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Subject: Review of Taxonomy, Distribution and Ecology of Maytenus buchananii

To: Arthur S. Barclay with cc to Robert E. Perdue, Jr.

Since detailed botanical reviews were undertaken in November of 1976, a considerable amount of data has been accumulated on the African vegetation and flora. Maytenus buchananii has been a problematical species to interpret due to the confusing taxonomic history in the genus. This species appears to consist of many ecotypes and this review attempts to group herbarium data according to major vegetation types. Specimens are first cited, and where appropriate literature was found, a more detailed description follows.

INTRODUCTION

Taxonomy:

Maytenus buchananii, as interpreted by Robson, belongs to a complex or aggregate of species typified by M. ovata. Unfortunately, Robson has not yet published his revision of the East African Celastraceae and some questions remain as to species that make up the M. ovata complex.* From Robson's publications (Flora Zambesiaca, 1966 & Soc. Brot. Biol., 1965) and our personal communications with him, his species interpretations seem close to that of Wilczek (1960) for the Flore du Congo Belge et du Ruanda-Urundi. Therefore, the Maytenus ovata complex might include the following: M. ovata (s.India), M. royleana (India - Iran), M. obscura (Ethiopia - n. Kenya), M. serrata (Ethiopia), M. arbutifolia (Ethiopia, Kenya, e. Zaire, Uganda?, Tanzania?, Rwanda?, Burundi?), M. gracilipes (Zaire, Cameroon, Angola, Gabon?), and M. buchananii (tropical Africa). This entire complex and evidently more (M. arguta) was treated as a single species (with varieties & forms) by Blakelock (1956).

Robson has mentioned that Gymnosporia filamentosa (Rwanda, Burundi?) might provide an earlier epithet for M. buchananii. Cufodontis (1958) has interpreted one specimen from Ethiopia under G. filamentosa. Also, Cufodontis indicated that G. intermedia was something in between M. ovata and M. undata.

Descriptions of M. rothiana from the Western Ghats of India and M. rufa from the Himalayas also seem similar to M. buchananii or M. serrata.

Some more distant but close relatives appear to be M. mossambicensis (E. & SE. Africa), M. arguta (E. Africa) and M. leptopus (Madagascar).

*Since this was written, I have learned from our written communications with Dr. Robson that he will not have time to finish his work on the Celastraceae. Dr. Robson has suggested that someone here might work on Maytenus otherwise he will try to find a student to work under him.

Distribution:

Maps showing the geographical distribution of M. buchananii were prepared using herbarium data compiled by R. E. Perdue at Kew. Many of the specimens examined by Perdue were annotated by Robson. Two other locations cited in Wilczek (1960) might also be added (northern Zaire).

Vegetation:

The title headings to follow are rather general and do not entirely correspond with other classifications used for African vegetation (ex. Greenway, 1973).

M. buchananii seems to occur most often as a marginal species of sclerophyll forests and thickets that are transitional to woodlands and wooded grasslands. The term "sclerophyll" here refers to evergreen plants with thick, usually entire and simple, evergreen leaves.

Sclerophyllous vegetation is usually associated with mediterranean climates. Some of the East African shrublands are reminiscent of the California chapparal. This resemblance is even striking with some of the plants. For example, the African Strychnos madagascariensis and the Californian Ceanothus velutinus are both evergreen, white-barked shrubs or trees with coriaceous, simple, opposite, microphyllous leaves that have three main palmately branched veins. The two species, of course, are not related.

The sclerophyll types in South Africa certainly compare well with those in East Africa. Acock's (1953) "Coastal Macchia" includes Tarchonanthus camphoratus, Myrsine africana, Maytenus heterophylla, Olea africana and species of Euclea, Rhus, Cassine. These taxa can be commonly seen together in the uplands of Kenya. Phillips (1930) noted a strong similarity between species of the Tanzanian "Subtropical Evergreen Forest" and those occurring in similar vegetation in South Africa (Alexandria Forest). Wide distribution gaps are apparent for some species like Tarchonanthus camphoratus, Trichocladus ellipticus, Gnidia subcordata and others. These disjunct taxa seem to reflect the fact that the communities themselves (in part) are disjunct, the intervening area occupied extensively by woodland, savanna and mist evergreen forests.

