Ethnobotanical Study of the Medicinal Plants Known by Men in Ambalabe, Madagascar

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Research

Abstract

Madagascar has high biodiversity and endemism that are threatened by growing human populations and climate change. Species loss has potential impacts on traditional knowledge and community health. The aim of this project was to identify medicinal plants known and used by men in the Commune of Ambalabe sourced from the Vohibe Forest in eastern Madagascar. Interviews were conducted that resulted in collection of 137 plant species used by men to treat illnesses, 35% of which are endemic to Madagascar. Twelve tree species were shown to have the highest Use Index among the men in Ambalabe: *Noronhia gracilipes* H.Perrier, *Xylopia humblotiana* Baill., *Fenerivia ghesquiereana* (Cavaco & Keraudren) R.M.K.Saunders, *Phyllarthron bojeranum* DC., *Mauloutchia humblotii* (H.Perrier) Capuron, *Aphloia theiformis* (Vahl) Benn., *Dillenia triquetra* (Rottb.) Gilg, *Chrysophyllum boivinianum* (Pierre) Baehni, *Oncostemum boivinianum* H.Perrier, *Peponidium humbertianum* (Cavaco) Razafim., Lantz & B.Bremer, *Eugenia goviala* H.Perrier, and *Macaranga alnifolia* Baker.

Background

Madagascar, like many tropical countries, is confronted with biodiversity loss and conservation problems as a result of the continued destruction of natural habitats (Gade 1996, Gallegos 1997, Goodman & Patterson 1997, Green & Sussmann 1990, Mittermeier *et al*. 1994). This problem is usually caused by bush fires, fast clearing of vegetation for agricultural expansion, and forest exploitation and is exacerbated by climate change and high levels of poverty (Busch *et al*. 2012). These factors seriously affect the areas of primary forest in Madagascar and thus lead to a dramatic decline in the number of medicinal plant species available (Novy 1997) which in turn may lead to the decline in ecological and cultural knowledge regarding traditional healing (Lyon & Hardesty 2005). Malagasy rural people are highly dependent on medicinal plants for their healthcare needs, particularly to treat infectious disease (Randrianarivelojosia *et al*. 2003). Socio-economically, the practice of traditional medicine helps to meet certain needs of the local population (Rajerison 1999). Economically, local residents have difficulty accessing modern drugs because of their high costs. The use of traditional medicine is cost effective as harvesting plants for therapeutic use often costs significantly less than buying pharmaceuticals. Furthermore, people turn to traditional remedies as they believe they have little to no side effects.

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This research contributes to the understanding of the socio-economic importance of these plants in the study area and works to better identify factors involved in the degradation and therefore conservation measures. This study was designed to document the forest species used as medicine by men, through self medication as well as by traditional healers. Our focus was on the response of men, while a similar study conducted at the same time focused on the knowledge and utilization of medicinal plants by the women of Ambalabe. We separate these two studies for both cultural and scientific reasons, and in the future we will compare the two bodies of knowledge. Culturally, we were sensitive to the community's desire to keep data separate so gender plant preference was not confused or lumped together. Scientifically, we were interested in analyzing the data separately to add to the growing body of gendered use studies (Ayantunde *et al*. 2008, Bussmann & Glenn 2010, Camou-Guerrero *et al*. 2008, Wayland 2011). Our hypothesis was that men in the community have specialized plant knowledge pertaining to only male health concerns.

Ambalabe community

Vohibe Forest is located within the rural municipality of Ambalabe, District Vatomandry, Atsinanana Region, and is the primary natural resource for this community. The community is predominately Betsmisaraka, which is characterized by large families with their respective leaders as well as the **tangalamena**, who are generally the eldest males and considered community spiritual leaders and close to the ancestor spirits. According to the census conducted in 2010 by the community, the population of the rural municipality of Ambalabe consists of 9036 inhabitants: 4252 men and 4784 women.

Access to markets and healthcare

Ambalabe is extremely isolated from the bustling marketplace in Vatomandry, the closest port town on the Indian Ocean. A road and bridge once connected Ambalabe to Vatomandry, but extreme weather destroyed the infrastructure in the 1970s. The community has been working to rebuild the road, but funding is problematic. The isolation of Ambalabe from other communities makes markets and healthcare options less accessible. Ambalabe Commune has a Center of Basic Health Level II (CSB II) located in the largest **fokontany**, or village, also named Ambalabe. However, the center cannot meet the demand for medical care of the population of all villages. Therefore, only people with serious illnesses consult the doctor, which is why the population often seeks traditional plant-based medicine instead of making use of modern medicine. Traditional healers still play important roles because often they have demonstrated the efficacy of certain plants in treating many diseases (Andriamaholy 1994). Data collected in 2006 show the CSB II found that patients were seen primarily for malaria (60%) and diarrhea (30%), with the remaining 10% seen for various diseases related to parasite infections.

