RED LISTS FOR MALAGASY PLANTS

II: ASTEROPEIACEAE

Fire-resistant bark of *Asteropeia labatii* – photo Chris Birkinshaw

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Introduction

Nowhere in the World can rival Madagascar in terms of the diversity and uniqueness of its flora. Estimates of the total number of plant species in the country continue to climb and now it is thought that at least 13,000 species of higher plant grow in the country (pers. comm. P. Phillipson). This remarkable diversity is especially important given that nearly all these species (around 90% - Schatz 1999) grow only in Madagascar. Sadly Madagascar's exceptional flora is highly threatened and an alarming number of plant species are now on the very brink of extinction. We must now choose whether to make strenuous efforts to conserve the Malagasy flora or accept, within the next few decades, the loss of a large number of plant species. Now is the last chance to make this choice.

An important part of effective conservation is prioritization: the relatively small amount of money available for conservation must be used where it will have most impact. To assist with the prioritization of conservation actions for the Malagasy flora a series of documents will be produced containing risk of extinction estimates for species in selected Malagasy plant families.

The research presented here was conducted as a collaborative project between Missouri Botanical Garden (MBG), Antananarivo University and Madagascar's National Association for the Management of Protected Areas (ANGAP).

Methods for estimating risk of extinction

The identification of the species with the highest priority for conservation action is based on estimates of their likelihood of becoming extinct in the next few decades. However before the risk of extinction of a species can be investigated it is necessary to ensure that it has been delimited using a taxonomic framework that closely reflects the real distribution of variation (that in turn reflects underlying evolutionary history) within the genus/family to which the species belongs. In an endeavor associated with our study the taxonomic framework of each of Madagascar's endemic families was examined by scientists from Missouri Botanical Garden and the National Museum of Natural History in Paris .and those judged inadequate were revised. These revisions were published as a series of articles in the journal *Adansonia* and resulted in new species being delimited, previously recognized species being re-circumscribed, and others placed in synonymy.

Information on the risk of extinction of each species was obtained from the analysis of its distribution and from observations made in the field. Most of this work was conducted by Malagasy students as part of their DEA (= Masters) studies. Species distribution was estimated using geo-referenced locality data obtained from herbarium specimens in the five herbaria (K, MO, P, TAN, TEF) with large holdings of Malagasy plants. Most recent herbarium specimens include precise longitude and latitude coordinates of the collection location obtained using a GPS, but many older specimens do not, necessitating *post facto* allocation of coordinates by locating the collection site on maps with the aid of MBG's Madagascar gazetteer (available on line at (http://www.mobot.org/MOBOT/Research/madagascar/gazetteer). The collection sites were mapped and analyzed using ArcView Geographic Information System (GIS) software. The resultant species distribution was quantified in terms of extent of occurrence, area of occupancy, and number of subpopulations. The analysis of each species' distribution in relation to various environmental base maps provided information on the habitat of the species in terms of geology, vegetation type, bioclimate and elevation.

Information on the habitat, abundance, pollination, seed dispersal, regeneration, threats, uses and vernacular name for each species was obtained by locating and studying at least one population in the wild. The best method of locating species proved to be with the assistance of local people living close to previous collection sites. Information on the vernacular name and uses of the species were also obtained from the labels of herbarium specimens.

Further information on the methods used in the study is provided in Table 1.

The information collected for each species is summarized in a Risk of Extinction Datasheet

Table 1. Methods for the collection of information presented in each of the data fields of the Species Conservation Priority Datasheet.

<table>
<tr><td>Species name and author: name of species according to the most recent taxonomic revision and name of author(s) who defined the species</td><td>Risk of extinction: based on the application of criteria presented in IUCN (2001)</td></tr>
<tr><td>Vernacular names: from information collected in the field and captured from herbarium specimens.</td><td>Conservation recommendations: our recommendations for actions to reduce the risk of extinction of the species.</td></tr>
<tr><td>Description: based on information in the literature and our own observations of herbarium specimens and living plants in the field.</td><td rowspan="3"></td></tr>
<tr><td>Habitat:
• Vegetation type: defined by observations in the field and analysis of the distribution of the species related to the vegetation map of DuPuy & Moat (1996)
• Bioclimate: defined by the analysis of the distribution of the species related to the bioclimate map of Cornet (1974)
• Geology: defined by observations in the field and analysis of the distribution of the species related to the geology map of DuPuy & Moat (1996)
• Altitude: based on field observations and information captured from the notes accompanying herbarium specimens</td></tr>
<tr><td>Biology:
• Pollination: probable pollinator identified from characteristics of flower and observations in the field
• Seed dispersal: probable method of seed dispersal identified from characteristics of fruit and observations in the field</td></tr>
<tr><td>Uses: based on information collected by interviewing local people in the field and captured from the literature and notes on herbarium specimens.</td><td rowspan="4">Observations of study population(s)
Location: study site with geo-reference
• Regeneration observed: presence of regeneration assumed from the presence at the site of individuals representative of all size classes.
• Tolerant to disturbance: presence of regenerating populations of the species in severely degraded vegetation (>50% of original biomass lost).
• Density: average number of mature individuals of the species per ha of appropriate habitat based on counts in replicated plots or along transects.
• Abundance: estimated number of mature individuals at the study site based on the density of the species at the site and an estimate of the area of suitable habitat available (abundance classes based on thresholds used in IUCN (2001).</td></tr>
<tr><td rowspan="3">Distribution: distribution of the species represented by the locations of the collection sites of the herbarium specimens attributed to the species in the five herbaria with large collections from Madagascar. Map created using Arcview 3.2 software.</td></tr>
<tr><td>Predicted future decline:
• Due to habitat loss: estimate of decline of population based on observations of tolerance of species to habitat perturbation and estimates of rate of loss of primary vegetation from (FAO 1993, Green & Sussman 1990, Steininger et al. 2002). Classes of population decline (i.e. 0-30%, ≥30-50%, ≥50-80%, ≥80%) relate to thresholds used in the IUCN (2001).
• Due to exploitation or poor regeneration: in addition to loss of habitat it is possible that populations may decline because of selective exploitation or poor regeneration resulting for example from the increasing rarity of pollinators or seed dispersers. Although we were unable to quantify these factors, their possible significance is noted.</td></tr>
<tr><td>Distribution attributes for total population:
(These analyses made using ArcVeiw 3.2)
• Extent of occurrence: estimated as the area contained within the shortest continuous imaginary boundary drawn to encompass all the collection locations for the species.
• Area of occupancy: estimated as the area of suitable habitat (defined in terms of vegetation type, bioclimate, altitude and geology) for the species within the extent of occurrence.
• Number of subpopulations: estimated as the number of collection locations but combining locations that are separated by less than 5 km.</td></tr>
<tr><td>Representation in protected areas:
Protected areas are defined as National Parks (PN), Special Reserves (RS), Nature Reserves (RNI), Biosphere Reserves (RB).
• Number of subpopulations: number of data points within protected areas but combining locations separated by less than 5 km.
• Protected areas: list of protected areas where the species has been recorded.</td></tr>
<tr><td colspan="2">Herbarium specimens examined: list of herbarium specimens examined for this study</td></tr>
</table>

Asteropeiaceae Takht.
(from Schatz 2001)

Endemic monotypic family, formerly treated in the Theaceae, but most closely related to the Malagasy endemic family Physenaceae based on chloroplast *rbc*L molecular sequence data, the two families together basal to the Caryophyllales.