In the Himalayas, one also finds Myrsine africana, Olea africana, Maytenus rufa and species of Rhus, Rhamnus, Berberis, Maesa, Carissa, Zanthoxylum, Buddleia, Jasminum, Ilex, Myrica occurring together along with the more typical Laurasian Cornus, Viburnum, Rhododendron, Prunus, etc. in the subtropical evergreen oak or cedar forests (Stainton, 1972).

The former distribution of the sclerophyll vegetation has been discussed by Axelrod in his paper "Evolution and Biogeography of Madrean-Tethyan Sclerophyll Vegetation" (Ann. Missouri Bot. Gard. 62, 1975). As shown on page 311, the early Tertiary sclerophyll vegetation perhaps occurred along the southern continental margins of North America, Eruope, Asia and northern margins of Africa.

LOWLAND MESIC EVERGREEN FOREST

Kenya: Data from herbarium specimens Shimba Hills, Buda and Mrima Forests, and Shimoni.

Observations and literature: Near Kwale Forest Station observed as a frequent scandent shrub in a dense understory of arborescent shrubs.

The tall trees (80 ft. or more) were not sampled but possibly are those described by Moomaw (1960) under the "Sterculia-Chlorophora-Memecylon Lowland Rain Forest" or in Dale (1939) under "Lowland Evergreen Rain Forest". Arborescent shrubs were generally 3 to 5 meters high that included species with: compound-membranous leaves (Clausena anisata), compound-coriaceous leaves (Pseudobersama mossambicensis), simple-membranous leaves (Vismia orientalis) to sclerophyllous types (Euclea natalensis). Small shrubs were also frequent and of various kinds: thorny with membranous, deciduous, compound leaves (Phyllanthus engleri), laurophyllous (Ochna mossambicensis, Psychotria lauracea) to sclerophyllous nano-leptophylls (Maytenus mossambicensis, Psychotria holtzii, Polysphaeria parvifolia).

A few kilometers north of Kwale Forest Station, Maytenus buchananii was more common as a fringing shrub on secondary forest islands surrounded by wooded grassland. The fringes were composed of shrubs similar in habit to M. buchananii such as: Canthium zanzibaricum, Harrissonia abyssinica, Scolopia rhamniphylla, Toddalia asiatica, Allophylus spp and Zanthexylum chalybeum. Frequent to common trees (30-60ft.) included: Manilkara sansibarensis, Vepris eugeniifolia, Chlorophora excelsa, Ficus quiba, Afzelia quazensis, Apodytes dimidiata, Euclea natalensis, Cassine schweinfurthiana, Olea capensis, Suregada zanzibarensis and Pachystela brevipes. Lianas were common on some forest patches such as Dictyophleba lucida, Landolphia spp. or Ancylobothrys spp. Uvaria lucida, and Canthium spp. Common shrubs or trees in the grassland were: Tetracera boiviniana, Xeromphis nilotica, Brysocarpus orientalis, Crossopteryx febrifuga and Vitex mombassana.

Presumably the more mature forest, as described in Dale (1939) and Moomaw (1960), include: Cylicodiscus battiscombii, Hymenaea verrucosa*, Rhodognaphalon schummaniana*, Manilkara cuneifolia (or sansibarensis*), Macrolobium coeruleum, Celtis soyauxii, Olax dissitiflora, Combretum schumannii, Cola sp. Tabernaemontana holstii, Albizia spp., Cistanthera parvifolia, Macaranga kilimandscharica, Chlorophora excelsa*, Antiaris toxicaria, Sterculia appendiculata, Cassipourea euryioides*, Cussonia zimmermannii*, Trichilia emetica, Memecylon verruculosum*, Olyria latifolia, Vismia orientalis*, Mimusops ugandensis, Pachystela brevipes*, and Sorindeia obtusifoliata.

