

Floristic richness in the Africa-Madagascar region: a brief history and prospective

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ABSTRACT

The floras of southern Africa (22,000 species) and Mediterranean Africa (6,000 species) are comparatively well known and have been the subject of many recent treatments; however, numerous gaps still exist in our understanding of the flora of tropical Africa (25,000 species). Certain regions are not covered by any of the current flora or inventory projects, whereas others are inaccessible for political reasons. Data on the floristic richness of the countries and regions in the Africa-Madagascar area are updated. Using the example of Madagascar, the density index is re-evaluated, showing that the values previously presented are underestimates. Most of the current floras and other large projects are progressing very slowly because of political instability in the areas concerned, lack of sufficient funding, and especially a shortage of qualified taxonomists. Several checklists are being prepared using modern computer technology, which now makes it possible to envision both a global checklist for the entire Africa-Madagascar area, and a General Flora of Tropical Africa similar to the Flora Neotropica, as suggested by LÉONARD in 1975.

KEY WORDS

Africa,
Madagascar,
floristic richness,
floras.

RÉSUMÉ

Si la flore de l'Afrique australe (22 000 espèces) et celle de l'Afrique méditerranéenne (6 000 espèces) sont relativement bien connues et sont l'objet de nombreux traitements récents, la flore tropicale africaine (25 000 espèces) présente encore de nombreuses lacunes dans sa compréhension. Certaines régions ne sont couvertes par aucun projet de Flore ni même d'inventaire, tandis que d'autres sont rendues inaccessibles par des troubles d'ordre politique. Des données entièrement actualisées concernant la richesse floristique dans différents états ou régions du domaine africano-malgache sont ici fournies. De même, à partir de l'exemple de Madagascar une réévaluation du "density index" est entreprise montrant la sous-estimation admise jusqu'à présent pour les pays du domaine africano-malgache. La plupart des Flores et des grands projets actuels ne progressent que très lentement, par manque de stabilité politique des états concernés, des crédits et surtout de taxonomistes qualifiés. Grâce aux possibilités offertes par l'outil informatique, de nombreuses checklists sont en cours d'élaboration qui permettent dès maintenant d'envisager d'une part une checklist globale pour l'ensemble du domaine étudié et d'autre part la réalisation d'une Flore Générale d'Afrique Tropicale, à l'image de la Flora Neotropica, comme l'avait déjà proposé LÉONARD en 1975.

MOTS CLÉS

Afrique,
Madagascar,
richesse floristique,
flores.

INTRODUCTION

The Africa-Madagascar phytogeographic region covers approximately 30.9 million km², including numerous islands in the surrounding waters (e.g., Mascarenes, Seychelles, Comoros, Socotra, Bioko, Cape Verde, etc.). According to the most recent estimates, the region includes a vascular plant flora of about 55,000 species, with nearly 45,000 occurring on the African continent, an estimated 21-25,000 of which are found in the tropical areas south of the Sahara and north of Namibia, Botswana, and South Africa (World Conservation Monitoring Centre 1992; BEENTJE et al. 1994; LEBRUN & STORK 1995) and about 22,000 in Southern Africa (COWLING et al. 1989; SMITH et al. 1995), with an additional 10-12,000 species occurring in Madagascar (HUMBERT 1959; PHILLIPSON 1994; SCHATZ et al. 1996). While the flora of this region is not nearly as rich as those of tropical America (with ca. 90,000 species; HENDERSON et al. 1991) and Asia (about 45,000 species), it is nevertheless far from being well known.

The evolution and diversification of the flora of the Africa-Madagascar region are largely due to the age of the continent and adjacent islands, and to their geological and climatological histories, which have together resulted in the very broad array of edaphic conditions observed today. A tremendous range of habitats are found in the region, which are reflected in an impressive variety of vegetation types, from dense, perhumid forests to drier deciduous forests, shrublands, woodland and grassland, and some of the world's harshest deserts, each of which also has one or more corresponding degraded forms such as secondary grasslands ("savannas") and secondary bushlands that are the result of human action.

The purpose of this paper is to evaluate progress in the development of our understanding of the botanical diversity in the Africa-Madagascar region. The information presented here is intended not only to summarize what we know today and where the gaps occur in our knowledge, but also to stimulate further studies of the flora of this important and intriguing region.

DISTRIBUTION OF FLORISTIC RICHNESS

The floristic richness in the Africa-Madagascar region is very irregularly distributed. Early studies, which were global in scale, pointed out the existence of a center of exceptional diversity in the Cape Province, which was quickly recognized as a floristic kingdom (ENGLER & DIELS 1936),

an interpretation that has consistently been followed by modern authors (e.g., TURRILL 1959; GOOD 1974; TAKHTAJAN 1986). Similarly, the Malagasy floristic region has long been recognized as having remarkably high levels of both endemism and species diversity (ENGLER & DIELS 1936; HUMBERT 1959; KOECHLIN et al. 1974; TAKHTAJAN 1986; PHILLIPSON 1994).

