Critically Endangered Fijian Crested Iguana (*Brachylophus vitiensis*) Shows Habitat Preference for Globally Threatened Tropical Dry Forest[1]

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Abstract: Tropical dry forests are a unique and threatened ecosystem in the Pacific and globally. In Fiji, the endangered Fijian crested iguana (*Brachylophus vitiensis*) is endemic to tropical dry forests. Yadua Taba Island contains one of the best remaining stands of tropical dry forest in the Pacific along with the largest (and only secure) population of *B. vitiensis* in Fiji and has been proposed as a translocation source for iguana conservation. In this study we determined the major vegetation types on Yadua Taba and identified forest habitat preferences of *B. vitiensis* to (1) characterize the island's habitats for tropical dry forest regeneration monitoring and (2) understand which forest types are preferred by iguanas for future translocation projects. Vegetation data were collected using reconnaissance, entitation, line transects, and aerial photos. Iguana abundance data were collected by nocturnal surveys of permanent transects. Six major vegetation types were identified of which tropical dry forest was the largest (46% of the island), followed by a combination of rocky cliff–shrubland/grassland vegetation (26%). Our conservative estimate of *B. vitiensis* population size on Yadua Taba is 12,000 iguanas, the majority of which occur in tropical dry forest. Superabundance of the dry forest understory tree *Vavaea amicorum*, the favorite fruit species of iguanas, may help account for the high density of iguanas observed. These results highlight the ecological link between tropical dry forest and *B. vitiensis* and emphasize the importance of rehabilitation or conservation of tropical dry forest habitat in potential iguana translocation sites as part of the management plan for *B. vitiensis* throughout the Fiji Islands.

Tropical dry forest generally occurs in seasonally dry tropical regions where the average annual rainfall is less than 2,000 mm. In addition, tropical dry forests usually experience dry seasons (monthly rainfall < 100 mm) that stretch over 3 months or more (Mooney et al. 1998). In the Pacific, tropical dry forest has been recorded from Australia, New Guinea, the Solomon Islands, Vanuatu, New Caledonia, Fiji, and Hawai'i (Keppel and Tuiwawa 2007). Due to a combination of factors including fire, grazing by goats, introduction of invasive plant species, and clearing for agriculture (e.g., sugarcane, coconut, and pineapple plantations), very few, usually small, patches of tropical dry forest remain in tropical dry areas. As such, tropical dry forests are now considered one of the most endangered tropical ecosystems globally (Janzen 1988, Lerdau et al. 1991) and in the

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Pacific (Keppel 2005, Keppel and Tuiwawa 2007).

Fijian tropical dry forest is restricted to the western, rain-shadow side of high islands and smaller offshore islands, where rainfall is low and droughts commonly occur. Most plant species occurring in Fijian tropical dry forest are widespread; however, approximately one-third are endemic to Fiji and several are endemic to Fijian tropical dry forest (Keppel and Tuiwawa 2007). Although little is known about the ecology of this ecosystem in Fiji, most Fijian tropical dry forest has been substantially degraded through clearing and the introduction of exotic species, with only a few, very small remnants of true tropical dry forest remaining. However, despite its uniqueness, rarity, and ongoing decline in both extent and quality, Fijian tropical dry forest is not listed as threatened or endangered under national legislation.

One of the best examples of tropical dry forest in Fiji and in the Pacific is found on Yadua Taba Island, a National Trust of Fiji Reserve in the northwest of Fiji. Over the past 25 yr, goats have been removed from the island, fires have been banned, and anthropogenic activities greatly restricted, which have increased the extent and improved the condition of tropical dry forest on Yadua Taba. In addition to having the only protected tropical dry forest in Fiji, Yadua Taba also supports the largest and only legally protected population of the critically endangered Fijian crested iguana, *Brachylophus vitiensis* Gibbons.

The endemic *B. vitiensis* is an herbivorous lizard restricted to tropical dry forest and similar habitats on islands in western Fiji (Gibbons 1981, 1984) and is part of a monophyletic lineage that includes the Lauan banded iguana (*B. fasciatus*), the Fijian banded iguana (*B. bula bula*) and at least two extinct species (Pregill and Steadman 2004, Keogh et al. 2008). It is currently listed as Critically Endangered under IUCN (2006) criteria and is the only Fijian reptile listed as Endangered in the Fiji National Biodiversity Strategy and Action Plan (NBSAP 1998). Over the past 20 yr it has been extirpated from almost 80% of its documented range primarily due to extensive destruction of its habitat (through fire and goat grazing) and, to a lesser extent, predation by cats, dogs, and mongooses. Currently only Yadua Taba and another small island, Macuata, harbor viable populations. The Macuata population is small, consisting of <80 individuals (Harlow et al. 2007), and Yadua Taba is the stronghold for the species, containing >6,000 individuals (Harlow and Biciloa 2001). All other populations are extremely small and likely doomed because of continued tropical dry forest habitat loss due to clearing, grazing by goats, fire, invasive plants, and predation (Harlow et al. 2007).

Although the population of *B. vitiensis* on Yadua Taba is currently thriving and secure, it is still vulnerable to the accidental introduction of exotic predators, disease, wildfire, invasive alien plant species, and natural hazards such as tropical cyclones, which are capable of decimating the population. As such, translocations of iguanas from Yadua Taba to other suitable islands within the former range of *B. vitiensis* have been proposed as a viable conservation management option for the species (IUCN Species Survival Commission 2008).

There are a number of factors associated with successful translocations including habitat quality or suitability: translocations into areas of high habitat quality or suitability are demonstrably more successful than those to areas that are of lower quality or are less suitable (Griffith et al. 1989, Bright and Morris 1994, Fischer and Lindenmayer 2000). However, to identify suitable translocation sites or restore habitat for successful species recovery, we need to have a good understanding of the habitat requirements and preferences of the focal species.

Although we have some knowledge of the habitat and vegetation preferences of *B. vitiensis*, this work has been largely opportunistic in nature (with the exception of Harlow and Biciloa [2001] and Harlow et al. [2007]). A previous study of *B. vitiensis* on Yadua Taba demonstrated that iguanas were primarily found in forest vegetation, were not found in nonnative forest types including grasslands, and were observed in very low abundance in rocky-cliff or shrubland vegetation (Harlow and Biciloa 2001).

The overall aims of the project were to determine the major vegetation types present on Yadua Taba and quantify the forest habitat preferences of *B. vitiensis* to (1) characterize the vegetation types on Yadua Taba for tropical dry forest regeneration monitoring and (2) identify the most suitable forest habitats for future iguana translocation projects. Specifically, the objectives were to (a) identify the major vegetation types on Yadua Taba and map their current distribution, (b) determine the extent of tropical dry forest regeneration on Yadua Taba, (c) compare the plant species diversity of Yadua Taba tropical dry forest with that on other Fijian islands, and (d) estimate iguana abundance and density in the different forest types and identify their preferred habitat(s). The results of this research will be used to provide a baseline to monitor future tropical dry forest reforestation or regeneration on Yadua Taba as well as provide essential ecological data for future iguana translocation programs.

MATERIALS AND METHODS

Study Site

Yadua Taba is a small (73 ha), uninhabited volcanic island located in the northwest of the Fiji Islands (16° 50′ S, 178° 20′ E). It reaches 120 m in height and lies 120 m off the much larger inhabited island of Yadua (1,360 ha). In 1972 goats were introduced to Yadua Taba and numbered over 200 by the late 1970s (Gibbons 1984). The tropical dry forest vegetation on the island during that time was severely depleted by a combination of grazing and fire used to drive goats for ease of capture. Since the island was declared a sanctuary in 1981 fires have been banned. Goats have been eradicated from the island, with most individuals removed between 2000 and 2001 and the last individual removed in 2003. Today the forest on the island has recovered to a remarkable extent and is currently one of the best remaining examples of tropical dry forest and coastal strand vegetation in the Pacific (Olson et al. 2002).