Livelihood and economy

Shifting cultivation (**tavy**) is a way of life for the Betsimisaraka (Quansah 1988). A plot of cleared natural forest is cultivated for one or two years, then left fallow for three to seven years before being cultivated again. In this period, pioneer species like *Psiadia altissima* (DC.) Drake, *Trema orientalis* (L.) Blume, *Aframomum angustifolium* (Sonn.) K.Schum., *Lantana camara* L., and *Rubus mollucanus* L. are monitored by the farmers as these species are considered indicators of soil fertility, and their growth signals that the land is suitable for cultivation. Farmers use watersheds for rice cultivation, with or without other food crops such as *Manihot esculenta* Crantz, *Ipomoea batatas* (L.) Lam., *Musa* spp., *Colocasia antiquorum* Schott, and *Saccharum officinarum* L. Subsistence agriculture is the primary occupation in eastern Madagascar, but daily living needs are supplemented by forest products (Byg & Balslev 2001). Vohibe Forest provides firewood, timber, medicinal plants, and edible plants to the community.

Methods

Study site

Vohibe Forest is 3117 ha of low altitude moist evergreen forest and part of the Ankeniheny-Zahamena forest corridor, located in the northwestern part of the District of Vatomandry, Madagascar, between 48°32'–48°35' E and 19°06'–19°10' S (Figure 1).

The topography alternates between valleys and mountains at altitudes of 400–1008 m (Rakotoarivony & Rasoavity 2007). The study site is underlain with metamorphic rocks rich in hornblende, garnet, and graphite (Besairie & Collignon 1972). The climate is tropical and humid with average annual rainfall at 1773 mm (Morat 1973). There are two seasons experienced in Vohibe Forest, the hot and humid season lasting from November to April (average temperature of 26.7°C) and the cool season from May to October (the coolest month with an average temperature of 20.85°C).

Vohibe Forest transitions between the low altitude (400–800 m) dense evergreen forest characterized by a canopy of 20–30 m and the medium altitude forest (800–1008 m) with canopies of 17 m high (Faramalala & Rajeriarison 1999). Botanical inventories of Vohibe Forest have identified 672 species distributed in 126 families and 327 genera with a specific endemic rate of 76% (Rakotoarivelo *et al*. 2013). Primatologists have documented four families of lemurs within Vohibe Forest: the Indridae, the Lemuridae, the Cheirogaleidae, and the Daubentoniidae,

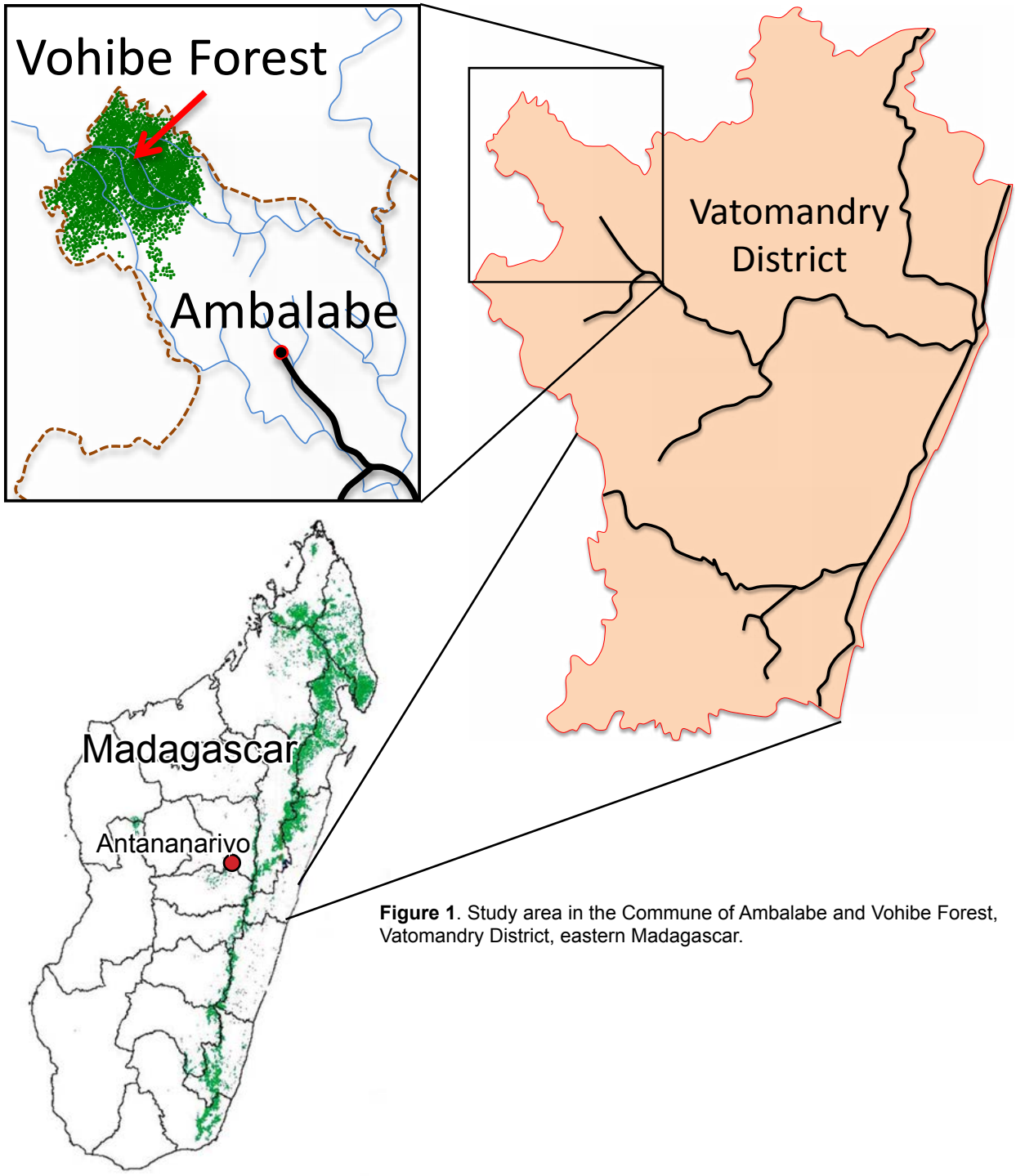

Figure 1. Study area in the Commune of Ambalabe and Vohibe Forest, Vatomandry District, eastern Madagascar.

