

Identification of priority areas for plant conservation in Madagascar using Red List criteria: rare and threatened Pandanaceae indicate sites in need of protection

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Appendix Malagasy Pandanaceae (6 species of *Martellidendron* and 85 species of *Pandanus*) with total number of subpopulations (determined from a 10 * 10 km grid, see text for details) and number in protected areas, extent of occurrence (EOO; see text for details; rounded to the nearest km if >2), area of occupancy (AOO; determined using the methods of Willis *et al.* (2003), Schatz *et al.* (2000), and a 3 * 3 km grid cell; grid cell size for the method of Willis *et al.* is given rounded to the nearest km if >1; see text for details), predicted future decline (PFD, see text for details), Red List category and criteria (determined using EOO and AOO, the latter based on a 3 * 3 km grid with the addition of information from field observations; see text for details), distribution, and occurrence in protected areas.

Species	No. of subpopulations		AOO (km ²)				PFD (%) ¹	Red List category & criteria ²	Distribution	Protected areas
	Total	In protected areas	EOO (km ²)	Willis <i>et al.</i> (grid cell size, km)	Schatz <i>et al.</i>	3 km grid				
<i>Martellidendron androcephalanthos</i> (Martelli) Callm. & Chassot	4	1	1,960	164 (6)	300	54	67	EN A3c; B1ab(i, iii)2ab(i, iii)	Sambirano lowland forests	Lokobe
<i>M. cruciatum</i> (Pic. Ser.) Callm. & Chassot	6	2	101,410	68,694 (107)	900	90	50	VU A3c; B2ab(ii, iii)	E & Sambirano humid forests	Mananara-Nord, Manongarivo
<i>M. gallinarum</i> (Callm.) Callm.	1	1			100	9	0	VU D2	E humid forests	Mananara-Nord
<i>M. karaka</i> (Martelli) Callm.	4	1	717	245 (7)	600	54	75	EN A3c; B1ab(ii, iii)2ab(ii, iii)	E humid forests	Masoala
<i>M. kariangense</i> (Huynh) Callm.	2	1			200	18	50	EN A3c; B2ab(iii)	E humid forests	Mananara-Nord
<i>M. masoalense</i> (Laivao & Callm.) Callm. & Chassot	5	3	7,135	2,646 (21)	400	63	50	EN A3c; B2ab(i, iii)	E humid forests	Masoala, Marojejy, Nosy Mangabe
<i>Pandanus ambongensis</i> Martelli	11	0	129,308	50,625 (75)	1,100	99	0	VU B2ab(iii)	W deciduous forests	None
<i>P. acanthostylus</i> Martelli	2	1			200	18	50	EN A3c; B2ab(i, ii, iii)	E humid forests	Ranomafana
<i>P. alpestris</i> Martelli	3	2	791	256 (8)	400	36	33	EN B1ab(iii)2ab(iii)	N mountains	Manongarivo, Tsaratanana
<i>P. alveolatus</i> Huynh	2	1	111	48 (4)	200	27	50	EN A3c; B1ab(iii)2ab(iii)	N mountains	Anjanaribe-Sud, Marojejy
<i>P. ambalavaoensis</i> Huynh	1	0			100	9	100	CR A3c; B2ab(iii)	C highlands	None
<i>P. analamazaotrensis</i> Martelli	2	1	24	4 (1)	200	27	50	EN A3c; B1ab(i, iii)2ab(i, iii)	E humid forests	Perinet
<i>P. analamerensis</i> Huynh	8	1	24,441	800 (10)	800	72	88	VU A3c; B2ab(i, iii)	N dry forests	Analamera
<i>P. andringitrensis</i> Huynh	3	2	3,032	300 (10)	300	36	33	EN B1ab(iii)2ab(iii)	E mountain forests	Andringitra, Ranomafana
<i>P. arenicola</i> Huynh	2	2			100	18	0	VU D1	W deciduous forests	Zombitsy

Appendix (Continued)