Many estimates of the number of species occur-

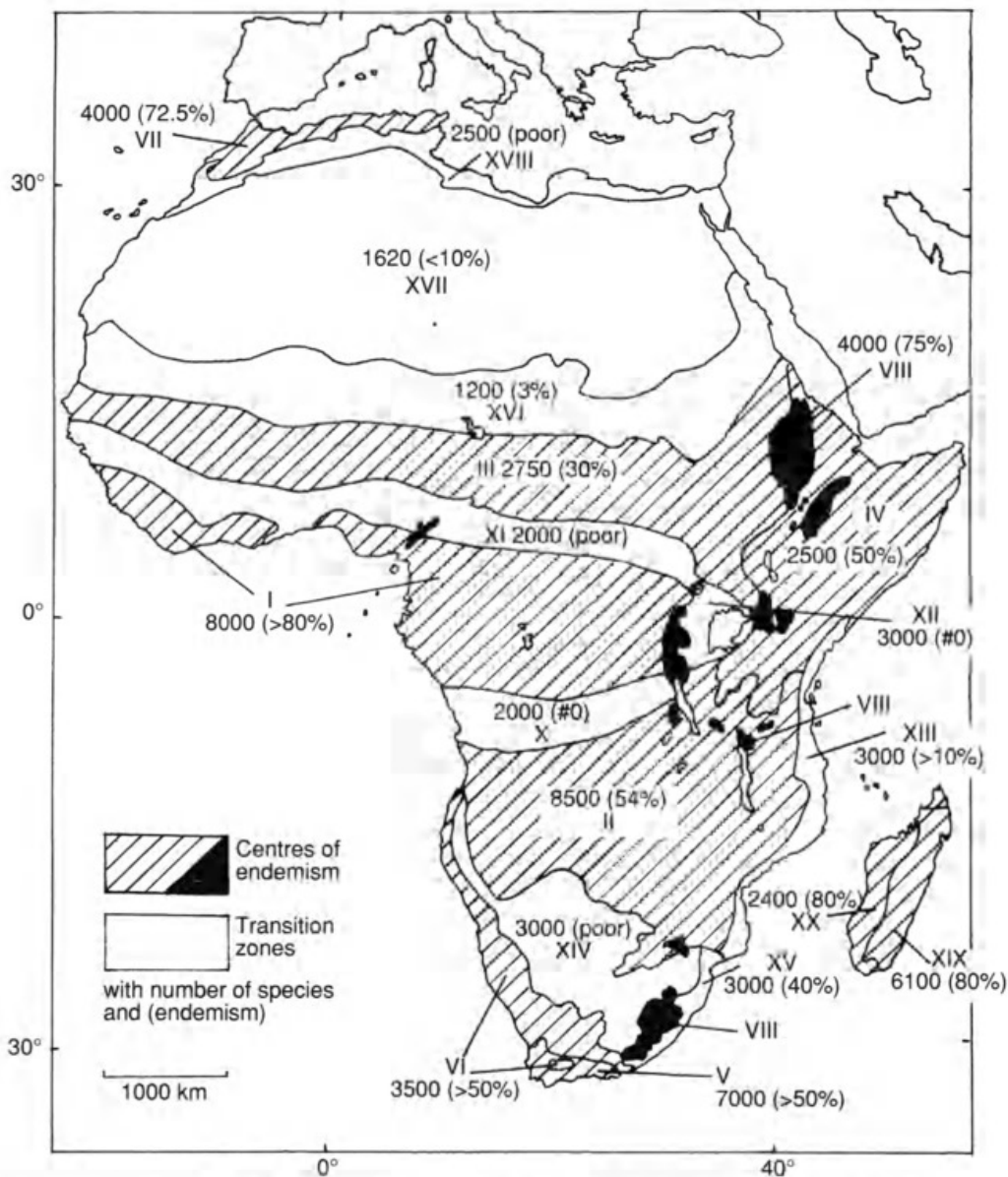


Fig 1.—Main phytochoria of Africa and Madagascar: I, Guineo-Congolian regional centre of endemism. II, Zambezian regional centre of endemism. III, Sudanian regional centre of endemism. IV, Somalia-Masai regional centre of endemism. V, Cape regional centre of endemism. VI, Karoo-Namib regional centre of endemism. VII, Mediterranean regional centre of endemism. VIII, Afroalpine archipelago-like regional centre of endemism, including IX, Afroalpine archipelago-like region of extreme floristic impoverishment (not shown separately). X, Guinea-Congolia/Zambezia regional transition zone. XI, Guinea-Congolia/Sudania regional transition zone. XII, Lake Victoria regional mosaic. XIII, Zanzibar-Inhambane regional mosaic. XIV, Kalahari-Highveld regional transition zone. XV, Tongaland-Pondoland regional mosaic. XVI, Sahel regional transition zone. XVII, Sahara regional transition zone. XVIII, Mediterranean/Sahara regional transition zone. XIX, East Malagasy regional centre of endemism. XX, West Malagasy regional centre of endemism.—After WHITE 1993.

ring in the Africa-Madagascar region have been made over the years (see below), each of which was the result of an updated compilation of data for various areas. These estimations have evolved constantly as readjustments were made following the completion of floras, revisions of individual families, monographs, checklists, maps, field work, etc.

The floristic richness of tropical Africa, including the area south of the Sahara to Angola, Zambia, Zimbabwe, and Mozambique, was for many years substantially overestimated at 30-35,000 species (e.g., BRENNAN 1978). Recent studies by LEBRUN & STORK (1995) indicate, however, that a more realistic figure would be about 25,000 species, slightly more than the figure of 22,000 currently reported for the Southern African region (Namibia, Botswana, South Africa, Lesotho, and Swaziland) (COWLING et al. 1989; SMITH et al. 1995), while about 10,000 species are thought to occur in North Africa (QUÉZEL 1985). Estimates for Madagascar range from 10,000 (HUMBERT 1959; PHILLIPSON 1994) to approximately 12,000 (GUILLAUMET & KOECHLIN 1971; SCHATZ et al. 1996), the latter of which is certainly more realistic.

One of the most widely cited publications that assesses the distributions of floristic richness in Africa is the AETFAT/UNESCO/UNSO vegetation map (WHITE 1983). WHITE recognized 20 phytochoria, including 10 regional centers of endemism separated from each other by one of seven regional transition zones; 2 regional mosaics and an afroalpine archipelago-like region of extreme floristic impoverishment were also recognized. A center of endemism was defined as having more than 50% of its flowering plant species endemic to the region, and a total of 1,000 endemic or near-endemic species (WHITE 1983, 1993). These regional centers of endemism correspond largely with the floristic areas recognized by ENGLER & DIELS (1936) and GOOD (1974), and subsequently simplified by TAKHTAJAN (1986). WHITE (1983) provided an assessment of the total number of species and the percentage of endemism in each phytochorion (Fig. 1), although in at least some cases these were probably underestimates.

