Orchid surveys in anthropised forests of Madagascar

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Abstract: The diversity of orchids was studied in the Beforona region of Madagascar. Signficant differences were found between near-primary, selectively logged and burnt forest. These differences relate to the types of orchids present rather than total numbers. Some species are heavily exploited and suggestions made for their sustianable use.

Keywords: conservation, epiphytes, exploitation, forest, Orchidaceae

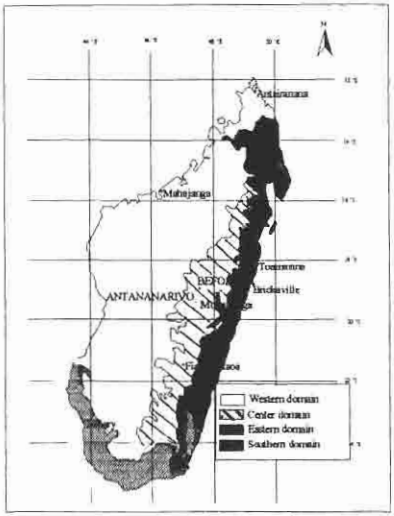
Considered as a micro-continent, Madagascar has in general four distinct bioclimatic subdivisions, specifically the eastern, central, western and southern domains (Humbert 1965). The flora of Madagascar has a predominance of woody taxa and is well known for its high level of endemism. For orchids alone, nearly 90% are endemic (Du Puy *et al.* 1999).

The eastern domain has many remarkable forests which are currently threatened by slash and burn agriculture and logging. Before being burnt, the humid forests of the eastern region are usually logged by different stakeholders interested in timber and non-timber forest products. The present study was conducted in the eastern domain of Madagascar.

Methods

The main objective of the study was to assess the level of forest use by the local population. The present article is focused on orchids. Inquiries revealed that all the consumed forest products are removed before the conversion of the forest to agricultural use. Inventories of orchids were carried out in different types of forests. The study was conducted specifically in a watershed (*900 ha*) located in Beforona region, east escarpment of Madagascar (Fig. 1). The differentiation of the forest was done with aerial photographs and according to the crown closure/crown cover chart proposed by Howard (1991). According to the textures encountered on the photographs and the results of field verification three types of forests were identified: a) near-primary forest; b); selectively logged forest and c) degraded forest. One plot of 1 ha was assessed in each forest type. Orchids were identified to species level as far as possible, otherwise to generic level.

The characterisation of orchids is based on their way of growing. Epiphytic characterises a plant growing over another plant without taking nutrition from the support plant. By opposition to epiphytic plants terrestrial plants grow on the ground.



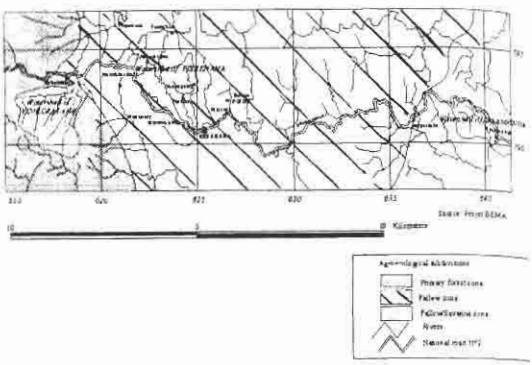


Fig. 1. Beforona and the study area in the Madagascar bioclimatic subdivisions (after Humbert 196).

Results

1. Near-primary forest:

In this forest 266 plants were located, divided into 40 species. Floristic diversity is defined as the manner in which species are distributed between individual inventories (Fournier & Sasson 1983). This floristic diversity is shown in table 1. 11 genera were identified most of which are epiphytic plants. 56% of the total number of plants are constituted by six species which are dominant in number. These species are represented by their percentage in Fig. 2. All of these species are epiphytes. Of the 40 species in this forest type, 15 were encountered only once. They constituted 6% of the total number. Three of them are sold frequnetly by the local population because of their monetary value: *Aerangis citrata*, *Angraecum rostratum* and *Beclardia macrostachya*.

2. Selectively logged forest:

In this forest 196 plants were located, divided into 28 species. The floristic diversity is shown in table 2. 7 genera were identified most of which are epiphytic plants. 51% of the total number of plants are constituted by three species which are dominant in number. These species are represented by their percentage in Fig. 3. All of the dominant species are epiphytes. Of the 28 species , 11 were encountered only once. They constituted 6% of the total.

