

## RED LISTS FOR MALAGASY PLANTS

### V: *Rhodolaena* (SARCOLAENACEAE)



*Rhodolaena altivola*, Ananalava Forest 2004 – photo Adolphe Lehavana

By Chris Birkinshaw, Mamisoa Andrianjafy, Roger Edmond, Cynthia Hong-Wa, Charlotte Rajeriarison, George Schatz

Missouri Botanical Garden  
Antananarivo University  
ANGAP

July 2004

## 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 the likelihood that they will become 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. Thus, each taxon included in this series of redlists has been subject to a recent taxonomic revision.

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 Risk of Extinction Datasheet.**

<p><b>Species name and author:</b> name of species according to the most recent taxonomic revision and name of author(s) who defined the species</p>	<p><b>Risk of extinction:</b> based on the application of criteria presented in IUCN (2001)</p>
<p><b>Vernacular names:</b> from information collected in the field and captured from herbarium specimens.</p>	<p><b>Conservation recommendations:</b> our recommendations for actions to reduce the risk of extinction of the species.</p>
<p><b>Description:</b> based on information in the literature and our own observations of herbarium specimens and living plants in the field.</p>	
<p><b>Habitat:</b></p> <ul style="list-style-type: none"> <li>• Vegetation type: defined by observations in the field and analysis of the distribution of the species related to the vegetation map of DuPuy &amp; Moat (1996)</li> <li>• Bioclimate: defined by the analysis of the distribution of the species related to the bioclimate map of Cornet (1974)</li> <li>• Geology: defined by observations in the field and analysis of the distribution of the species related to the geology map of DuPuy &amp; Moat (1996)</li> <li>• Altitude: based on field observations and information captured from the notes accompanying herbarium specimens</li> </ul>	
<p><b>Biology:</b></p> <ul style="list-style-type: none"> <li>• Pollination: probable pollinator identified from characteristics of flower and observations in the field</li> <li>• Seed dispersal: probable method of seed dispersal identified from characteristics of fruit and observations in the field</li> </ul>	
<p><b>Uses:</b> based on information collected by interviewing local people in the field and captured from the literature and notes on herbarium specimens.</p>	
<p><b>Distribution:</b> 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.</p>	<p><b>Observations of study population(s)</b>            Location: study site with geo-reference</p> <ul style="list-style-type: none"> <li>• Regeneration observed: presence of regeneration assumed from the presence at the site of individuals representative of all size classes.</li> <li>• Tolerant to disturbance: presence of regenerating populations of the species in severely degraded vegetation (&gt;50% of original biomass lost).</li> <li>• Density: average number of mature individuals of the species per ha of appropriate habitat based on counts in replicated plots or along transects.</li> <li>• 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)).</li> </ul>
	<p><b>Predicted future decline:</b></p> <ul style="list-style-type: none"> <li>• 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 &amp; 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).</li> <li>• 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.</li> </ul>
	<p><b>Distribution attributes for total population:</b>            (These analyses made using ArcView 3.2)</p> <ul style="list-style-type: none"> <li>• Extent of occurrence: estimated as the area contained within the shortest continuous imaginary boundary drawn to encompass all the collection locations for the species.</li> <li>• 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.</li> <li>• Number of subpopulations: estimated as the number of collection locations but combining locations that are separated by less than 5 km.</li> </ul>
	<p><b>Representation in protected areas:</b>            Protected areas are defined as National Parks (PN), Special Reserves (RS), Nature Reserves (RNI), Biosphere Reserves (RB).</p> <ul style="list-style-type: none"> <li>• Number of subpopulations: number of data points within protected areas but combining locations separated by less than 5 km.</li> <li>• Protected areas: list of protected areas where the species has been recorded.</li> </ul>
<p><b>Herbarium specimens examined:</b> list of herbarium specimens examined for this study</p>	

**SARCOLAENACEAE** Caruel  
(from Schatz 2001)

Sarcolaenaceae is one of five families that are currently recognised as being endemic to Madagascar. It contains 8 genera and ca. 44 species.

### Description

Hermaphrodite shrubs to large trees, often with stellate pubescence. Leaves alternate, simple, entire, penninerved or rarely pseudo-triplinerved by virtue of induplicate vernation traces, with caducous stipules. Inflorescences umbelliform or paniculate cymes, for sometimes flowers solitary, flowers small to often large and showy, regular, 5-merous, subtended by an involucre of bracts which are sometimes fused to form a cup; sepals 3 (-5), imbricate; petals 5 (-6), free, or slightly fused at their base, twisted in bud; nectary disc present or not; stamens 5-numerous, sometimes slightly fused at their base into 5 fascicles, filaments slender, anthers bilocular, longitudinally dehiscent; ovary superior, 1-5-locular, style terminal, stigma 3-5-lobed; ovules 2-many per locule. Fruit a dehiscent capsule or indehiscent and somewhat woody, often surrounded partially or completely by the involucral bracts or cup; endosperm present.