Birch (1963) list the major canopy trees for the Shimoni Forest as: Antiaris toxicaria, Chlorophora excelsa, Cussonia zimmermanii, Lecaniodiscus fraxinifolius, Sorindeia obtusifoliolata, Terminalia kilimandscharica and Trichilia emetica. He noted that M. buchananii (cited as M. ovata) occurred only at the fringes.

*Specimens collected by Sandra Saufferer and Richard Spjut in the area where M. buchananii was collected. Identified by the staff at the East African Herbarium, Nairobi, Kenya.

Tanzania: Data from herbarium specimens Pangani District, Bushini Estate: Described as a small spreading tree at edge of forest.

Lake Victoria (Southern shores). Four collections - Bukoba District (Ruiga River & Biharamulo Road) and Mwanza Province (Ukeweme? & Ukerewe Island).

Literature: No specific information on the above locations. A generalized vegetation map of East Africa (Trapnell & Langdale-Brown, 1972) shows some forests, forest-savanna mosaic, bushland and thickets, and Brachystegia Woodland near the southern shores of Lake Victoria. Rainfall Maps (Scale-1:2x10⁶) show sharp gradients of annual precipitation that decrease with greater distances from the Lake. The vegetation west of Pangani might be similar to that described above for the Shimba Hills.

Comments: The coastal vegetation might be separated into the following elements:

1. Species or related species typically found in the wooded grasslands and woodlands of central and western Africa but also along the eastern coast of Tanzania and Kenya with some reaching their northern distribution in the Shimba Hills. Examples are Brysocarpus, Crossopteryx febrifuga, Psorospermum febrifugum, Parinari curatellifolia, Brachystegia spiciformis, Julbernardia, Ximenia, Lannea, Sclerocarya.

2. Genera and some species generally characteristic of lowland to intermediate elevation rain forests in western and central Africa. These include: Antiaris toxicaria, Chlorophora excelsa, Sterculia, Cola, Memecylon, Manilkara, Hunteria, Pycnocoma, many genera in the Annonaceae. Comparisons might even be drawn between "associations" - the "Antiaris-Chlorophora" association (Taylor, 1960) in Ghana with Bombax, Parkia, Terminalia, Ceiba, Sterculia, Triplochiton, Afzelia, Trichilia or the Cynometra forest in eastern Zaire and Uganda and near Kakuyuni, Kenya which has Lasiodiscus.

3. Species or related species typical of sclerophyll forest and thickets in the uplands of eastern Africa or at various elevations in South Africa. In the Shimba Hills and with M. buchananii were: Cassipourea, Olea, Euclea, Cassine, Eugenia, Scolopia, Apodytes dimidiata, Toddalia asistica. Elsewhere along the coast: Warburgia, Brachylaena, Rhus, Carissa, Croton, Teclea, Strychnos henningsii, Scutia myrtina.

4. Genera and species often associated with semi-desert environments: Commiphora, Acacia, Salvadora, Balanites, Euphorbia. None of these were seen with M. buchananii in the Shimba Hills.

The Shimba Hill forests with M. buchananii have elements of both rain and sclerophyll types; perhaps such forests might be called "Mixed Rain and Sclerophyll Forest".

MONTANE SCLEROPHYLL FOREST

Sudan: Data from herbarium specimens Nagichot, Didinga Mountains at 6,600 ft. Commonest small tree in a little coppice on Basalt Plateau.

Literature The Didinga Mountains have been dominated by Podocarpus milanjianus, Juniperus procera (= J. excelsa?) and Olea africana. Much of the Juniperus was destroyed by fire (Bari, 1968).