Asteropeia Thouars, Hist. Veg. Isles Austrl. Afriq.: 51, t. 15. 1805.

Endemic genus of 8 species.

Hermaphrodite small to large trees, the young branches often black or covered with a dense brown-ferruginous indument. Leaves alternate, simple, entire and sometimes undulate, penninerved, although the venation usually rather indistinct, usually somewhat coriaceous, exstipulate. Inflorescences terminal, or less often axillary, more or less branched panicles, the lower bracts foliaceous, the axes sometimes covered with a dense brown-ferruginous pubescence, flowers small to large, regular, 5-merous; sepals 5, free or slightly fused at their base, imbricate, persistent and accrescent-scarious with evident venation in fruit; petals 5, free, valvate, thin, delicate, white, caducous; stamens usually 10, rarely 15, unequal, those opposite the sepals longer, filaments slender, thicker at the base and fused into short cupule-like ring, often persistent in fruit, anthers bilocular, sub-basifixed, extrorse longitudinally dehiscent; ovary superior, 3-locular, the locules often incompletely separated, common style filiform, stigma capitate 3-lobed, or 3 short style/stigma branches; ovules 2-4 (-6) per locule. Fruit a small to large, dry, irregularly dehiscent, 1-seeded capsule, spherical to ovoid-conical, smooth, often tearing irregularly at the base, subtended by the accrescent calyx; seed with scant endosperm.

Asteropeia is distributed throughout humid to subhumid to montane evergreen forest from littoral forest along the E coast to nearly 2,000 m elevation, including sclerophyllous woodland on the Central High plateau to as far west as the Isalo Massif, as well as the Sambirano region, and also dry deciduous forest in the Ambongo-Boina region. It is most easily recognized by its persistent, accrescent calyx surrounding the smooth spherical to conical capsule.

Key to species of Asteropeiaceae (from Schatz et al 1999)

1. Inflorescence axes glabrous.....2
1'. inflorescence axes and lower surface of young leaves covered with dense, short, rusty brown ferruginous indumentum (older inflorescences occasionally glabrous).....7
2. Flowers and fruits sessile.....3
2'. Flowers and fruits with evident pedicel at least (2.5-) 5 mm long 5
3. Leaves narrowly oblanceolate, usually greater than five times as long as wide, subsessile; calyx lobes in fruit greater than 5 mm long; tapia woodland, Itremo and Isalo, 800-1500 m. .....*A. labatii*
3'. Leaves elliptic to obovate, never more than 3 times as long as wide, distinctly petiolate; calyx lobes in fruit less than 5 mm long.....4
4. Leaves coriaceous, mostly 2 times as long as wide, 3.5-6 cm long, margins strongly revolute, at least some folded under in dried material; calyx lobes spreading to reflexed-convex in fruit; humid forest, Analamazaotra-Périnet, Ambatovy, Zahamena RNI, 800-1,100 m.....*A. mcphersonii*
4'. Leaves subcoriaceous, mostly 3 times as long as wide, 7.2-11.3 cm long, margins weakly revolute to flat, rarely folded under in dried material; calyx cupuliform in fruit, the lobes ascending to erect, concave; littoral forest on sand. Tampolo STF to Fort Dauphin.....*A. micraster*
5. Ovary and fruit conical-ovoid, with three distinct ridges extending to acuminate apex, surmounted by three sessile stigmatic branches; littoral forest on sand, and occasionally humid forest at higher elevation on weathered quartzite sands, Sambava to Fort Dauphin. .....*A. multiflora*
5'. Ovary and ruit depreseed ovoid to subglobose, without distinct ridges, the apex rounded to somewhat indented, surmounted by an evident slender style with a capitate, 3 lobed stigma 6
6. Calyx lobes in fruit (9-)11-15 mm long; mature fruit 4-5 mm in diam.; largest leaves 8.5-17.5 cm long; low elevation forest on sand and laterite, S. of Vohemar to Ambila-Lemaitso.....*A. matrambody*
6'. Calyx lobes in fruit 6-9(-10) mm long; mature fruit 2.8-3.5 (-4) mm in diam.; largest leaves 6.5-10(-12.5) cm long; subhumid to dry forest, N, NW (Ambongo-Boina region S to Soalala) and Center (Itremo S to upper Mandrare River Basin).....*A. ambylocarpa*
7. Pedicels with numerous, minute, caducous bracteoles at the base, leaving evident scars; fruit spherical to ellipsoid, broadest at the middle, hard, smooth and shiny-glabrous; usually gnarled shrubs 1.5-2.5 m tall, occasionally prostrate or forming small trees to 8 m tall; Ibity to Andringitra RNI, 1400-1800 m.....*A. densiflora*
7'. Pedicels without bracteoles at the base; fruit ovoid, broadest below the middle, verrucose and dull, occasionally with persistent indumentum; trees 6-25 m tall or rarely large shrubs 3-5 m tall; Sambirano; Marojejy, Beanjada, Analamazaotra-Périnet, Ambatovy, Anjozorobe.....*A. rhopaloides*

Asteropeia densifolia **infrutescence (Ibity, March 2003) – photo Chris Birkinshaw**

Regeneration of cut stem of *Asteropeia labatii* (Itremo, 1999) – photo Chris Birkinshaw

Asteropeia multiflora **flower (Antaimby-Ambalavontaka, February 2004) – photo David Rabehevitra**

Asteropeia multiflora **infrutescence (Antaimby-Ambalavontaka, February 2004) – photo David Rabehevitra**

Asteropeia labatii **inflorescence (Itremo, 1999) – photo Chris Birkinshaw**

Young twigs of *Asteropeia densiflora* showing characteristic reddish indumentum (Ibity, March 2003) – photo Chris Birkinshaw

***Asteropeia ambylocarpa* fruits, Tampolo, April 2004 – photo Chris Birkinshaw**

***Asteropeia rhopaloides*, Anzojorobe – photo G. Schatz**

***Asteropeia micraster*, Mandena – photo J. Zarruchi**

***Asteropeia micraster*, Mandena – photo J. Zarruchi**

***Asteropeia labatii*, Itremo – photo J-N. Labatt**

***Asteropeia labatii,* Itremo – photo J-N. Labatt**

RISK OF EXTINCTION DATASHEETS

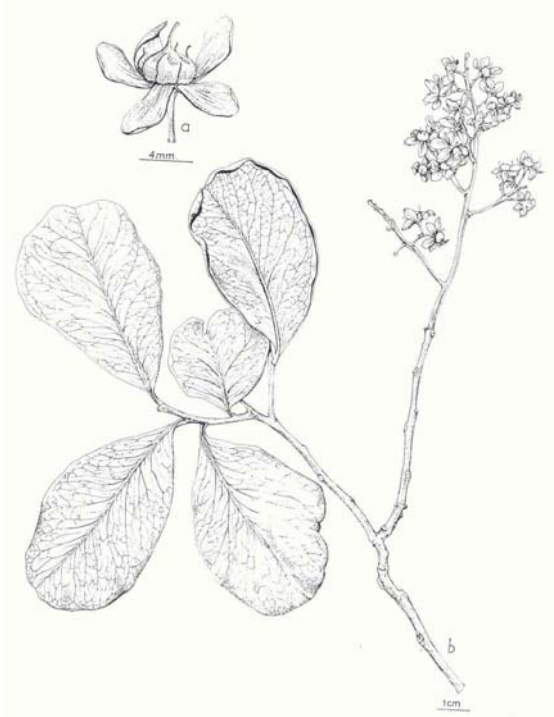
Asteropeia amblyocarpa Tul.