Species	No. of subpopulations		AOO (km ²)					Red List category & criteria ²	Distribution	Protected areas
	Total	In protected areas	EOO (km ²)	Willis <i>et al.</i> (grid cell size, km)	Schatz <i>et al.</i>	3 km grid	PFD (%) ¹			
<i>P. aridus</i> St John	6	2	19,482	5,488 (28)	800	81	33	EN B2ab(i, iii)	Spiny bush	Andohahela, Zombitsy
<i>P. bakeri</i> Warb.	3	0	191	100 (5)	300	36	0	EN B1ab(iii)2ab(iii)	C highlands	None
<i>P. barbellatus</i> Huynh	1	1			100	9	0	VU D2	Spiny bush	Andohahela
<i>P. biceps</i> B.C. Stone & Guillaumet	2	2	6	1 (0.5)	100	27	0	VU D1	Eroded limestone of Ankarana massif	Ankarana
<i>P. bipyramidatus</i> Martelli	4	2	50,093	48,400 (110)	700	63	0	VU B2ab(ii, iii)	E humid forests	Masoala, Marojejy
<i>P. callmanderiana</i> Laivao & Buerki	3	0	310	48 (4)	300	36	100	CR A3c; C2a(i)	Littoral forests	None
<i>P. cephalotus</i> B.C. Stone	3	0	10,152	23,716 (77)	300	36	0	VU B2ab(ii, iii)	Littoral forests	None
<i>P. ceratophorus</i> Baker	4	1	7,033	6,400 (40)	400	45	75	VU A3c; B1ab(ii, iii)2ab(ii, iii)	E humid forests	Ranomafana
<i>P. columnaris</i> St John	4	1	10,825	3,645 (27)	500	45	75	VU A3c; B1ab(iii)2ab(iii)	E humid forests	Masoala
<i>P. comatus</i> Martelli	3	1	378	4,332 (38)	300	27	67	EN A3c; B1ab(i, iii)2ab(i, iii)	E humid forests	Masoala
<i>P. concretus</i> Baker sensu lato	13	2	14,946	17,328 (38)	1,400	144	0	VU B1ab(iii)	Littoral forests from Mananara to S of Vatoman-dry	Masoala
<i>P. connatus</i> St John	1	1	3	1 (0.5)	100	18	0	VU D1	Montagne d'Ambre humid forest massif	Montagne d'Ambre
<i>P. coriaceus</i> Huynh	5	1	9,988	3,174 (23)	700	72	87	VU A3c; B1ab(iii)2ab(iii)	N dry forests	Analamera
<i>P. dauphinensis</i> Martelli	5	0	142	96 (4)	500	54	0	EN B1ab(iii)2ab(iii)	Littoral forests around Fort-Dauphin	None
<i>P. diffusus</i> Martelli	3	1	8,383	14,700 (70)	300	27	67	VU A3c; B1ab(i, iii)2ab(i, iii)	E humid forests	Mananara-Nord
<i>P. dyckioides</i> Baker	9	3	48,004	14,257 (36)	1,200	144	67	LC	E & C highlands' humid forests	Ambohitantely, Zahamena
<i>P. erectus</i> St John	2	0			100	9	0	DD	Littoral forests around the Baie d'Antongil	None
<i>P. flagellaris</i> B.C. Stone	4	1	577	75 (5)	300	36	50	EN A3c; B1ab(i, ii, iii)2ab(i, ii, iii)	N dry forests	Analamera
<i>P. freycinetioides</i> (Gaudich.) Kurz	3	0	17,958	8,100 (45)	400	45	100	VU A3c; B1ab(i, iii)2ab(i, iii)	E humid forests	None
<i>P. grallatus</i> B.C. Stone	5	1	3,067	405 (9)	500	45	67	EN A3c; B1ab(i, ii, iii)2ab(i, ii, iii)	N dry forests	Analamera, Ankarana

Appendix (Continued)