DISTRIBUTION BY COUNTRY

In order to evaluate our current understanding of African floristics, an assessment can be made of the total number of species thought to be present in each country, or each group of countries being treated together by ongoing or recently completed flora projects. Most of these projects (which include the publication of comprehensive floras, but in some cases also inventories and checklists) strictly follow political borders, which in nearly all cases are artificial, at least with regard to the distribution of plant diversity. Some projects are strictly national in scope (e.g., *Flore du Gabon*, *Flore du Cameroun*), while others include several countries (such as *Flore de l'Afrique Centrale*, *Flora of Tropical East Africa*, and the *Numération des plantes d'Afrique tropicale*). There are only a few examples of projects that cut across political boundaries, such as *Flora Zambesiaca*, which includes the Caprivi Strip of Namibia, or the *Flora of West Tropical Africa*, whose coverage has a northern limit that follows the sixteenth parallel, corresponding approximately with the southern limit of the *Flore de l'Afrique du Nord* and the *Med-Checklist* project.

The current estimate of the number of species that occur in each country within the Africa-Madagascar region is shown in Fig. 2. The data are based on LEBRUN (1976, as revised in 1991), the World Conservation Monitoring Centre (1992), and BEENTJE et al. (1994), and have been further revised and updated where possible using a combination of more recently available information and several older sources that are considered to provide the most accurate figures available today for particular areas (GUINEA 1946; KEMP 1983; HIEPKO & SCHOLZ 1989; AKPAGANA & BOUCHET 1994; AKPAGANA et al. 1994; FRIEDMANN 1994; LÉONARD 1994; BOULOS 1995; LEBRUN 1997a, 1997b). The current data are not totally comparable from one country or region to another, primarily because the documents on which they are based do not always indicate whether for example they are dealing with all vascular plants or angiosperms only, or whether they cover only the indigenous flora or all of the species present in a given area,

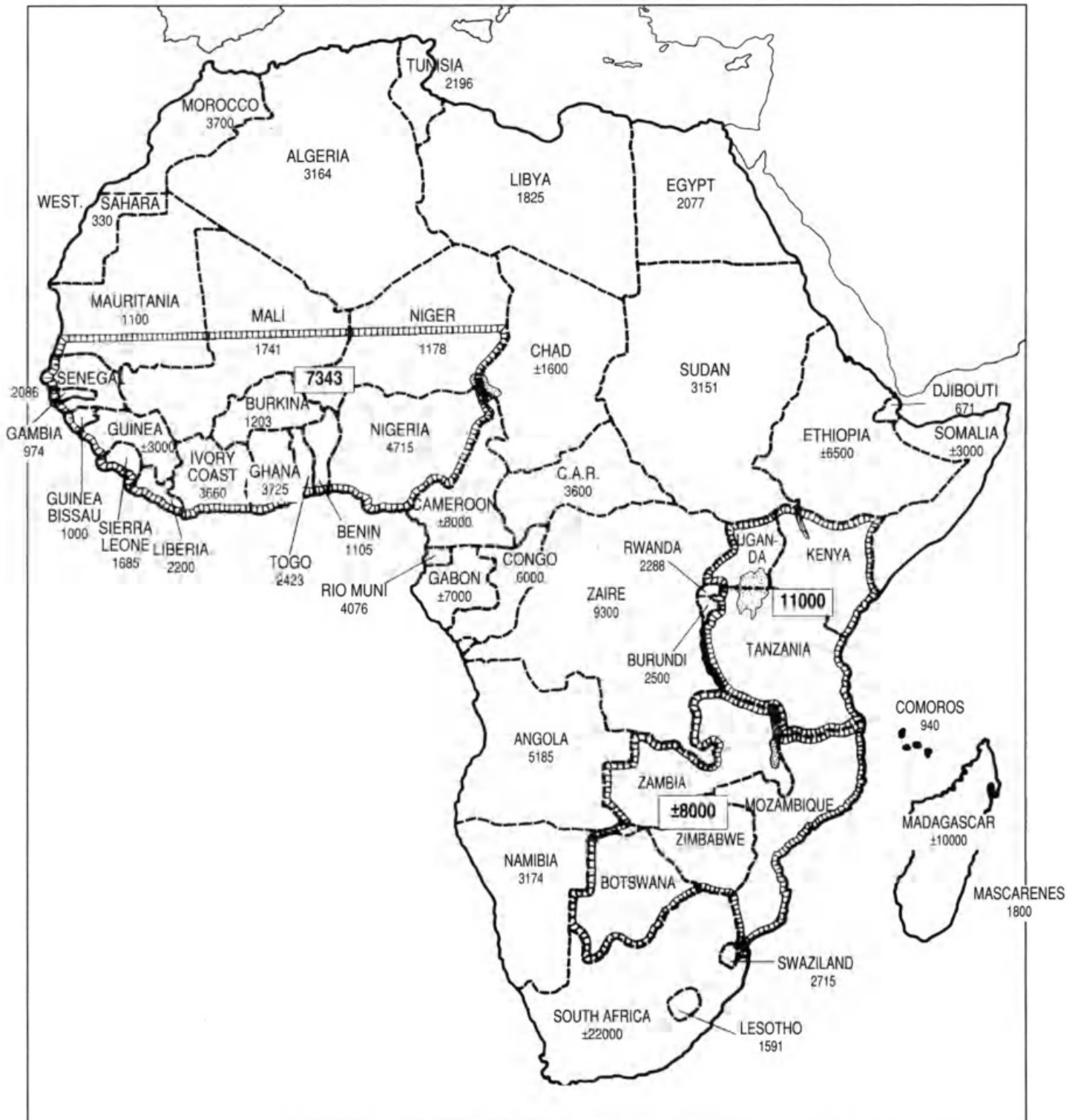


Fig 2.—Distribution of floristic richness by country or ongoing project.

including those that are naturalized and/or cultivated. Furthermore, although the figures published for some countries are presented as being accurate and exhaustive down to the last species (such as values of 2,423 species for Togo, or

1,203 for Burkina Faso), in fact they only reflect the information available to the authors at the time their works were completed (e.g., GUINEA 1946; LEBRUN et al. 1991).