### Key to genera of Sarcolaenaceae

1. Leaves with longitudinal lines (vernation traces) on either side of the midrib as a result of folding in bud, resembling veins and thus the venation superficially triplinerved to 3-palmatinerved, rarely the traces absent (*S. isaloensis*)  
.....*Sarcolaena*
- 1'. Leaves lacking vernation traces on either side of the midrib, never superficially triplinerved or palmatinerved.
  2. Leaves with mixture of stellate and lepidote indument, often dense; involucre very small at anthesis, very late accrescent in fruit or not at all.
    3. Fruit indehiscent, surrounded by accrescent, entire involucre; ovary 2-locular .....*Perrierodendron*
    - 3'. Fruit dehiscent, the involucre accrescent or not, lobed; ovary 3-5-locular.
      4. Sepals strongly unequal, the outer 2 much smaller; petals strongly contorted in bud; ovary 3-locular; ovules 2 per locule .....*Eremolaena*
      - 4'. Sepals more or less equal; petals slightly contorted in bud; ovary 5-locular; ovules 4-6 per locule  
.....*Pentachlaena*
  - 2'. Leaves glabrous or with simple indument; involucre well-developed at anthesis or not, accrescent in fruit.
    5. Flowers with involucre well-developed at anthesis, deeply cup- or urn-shaped, partially or completely enclosing the flower in bud.
      6. Involucre only partially enclosing the flower in bud; stamens arranged in 5 fascicles; ovules many per locule; involucre in fruit very large, bell-like, woody, narrowly ellipsoid, thick-walled, with a circular opening at the apex, the fruit at the base .....*Xyloolaena*
      - 6'. Involucre completely enclosing the flower in bud; stamens not in fascicles; ovules 2 (-4) per locule; involucre only slightly accrescent in fruit, not thick walled and bell-like with the fruit at the base  
.....*Leptolaena* (and  
*Sarcolaena isaloensis*)
    - 5'. Flowers with involucre small at anthesis, not deeply cup- or urnshaped and partially or completely enclosing the flower.
      7. Sepals 5, the outer 2 smaller; flowers large, pendulous, the petals showy pink-violet forming a funnel-shaped corolla; involucre late accrescent in fruit, fleshy but not viscous, lobed but never spiny  
.....*Rhodolaena*
      - 7'. Sepals 3; flowers small to large, petals white to cream-yellow, rarely pink, spreading, not forming a funnel-shaped corolla; involucre strongly accrescent in fruit, viscous and fleshy, entire or lacinate or with fleshy spines .....*Schizolaena*

**Rhodolaena** Thouars, Hist. Vég. Iles. Austrl. Afriq.: 47. 1805.

Hermaphrodite medium to large trees. Leaves alternate, simple, entire, penninerved although the secondary venation obscure, stipules very small, caducous. Inflorescences terminal, long-pedunculate, pendent, flowers, large, paired, distinctly pedicellate and subtended by very small, scale-like involucral bracts, 5-merous; sepals 5, unequal, the outer 2 very small, the inner 3 large, persistent and accrescent, coriaceous in fruit; petals 5, contorted in bud, erect and forming a funnel at anthesis, pink-violet, very showy; disc annular; stamens 15-50, free, filaments inserted at the inner base of the disc, anthers longitudinally dehiscent; ovary 3-locular, common style long slender, stigma capitate; ovules 4-12 per locule. Fruit a large, woody, dehiscent, 3-valved capsule, surrounded by the accrescent inner sepals, the involucral bracts tardily accrescent and fleshy; seeds 1-2 per locule, with abundant endosperm.



*Rhodolaena* is distributed in humid to subhumid evergreen forest from littoral forest at sea level to 1,600 m elevation. With its large, pendulous flowers with pink-violet petals collectively forming a funnel-shaped corolla, it is among the most beautiful of Malagasy trees and deserving of cultivation.



Key to species of *Rhodolaena*  
(from Schatz *et al.* 2000)



1. Young branches and midrib of blade below usually with dense golden indument, the trichomes ca. 0.5 mm long; stipules linear to narrowly triangular, persistent ..... ***R. humblotii***
- 1'. Young branches and midrib of blade below glabrous, or twig with dense brownish indument, the trichomes less than 0.1 mm long; stipules triangular, caducous.....2
2. Leaves with a rounded apex (rarely acute) and usually emarginate, sometimes with a tiny mucro .....3
- 2'. Leaves with an acute to acuminate apex.....4
3. Twigs usually glabrescent, and often glaucescent; leaves strongly coriaceous, the largest blade usually greater than 7 cm long (rarely less) inner sepals coriaceous (2)2.5-3.5 cm long..... ***R. coriacea***
- 3'. Twigs with dense brownish indument; leaves chartaceous, the largest blade usually less than 6 cm long (rarely to 7cm) inner sepals chartaceous, not exceeding 1.8 cm long..... ***R. bakeriana***
4. Leaves with secondary veins nearly perpendicular to the midvein (>80°); involucre a distinct collar at anthesis; ovary densely golden tomentose; seeds with dense white indument .....***R. leroyana***
- 4'. Leaves with secondary veins ascending (<70°); involucre mostly indistinct at anthesis; ovary subglabrous, or white puberulent to tomentose; seeds glabrous .....5
5. Leaves drying olive green, with evident secondary veins on the glossy upper surface strongly ascending (<45° to the midvein), tertiary veins forming an open reticulated network; twigs lacking conspicuous raised lenticels; flowers solitary; fruit large, the valves 2-3.3 x 2-2.5 cm..... ***R. macrocarpa***
- 5'. Leaves drying maroon-brownish, the secondary veins usually obscure on the dull upper surface, ascending at a 60-70° angle to the midvein, tertiary veins forming a dense reticulated network; twigs often with distinctly raised rusty brown lenticels; flowers paired..... 6
6. Leaves narrowly elliptic to slightly ovate, broadest near the middle, largest blades not exceeding 3(-3.6) cm wide, leaf base acute; sepals covered with dense, short, appressed trichomes on the portion covered by the adjacent sepal in bud; fruit dark green to black (in dry material), densely short tomentose, the trichomes ca. 0.2-0.3 mm long..... ***R. acutifolia***
- 6'. Leaves ovate, broadest below the middle, largest blades at least (4-)4.5 cm wide, leaf base more or less rounded; sepals glabrous, shiny; fruit chocolate brown (in dry material) sparsely puberulent, the trichomes less than 0.1 mm long ..... ***R. altivola***