Uganda: Data from herbarium specimens (1) Mt. Rom (Chua) at 6,500 ft. (2) Timu Forest, Karamoja; hilltop forest at 6,500 ft. - common tree, 30 ft. (3) at Agoro Chua above Acacia xiphocarpa zone, 8,800 ft. (Eggeling - 2381, Thomas - 3215, Eggeling - No.?).

Literature: Wilson (1962 under montane forest ("m ")) mentions the following association for the Timu area "Calpurnia subdecandra-Catha edulis-Euclea sp.- Juniperus procera - Maytenus sp. - Olea chrysophylla (= O. africana)-Teclea nobilis". Also a Maytenus sp. is listed under similar vegetation on volcanic soils in the Moroto and Chemorongit Mountains.

From Langdale-Brown et al. (1964, pp. 43 & 44) under "Dry Montane Forest of Juniperus-Podocarpus": "An irregular understory of Ilex mitis, Teclea nobilis and Maytenus sp. is often present. Frequently however there is no continuous upper canopy, merely large scattered trees emerging from a thicket 20 - 30 ft. high, composed mainly of species with small leathery leaves such as Olea africana, Euclea divinorum and Olinia usambarensis. One distinct form of this occurs near the Suam River on Mount Elgon, where the thicket is composed mainly of Trichocladus malosanus (= T. ellipticus) and another rather drier type in the Timu area of north-east Karamoja where Strychnos sp. is abundant".

Comments: The Maytenus sp. mentioned for the Timu area is probably M. buchananii but in other areas such as on Mt. Elgon, this may be M. arbutifolia (listed in Tweedie, 1976 as M. englerana). Under Blakelock's (1956) list of cited specimens, M. obscura appears also to occur in the Karamoja District. The distributions of M. buchananii, M. arbutifolia and M. obscura overlap in northern Uganda and northern Kenya.

Kenya: Data from herbarium specimens (1) Tarambass Forest, Aburuwa, 6,000 - 7,000 ft. - Small tree in Trichocladus malosanus undergrowth. (2) Matthews Range - Common rather dry woody shrub of drier forest zone. (3) Uaso (probably Ewaso) Narok near Rumuruti, 6,600 ft. Dense thickets on lava soil - Locally plentiful bush(Dale-2447; Kerfoot-2607; Trapnell-2336) (4) Marakwet Hills, Podo Forest, 8,800 ft - Straggling Shrub to 20 ft. (Dale-3425). (5) Aberdare Range, 2,200 meters (Fries & Fries #531).

Literature: Vegetation Map of S. W. Kenya Highlands list the following types near Rumuruti and Ewaso Narok Swamp: "Open evergreen and semi-deciduous bushland of central Rift region, undifferentiated (#13)", "Undifferentiated secondary gassland (#1)", "Acacia brevispica - A. drepanolobium (bushland) with evergreen elements on lava soils (#22b)" and Acacia xanthophhloea type (woodland, savanna or bushland along swamp". West of Rumuruti there are also patches of "Evergreen or Semi-Deciduous lava bushland (# 24b)".

Comments: Fries & Fries (1948) and Kerfoot (1964) were also reviewed here. On the western slopes of Mt. Kenya and Mt. Aberdare, Podocarpus-Juniperus forest types were described at elevations from 2250-2380 meters. Fries & Fries listed Gymnosporia maranguensis (= M. heterophylla) and G. luteola (=M. undata) as fairly common species. The combination G. luteola var. maranguensis was also cited and is difficult to interpret. Maytenus undata and M. herophylla are common species in the drier montane or sclerophyll forest and bushlands. Maytenus buchananii was not noted in either of these publications even though the authors' specimens are cited above.

Tanzania: Data from herbarium specimens Salanka Forest Reserve, Bereku, Kondoa District - Thorny tree, 15 ft. (Natulu - No.?).

