuality, having a similar ratio of hermaphroditic:monoecious:dioecious and more than 30% of the
2 species being monoecious.

3

4 **Disturbance**

5 Almost all the TDF sites have higher disturbance indices than the MF sites studied (Table 1). There is a
6 strong negative correlation between average rainfall and the disturbance index ($r = 0.87$). Six of the
7 seven TDF sites showed signs of recent fires, and recent grazing had affected five of those. The
8 Monuriki and Navo forests suffered from extensive goat grazing that prevent regeneration of native
9 species and the Navo and Vatia forests were dominated by invasive species in most locations.

10

11

12 **DISCUSSION**

13

14 Fiji's TDF and MF are two fundamentally different forest types that differ in species composition and
15 life history traits. Total annual rainfall and seasonality of rainfall seem to be major factors determining
16 the type of forest present and the degree of deciduousness, but existing climate data are not sufficiently
17 precise to determine the exact effect of climate. Generally, areas with an average total precipitation of
18 2400 mm or less and several successive months with less than 100 mm of rain between May and
19 September support TDF (Fig. 2). This is considerably more than the maximum of 2000 mm proposed
20 elsewhere (Holdridge 1971; Mooney et al. 1998). Although the WorldClim values probably
21 overestimate rainfall because of high uncertainties in the underlying algorithm on isolated Pacific
22 Islands (Hijmans et al. 2005), rainfall is likely to be higher than 2000 mm. This could be caused by
23 occasional extreme weather events associated with cyclonic systems pushing the annual rainfall
24 average up.

25

1 Macuata (2337 mm), Naicobocobo (2362 mm), and, especially, Gau (2439 mm) have relatively high
2 rainfall but cluster with TDF sites. These sites are on small offshore islands or peninsulas on the
3 leeward side of high and relatively large islands. The strong rainshadow effect on the leeward site is
4 probably not well estimated by World Clim, as the numerous leafless deciduous trees during the dry
5 season attest to the water stress trees experience (Borchert et al. 2002). The frequent winds in coastal
6 locations may exert a “drying effect”, reducing the soil moisture. In addition, soil drainage needs to be
7 considered, as well-drained soils may support “low-rainfall” vegetation in areas of high rainfall. In
8 addition type, depth and water-holding capacities of the soils potentially play a major role determining
9 the type of forest present at a particular rainfall regime, although TDF sites generally had shallow soils
10 (few cm deep and rock outcrops present). Unfortunately, information on the above is not readily
11 available and our study did not investigate these aspects. Setting up rainfall gauges at different TDF
12 sites and recording basic soil properties should be considered a priority and is the only way to
13 determine actual water stress.

14
15 The two forest types differ in structure, composition and life history. While the canopy of MF is to 30m
16 tall and closed, that of TDF usually doesn't exceed 20cm and is more open, with several of the tallest
17 trees being deciduous. Overall MF are more diverse and have much higher endemism. Lianas,
18 however, are diverse and common in TDF, a common phenomenon (Lott et al. 1987, Sussman &
19 Rakotozafy 1994). Probably because of the prolonged droughts in TDF, epiphytes are uncommon and
20 tree ferns and other rain forest taxa are absent (Table 2). These trends are reflected in the diversity
21 within families. The mostly epiphytic Orchidaceae and the rain forest families Myrtaceae and
22 Clusiaceae are more diverse in MF, while the Rhamnaceae and Passifloraceae (which have many
23 species of climbers) are more diverse in TDF (Table 3). Nitrogen-fixing legumes are also more diverse
24 in TDF than in MF, possibly because of the shallower soils.

25

1 The clear compositional distinction between the two forest types is reflected in the DCA plot (Fig. 3),
2 with TDF & MF sites forming two distinct clusters. Several species are restricted to each forest type and
3 some are shared. Other than this, the DCA plot is difficult to interpret. While the first axis is obviously
4 related to precipitation to some degree, factors effecting the second axis are less clear. The wedge-
5 shaped distribution of the species and study sites on the DCA plot is interesting but possibly simply
6 caused by the fact that the MF cluster consists of only three sites, compared to the seven TDF sites.

7
8 In Fiji, MF seems to be associated with climates with moderate annual rainfall (2400 mm or more)
9 lacking a distinctive dry season, although monthly rainfall may be less than 100 mm per month
10 between June and August. MF appears to be very heterogenous with species composition varying
11 considerably, which has been noted by Berry & Howard (1973) and Keppel et al. (2006). This could be
12 caused by variation in climatic and edaphic features. The presence of tree ferns, filmy ferns, ginger,
13 Elaeocarpaceae, and Melastomataceae and the relatively high diversity of orchids are elements
14 normally associated with tropical rain forest and attest to the moist conditions of this forest type. The
15 site with the highest rainfall (Naiutuutu; 2458 mm) is most similar to rain forest. Also, the percentage
16 of vertebrate-dispersed species (82%) is similar to that of lowland tropical rainforest (cf. 85% in
17 Bornean rainforest; Webb & Peart 2001).

18
19 TDF is here reported for the first time in Fiji. It is characterized by a distinct species assemblage and
20 more than 20% of its tree species being deciduous. While some species loose all their leaves on a
21 yearly basis (deciduous), others only lose their leaves during extremely dry spells (drought-deciduous).
22 The moderate number of deciduous species and comparatively high annual rainfall, place Fiji's TDF as
23 semi-deciduous TDF on the spectrum from evergreen MF to deciduous TDF, in which more than half
24 the canopy species are deciduous (Bullock et al. 1998). Although MF and TDF differ considerably in
25 the composition of taxa, natural history, and climate, they should not be considered clearly delimited

1 forest types but rather as extremes of varying degrees deciduousness and other features (Lerdau et al.
2 1991; Medina 1998). Unfortunately, zones where the two forest types intergrade have been largely
3 destroyed. Only at Naicobocobo did we observe such a transition, which was an abrupt change from
4 TDF to MF dominated by *Gymnostoma vitiense*.

5
6 In the Pacific region, TDF has been recorded from Australia (Fensham 1995), New Guinea (Paijmans
7 1976, p.66; Heylingers 1982), the Solomon Islands (Whitmore 1969), Vanuatu (Mueller-Dombois &
8 Fosberg 1998), New Caledonia (Gillespie & Jaffré 2003), and Hawaii (Hatheway 1952). Except for
9 Hawaii, they seem to share the presence of *Gyrocarpus americanus*, *Garuga floribunda*, and *Intsia*
10 *bijuga*. The percentage of genera shared with Fiji is 21% for Hawaii, 25% for New Caledonia, and 33%
11 for Australia. High similarity with Australia and relative low endemism in Fiji (compared Fijian MF
12 and rain forest; Keppel et al. 2003, 2006) suggest that plant species of Pacific TDF are good dispersers.

13
14 High similarity with Australia may also help to explain the high percentage (30-35%) of monoecious
15 tree species in Fijian dry zone vegetation, which is higher than that reported in other tropical vegetation
16 (5-20%; Gross 2005; Machado et al. 2006). Only in Australia have similar percentages of monoecy
17 (20-35%) been reported and New Guinea is suggested to have similar levels of monoecy (Gross 2006).
18 As New Guinea is believed to be the major source area for the Melanesian flora, close phylogeographic
19 relationships could be the reason for the high percentage of monoecious species in Fiji.

20
21 Most TDFs surveyed were highly disturbed (Table 1), and the strong negative correlation between
22 disturbance and rainfall ($r = 0.87$) in this study suggests that the driest forests are likely to be most
23 vulnerable to disturbance. This corresponds well with findings that dry zones on Pacific islands are
24 especially vulnerable to anthropogenic effects (Rolett & Diamond 2004). It can also explain the failure
25 by earlier botanists and naturalists (Mead 1928; Smith 1951; Berry & Howard 1973) to discover TDF.

1 An increase in the frequency of fire since the arrival of people some 3000 years ago (Austin 1999)
2 probably decimated TDF so that it was already rare in the early 20th century. The global apathy
3 towards TDF that was prevalent until recently may have also contributed to Fijian TDF being
4 overlooked.

5
6 Currently only small fragments of TDF remain in Fiji, with only that on Yadua Taba having some
7 protection. This makes TDF one of (if not the) most endangered ecosystems in Fiji. It is essential that
8 the dry forests on Yadua Taba and Macuata islands be treated as conservation priorities, not only
9 because they harbour the last viable populations of the endemic crested iguana (*Brachylophus*
10 *vitiensis*), but also because of relatively good and extensive TDF stands. In addition, both forests are
11 located on islands, which eases their protection from fires and other human effects. The TDF of Vatia
12 and Naicobocobo are the biggest remaining fragments of TDF on Fiji's two biggest islands and as such
13 should be protected and rehabilitated where necessary. The latter may be the only location in Fiji,
14 where the transition between TDF and MF can still be observed. Extensive stands of MF, though
15 threatened by logging, remain only on Vanua Levu, and concrete protective measures are urgently
16 needed (Keppel et al. 2006). Small remnants may also still be found on Viti Levu, Kadavu and other
17 islands (Berry & Howard 1973). A corollary of the importance of climate (especially rainfall regime) is
18 that climate change will change the boundaries of forest types, as has occurred in the past (Southern
19 1986; Stevenson & Hope 2005). Conservation programmes therefore need to take into account global
20 warming and its effect on local climates during reserve system design.