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	Total	In protected areas	EOO (km ²)	Willis <i>et al.</i> (grid cell size, km)	Schatz <i>et al.</i>	3 km grid					
<i>P. guillaumetii</i> B.C. Stone	7	4	20,147	15,125 (55)	1,000	90	36	VU B2ab(iii)	E humid forests	Mananara-Nord, Masoala, Nosy Mangabe	
<i>P. imerinensis</i> Martelli	5	0	17,587	38,720 (88)	500	45	0	VU B1ab(iii)2ab(iii)	Littoral forest of the E coast	None	
<i>P. insuetus</i> Huynh	3	1	90	27 (3)	300	27	67	CR B1ab(i, iii)	E humid forests in the Masoala Peninsula	Masoala	
<i>P. isalicus</i> Huynh	7	2	19,760	3,200 (20)	800	81	0	VU B1ab(iii)2ab(iii)	W deciduous forests	Isalo	
<i>P. kimlangii</i> Callm. & Laivao	4	3	22,577	14,400 (60)	400	54	25	VU B2ab(ii, iii)	N & E humid forests	Manongarivo, Tsaratanana, Zahamena	
<i>P. kuepferi</i> Callm., Wohlhauser & Laivao	1	1			100	9	0	VU D2	N mountains	Tsaratanana	
<i>P. latistigmaticus</i> Huynh	3	2	307	192 (8)	300	27	67	EN A3c; B1ab(iii)2ab(iii)	Daraina forests & Montagne d'Ambre massif	Montagne d'Ambre	
<i>P. leptopodus</i> Martelli	10	4	19,905	35,287 (71)	1,000	135	60	VU A3c; B1ab(iii)	E humid forests	Masoala, Ranomafana, Zahamena	
<i>P. linguiformis</i> B.C. Stone	2	2	129	675 (15)	200	18	0	VU D1	N mountains	Manongarivo, Marojejy	
<i>P. longecuspидatus</i> Pic. Serm.	4	3	3,794	1,024 (16)	400	36	25	VU B1ab(ii, iii)2ab(ii, iii)	E humid & mountain forests	Nosy Mangabe, Mananara-Nord, Masoala	
<i>P. longipes</i> Perrier ex Martelli	3	3	151	75 (5)	300	27	0	VU D1	N mountains	Manongarivo, Tsaratanana	
<i>P. longissimipedunculatus</i> Martelli	5	2	20,588	14,580 (54)	700	63	40	VU A3c; B2ab(iii)	E humid forests	Zahamena	
<i>P. longistylus</i> Martelli & Pic. Serm.	2	0	430	578 (17)	300	27	100	EN A3c; B1ab(iii)2ab(iii)	Littoral forests of the SE	None	
<i>P. macrophyllus</i> Martelli	2	0			200	18	100	CR A3c; C2a(i); D	E humid forests	None	
<i>P. malgassicus</i> Pic. Serm.	5	0	6,493	8,820 (42)	700	72	100	VU A3c; B1ab(i, ii, iii)2ab(i, ii, iii)	E Littoral forests	None	
<i>P. mammillaris</i> Martelli & Pic. Serm.	3	2	227	100 (5)	300	36	33	EN B1ab(iii)2ab(iii)	N mountains	Manongarivo, Tsaratanana	
<i>P. mangokensis</i> Martelli	5	3	8,761	18,000 (60)	500	45	60	VU A3c; B1ab(ii, iii)2ab(ii, iii)	E humid forests	Ranomafana, Zahamena	
<i>P. manambolensis</i> Huynh	7	2	2,387	1,792 (16)	700	63	29	VU B1ab(ii, iii)2ab(ii, iii)	W deciduous forests	Bemaraha	
<i>P. marojejicus</i> Callm. & Laivao	1	1	0.4	0.18 (0.3)	200	18	0	VU D1	N mountains	Marojejy	

Appendix (Continued)

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<i>P. maromokotrensis</i> Callm. & Wohlhauser	1	1			100	9	0	VU D2	N mountains	Tsaratana
<i>P. membranaceus</i> Huynh	2	1	27	20 (2)	400	45	50	EN A3c; B1ab(iii)2ab(iii)	W deciduous forests	Bemaraha
<i>P. microcephalus</i> Baker	5	1	11,485	19,600 (70)	500	54	80	VU B2ab(iii)	E humid forests	Zahamena
<i>P. myriocarpus</i> Baker	2	1			200	18	0	EN B2ab(iii)	Sambirano lowlands' forests	Tsaratana
<i>P. namakiensis</i> Martelli	5	1	16,307	1,620 (18)	500	54	80	VU A3c; B1ab(ii, iii) 2ab(ii, iii)	C highlands	Zahamena
<i>P. neoleptodus</i> Pic. Serm.	3	0	7,815	11,163 (61)	400	36	100	EN A3c; B1ab(i, ii, iii) 2ab(i, ii, iii)	Littoral forests	None
<i>P. sp. nov. 'humbertii'</i> ined. Laivao, Callm. & Buerki	1	1	1	0.03 (0.1)	100	18	0	VU D2	N mountains	Marojejy
<i>P. sp. nov. 'neosermodii'</i> Ined.	1	0			100	9	100	CR A3c; C2a(i); D	Galoka massif	None
<i>P. oligocarpus</i> Martelli	4	1	19,212	4,096 (32)	400	45	75	VU B1ab(iii)2ab(iii)	W deciduous forests	Bemaraha
<i>P. oligocephalus</i> Baker	8	3	66,017	45,927 (81)	1,000	99	63	LC	E humid forests	Masoala, Zahamena
<i>P. perrieri</i> Martelli	2	0			200	18	100	CR A3c; C2a(i); D2	W & N forests	None
<i>P. pervilleanus</i> Solms	14	3	60,194	115,248 (98)	1,900	198	84	LC	E humid forests	Masoala
<i>P. petrosus</i> Martelli	1	0			100	9	100	DD	W deciduous forests (limestone of Kelyfely)	None
<i>P. peyrierasii</i> B.C. Stone & Guillaumet	2	0	110	128 (8)	200	36	100	CR A3c; C2a(i)	SE Littoral forests in swamps	None
<i>P. platyphyllus</i> Martelli	4	0	2,412	21,316 (73)	500	45	0	EN B1ab(iii)2ab(iii)	Littoral forest of the E coast in swamps	None
<i>P. pluriaculeatus</i> Huynh	1	1	47	4 (1)	200	18	0	VU D1	N mountains	Manongarivo, Tsaratana
<i>P. princeps</i> B.C. Stone	2	0	13	98 (7)	200	18	0	CR B1ab(iii)	Littoral forest along streams (Baie d'Antongil, Masoala)	None
<i>P. pristin</i> B.C. Stone	2	1	25	12 (2)	200	27	50	EN B1ab(iii)2ab(iii)	Eroded limestone of Ankarana massif	Ankarana
<i>P. pseudobathiei</i> Pic. Serm.	4	3	4,105	900 (15)	500	45	40	EN B1ab(iii)2ab(iii)	N mountains	Manongarivo, Marojejy, Tsaratana
<i>P. pseudocollinus</i> Pic. Serm.	4	0	5,044	10,816 (52)	400	36	100	EN A3c; B2ab(i, ii, iii)	E lowland & Littoral forests	None
<i>P. pulcher</i> Martelli	1	0			100	9	100	DD	W deciduous forests	None