Literature: Phillips (1930, p. 224), "Vegetation Communities of the Central Province of Tanganyika" under "Sub-tropical Evergreen Scrub" gives a lengthy list of principal species which include: Akocanthera schimperi, Gymnosporia nr. nemorosa, G. buxifolia, G. senegalensis, G. putterlickioides, G. gracilipes, Cassine aethiopica, Elaeodendron spp., Euclea divinorum, Rhus glauceseens, Rhamnus prinoides and Olinia usambarensis. The more recent interpretations of M. gracilipes do not indicate this to occur in Tanzania. M. gracilipes is very similar to M. buchananii. Burtt (1942, p.120) noted "relict patches of subtropical evergreen forest are found along the summits of the Bereku ridge north of Kondoa Irangi". From 6,000 - 7,000 ft. the dominant trees are Podocarpus gracilior, P. milanjianus, species of Ochna and large Albizia laevicorticata. Other species include: Apodytes dimidiata, Clausena anisata, Myrsine africana, Calodendrum capense, Phoenix reclinata, Olea hochstetteri, Cassine crocea, Diospyros whyteana, Euclea macroglossa, Psychotria capensis, Toddalia asiatica, Chrysophyllum spp. and Tabernaemontana sp.

An interesting description was found in Greenway (1933), "The Vegetation of Mpwapwa". "On the northern slopes of Wald Mountain - at an altitude of 6,100 ft. a patch of forest occurred. The fringe was composed of a practically pure stand of a 30 ft. tall, much-branched Celastraceous trees of Gymnosporia sp. or Elaeodendron sp. with thorny branchlets". Burtt (1942) mentions "subtropical evergreen

forest is found near Mpwapwa from 5,000-6,100 ft. These forests occur as remnants of the original primaeval forest that at one time clothed a very much larger area of the mountain tops than they do today; the ravages of seasonal grass fires and the consequent exposure and removal of the humus by erosion have now reduced them to small areas on sheltered slopes, in ravines and on the mountain peaks themselves. Occasional isolated and aged forest trees still survive in the upland savannahs; they are clothed with epiphytes and surrounded by a thicket of secondary forest elements sheltering under the shade of the survivor, and protecting it from otherwise inevitable destruction."

Kerfoot (1964), "A first Check-List of the Mbeya Range" records "Maytenus ovata var. ovata". In another publication he briefly describes the vegetation. The forest canopy includes: Aningeria, Apodytes, Pittosporum, Nuxia, Podocarpus, Casearia, Chrysophyllum, Prunus, Syzygium, Parinari. Some of the small trees and shrubs are species of Allophylus, Canthium, Pavetta, Trichilia, Trichocladus, Rapanea and Dracaena. "Fringing the evergreen forest with no transition zone between the two is a narrow belt of more shrubby vegetation". Listed are species of Catha, Rhamnus, Rhus, Gnidia, Olinia, Clausena, Maytenus ("spp."), Allophylus, Olea and Clutia. Kerfoot list most of these species again under his montane woodland which is evidently a sclerophyll thicket with emerging trees that do not form a canopy. Additionally, there are species of Cassine, Myrsine, Scolopia, Toddalia.

Malawi: From correspondence and literature It has been reported that M. buchananii is common in the Misuku Hills near or in a forest at 5,500 ft. Chapman & White (1970) in "The Evergreen Forests of Malawi" mention that in the Misuku Hills on the drier northwest slopes the forest decends as low as 5,500 ft. Rainfall is between 50 and 60 inches. At 6,150 ft. they describe a "Entandrophragma-Aningeria-Chrysophyllum" forest. Cassipourea, Podocarpus and Apodytes are also listed. Secondary forest species include: Albizia, Dombeya, Maesa, Bersama, Bridelia, Catha, Croton, Cussonia, Myrica, Schrebera, Scolopia and Trema.

Zambia: Data from herbarium specimens Mwenga, Shiwa, Ngandu; 4,900 ft. A much-branched, scandent evergreen, thorny shrub with reddish pink fruits. Local with Rhus on the margins of Apodytes, Pygeum (= Prunus) Euclea, Croton, Bridelia. Relict patch of evergreen forest, but more common with Ziziphus, Prunus and Acacia woodii (= A. sieberana var woodii) on ant hills in gray sandy loam (Greenway & Trapnell, # 5731).