21
22 As TDF is here reported for the first time, the need and opportunities for further research are immense.
23 Virtually nothing is known about the ecology of this ecosystem and its resident flora and fauna, which
24 underlines that the leeward sides of high Pacific islands require immediate and thorough attention by
25 scientists and conservationists. This is underlined by the discovery of new taxa and records for Fiji

1 from the TDF within the last 10 years (Gardner 1997; this study). There is an urgent need to identify,
2 map and assess the conservation status of all remaining TDF fragments to ensure that the best
3 remaining fragments of Fiji's TDF are preserved. This needs to be coupled with a quantitative study
4 of TDF vegetation, investigation of prevalent climatic and soil conditions, and a detailed evaluation of
5 the conservation status of the rare and potentially highly endangered plant species that are endemic to
6 this forest type in Fiji, such as *Cynometra falcata* and *Guettarda wayaensis*. Finally, there is an urgent
7 need to gain an understanding about the dynamics of Fijian TDF and the influence of various
8 environmental factors have. This should facilitate predicting the response of TDF to long-term stresses,
9 which is likely scenario under climate change.

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1 **Table 1** Location, substrate, rainfall, and disturbance regimes for the 10 study sites. Study sites are sorted by disturbance index. TDF,
 2 tropical dry forest; MF, moist forest. * Data estimates obtained from the WorldClim webpage (Hijmans et al. 2005). ^ Dry months are
 3 months with less than 100 mm rainfall, the number in brackets gives the number of months with less than 120 mm of rainfall.

4

Site	Elevation (m a.s.l.)	Latitude, longitude	Substrate, topography	Mean annual rainfall (mm)*	Number of dry months per year**^	Disturbance			
						Grazing	Fire	Invasive	Index
Monuriki (TDF)	5-50	17°36'34 S, 177°02'07 W	Volcanic, steep slopes	1780	6 (6)	4	3	2	9
Navo (TDF)	5-10	18°06'40 S, 177°19'07 W	Limestone, mostly flat	2031	3 (6)	4	2	3	9
Vatia (TDF)	20-40	17°23'10 S, 177°49'14 W	Volcanic, moderate slopes	2092	3 (5)	3	3	3	9
Macuata (TDF)	5-30	17°21'14 S, 178°01'60 W	Volcanic, moderate slopes	2337	2 (3)	2	3	2	7
Yadua Taba (TDF)	5-200	16°50'06 S, 178°16'40 W	Volcanic, steep slopes	2248	2 (4)	2	2	2	6

Gau (TDF)	5-20	18°00'14 S, 179°14'47 W	Volcanic, moderate slopes	2439	0 (3)	1	2	1	4
Dogotuki (MF)	40-70	16°13'55 S, 179°46'32 W	Volcanic, mostly flat	2400	2 (3)	1	2	1	4
Naicobocobo (TDF)	5-50	16°49'00 S, 178°29'45 W	Volcanic, moderate slopes	2362	2 (2)	1	2	1	3
Lekutu (MF)	220-230	16°38'04 S, 178°50'07 W	Volcanic, mostly flat	2411	2 (3)	1	1	1	3
Nautuutu (MF)	30-40	16°13'55 S, 179°49'27 W	Volcanic, mostly flat	2458	2 (3)	1	1	1	3

1 **Table 2** Summary of the species origin in the dry zone forests of Fiji with regard to major
 2 taxonomic group and life form (*italics*). Numbers for moist forest (M) and tropical dry forest (T) are
 3 given in brackets. *, includes endemic species.

Taxonomic Group/ <i>Life Form</i>	Endemic	Indigenous*	Invasive and/or naturalised	Total
Ferns & Allies	4 (M:4,T:0)	38 (M:36,T:10)	0	38 (M:36,T:10)
Gymnosperms	0	5 (M:5,T:1)	0	5 (M:5,T:1)
Dicotyledon	91 (M:80,T:28)	227 (M:172,T:128)	14 (M:11,T:12)	241 (M:183,T:140)
Monocotyledons	8 (M:8,T:0)	40 (M:37,T:15)	0	40 (M:37,T:15)
<i>Epiphytes</i>	4 (M:4, T:0)	23 (M:22, T:5)	0	23 (M:22, T:5)
<i>Climbers</i>	5 (M:5, T:2)	41 (M:28, T:32)	4 (M:4, T:4)	45 (M:31, T:36)
<i>Herbs</i>	6 (M:6, T:0)	44 (M:41, T:14)	3 (M:2, T:1)	47 (M:44, T:15)
<i>Shrubs/Small Trees</i>	25 (M:23, T:7)	60 (M:48, T:36)	3 (M:3, T:3)	63 (M:51, T:39)
<i>Tree Ferns</i>	1 (M:1, T:0)	2 (M:2, T:0)	0	2 (M:2, T:0)
<i>Trees</i>	62 (M:53, T:18)	140 (M:109; T:67)	4 (M:2, T:4)	144 (M:111, T:71)
Totals	103 (M:92,T:27)	310 (M:250,T:154)	14 (M:11,T:12)	324 (M:261,T:166)

5

6

1 **Table 3** Most diverse families in TDF and MF. First value give total number of species, number
 2 of species endemic to Fiji are given in brackets.

3

Tropical Dry Forest		Moist Forest	
Euphorbiaceae	12 (2) spp.	Rubiaceae	20 (13) spp.
Rubiaceae	12 (3) spp.	Euphorbiaceae	15 (11) spp.
Moraceae	9 (2) spp.	Orchidaceae	12 (3) spp.
Caesalpinaceae	7 (4) spp.	Moraceae	10 (4) spp.
Mimosaceae	7 (1) spp.	Cyperaceae	8 (0) spp.
Apocynaceae	7 (1) spp.	Myrtaceae	8 (6) spp.
Fabaceae	6 (0) spp.	Sapotaceae	7 (3) spp.
Flacourtiaceae	6 (2) spp.	Apocynaceae	6 (1) spp.
Sapindaceae	5 (0) spp.	Clusiaceae	6 (2) spp.
Passifloraceae	4 (0) spp.	Poaceae	6 (2) spp.
Rhamnaceae	4 (0) spp.	Caesalpinaceae	5 (1) spp.
		Meliaceae	5 (4) spp.
		Mimosaceae	5 (1) spp.

1 **Table 4** Percentages of large tree species recorded in leaf type, dispersal, and floral sexuality categories. TDF, tropical dry forest ($n = 43$),
 2 MF, moist forest ($n = 60$).

3

Forest Type	Leaf Type ¹		Dispersal ²			Floral Sexuality		
	% Decidu- ousness	% Sclero- phyll	Vertebrate	Wind	Other	Hermorphrodite	Dioecious	Monoecious
TDF	20.9	27.9	69.8	7.0	23.3	40.5	26.2	33.3
MF	3.3	28.3	81.7	5.0	13.3	36.5	27.0	36.5

4

1 **Fig. 1** Location of study sites and weather stations (both indicated by arrows) and approximate 2000
2 mm (dotted line) and 2500 mm (dashed line) rainfall boundaries (after Fitzpatrick (1966) and
3 Krishna (1980)) in the Fiji group. Study sites named; weather stations mentioned in text: A, Suva; B,
4 Nadi; C, Udu Point.

5
6 **Fig. 2** Results of agglomerative clustering using average linkage and the Jaccard coefficient. The
7 average annual rainfall is given in brackets below each study location.

8
9 **Fig. 3** DCA plot of tree species. Circles, study sites; squares, species. Species affinities are shown in
10 Appendix 1 and the input data set in Appendix 2.

11

1 **Appendix 1 Plants collected or recorded in the forests of Fiji's dry zone.** ^E, endemic to Fiji; ^{var. E},
2 variety endemic to Fiji; *, introduced; ^T, plants recorded in tropical dry forest; ^M, plant recorded in
3 moist forest. Values in brackets state life form. C, climber; E, epiphyte; H, herb; S, shrub/small tree;
4 TF, tree fern, ST, strangler; T, tree. Nomenclature follows Brownlie (1977), Smith (1979, 1981, 1985,
5 1988, 1991, 1996) and IPNI (2007).