## **RISK OF EXTINCTION DATASHEETS**







<p><b>Rhodolaena acutifolia</b> Baker</p>	<p><b>Risk of Extinction:</b> <b>Vulnerable (A3c)</b></p>
<p><b>Vernacular names:</b> Anjananjana, Hazompasina</p>	<p><b>Conservation recommendations:</b> a) good management of protected areas; b) inclusion of additional populations in protected areas</p>
<p><b>Description:</b> Small trees (shrubs). Twigs hairless. Stipules located either side of petiole. Leaves small/medium, narrowly elliptic/ovate, broadest around the middle, apex acuminate. Inflorescence consists of 2 flowers on a long stem. Flowers very large with 5 unequal sepals densely covered with tiny appressed hairs, 5 bright purple-pink petals (5 cm long), many stamens with long filaments, a circular nectary disk, ovary with long style. Fruits medium, woody, densely hairy, dehiscent.</p>	 <p style="text-align: center;">photo – Fidisoa Ratovoson</p>
<p><b>Habitat</b></p> <ul style="list-style-type: none"> <li>• Vegetation type: low elevation evergreen forest</li> <li>• Bioclimate: humid</li> <li>• Geology: basement rocks</li> <li>• Altitude: 350 - 800 m</li> </ul>	
<p><b>Biology</b></p> <ul style="list-style-type: none"> <li>• Pollination: probably insects and birds (based on the characteristics of the flower and observations of bees, hornets and the sunbird (<i>Nectarina souimanga</i>) visiting the flowers of <i>R. bakeriana</i>)</li> <li>• Seed dispersal: the fruit is capsular and seeds apparently fall to the ground close to the parent plant</li> </ul>	
<p><b>Uses:</b> Timber</p>	
<p><b>Distribution</b></p> 	<p><b>Observations of study population(s):</b></p> <ul style="list-style-type: none"> <li>• Location: Anjirobe (48°57'17"E, 17°24'04"S)</li> <li>• Regeneration observed: yes</li> <li>• Tolerant to disturbance: no</li> <li>• Abundance: &gt; 10,000 mature individuals</li> </ul> <p><b>Predicted future decline:</b></p> <ul style="list-style-type: none"> <li>• due to habitat loss: 30-50% (cause of loss = shifting cultivation)</li> <li>• because of exploitation or poor regeneration: decline possible because of exploitation for timber</li> </ul> <p><b>Distribution attributes for total population:</b></p> <ul style="list-style-type: none"> <li>• Extent of occurrence: 501 km<sup>2</sup></li> <li>• Area of occupancy: 442 km<sup>2</sup></li> <li>• Number of subpopulations: 6</li> </ul> <p><b>Representation in protected areas:</b></p> <ul style="list-style-type: none"> <li>• Number of subpopulations: 2</li> <li>• Protected areas: Zahamena AP</li> </ul>
<p><b>Herbarium specimens examined:</b> Madagascar : <a href="#">R. Baron 6086</a> , <a href="#">Baron 2427</a> (HT: K; IT: K(2)). Toamasina: Zahamena RNI, <a href="#">SF(Laibosaka) 26090</a> (P, TEF) ; Zahamena RNI, <a href="#">RN(Botoalina) 3163</a> ; Maningory, <a href="#">H. Perrier de la Bâthie 2224</a> ; Zahamena RNI, <a href="#">RN 10487</a> ; Tsonsona, <a href="#">G. Cours 1553</a> ; Sahalangina, <a href="#">N.M. Andrianjafy &amp; L.R. Andriamiarisoa 117</a> ; Sahalangina, <a href="#">M. Andrianjafy 118</a> ; Zahamena PN, <a href="#">S.T. Rakotonandrasana &amp; F. Ratovoson 450</a> ; Zahamena AP, <a href="#">Fidy Ratovoson et al. 307</a> ; Zahamena AP, <a href="#">F. Ratovoson et al. 315</a> ; Zahamena RN, <a href="#">Simon Malcomber et al. 2513A</a> ; Zahamena AP, <a href="#">S. Randrianasolo et al. 389</a> ; Zahamena AP, <a href="#">Roland Rakotondrajaona et al. 282</a>.</p>	



<p><i>Rhodolaena altivola</i> Thouars</p>	<p><b>Risk of extinction:</b> <b>Critically Endangered (A3c, B1ab)</b></p>
<p><b>Vernacular names:</b> Voandrozana</p>	<p><b>Conservation recommendations:</b> inclusion of populations in new conservation sites</p>
<p><b>Description:</b>  Small (medium) trees. Twigs hairless. Stipules located either side of the petiole. Leaves medium, ovate, with acuminate apex and rounded base; young petioles reddish. Inflorescences with 1 or 2 flowers on a long pendant stem. Flowers very large with 5 unequal glabrous sepals, 5 bright purple-red petals (5 cm long), many stamens with long filaments, a circular nectary disk, ovary with long style. Fruits large, woody, dehiscent, sparsely hairy</p>	 <p style="text-align: center;">photo - Adolophe Lehavana</p>
<p><b>Habitat</b></p> <ul style="list-style-type: none"> <li>• Vegetation type: low elevation evergreen forest, mid-elevation evergreen forest</li> <li>• Bioclimate: humid, subhumid</li> <li>• Geology: basement rocks, lake and alluvial deposits</li> <li>• Altitude: 200 - 1,000 m</li> </ul>	
<p><b>Biology</b></p> <ul style="list-style-type: none"> <li>• Pollination: probably insects and birds (based on the characteristics of the flower and observations of bees, hornets and the sunbird (<i>Nectarina souimanga</i>) visiting the flowers of <i>R. bakeriana</i>)</li> <li>• Seed dispersal: the fruit is capsular and seeds apparently fall to the ground close to the parent plant</li> </ul>	
<p><b>Uses:</b> none reported but probably exploited for timber</p>	
<p><b>Distribution</b></p> 	<p><b>Observations of study population(s):</b></p> <ul style="list-style-type: none"> <li>• Location: Analalava (49°47'20"E, 17°42'04"S)</li> <li>• Regeneration observed: yes</li> <li>• Tolerant to disturbance: no</li> <li>• Abundance: 1,000 - 2,500 mature individuals</li> </ul> <p><b>Predicted future decline:</b></p> <ul style="list-style-type: none"> <li>• due to habitat loss: &gt; 80% (cause = shifting cultivation and fire)</li> <li>• because of exploitation or poor regeneration: decline possible because of exploitation for timber</li> </ul> <p><b>Distribution attributes for total population:</b></p> <ul style="list-style-type: none"> <li>• Extent of occurrence: 2,335 km<sup>2</sup></li> <li>• Area of occupancy: 554 km<sup>2</sup></li> <li>• Number of subpopulations: 5</li> </ul> <p><b>Representation in protected areas:</b></p> <ul style="list-style-type: none"> <li>• Number of subpopulations: 0</li> <li>• Protected areas: none</li> </ul>
<p><b>Herbarium specimens examined:</b> Madagascar : <a href="#">A. du Petit-Thouars s.n.</a> Toamasina: Antongil, <a href="#">Ch. d'Alleizette 539</a> ; Manahar, 1000-1500 m, <a href="#">H. Humblot 215</a> ; Antetezana, <a href="#">SF(Capuron) 28891</a> ; Didy, <a href="#">L. Catat 1726</a> ; Analalava, <a href="#">N.M. Andrianjafy &amp; M. Rakotondrasoa 85</a> ; Analabe, <a href="#">Rakotozafy, A. 1438</a> ; Analabe, <a href="#">Rakotozafy, A. 1438bis</a> ; Analalava, <a href="#">SF(Rabevohitra) 33539</a> (TEF) ; Analalava, <a href="#">M. Andrianjafy &amp; M. Rakotoarisoa 132</a> ; Vohimena, <a href="#">L.M. Randrianjanaka et al. 690</a>.</p>	