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distributed across 10 species (Rakotoarivony & Rasoavity 2007).

Ethnobotanical surveys

Ambalabe community has participated as a community-based conservation site operated by the Missouri Botanical Garden since 2005. Collaborating with local staff to facilitate our ethnobotanical survey expedited the process of identifying potential informants and establishing interview schedules. Initial community visits were made in November to December 2008 and were devoted to making contact with the leaders of the village including the **tangalamena**, traditional leaders, and administrative heads of the municipality. Community meetings were widely advertised by our local collaborators before we arrived and were held in a community space. The preliminary phase was to familiarize ourselves with the residents and obtain a clear picture of the knowledge of medicinal plants by men and use of forest products in the life of the local population. A simultaneous study of the use of medicinal plants known and used by women was conducted by a female researcher. The results of that study are still pending.

The second field visit lasted 25 days in January–February 2009. Surveys were conducted with traditional healers, knowledgeable men, and the medical personnel of CSB II. Local guides facilitated introductions and helped identify traditional healers and those willing to share information. Informed consent was given by tribal leaders, government officials, and individuals prior to interviews. Information documented included species used, parts used, methods of collecting, locations of harvest, and diseases treated. Interviews were conducted in Malagasy by the first author, a native speaker, with dialect translation help by the local guide. In total, 177 men were interviewed from 18 villages in Ambalabe Commune. The ages ranged from 16 to 70 years of age (Figure 2). Participants listed occupations such as farmers, nurserymen, and government administrators.

Two modes of inquiry were employed: group interviews held in **lapa**, outdoor community spaces, and individual interviews with available men who were willing to share information. The surveys were conducted in the form of semi-direct questions with semi-open groups (Martin 1995). This approach allowed for flexibility in the conversation and open exchange with the informants. Interviews were conducted using two approaches: through illness (description of symptoms and designation of the plants used) or through the plant name (matching plant names to the therapeutic indications). Following the interviews, vouchers were collected both with the guides and with the local people in the areas of harvest. Plants were identified by their common name by the guides and local people. Vouchers were deposited at the Missouri Botanical Garden (MBG), the Herbarium of Parc de Tsimbazaza (TAN), and the Herbarium at the Centre National de la Recherche Appliquée au Developement Rural (TEF).

Quantitative analysis

To evaluate the species most used by the population, the Use Index (I%) of each species was calculated using the formula (Lance *et al*. 1994):

$$I\% = n/N \times 100$$

where I% is the percentage index of use, n is the number of people citing the species, and N is the total number of people surveyed. If the value of I% is between 60 and 100%, the species is well known; if I% is between 30 and

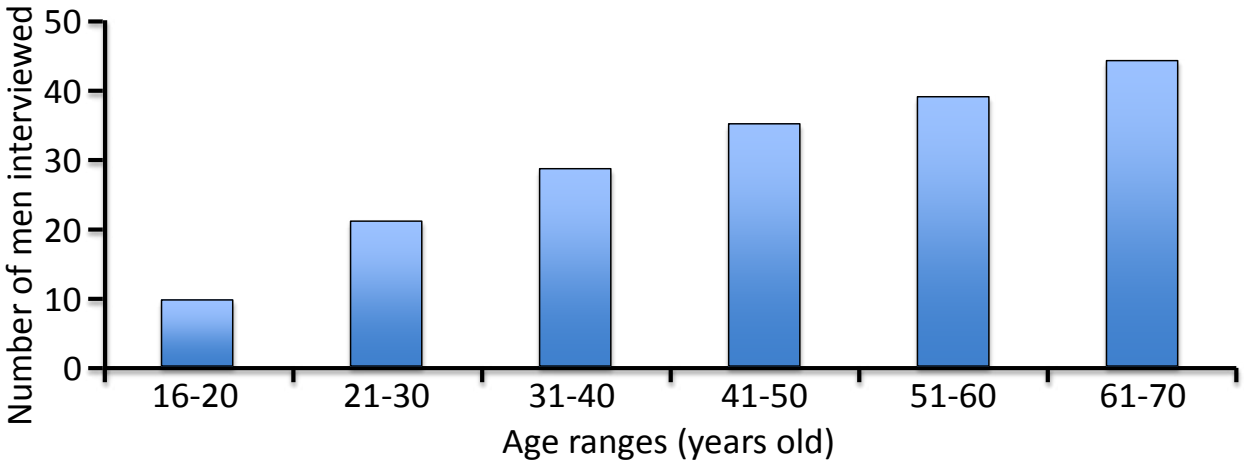

Figure 2. Men from the Commune of Ambalabe in eastern Madagascar interviewed about medicinal plants sourced from the Vohibe Forest.