On Yadua Taba the dry season generally lasts from May to October, though in drought years it has lasted from May to January. Air temperature ranges from a minimum of 16°C in July–August to a maximum of 31°C in January–February (Gibbons 1984).

Fijian Crested Iguana (Brachylophus vitiensis)

The Fijian crested iguana is a herbivorous, diurnal, and strongly arboreal species (Morrison 2003). It is a moderately sized iguana (adults 185–236 mm snout–vent length [SVL], hatchlings 83–88 mm SVL) in which the sex of adults is easily distinguished by the presence of enlarged femoral pores in males (Morrison 2003). Reproductive cycles are poorly known; however the mating season on Yadua Taba appears to run from December to March, and gravid females are seen from January to April (S. F. Morrison, Australian National University, unpubl. data, 2006). Females dig burrows on the forest floor, where three to five eggs are laid and the burrow is then filled in. Eggs hatch roughly 8–9 months later (October–November) at the onset of the wet season (S. F. Morrison, Australian National University, unpubl. data, 2006).

Plant Surveys/Vegetation Surveys

During the first trip, from 23 to 25 March 2002, plant species were identified and vegetation types classified using the processes of reconaissance and entitation (Mueller-Dombois and Ellenberg 2002). The island was surveyed by walking around it during low tides and visiting each different vegetation type. We spent a minimum of 1 hr walking through each preliminary vegetation type, recorded all the plant species encountered (presence/absence), and noted the presence of iguanas or their feeding marks (on leaves) in each vegetation type. In addition, we set up a 10 m wide belt transect across the island (transect length approx. 500 m), mostly covering tropical dry forest, to determine forest composition following Gentry (1988). This Gentry transect consisted of 10 smaller transects (50×2 m), spaced 10 m apart.

Because iguanas appeared to be almost exclusively restricted to forested areas (Harlow and Biciloa 2001), we established six line transects (250 × 10 m) during our second trip, from 12 to 22 September 2005; two in each putatative tropical dry forest subtype: tropical dry forest, coastal tropical dry forest (tropical dry forest with high abundance of coastal vegetation species), and *Casuarina* forest with abundant tropical dry forest understory. In these transects the abundance of all tree species was recorded, and they were categorized as either canopy or understory species.

During both trips, species were identified in the field where possible. Species that could not be identified in the field samples were collected and identified at the South Pacific Regional Herbarium (SUVA) using Smith (1979–1991). Data from both surveys were combined to produce a comprehensive plant list for the island (see Appendix).

Habitat Mapping

We used a MobileMapper Pro (Thales Navigation) to map the following vegetation types on Yadua Taba: tropical dry forest, coastal vegetation, coastal tropical dry forest (areas in tropical dry forest with high abundance of coastal vegetation species), *Casuarina* forest (areas in shrubland/grassland dominated by *Casuarina equisetifolia*), rocky cliff and shrubland/grassland combined, and *Leucaena leucocephala* forest. The mobile mapper was used while walking around the edge of each vegetation type to delineate and accurately plot habitat boundaries. *Casuarina* forest was mapped separately from shrubland/grassland vegetation, because two iguana transects (described in the next section) were exclusively in this habitat type. We mapped the rocky-cliff vegetation and the remaining shrubland/grassland vegetation as a combined habitat because there were no iguana transects in either of those vegetation types and because they were always adjoining.

Iguana Surveys

TRANSECT SETUP AND SURVEY DATES. In September 2005 we set up six permanent 250 m long transects in the three forest habitat types: two transects in each of tropical dry forest, coastal tropical dry forest, and *Casuarina* forest. We focused on forest habitats because other vegetation types had few or no iguanas in them (Harlow and Biciloa 2001, Harlow et al. 2007). Each transect was surveyed once on each of four survey trips: 12–23 September 2005 (referred to herein as September), 28 November–9 December 2005 (December), 20 February–3 March 2006 (February), and 29 May–9 June (June). Based on our previous fieldwork, these survey times were chosen to reflect major seasonal differences in weather and plant phenology. We did not set up transects in the rocky-cliff–shrubland/grassland vegetations because they consisted mainly of grassland and low shrubs (not favored by iguanas [Harlow and Biciloa 2001]) or in the introduced *L. leucocephala* patches because they were too small to accommodate a 250 m transect (also not favored by iguanas [Harlow and Biciloa 2001]). True coastal vegetation was also not surveyed due to the small size of the habitat.

TRANSECT SURVEYS. We used line transects (Harlow and Biciloa 2001) for the iguana surveys. Although the iguanas are diurnal animals, they are extremely cryptic and difficult to observe during the day. They are easier to spot at night while sleeping on horizontal branches because their pale ventral surface contrasts markedly with the surrounding vegetation. Iguanas were clearly visible up to 20 m high even in relatively thick vegetation. Each night four searchers (two on either side of the central line) with strong torches surveyed all iguanas along the transect line. We searched all trees, shrubs, and vine mats up to 25 m high paying particular attention to those directly above the line. On each side of the transect line one searcher walked roughly 1 m from the line while the other walked roughly 4–5 m from the line. This allowed us to search for iguanas from a wider range of angles as well as directly above the line. For each iguana observed we recorded its perpendicular distance to the central line (to nearest 0.1 m) using tape measures and estimated its height to the nearest 0.5 m.

Analyses

VEGETATION. All species were classified as either endemic, indigenous, or recently introduced to Fiji. Presence/absence data for the various vegetation types were used to create a Bray-Curtis similarity matrix, which was used for nonmetric multidimensional scaling with 200 restarts using PRIMER 5 (Clarke and Gorley 2001).

The frequency of species in the Gentry transect was used as an estimate of their abundance, and the diameter at breast height (dbh) was used to calculate the basal area (basal area $= \pi[\frac{1}{2}\ \text{dbh}]^2$) as an estimate of their relative dominance. The data were then compared with those of similar transects in Fiji (T. W. Gillespie, unpubl. data).

Abundance data from the six 250×10 m transects were divided into canopy trees and understory trees after introduced species had been removed. Introduced species were excluded from the analysis because they are not exclusive to different habitat types and were often found in all vegetation types to various extent. Canopy and understory data were subjected to nonmetric multidimensional scaling based on Sorensen similarity using the Community Analysis Package 2.15 (Henderson and Seaby 2002). We tested the null hypothesis that there are no significant differences between the three vegetation subtypes (tropical dry forest, coastal tropical dry forest, and *Causarina* forest) for all data sets (canopy, understory, and combined) by analysis of similarity (ANOSIM) using PRIMER 5 (Clarke and Gorley 2001). The sample statistic (Global *R*) produced during ANOSIMs is similar to that of the Pearson Correlation Coefficient (*R*). If Global $R = 0$, the groups are completely similar, if Global $R = 1$, the groups are completely dissimilar. The ANOSIM was conducted on a square-root transformed Bray-Curtis similarity matrix with 999 permutations.

HABITAT AREA. Using the Geographic Information System (GIS) data from on-the-ground mapping, aerial photos, and the computer program Corel Draw 12.0, we generated a habitat map of Yadua Taba and calculated the area of occurrence of each habitat type. This was done by using the aerial photo to provide the outline area of the island, and the GIS data were used to overlay habitat boundaries on this outline. We used Corel Draw to calculate the area of each habitat type.