<i>Rhodolaena bakeriana</i> Baill.	<b>Risk of Extinction:</b> <b>Vulnerable (A3c)</b> (not classified as more threatened because this species has large and apparently stable populations in several protected areas)
<b>Vernacular names:</b> Fotana	<b>Conservation recommendations:</b> a) good management of protected areas; b) inclusion of additional populations in protected areas
<b>Description:</b> Medium trees. Twigs hairy. Stipules located either side of the petiole. Leaves small (medium), elliptical/oblong/obovate with rounded or notched apex and rounded base, papery. Inflorescences with 1 or 2 flowers on a long pendant stem. Flowers very large with 5 unequal glabrous sepals, 5 bright purple-red petals (5 cm long), many stamens with long filaments, a circular nectary disk, ovary with long style. Fruits medium, woody, dehiscent, with fleshy involucre below fruit.	 <p style="text-align: center;">photo – George Schatz</p>
<b>Habitat</b> <ul style="list-style-type: none"> <li>• Vegetation type: mid-elevation evergreen forest</li> <li>• Bioclimate: humid, subhumid</li> <li>• Geology: basement rocks</li> <li>• Altitude: 900 - 1,400 m</li> </ul>	
<b>Biology</b> <ul style="list-style-type: none"> <li>• Pollination: probably insects and birds (based on the characteristics of the flower and observations of bees, hornets and the sunbird (<i>Nectarina souimanga</i>) visiting flowers at Analamazaotra RS)</li> <li>• Seed dispersal: the fruit is capsular and seeds may fall to the ground undispersed or it is possible that they are dispersed by lemurs if these consume the fleshy involucre.</li> </ul>	
<b>Uses:</b> timber, posts for power cables	
<b>Distribution</b> 	<b>Observations of study population(s):</b> <ul style="list-style-type: none"> <li>• Location: Analamazaotra (48°25'05"E, 18°55'57"S)</li> <li>• Regeneration observed: yes</li> <li>• Tolerant to disturbance: no</li> <li>• Abundance: &gt;10,000 mature individuals</li> </ul> <b>Predicted future decline:</b> <ul style="list-style-type: none"> <li>• due to habitat loss : 50-80%</li> <li>• because of exploitation or poor regeneration: decline possible because of exploitation for timber</li> </ul> <b>Distribution attributes for total population:</b> <ul style="list-style-type: none"> <li>• Extent of occurrence: 28,860 km<sup>2</sup></li> <li>• Area of occupancy: 5,460 km<sup>2</sup></li> <li>• Number of subpopulations: 13</li> </ul> <b>Representation in protected areas:</b> <ul style="list-style-type: none"> <li>• Number of subpopulations: 3</li> <li>• Protected areas: Ambohitantely RS, Ranomafanana PN, Perinet-Analamazaotra nRS</li> </ul>