In reality, all of the numbers presented in Fig. 2

must be regarded as approximations, which will inevitably change as additional botanical exploration, analysis of specimens, and taxonomic revision proceed. Thus, while the level of accuracy indicated at the time of publication of these works can reasonably be accepted, provided that the constraints and limitations indicated by the authors are kept in mind (such as poorly explored or unknown areas, and the lack of sufficient herbarium collections), even the most carefully compiled figures nevertheless quickly become outdated as new collections and information become available, and as taxonomic concepts are revised. For example, the number of species recorded from Togo increased in just a decade from 2,195 reported by BRUNEL et al. (1984) to 2,423 cited by AKPAGANA & GUELLY (1994; after corrections are made to the errors in the figures they provide).

For areas in which flora projects are still in progress, the data presented in Fig. 2 are estimates derived by extrapolation from the work already completed, taking into consideration the projected richness of the particular groups that remain to be treated. In most cases, these figures were either provided by, or at least verified by, the person(s) responsible for coordinating the respective

projects. In a few cases, we have had to estimate the numbers of species ourselves using the available base line information, much of which is very difficult to verify.

It is worth noting that the "Dahomey Gap" referred to by FRODIN (1984) has now been closed, or at least largely so, by the completion of the "Flore analytique du Togo" (BRUNEL et al. 1984), as well as a careful inventory of the plants occurring in Burkina Faso (LEBRUN et al. 1991) and a somewhat cursory listing of those in Benin (SOUZA 1989). On the other hand, Liberia and Guinea remain very poorly known.

CURRENT STATE AND PROGRESS OF FLORAS

Thanks in large part to the Association for the Taxonomic Study of the Flora of Tropical Africa (known by its French acronym, AETFAT), progress made by the various flora projects in sub-Saharan Africa has been regularly evaluated (BAMPS 1994). Since the most recent update (i.e., between June 1994 and December 1996), new treatments (or partial treatments) covering 65 families have been published entirely or in

TABLE 1.—Progress in ongoing African flora projects between June 1994 and December 1996.

	Camer.	Gabon	C. Afr.	Ethiopia	Somalia	FTEA	Angola	Zamb.	S.Afr.	Madag.	Masc.	TOTAL
Number of families published between June 1994 and December 1996 (according to BAMPS 1994 and updated) (pers. comm.)	0	1	2	1	1	32	12	2	0	0	13	65
Date of publication of first fascicule or volume	1963	1960	1948	1991	1993	1952	1937	1960	1963	1936	1976	
Percent published or accessible	25	33	67	13	46	72	55	45	13	60	65	

Camer. = Flore du Cameroun
 Gabon = Flore du Gabon
 C. Afr. = Flore de l'Afrique Centrale
 Ethiopia = Flora of Ethiopia
 Somalia = Flora of Somalia
 FTEA = Flora of Tropical East Africa

Angola = Conspectus Florae Angolensis
 Zamb. = Flora Zambesiaca
 S. Afr. = Flora of Southern Africa
 Madag. = Flore de Madagascar et des Comores
 Masc. = Flore des Mascareignes

part in the ongoing floras, as indicated in Table 1. Data from regional or national floras (for example those for Togo and Mozambique), as well as from more restricted or incomplete works (e.g., floras limited to specific groups such as trees, ferns, grasses, etc.) or incomplete projects (including those for Ghana, Nigeria, Ivory Coast, and Rwanda), have only been taken into consideration in a few cases, primarily because these treatments cover areas that are included in other, more extensive projects such as the Flora of West Tropical Africa, Flora Zambesiaca, Flore d'Afrique Centrale, etc.

Careful examination of the list of 65 family treatments presented in Table 1 shows that they are very unequal in size, largely reflecting the overall richness of each group within the Africa-Madagascar region. Some additional variation may also be due to differences in species concepts or taxonomic system (e.g., recognition of Tristichaceae as distinct from Podostemaceae). Nevertheless, as indicated by BAMPs, THULIN, POPE and WHITEHOUSE (pers. comm.), several very large and important groups have been revised since BAMPs' most recent compilation (1994), including:

- Poaceae (Flora of Ethiopia, Flora of Somalia),
- Euphorbiaceae, in part (Flora Zambesiaca, Flore de l'Afrique Centrale),
- Orchidaceae, all (Flora of Somalia) or in part (Flora Zambesiaca).

It is perhaps worth noting that two thirds of the family treatments published during the period from 1994 to the end of 1996 (Table 1) appeared in the Flore des Mascareignes and Flora of Somalia, which both cover a small area with a limited number of species, the latter of which is a rapidly expanding project.

Regarding the current state of progress of the various sub-Saharan flora projects and floristic compilations, three have now been completed: Flora of West Tropical Africa in 1972; Flora of Sudan in 1956; and the Prodröm einer Flora von Südwestafrika in 1972. Three other large endeavors are now approximately two thirds complete: Flora Zambesiaca, Flora of Tropical East Africa, and Flore de l'Afrique Centrale. The other ongoing sub-Saharan projects, covering

Gabon, Cameroon, Madagascar and the Comoros, Somalia, Ethiopia, the Mascarenes, etc., are at various stages of completion, and are in many cases progressing very slowly, usually due to a combination of insufficient funds and/or a lack of personnel.