IGUANA ABUNDANCE ESTIMATES. We used the computer program Distance 4.1 (Thomas et al. 2004) to fit detection functions and determine iguana abundance per hectare for each of the forest types studied based on transect counts. We analyzed the data from each transect and trip separately. We then estimated the total number of crested iguanas on the entire island by multiplying the average calculated densities of iguanas for each vegetation type by the area of those habitats available. As we resurveyed the same transects each time on Yadua Taba, iguana abundance and density in each forest habitat were compared using repeated measures Analyses of Variance (ANOVAs). SPSS Version 13.0 was used for the analyses and α was set at 0.05.

RESULTS

Vascular Plant Flora

A total of 140 vascular plant species was identified during the survey. Indigenous vascular plants on the island made up 79% (110 species) of the flora. Fifteen species (14% of the indigenous flora) are endemic, most of which are relatively common in Fiji. *Cynometra falcata*, *Croton metallicus*, and *Excoecaria acuminata*, however, are restricted to Fiji's dry zone.

Seven of the invasive plants present, *Mikania micrantha*, *Sphagneticola trilobata*, *Samanea saman*, *Passiflora foetida*, *L. leucocephala*, *Annona glabra*, and *Lantana camara*, are of concern, because these may establish in natural vegetation (Meyer 2000). The remaining invasive species are usually restricted to disturbed vegetation.

Vegetation Types

Six major vegetation types (and several subtypes) were identified based on the dominant canopy species (Figure 1, Table 1): (1) coastal

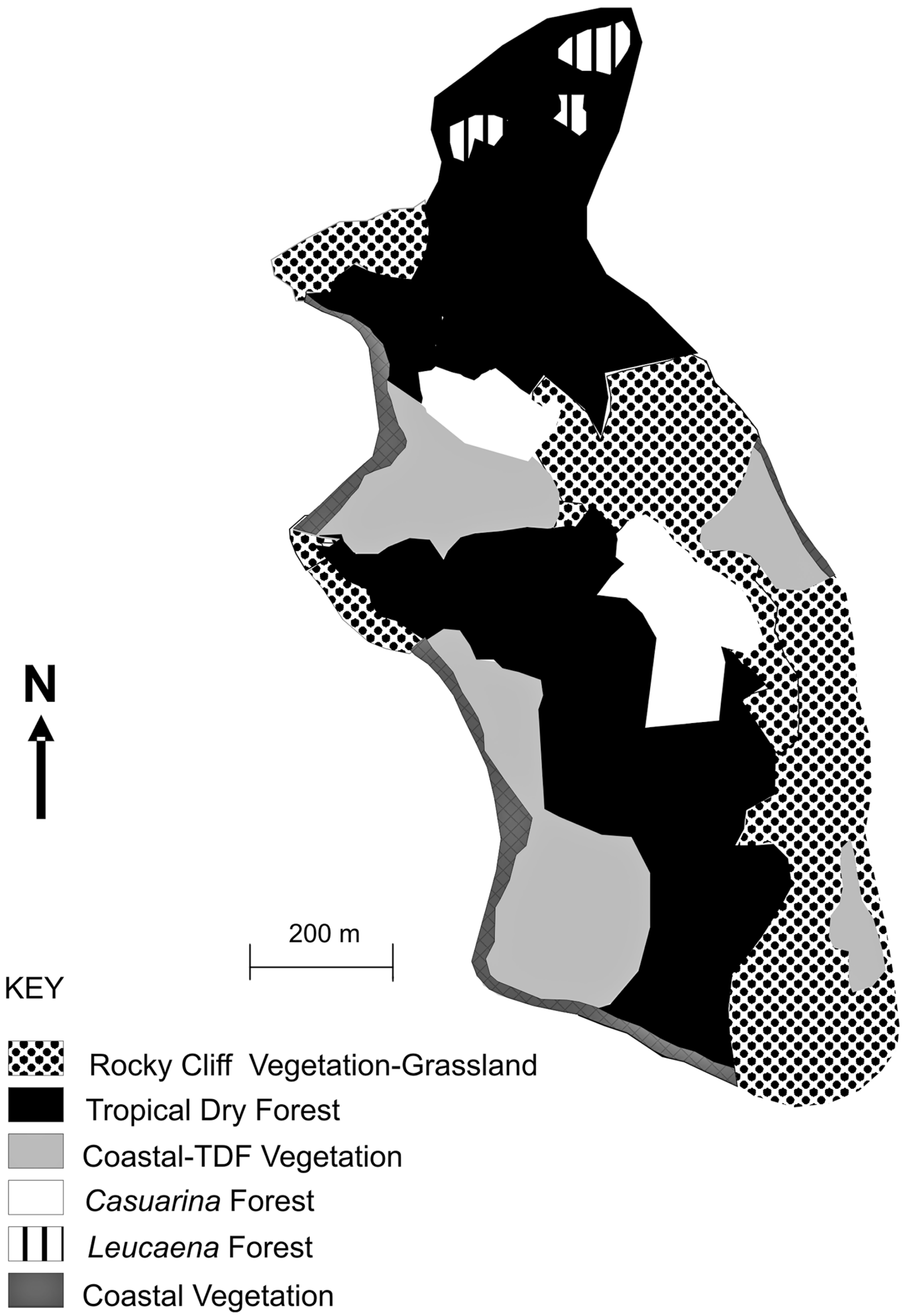

FIGURE 1. Vegetation map of Yadua Taba.

TABLE 1

Summary of Species Richness, Dominant Species, and Observed Presence of Iguanas in the Vegetation Types on Yadua Taba

Vegetation Type	No. of spp.	Dominant spp.	Iguanas?
1. Coastal vegetation			
(a) Beaches	58	Herbaceous zone: *Stenotaphrum micranthum*, *Thuarea involuta*, *Lepturus repens*, *Vigna marina*, *Ipomoea macrantha*, *Ipomea pes-caprae*, *Canavallia sericea;* shrub zone: *Colubrina asiatica*, *Clerodendron inerme*, *Vitex trifolia*, *Scaevola taccada*, *Eugenia reinwardtiana*, *Acacia simplex;* forest zone: *Neisosperma oppositifolia*, *Terminalia* spp., *Millettia pinnata*, *Cocos nucifera*, *Hibiscus tiliaceus*, *Thespesia populnea*, *Planchonella grayana*, *Calophyllum inophyllum*, *Guettarda speciosa*	Yes (forest)
(b) Rocky shores	63	Herbaceous zone: *Mariscus javanicus*, *Fimbristylis dichotoma;* shrub zone: *Xylocarpus moluccensis*, *Dendrolobium umbellatum*, *Clerodendron inerme;* forest zone: *Calophyllum inophyllum*, *Excoecaria agallocha*, *Homalium vitiense*, *Guettarda speciosa*, *Thespesia populnea*, *Planchonella grayana* (understory: *Casearia richii*, *Excoecaria acuminata*, *Hibiscus tiliaceus;* climber: *Derris trifoliata*)	Yes (forest)
2. Rocky-cliff vegetation	13	Shrubs: *Croton metallicus*, *Ficus tinctoria*, *Clerodendron inerme*, *Maesa tabacifolia*, *Solanum viride*, *Vitex trifolia;* herbs: *Bothriochloa bladhii*, *Cheilanthes hirusta*, *Elaeocharis geniculata*, *Digitaria radicosa*, *Oxalis corniculata*	No
3. Tropical dry forest			
(a) Inland	62	Canopy: *Gyrocarpus americanus*, *Erythrina variegata*, *Millettia pinnata*, *Ficus obliqua*, *F. prolixa*, *Kingiodendrum platycarpum*, *Cynometra insularis*, *Planchonella grayana*, *Pittosporum brackenridgei*, *Drypetes vitiensis* (subcanopy: *Vavaea amicorum*, *Mallotus tiliifolius*, *Diospyros elliptica*, *Micromelum minutum*, *Antirhea inconspicua;* climbers: *Ventilago vitiense*, *Pteris ensiformis*, *Cheilanthes hirsuta*)	Yes
(b) Coastal	69	Similar to 3(a) but *Cordia subcordata*, *Erythrina variegata*, *Psydrax odorata* common, and *Ficus obliqua*, *F. prolixa*, *Kingiodendrum platycarpum*, *Drypetes vitiensis*, and *Antirhea inconspicua* are absent or rare	Yes
4. *Casuarina* forest			
(a) Grass understory	34	Canopy: *Casuarina equisetifolia;* herbs: *Pennisetum polystachion*	No
(b) Tropical dry forest understory	30	Canopy: *Casuarina equisetifolia*, *Glochidion vitiense*, *Tabernaemontana pandacaqui*, *Micromelum minutum*, *Vavaea amicorum*	Yes
5. Grasslands			
(a) *Pennisetum*-dominated	23	*Pennisetum polystachion*	No
(b) *Miscanthus*-dominated	21	*Miscanthus floridulus*	No
6. *Leucaena* forest	12	*Leucaena lecocephala*	No