UPLAND ACACIA SAVANNA AND THICKETS

Rwanda, Uganda: Data from herbarium specimens Biumba, Mutara region near Mimuli; savanna with Acacia - Tree to 2 meters (Troupin-4825). Nyakatale, northwest of Gabiro; savanna with Acacia and Themeda - Tree to 3 meters (Germain-2900). Kamwezi, Kigezi; short grassland, 5,000 ft. - Shrub, 6 ft. (Purseglove # 2589).

Literature: Langdale-Brown et al. (1964) have mapped the Kamwezi area as "Acacia-Cymbogon/Themeda Complex (P1)" plus "Themeda-Loudetia Grass Savanna (Q 5)". The species of Acacia include: A. etbaica, A. hockii, A. senegal var. senegal, A. sieberana var. sieberana & var. vermoesenii, and A. gerrardii var. gerrardii. Not listed is Purseglove"s specimen # 2586 - A. brevispica, his number for M. buchananii was 2589.

Comments Specimens from northern Cameroun, Nigeria and Central African Republic are also reported from savanna and woodland communities. It is difficult to imagine M. buchananii as a scattered tree in grassland communities. Sillans (1958, p. 308) list two localities for M. buchananii (cited as Gymnosporia ndeleensis) in the northern savanna of the Central African Republic. It was indicated to be a scandent shrub of thickets in savanna. He also cited Gymnosporia filamentosa - a rare shrub on rocks in savanna. Comparisons here might be made with the Acacia brevispica-A. drepanolobium bushland with evergreen elements on lava soils near Rumuruti, Kenya.

SWAMP AND RIPARIAN FORESTS

Most herbarium specimens refer to streams or swamps. No attempt will be made to cite all of these, only those that mention M. buchananii was common.

Zambia: Data from herbarium specimens Nsumbu Island, Lake Bangwelo; common in parts of patch of dense forest and bush near shore (Michelmore-564). Mwinilunga District - Scandent shrub up to 15 ft.; very common, fringing Mushitu (Holmes-1295). Locality somewhat illegible, believed to be Kapushi River, Lukanga - As Mushitu or fringing bush; common here, tree 25-40 ft. (Trapnell-2053).

Comments and literature: The riparian vegetation is usually evergreen (Mushitu). In Nigeria (Mambila Plateau), Hepper (1966) found M. buchananii along the steeper less accessible streams with Ilex, Salix, Syzygium, Cyathea, Anthocleista, Bridelia, Canthium, Clausena, Dracaena, Eugenia, Harungana, Hippocratea, Maesobotrya, Neoboutonia, Phoenix, Pseudospondias, Psychotria, and Sorindeia. Hepper suggested that "stream banks form refuges for plants that would not otherwise find suitable habitats on the open cattle grazed Mambila Plateau".

Sillans (1958) recorded a single plant from a bamboo thicket of Oxyanthera abyssinica in the Central African Republic

From our correspondence, a collection was taken from near Rumphi, Malawi. Chapman & White (1970) noted that the South African Podocarpus falcatus occurred along the Rumphi Stream. Fringing forest along streams in the Vipya Plateau region typically have Ilex mitis, Syzygium cordatum, Cussonia spicata, Diospyros whyteana, Erythroxylum emarginatum, Mimusops zeyheri, Parinari excelsa, Podocarpus milanjianus, Trichocladus ellipticus. The eastern Vipya Rift include Uapaca, Adina microcephala, Khaya nyasica and Pterocarpus stolzii.

Unpublished data at the Division of Forest Research, Kitwe indicated that M. buchananii is of local occurrence along streams, swamps, in seasonally flooded grasslands, on Miombo anthills and Limestone Chipya. Its abundance was noted as frequent along streams but mostly occasional in the other ecological formations.