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60%, the species is moderately known; if I% is less than 30%, the species is little known.

Results

The ethnobotanical survey revealed 137 forest and weedy species with therapeutic uses known by the men of Ambalabe Commune (Table 1). They belong to 69 families distributed in 120 genera. Thirty-five percent of these species are endemic to Madagascar (MadCat 2012).

In the study area, almost all the different plant parts (leaves, stem, root, and fruit) are used for healing. Leaves have the highest percentage of use (68%), followed by bark (10%) and stems (9%). Four methods of collecting

Table 1. Medicinal plants sourced from Vohibe Forest known by men of Ambalabe, Madagascar. Part used: **B**. Bark, **E**. Entire plant, **F**. Fruit, **L**. Leaf, **R**. Root, **RF**. Ripe fruit, and **S**. Stem. Distribution: **E**. Endemic to Madagascar, **I**. Indigenous or native to Madagascar,**C**. Comoros, **M**. Mascarene Islands, **S**. Seychelles, **Af**. Africa, **Cu**. Cultivated in Madagascar, **Na**. Naturalized in Madagascar, **As**. Asia, **Au**. Australasia, **N**. Neotropical, and **NE**. Not endemic or native to region.

Scientific Names	Vernacular Names	Part used	Disease/Use	Distribution
AMARANTHACEAE				
Amaranthus sp.	**Anampatsa**	S	Bilharzia	
Dysphania ambrosioides (L.) Mosyakin & Clemants	**Taimborintsiloza**	L	Intestinal parasites	Na
ANACARDIACEAE				
Abrahamia nitida (Engl.) Randrian. & Lowry	**Sefana**	L	Abdominal pain, urine retention, injury	E
Mangifera indica L.	**Manga**	L	Dental cavity	Cu
		B	Hemorrhoids, diarrhea	
Sorindeia madagascariensis DC.	**Voasirindrina**	L	Cancer, stomach pain, urine retention	C, I, Af
		R	Back pain	
ANNONACEAE				
Fenerivia ghesquiereana (Cavaco & Keraudren) R.M.K.Saunders	**Ambavy**	B	Gonorrhea, sexual problems	E
Xylopia humblotiana Baill.	**Hazoambo**	L	Back pain, stomach pain, fatigue, urine retention, dizziness	E
APHLOIACEAE				
Aphloia theiformis (Vahl) Benn.	**Fandramanana**	S	Dental cavity, fatigue, muscle pain	C, M, S, Af
		L	Wounds, burns, boils	
APIACEAE				
Centella asiatica (L.) Urb.	**Viliantsahona**	L	Boils	Na
APOCYNACEAE				
Catharanthus roseus (L.) G.Don	**Vonenina, revitambelona**	E	Cancer, stomach pain, urine retention, pancreas problems	E
Tabernaemontana ciliata Pichon	**Intona**	B	Stomach pain, malaria	E
		L	Stomach pain	
		L, S	Abdominal pain	
		S	Intestinal parasites	
AQUIFOLIACEAE				
Ilex mitis (L.) Radlk.	**Hazondrano**	L	Back pain	Af

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ARACEAE				
Typhonodorum lindleyanum Schott	**Via**	S	Wounds	C, M, Af
ARECACEAE				
Raphia sp.	**Rofia**	L	Wounds	
ASPARAGACEAE				
Dracaena reflexa Lam.	**Hasina**	RF	Boils	M, Af
ASTERACEAE				
Acanthospermum hispidum DC.	**Bakakely**	L	Diarrhea, abdominal pain, wounds	Af
Elephantopus mollis Kunth	**Angadoha**	L	Intestinal parasites	Cu
Helianthus annuus L.	**Tanamasoandro**	L	Intestinal parasites	Cu
Humbertacalia leucopappa (DC.) C.Jeffrey	**Vorovoka**	L	Gonorrhea	E
		L, S	Urine retention	
Oliganthes pseudocentauropsis (Humbert) Humbert	**Hazomboay**	B	Malaria, dental cavity	E
Psiadia altissima (DC.) Drake	**Dingadingana**	F	Deafness	E
		B	Dental cavity	
		S	Intestinal parasites	
Vernonia appendiculata Less.	**Antsotry**	L	Dental cavity	E
BIGNONIACEAE				
Phyllarthron bojeranum DC.	**Zahana**	L	Urine retention, stomach pain, fatigue, sexual problems, back pain, dizziness	E
BRASSICACEAE				
Nasturtium officinale W.T.Aiton	**Anandrano**	L	Hypertension	Cu
BROMELIACEAE				
Ananas comosus (L.) Merr.	**Mananasy**	Bud	Urine retention	Cu
CANELLACEAE				
Cinnamosma fragrans Baill.	**Fanalamangidy**	L, F	Intestinal parasites	E
		L	Dental cavity	
	Mandravasarotra	S	Abdominal pain	
Cinnamosma madagascariensis Danguy	**Sakarivohazo**	R	Diarrhea	E
CANNABACEAE				
Trema orientalis (L.) Blume	**Vakoka**	Seed	Dental cavity	Af
		L	Boil	
CARICACEAE				
Carica papaya L.	**Mampaza**	L	Stomach pain, dental cavity, urine retention, breast tumor	Cu
		R	Gonorrhea	
		F	Bilharzia	