3. Degraded forest:

In this forest 255 plants were located divided into 37 species. This floristic diversity is shown in table 3. 12 genera were identified, most of which are epiphytic plants. 52% of the total number of plants are constituted by three species which are dominant in number. These species are represented by their percentage in Fig. 4. All of the dominant species are epiphytes. Among the 37 species, 13 were located once, constituting 6% of the total number.

Table 1. Floristic diversity of orchids in near-primary forest

Genus	Number of species	Number of plants	Characteristic
Aerangis	2	2	Epiphytic
Aeranthes	4	5	Epiphytic
Angraecum	13	94	Epiphytic or terrestrial
Beclardia	1	1	Epiphytic
Bulbophyllum	8	107	Epiphytic or terrestrial
Calanthe	1	2	Terrestrial
Cynosorchis	2	6	Epiphytic
Jumellea	5	43	Epiphytic
Lyparis	1	2	Terrestrial
Oenia	1	1	Epiphytic
Polystachia	2	3	Epiphytic
Total	40	266	

Table 2. Floristic diversity of orchids in selectively logged forest

Genus	Number of species	Number of individuals	Characteristic
Aeranthes	5	47	Epiphytic
Angraecum	7	55	Epiphytic or terrestrial
Bulbophyllum	8	67	Epiphytic or terrestrial
Jumellea	5	24	Epiphytic
Oberenia	1	1	Epiphytic
Oenia	1	1	Epiphytic
Phaius	1	1	Epiphytic
Total	28	196	

Table 3. Floristic diversity of orchids in degraded forest

Genus	Number of species	Number of individuals	Characteristic
Aerangis	3	7	Epiphytic
Aeranthes	5	11	Epiphytic
Angraecum	8	62	Epiphytic or terrestrial
Bulbophyllum	9	120	Epiphytic or terrestrial
Cirrhopetalum	1	3	Terrestrial
Cynorkis	1	1	Terrestrial
Gussonia	1	3	Epiphytic
Jumellea	3	7	Epiphytic
Liparis	1	4	Epiphytic
Oberonia	1	3	Epiphytic
Oenia	1	1	Epiphytic
Polystachia	3	3	Epiphytic
Total	37	225	

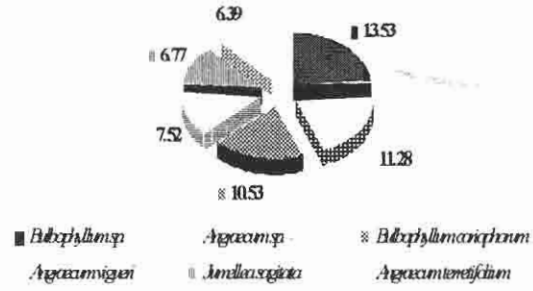


Fig. 2. Orchids: most abundant species in near-primary forest

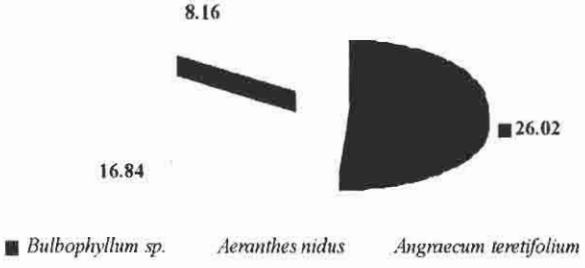


Fig. 3. Orchids: most abundant species in selectively logged forest

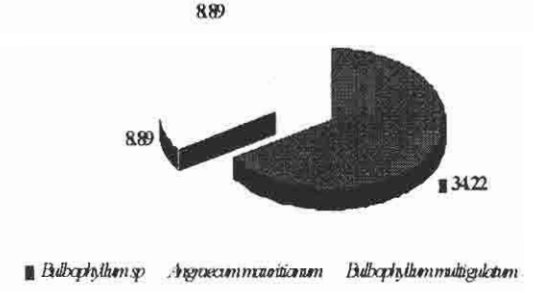


Fig. 4. Orchids: most abundant species in degraded forest

Table 4. Synthesis

Type of forest	Near-primary forest	Selectively logged forest	Degraded forest
Size of plants assessed	266	196	225
Size of species assessed	40	28	37
Size of dominant species	6	3	3

Discussion

The three types of forest are compared in Table 4. The data show that more orchids were located in near-primary forest than other forest types. The number of orchids located in each forest is not related to its state of perturbation. Catgeorization of the state of perturbation may be refined if criteria other than the crown cover were to be taken into account, such as the health of orchids.