**Herbarium specimens examined: Madagascar** : [Service de Colonisation 66](#) ; [R. Baron 1980](#) ; [R. Baron 3649](#) ; [Exposition coloniale de Marseille 721](#) ; [R. Baron s.n.](#) **Antananarivo**: Anjozorobe, [A. Rakotozafy, P. Phillipson, S. Malcomber & S. Razafimandimbison 2685](#) ; Anjozorobe, [G.E. Schatz, B. Lewis & C. Kremen 3640](#) ; Ambohitantely RS, [SF 8371](#) ; Imerina, 18.55.00S 47.31.00E, Jan 1881, [J.M. Hildebrandt 3823](#) ; Antsahambavy, [SF 15868](#) ; Mandraka, [Ch. d'Alleizette 710](#) ; Andranomay, 1360 m, 18.28.48S 47.57.18E, 15-20 décembre 1996, [R. Ranaivojaona et al. 87](#). Fianarantsoa: Ranomafana PN, [SF\(Capuron\) 23214](#) (P, TEF). **Toamasina**: Analamazaotra-Perinet RS, [SF 34083](#) ; Analamazaotra-Perinet RS, [James S. Miller 3747](#) ; Sandrangato, [L.J. Dorr with L.C. Barnett & A. Rakotozafy 4575](#) ; Analamazaotra-Perinet RS, [Al Gentry, L. Dorr, L. Barnett & A. Rakotozafy 52559](#) ; Analamazaotra-Perinet RS, [Al Gentry, L. Dorr, L. Barnett & A. Rakotozafy 52648](#) ; Analamazaotra-Perinet RS, [L.J. Dorr, L.C. Barnett, A.J.M. Leeuwenberg & N. Ralimanana 4493](#) ; Perinet-Analamazaotra RS, [SF\(Ratovoarison\) 2922](#) ; Anosibe An'Ala, [SF\(Rakoto J.D.\) 2196](#) ; Perinet-Analamazaotra RS, [SF\(Botoalina\) 1170](#) ; Perinet-Analamazaotra RS, [SF\(Stat.Analamazaotra\) 21162](#) ; Perinet-Analamazaotra RS, [SF\(P.Guéneau\) 26022](#) ; Perinet-Analamazaotra RS, [SF\(P. Guéneau\) 26023](#) ; Perinet-Analamazaotra RS, [SF\(P.Guéneau\) 25760](#) ; Perinet-Analamazaotra RS, [SF\(P.Guéneau\) 25763](#) ; Perinet-Analamazaotra RS, [SF\(P.Guéneau\) 25715](#) ; Perinet-Analamazaotra RS, [SF\(P.Guéneau\) 25716](#) ; Perinet-Analamazaotra RS, [SF\(P.Guéneau\) 25717](#) ; Lakato, [SF\(Razafindradora\) 5811](#) ; Perinet-Analamazaotra RS, [SF\(Ratovoarison\) 12432](#) ; Analamay, [P.J. Rakotomalaza et al. 1319](#) ; Ambatovy, [F. Andriatsiferana et al. 2094](#) ; Ambatovy, [P.-J. Rakotomalaza et al. 1076](#) ; Analamazaotra Perinet RS, [RN\(E.Ursch\) 35](#) ; Analamazaotra Perinet RS, 18.56S 048.26E, Jan 1937, [RN\(Goulbert Andrianavo\) 44](#) ; Périntet-Analamazaotra RS, [SF 15686](#) ; Analamazaotra-Perinet RS, [Service Forestier 8357](#) ; Analamazaotra-Perinet RS, [SF\(Capuron\) 18047](#) ; Antsevabe, [G. Cours 4069](#) ; Périntet-Analamazaotra RS, [SF 4654](#) ; Périntet-Analamazaotra RS, [SF 15004](#) ; Analamazaotra-Perinet RS, [H. Perrier de la Bâthie 5335](#) ; Sandrangato, [SF\(R.Capuron\) 24418](#) ; Périntet-Analamazaotra, [G.E. Schatz & J. Rabenantoandro 3988](#) ; Analamazaotra RS, [Andrianjafy, M. et al. 23](#) ; Périntet-Analamazaotra RS, 850 - 900 m, [Mabberley, D.J. 812](#) ; Périntet-Analamazaotra RS, [Schedl 64](#) ; Périntet-Analamazaotra RS, [Léandri, J. 710](#) ; Sandrangato, [Descoings, B. 33](#) ; Périntet-Analamazaotra RS, [SF 8342](#) ; Fierenana, [SF 28781bis](#) (TEF) ; Périntet-Analamazaotra RS, [SF\(R.Capuron\) 28137](#) ; Périntet-Analamazaotra RS, [SF 25322](#) ; Périntet-Analamazaotra RS, [SF 131-R-172](#) ; Périntet-Analamazaotra RS, [SF 169-R-172](#) ; Périntet-Analamazaotra RS, [SF 31085](#) ; Analamazaotra-Périntet RS, [SF 17B-R-172](#) ; Analamazaotra-Périntet RS, [SF 30642](#) ; Analamazaotra-Périntet RS, [E. Thouvenot 44](#) ; Tampina, [H. Perrier de la Bâthie \(Louvel no. 6\) 15874](#) ; Analamazaotra-Périntet RS, [SF \(P. Guéneau\) 26188](#) ; Analamazaotra-Périntet RS, [SF 17930](#) ; Analamazaotra-Périntet RS, [SF\(M.Razafimandimby\) 76-R-211](#) ; Analamazaotra-Périntet RS, [E. Ursch 83](#) ; Analamazaotra-Périntet RS, [E. Ursch 10](#) ; Analamazaotra-Perinet RS, [RN\(Ratovoarison\) 1299](#) ; Analamazaotra-Perinet RS, [SF\(Ratovoarison F. d'A.\) 169B-R-172](#) ; Analamazaotra-Périntet RS, [J.-N. Labat et al. 3081](#) ; Analamazaotra-Perinet RS, [N.M. Andrianjafy et al. 142](#) ; Analamazaotra-Perinet RS, [Z.S. Rogers et al. 43](#) ; Farizana, [Lalao Jérôme Razafitsalama & A.D. Rabehevitra 126](#)