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CHRYSOBALANACEAE				
Grangeria porosa Boivin ex Baill.	**Maitsoririnina**	L	Urine retention	E
COMBRETACEAE				
Terminalia sp.	**Atafanala**	L	Back pain	
COMMELINACEAE				
Rhopalephora rugosa (H.Perrier) Faden	**Lomanorano**	F	Cough	E
CONNARACEAE				
Agelaea pentagyna (Lam.) Baill.	**Vahimintina**	S	Malaria, abdominal pain, sexual problems, vision problems	C, M, Af
		B	Wound	
		L, S	Gonorrhea	
CRASSULACEAE				
Kalanchoe prolifera (Bowie ex Hook.) Raym.-Hamet	**Sodifafana**	L	Cough	E
CUCURBITACEAE				
Cucurbita maxima Duchesne	**Pongy**	L	Urine retention	Na
CYATHEACEAE				
Cyathea marattioides Willd.	**Fanjana, Faho**	L	Back pain	E
DILLENIACEAE				
Dillenia triquetra (Rottb.) Gilg	**Bararaka**	L	Sexual problems	E
Tetracera madagascariensis Willd. ex Schltdl.	**Vahimarana**	L	Intestinal parasites, back pain	E
ERYTHROXYLACEAE				
Erythroxylum sp.	**Menahihy**	L	Stomach pain	
		B	Diarrhea	
		S	Stomach pain	
EUPHORBIACEAE				
Euphorbia hirta L.	**Jean Robert**	S	Gonorrhea	Na
		L	Urine retention	
Euphorbia sp.	**Tanatanamanga**	L	Pancreas problems, increase blood protein content	
Hura crepitans L.	**Hazomboay**	L	Dental cavity, wound	NE
		B	Diarrhea	
Macaranga alnifolia Baker	**Mankaranana**	B	Diarrhea	E
		Latex	Boil	
Manihot esculenta Crantz	**Mangahazo**	L	Intestinal parasites	Cu
FABACEAE				
Abrus precatorius L.	**Voamaintilany**	B	Cough	Af , As
Cajanus sp.	**Antsotry morona**	L, S	Urine retention	
Cajanus sp.	**Antsotry**	L	Boils	

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Chamaecrista mimosoides (L.) Greene	**Ramirina**	L	Diarrhea, bilharzia	NE
		S	Fatigue	
Clitoria lasciva Bojer ex Benth.	**Vahitsikomba**	S	Wound	E
Crotalaria xanthoclada Bojer ex Benth.	**Maitsoririnina**	L, S	Diarrhea, intestinal parasites	Af
		L	Wound	
Desmodium ramosissimum G.Don	**Tsilavondrivotra**	L	Diarrhea, abdominal pain, dental cavity	NE
Entada gigas (L.) Fawc. & Rendle	**Vahinkarabo**	S	Boils, diarrhea	NE
Millettia hitsika Du Puy & Labat	**Hitsika**		Bilharzia	E
Phylloxylon sp.	**Harahara, arahara**	L	Stomach pain, fatigue, urine retention	E
GENTIANACEAE				
Exacum quinquenervium Griseb.	**Mamoahely**	R	Malaria	M
		B	Back pain	
HYPERICACEAE				
Harungana madagascariensis Lam. ex Poir.	**Harongana**	B	Diarrhea	C, M, Af
		L	Intestinal parasites, urine retention, increase blood protein content	
		S	Vision problems	
LAMIACEAE				
Cassytha filiformis L.	**Maroampototra**	S	Dental cavity	I
Clerodendrum aucubifolium Baker	**Atambalahy**	L	Wound	E
Clerodendrum sp.	**Sifontsohy**	L	Urine retention	
Ocimum gratissimum L.	**Romba**	L	Dental cavity, cough	C, M, S, Af, As
LYCOPODIACEAE				
Lycopodium clavatum L.	**Tanatrandraka**	L, S	Urine retention	I
		L	Boil, stomach pain	
		R, L	Malaria	
LYGODIACEAE				
Lygodium lanceolatum Desv.	**Famatotrakanga**	L	Diarrhea, pancreas problems, hypertension, fatigue, hemorrhoids	I
MALVACEAE				
Pavonia urens Cav.	**Tsontsona lahy**	L	Boils	Af
MELASTOMATACEAE				
Clidemia hirta (L.) D.Don	**Mazambody**	R	Stomach pains	Na
		L	Wounds	
Tristemma mauritianum J.F.Gmel.	**Voatrotroka**	L	Abdominal pain, bilharzia, urine retention	C, Af