6

- 1 **PTERIDOPHYTA (Ferns and Fern Allies)** 30 **CYATHACEAE**
- 2
- 3 **LYCOPSIDA** 31 *Cyathea lunulata* Copel. ^M(TF)
- 4 32 *Cyathea propinqua* Mett. ^{E, M}(TF)
- 5 **LYCOPODIACEAE** 33
- 6 *Lycopodiella cernua* (L.) Pic.Serm. ^M(H) 34 **DAVALLIACEAE**
- 7 *Huperzia phlegmaria* (L.) Rothm. ^M(E) 35 *Davallia solida* var. *fejeensis* (Hook.) Noot. ^{(var. E), M}(E)
- 8 *Huperzia squarrosa* (G.Forst.) Trevis. ^M(E) 36 *Davallia solida* (G.Forst.) Sw. ^{M, T}(E)
- 9 37 *Humata heterophylla* (Sm.) Desv. ^M(E)
- 10 **SELAGINELLACEAE** 38
- 11 *Selaginella breynioides* Baker ^{E, M}(H) 39 **DENNSTAEDTIACEAE**
- 12 *Selaginella laxa* Spring ^M(H) 40 *Pteridium esculentum* (G.Forst.) Cockayne ^M(H)
- 13 *Selaginella viridangula* Spring ^{E, M}(H) 41 *Tapeinidium melanesicum* Kramer ^M(H)
- 14 42
- 15 43 **DICKSONIACEAE**
- 16 **FILICOPSIDA** 44 *Calochlaena straminea* (Labill.) M.D.Turner & R.A.White ^M(H)
- 17 **ADIANTACEAE** 45
- 18 *Adiantum hispidulum* Sw. ^T(H) 46 **DRYOPTERIDACEAE**
- 19 *Cheilanthes nudiuscula* (R.Br.) T.Moore ^T(H) 47 *Tectaria latifolia* (G.Forst.) Copel. ^M(H)
- 20 *Doryopteris concolor* (Langsd. & Fisch.) Kuhn ^T(H) 48
- 21 *Taenitis pinnata* (J.Sm.) Holttum ^M(H) 49 **GLEICHENIACEAE**
- 22 50 *Gleichenia oceanica* Kuhn ^M(H)
- 23 **ASPLENIACEAE** 51
- 24 *Asplenium australasicum* Hook. ^M(E) 52 **HYMENOPHYLLACEAE**
- 25 *Asplenium polyodon* G.Forst. ^M(E) 53 *Abrodictyum dentatum* (Bosch) Ebihara & K.Iwats. ^M(H)
- 26 54 *Cephalomanes atrovirens* C.Presl. ^M(H)
- 27 **BLECHNACEAE** 55 *Crepidomanes intermedia* (Bosch) Ebihara & K.Iwats. ^M(H)
- 28 *Blechnum orientale* L. ^M(H) 56
- 29 57
- 58 **LOMARIOPSIDACEAE**
- 59 *Lomagramma polyphylla* Brack. ^M(C/E)

1		30	
2	MARATTIACEAE	31	CYCADALES
3	<i>Angiopteris evecta</i> (G.Forst.) Hoffm. ^M (H)	32	
4		33	CYCADACEAE
5	OLEANDRACEAE	34	<i>Cycas seemanii</i> A.Braun ^{M, T} (T)
6	<i>Nephrolepis biserrata</i> (Sw.) Schott ^{M, T} (H)	35	
7	<i>Nephrolepis hirsutula</i> (G.Forst.) C.Presl ^M (H)	36	
8		37	CONIFERALES
9	POLYPODIACEAE	38	
10	<i>Drynaria rigidula</i> (Sw.) Bedd. ^{M, T} (E)	39	ARAUCARIACEAE
11	<i>Pyrrosia lanceolata</i> (L.) Farwl ^{M, T} (E/C)	40	<i>Agathis macrophylla</i> (Lindl.) Mast. ^M (T)
12		41	
13	PTERIDACEAE	42	PODOCARPACEAE
14	<i>Pteris ensiformis</i> Burm.f. ^{M, T} (H)	43	<i>Dacrydium nidulum</i> de Laub. ^M (T)
15	<i>Pteris pacifica</i> Hieron. ^M (H)	44	<i>Podocarpus neriifolius</i> D.Don ^M (T)
16		45	
17	SCHIZAEACEAE	46	
18	<i>Lygodium reticulatum</i> Schkuhr ^M (C)	47	GNETALES
19	<i>Schizaea dichotoma</i> (L.) Sm. ^{M, T} (H)	48	
20		49	GNETACEAE
21	THELYPTERIDACEAE	50	<i>Gnetum gnemon</i> L. ^M (T)
22	<i>Sphaerostephanos invisus</i> (G.Forst.) Holttum ^{M, T} (H)	51	
23		52	
24	VITTARIACEAE	53	ANGIOSPERMAE (Angiosperms)
25	<i>Haplopteris elongata</i> (Sw.) E.H.Crane ^M (E)	54	
26	<i>Monogramma acrocarpa</i> (Holttum) D.L.Jones ^{E, M} (E)	55	DICOTYLEDONAE (Dicotyledons)
27		56	
28		57	ACANTHACEAE
29	GYMNOSPERMAE (Gymnosperms)		

- 1 *Graptophyllum insularum* (A.Gray) A.C.Sm. ^M(S) 31
- 2 *Pseuderanthemum laxiflorum* (A.Gray) C.E.Hubb. ex 32 **ASCLEPIADACEAE**
- 3 L.H.Bailey ^{E, M}(S) 33 *Hoya australis* R.Br. ex J.Traill ^{M, T}(C)
- 4 34 *Tylophora brackenridgei* A.Gray ^{M, T}(C)
- 5 **ANACARDIACEAE** 35
- 6 *Buchanania attenuata* A.C.Sm. ^{E, M, T}(T) 36 **ASTERACEAE**
- 7 *Buchanania vitiensis* Engl. ^{E, M}(T) 37 **Mikania micrantha* H.B. & K. ^{M, T}(C)
- 8 *Pleiogynium timoriense* (DC.) Leenh. ^{M, T}(T) 38
- 9 *Rhus taitensis* Guill. ^{M, T}(T) 39 **BIGNONIACEAE**
- 10 *Semecarpus vitiense* (A.Gray) Engl. ^M(T) 40 **Spathodea campanulata* P.Beauv. ^{M, T}(T)
- 11 41
- 12 **ANNONACEAE** 42 **BORAGINACEAE**
- 13 *Cyathocalyx* cf. *vitiensis* A.C.Sm. ^{E, M}(T) 43 *Cordia subcordata* Lam. ^T(T)
- 14 *Polyalthia laddiana* A.C.Sm. ^T(T) 44
- 15 45 **BURSERACEAE**
- 16 **APOCYNACEAE** 46 *Canarium* cf. *vitiense* A.Gray ^M(T)
- 17 *Alstonia pacifica* (Seem.) A.C.Sm. ^M(T) 47 *Garuga floribunda* Decne. ^T(T)
- 18 *Alstonia costata* (G.Forst.) R.Br. ^M(T) 48 *Haplolobus floribundus* subsp. *salomonensis* (C.T.White)
- 19 *Alyxia bracteolosa* Rich. ex. A.Gray ^T(C/S) 49 Leenh. ^M(T)
- 20 *Alyxia stellata* (J.R.Forst. & G.Forst.) Roem. & Schult. ^{M, T} 50
- 21 (C/S) 51 **CAESALPINIACEAE**
- 22 *Cerbera manghas* L. ^{M, T}(T) 52 *Caesalpinia major* (Medik.) Dandy & Exell ^T(C)
- 23 *Ochrosia vitiensis* (Markgr.) Pichon ^T(T) 53 *Cynometra falcata* A.Gray ^{E, T}(T)
- 24 *Parsonsia laevis* (A.Gray) Markgr. ^{M, T}(C) 54 *Cynometra insularis* A.C.Sm. ^{E, M, T}(T)
- 25 *Parsonsia smithii* Markgr. ^{E, T}(C) 55 *Intsia bijuga* (Colebr.) Kuntze ^{M, T}(T)
- 26 *Tabernaemontana pandacaqui* Lam. ^{M, T}(S/T) 56 *Kingiodendron platycarpum* B.L.Burtt ^{E, M, T}(T)
- 27 57 *Maniltoa grandiflora* (A.Gray) Scheff. ^{M, T}(T)
- 28 **ARALIACEAE** 58 *Maniltoa vestita* A.C.Sm. ^{E, M, T}(T)
- 29 *Plerandra vitiensis* (Seem.) Baill. ^{E, M}(T)
- 30 *Polyscias multijuga* (A.Gray) Harms ^{M, T}(S/T)