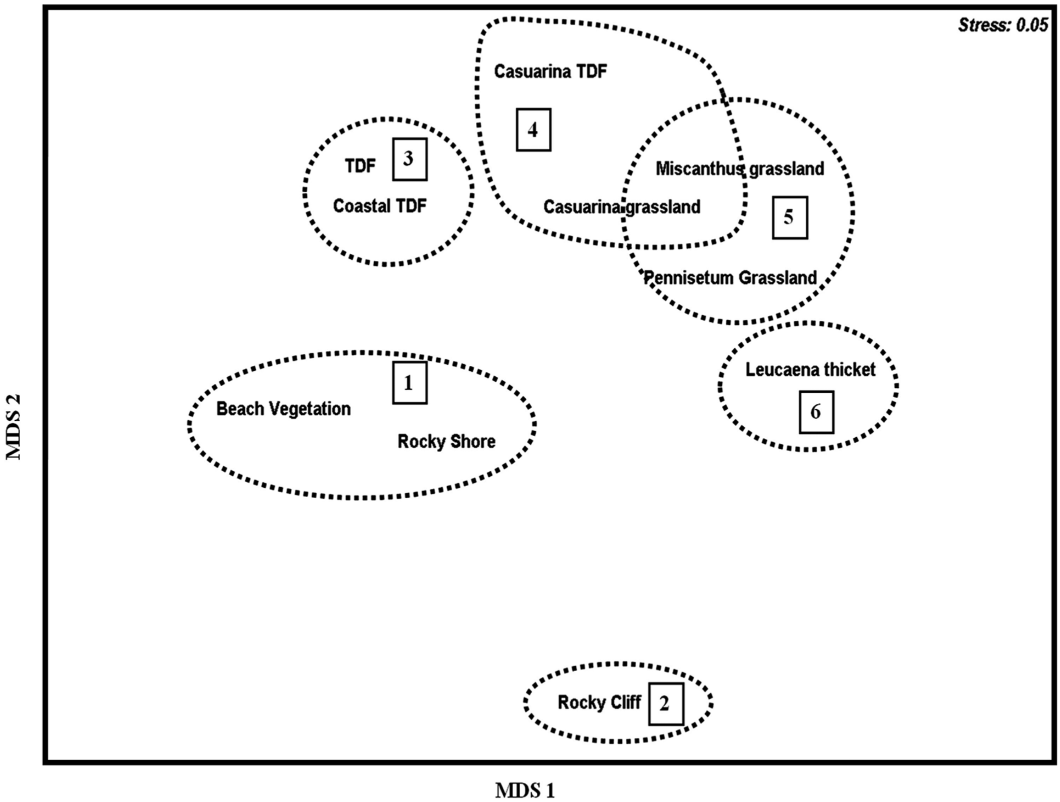

Figure 2. Nonmetric multidimensional scaling plots of transects using presence/absence data from the various vegetation types. 1, Coastal vegetation (including sandy beach and rocky-shore vegetation); 2, rocky-cliff vegetation; 3, tropical dry forest (including coastal and inland tropical dry forest); 4, *Casuarina* forest (including *Casuarina* forest with grassland and tropical dry forest understory); 5, grasslands (including those dominated by *Pennisetum polystachion* and those dominated by *Miscanthus floridulus*); 6, *Leucaena lecocephala* shrubland.

vegetation, (2) rocky-cliff vegetation, (3) tropical dry forest (including true tropical dry forest and coastal tropical dry forest), (4) *Casuarina* forest, (5) shrubland/grasslands, and (6) *Leucaena* forest. These vegetation types generally form separate clusters on the nonmetric multidimensional scaling plot (Figure 2), although there was some overlap between the shrubland/grasslands and the *Casuarina* forest with grassland understory.

Yadua Taba's coastal vegetation does not differ much from that found on nearby smaller islands (Mueller-Dombois and Fosberg 1998, Ghazanfar et al. 2001). On sandy beaches, the three zones (herbaceous, shrub, and forest) are well developed, but on rocky shores this horizontal stratification is much less pronounced than on sandy beaches and almost entirely lacking in some areas. On rocky cliffs, which had a limited number of species, plant species adapted to harsh conditions were observed (e.g., *C. metallicus* and *Elaeocharis geniculata*).

Two types of grasslands with occasional shrubs were present: one dominated by *Miscanthus floribundus* and the other by *Pennisetum polystachion*. At the northern end of the island, *L. leucocephala* formed almost pure stands in some locations, reaching 7 m in height.

The tropical dry forest reaches 15–20 m in height, with the canopy dominated by deciduous trees (e.g., *Gyrocarpus americanus*, *Erythrina variegata*, *Millettia pinnata*), strangler figs

TABLE 2

Basal Area and Abundance of Plant Species in the Gentry Transect (500 m Belt Transect Composed of 10 × 50 m Subtransects in Tropical Dry Forest)

Species	Basal Area (m^2)	Abundance
Mallotus tiliifolius	1.1527	61
Gryrocarpus americanus	1.0005	11
Erythrina variegata	0.9164	5
Vavaea amicorum	0.7818	131
Premna protrusa	0.1412	1
Antirhea inconspicua	0.1116	5
Drypetes vitiensis	0.0995	1
Diospyros phlebodes	0.0861	11
Glochidion vitiense	0.0840	1
Psydrax odorata	0.0357	4
Micromelum minutum	0.0186	18
Capparis quiniflora	0.0107	5
Derris trifoliata	0.0099	6
Morinda citrifolia	0.0075	1
Lantana camara	0.0105	9
Tabernaemontana pandacaqui	0.0044	4
Mucuna gigantea	0.0029	3
Planchonella grayana	0.0013	1
Ficus barclayana	0.0007	1

(e.g., *Ficus obliqua*), and nondeciduous species (e.g., *Kingiodendrum platycarpum*, *Cynometra insularis*, *Planchonella grayana*, *Pittosporum brackenridgei*, *Drypetes vitiensis*). *Gyrocarpus americanus*, *E. variegata*, *Mallotus tiliifolius*, and *Vavaea amicorum* contributed about 86% of the total basal area in the Gentry transect (Table 2). The latter two species are understory species (and contributed about 69% of all stems), and the former two are canopy species. In the six line transects other species, some of which were not encountered in the Gentry transect, were also abundant (Table 3). Near the coast, species associated with coastal vegetation (e.g., *Cordia subcordata*, *E. variegata*, *Psydrax odorata*) are important elements, forming a vegetation subtype that is here called coastal tropical dry forest (Table 3). A total of 277 individual plants belonging to 19 species (15 trees and four lianas) with an extrapolated average basal area of 0.48 m^2 ha^{-1} was encountered in the Gentry transect. Near the main ridge of the island *C. falcata* is locally common.