<p><i>Rhodolanea coriacea</i> G.E. Schatz, Lowry &amp; A.-E. Wolf</p>	<p><b>Risk of extinction:</b> Least Concern (although the population of this species is predicted to decline it has several large and apparently secure sub-populations within protected areas).</p>
<p><b>Vernacular names:</b> Pikazana, Arina</p>	<p><b>Conservation recommendations:</b> good management of protected areas</p>
<p><b>Description:</b> Small/medium trees. Stipules located either side of petiole. Leaves medium, elliptical with rounded or notched apex, leathery. Inflorescence with 1 or 2 flowers on long peduncle. Flowers very large with 5 hairless unequal sepals, 5 purple-pink petals (to 5 cm long), many stamens with long filaments, a circular nectary disk, ovary with long style. Fruit large, woody, dehiscent, with fleshy involucre below fruit.</p>	 <p style="text-align: center;">photo – Fidisoa Ratovoson</p>
<p><b>Habitat</b></p> <ul style="list-style-type: none"> <li>• Vegetation type: low elevation evergreen forest, mid-elevation humid forest, littoral forest</li> <li>• Bioclimate: humid, subhumid</li> <li>• Geology: basement rocks</li> <li>• Altitude: 20 - 1,700 m</li> </ul>	
<p><b>Biology</b></p> <ul style="list-style-type: none"> <li>• Pollination: probably insects and birds (based on the characteristics of the flower and observations of bees, hornets and the sunbird (<i>Nectarina souimanga</i>) visiting the flowers of <i>R. bakeriana</i>)</li> <li>• Seed dispersal: probably lemurs (the involucre of this species is fleshy and is reported to be eaten by lemurs at Vohitraomby, Brickaville (Lejoma Talata, pers. comm..))</li> </ul>	
<p><b>Uses:</b> timber</p>	
<p><b>Distribution</b></p> 	<p><b>Observations of study population(s):</b></p> <ul style="list-style-type: none"> <li>• Location: Vohitraomby (48°27'13"E, 15°44'50"S)</li> <li>• Regeneration observed: yes</li> <li>• Tolerant to disturbance: no</li> <li>• Abundance: &gt;10,000 mature individuals</li> </ul> <p><b>Predicted future decline:</b></p> <ul style="list-style-type: none"> <li>• due to habitat loss: 50-80% (cause = shifting cultivation)</li> <li>• because of exploitation or poor regeneration: decline possible because of exploitation for timber and increasing rarity of animal seed dispersers</li> </ul> <p><b>Distribution attributes for total population:</b></p> <ul style="list-style-type: none"> <li>• Extent of occurrence: 85,060 km<sup>2</sup></li> <li>• Area of occupancy: 33,860 km<sup>2</sup></li> <li>• Number of subpopulations: 24</li> </ul> <p><b>Representation in protected areas:</b></p> <ul style="list-style-type: none"> <li>• Number of subpopulations: 12</li> <li>• Protected areas: Ambohitantely RS, Anjanaharibe-Sud RS, Betampona RN, Mananara Nord RB, Marojejy PN, Masoala PN, Zahamena PN.</li> </ul>
<p><b>Herbarium specimens examined:</b>  <b>Madagascar :</b> <b>Antananarivo:</b> Ambohitantely RS, <a href="#">SF(Rakotoarisoa F.) 69-R-165</a> ; <b>Antsiranana:</b> Marojejy RNI, <a href="#">F. Rasoavimbahoaka 674</a> ; Anjanaharibe-Sud RS, <a href="#">Desiré Ravelonarivo &amp; R. Rabesonina 608</a> ; <b>Fianarantsoa:</b> Ampasinambo, <a href="#">SF 14735</a> ; <b>Toamasina:</b> Betampona RN, <a href="#">B. Carlson 419</a> ; Sahamamy, <a href="#">SF(Goyeneche) 10763</a> ; Rantabe, <a href="#">SF(Capuron) 8893</a> ; Tampolo, <a href="#">SF(Capuron) 18174</a> ; Ambatondradama, <a href="#">SF(Capuron) 8800</a> ; Ambatondradama, <a href="#">SF(Capuron) 8864</a> ; Ampasimadinika, <a href="#">Service Forestier 25521</a> ; Mananara-Nord RB, <a href="#">F. Raharimalala 370</a> ; Mananara-Nord RB, <a href="#">F. Raharimalala 241</a> ; Sahajinja, <a href="#">SF(Capuron) 9099</a> ; Zahamena AP, <a href="#">F. Ratovoson et al. 257</a> ; Betampona RNI, <a href="#">Andrianjafy, N.M. et al. 88</a> ; Betampona RNI, <a href="#">Andrianjafy, N.M. et al. 89</a> ; Faravohitra, <a href="#">SF 26073</a> ; Sahalampy, <a href="#">G. Cours 2422</a> ; Zahamena RNI, <a href="#">RN(Ramanatsoavina) 2812</a> ; Sahalagina, <a href="#">Andrianjafy, M. 121</a> ; Sahamamy, <a href="#">M. Andrianjafy &amp; V. Velonjara 141</a> ; Betampona RNI, <a href="#">Bernard Iambana et al. 255</a> ; Zahamena PN, <a href="#">S. Rakotonandrasana 500</a> ; Zahamena AP, <a href="#">F. Ratovoson et al. 542</a> ; Antanambao, <a href="#">J. Rabenantoandro et al. 1188</a> ; Betampona RNI, <a href="#">Lalao Jérémie Razafitsalama &amp; A.D. Rabehevitra 122</a> ; Zahamena AP, <a href="#">F. Ratovoson, S. Rakotondrajoana, J. Randriamanarivo, L.M. Randrianjanaka, A. Belalahy &amp; A. Rapapolomanjara 298</a> ; Zahamena AP, <a href="#">L.M. Randrianjanaka et al. 643</a>.</p>	