Risk of extinction: Least Concern (although this species has a high predicted population decline it has several large and apparently secure sub-populations within protected areas).

Vernacular names: Haraka, Hazonjia

Conservation Recommendations: good management of protected areas

Description: Shrub/small tree. Leaves medium, obovate with rounded/notched apex and acute base, quite leathery; petiole short (2.5 mm). Inflorescence a terminal (axillary) panicle with hairless axes. Flower with short stalk. Fruit globose and surrounded by long sepals that act as wings.

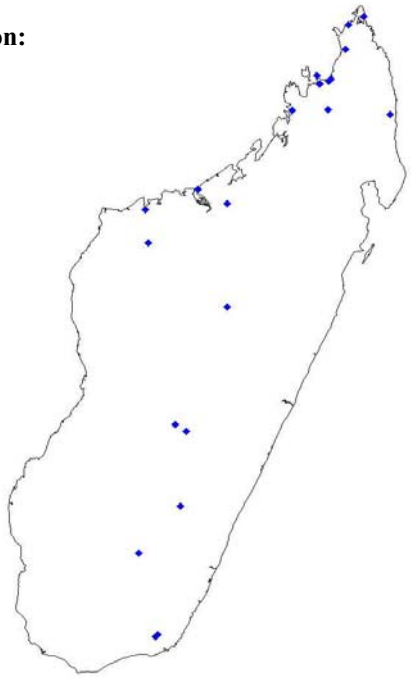


Habitat
- Vegetation type: low and mid-elevation evergreen forest, dry deciduous forest.
- Bioclimate: humid, subhumid, dry
- Geology: basement rocks, sandstone, mesozoic limestone, lava, alluvium, quartzites
- Altitude: 0-1,400 m

Biology
- Pollination: probably insects (at Tsaratanana flowers were visited by many bees and other insects and at Andranofeno-Sud they were visited by bees and beetles)
- Seed dispersal: wind

Uses: Timber (but not extensively exploited at study site)

Distribution:



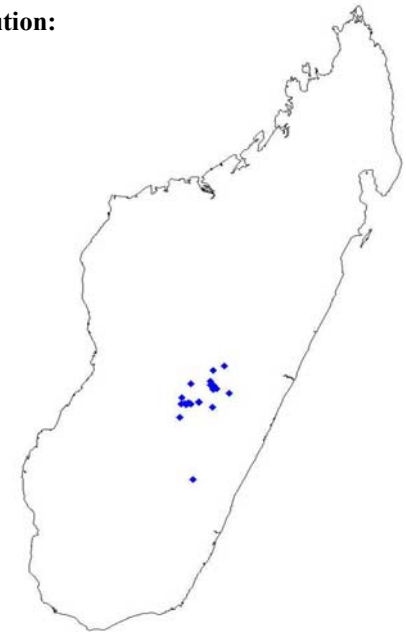
Observations of study population(s)
- Location: Andranofeno-Sud (47˚10'E, 18˚04' S)
- Regeneration observed: yes
- Tolerant to disturbance: no
- Density: 56 individuals per ha
- Abundance: <50 mature individuals

Predicted future decline:
- Due to habitat loss: 50-80% (reasons for loss = grassland fires)
- Due to exploitation or poor regeneration: decline possible because of exploitation for timber

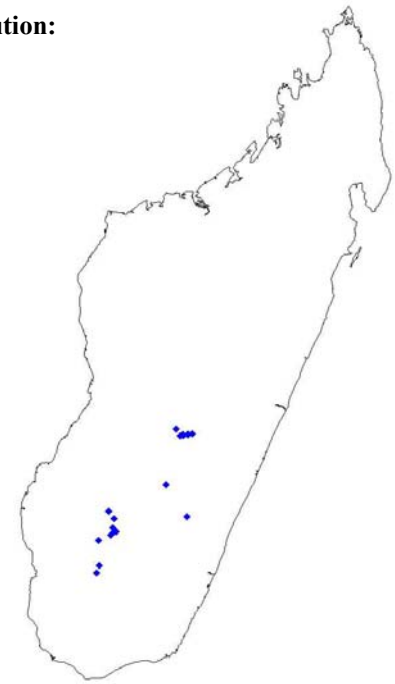
Distribution attributes for total population
- Extent of occurrence: 314,167 km²
- Area of occupancy: 33,390 km²
- Number of subpopulations: 24

Distribution attributes for population within protected areas
- Number of subpopulations: 6
- Protected areas: Ankarana RS, Baie de Baly PN, Andringitra RNI, Andohahela PN, Ankarafantsika RS, Tsaratanana RNI

Herbarium specimens examined: Antananarivo: Ankazobe, C. Birkinshaw et al. 595 Andranofeno-Sud, F. Randriantafika 97 Antsiranana: Antsatrana SF(Capuron) 18932: Ankarana RS, SF(Belin) 12035: Andilamboay, SF 15837: Ambanilalana, Ch. Bernier 281: Vavatobé, J.M. Hildebrandt 3315: Antafiambotry, M. Debray 1607: Mananara, SF 15926: Andilamboay, SF 19569: Tsaratanana RNI, Chris Birkinshaw, P.J. Randria & P. Antilahimena 761: Tsihomanaomby massif, C. Birkinshaw et al. 725 Fianarantsoa: Ambatomenaloha, SF(R. Capuron) 11562: Itremo, H. Humbert 28154: Andringitra RN, RN(Rakotovao) 9929: Andringitra RN, RN(Rakotoson) 11559 Mahajanga: Antsoa, SF(Razanajatovo,B.) 3632: Ankarafantsika RN, RN(Ramamonjisoa) 2083: Ankarafantsika RN, RN(Ramamonjisoa) 2585: Bokorafa, Ankarafantsika RN, RN(Ramamonjisoa) 2041: Marokitrana, Boanarisolo 122: Analabe, SF(Ramarolahy) 39-R-311 Toamasina: Mahatsara, SF(Rabevohitra) 33226 Toliara: Andohahela RN, , H. Humbert 14065 Apiky, H. Humbert 13865: Vohipolaka, H. Humbert 11654

Asteropeia densiflora Baker	**Risk of extinction:** Least Concern (although this species only occurs in one protected area it appears able to survive in human-impacted landscapes)
Vernacular names: Fandambanana, Sapemadinika	**Conservation Recommendations:** none
Description: Shrub (sometimes very short and carpeting)/small tree. Leaves small, elliptical/oblanceolate/lanceolate with obtuse/notched apex and obtuse base, coriaceous, covered with short, dense red-brown hairs when young; petiole very short. Inflorescence a dense terminal panicle with axes covered with dense short brown hairs. Flower stalks with many tiny bracteoles (that fall to leave evident scars). Fruit medium, globose, smooth and somewhat fleshy, with short sepals.	
Habitat • Vegetation type: sclerophyllous woodland and thicket • Bioclimate: subhumid, montane • Geology: basement rocks, quartzites • Altitude: 0-2,200 m	
Biology • Pollination: probably insect (diptera seen visiting flowers at Fianandana) • Seed dispersal: fruits fleshy and probably bird dispersed.	
Uses: none known	
Distribution: 	**Observations of study population(s)** • Location: Itremo (46˚34'E 20˚ 35'S) • Regeneration observed: yes • Tolerant to disturbance: yes (appears to persist as regenerating populations in secondary grassland and thicket) • Density: 4.25 individuals per ha. • Abundance: >10,000 mature indviduals
	Predicted future decline: • Due to habitat loss: 0-30% • Due to exploitation or poor regeneration: none expected
	Distribution attributes for total population • Extent of occurrence: 16,850 km² • Area of occupancy: 102 km² • Number of subpopulations: 17
	Distribution attributes for population within protected areas • Number of subpopulations: 1 • Protected areas: Andringitra RNI