In all cases most of orchids have rhizomes which creep along the supporting tree (for epiphytic orchids) or below the ground (for terrestrial orchids). Rhizomes are modified stems, generally with nutritive reserve accumulation properties. A synopsis of the characters is describe below for each genus identified. Descriptions are taken from Cullen (1992) and Du Puy (1999).

Aerangis:

Habit: monopodial epiphytes with short, compressed stems
Leaves: leathery, unequally 2-lobed at the apex
Inflorescence: racemes with 7 to many flowers, hanging from the leaf axilis, bracts small, brownish
Flowers: usually white, fragrant

Aeranthes:

Habit: epiphytes
Leaves: leathery
Inflorescence: racemes
Flowers: many

Angraecum:

Habit: monopodial epiphyte with long or short stems
Leaves: variable in 2 rank,
Flowers: variabily resupinate or not, solitary in the leaf axils, or in axillary racemes

Beclardia:

Habit: epiphytes
Leaves: leathery
Inflorescence: racemes
Flowers: many

Bulbophyllum:

Habit: epiphytic or terrestrial
Pseudobulbs: simple, distant or clustered
Leaves: stalked or stakless, leathery
Flowers: many, in spikes, racemes or umbels

Calanthe:

Habit: usually terrestrial
Pseudobulbs: usually inconspicuous, more rarely large and grooved
Leaves: large, thin, pleated, rolled when young, mostly evergreen
Inflorescence: racemes, araising from the leaf axilis
Flowers: many

Cirrhopetalum:

Habit: epiphytic
Pseudobulbs: simple, distant or rarely clustered
Leaves: large, 2 cm or more
Flowers: solitary

Cynokis :

Habit: terrestrial
Inflorescence: racemes
Flowers: few to many

Jumellea:

Habit: epiphytic or terrestrial
Leaves: leathery
Inflorescence: racemes arising from the leaf axilis
Flowers: few to many

Liparis:

Habit: terrestrial, perennial herbs, growing on rocks or epiphytic
Leaves: membranous or leathery, pointed at the base or not
Inflorescence: raceme
Flowers: few to many

Microcoelia:

Habit: epiphytic
Leaves: membranous or leathery
Inflorescence: racemes
Flowers: many

Oberenia:

Habit: epiphytic
Leaves: leathery,
Inflorescence: raceme
Flowers: many

Oenia:

Habit: epiphytic
Leaves: leathery

Phaius:

Habit: terrestrial or epiphytic
Inflorescence: raceme
Flowers: Few to many

Polystachia:

Habit: epiphytic
Pseudobulbs: variable, simple, ovoid, bearing 2 or more leaves
Inflorescence: raceme or panicle
Flowers: many

Endemism level was determined according to De La Bathie (1939), the result is shown in Fig. 5. The total list of all orchids assessed in the watershed is given in the appendix with their distribution according the endemicity of the genus. For all forest types, 51 species were identified, of which 30 are endemic to Madagascar; 5 are endemic to the eastern region and 16 have a wide distribution in Mascarenes. The others 8 species were probably introduced and naturalised in Madagascar.

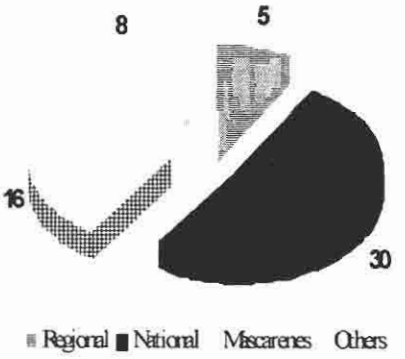


Fig. 5. Surveyed orchids divided into their levels of endemism

The stakeholders using the natural forest includes the local population, who depend on forest products (timber and non timber). Concurrent to inventories, surveys in 11 villages were conducted to determine the importance of orchids (as non-timber forest products) to the local population. The aim was to discover whether or not orchids represent an important extra income. According to this survey 31% gathered orchids in the forest as a commercially valuable product. Orchids are still available in the region and so the local population does not have an interest in keeping them in a nursery for reproduction. Nevertheless, their ecology (flowering periods, symbioses between host and orchids, parasites, light requirements, etc.) are known in general by them. Even if all the exploited species can be reproduced easily by vegetative means using the pseudobulb, the technical base is not well controlled by the local population at present. The local population ise interested in gathering orchids in various area sinside the forest and in caring for a while for those species that can be sold easily.