Casuarina forests often form a link between the tropical dry forest and scrubland/grassland vegetation. These forests range from almost pure, dense stands of *C. equisetifolia* to more widely spaced *C. equisetifolia* canopy with an understory of the grass *P. polystachion* (*Casuarina* woodland) to *C. equisetifolia* canopy with a subcanopy or understory of tropical dry forest species, including *Tabernaemontana pandacaqui*, *V. amicorum*, *Micromelum minutum*, and *Glochidion vitiense*. High abundance of *C. equisetifolia* and *T. pandacaqui* differentiate *Casuarina* forest (with tropical dry forest species undergrowth) from tropical dry forest and coastal tropical dry forest (Table 3).

TABLE 3

Abundance of Common Trees and Shrubs in Tropical Dry Forest (TDF), Coastal TDF, and *Casuarina* Forest

Species	TDF[a]	Coastal TDF[a]	*Casuarina* Forest[a]
Casearia richii	+	+	0
Casuarina equisetifolia	x	0	++
Cocos nucifera	x	0	+
Cordia subcordata	0	+	0
Cordyline fruticosa	+	0	0
Cynometra insularis	++	+	0
Decaspermum vitiense	+	++	x
Diospyros spp.	+++	+++	+++
Erythrina variegata	0	x	0
Eugenia reinwardtiana	++	+	x
Ficus barclayana	0	+	0
Ficus obliqua	0	0	+
Glochidion vitiense	+	+	++
Gyrocarpus americanus	+	+	++
Hibiscus tiliaceus	+	0	0
Kingiodendrum platycarpum	+	+	0
Mallotus tiliifolius	+	+++	+
Melochia degeneriana	+	x	x
Micromelum minutum	+++	+++	+++
Millettia pinnata	+	x	+
Pittosporum brackenridgei	+	x	x
Planchonella grayana	++	0	x
Premna protrusa	0	x	x
Psydrax odorata	x	+++	+
Tabernaemontana pandacaqui	+	++	+++
Terminalia catappa/litoralis	+	x	x
Thespesia populnea	0	x	x
Vavaea amicorum	+++	+++	+++

[a] +++, superabundant (>100 individuals); ++, abundant (50–100 individuals); +, common (10–49 individuals); x, uncommon (<10 individuals); 0, absent.

TABLE 4

Number of Iguanas Sighted per 250 m Transect and Iguana Density Estimates (per ha, with 95% Confidence Intervals) for Each Transect on Yadua Taba (Also Included Are Coordinates of Starting Point of Each Transect and Direction)

Transect[a]	Sep. 2005	Dec. 2005	Feb. 2006	Jun. 2006	Average	Lat./Long. (Direction)
TDF1	59	79	67	54	67.3	16° 50′ 13.38″ S
	213.0	242.7	311.0	224.1	247.6	178° 16′ 38.36″ E
	(152–299)	(181–325)	(226–428)	(123–410)		(115° E)
TDF2	100	104	97	76	94.3	16° 50′ 7.51″ S
	247.2	235.1	310.1	299.2	272.8	178° 16′ 35.89″ E
	(183–334)	(177–313)	(209–461)	(219–410)		(115° E)
CA1	28	11	20	16	18.0	16° 50′ 0.65″ S
	94.1	37.7	54.8	40.5	56.8	178° 16′ 42.41″ E
	(55–160)	(15–94)	(27–107)	(20–81)		(150° E)
CA2	28	36	45	48	38.8	16° 49′ 52.5″ S
	96.4	78.7	122.3	154.3	112.9	178° 16′ 32.29″ E
	(59–156)	(46–135)	(80–187)	(101–235)		(150° E)
CTF1	57	47	70	44	54.5	16° 49′ 56.65″ S
	172.3	126.1	196.4	111.2	151.4	178° 16′ 35.26″ E
	(120–248)	(83–193)	(137–281)	(73–171)		(150° E)
CTF2	42	111	63	122	84.5	16° 50′ 13.52″ S
	159.7	267.3	198.1	364.4	247.3	178° 16′ 38.21″ E
	(107–238)	(202–354)	(118–334)	(251–528)		(150° E)

[a] TDF, tropical dry forest; CA, *Casuarina* forest; CTF, coastal tropical dry forest.

Tropical Dry Forest Heterogeneity

The three putative subtypes of tropical dry forest (tropical dry forest, coastal tropical dry forest, and *Casuarina* forest) were very similar when the whole data set was considered (Global $R = 0.283$). This was due to the understory being similar in all three forest subtypes (Global $R = 0.230$), with *Diospyros* spp., *M. minutum*, and *V. amicorum* dominating all subtypes (Table 2). When canopy trees were considered separately, however, the three vegetation subtypes were considerably different (Global $R = 0.452$).

Habitat Area

The largest habitat type on Yadua Taba was tropical dry forest (33.6 ha, 46% of island [Figure 1]) followed by the rocky cliff/grassland combination (19.2 ha, 26%). Coastal tropical dry forest vegetation covered 18% (13.5 ha) of Yadua Taba, and *Casuarina* forest and true coastal vegetation were poorly represented, covering only 6% (4.6 ha) and 2% (1.34 ha), respectively. *Leucaena leucocephala* stands covered 1% of the island (0.9 ha).

Abundance and Density of Iguanas in Each Habitat

The abundance of iguanas on transects ranged from 11 to 122 per 250 m transect (Table 4). There were significantly more iguanas found on transects located in tropical dry forest and coastal tropical dry forest than in *Casuarina* forest (repeated measures ANOVA: habitat $F = 71.04$, df $= 1, 3$, $P = .004$; transect $F = 9.311$, df $= 1, 1$, $P = .08$; habitat*transect $F = 0.228$, df $= 1, 3$, $P = .665$).

The density estimates of iguanas ranged from 38 iguanas/ha in *Casuarina* forest to over 360/ha in coastal tropical dry forest (Table 4). On average, the density of iguanas was significantly highest in tropical dry forest followed by coastal tropical dry forest (repeated measures ANOVA: habitat $F = 49.17$, df $=$ $1, 3$, $P < .001$; transect $F = 3.581$, df $= 1, 1$, $P = .155$; habitat*transect $F = 1.325$, df $=$ $1, 3$, $P = .334$). Although seasonal variation in iguana density on any given transect ranged from 56 iguanas/ha (minimum 38/ha in December, maximum 94/ha in September on transect 2) to over 160 iguanas/ha (minimum 198/ha in February, maximum 364/ha

TABLE 5

Number of Iguanas in Each Habitat Type Based on Habitat Area and Average Iguana Density in Each Habitat (Values in Parentheses Represent Range of Density Estimates for Each Habitat Type Based on Seasonal Variation)

Habitat	Habitat Area (ha)	Average Iguana Density per ha[a]	No. of Iguanas
Tropical dry forest	33.61	260.2 (213–311)	8,745.3 (7,791–11,213)
Coastal tropical dry forest	13.53	199.4 (111–267)	2,697.8 (1,581–3,699)
Coastal vegetation[b]	1.34	111.2	149.0
Casuarina forest	4.66	84.9 (38–122)	395.6 (177–569)
Rocky cliff/grassland[c]	19.20	0	0
Leucaena forest[c]	0.95	0	0
Total	73.29		11,987.7 (9,549–15,481)

[a] Based on average of two transects in each habitat all seasons combined from Table 4.