Herbarium specimens examined: Antananarivo: Ibity, P.B. Phillipson, R.A. Clement & G. Rafamantananantsoa 4030: Ibity, H. Perrier de la Bâthie 18500: Ibity, H. Perrier de la Bâthie 7098ter: Ibity, R. Viguier & H. Humbert 1504: Vozontanin'i Tapia, P. Morat 3173 Vozontanin'i Tapia, Bosser 6054: Marovato, A. Rakotozafy 634: Fiadanana, Chris Birkinshaw et al. 815 . Ibity, G.E. Schatz et al. 4122 Antsiranana: Tsaratanana, Chris Birkinshaw 814 Fianarantsoa: [Ambohimanjaka, L.J. Dorr, L.C. Barnett, M.R. Cheek, A. Rakotozafy & N. Razafimalala 3839: Mont Ibity, , L.J. Dorr, L.C. Barnett, A. Rakotozafy, M.R. Cheek & N. Razafimalala 3870: Mont Ibity, L.J. Dorr & A. Rakotozafy 4505: Itremo, SF(Capuron) 11550 Andringitra RN RN(Razafindrakoto) 3600: Andringitra RN, RN(Razafindrakoto) 2383: Andringitra RN, H. Perrier de la Bâthie 13713 Itremo, J. Bosser 9880 Faliarivo, H. Humbert & R. Capuron 28007: Itremo, H. Humbert 29960: Ambatofinandrahana, H. Humbert & R. Capuron 28095: Itremo, SF 4721 Ambatomainty, H. Perrier de la Bâthie 10143 : Faliarivo, H. Humbert 14491 Itremo, J.-L. Guillaumet 4254: Ambatofinandrahana, R. Decary 13234: Col des Tapia, H. Humbert 7113: Col des Tapias, , J. Bosser 18768: Itremo, J. Bosser 10016: Fiadanana, J.& M. Peltier 2162: Ampandrianombilapa, SF(R. Capuron) 23491: Itremo, Ph. Morat 908: Andringitra RN, RN(Rakotovao) 9890: Ambatomenaloha, SF(Capuron) 29052: Col des Tapias Labat, Haevermans & Rabenantoandro 3028: Itremo, Chris Birkinshaw et al. 561: Itremo, G.E. Schatz et al. 3965

Asteropeia labatii G.E. Schatz & Lowry	**Risk of extinction:** Least Concern (although this species has a high predicted population decline it has several large and apparently secure sub-populations within two protected areas).
Vernacular names: Heza, Hezana	**Conservation Recommendations:** good management of Isalo PN, control of excessive burning on Itremo massif.
Description: Small tree with thick and deeply fissured bark. Leaves small/medium, narrowly oblanceolate with obtuse/rounded/notched apex and acute base; petiole very short (to 1 mm long). Infloresence an axillary panicle with hairless axes. Flower stalk very short with many small bracteoles. Fruit small, dry, hard, ovate to pyramidal, surrounded by long sepals (lobes > 5 mm) that act as wings.	
Habitat • Vegetation type: sclerophyllous woodland • Bioclimate: humid, subarid • Geology: sandstone, quartzites, basement rocks • Altitude: 800 - 1800 m	
Biology • Pollination: probably insect • Seed dispersal: wind	
Uses: timber (close to villages quite heavily exploited but trunks re-grow after felling), firewood, medicine	
Distribution: 	**Observations of study population(s)** • Location: Itremo (46°34', 20°35) • Regeneration observed: yes • Tolerant to disturbance: no (mature trees are very tolerant to burning but young plants are killed by grassland fires) • Density: 10 individuals per ha. • Abundance: 2,500 - 10,000 mature individuals
	Predicted future decline: • Due to habitat loss: 50-80% (reasons for loss = grassland fires) • Due to exploitation or poor regeneration: decline possible because of exploitation of trees for timber and firewood
	Distribution attributes for total population • Extent of occurrence: 36,175 km² • Area of occupancy: 1,054 km² • Number of subpopulations: 15
	Distribution attributes for population within protected areas • Number of subpopulations: 5 • Protected areas: Andringitra PN, Isalo PN

Herbarium specimens examined: Fianarantsoa: Ambatofinandrahana, P.B. Phillipson, R.A. Clement & G. Rafamantanantsoa 3842: Ingaro, SF(Razafindrakoto,A.) 13758: Isalo PN, H. Jacquemin 372: Isalo PN, Ph. Morat 2500: Itremo, SF 4722: Isalo PN, H. Humbert 28693: Isalo PN, H. Humbert 19512: Ingaro, G. Cremers 3612: Ambatofinandrahana, R. Decary 13037: Col des Tapias, H. Humbert 11226bis: Itremo, J.-N. Labat, D.J. Du Puy & J. Andriantiana 2411: Ambatofinandrahana, H. Perrier de la Bâthie 12411: Isalo PN, SF(R. Capuron) 11652: Itremo, Baum, David A. 59: Isalo, Lorence, D. 2052: Isalo PN, Razafindramonjy 133: Isalo PN, SF(Abraham) 31413 Isalo PN, SF(Kasambo) 30799: Itremo, SF(Capuron) 29038: Andringitra RNI, RN(Rakotoson) 12509: [Isalo PN], Lorence, D. 2078: Iremo, Labat, Haevermans, Rabenantoandro & B. Cook 3036: Itremo, J. Rabenantoandro et al. 61: Itremo, G.E. Schatz et al. 3971: Isalo PN, C. Hong Wa & Ludovic Reza 36 Toliara: Benenitra, Dinard, A. 190: Sakamarekely, H. Humbert 2854

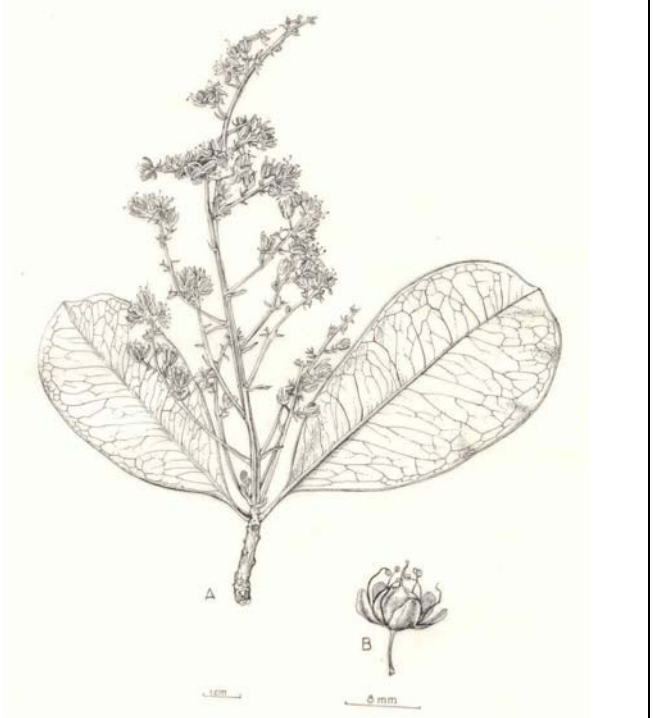
Asteropeia matrambody G.E. Schatz & Lowry

Risk of extinction: Least Concern (although this species has a high predicted population decline it has several large and apparently secure sub-populations within protected areas).