- 1
- 2 **CAPPARACEAE**
- 3 *Capparis quiniflora* DC. ^T(C)
- 4
- 5 **CARICACEAE**
- 6 **Carica papaya* L. ^{M,T}(S/T)
- 7
- 8 **CASUARINACEAE**
- 9 *Gymnostoma vitiense* L.A.S.Johnson ^{E,M}(T)
- 10
- 11 **CELASTRACEAE**
- 12 *Celastrus richii* A.Gray ^T(C)
- 13 *Maytenus vitiensis* (A.Gray) Ding Hou ^T(S/T)
- 14
- 15 **CHRYSOBALANACEAE**
- 16 *Parinari insularum* A.Gray ^M(T)
- 17
- 18 **CLUSIACEAE**
- 19 *Calophyllum cerasiferum* Vesque ^{E,M}(T)
- 20 *Calophyllum vitiense* Turrill ^{E,M}(T)
- 21 *Garcinia adiantha* A.C.Sm. & S.P.Darwin ^{E,M}(T)
- 22 *Garcinia myrtifolia* (A.Gray) Seem. ^M(T)
- 23 *Garcinia pseudoguttifera* Seem. ^M(T)
- 24 *Garcinia sessilis* (G.Forst.) Seem. ^{M,T}(T)
- 25
- 26 **COMBRETACEAE**
- 27 *Terminalia catappa* L. ^T(T)
- 28 *Terminalia littoralis* Pancher ex Guillaumin ^T(T)
- 29
- 30 **CONNARACEAE**
- 31 *Connarus pickeringii* A.Gray ^{E,M}(C)
- 32
- 33 **CONVOLVULACEAE**
- 34 *Ipomoea macrantha* Roem. & Schult. ^{M,T}(C)
- 35 *Merremia peltata* (L.) Merr. ^{M,T}(C)
- 36
- 37 **CUNNONIACEAE**
- 38 *Geissois ternata* A.Gray ^{E,M}(T)
- 39
- 40 **CURCUBITACEAE**
- 41 **Coccinia grandis* (L.) Voigt ^{M,T}(C)
- 42
- 43 **DICHAPETALACEAE**
- 44 *Dichapetalum vitiense* (Seem.) Engl. ^{M,T}(S/C)
- 45
- 46 **DILLENACEAE**
- 47 *Dillenia biflora* (A.Gray) Martelli ex Durand & Jacks. ^M(T)
- 48 *Hibbertia lucens* Brongn. & Gris ex Sébert & Pancher ^M(S)
- 49
- 50 **EBENACEAE**
- 51 *Diospyros elliptica* (J.R.Forst. & G.Forst.) P.S.Green ^T(T)
- 52 *Diospyros major* (G.Forst.) Bakh. ^{M,T}(T)
- 53 *Diospyros phlebodes* (A.C.Sm) A.C.Sm. ^{E,T}(T)
- 54
- 55 **ELAEOCARPACEAE**
- 56 *Elaeocarpus storckii* Seem. ^{E,M}(T)
- 57
- 58 **EUPHORBIACEAE**
- 59 *Acalypha insulana* Müll.Arg. ^{M,T}(S/T)

- 1 *Acalypha repanda* Müll.Arg. ^{E, M, T}(S/T)
- 2 *Aleurites moluccana* (L.) Willd. ^{M, T}(T)
- 3 *Baccaurea stylaris* Müll.Arg. ^{E, M}(T)
- 4 *Claoxylon echinospermum* Müll.Arg. ^{E, M}(S/T)
- 5 *Claoxylon fallax* Müll.Arg. ^{E, M}(S/T)
- 6 *Croton metallicus* Müll.Arg. ^T(S)
- 7 *Croton microtigilium* Burkill ^T(T)
- 8 *Drypetes vitiensis* Croizat ^T(T)
- 9 *Endospermum macrophyllum* (Müll.Arg.) Pax & K.Hoffm. ^{E, M, T}(S/T)
- 10 ^M(T)
- 11 *Excoecaria acuminata* Gillespie ^T(T)
- 12 *Glochidion amentuligerum* (Müll.Arg) Croizat ^{E, M}(S/T)
- 13 *Glochidion cordatum* Seem. ^{E, M}(S/T)
- 14 *Glochidion ramiflorum* J.R.Forst. & G.Forst. ^{M, T}(S/T)
- 15 *Glochidion seemannii* Müll.Arg. ^{E, M, T}(S/T)
- 16 *Glochidion vitiense* (Müll.Arg.) Gillespie ^T(S/T)
- 17 *Homalanthus nutans* (G.Forst.) Guill. ^M(T)
- 18 *Macaranga membranaceae* Müll.Arg. ^{E, M}(T)
- 19 *Macaranga seemannii* (Müll.Arg.) Müll.Arg. ^M(T)
- 20 *Macaranga vitiensis* Pax & K.Hoffm. ^{E, M}(T)
- 21 *Mallotus tiliifolius* (Blume) Müll.Arg. ^T(T)
- 22 *Phyllanthus heterodoxus* Müll.Arg. ^{E, M}(S)
- 23 *Stillingia pacifica* Müll.Arg. ^T(T)
- 24
- 25 **FABACEAE**
- 26 *Abrus precatorius* L. ^T(C)
- 27 *Derris trifoliata* Lour. ^{M, T}(C)
- 28 *Erythrina variegata* L. ^T(T)
- 29 *Inocarpus fagifer* (Parkinson) Fosberg ^{M, T}(T)
- 30 *Millettia pinnata* (L.) Panigrahi ^T(T)
- 31 *Mucuna gigantea* (Willd.) D.C. ^T(C)
- 32
- 33 **FLACOURTIACEAE**
- 34 *Casearia richii* A.Gray ^T(S)
- 35 *Erythrospermum accuminatissimum* (A.Gray) A.C.Sm. ^M, ^T(T)
- 36 ^T(T)
- 37 *Flacourtia subintegra* A.C.Sm. ^{E, M, T}(T)
- 38 *Homalium laurifolium* A.C.Sm. ^{M, T}(T)
- 39 *Homalium vitiense* Benth. ^{E, M, T}(T)
- 40
- 41 **GYROCARPACEAE**
- 42 *Gyrocarpus americanus* Jacq. ^{M, T}(T)
- 43
- 44 **LAURACEAE**
- 45 *Cinnamomum* Schaeffer sp. ^T(T)
- 46 *Cryptocarya hornei* Gillespie ^M(T)
- 47
- 48 **LECYTHIDACEAE**
- 49 *Barringtonia edulis* Seem. ^{E, T}(T)
- 50
- 51 **LOGANIACEAE**
- 52 *Fagraea berteriana* A.Gray ex Benth. ^M(T/E)
- 53 *Fagraea gracilipes* A.Gray ^M(T)
- 54 *Geniostoma rupestre* J.R.Forst. & G. Forst. ^M(S)
- 55 *Neuburgia* cf. *corynocarpa* (A.Gray) Leenh. ^M(T)
- 56
- 57 **LORANTHACEAE**
- 58 *Decasynina forsterana* (Schult. & Schult.f.) Barlow ^M(E/HP)
- 59

- 1 **MALPHIGIACEAE**
- 2 *Hiptage myrtifolia* A.Gray^{E, M, T}(C)
- 3
- 4 **MALVACEAE**
- 5 *Hibiscus tiliaceus* L.^T(S/T)
- 6 *Thespesia populnea* (L.) Sol. ex Correa^T(T)
- 7
- 8 **MELASTOMATACEAE**
- 9 *Astronidium* cf. *parviflorum* A.Gray^{E, M}(T)
- 10 **Clidemia hirta* (L.) D.Don^M(H)
- 11 *Melastoma denticulatum* Labill.^M(S)
- 12 *Memecylon vitiense* A.Gray^M(T)
- 13
- 14 **MELIACEAE**
- 15 *Aglaiia basiphylla* A.Gray^{E, M, T}(T)
- 16 *Dysoxylum richii* (A.Gray) C.DC.^{E, M, T}(T)
- 17 *Dysoxylum tenuiflorum* A.C.Sm.^{E, M}(T)
- 18 *Vavaea amicorum* Benth.^{M, T}(T)
- 19 *Vavaea harveyi* Seem.^{E, M}(T)
- 20
- 21 **MENISPERMACEAE**
- 22 *Pachygone vitiensis* Diels^T(C)
- 23
- 24 **MIMOSACEAE**
- 25 **Adenantha pavonina* L.^{M, T}(T)
- 26 **Albizia lebbeck* (L.) Benth.^T(T)
- 27 *Entada phaseoloides* (L.) Merr.^{M, T}(C)
- 28 **Leucaena leucocephala* (Lam.) de Wit^{M, T}(S/T)
- 29 *Racosperma richii* (A.Gray) Pedley^{E, M}(T)
- 30 **Samanea saman* (Jacq.) Merr.^T(T)
- 31 *Serianthes melanesica* Fosberg^{M, T}(T)
- 32 *Serianthes vitiensis* A.Gray^{E, T}(T)
- 33
- 34 **MORACEAE**
- 35 *Ficus barclayana* (Miq.) Summerh.^{E, M, T}(S/T)
- 36 *Ficus fulvo-pilosa* Summerh.^{E, M, T}(S/T)
- 37 *Ficus greenwoodii* Summerh.^{E, M}(S/T)
- 38 *Ficus obliqua* G.Forst.^{M, T}(T/S/T)
- 39 *Ficus prolixa* G.Forst.^{M, T}(T/S/T)
- 40 *Ficus storckii* Seem.^{M, T}(S/T)
- 41 *Ficus theophrastoides* Seem.^{E, M}(S/T)
- 42 *Ficus tinctoria* G.Forst.^T(S/T)
- 43 *Ficus vitiensis* Seem.^{E, M}(T)
- 44 *Malaisia scandens* (Lour.) Planch.^{M, T}(C)
- 45 *Streblus anthropophagorum* (Seem.) Corner^{M, T}(S/T)
- 46 *Streblus pendulinus* (Endl.) F.Muell.^{M, T}(S/T)
- 47
- 48 **MYRISTICACEAE**
- 49 *Myristica castaneifolia* A.Gray^{E, M}(T)
- 50 *Myristica gillespieana* A.C.Sm.^{E, M}(T)
- 51
- 52 **MYRSINACEAE**
- 53 *Maesa corylifolia* A.Gray^{E, M}(S)
- 54 *Maesa insularis* Gillespie^{E, M}(S)
- 55 *Maesa persicifolia* A.Gray^{E, M, T}(S)
- 56 *Maesa pickeringii* A.Gray^{E, T}(S)
- 57 *Maesa tabacifolia* Mez^{M, T}(S)
- 58 *Rapanea myricifolia* (A.Gray) Mez^{M, T}(T/S)
- 59 *Tapeinosperma grande* (Seem.) Mez^{E, M}(S)
- 60