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MELIACEAE				
Melia azedarach L.	**Voandelaka**	L, R	Pancreas problems	Na
		B	Intestinal parasites	
		L	Fatigue	
MENISPERMACEAE				
Strychnopsis thouarsii Baill.	**Tanteliravina**	R	Gonorrhea	E
MOLLUGINACEAE				
Mollugo nudicaulis Lam.	**Aferontany**	L	Increase blood protein content, cough	Au, Af, N
		E	Malaria, diarrhea, abdominal pain, infection during pregnancy	
		B	Burns	
MONIMIACEAE				
Tambourissa thouvenotii Danguy	**Ambora maventy**	L	Urine retention	E
MORACEAE				
Artocarpus integer (Thunb.) Merr.	**Ampalibe**	L	Diarrhea	NE
Artocarpus sp.	**Frampe**		Asthma	
Ficus sycomorus L.	**Voara**	F	Intestinal parasites	C, Af
Ficus polita Vahl	**Mandrisy**	L	Stomach pain, urine retention	Af
		E	Fatigue	
Ficus polyphlebia Baker	**Voararano**	L	Wound, gonorrhea	E
Ficus pyrifolia Burm.f.	**Nonoka**	L	Cough, wounds	E
Ficus politoria Lam.	**Ramiringitra**	B	Boils	E
Morus alba L.	**Voandroy**	L	Stomach pain, urine retention	Na
MUSACEAE				
Musa sp.	**Akondro**	L	Diarrhea	
		Trunk	Abdominal pain	
MORACEAE				
Streblus sp.	**Dipaty**	L	Wounds, urine retention	
MYRISTICACEAE				
Mauloutchia humblotii (H.Perrier) Capuron	**Ilondraharaha**	L	Cough	E
		F	Wound	
MYRTACEAE				
Eucalyptus sp.	**Kininina**	Bud	Abdominal pain	
Myrcianthes fragrans (Sw.) McVaugh	**Jirofo**	L	Malaria, dental cavity	N
Eugenia goviala H.Perrier	**Gavoala**	L	Stomach pain, diarrhea, dental cavity	E
Eugenia sp.	**Rotra**	B	Diarrhea	
Psidium cattleyanum Sabine	**Gavo madinika, goavy**	B	Diarrhea, abdominal pain, dental cavity	Na
Syzygium bernieri (Drake) Labat & G.E.Schatz	**Goaviala**	Bud	Stomach pain	E

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OLEACEAE				
Noronhia gracilipes H.Perrier	**Tsilaitra**	L	Malaria, dizziness	E
ONAGRACEAE				
Ludwigia octovalvis (Jacq.) P.H.Raven	**Tongobintsy**	L	Intestinal parasites	Af, N
PANDANACEAE				
Pandanus sp.	**Vakoana**	L	Fatigue	
PHYLLANTHACEAE				
Phyllanthus amarus Schumach. & Thonn.	**Mandrihariva**	E	Stomach pain	Na
Uapaca bojeri Baill.	**Vakoana**	R	Sexual problems	E
Uapaca sp.	**Voampaka kely**	L	Fatigue	
PHYSENACEAE				
Physena sp.	**Fanamamangidy**	S	Toxicity	E
PIPERACEAE				
Piper sp.	**Tsimalatsaka**	B	Gonorrhea	
PITTOSPORACEAE				
Pittosporum sp.	**Sanganakoholahy**	L	Urine retention	
POACEAE				
Imperata cylindrica (L.) Raeusch.	**Tenona**	L	Fatigue, hypertension, boils, abdominal pain, hemorrhoids	Na
		E	Urine retention	
Panicum sp.	**Ahipody**		Dental cavity	
Sporobolus pyramidalis P.Beauv.	**Ahidroranga**	L	Back pain	Na
Zea mays L.	**Katsaka**	F	Urine retention	Cu
POLYGONACEAE				
Persicaria senegalensis (Meisn.) Soják	**Arivotoambelona**	R	Malaria, abdominal pain	Na
		R, L	Diarrhea	
		L	Cancer	
PRIMULACEAE				
Embelia concinna Baker	**Takasina**	B	Cough	E
Oncotemum boivinianum H.Perrier	**Ramitsiaka**	L	Wound	E
Oncostemum palmiforme H. Perrier	**Kelimalaza**	S	Wound	E
ROSACEAE				
Eriobotrya japonica (Thunb.) Lindl.	**Pibasy**	L	Infection during pregnancy	Cu
		S	Bilharzia	
Rubus buergeri Miq.	**Takoaka**	L	Diarrhea, abdominal pain	Cu
RUBIACEAE				
Chapelieria madagascariensis A.Rich. ex DC.	**Ravimbolo**	L	Stomach pain, abdominal pain, dental cavity, urine retention	E
		S, L	Back pain	

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Chassalia sp.	**Ahitrimpa**	L	Stomach pain	
Danais rhamnifolia Baker	**Hazombary**	L	Cough	E
Diodella sarmentosa (Sw.) Bacigalupo & Cabral ex Borhidi	**Lelamenarana**	Latex	Wound	Na
Gaertnera macrostipula Baker	**Tsikafekafe**	L	Urine retention	E
Paederia sp.	**Vahivola**	L	Abdominal pain, cancer	
	Vahilaingo	Latex	Dental cavity	
	-	B	Gonorrhea	
Pauridiantha paucinervis (Hiern) Bremek.	**Tsiandrova**	L	Stomach pain, malaria	I
Peponidium humbertianum (Cavaco) Razafim., Lantz & B.Bremer	**Pitsikahitra**	L	Malaria, stomach pain	E
Psychotria sp.	**Marovelo**	L	Fatigue	
RUTACEAE				
Citrus × *aurantium* L.	**Vohangintsinoa**	F	Cough	Na
	Voahangiala	L	Cough	
Toddalia asiatica (L.) Lam.	**Anakasimba**	L	Stomach pain, back pain	C, M, S, Af , As
Vepris ampody H.Perrier	**Ampody**	L	Abdominal pain	E
		S	Wound	
SALICACEAE				
Homalium axillare (Lam.) Benth.	**Hazombato**	B	Burns	E
		S	Back pain	
Homalium sp.	**Tendrompony**	R	Back pain	
		L	Urine retention	
SAPINDACEAE				
Allophylus decaryi Danguy & Choux	**Mampe**	L	Asthma	E
Allophylus sp.	**Teloravina**	L	Vision problems	
Litchi sinensis Sonn.	**Letchi**	L	Abdominal pain	Cu
SAPOTACEAE				
Chrysophyllum boivinianum (Pierre) Baehni	**Famelona**	L	Malaria, fatigue, increase blood protein content, levels, muscle pain	C,
SOLANACEAE				
Nicotiana tabacum L.	**Paraky gasy**	L	Bilharzia	Cu
Solanum mauritianum Scop.	**Bakobako**	B	Abdominal pain	Na
SPHAEROSEPALACEAE				
Rhopalocarpus louvelii (Danguy) Capuron	**Hazomamy**	B	Intestinal parasites	E
		L	Toxicity	
STILBACEAE				