ECOLOGY OF OTHER RELATED SPECIES

M. arguta: Transitional forests, forests at 2,200 meters, and riparian forests (Wilczek, 1960).

M. arbutifolia: Montane sclerophyll forests, wooded and herbaceous savannas (Wilczek, 1960). In Ethiopia, Gillet (1941) list G. arbutifolia from limestone slopes in lower Podocarpus-Juniperus Forest.

Maytenus gracilipes: Riparian forests (Wilczek, 1960). Lind & Morrison (1974) include this in a list of species of the Mpanga Forest, Uganda but this is possibly M. arguta.

M. obscura: No information available.

M. ovata: Ecotone forests between subtropical and temperate types in the mountains of southern India.

M. rothiana: Common shrub in deciduous and evergreen forests along the Western Ghats of India. At elevations from 1,500-3,000 ft. with an annual rainfall from 40-80 inches, the forests and thickets include species of Acacia, Holoptelea, Terminalia, Olea, Mimusops, Sterculia, Bombax, Ficus, Bridelia, Tetrameles, Albizia, Lagerostroemia, Garcinia Strychnos, Strobilanthes, Capparis, Knema, Mezoneuron, Carissa, Grewia, Allophylus, Diospyros, Murraya, Sapium, Ixora, Psychotria, Zanthoxylum, Mallotus, Xeromphis, Erythroxylum, Gardenia, Pavetta, Flacourtia, Adina. In higher rainfall areas, the dominants are Apodytes dimidiata, Antiaris toxicaria, and species of Alstonia, Mammea, Terminalia, Syzygium, Memecylon, Cassine, Polyathia, Diospyros, Eugenia, Canarium, Mesua, Vitex, Aglaia, Artocarpus, Bischofia, Gordonia, Olea. Diptercarps are poorly represented or absent except to the far south where M. rothiana is also less common. (Subramanyam & Nayar, 1974; Santapau, 1967).

M. royleana: From Afghanistan in "Evergreen Sclerophyllous Forests & Woodlands" with Reptonia buxifolia, Olea africana, Acacia modesta, Pistacia khinjuk, Sagertea brandrethiana, Dodonaea viscosa, and Nannorrhaps retchieana (Freitag, 1971). Similarily, in India with also Carissa, Adhatoda & Monotheca (Champion & Seth, 1968).

M. serrata: In Ethiopia Gillet (1941) records G. serrata in evergreen scrub and Juniperus Forest.

DISCUSSION

The former Gymnosporia in Maytenus show a Gondwanaland distribution with significant numbers of species in South Africa, India, Madagascar, and New Caledonia. Raven & Axelrod (1974) concluded that the Celastraceae are easily dispersed over long distances since the family is cosmopolitan in distribution and occurs on the Hawiian Islands. However, an analysis on the distribution of all genera in the family shows centers of diversity that fit well with Good's (1964) classification of phytogeographical kingdoms and subkingdoms. Moreover, there is only one indigenous species (in Perotettia) on the Hawiian Islands; there are more species in Death Valley, California. The possible presence of the Celastraceae in Cretaceous fossils (ex. Wolfe, 1969*) seems evidence for plenty of time to evolve and spread mostly over land. Additionally, the poorly defined generic boundaries in the family suggest a slow rate in evolution

Some of the Eocene-Miocene fossils from central U. S. and parts of Eurasia have been referred to Maytenus and its widespread associates: Ficus, Myrica, Dodonaea, Randia, Zizyphus, Ilex, Rhus, Rhamnus, Myrsine, Diospyros, Berberis, Oncoba, Memecylon, Terminalia, Mimusops, Bombax, Sterculia, Pittosporum (Axelrod, 1975, 1958; Wolfe, 1969). Those from Lake Victoria (Chesters, 1957), Northeast Africa (Aubreville, 1970) and India (Lakhanpal, 1970) belong to families and genera that are today confined mostly to the tropical lowlands. Also, the abundance of the Caesalpinoideae in the Indian fossils and the presence of the Dipterocarpoideae in East and northeast Africa suggest a stronger similarity between the African-Asian lowland floras than that now seen.