In Southern Africa, the Flora Capensis is now outdated, and the Flora of Southern Africa, covering the area south of Angola, Zambia, Zimbabwe and Mozambique, is only about 13% complete (P. GOLDBLATT, pers. comm.) and is currently inactive, although it remains a long-term priority project (SMITH et al. 1995). This area is considered one of the best known floristically within the Africa-Madagascar region, largely because numerous modern partial floras and monographs have been published covering all or parts of Southern African. Also, a comprehensive database, PRECIS, has been compiled that includes specimen and taxon information on essentially all of the estimated 22,000 species and 2,500 infraspecific taxa occurring in the area (SMITH et al. 1995).

In North Africa, a flora is available for Egypt (TÄCKHOLM 1969, 1974), updated by a more recent checklist (BOULOS 1995), while the rest of the region, including the countries from Libya to the northern part of Mauritania, is covered by MAIRE's Flore de l'Afrique du Nord (1952-1987), which has been updated by QUÉZEL (1985), and is now 65% complete. The Med-Checklist OPTIMA project, which includes the Mediterranean part of Africa, has compiled information on about 6,000 of the estimated total of 20,000 species that occur in the area, but is now progressing very slowly for the reasons mentioned above regarding other projects.

PROBLEMS AND INFORMATION GAPS

In addition to the floristic works mentioned above, numerous monographs, distribution maps and indexes are also available, including *Distributiones plantarum africanarum* (Anon. 1969-) and the *Index de répartition des plantes vasculaires d'Afrique* (LEBRUN & STORK 1977, 1981; STORK & LEBRUN 1988), along with many vegetation maps at various scales, all of which are

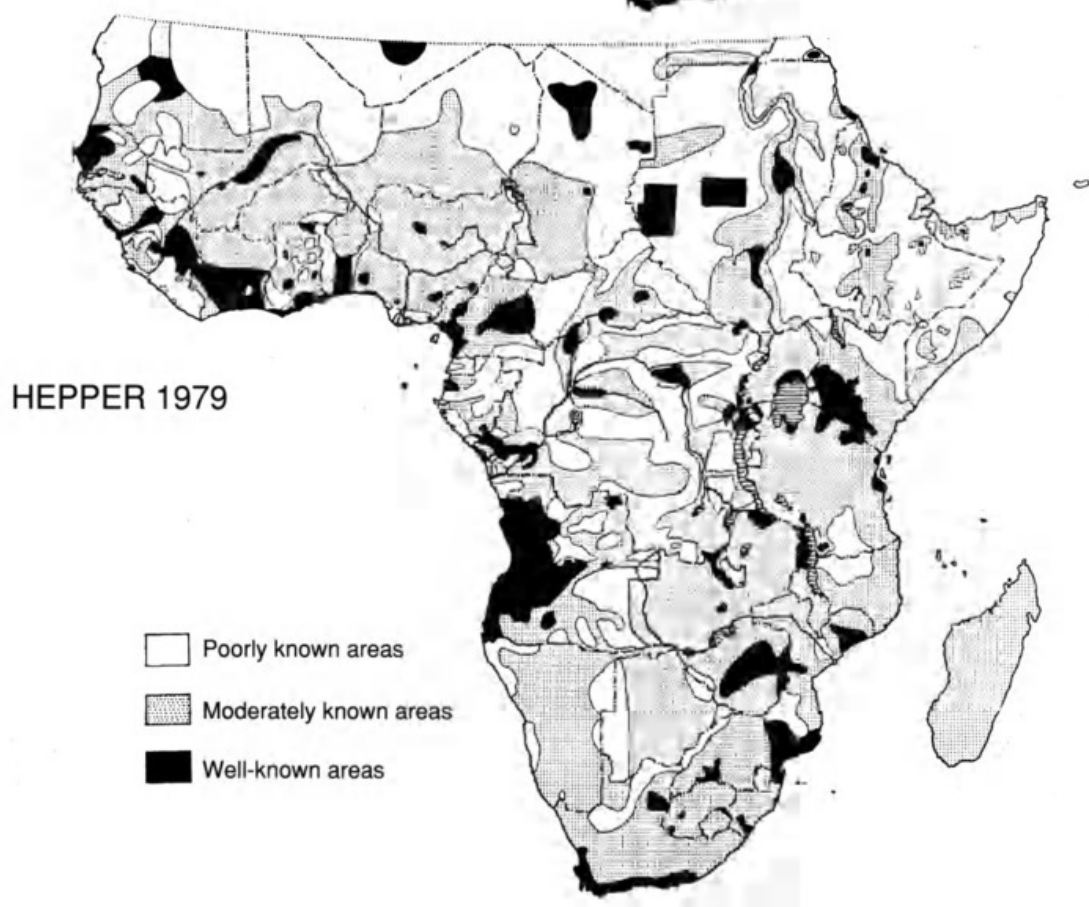
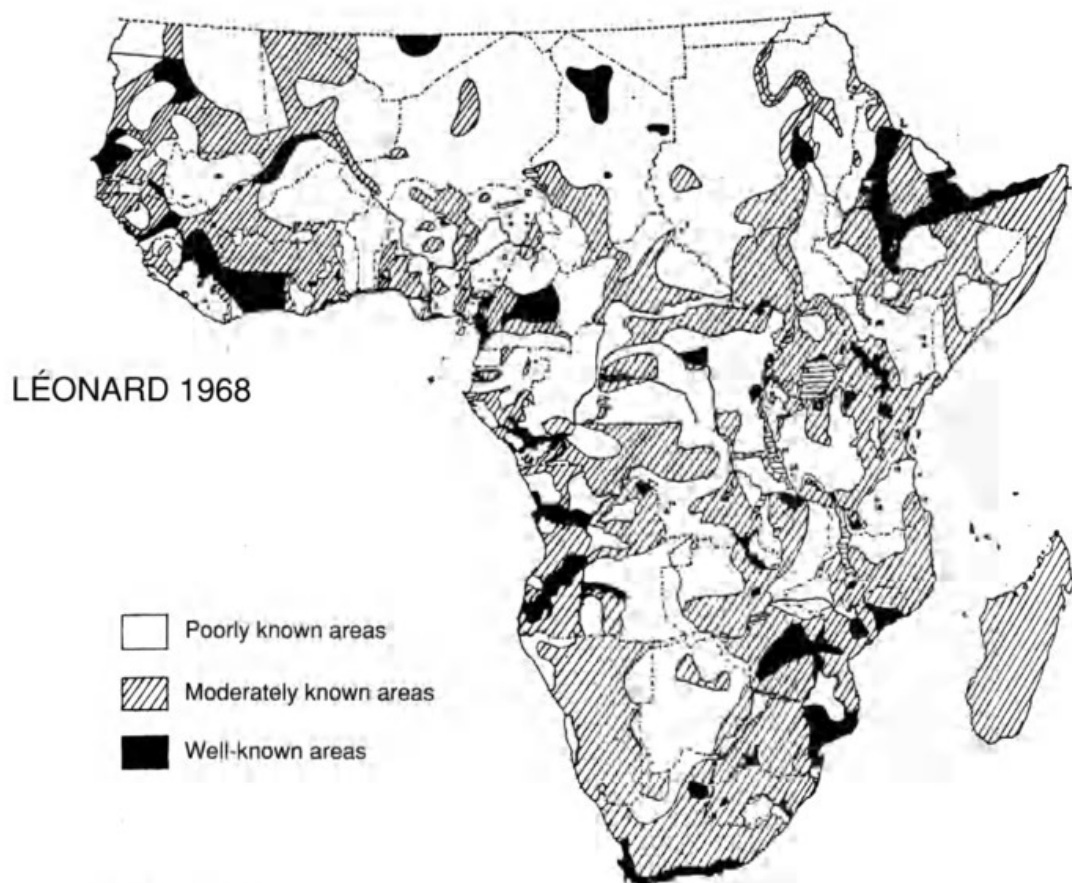