[b] Because no transects were exclusively in coastal vegetation, we have used the lowest density estimate for iguanas in coastal tropical dry forest (111.2 iguanas/ha, coastal tropical dry forest transect 1) as the density of iguanas in this vegetation type.

[c] Due to results of previous studies (Harlow and Biciloa 2001), we do not assume that there are any iguanas in these habitats on Yadua Taba.

in June on transect 5), none of these differences was significant due to the large 95% CI associated with each of the estimates.

Overall Population Estimate for B. vitiensis *on Yadua Taba*

Previous studies by Harlow and Biciloa (2001) did not record iguanas in over 240 m of transect length of grassland habitat. We took a precautionary approach of underestimating rather than overestimating the population size of *B. vitiensis* on Yadua Taba and therefore did not assume that there were any iguanas in the rocky cliff/grassland habitat or the *Leucaena* thicket. This, in conjunction with the fact that it is unlikely that we observed all *B. vitiensis* on each transect (due to their cryptic nature), ensures that our estimate is a conservative estimate of the total population size.

Our overall population estimate for iguanas on Yadua Taba is 11,987 iguanas (95% CI 9,549–15,481 [Table 5]). The majority of these iguanas (73%) were found in tropical dry forest habitat, followed by 22% in coastal tropical dry forest.

DISCUSSION

Vegetation and Flora

Almost 80% of the 140 vascular plant species recorded on the island were indigenous. Only 15 species were endemic to Fiji, three of which are apparently restricted to Fiji's dry zone (*C. falcata*, *C. metallicus*, and *E. acuminata*). *Cynometra falcata* is listed as Critically Endangered under current IUCN (2007) criteria, and the other two species should be considered threatened due to their restricted distribution and threats to their habitat (Keppel and Tuiwawa 2007).

Gillespie (unpubl. data, 2006) compared the species richness of tropical dry forest on several islands in Fiji. The tropical dry forest species richness of Yadua Taba (based on the Gentry transect presented here) is lower than that on or near Fiji's biggest island, Viti Levu, but is similar to that of tropical dry forest on small islands in the Yasawa Group. Although it is not surprising that a larger island would be more species rich because of its larger species pool, our data show that there are at least 10 common tropical dry forest species on Yadua Taba that were not represented in the Gentry transect, including *C. insularis* and

Eugenia reinwardtiana, which were "abundant" (Table 3) in our iguana transects. This casts doubt on the ability of single belt Gentry transects as proposed by Gentry (1988) to adequately estimate species richness in tropical dry forest. In addition, its validity as a method for comparing species richness should be vigorously tested.

Although the density of 277 individual trees per transect is close to the Fijian average, the Yadua Taba tropical dry forest had the highest basal area per hectare of all Fijian tropical dry forest surveyed by Gillespie (unpubl. data, 2006). This probably reflects the presence of large, mature trees due to the low frequency of anthropogenic burning.

Tropical dry forest is heterogeneous and we distinguish, based on the composition of canopy trees, three subtypes: "true" tropical dry forest, coastal tropical dry forest, and tropical dry forest below *Casuarina* trees, with coastal tropical dry forest forming a broad interface between "true" coastal forest and "true" tropical dry forest. The species composition of the understory, however, was similar among the three tropical dry forest subtypes and was dominated by *V. amicorum*, *M. minutum*, and *Diospyros* species. These species are also common elements in the more diverse understory of limestone forests in higher rainfall areas (Drake et al. 1996, Franklin et al. 1999, 2008).

Of the six vegetation types recorded, only coastal vegetation (which differed on sandy and rocky shores), tropical dry forest, and rocky-cliff vegetation are natural, and *Casuarina* forests, grasslands, and *Leucaena* thickets are the result of previous fires and goat grazing. That the latter three communities are not natural is supported by them being replaced by tropical dry forest (see next section). The absence of *C. equisetifolia* seedlings in *Casuarina* forest with tropical dry forest species in the understory also suggests that the remnant *Casuarina* trees will be replaced by tropical dry forest after they die.

Forest Regeneration

Yadua Taba was most likely originally covered largely by tropical dry forest (Latham 1983, Southern 1986) and coastal forest with limited coastal scrub and rocky-cliff vegetation in the most windblown and steep, rocky areas. Grazing by introduced goats and the subsequent frequent use of fire to herd the goats substantially reduced the forest cover, resulting in large scrubland and grassland areas on the island.

Comparing our habitat map with historical maps (e.g., Gibbons 1984, Laurie et al. 1987) and aerial photographs (Fiji Department of Lands and Surveys 1994), Yadua Taba appears to be rapidly regaining forest cover. Between 1987 and 1994, less than 30% of the island was covered by tropical dry forest and coastal vegetation (Gibbons 1984, Laurie et al. 1987, Fiji Department of Lands and Surveys 1994), but today forest cover is roughly 65% (this study). The grasslands and scrublands appear to be diminishing most quickly in the central and southern sections of the island. The northern section still supports considerable areas of scrub and stands of the introduced plant *L. leucocephala*, and forest recovery seems slowest in this area (Raghu et al. 2005). The National Trust of Fiji in conjunction with weed specialists from Taronga Zoo, the University of New South Wales, and the villagers of Denimanu (traditional custodians of Yadua Taba) have been conducting a weed eradication program to reduce the raintree, *S. saman*, population on Yadua Taba to further improve tropical dry forest regeneration (Taylor et al. 2005).

Why Are There So Many Iguanas in Tropical Dry Forest?

Our conservative estimate of the population size of iguanas on Yadua Taba is approximately 12,000 iguanas. The majority of these iguanas were found in tropical dry forest (73%) and coastal tropical dry forest (22%) habitats. Previous published estimates of the population size of iguanas on Yadua Taba range from 200 (Gibbons 1981) to over 6,000 (Laurie et al. 1987, Harlow and Biciloa 2001) and also report higher abundances in tropical dry forest and coastal tropical dry forest. Few (3%) iguanas were found in *Casuarina* forest with tropical dry forest undergrowth, suggesting that a closed canopy, which *Casuarina* does not provide, may be important for iguanas to avoid predation by Pacific harriers (*Circus approximans*) (Harlow et al. 2007).

Our estimate of 12,000 iguanas on Yadua Taba with an average density over the whole island of 164 iguanas/ha (in tropical dry forest the average is 270 iguanas/ha) is currently the highest recorded density for terrestrial iguanas anywhere in the world and with the exception of tuataras is possibly the highest biomass/ha of reptiles in the world (Tyrrell et al. 2000).

The high abundance of *B. vitiensis* in the tropical dry forest habitat is possibly due to the higher densities of their preferred diet plant species in this habitat. Morrison et al. (2008) conducted a survey of the diet and perch preferences of *B. vitiensis* on Yadua Taba and concluded that despite the iguanas utilizing over 30 different plant species they were primarily consuming or perching in one of 11 species. These species were *V. amicorum*, *D. elliptica*, *M. minutum*, *Hibiscus tiliaceus*, *Jasminum didymum*, *M. tiliifolius*, *C. insularis*, *E. reinwardtiana*, *K. platycarpum*, *M. pinnata*, and *G. americanus* and were utilized in equal proportions by the different age-sex classes of iguanas. Many of these species are also abundant in limestone forest in the Lau Group (eastern Fiji [Franklin et al. 2008]) and Tonga (Drake et al. 1996, Franklin et al. 1999), where the Lauan banded iguana, *B. fasciatus*, is found.