Vernacular names: Haraka, Matrambody

Conservation Recommendations: good management of protected areas

Description:
Small/medium tree. Leaves medium (large), obovale with rounded apex and acute base, leathery; petiole short. Inflorescence an axillary/terminal panicle with hairless axes. Flower stalk long. Fruit globose, dry, hard, surrounded by long sepals (to 15 mm).



Habitat
- Vegetation type: low and mid elevation evergreen forest
- Bioclimate: perhumid, humid
- Geology: basement rocks, sandstones, unconsolidated sands
- Altitude: 0 - 410 m

Biology
- Pollination: probably insect
- Seed dispersal: wind

Uses: timber

Distribution:

Observations of study population(s)
- Location: Tampolo (49°24', 17°16')
- Regeneration observed: not studied
- Tolerant to disturbance: not studied
- Density: 1 mature individual per ha.
- Abundance: 250-1000 mature individuals

Predicted future decline:
- Due to habitat loss: 50-80 % (reason for loss = shifting cultivation)
- Due to exploitation or poor regeneration: decline possible because of selective exploitation for timber

Distribution attributes for total population:
- Extent of occurrence: 28,538 km²
- Area of occupancy: 15,998km²
- Number of subpopulations: 8

Distribution attributes for population within protected areas:
- Number of subpopulations: 3
- Protected areas: Ambatovaky RS, Betampona RNI, Masoala PN

Herbarium specimens examined: Antsiranana: Masoala RNI, RN(Duran) 2254 Ambodisatirana, Kiener, A. 127: Ifonty, SF 13957 Toamasina: Mahatsara, SF 34295: Tampolo, SF 15697: Ambila-Lemaitso SF, , SF 8304: Ambila-Lemaitso SF, SF(R285) 8318: Ambila-Lemaitso STF, SF 9747: Betampona RNI, M. Andrianarisata 153: Ambatovaky RS, RN(Ratoto) 10345: Mahatsara STF, SF 32925: Ambila-Lemaitso, André 97: Brickaville, Bégué 746: Tampolo STF, L.C. Raholivelo & G.E. Schatz 44: Ambila Lemaitso STF, SF(Rabetsitonta) 46-R-135: Ambila Lemaitso SF, SF(Andre) 97-R-196: Ambila-Lemaitso STF, SF(Begué) 746-R-1: Ambila-Lemaitso, STF., SF (G. Rabetsitonta) 46 R 135: Tampolo STF, N. Mamisoa Andrianjafy et al. 78: Tampolo STF, N. Mamisoa Andrianjafy et al. 80

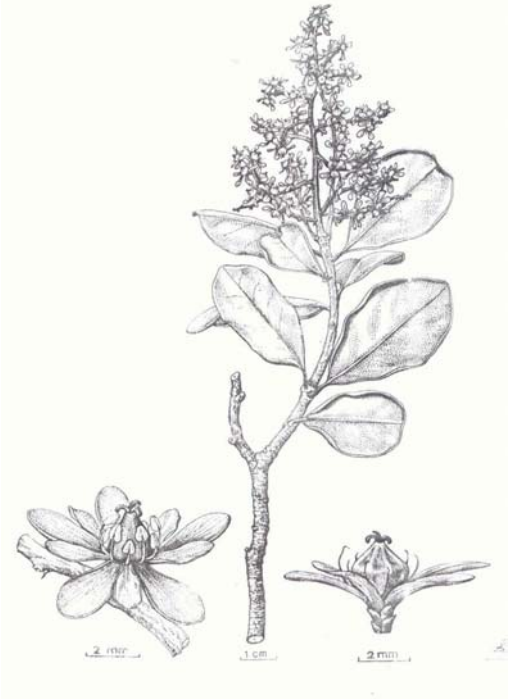
Asteropeia mcphersonii G.E. Schatz & Lowry

Vernacular names: Manoka, Manoka Mena, Manoka Fotsy, Manoka Mavo, Moara

Risk of extinction: Vulnerable (A3c, B1ab, C1)

Conservation Recommendations: a) good management of protected areas, b) restoration of natural forest at Ambatovy following proposed mineral extraction

Description:
Shrub to large tree. Leaves small/medium, obovate/elliptical with rounded apex and acute base, margine strongly rolled over, very leathery. Infloresence appearing as a terminal panicle with hairless axes. Flowers lacking stalk. Fruit small ovoid to globose, surrounded by sepals (lobes < 5 mm long).

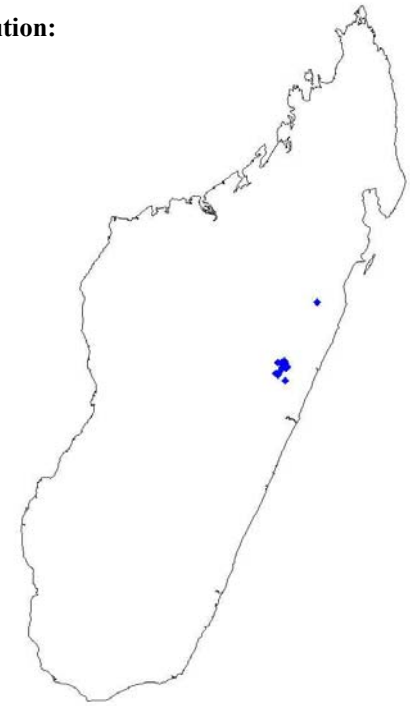


Habitat
- Vegetation type: mid-elevation evergreen forest
- Bioclimate: humid
- Geology: basement rocks, ultrabasics
- Altitude: 600 – 1400 m

Biology
- Pollination: probably insect
- Seed dispersal: wind

Uses: timber (but not extensively exploited at study site), medicine

Distribution:



Observations of study population(s)
- Location: Ambatovy (48°18', 18°51')
- Regeneration observed: yes
- Tolerant to disturbance: no
- Density: 4.6 indivuals per ha
- Abundance: 1000-2500 mature individuals

Predicted future decline:
- Due to habitat loss: 50-80% (cause of loss = shifting cultivation and mining)
- Due to exploitation or poor regeneration: decline possible because of selective exploitation for timber.