Fig 3.—Evolution of the knowledge of the Africa-Madagascar flora between 1968 and 1979.

too numerous to cite here. A number of gaps nevertheless remain, primarily because some parts of the Africa-Madagascar region fall outside the areas treated by the ongoing or recently completed flora projects. The most striking examples are Congo, the Central African Republic, and Chad, which are only covered by floristic listings whose accuracy and completeness are uncertain. Additional gaps also exist because the available reference collections, upon which even the most advanced floristic works must be based, are far from adequate.

As of 1972, for example, an area in Chad comprising about ten square degrees (that is, a hundred thousand km²), and situated in a zone that is considered to be potentially rich in plant species, had practically never been collected (LEBRUN et al. 1972), and no additional field work has been reported since then. Furthermore, many areas, or even entire countries, must still be regarded as "insufficiently known", based on LÉONARD's (1968) standard of three times as many specimens as species, which is very modest indeed.

Figure 3 shows the level of floristic exploration in Africa as of 1965 (as presented by LÉONARD 1968), and Fig. 4 presents the same information 14 years later (HEPPER 1979). Both maps recognized areas that are: 1) poorly known, in which the number of specimens collected is less than the number of species thought to be present; 2) moderately well known, with the number of specimens ca. 1-3 times the number of species; and 3) well known, where the available specimen base is greater than three times the estimated number of species. The botanical specimen base clearly increased between 1965 and 1979 for certain regions of Angola, East Africa and Sudan (which went from being "moderately well known" to "well known"), and for a fairly large part of Southern Africa and the western part of the continent (from "poorly known" to "moderately well known"). However, several other regions, such as Ethiopia, Somalia, Mauritania, and Mali, appear to have regressed as a result of an initial overestimate of the number of specimens available. Madagascar was only superficially treated by LÉONARD (1968) and HEPPER (1979), and while botanical exploration there is

still far from uniform, substantial progress was made between the time of LÉONARD's analysis and that of HEPPER.

These figures highlight the subjective nature of this kind of evaluation, and indicate just how slow progress was during the 14 years through 1979. Clearly a major effort has been made in many parts of the Africa-Madagascar region since then, but even more will be required in the future, especially considering that in many areas regarded as poorly or only moderately well known botanically, the native vegetation is currently undergoing rapid and accelerating levels of degradation. HEPPER (in CAMPBELL & HAMMOND 1989) indicated that an estimated 260,000 ha of forest were being lost in Nigeria each year, and that 400,000 ha were destroyed annually in Ivory Coast. For Madagascar, GREEN & SUSSMAN (1990) estimate that 111,000 ha of rain forest are cut each year in the eastern part of the country alone, as much as or more than in Amazonia.

PRANCE (1977), VINK (1981), and others have proposed an alternative method for evaluating our level of knowledge of floras, the density index. According to these authors, a given area must have more than 100 collections per 100 km² (or one per km²) to be regarded as sufficiently known. Using this method, CAMPBELL & HAMMOND (1989) determined that no country in Africa reached this level as of 1981 (Table 2), and that based on estimates of the rate of collecting at that time, they indicated that it would take several decades, centuries, or even longer, depending on the case (Table 3), before the collection density would meet the criteria for being regarded as sufficiently known (Fig. 4). The figures presented by CAMPBELL & HAMMOND (1989) are, however, clearly underestimates for at least certain countries, and perhaps for all of them. For example, the density index of 9 assigned to Madagascar (Table 2) for both 1964 and 1981, corresponding to just 53,100 numbers in all for the country, obviously does not take into account the large number of collections (more than 10,000) made in the 17 intervening years. Moreover, based on a careful estimate made by the first author in 1976, nearly 200,000 numbers from Madagascar, representing a density index of

TABLE 2.—Number of herbarium specimens per tropical country/region, 1952-1981 (from CAMPBELL & HAMMOND 1989).