Morrison et al. (2008) estimated the density of the 11 plant species preferred by iguanas in different vegetation types on Yadua Taba and found that the density of these species varied over the island (e.g., density of *V. amicorum* ranged from 248 to 1,400 plants/ha) but was highest in tropical dry forest habitats. *Hibiscus tiliaceus* and *M. pinnata* were the exception and were most abundant in coastal vegetation because they are primarily coastal forest species. There was a strong correlation between plant species density and utilization by iguanas. For example, *V. amicorum* was the most common tree species on the island and was most abundant in tropical dry forest habitats. It was also the most preferred diet and perch plant species of *B. vitiensis* irrespective of iguana age or gender on Yadua Taba (Morrison et al. 2008).

The high abundance of *V. amicorum* in Yadua Taba tropical dry forest (compared with other Fijian tropical dry forest [T. Gillespie, unpubl. data, 2006]) is intriguing. Fruits of *V. amicorum* are a major dietary component of iguanas and are transported by endozoochory (Morrison et al. 2008). Although birds are also important dispersers of *V. amicorum* (Fall et al. 2007), this suggests that the iguanas are having a strong impact on the composition of the vegetation on Yadua Taba (S. F. Morrison, Australian National University, pers. comm.).

Implications of Results for Tropical Dry Forest and B. vitiensis *Conservation*

The tropical dry forest of Yadua Taba is one of the least-disturbed fragments of tropical dry forest remaining in the Pacific (Keppel and Tuiwawa 2007). Although it has lower plant species richness than some other Fijian tropical dry forests (T. Gillespie, unpubl. data, 2006), the presence of threatened plant species endemic to Fijian tropical dry forests and *B. vitiensis* make it high priority for conservation. In addition, its current protected status makes it an ideal location to monitor the recovery trajectory of tropical dry forest toward its original condition before anthropogenic influences. From this monitoring, we will be able to increase our confidence in using it as a benchmark for tropical dry forest restoration and management in other sites throughout Fiji including Macuata Island, Vatia Peninsula (Viti Levu), Naicobocobo, and islands in the Yasawa Group.

The relatively good tropical dry forest habitat quality and the absence of predators including cats, dogs, and mongooses are the primary reasons for the high iguana density on Yadua Taba when compared with other Fijian islands. These factors not only influence basic individual survival (no predation) but also result in the provision of food of appropriate nutrient quality and availability, suitable vegetation structure for shelter, and soil moisture requirements for egg development. In addition, Yadua Taba provides seemingly ideal habitat for feeding, shelter, and reproduction of a population sufficiently large so that extreme environmental fluctuations (e.g., prolonged drought or tropical cyclones) or demographic stochasticity do not lead to extinction. As such, future translocations/reintroductions of *B. vitiensis* need to ensure that suitable tropical dry forest or coastal tropical dry forest habitat is present (to meet the requirements mentioned here) and predators are absent in translocation sites to improve the chances of translocation or reintroduction success.

The use of translocations for conservation raises a host of theoretical problems related to the ecology, population dynamics, behavior, and genetics of the species. Usually when dealing with endangered species one constraint overrides these theoretical issues: the number of translocated individuals is usually limited to minimize impacts on the source population. This should not be a major issue in translocations of *B. vitiensis* due to the large population on Yadua Taba. This is not to say that we can take as many iguanas as we want from Yadua Taba, but rather that we should (with appropriate knowledge of *B. vitiensis* population genetics and demography) be able to transfer a large enough number of individuals (essentially a minimum viable population size) to ensure that we are not compromising the success of the translocation due to constraints with population genetics and social structure, nor the security of the source population. Further research on the population dynamics and genetics of *B. vitiensis* is needed before we can determine the minimum viable population size and the minimum area of suitable habitat required for successful translocations.

Finally, it is important to understand that simply rehabilitating tropical dry forest sites and reintroducing iguanas is insufficient for the conservation management of both tropical dry forest and *B. vitiensis* in Fiji. Factors such as legislation, effective enforcement (e.g., use of rangers to monitor sites), fire control protocols, and long-term funding strategies are critical in the overall protection of future tropical dry forest rehabilitation sites and *B. vitiensis* translocation sites throughout Fiji and must be considered in any long-term conservation plans.

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Appendix

Vascular Plants of Yadua Taba Island, Fiji

- Pteridophyta (7 species)
  - Adiantaceae
    - _Cheilanthes hirsuta_ (Poir.) Mett.[I]
    - _Doryopteris concolor_ (Langsd. & Fisch.) Kuhn[I]
    - _Pteris ensiformis_ Burm.[I]
  - Aspleniaceae
    - _Asplenium australasicum_ Hook.[I]
  - Davalliaceae
    - _Davallia solida_ (Forst.) Sw. var. _solida_[I] (**kolumu**)
    - _Nephrolepis biserrata_ (Sw.) Schott[I]
  - Polypodiaceae
    - _Microsorum grossum_ (Langsd. & Fisch.) S. B. Andrews[I] (**vativati**)
- Monocotyledonae (24 species)
  - Agavaceae
    - _Cordyline fruticosa_ (L.) A. Chev.[I]
  - Amaryllidaceae
    - _Crinum asiaticum_ L.[I] (**viavia**)
  - Araceae
    - _Epipremnum pinnatum_ (L.) Engler[I] (**yalu**)
  - Arecaceae
    - _Cocos nucifera_ L.[I] (**niu**)
  - Cyperaceae
    - *_Eleocharis geniculata_ (L.) Roem. & Schult.
    - *_Fimbrystylis dichotoma_ (L.) Vahl
    - _Mariscus javanicus_ (Houtt.) Merr. & Metcalf[I]
    - _Scleria lithosperma_ (L.) Sw.[I]
  - Orchidaceae
    - _Corymborkis veratrifolia_ (Reinw.) Blume[I]
    - cf. _Eulophia_ R. Br. sp.
  - Pandanaceae
    - _Pandanus tectorius_ Parkinson[I] (**balawa**)
  - Poaceae
    - *_Bothriochloa bladhii_ (Retz.) S. T. Blake
    - *_Cenchrus echinatus_ L.
    - *_Cymbopogon refractus_ (R. Br.) A. Camus
    - _Digitaria radicosa_ (C. Presl) Miq.[I]
    - *_Eragrostis tenella_ (L.) P. Beauv. ex Roem. & Schult.
    - _Lepturus repens_ (G. Forst.) R. Br.[I]
    - _Miscanthus floridulus_ Warb. ex K. Schum. & Lauterb.[I] (**gasau**)
    - _Oplismenus hirtellus_ (L.) P. Beauv.[I]
    - *_Panicum maximum_ Jacq.
    - *_Pennisetum polystachion_ (L.) Schult. (**sotia, manivusi**)
    - _Stenotaphrum micranthum_ (Desv.) C. E. Hubb.[I]
    - _Thuarea involuta_ (G. Forst.) R. Br. ex Sm.[I]
  - Taccaceae
    - _Tacca leontopetaloides_ (L.) Kuntze
- Dicotyledonae (109 species)
  - Amaranthaceae
    - _Achyranthes aspera_ L.[I] (**soni veivi**)
  - Annonaceae
    - *_Annona glabra_ L.[I]
  - Apocynaceae
    - _Alyxia bracteolosa_ Rich ex A. Gray[I] (**vono**)
    - _Alyxia stellata_ Roem. & Schult.[I] (**vono**)
    - _Cerbera manghas_ L.[I] (**rewa**)
    - _Tabernaemontana pandacaqui_ Lam.[I] (**laqaiqai**)
    - _Neisosperma oppositifolia_ (Lam.) Fosberg & Sachet[I] (**vao**)

Appendix (continued)