Distribution attributes for total population:
- Extent of occurrence: 3,430 km²
- Area of occupancy: 2,742 km²
- Number of subpopulations: 8

Distribution attributes for population within protected areas:
- Number of subpopulations: 2
- Protected areas: Analamazaotra RS, Zahamena RNI

Herbarium specimens examined: Toamasina: Ampasimpotsy-Gara SF, SF(Ratovoarison) 2617: Analamazaotra-Périnet RS, SF(Ratovoarison) 1394: Perinet-Analamazaotra RS, SF(Ratovoarison) 5271: Perinet-Analamazaotra RS, SF(Ratovoarison) 5586: Analamazaotra-Périnet RS, SF(Rakotondrainibe,C.) 12889: Perinet-Analamazaotra RS, SF(J.P. Sampana) 10351: Perinet-Analamazaotra RS, SF(Sampana,J.P.) 10355: Analamazaotra Périnet RS, SF(Ratovoarison) 10369: Anamalazaotra-Périnet RS, SF 4640: Analamazaotra-Périnet RS, E. Ursch 60: Analamazaotra-Périnet RS, SF 14949 Ambatovy, , Ph. Morat 3221: Analamazaotra-Périnet RS, H. Perrier de la Bâthie 6717: Analamazaotra-Périnet RS, H. Perrier de la Bâthie 14772: Zahamena RN, RN(Botoalina) 3739: Analamazaotra-Périnet RS, E. Thouvenot (Ramanantoavolana) 149: Analamazaotra-Périnet RS, SF 3774: Analamazaotra-Périnet RS, SF 3833: Antaniditra, SF 8369: Analamay, P.J. Rakotomalaza et al. 1379: Analamazaotra-Perinet RS, Cremers 1428: Ampitambe, SF(Abraham) 31262 Analamazaotra SF, Botoalina 70: Lakato, SF(Rabevohitra) 29720: Ampitambe, SF 25290: Ambatovy, Gordon McPherson 17473: Ambatovy, Gordon McPherson 17528: Ambatovy, J. Rabenantoandro et al. 136: Sahamaloto, C. Hong Wa, Ludovic Reza & Tsihanina 42

Asteropeia micraster Hallier	**Risk of extinction:** Endangered (A3c)
Vernacular names: Fanola, Fanola Mena	**Conservation Recommendations:** a) creation of new protected area in littoral forest that includes this species, b) inclusion of this species in forest restoration endeavors at Tampolo and Mandena.
Description: **Medium tree.** Leaves medium, obovate with rounded/notched apex and acute base, somewhat leathery. Infloresence a terminal panicle with hairless axes. Flowers almost stalkless. Fruit small, ovate, dry and hard, surrounded by erect sepals (lobes < 5 mm long).	
Habitat • Vegetation type: littoral forest • Bioclimate: perhumid, humid • Geology: unconsolidated sand, basement rocks, alluvial deposits • Altitude: 0 - 50 m	
Biology • Pollination: probably insect • Seed dispersal: wind	
Uses: timber (not extensively exploited at study site)	
Distribution: 	**Observations of study population(s)** • Location: Mandena (47°00', 24°57') • Regeneration observed: yes • Tolerant to disturbance: yes (appears to be able to persist as a regenerating population in secondary forest and thicket) • Density: 70 individuals per ha • Abundance: >10,000 mature individuals
	Predicted future decline: • Due to habitat loss: 50-80% (cause of loss = tavy, exploitation of forest for charcoal, fire, mining (at Mandena)) • Due to exploitation or poor regeneration: decline possible because of selective exploitation for timber
	Distribution attributes for total population: • Extent of occurrence: 29,709 km² • Area of occupancy: 183 km² • Number of subpopulations: 9
	Distribution attributes for population within protected areas: • Number of subpopulations: 0 • Protected areas: none

Herbarium specimens examined: Fianarantsoa: Vangaindrano, SF 9985: Mahabo, R. Rabevohitra & J. Rabenantoandro 3810 Toamasina: Tampolo STF, SF(Zavah Paul) 17818: Tampolo STF, L.C. Raholivelo, B. Rakotoninina & B. Rakotoanadahy 210: Antanambao, J. Rabenantoandro et al. 1210 Toliara: Mandena SF, Nicolas Dumetz 581: Mandena SF, N. Dumetz 676: Mandena SF, N. Dumetz & G. McPherson 1141: Mandena SF, Nicolas Dumetz 500: Mandena, James L. Zarucchi et al. 7610 Mandena, G. McPherson 14376: Mandena, G. McPherson & N. Dumetz 14668: Mandena, G. McPherson, et al. 14792: Ste. Luce, G. McPherson, et al. 14806: Mandena, R.E. Gereau & N. Dumetz 3268: Mandena, R. Rabevohitra 2202: Mandena STF SF(Lamarque, P.) 8083: Mandena STF, SF(Ranjatoson,E.) 3356: Mandena STF, SF(Capuron) 395: Mandena STF, SF(Rakotozafy,J.B.) 7004: Ambinanibe(=Vinanibe), SF(Capuron) 20529: Mandromodromotra, SF(R. Capuron) 28648: Fort-Dauphin, Y. Cloisel s.n.: Ambinanibe, , M. Debray 1956: Mandena SF, Lamarque 93: Mandena SF, Lamarque 194: Mandena SF, Lamarque 184: Sainte Luce, A. Randrianasolo 561: Mandena STF, J. Bosser 14418: Mandena STF, SF(Lamarque) 184-R-16: Mandena STF, SF(Lamarque) 93-R-16: Mandena STF, SF(Lamarque) 194-R-16: Mandena SF, Faly Randriantafika et al. 65: Mandena, J. Rabenantoandro et al. 274: Manafiafy, J. Rabenantoandro et al. 354: Mandena SF, R. Rabevohitra et al. 3685 .Mandena, L. Faliniaina et al. 75 Mandena STF, RAKOTONASOLO 32: Mandena STF, C. Hong Wa, Ludovic Reza & Mara Brunot 20

Asteropeia multiflora Thouars ex Tul.

Risk of extinction: Least Concern (although this species is predicted to decline it has some resistance to habitat degradation and has several large and apparently secure sub-populations within protected areas).

Vernacular names: Andrampotsy, Andrevola, Fanola, Haraka, Hazoseha, Jodo, Manoka, Matrambody, Merana, Moara, Ramangoaka, Tambonana

Conservation Recommendations: good management of protected areas.

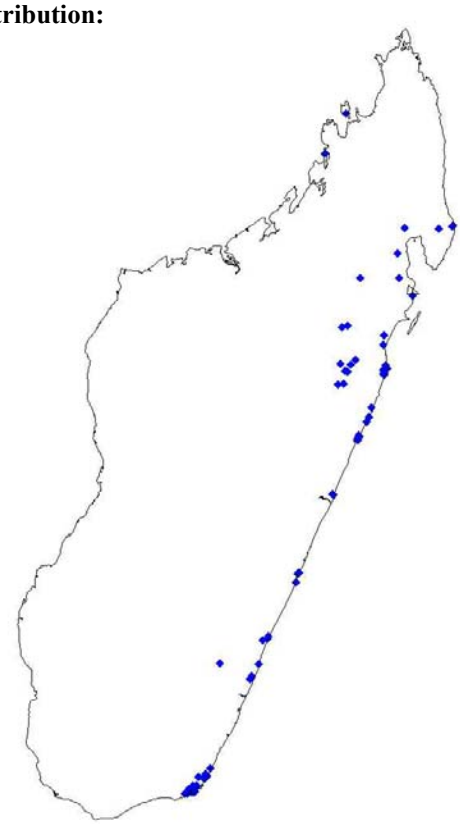
Description: Small/medium tree. Leaves (small) medium, spoon-shaped with rounded apex, leathery; petiole short. Inflorescence a terminal panicle with hairless axes. Flowers with long stalk (> 5mm). Fruit small, dry, hard, conical-ovoid with 3 distinct ridges, surrounded by long sepals that act as wings.

Habitat
- Vegetation type: littoral forest, low and mid-elevation evergreen forest
- Bioclimate: humid
- Geology: unconsolidated sands, basement rocks, lake and alluvial deposits, lavas
- Altitude: 0 – 1000 m

Biology
- Pollination: probably insect (at Ambila Lemaitso the flowers were visited by beetles and bees)
- Seed dispersal: wind

Uses: timber (but not heavily exploited at study sites)

Distribution:



Observations of study population(s):

Location 1: Ambila Lemaitso (49°07', 18°53')
- Regeneration observed: yes
- Tolerant to disturbance: yes
- Density: 16.6 mature individuals per ha.
- Abundance: 1000-2,5000 mature individuals.