<p><i>Rhodolaena humblotii</i> Baill.</p>	<p><b>Risk of Extinction:</b> <b>Vulnerable (A3c)</b> (not classified as more threatened because this species has large and apparently stable populations in several protected areas)</p>
<p><b>Vernacular names:</b> Malemisisika</p>	<p><b>Conservation recommendations:</b> a) good management of protected areas; b) inclusion of additional populations in protected areas</p>
<p><b>Description:</b> Small/medium trees (shrubs). Twigs with dense golden hairs. Stipules located on either side of petiole. Leaves small, elliptical with rounded/acute/acuminate apex, midrib hairy. Inflorescence with short (1 cm) hairy peduncle bearing two flowers. Flowers very large with 5 hairy unequal sparsely hairy sepals, 5 pink-red petals (to 5 cm long), many stamens with long filaments, a circular nectary disk, ovary with long slender style. Fruit medium, woody, dehiscent.</p>	 <p style="text-align: center;">photo – Mamisoa Andrianjafy</p>
<p><b>Habitat</b></p> <ul style="list-style-type: none"> <li>• Vegetation type: low elevation evergreen forest, mid-elevation humid forest, (littoral forest?)</li> <li>• Bioclimate: humid, subhumid</li> <li>• Geology: basement rocks, lake and alluvial deposits, (loose sand?)</li> <li>• Altitude: 20 - 1,200 m</li> </ul>	
<p><b>Biology</b></p> <ul style="list-style-type: none"> <li>• Pollination: probably insects and birds (based on the characteristics of the flower and observations of bees, hornets and the sunbird (<i>Nectarina souimanga</i>) visiting the flowers of <i>R. bakeriana</i>)</li> <li>• Seed dispersal: the fruit is capsular and seeds apparently fall to the ground close to the parent plant</li> </ul>	
<p><b>Uses:</b> timber</p>	
<p><b>Distribution</b></p> 	<p><b>Observations of study population(s):</b></p> <ul style="list-style-type: none"> <li>• Location: Beanana (49°27'13"E, 15°44'50"S)</li> <li>• Regeneration observed: yes</li> <li>• Tolerant to disturbance: no</li> <li>• Abundance: &gt;10,000 mature individuals</li> </ul> <p><b>Predicted future decline:</b></p> <ul style="list-style-type: none"> <li>• due to habitat loss: 50-80%</li> <li>• because of exploitation or poor regeneration: decline possible because of exploitation for timber</li> </ul> <p><b>Distribution attributes for total population:</b></p> <ul style="list-style-type: none"> <li>• Extent of occurrence: 37,880 km<sup>2</sup></li> <li>• Area of occupancy: 21,280 km<sup>2</sup></li> <li>• Number of subpopulations: 17</li> </ul> <p><b>Representation in protected areas:</b></p> <ul style="list-style-type: none"> <li>• Number of subpopulations: 4</li> <li>• Protected areas: Betampona RN, Mananara Nord RB, Zahamena PN</li> </ul>
<p><b>Herbarium specimens examined:</b>  <b>Madagascar:</b> <a href="#">H. Humblot s.n.</a> (P) ; <a href="#">A.-M. Homolle 1844</a> (P) ; <a href="#">M. Thiry s.n.</a> (P) ; <b>Fianarantsoa:</b> Ifanadiana, <a href="#">SF(Capuron) 23229</a> ; <b>Toamasina:</b> Zahamena RN, <a href="#">Simon Malcomber et al. 2513</a> ; Mananara PN, <a href="#">Marion Nicoll 501</a> ; Fampanambo, <a href="#">F. Ratovoson et al. 92</a> ; Sahajinja, <a href="#">SF(Capuron) 9109</a> ; Beanana, <a href="#">SF(Capuron) 9060</a> ; Zahamena RNI, <a href="#">RN(Ramarokoto) 7834</a> ; Antsianaka, <a href="#">H. Humblot 428</a> ; Antsianaka, <a href="#">H. Humblot 474</a> ; Mananara-Nord RB, <a href="#">Service Forestier 4484</a> ; Zahamena RNI, <a href="#">RN(Laibosaka) 10508</a> ; Betampona RNI, <a href="#">RN(Razanaparany) 8749</a> ; Betampona RNI, <a href="#">RN(Rakoto Jean de la Croix) 7414</a> ; Ambodivoangy, <a href="#">G. Cours 1844</a> ; Beanana, <a href="#">N.M. Andrianjafy 68</a> ; Zahamena AP, <a href="#">N. Andrianjafy &amp; F. Ratovoson 102</a> ; Zahamena RNI, <a href="#">Rakotozafy, A. 677</a> ; Zahamena RNI, <a href="#">RN(Botoalina) 3723</a> ; Antanambao-Manampotsy, <a href="#">Guillaumet, J.L. 2420</a> ; Zahamena RNI, <a href="#">RN(Botoalina) 12442</a> ; Betampona RNI, <a href="#">SF(Razaparany) 17558</a> ; Tsinjoarivo, <a href="#">SF 21420</a> ; Mananara-Nord PN, <a href="#">SF 31934</a> ; Sahalampy, <a href="#">G. Cours 2429</a> ; Sahalampy, <a href="#">G. Cours 2392</a> ; Zahamena RNI, <a href="#">H. Jacquemin 226</a> ; Betampona RNI, <a href="#">B. Iambana et al. 146</a> ; Tampolo STF, <a href="#">L.C. Rahoivelo, B. Rakotoninina &amp; B. Rakotoanadahy 57</a> ; Tampolo STF, <a href="#">L.C. Rahoivelo, B. Rakotoninina &amp; B. Rakotoanadahy 234</a> ; Zahamena AP, <a href="#">S. Randrianasolo et al. 368</a>.</p>	

<p><i>Rhodolaena leroyana</i> G.E. Schatz, Lowry &amp; A.-E. Wolf</p>	<p><b>Risk of extinction:</b> <b>Vulnerable (D1, D2)</b></p>
<p><b>Vernacular names:</b> Tsiarinaarina Fotsy</p>	<p><b>Conservation Recommendations:</b> good management of Betampona RNI</p>
<p><b>Description:</b> Shrubs or small trees. Twigs hairless. Stipules located either side of the petiole. Leaves medium, elliptical/obovate, with acuminate apex and acute base. Inflorescences with 1 or 2 flowers on a long pendant stem. Flowers very large with 5 unequal sepals with short dense hairs, 5 bright purple-red petals (5 cm long), many stamens with long filaments, a circular nectary disk, ovary with long style. Fruits large, woody, dehiscent, hairy, surrounded by large somewhat fleshy, frilly involucre.</p>	 <p style="text-align: center;">photo – Mamisoa Andrianjafy</p>
<p><b>Habitat</b></p> <ul style="list-style-type: none"> <li>• Vegetation type: low elevation evergreen forest</li> <li>• Bioclimate: humid</li> <li>• Geology: basement rocks</li> <li>• Altitude: 300 - 550 m</li> </ul>	
<p><b>Biology</b></p> <ul style="list-style-type: none"> <li>• Pollination: probably insects and birds (based on the characteristics of the flower and observations of bees, hornets and the sunbird (<i>Nectarina souimanga</i>) visiting the flowers of <i>R. bakeriana</i>)</li> <li>• Seed dispersal: the fruit is capsular and seeds apparently fall to the ground close to the parent plant</li> </ul>	
<p><b>Uses:</b> none reported</p>	
<p><b>Distribution</b></p> 	<p><b>Observations of study population(s):</b></p> <ul style="list-style-type: none"> <li>• Location: Betampona RNI (49°12'12"E, 17°55'50"S)</li> <li>• Regeneration observed: yes</li> <li>• Tolerant to disturbance: no</li> <li>• Abundance: 250 - 1000 mature individuals</li> </ul> <p><b>Predicted future decline:</b></p> <ul style="list-style-type: none"> <li>• due to habitat loss : 0%</li> <li>• because of exploitation or poor regeneration: 0%</li> </ul> <p><b>Distribution attributes for total population:</b></p> <ul style="list-style-type: none"> <li>• Extent of occurrence: 0.25 km<sup>2</sup></li> <li>• Area of occupancy: 0.25 km<sup>2</sup></li> <li>• Number of subpopulations: 1</li> </ul> <p><b>Representation in protected areas:</b></p> <ul style="list-style-type: none"> <li>• Number of subpopulations: 1</li> <li>• Protected areas: Betampona RN</li> </ul>
<p><b>Herbarium specimens examined:</b>  <b>Madagascar:</b> Toamasina: Betampona RNI, <a href="#">SF(Ralaikoto) 3573</a> ; Betampona RNI, <a href="#">M. Andrianarisata et al. 224</a> ; Betampona RNI, <a href="#">M. Andrianarisata 127</a> ; Betampona RNI, <a href="#">M. Andrianarisata 171</a> ; Betampona RNI, <a href="#">RN(Rakotoniaina) 124</a> ; Betampona RNI, <a href="#">N.M. Andrianjafy 86</a> ; Betampona RNI, <a href="#">Bernard Iambana et al. 281</a>.</p>	