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Scientific Names	Vernacular Names	Part used	Disease/Use	Distribution
Nuxia oppositifolia (Hochst.) Benth.	**Valanirana**	L	Stomach pain	Af, As
		L	Urine retention, pancreas problems	
STRELITZIACEAE				
Ravenala madagascariensis Sonn.	**Ravinala**	Heart	Stomach pain	E
		L	Cough, urine retention	
THEACEAE				
Camellia sinensis (L.) Kuntze	**Tsiandrova**	L	Fatigue, dizziness	Na
VERBENACEAE				
Lantana camara L.	**Radriaka**	L	Malaria, wounds, sexual problems, hypertension	Na
		R	Intestinal parasites	
VITACEAE				
Vitis vinifera L.	**Voalomboka**	F	Urine retention	Cu
XANTHORRHOEACEAE				
Dianella ensifolia (L.) DC.	**Herana**	R	Abdominal pain	M, S, Au, Af , As
Aloe macroclada Baker	**Vahona**	L	Stomach pain	E
ZINGIBERACEAE				
Aframomum angustifolium (Sonn.) K.Schum.	**Longoza**	L	Intestinal parasites	Af
Curcuma longa L.	**Tamotamo**	R	Malaria, yellow fever	Cu

medicinal plants were reported: barking, gathering leaves, cutting branches, and uprooting the whole plant.

Nearly 30 diseases were listed as having medicinal plant treatments. Commonly mentioned diseases were malaria, sexual problems, urinary retention, muscle aches, fatigue, dental problems, diarrhea, cough, and bilharzia (Table 2). It was very common for one species to be used to treat two or more diseases. For example: dental cavity, wounds, burns, boils, fatigue, and muscle pain are all treated with *Aphloia theiformis* (Vahl) Benn. Similarly two or more species may be utilized in the treatment of a single disease. For example, malaria is treated with *Exacum*

Table 2. Diseases known to have a medicinal plant treatment by men from Amabale, Madagascar

Disease	# of species as treatment
Abdominal pain	20
Asthma	2
Back pain	13
Bilharzia	7
Boils	9
Burns	3
Cancer	4
Cough	12
Deafness	1
Dental cavity	18

Disease	# of species as treatment
Diarrhea	20
Dizziness	4
Fatigue	14
Gonorrhea	9
Hemorrhoids	3
Hypertension	4
Increase blood protein content	4
Infection during pregnancy	2
Intestinal parasites	16

Disease	# of species as treatment
Malaria	14
Muscle pain	2
Pancreas pain	5
Sexual problems	6
Stomach pain	25
Toxicity	2
Urine retention	30
Vision problems	3
Wounds	7
Yellow fever	1

Table 3. Species from Vohibe Forest, Madagascar, with highest Use Index (I%) with additional uses and ecological status. IUCN Status (IUCN Red List 2013): endangered (E), vulnerable (V).

Species	Distribution	IUCN status	I%	Local use
Dillenia triquetra (Rottb.) Gilg	Endemic	E	94	Used in the construction of houses. It is in high demand by men with sexual problems and is seen as an effective stimulant.
Noronhia gracilipes H.Perrier	Endemic	E	92	This species is highly sought after by locals because of the hardness of its wood. Used in the treatment of diseases such as malaria.
Chrysophyllum boivinianum (Pierre) Baehni	Comoros	V	88	This species is highly prized by locals for the treatment of many diseases. Locally used to construct houses.
Xylopia humblotiana Baill.	Endemic	E	86	This species is highly sought after as medicine. It is also used in the construction of houses.
Phyllarthron bojeranum DC.	Endemic	E	85	This species is widely used by men as a medicinal tonic. It is highly valued by local people for making canes for the **tangalamena**.
Mauloutchia humblotii (H.Perrier) Capuron	Endemic	E	85	This species is highly valued for treating injuries during circumcision. It is used to make canoes, and the oil is used in the hair.
Aphloia theiformis (Vahl) Benn.	Comoros, Mascarenes Seychelles, Africa	V	82	Locally, this species is used for treating many diseases including injury during circumcision. People use this species for timber and firewood.
Macaranga alnifolia Baker	Endemic	V	81	Used as treatment of diarrhea and boils. It plays an important role in the coming of age rituals and customs as well as in the manufacture of canes.
Eugenia goviala H.Perrier	Endemic	E	79	This species is used to treat certain diseases like tooth decay, diarrhea, and stomach pain. It is highly prized for the construction of furniture.
Oncostemum boivinianum H.Perrier	Endemic	E	74	Used for treatment of injuries during circumcision. Also used as firewood.
Peponidium humbertianum (Cavaco) Razafim., Lantz & B.Bremer	Endemic	E	71	Used for the treatment of diseases like malaria and stomach pain, as well as timber.
Fenerivia ghesquiereana (Cavaco & Keraudren) R.M.K.Saunders	Endemic	E	69	Highly prized by men with sexual problems and sexually transmitted diseases like gonorrhea. People use this species for timber, wood manufacturing, and wood plank cooking.

quinquenervium Griseb., *Lycopodium clavatum* L., and *Myrcianthes fragrans* (Sw.) McVaugh.