Location 2: Mandena (47°00', 24°57')
- Regeneration observed: yes
- Tolerant to disturbance: yes
- Density: 24.4 mature individuals per ha.
- Abundance: >10,000 mature individuals.

Location 3: Tampolo (49°24', 17°16')
- Regeneration observed: yes
- Tolerant to disturbance: yes
- Abundance: 2,500-10,000 mature individuals

Predicted future decline:
- Due to habitat loss: 30-50% (cause of loss = tavy, exploitation of forest for charcoal, fire)
- Due to exploitation or poor regeneration: decline is also possible because of selective exploitation for timber.

Distribution attributes for total population:
- Extent of occurrence: 212,474 km²
- Area of occupancy: 55,595 km²
- Number of subpopulations: 47

Distribution attributes for population within protected areas:
- Number of subpopulations: 8
- Protected areas: Lokobe RNI, Marotandrano RS, Masoala PN, Mananara RB, Manombo RS, Zahamena RNI

Herbarium specimens examined:: Antsiranana: Ambohitralanana, SF(Roberson) 1146: Nosy-Komba SF, SF 5890: Masoala RNI, RN(Naivo Pierre) 8732: Masoala RNI, SF(Naivo Pierre) 17541: Masoala RNI, SF(Naivo Pierre) 17619: Masoala RNI, RN(Naivo Pierre) 8808: Analamay,SERVICE FORESTIER s.n.: Ambohitralalana, Chris Birkinshaw 831 Fianarantsoa: Ampasimenaloka, SF(Bouqueau) 5118 Ampangalana-Atsimo, SF(Ranaivo,E.) 19523: Ifandana, R. Decary 5175: Mananjary, F. Geay 7656: Mananjary, F. Geay 8149: Canal des Pangalanes, SF 9478: Mangatsiotra, SF 4759: Zohakandra-Nord [Tohakandra], SF 4851: Vohitrindry, SF 7094: Misevo, Randrianasolo, G. 25: Manampano, Jonarson, M. 32: Manombo RS, SF(Rabevohitra) 34644: Misevo, SF(Georges Randrianasolo) 25-R-208 Mahabo, R. Rabevohitra & J. Rabenantoandro 3809: Manombo RS, Naina Mamisoa Andrianjafy et al. 48: Manombo RS, Naina Mamisoa Andrianjafy et al. 47 Mahajanga: Marotandrano, SF(Ravelo,J.M.) 15130: Sahamalaza, J. Dequaire 27830 Analalava, L.J. Dorr, L.C. Barnett, A.J.M. Leeuwenberg & N. Ralimanana 4412: Ambila-Lemaitso, G. E. Schatz & P. P. Lowry 1322: Ambila-Lemaitso, G.E. Schatz, et al. 1960: Ambila-Lemaitso STF, SF(Lemanivo) 2984: Andilamena, SF(Jerome) 2562: Ambila-Lemaitso STF, SF(Verdet) 3258: Mananara RB, C. Birkinshaw et al. 345: Antetezana STF, SF(Todivelona) 1336: Anosinkoraka, SF(Todivelona) 1356: Ambila-Lemaitso STF, SF(Rakotozafy,Pau.) 6458: Analamena, SF(Randrianatody,G.) 13116: Tampolo SF, SF(Laisonoa) 10077: Mahatsara, SF(Paul,E.) 10587: Ambila-Lemaitso STF, SF(André) 21215: Foulpointe, J. Bosser 16989: Foulpointe, G. Cremers 2153: Rombevavy, G. Cours 4164: Tampina, E.Ursch 104: Ambila Lemaitso, R. Decary 6341: Ambila Lemaitso, R. Decary 6495: Ambila Lemaitso, H. Perrier de la Bâthie 15999: Mananara-Nord RB, F. Raharimalala 319: Zahamena RN, RN(Botoalina) 3201: Nossivé, H. Humblot 138: Zahamena RN, RN(Rakotovao) 10606: Tampolo STF, SF 15696: Tampolo STF, SF(R. Capuron) 9198: Ambila-Lemaitso STF, SF 9526: Tampolo STF, SF 9595: Ambila-Lemaitso STF, SF 19501: Androrangambo, Service Forestier 19622: Ambila Lemaitso SF, Martine C17: Ambila-Lemaitso SF, SF 2104: Ambila-Lemaitso STF, SF 4705: Ambila-Lemaitso STF, SF 4925: Ambila-Lemaitso STF, SF 8288: Ambila-Lemaitso SF, SF 8319: Ambila-Lemaitso STF, SF(R. Capuron) 8573: Beanana, SF(R. Capuron) 9065: Tampolo STF, Service Agricole 1047: Analalava, SF(Rabevohitra) 33542: Tampolo STF, SF(Rabevohitra) 32674: Andranokoditra SF(Rabevohitra) 32443: Tampolo STF, Rakotozafy 1337: Tampolo STF, Rakotozafy 1352: Bemainty, , Herbier de la Station Agricole de l'Alaotra 4164: Mahatsara SF, SF 32226: Zahamena RNI, SF(Rabevohitra) 29484: Tampolo SF, Zavah, P. 298: Antetezana, Rakotoarisoa 30: Ankirindro, George E. Schatz et al. 3896: Tampolo STF, SF(P. Zavah) 298-R-107: Tampolo SF, SF(P. Zavah) 480-R-107: Antetezana SF, SF(Félix Rakotoarisoa) 30-EFT: Andavakimenarana, C. Birkinshaw et al. 555: Tampolo, Hélène Ralimanana et al. 80: Antetezana STF, SF(RAKOTOARISOA Félix) 30-R-165: Tampolo STF, SF (Zavah Paul) 15898: Vohibola, Johny Rabenantoandro, R. Razakamalala & Jean Paul 865: Vohibola, Johny Rabenantoandro, R. Razakamalala & Jean Paul 870A: Ambila-Lemaitso, Fidy Ratovoson, J. Rabenantoandro & F. Randriantafika 133: Tampolo STF, Liliane Christine Raholivelo et al. 147: Zahamena PN, F. Ratovoson et al. 459 Toliara: [Vinanibe], L.J. Dorr, L.C. Barnett, A. Rakotozafy, M.R. Cheek & N. Razafimalala 4036: St. Luce (Manafiafy), N. Dumetz, et al. 760 Petriky, , N. Dumetz 648: Mandena SF, N. Dumetz 709: Mandena, James L. Zarucchi et al. 7581 Mandena, James L. Zarucchi et al. 7529: Petriky Forest, G. McPherson, et al. 14116: Mandena, G. McPherson, et al. 14143: [Petriky], James S. Miller & A. Randrianasolo 6202: St. Luce, R. Rabevohitra 2144: Ste. Luce, A. Randrianasolo, et al. 200: [Vinanibe], W.G. D'Arcy & A. Rakotozafy 15407 Mandena STF, SF(Ranjatoson) 2855: [Mandena STF], SF[Ranjatoson,E.] 3365 Ambinanibe, SF(Capuron) 11757 Sainte-Luce, H. Jacquemin 1164 Fort-Dauphin, Ch. Alluaud 6: Fort-Dauphin, Y. Cloisel 110: Fort-Dauphin, R. Decary 4287: Fort-Dauphin, R. Decary 4380: Fort-Dauphin, R. Decary 9981 Soanierana, R. Decary 10765 Ambinanibe, R. Decary 10866 Fort Dauphin, G.F. Scott-Elliot 2537: Ebakika, R. Decary 11000: Mandena SF, Lamarque 92: Mandena SF, A. Randrianasolo 548 Ft. Dauphin, Scott-Elliot 2334: Mandena STF, SF(Lamarque) 92-R-16: Petriky, F. Randriantafika et al. 79: Atsotso, J. Rabenantoandro et al. 381: Mandena, J. Rabenantoandro et al. 398: Manafiafy, J. Rabenantoandro et al. 363: Mandena SF, R. Rabevohitra et al. 3676: Mandena, L. Faliniaina et al. 78: Mandena STF, S.G. Razafimandimbison 213: Mandena STF, RAKOTONASOLO 83: Mandena STF, Reza Ludovic & C. Hong Wa 137