<p><b><i>Rhodolaena macrocarpa</i></b> G.E. Schatz, Lowry &amp; A.-E. Wolf</p>	<p><b>Risk of extinction: Critically Endangered (A3c, B1ab)</b></p>
<p><b>Vernacular names:</b> Voandrozana, Fombantafo</p>	<p><b>Conservation recommendations:</b> a) inclusion of populations in new conservation sites; b) ex-situ conservation.</p>
<p><b>Description:</b> Small/medium trees. Twigs hairless. Stipules located either side of the petiole. Leaves medium, elliptic/ovate with rounded or shortly acuminate apex and rounded base, stiffly leathery. Inflorescence consisting of 1 flower on a long pendant stem. Flowers very large with 5 unequal glabrous sepals, 5 bright purple-red petals (5 cm long), many stamens with long filaments, a circular nectary disk, ovary with long style. Fruits very large, woody, dehiscent, hairy, with fleshy involucre below fruit</p>	 <p style="text-align: center;">photo – Pete Lowry</p>
<p><b>Habitat</b></p> <ul style="list-style-type: none"> <li>• Vegetation type: low elevation evergreen forest</li> <li>• Bioclimate: humid</li> <li>• Geology: basement rocks</li> <li>• Altitude: 150 m</li> </ul>	
<p><b>Biology</b></p> <ul style="list-style-type: none"> <li>• Pollination: probably insects and birds (based on the characteristics of the flower and observations of bees, hornets and the sunbird (<i>Nectarina souimanga</i>) visiting the flowers of <i>R. bakeriana</i>)</li> <li>• Seed dispersal: the fruit is capsular and seeds apparently fall to the ground close to the parent plant</li> </ul>	
<p><b>Uses:</b> timber</p>	
<p><b>Distribution</b></p> 	<p><b>Observations of study population(s):</b></p> <ul style="list-style-type: none"> <li>• Location: Tsihomanaomby (50°02'52"E, 14°06'03"S)</li> <li>• Regeneration observed: yes</li> <li>• Tolerant to disturbance: no</li> <li>• Abundance: 2,500 - 10,000 mature individuals</li> </ul>
	<p><b>Predicted future decline:</b></p> <ul style="list-style-type: none"> <li>• due to habitat loss : &gt;80%</li> <li>• because of exploitation or poor regeneration: decline possible because of exploitation for timber</li> </ul>
	<p><b>Distribution attributes for total population:</b></p> <ul style="list-style-type: none"> <li>• Extent of occurrence: 1.5 km<sup>2</sup></li> <li>• Area of occupancy: 1.5 km<sup>2</sup></li> <li>• Number of subpopulations: 1</li> </ul>
	<p><b>Representation in protected areas:</b></p> <ul style="list-style-type: none"> <li>• Number of subpopulations: 0</li> <li>• Protected areas: none</li> </ul>
<p><b>Herbarium specimens examined:</b> Madagascar: Antsiranana: Andrangana, <a href="#">SF(Capuron) 27200</a> ; Andrangana, <a href="#">Andrianjafy, M. et al. 61.</a></p>	



## References

- Andrianjafy N.M. (2001). Description, distribution, écologie, utilisation et risqué d'extinction des espèces de *Rhodolaena* (famille des Sarcolaenaceae: endémique de Madagascar). Mémoire de DEA (SBA), Faculté des Sciences, l'Université d'Antananarivo.
- Cavaco A. (1952a). Recherches sur les Chlénacées, familles endémiques de Madagascar. Mém. Inst. Sci. Madagascar, sér. B Biol. Vég. 4: 59-92.
- Cavaco A. (1952b). Chlénacées. Flore de Madagascar 126: 1-37.
- Cornet A. (1974). Essai de Cartographie bioclimatique à Madagascar. ORSTOM, Paris.
- DuPuy D.J. & Moat J. (1996). A refined classification of the primary vegetation of Madagascar based on underlying geology: using GIS to map its distribution and to assess conservation status. In Lourenco W.R. (Ed) Proceedings of the International Symposium on the biogeography of Madagascar: 205-218. ORSTOM, Paris.
- FAO (1993). Forest Resources assessment 1990. Tropical Countries. FAO Forestry Paper 112.
- Green G.M. and Sussman R.W. (1990). Science 248: 212-215.
- IUCN (2001). IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland Switzerland.
- Schatz G.E. (2001). Generic Tree Flora of Madagascar. Royal Botanic Gardens, Kew and Missouri Botanical Garden.
- Schatz G.E., Lowry P.P., and Wolf A-E. (2001). Endemic families of Madagascar VI. A synoptic revision of *Rhodolaena* (Sarcolaenaceae). Adansonia sér 3. 22(2): 239-252.
- Steininger M., Harper G., Juhn D., and Hawkins F. (2002). Analyse de Changement de Couverture Forestière Nationale: 1990-2000. CI, CABS, NASA.