1	MYRTACEAE (Myrtle Family)	31	
2	<i>Decaspermum vitiense</i> J.R.Forst. & G.Forst. ^{E, M} (T/S)	32	PHYTOLACCACEAE
3	<i>Eugenia reinwardtiana</i> (Blume) DC. ^T (S/T)	33	* <i>Rivina humilis</i> L. ^T (H)
4	<i>Syzygium curvistylum</i> (Gillespie) Merr. & L.M.Perry ^M (T)	34	
5	<i>Syzygium decussatum</i> (A.C.Sm.) Biffin & Craven ^{E, M} (T)	35	PIPERACEAE
6	<i>Syzygium effusum</i> (A.Gray) C.Muell. ^M (T)	36	<i>Macropiper puberulum</i> f. <i>glabrum</i> (C.DC.) A.C.Sm. ^M (S)
7	<i>Syzygium eugenioides</i> (Merr. & L.M.Perry) Biffin & Craven ^M	37	
8	^E (T)	38	PITTOSPORACEAE
9	<i>Syzygium fijiense</i> L.M.Perry ^{E, M} (T)	39	<i>Pittosporum arborescens</i> A.Gray ^{M, T} (T)
10	<i>Syzygium rubescens</i> (A.Gray) C.Muell. ^{E, M} (T)	40	<i>Pittosporum brackenridgei</i> A.Gray ^T (T)
11	<i>Syzygium simillimum</i> Merr. & L.M.Perry ^{E, M} (S/T)	41	<i>Pittosporum rhytidocarpum</i> A.Gray ^{E, M} (T)
12		42	
13	NYCTGINACEAE	43	RHAMNACEAE
14	<i>Pisonia grandis</i> R.Br. ^T (T)	44	<i>Alphitonia franguloides</i> A.Gray ^{E, M} (T)
15		45	<i>Alphitonia zizyphoides</i> (Spreng.) A.Gray ^{M, T} (T)
16	OCHNACEAE	46	<i>Colubrina asiatica</i> (L.) Brongn. ^T (C)
17	<i>Brackenridgea nitida</i> A.Gray ^{M, T} (S/T)	47	<i>Gouania richii</i> A.Gray ^{E, M} (C)
18		48	<i>Rhamnella vitiensis</i> (Benth.) A.C.Sm. ^T (C)
19	OLACEAE	49	<i>Ventilago vitiensis</i> A.Gray ^{M, T} (C)
20	<i>Anacolosia lutea</i> Gillespie ^M (T)	50	
21		51	RHIZOPHORACEAE
22	OLEACEAE	52	<i>Crossostylis pachyantha</i> A.C.Sm. ^{E, M} (T)
23	<i>Jasminum didymum</i> G.Forst. ^{M, T} (C)	53	<i>Crossostylis richii</i> (A.Gray) A.C.Sm. ^{E, M} (T)
24	<i>Jasminum simplicifolium</i> G.Forst. ^{M, T} (C)	54	
25		55	RUBIACEAE
26	PASSIFLORACEAE	56	<i>Airosperma vanuense</i> S.P.Darwin ^{E, M, T} (T)
27	<i>Passiflora aurantia</i> G.Forst. ^T (C)	57	<i>Antirhea inconspicua</i> (Seem.) Christoph. ^{M, T} (T)
28	* <i>Passiflora foetida</i> L. ^{M, T} (C)	58	<i>Antirhea smithii</i> (Fosberg) Merr. & L.M.Perry ^M (T)
29	<i>Passiflora laurifolia</i> L. ^T (C)	59	<i>Coprosma persicifolia</i> A.Gray ^T (S/T)
30	* <i>Passiflora suberosa</i> L. ^{M, T} (C)	60	<i>Cyclophyllum sessilifolium</i> (A.Gray) A.C.Sm. & S.P.Darwin

1	^T (S/T)	31	SANTALACEAE
2	<i>Gardenia gordonii</i> Baker ^{E, M} (T)	32	<i>Exocarpos vitiensis</i> A.C.Sm. ^{E, M} (S/T)
3	<i>Gardenia hillii</i> Horne ex Baker ^{E, M} (T)	33	
4	<i>Guettarda wayaensis</i> R.O.Gardner ^{E, T} (T)	34	SAPINDACEAE
5	<i>Guettarda speciosa</i> L. ^T (T)	35	<i>Arytera brackenridgei</i> (A.Gray) Radlk. ^T (T)
6	<i>Gynochthodes epiphytica</i> (Rech.) A.C.Sm. & S.P.Darwin	36	<i>Dodonaea viscosa</i> (L.) Jacq. ^{M, T} (S)
7	^M (C)	37	<i>Elattostachys falcata</i> (A.Gray) Radlk. ^{M, T} (T)
8	<i>Ixora elegans</i> Gillespie ^{E, M} (S/T)	38	<i>Koelreuteria elegans</i> (Seem.) A.C.Sm. ^{M, T} (T)
9	<i>Ixora</i> cf. <i>myrtifolia</i> A.C.Sm. ^{E, M} (S/T)	39	Unknown genus ^T (T)
10	<i>Mastixidendron flavidum</i> (Seem.) A.C.Sm. ^{E, M} (T)	40	
11	<i>Morinda citrifolia</i> L. ^{M, T} (S/T)	41	SAPOTACEAE
12	<i>Morinda mollis</i> A.Gray ^T (C)	42	<i>Burckella richii</i> (A.Gray) H.J.Lam. ^M (T)
13	<i>Morinda myrtifolia</i> A.Gray ^{E, M, T} (C)	43	<i>Manilkara dissecta</i> (L.f.) Dubard ^{M, T} (T)
14	<i>Ophiorrhiza leptantha</i> A.Gray ^M (H)	44	<i>Manilkara smithiana</i> H.J.Lam & Mass Geester. ^{E, M} (T)
15	<i>Pelagodendron vitiense</i> Seem. ^{E, M} (T)	45	<i>Palaquium fidjiense</i> Pierre ex Dubard ^{E, M} (T)
16	<i>Psychotria amoena</i> A.C.Sm. ^{M, T} (S/T)	46	<i>Palaquium porphyreum</i> A.C.Sm. & S.P.Darwin ^{E, M} (T)
17	<i>Psychotria argantha</i> A.C.Sm. ^{E, M} (S/T)	47	<i>Pouteria</i> cf. <i>garberi</i> (Christophers.) Baehni ^M (T)
18	<i>Psychotria gibbsiae</i> S.Moore ^{E, M} (S/T)	48	<i>Pouteria grayana</i> (H.St.John) Fosberg ^{M, T} (T)
19	<i>Psychotria hypargyrea</i> A.Gray ^{E, M} (S/T)	49	<i>Pouteria membranacea</i> (H.J.Lam) Baehni ^M (T)
20	<i>Psychotria tephrosantha</i> A.Gray ^{E, M} (C)	50	
21	<i>Psychotria volii</i> R.O.Gardner ^{E, T} (S/T)	51	SIMAROUBACEAE
22	<i>Psydrax odorata</i> (G.Forst.) A.C.Sm. & S.P.Darwin ^{M, T} (S/T)	52	<i>Amaroria soulameoides</i> A.Gray ^{E, M} (T)
23	* <i>Spermacoce remota</i> Lam. ^M (H)	53	
24	<i>Tarenna seemanniana</i> A.C.Sm. & S.P.Darwin ^{E, M} (T)	54	SOLANACEAE
25		55	<i>Capsicum frutescens</i> L. ^T (S)
26	RUTACEAE	56	
27	<i>Melicope cucullata</i> (Gillespie) A.C.Sm. ^{E, T} (T)	57	STERCULIACEAE
28	<i>Micromelum minutum</i> (G.Forst.) Wight & Arn. ^{M, T} (S/T)	58	<i>Commersonia bartramia</i> (L.) Merr. ^M (T)
29	<i>Sarcomelicope petiolaris</i> (A.Gray) A.C.Sm. ^{E, M} (T)	59	<i>Firmiana diversifolia</i> A.Gray ^{E, M} (T)
30		60	<i>Heritiera ornithocephala</i> Kosterm. ^M (T)