Appendix (Continued)

Species	No. of subpopulations		AOO (km ²)					Red List category & criteria ²	Distribution	Protected areas
	Total	In protected areas	EOO (km ²)	Willis <i>et al.</i> (grid cell size, km)	Schatz <i>et al.</i>	3 km grid	PFD (%) ¹			
<i>P. pygmaeus</i> Thouars	12	6	178,463	149,769 (129)	1,300	126	54	LC	E humid forests	Andohahela, Andringitra, Lokobe, Masoala
<i>P. rollotii</i> Martelli	7	1	17,039	69,112 (105)	1,200	108	0	VU B1ab(iii)2ab(iii)	Littoral forest of the E coast in swamps	Masoala
<i>P. sambiranensis</i> Martelli	5	3	1,847	343 (7)	700	63	40	EN B1ab(i, iii)2ab(i, iii)	N mountains	Manongarivo, Tsaratanana
<i>P. saxatilis</i> Martelli	5	3	1,160	216 (6)	400	45	25	EN B1ab(i, iii)2ab(i, iii)	N mountains	Manongarivo, Tsaratanana
<i>P. sparganioides</i> Baker	1	1			100	9	0	VU D1	N mountains	Tsaratanana
<i>P. spicatus</i> St John	1	1	1.5	0.27 (0.3)	100	9	0	VU D1	Montagne d'Ambre massif	Montagne d'Ambre
<i>P. spinifer</i> Warb.	3	2	1,791	507 (13)	400	36	80	EN A3c; B1ab(iii)2ab(iii)	C highlands	Ambohitantely
<i>P. stellatus</i> Martelli	4	1	10,751	4,107 (37)	400	36	71	VU A3c; B1ab(iii)B2ab(iii)	W deciduous forests	Bemaraha
<i>P. syloicola</i> Huynh	1	0	11	4 (1)	100	9	100	CR A3c; B1ab(i, ii, iii)2ab(i, ii, iii)	E Littoral forests	None
<i>P. tabellarius</i> Huynh	1	1			100	9	0	VU D2	N mountains massifs	Marojejy
<i>P. tazoanii</i> Callm. & Wohlhauser	1	1			100	9	0	VU D2	N mountains massifs	Tsaratanana
<i>P. tenuiflagellatus</i> Huynh	3	1	2,387	432 (12)	300	27	67	EN A3c; B1ab(iii)2ab(iii)	W deciduous forests	Bemaraha
<i>P. tolanarensis</i> Huynh	4	1	604	80 (4)	500	45	75	EN A3c; B1ab(iii)2ab(iii)	SE humid forests	Andohahela
<i>P. tsaratananensis</i> Martelli	4	1	218	45 (3)	400	45	75	EN A3c; B1ab(iii)2ab(iii)	N mountains	Tsaratanana
<i>P. vandamii</i> Martelli & Pic. Serm.	7	3	5,222	1,352 (13)	800	90	63	VU B1ab(iii)	Sambirano lowlands' forests	Lokobe, Manongarivo, Tsaratanana
<i>P. variabilis</i> Martelli	1	0			100	9	0	DD	W deciduous forests	None

¹Predicted Future Decline²CR, Critically Endangered; EN, Endangered; VU, Vulnerable; DD, Data Deficient; LC, Least Concern. Descriptions of criteria (A, B, C and D and their subcriteria) are in IUCN (2001).