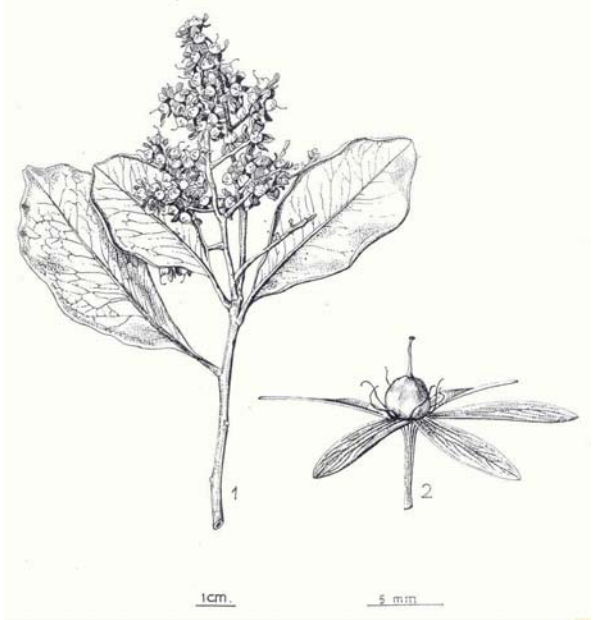
Asteropeia rhopaloides Baillon

Risk of extinction: Least Concern (although this species has a high predicted population decline it has several large and apparently secure sub-populations within protected areas).

Vernacular names: Manoko fotsy, Manoko Mavo, Tsararavina

Conservation Recommendations: good management of protected areas

Description:
Small/medium/large tree. Leaves (small) medium, spoon-shaped with rounded/obtuse apex, leathery, sometimes hairy below. Infloresence a terminal panicle with axes covered with short brown hairs. Flowers with short stalk (< 5mm) and without bracteoles. Fruit small, dry, hard, ovoid, surrounded by long sepals that act as wings.

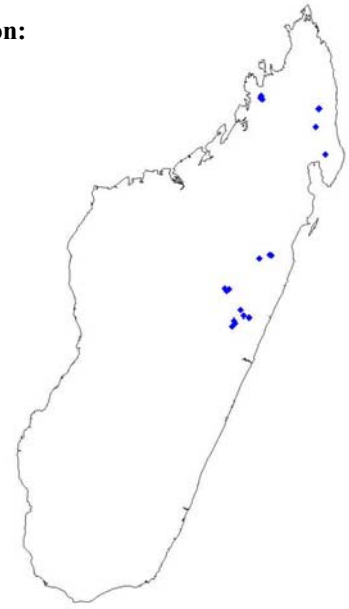


Habitat
- Vegetation type: low and mid-elevation evergreen forest
- Bioclimate: humid, subhumid
- Geology: basement rocks
- Altitude: 800 - 2060 m

Biology
- Pollination: probably insect
- Seed dispersal: wind

Uses: timber (but not extensively exploited at study site)

Distribution:



Observations of study population(s)
- Location: Ambatovy (48°18', 18°51')
- Regeneration observed: yes
- Tolerant to disturbance: no
- Density: 121.5 individuals per ha.
- Abundance: >10,000 mature individuals

Predicted future decline
- Due to habitat loss: 50-80% (cause of loss = tavy)
- Due to exploitation or poor regeneration: decline possible because of selective exploitation for timber

Distribution attributes for total population:
- Extent of occurrence: 87,426 km²
- Area of occupancy: 33,959 km²
- Number of subpopulations: 14

Distribution attributes for population within protected areas:
- Number of subpopulations: 5
- Protected areas: Manongarivo RS, Marojejy PN, Masoala PN, Analamazaotra RS, Zahamena RNI

Herbarium specimens examined: Antananarivo: Anjozorobe, G.E. Schatz, W.D. Stevens & P.P. Lowry 3513: Anjozorobe, G.E. Schatz, B. Lewis & C. Kremen 3638 Anjozorobe, James S. Miller, J. Bradford, F. Rakotonasolo & A. Randrianasolo 8782: Anjozorobe, Rakoto, Féréol 22 Antsiranana: Manongarivo RS, P.J. Rakotomalaza 46: Manongarivo RS, G. McPherson & H. van der Werff 16338: Manongarivo RS, G. McPherson & H. van der Werff 16371: Manongarivo RS, G. McPherson & H. van der Werff 16393: Manongarivo RS, H. van der Werff & G. McPherson 13493: Manongarivo RS, S. Malcomber & L. Rakotomalala 2607: Manongarivo RS, SF(R. Capuron) 11454: Betsomanga, SF(R. Capuron) 838: Beanjada, SF(R. Capuron) 8802: Manongarivo RS, L. Gautier & P. Derleth 2587: Betsomanga, H. Humbert & R. Capuron 24309: Betsomanga, H. Humbert & R. Capuron 24350 Masiaposa, Desiré Ravelonarivo & Pete Lowry 882: Manongarivo RS, L. Gautier, N. Messmer & S. Totozafy Be 3081: Anjenabe, H. Humbert & R. Capuron 24119: Manongarivo RS, Gautier, L. et al. 3578: Manongarivo RS, Gautier, L. et al. 3638 Toamasina: Beforona, SF(Razafindradora) 2096: Analamazaotra-Périnet RS, , SF(Ratovoarison) 2255: Analamazaotra-Périnet RS, SF(Botoalina) 2532 Analamazaotra-Périnet RS, E. Ursch 39 Sandrangato, SF(R. Capuron) 24419: Analamazaotra-Périnet RS, H. Perrier de la Bâthie 4643: Analamazaotra-Périnet RS, Gouvernement de Madagascar 36: Analamazaotra-Périnet RS, Service de Colonisation (Randrianasolo) 46: Analamazaotra-Périnet RS, SF 4659: Analamay, P.J. Rakotomalaza et al. 990 Analamay, P.J. Rakotomalaza et al. 999: Ampitsofanafo, Abraham 46: Anosibe An'Ala, SF(J. P. Abraham) 25587: Analamazaotra Périnet RS, SF(Ratovoarison) 117B-R-172 Zahamena PN, Juliette Randriamanarivo et al. 5: Zahamena PN, Fidy Ratovoson et al. 156: Zahamena PN, Fidy Ratovoson, S. Rakotonandrasana & R. Rakotondrajaona 295 Sahamaloto, C. Hong Wa, Ludovic Reza & Tsihanina 49 Toliara: Fort-Dauphin, G.F. Scott-Elliot 2393

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