1	<i>Kleinhovia hospita</i> L. ^T (T)	30
2	<i>Melochia degeneriana</i> A.C.Sm. ^{E, T} (T)	31
3	<i>Melochia grayana</i> A.C.Sm. ^{E, M} (T/S)	32
4		33
5	THYMELAEACEAE	34
6	<i>Phaleria glabra</i> (Turrill) Domke ^M (S)	35
7	<i>Wikstroemia foetida</i> (L.f.) A.Gray ^{M, T} (S)	36
8		37
9	TILIACEAE	38
10	<i>Grewia crenata</i> (J.R.Forst. & G.Forst.) Schinz & Guillaumin ³⁹	
11	^T (T)	40
12	<i>Trichospermum richii</i> (A.Gray) Seem. ^M (T)	41
13		42
14	ULMACEAE	43
15	<i>Gironniera celtidifolia</i> Gaudich. ^M (T)	44
16	<i>Trema cannabina</i> L. ^T (T)	45
17		46
18	URTICACEAE	47
19	<i>Leucosyke corymbulosa</i> (Wedd.) Wedd. ^M (S)	48
20		49
21	VERBENACEAE	50
22	<i>Clerodendrum inerme</i> (L.) Gaertn. ^T (C)	51
23	<i>Faradaya ovalifolia</i> (A.Gray) Seem. ^{E, M} (C)	52
24	<i>Gmelina vitiensis</i> (Seem.) A.C.Sm. ^{E, M} (T)	53
25	* <i>Lantana camara</i> L. var. <i>aculeata</i> (L.) Moldemke ^{M, T} (S/C)	54
26	<i>Premna protrusa</i> A.C.Sm. & S.P.Darwin ^{E, M, T} (T)	55
27		56
28		57
29	MONOCOTYLEDONAE (Monocotyledons)	58
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- 1 *Bulbophyllum gracillimum* (Rolfe) Rolfe ^M(E)
- 2 *Bulbophyllum* cf. *hassallii* P.J.Kores ^{E, M}(E)
- 3 *Bulbophyllum rostriceps* Rchb.f. ^M(E)
- 4 *Corymborkis veratrifolia* (Reinw.) Blume ^T(H)
- 5 *Dendrobium catillare* Rchb.f. ^{E, M}(E)
- 6 *Dendrobium platygastrium* Rchb.f. ^M(E)
- 7 *Dendrobium tokai* Rchb.f. ex Seem. ^M(E)
- 8 *Luisia teretifolia* Gaudich. ^M(E/C)
- 9 *Malaxis* Sol. spp. ^M(H)
- 10 *Oberonia heliophila* Benth. & Hook.f. ex Drake ^M(E)
- 11 *Pseuderia smithiana* C.Schweinf. ^{E, M}(E)
- 12 *Taeniophyllum fasciola* (Sw.) Seem. ^{M, T}(E)
- 13 *Trachoma* Garay spp. ^T(E)
- 14
- 15 **PANDANACEAE**
- 16 *Freycinetia* cf. *impavida* (Gaudich. ex Hombr.) Stone ^M(C)
- 17 *Pandanus tectorius* Parkinson ^{M, T}(S/T)
- 18
- 19 **POACEAE**
- 20 *Centosteca lappacea* (L.) Desv. ^{M, T}(H)
- 21 *Digitaria setigera* Roth ex Roem. & Schult. ^M(H)
- 22 *Garnotia linearis* Swallen ^{E, M}(H)
- 23 *Leptaspis angustifolia* Summerh. & C.E.Hubb. ^{E, M}(H)
- 24 *Oplismenus compositus* (L.) P.Beauv. ^{M, T}(H)
- 25 *Oplismenus hirtellus* (L.) P.Beauv. ^{M, T}(H)
- 26
- 27 **SMILACEAE**
- 28 *Smilax vitiensis* (Seem.) A.DC. ^{M, T}(C)
- 29
- 30 **TACCACEAE**
- 31 *Tacca leontopetaloides* (L.) Kuntze ^T(H)
- 32
- 33 **ZINGIBERACEAE**
- 34 *Alpinia boia* Seem. ^{E, M}(H)
- 35 *Alpinia vitiensis* Seem. ^{E, M}(H)
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- 37

1 **Appendix 2. Tree species data set used for cluster analysis.** Only canopy and subcanopy trees
2 genuinely associated with mature-stage forest were included. The major dispersal mechanism and
3 floral sexuality are indicated for tree species: ^{DE}, species deciduous; ^{SC}, species sclerophyllous; ^V,
4 vertebrate dispersed; ^W, wind dispersed; ^O, dispersed by other means (water, gravity, self-dispersed);
5 ^{He}, hermaphrodite; ^{Di}, dioecious; ^{Mo}, monoecious.

6

	Nautu- utu	Dogo- tuki	Lekutu	Navo	Vatia	Yadua Taba	Naicobo- cobo	Monu- riki	Gau	Macua- ta
<i>Agathis macrophylla</i> ^{SC, W, Mo}	0	1	0	0	0	0	0	0	0	0
<i>Amaroria soulameoides</i> ^{V, Di}	1	1	1	0	0	0	0	0	0	0
<i>Antirhea inconspicua</i> ^{DE, V, Di}	0	0	0	1	0	1	1	0	1	1
<i>Arytera brackenridgei</i> ^{SC, O, Mo}	0	0	0	0	0	0	1	1	0	1
<i>Buchanania attenuata</i> ^{V, He}	0	1	1	0	0	0	1	0	0	0
<i>Buchanania vitiensis</i> ^{V, He}	1	1	0	0	0	0	0	0	0	0
<i>Burckella richii</i> ^{SC, V, Mo}	0	0	0	0	0	0	0	1	0	0
<i>Calophyllum cerasiferum</i> ^{SC, V, He}	0	1	0	0	0	0	0	0	0	0
<i>Calophyllum vitiense</i> ^{V, He}	0	1	0	0	0	0	0	0	0	0
<i>Canarium vitiense</i> ^{V, Di}	0	1	1	0	0	0	0	0	0	0
<i>Cerbera manghas</i> ^{O, M}	1	0	0	0	1	1	0	0	0	1
<i>Cordia subcordata</i> ^{V, He}	0	0	0	1	0	1	0	0	0	1
<i>Crossostylis pachyantha</i> ^{V, He}	0	1	0	0	0	0	0	0	0	0
<i>Croton microtiglium</i> ^{V, Mo}	0	0	0	0	0	1	0	0	0	1
<i>Cryptocarya hornei</i> ^{V, He}	0	0	1	0	0	0	0	0	0	0
<i>Cyathocalyx cf. vitiensis</i> ^{V, He}	0	1	1	0	0	0	0	0	0	0
<i>Cycas seemanii</i> ^{SC, V, Di}	0	0	1	0	0	0	0	0	1	0
<i>Cynometra falcata</i> ^{SC, V, He}	0	0	0	0	1	1	1	0	0	1