Currently in Madagascar, some specialist research institutions are successfully working on the reproduction of orchids (DEF 1987). At a global level, orchid artificial reproduction is very successful (Cullen 1992), although the natural ecology of orchids is not well known and available data are largely based on dispersed observations by amateurs (Sandford 1978).

For the future of orchids it is important to work with the local population. Instead of collecting the forest species that can be sold easily, it should be more productive for locals to keep and propagate them in nurseries. Nevertheless, they need a basic training for such activities. So, creating a program aiming at both the protection of orchids and their reproduction, and at the same time helping the local population is of great interesting.

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Appendix: List of all orchids assessed in the watershed

Number	Species	Endemism level			
		Regional	National	Mascarenes	Others
1	*Aerangis alata*	0	1	0	0
2	*Aerangis citrata*	0	1	0	0
3	*Aerangis fuscata*	0	1	0	0
4	*Aerangis* sp.	0	1	0	0
5	*Aeranthes caudata*	0	0	0	1
6	*Aeranthes nidus*	0	1	0	0
7	*Aeranthes peyrotii*	0	0	0	1
8	*Aeranthes ramosa*	0	1	0	0
9	*Aeranthes sagitata*	0	0	0	1
10	*Aeranthes* sp.	0	0	0	1
11	*Angraecum compactum*	1	1	0	0
12	*Angraecum cultriformis*	0	1	0	0
13	*Angraecum didieri*	0	0	1	0
14	*Angraecum elephantianum*	0	1	0	0
15	*Angraecum ferkoanum*	0	1	0	0
16	*Angraecum germinyanum*	0	1	0	0
17	*Angraecum humblotianum*	0	1	0	0
18	*Angraecum mauritianum*	0	0	1	0
19	*Angraecum mauritianum*	0	0	1	0
20	*Angraecum nigriflorum*	0	0	0	1
21	*Angraecum pachapus*	0	0	0	1
22	*Angraecum panicifolium*	1	1	0	0
23	*Angraecum rostratum*	0	1	0	0
24	*Angraecum sedifolium*	0	1	0	0
25	*Angraecum* sp.	0	0	1	0
26	*Angraecum teretifolium*	0	1	0	0
27	*Angraecum viguieri*	0	0	0	1
28	*Beclardia macrostachya*	0	0	1	0
29	*Bulbophyllum alexandrae*	0	0	1	0
30	*Bulbophyllum coriophorum*	0	0	1	0
31	*Bulbophyllum leandrianum*	0	0	1	0
32	*Bulbophyllum longiflorum*	0	0	1	0
33	*Bulbophyllum nigriflorum*	0	1	0	0
34	*Bulbophyllum obtulabium*	0	1	0	0
35	*Bulbophyllum occlosum*	0	1	0	0
36	*Bulbophyllum occultum*	0	0	1	0
37	*Bulbophyllum ochrochlamys*	0	1	0	0
38	*Bulbophyllum pachypus*	0	1	0	0
39	*Bulbophyllum* sp.	0	0	0	1
40	*Calanthe madagascariensis*	0	1	0	0
41	*Cynorkis* sp.	0	0	1	0
42	*Cynorkis uncinata*	0	1	0	0
43	*Gussonea macranta*	0	1	0	0
44	*Jumellea arborescens*	0	1	0	0
45	*Jumellea intricata*	0	1	0	0
46	*Jumellea maxillarioides*	0	1	0	0
47	*Jumellea punctata*	1	0	0	0
48	*Jumellea sagittata*	0	1	0	0
49	*Jumellea* sp.	0	0	1	0
50	*Jumellea teretifolia*	0	1	0	0
51	*Liparis bulbophylloides*	0	1	0	0

Appendix (cont.): List of all orchids assessed in the watershed

Number	Species	Endemism level			
		Regional	National	Mascarenes	Others
52	*Oberonia disticha*	0	0	1	0
53	*Oenia volucris*	0	0	1	0
54	*Phaius pulchellus*	1	0	0	0
55	*Polystachya rosellata*	0	0	1	0
56	*Polystachya* sp.	0	0	1	0
57	*Polystachya virescens*	1	0	0	0
TOTAL		**5**	**30**	**16**	**8**