Country	Collection density index ^a						
	1952	1954	1956	1959	1964	1974	1981
Sierra Leone	0	0	0	0	0	41	50
Liberia	0	0	0	0	3	6	6
Ivory Coast	0	1	1	1	1	7	7
Ghana	0	10	10	21	21	42	48
Benin & Togo	0	0	0	0	0	0	5
Nigeria	2	3	3	3	4	6	14
Cameroon	0	0	1	1	1	1	10
Gabon	0	0	0	0	0	0	1
Congo Republic	0	1	1	1	3	9	9
Zaire	0	0	4	4	4	5	5
Central African Republic	0	1	1	1	1	1	1
Angola	0	0	1	1	1	4	5
Uganda	3	15	15	15	17	30	7
Kenya	14	17	17	17	28	55	64
Tanzania	0	0	0	1	1	3	5
Madagascar	2	2	2	2	9	9	9

^a Collection density index = number of collections/100 km² within the borders of the tropical-forested country.

TABLE 3.—Rates of botanical inventory in tropical countries/regions (from CAMPBELL & HAMMOND 1989).

Country/Region	No. collections/ 100 km ² in 1981	Collections/ 100 km ² /year 1974-1981	No. years required to reach level of 100 specimens/ 100 km ² within country/region
Sierra Leone	50	1.18	43
Liberia	6	0.00	∞
Ivory Coast	7	0.00	∞
Ghana	48	0.90	58
Benin & Togo	5	0.75	126
Nigeria	14	0.49	175
Cameroon	10	1.38	65
Gabon	1	0.16	618
Congo Republic	9	0.00	∞
Zaire	5	0.00	∞
Central African Republic	1	0.00	∞
Angola	5	0.50	90
Uganda	7	-3.27	∞
Kenya	64	1.32	27
Tanzania	5	0.24	398
Madagascar	9	0.00	∞

40, were already on deposit at the time in the herbarium of the Laboratoire de Phanérogamie, Paris (P) alone.

Between 1981 and today, intensive field work has substantially increased the density index in a number of countries, including Gabon, Ethiopia,

and Madagascar. We currently estimate, for example, that as of the end of 1996 approximately 55,500 collections have been made in Madagascar since 1981, increasing the density index to at least 43. If this level of effort is maintained, it will take about 51 years to reach a den-

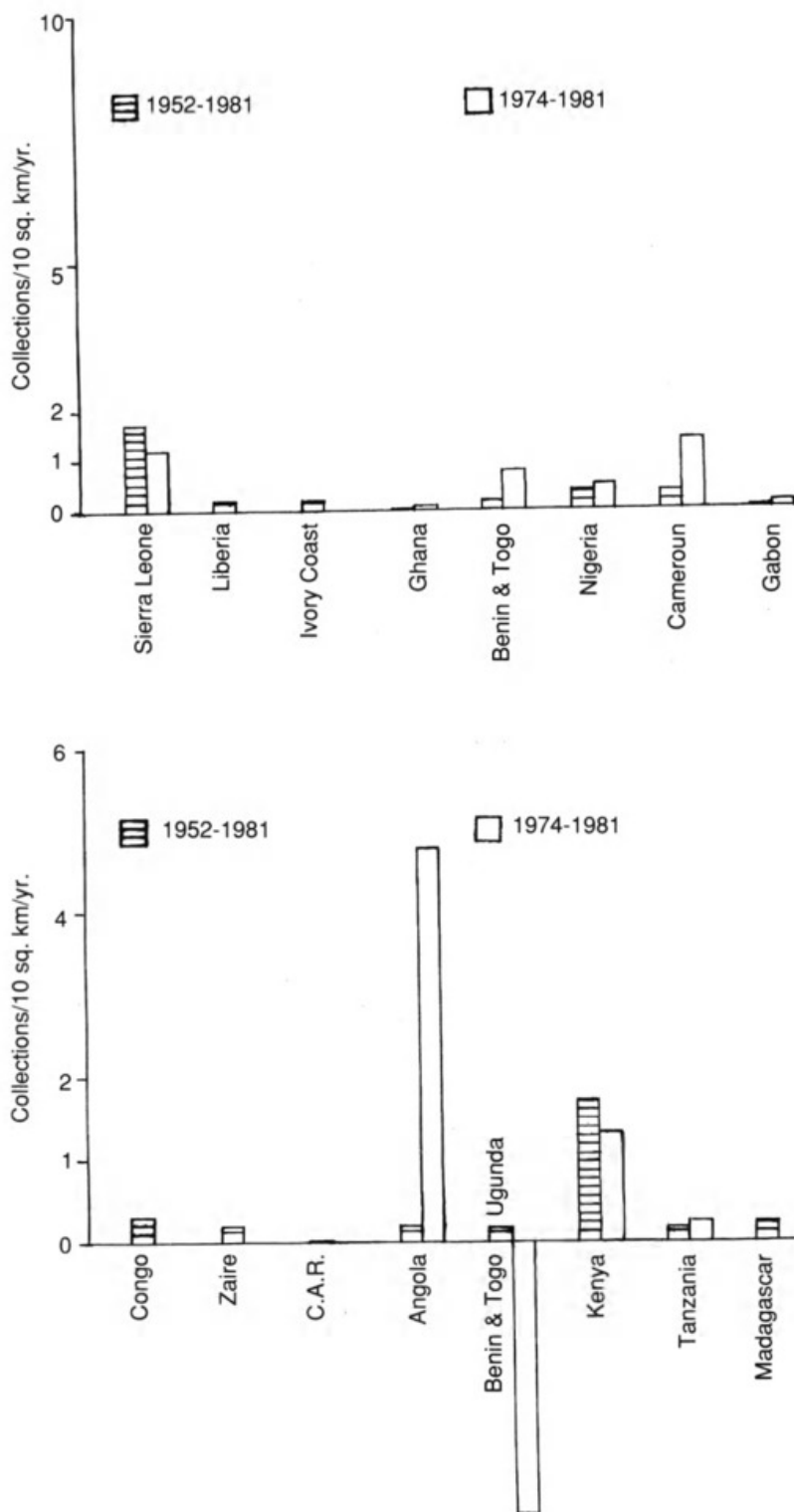


Fig 4.— Collection rate in the Africa-Madagascar region (from CAMPBELL & HAMMOND 1989).