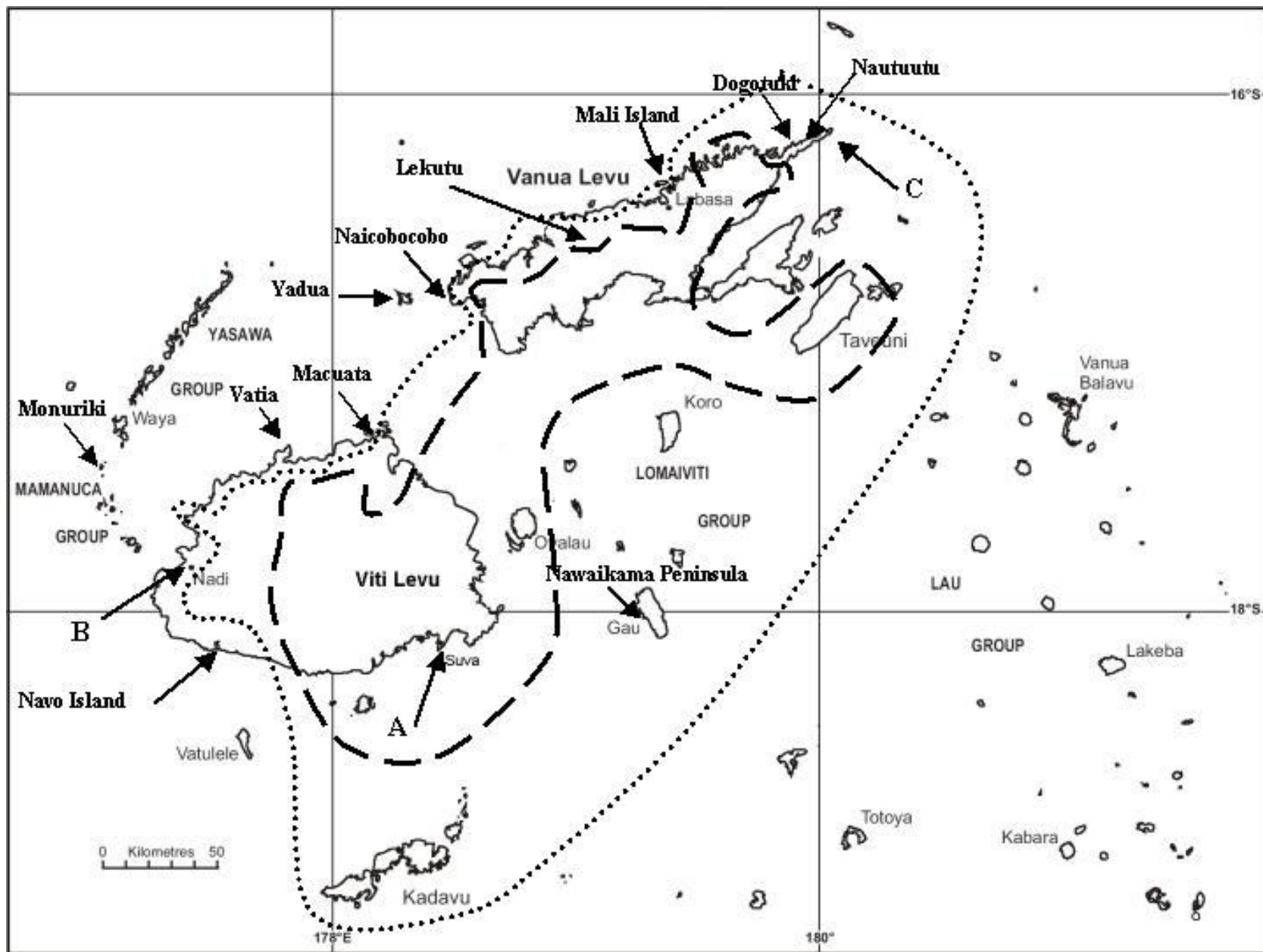
<i>Cynometra insularis</i> ^{V, He}	0	1	0	1	0	0	0	0	1	1
<i>Dacrydium nidulum</i> ^{SC, V, Di}	0	1	1	0	0	0	0	0	0	0
<i>Decaspermum vitiense</i> ^{SC, V, He}	0	1	1	0	0	0	0	0	0	0
<i>Dillenia biflora</i> ^{V, Mo}	1	1	0	0	0	0	0	0	0	0
<i>Diospyros elliptica</i> ^{V, Di}	0	0	0	1	1	0	1	1	1	1
<i>Diospyros phlebodes</i> ^{SC, V, Di}	0	0	0	0	1	1	0	1	1	1
<i>Drypetes vitiensis</i> ^{V, Di}	0	0	0	0	0	1	0	1	0	0
<i>Dysoxylum richii</i> ^{V, Di}	0	1	0	1	1	0	1	0	0	0
<i>Dysoxylum tenuiflorum</i> ^{V, He}	0	1	0	0	0	0	0	0	0	0
<i>Elattostachys falcate</i> ^{SC, V, Mo}	0	0	0	1	1	0	0	0	0	0
<i>Erythrina variegata</i> ^{DE, O, Mo}	0	0	0	1	1	1	1	0	0	0
<i>Excoecaria acuminata</i> ^{V, Di}	0	0	0	1	0	1	1	1	0	1
<i>Fagraea gracilipes</i> ^{V, He}	0	1	1	0	0	0	0	0	0	0
<i>Ficus obliqua</i> ^{SC, V, Mo}	0	0	0	1	0	1	1	0	0	0
<i>Ficus prolixa</i> ^{SC, V, Mo}	0	0	0	1	0	1	1	0	0	0
<i>Garcinia pseudoguttifera</i> ^{V, Di}	1	1	0	0	0	0	0	0	0	0
<i>Garcinia sessilis</i> ^{SC, V, Di}	0	0	0	0	0	0	1	0	0	0
<i>Garuga floribunda</i> ^{DE, V, He}	0	0	0	0	1	0	1	0	0	0
<i>Gmelina vitiensis</i> ^{O, He}	0	1	0	0	0	0	0	0	0	0
<i>Gnetum gnemon</i> ^{V, Di}	0	1	1	0	0	0	0	0	0	0
<i>Guettarda wayaense</i> ^{DE, V, He}	0	0	0	0	0	0	1	1	0	0
<i>Gymnostoma vitiense</i> ^{SC, W, Mo}	1	1	0	0	0	0	0	0	0	0
<i>Gyrocarpus americanus</i> ^{DE, W, Mo}	0	0	0	1	1	1	1	1	1	1
<i>Haplolobus floribundus</i> ^{V, Di}	0	1	1	0	0	0	0	0	0	0
<i>Homalium laurifolium</i> ^{V, He}	0	0	1	0	0	0	0	0	0	0
<i>Homalium vitiense</i> ^{V, He}	0	0	0	1	0	1	1	1	0	0
<i>Intsia bijuga</i> ^{O, Mo}	1	1	0	1	1	0	0	1	0	0

<i>Kingiodendron platycarpum</i> ^{O, He}	0	0	0	1	0	1	1	1	0	0
<i>Koelreuteria elegans</i> ^{DE, W, Mo}	0	0	0	0	1	0	1	0	0	0
<i>Macaranga membranaceae</i> ^{V, Mo}	0	1	0	0	0	0	0	0	0	0
<i>Macaranga vitiensis</i> ^{V, Mo}	0	1	0	0	0	0	0	0	0	0
<i>Mallotus tiliifolius</i> ^{V, Di}	0	0	0	0	1	1	1	1	1	1
<i>Manilkara dissecta</i> ^{SC, V, Mo}	0	1	0	1	0	1	1	0	0	0
<i>Maniltoa grandiflora</i> ^{O, Mo}	0	1	0	0	0	0	1	0	0	0
<i>Maniltoa vestita</i> ^{SC, O, Mo}	1	0	0	0	1	0	0	1	0	1
<i>Mastixiodendron flavidum</i> ^{V, He}	0	0	1	0	0	0	0	0	0	0
<i>Millettia pinnata</i> ^{DE, O, He}	0	0	0	0	1	1	0	1	1	0
<i>Myristica castaneifolia</i> ^{V, Di}	0	1	0	0	0	0	0	0	0	0
<i>Myristica gillespieana</i> ^{V, Di}	1	1	1	0	0	0	0	0	0	0
<i>Palaquium fidjiense</i> ^{V, He}	1	1	1	0	0	0	0	0	0	0
<i>Parinari insularum</i> ^{V, He}	0	1	1	0	0	0	0	0	0	0
<i>Pittosporum arborescens</i> ^{V, He}	0	1	0	1	0	0	1	0	0	0
<i>Pittosporum brackenridgei</i> ^{V, He}	0	0	0	0	0	1	1	0	0	0
<i>Pleiogynium timoriense</i> ^{DE, V, Di}	0	1	0	0	1	0	1	0	0	1
<i>Podocarpus nerifolius</i> ^{SC, V, Di}	0	1	1	0	0	0	0	0	0	0
<i>Polyalthia laddiana</i> ^{V, He}	0	0	0	1	0	0	1	0	0	0
<i>Pouteria garberi</i> ^{V, He}	0	1	1	0	0	0	0	0	0	0
<i>Pouteria grayana</i> ^{V, He}	0	0	0	1	1	1	1	1	1	1
<i>Premna protusa</i> ^{V, He}	0	0	0	0	0	1	1	0	0	1
<i>Racosperma richii</i> ^{SC, O, Mo}	0	1	1	0	0	0	0	0	0	0
<i>Rapanea myrtifolia</i> ^{SC, V, Di}	0	1	1	0	0	0	0	0	0	0
<i>Sarcomelicope petiolaris</i> ^{V, Di}	0	1	1	0	0	0	0	0	0	0
<i>Semecarpus vitiensis</i> ^{V, Di}	0	1	0	0	0	0	0	0	0	0
<i>Serianthes melanesica</i> ^{O, He}	0	0	0	0	0	0	0	0	0	1