Araliaceae
Polyscia multijuga Harms[I] (**danidani**)
Asclepiaceae
**Asclepias curassavica* L.
Asteraceae
Mikania micrantha* Kunth (wabosucu**)
**Synedrella nodiflora* Gaertn.
**Tridax procumbens* L.
Vernonia cinerea* (L.) Less. (nai masi ni kaukaumea**)
**Wedelia trilobata* (L.) Hitchc.
Wollastonia biflora (L.) DC.[I] (**cikawa**)
Boraginaceae
Cordia subcordata Lam.[I] (**nawanawa**)
Tournefortia argentea L.f.[I] (**hai yalewa**)
Caesalpinaceae
Cynometra falcata A. Gray[E] (**cibicibi**)
Cynometra insularis A. C. Sm.[I] (**cibicibi**)
Kingiodendrum platycarpum B. L. Burtt[E] (**moivi**)
Capparaceae
Capparis quiniflora DC.[I] (**yalewa kalukalu**)
Caricaceae
Carica papaya* L. (olete**)
Cassythaceae
Cassytha filiformis L.[I]
Casuarinaceae
Casuarina equisetifolia L.[I] (**nokonoko**)
Clusiaceae
Calophyllum inophyllum L.[I] (**dilo**)
Combretaceae
Terminalia catappa L.[I] (**tivi**)
Terminalia littoralis Pancher ex Guillaumin[I] (**tivi kei yalo**)
Convolvulaceae
Ipomoea macrantha Roem. & Schult.[I]
Ipomoea pes-caprae subsp. *brasiliense* (L.) v. Ooststr.[I] (**wa vulavula**)
Dichapetalaceae
Dichapetalum vitiense (Seem.) Engl.[I] (**bubumarase**)
Ebenaceae
Diospyros elliptica var. *elliptica* (J. R. Forst. & G. Forst.) P. S. Green[I] (**sisitika, kailoa**)
Diospyros phlebodes (A. C. Sm.) A. C. Sm.[E] (**sisitika, kailoa**)
Euphorbiaceae
Aleurites moluccana* (L.) Willd. (laci**)
**Chamaesyce atoto* (G. Forst.) Croizat[I]
Croton metallicus Müll. Arg.[E] (**yasi dravu**)
Croton microtiglium Burkill[I] (**molau yalewa**)
Drypetes vitiensis Croizat[I]
Excoecaria acuminata Gillespie[E] (**sinu ni vanua**)
Excoecaria agallocha L.[I] (**sinu ni baravi**)
Glochidion vitiense (Müll. Arg.) Gillespie[E] (**molau tagane**)
Mallotus tiliifolius (Blume) Müll. Arg.[I] (**yagata**)
Fabaceae
Abrus precatorius L.[I] (**lere**)
Canavalia sericea A. Gray[I] (**rau tolu, rau tolu voti, drau tolu**)
Dendrolobium umbellatum (L.) Benth.[I]
Derris trifoliata Lour.[I] (**tuva**)
Erythrina variegata L.[I] (**rara**)
Millettia pinnata (L.) Panigrahi[I] (**hari siga, tohiga**)
Mucuna gigantea (Willd.) DC.[I] (**wa kori**)
**Pueraria lobata* (Willd.) Ohwi
Sophora tomentosa L.[I]
Vigna marina (Burm.) Merr.[I]

Appendix (continued)

Flacourtiaceae
Casearia richii A. Gray[E]
Homalium vitiense Benth.[E]
Goodeniaceae
Scaevola taccada (Gaertn.) Roxb.[I] (**dreidrei**)
Hernandiaceae
Gyrocarpus americanus Jacq.[I] (**wiriwiri**)
Hernandia nymphaeifolia (Presl) Kubitzki[I] (**evuevu**)
Lecythidaceae
Barringtonia asiatica (L.) Kurz[I] (**vutu**)
Malvaceae
Hibiscus tiliaceus L.[I] (**vau**)
Thespesia populnea (L.) Correa[I] (**mulomulo**)
**Urena lobata* L.
Meliaceae
Vavaea amicorum Benth.[I] (**cevua)**
Xylocarpus moluccensis (Lam.) M. Roem.[I] (**leqileqi**)
Mimosaceae
Acacia simplex (Sparrman) Pedley[I] (**tataqia**)
Entada phaseoloides (L.) Merr.[I] (**wa tiqiri**)
Leucaena leucocephala* (Lam.) de Wit (vaivai**)
Samanea saman* (Jacq.) Merr. (vaivai mocemoce**)
Moraceae
Ficus barclayana (Miq.) Summerh.[E] (**losilosi**)
Ficus obliqua G. Forst.[I] (**baka**, **baka ni Viti**)
Ficus tinctoria G. Forst.[I] (**baka**, **baka ni Viti**)
Streblus anthropophagorum (Seem.) Corner[I]
Myrsinaceae
Maesa persicifolia A. Gray[E] (**bubumeirase**)
Maesa tabacifolia Mez[I]
Myrtaceae
Decaspermum vitiense (A. Gray) F. Niedenzu[E] (**nuqanuqa**)
Eugenia reinwardtiana DC.[I] (**kinikoro**, **qaqikoro**)
Psidium guajava* L. (quava**)
Olaceae
Ximenia americana L.[I] (**homuhomu**)
Oleaceae
Jasminum didymum subsp. *didymum* G. Forst.[I] (**gasau cebucebu**)
Jasminum simplicifolium G. Forst.[I]
Oxalidaceae
Oxalis corniculata* L. (rogomi**, **matakonikoni**)
Passifloraceae
Passiflora foetida* L. (poro matila**)
**Passiflora suberosa* L.
Pittosporaceae
Pittosporum brackenridgei A. Gray[I] (**duva kalou**)
Rhamnaceae
Colubrina asiatica (L.) Brongn.[I] (**vere**)
Ventilago vitiensis A. Gray[I] (**vere**)
Rhizophoraceae
Rhizophora stylosa Griff.[I]
Rubiaceae
Antirhea inconspicua (Seem.) Christoph.[I] (**bobo damu**)
Coprosma persicifolia A. Gray[E]
Guettarda speciosa L.[I] (**buabua**)
Morinda citrifolia L.[I] (**kura**)
Psychotria tephrosantha A. Gray[E]
Psydrax odorata (G. Forst.) A. C. Sm. & S. P. Darwin[I] (**noko ni savu**)
**Spermacoce assurgens* Ruiz & Pav.

Appendix (continued)

Rutaceae
Micromelum minutum (G. Forst.) Wright & Arn.[I] (**qiqila**)
Sapindaceae
Dodonaea viscosa Jacq.[I] (**wasi**)
Sapotaceae
Manilkara dissecta Dubard[I]
Planchonella grayana St. John[I] (**draubalavu**)
Solanaceae
Capsicum frutescens L. (**boro**) *
Solanum americanum Mill. *
Solanum viride Sol. ex G. Forst.[I] (**boro**)
Sterculiaceae
Heritiera littoralis [Dryand.][I]
Melochia degeneriana A. C. Sm.[E] (**vuvudi**)
Thymeleaceae
Wikstroemia foetida A. Gray[I] (**mudu**)
Tiliaceae
Grewia crenata Schinz & Guillaumin[I] (**kurulo**)
Ulmaceae
Trema cannabina L.[I]
Verbenaceae
Clerodendrum inerme L.[I] (**yaria**)
Lantana camara var. *aculeata* (L.) Moldenke (**bona ni bulumakau**) *
Premna protrusa A. C. Sm. & S. P. Darwin[E]
Vitex trifolia var. *trifolia* L.[I] (**drala**)
Unidentified species
cf. Vitaceae (climber)

Note: A more detailed list can be obtained from the authors. Names in **boldface** in parentheses after botanical name are plant names used in Denimanu village.

*, introduced; [I], indigenous; [E], endemic.