sity index of 100 corresponding to a sufficient level of floristic knowledge, contrary to what was suggested by CAMPBELL & HAMMOND (1989). It is nevertheless vividly clear that a tremendous effort is still required to generate an adequate specimen base, even for those fortunate areas where a reasonable level of field work has been conducted; in the vast majority of African countries, however, the situation is regrettably much less encouraging.

In order to fill these tremendous gaps and to round out even our basic understanding of floristic diversity in the Africa-Madagascar region, a number of serious difficulties will first have to be overcome.

1. Financial problems of varying magnitude plague all of the herbaria involved in the study of the African flora, whether in Europe, Africa, North America, or elsewhere. Field work is chronically under-funded, staff levels are far too low, and current trends suggest that the situation will become even worse in the coming years.

2. Political instability, a lack of security, and even the lingering effects of previous conflicts (e.g., the millions of anti-personnel mines still buried in several African countries) hinder field exploration, and even effect the ability of botanists to work in certain herbaria. As reported by Mats THULIN in 1993 (pers. comm.), the herbarium in Mogadishu, Somalia, was destroyed during the recent conflict in that country, and all the local botanists were in exile. The herbarium in Brazzaville, Congo, was seriously vandalized in early 1994, resulting in the loss of all documents and equipment, and all unmounted specimens, although about 80% of the mounted collections were fortunately saved.

3. The number of qualified taxonomists in professional positions that enable them to contribute to the study the flora of the Africa-Madagascar region is steadily declining. Many projects have been or will soon be suspended because of a lack of personnel. Furthermore, several large and complex taxonomic groups (e.g., Rubiaceae and Euphorbiaceae) are nearly always left untreated, or are the last to be studied in ongoing flora projects, largely because there are not enough specialists working on them. This deficiency is responsible in part for the slow progress of cer-

tain flora projects, which were begun several decades ago, but remain unfinished. In the case of the *Flore de Madagascar et des Comores*, for example, while some of the largest families are finally being treated (e.g., Euphorbiaceae, Fabaceae), virtually all of the earlier treatments published prior to 1960 must now be regarded as badly outdated and are in need of complete revision, especially since the specimen base has grown so much in the last several decades.

As if the situation presented above were not troublesome enough, we have not even considered the status of floristic investigation for the many groups of cryptogams, about which even less is known. Nor have we touched on such critically important disciplines as pollination biology, phenology, dispersal, growth, germination, etc., which receive virtually no attention throughout huge parts of the Africa-Madagascar region.

PROSPECTS FOR THE FUTURE

Despite the fact that our knowledge of the flora of the Africa-Madagascar region is far from complete (even though an average of one species has been described per day since 1953, according to LEBRUN 1991), the available information base for the region is still more advanced than for either tropical America or Asia. For this reason, the accumulated data on vascular plants from Africa and Madagascar, which now cover about 75% of the species, are perhaps the best suited of all for developing a comprehensive project to verify, compare and standardize information using modern computer technologies. Such an effort, if properly designed and implemented in a collaborative manner to take full advantage of the available expertise, could realistically prepare a reliable, on-line computerized accounting of the vascular plants of the Africa-Madagascar region in as little as a decade.

Several projects dealing with specific parts of the region are now well under way, including the *Conspectus of the Vascular Plants of Madagascar* (SCHATZ et al. 1996; PONCY & LABAT 1995), which could serve as a very useful model for a larger undertaking. Similarly, the PRECIS data-

base contains much of the baseline botanical information for Southern Africa, and several additional projects have likewise started to assemble relevant data from other areas, including LEAP (List of East African Plants).

A computerized project that treats the entire African flora could serve as an important and useful precursor to a future Flora Africa, a synthetic work first proposed by LÉONARD in 1975, but which has thus far not progressed beyond the planning stage. A computerized database of African plants would also facilitate better access to a whole range of valuable floristic information, and thereby make it possible to assess more accurately how well our knowledge of the flora of the Africa-Madagascar region is progressing. An international effort, involving a broad range of institutions with complementary strengths, working together to study this important region, is critically essential, and should be regarded as a top priority for future botanical work in Africa.

Acknowledgments

This paper was expanded and updated from a talk entitled "Do we really know as much as we think about the flora of the Africa-Madagascar region?" presented at the symposium on "Floras of the world: current knowledge and future prospects", organized by N.R. MORIN and held at the XV International Botanical Congress, Yokohama, Japan, 3 September 1993. We are grateful to the following persons for valuable information from work in progress on the African flora and/or from projects for which they are responsible: L. ANDRIAMIHELARIVO, F. BADRE, P. BAMPS, J. BOSSER, S. CASTROVIEJO, M. CHALOPIN, C. CUSSET, J.-J. FLORET, F. FRIEDMANN, L. GAUTIER, P. GOLDBLATT, W. GREUTER, I. HEDBERG, J.-P. LEBRUN, I. MOREIRA, R. POLHILL, G. POPE, J. RAHARIMAMPIONONA, F. RAKOTONDRAINIBE, K. SIKES, G.F. SMITH and M. THULIN.

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*Manuscript received 9 September 1996;
revised version accepted 17 February 1997.*



Lowry, Porter Prescott. and Morat, Philippe. 1997. "Floristic richness in the Africa-Madagascar region: a brief history and prospective." *Adansonia* 19(1), 101–15.

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