<i>Stillingia pacifica</i> ^{SC, O, Mo}	0	0	0	0	0	0	0	0	1	0
<i>Syzygium decussatum</i> ^{V, Mo}	0	1	0	0	0	0	0	0	0	0
<i>Syzygium eugenoides</i> ^{SC, V, Mo}	0	1	1	0	0	0	0	0	0	0
<i>Syzygium fijiensis</i> ^{SC, V, Mo}	0	1	1	0	0	0	0	0	0	0
<i>Syzygium rubescens</i> ^{V, Mo}	0	1	1	0	0	0	0	0	0	0
Sapindaceae ^{DE, V, He}	0	0	0	1	1	0	1	0	0	0
<i>Vavaea amicorum</i> ^{V, He}	1	1	0	1	1	1	1	1	1	1
<i>Veitchia filifera</i> ^{V, Mo}	1	1	0	0	0	0	0	0	0	0

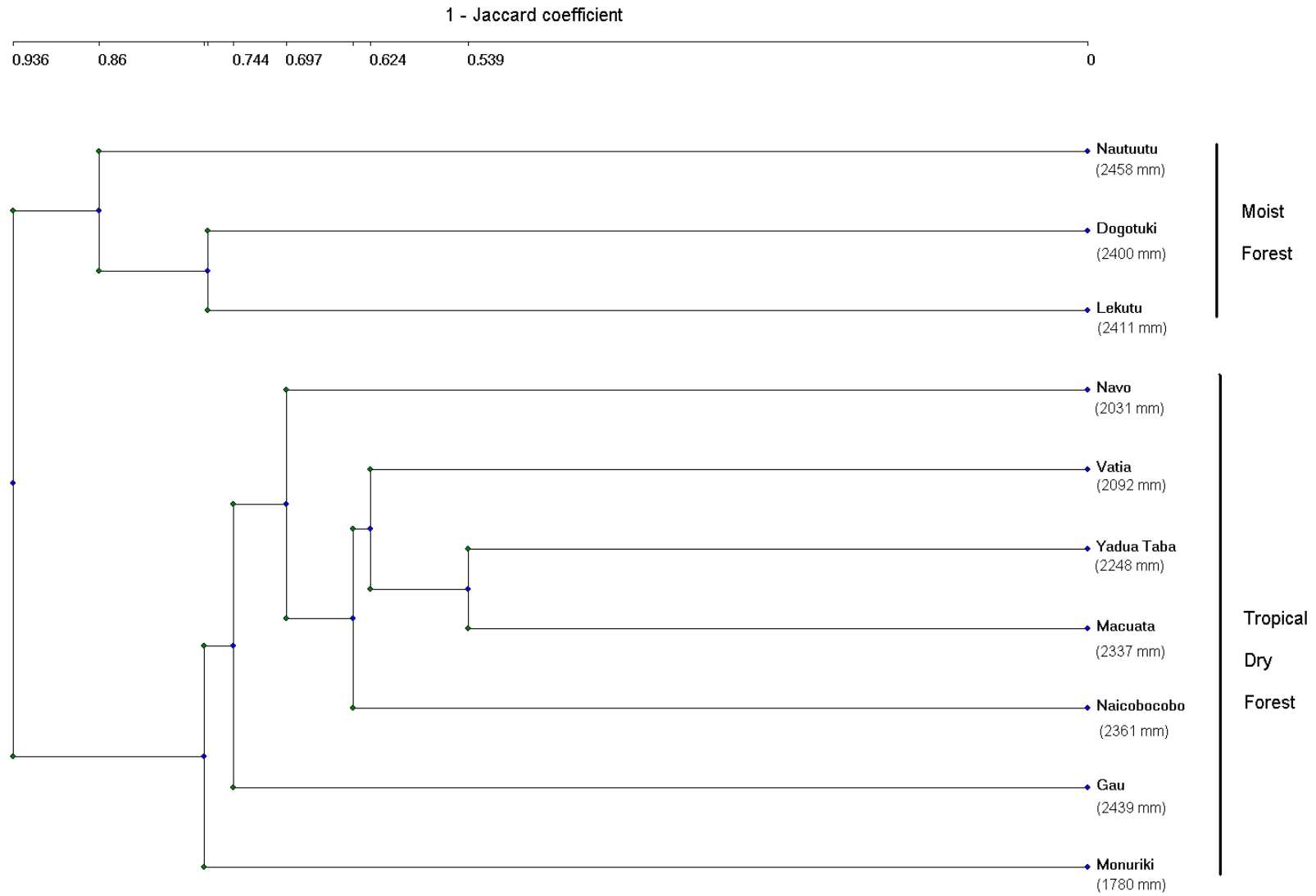
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1 **Fig. 1**



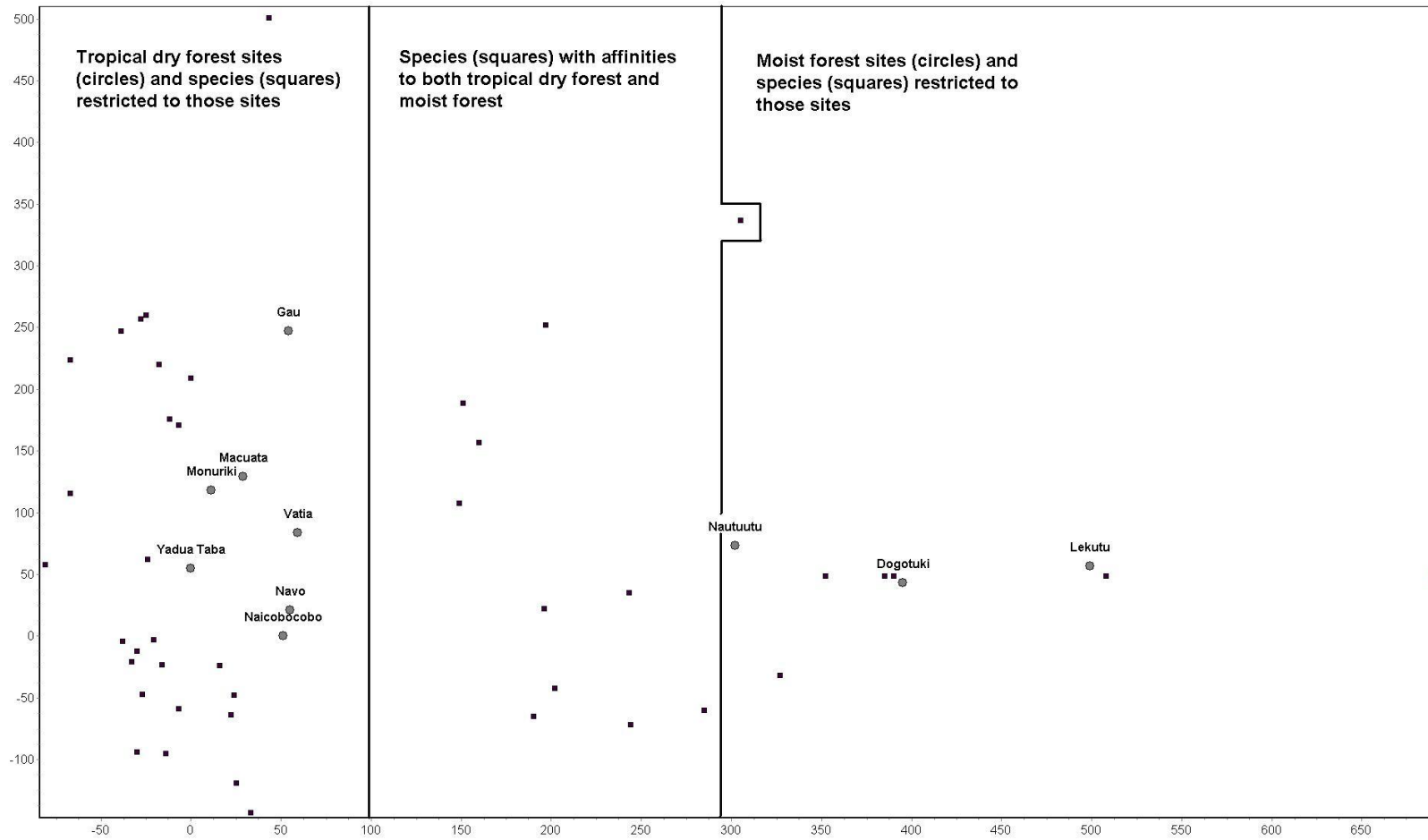
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1 Fig. 2



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1 Fig. 3



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