Use Index

Among the 137 species recorded, 12 species had Use Index (I%) ratings at 60% or higher, showing they were most well-known within the community. The rate of endemism within the most well-known species is 83%. The uses cited for these well-known species are not only medicinal but also for other realms of livelihood such as construction and rituals. Table 3 shows the IUCN status, as well as other uses and importance, of these species to the community.

Discussion

We have indication that our hypothesis of gendered use and knowledge of medicinal plants was supported as the men cited medicinal species used against the retention of urine, muscle pain, and fatigue and as aphrodisiacs, far more (and in the case of aphrodisiac, exclusively a male use category) than the women (Raveloson, forthcoming). However, the male pharmacopeia was not restricted to male diseases as mentions of plants to treat pregnancy

complications as well as general diseases like malaria and cancer were also present.

Plant collecting methods reported by interviewees (gathering bark and leaves as well as cutting branches and uprooting the whole plant) give some cause for conservation concern. The removal of the bark in large quantities can destroy the plant because this part of the plant can no longer play the role of protector. Pulling up roots causes the total destruction of the plant (as is common in the collection of herbs and shrubs). These methods of gathering thus strongly undermine the sustainability of medicinal species use. The collection of leaves does not affect plant health as severely if the amount recovered is limited. Similarly, cutting the branches should not have negative impacts if the amount collected is reasonable. However, male Ambalabe collectors tend to strip the whole plant instead of focusing strictly on the necessary part.

While some studies have reported a low rate of use of endemic species as medicinal plants (Shangali *et al*. 2008), a similar study in Madagascar found a high rate of endemism and nativity in locally used medicinal species (Razafindraibe *et al*. 2013). A high rate of endemism in useful plants could be expected in a flora as unique as Madagascar with an 82% overall rate of endemism (Callmander *et al*. 2013), especially since many of the species with high calculated I% are tree species, which have a higher rate of endemism in Madagascar (92%) (Callmander *et al*. 2013).

While the use of endemic species is high it does not necessarily imply the species are rare. Vohibe Forest is a low to mid-elevation rainforest along the eastern escarpment of Madagascar, a dominant ecosystem in the region and part of a large corridor of humid rainforest. A rudimentary look at the IUCN Red List status within Madagascar (2013) of these widely known species shows that most of them are categorized as endangered or vulnerable. While risk is not extremely high, there is some concern for the conservation status and future status for these species if used unsustainably.

High levels of use of these largely endemic plant species could prove problematic if done unsustainably, especially those species with multiple use categories (medicine, ritual, timber, construction, etc.). A more in-depth study on how these endemic species are used and selected, as well as a comparison study of other sites within Madagascar, is needed to further understand the uniqueness of this traditional knowledge while a closer look at the local conservation status is needed to build a sustainable use plan.

Conclusions

The use of medicinal plants is still a common practice especially in rural areas of Madagascar. Moreover, the economic difficulties of the local people and the lack of basic health facilities promote the use of traditional medicine with medicinal plants. Based on the ethnobotanical surveys conducted among villagers, the majority of the population in Ambalabe employs the use of medicinal plants to treat diseases and maintain good health. The rate of endemism of the medicinal plants used by men from Vohibe Forest is 35%. Our study found the most well-known medicinal species have an even higher rate of endemism (83%). While many of these species are used to treat non-life threatening illnesses, they are also used for firewood, construction materials, and for rituals. The intense harvesting of leaves in traditional medicine does not present an alarming threat to the forest species, although the rate of use is enormous (68%). However, the utilization of bark (10%) is quite problematic. Furthermore, the use of roots even at a low rate (6%), especially the practice of completely uprooting a plant, constitutes a severe threat to the species.

The island nation of Madagascar has a high rate of endemic plant species. In Ambalabe, the use of plant species for daily living needs carries its own set of implications on the health of the natural resources. There is a relationship between the part of the plant used and the health of the plant population (Cunningham 1996). Information on pressures and threats on well-known and widely used species and their habitat are necessary for the conservation of these species, which in turn protects biodiversity and helps secure traditional practice in the future. Most threats to these species stem from human activities such as traditional slash and burn agriculture (**tavy**), overharvesting of plants with therapeutic properties, and overharvesting of timber (house building, canoe building, and craft work). The method of plant collecting and the heavy use of some species may contribute to the degradation of plant biodiversity and the health of Vohibe Forest and Ambalabe Commune. A deeper study on biological and ecological characteristics of species would be essential, especially for the most exploited species, in order to establish a better sense of potential biodiversity and traditional plant loss if conservation methods are not put into place.

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