The present center of distribution for the M. ovata complex lies in the eastern mediterranean. Their similar ecologies suggest that minor morphological differences were the result of geographical isolation. Increasing aridity during the Neogene (Axelrod, 1975) may have fragmented a widespread occurrence of the M. buchananii ancestor with populations retreating south into Africa, east into Asia, and south into India. Many of these seem to have found refuge in the mountains that formed during the Pliocene and Pleistocene.

*A number of recent papers strongly question the accuracy of many fossil identifications (Wolfe, 1975; Wolfe, Doyle & Page, 1975; Doyle & Hickey, 1976).

Further speciation of the M. ovata complex probably occurred during the Pleistocene as a result of alternating humid and dry climates. As Vuilleumier (1971) indicated, there were ample opportunities for speciation during periods of ecological isolation. Later, when the geographical isolates expanded their range under favorable climates, reunions with hybridation possibly occurred, leading to the present overlap in taxonomy and geography that we now see. Of all species in the M. ovata complex, M. buchananii is the most widely distributed and ecologically variable.

From the literature it is difficult to identify other complexes that might be related to M. ovata. A taxonomic revision of the genus would certainly help. On the basis of phytogeography, one might first look to the West Indies. Many species there do have ovate, coriaceous, entire-serrate leaves but lack spines that have been heavily weighed by taxonomists as a generic character (Gymnosporia). Assuming that Maytenus originated in southern Gondwanaland, then we might look for other lineages in South Africa, Madagascar, Australia, New Caledonia, Fiji or India.

Although M. buchananii is usually reported at the fringes of forests, it is rather spotty in occurrence in comparison to some of its associates like Toddalia asiatica, Scutia myrtina and Harrisonia abyssinica. Evidently, its fringing nature may mean only where natural ecotones exist between forest and woodlands or wooded grasslands. Because the African vegetation has been modified considerably by man (fire, clearing, etc.), present forest margins often do not correspond with those in the recent past; natural ecotones are now rarely seen.

The association of M. buchananii with woodland-forest ecotone correlates well with data presented earlier. The coastal vegetation in East Africa is the result of a complex history that includes forests, woodlands, savannas, and semi-desert elements in sclerophyll bushlands; thus ecotones here are not surprising. At the southern end of Lake Victoria there are sharp gradients of decreasing rainfall which reflects vegetational changes from forests to savannas. In the montane zone, literature and herbarium records sometimes suggest an ecotone - "above Acacia xiphocarpha zone (Eggeling #) or lower Juniperus - Podocarpus forests (Gillett, 1941 - M. arbutifolia). The many records from Zambia are also understandable because in the past (Pleistocene) this area was the southern margins of the tropical lowland forests. Lawton (1963) and Wild (1968) suggest evidence for a Pleistocene continuous forest in Zambia based on the present constituents of relict forests seen mostly along streams. Finally, in central Africa, records of M. buchananii were not collected from the rain forest region but near its extremes.

Criteria for finding an abundance of M. buchananii depends not only on geography, climate and vegetation but also forest reserves that preserve natural vegetation. Along the coast the vegetation is very complex, making it difficult to judge potential localities in forest reserves. The montane

sclerophyll forest and shrublands can be generally deduced from data on rainfall, elevation or topography and soil. The montane sclerophyll forest and scrub are fairly extensive in eastern Africa from southern Tanzania north through Ethiopia but also along the mountains of eastern Zaire including Rwanda, Burundi, western Uganda and southern Sudan.

In summary, if more M. buchananii is needed, I recommend reconnaissance in areas where the following distributions overlap: (1) Maytenus buchananii (2) margins of montane sclerophyll forest of Podocarpus-Juniperus including its seral types and (3) forest reserves.

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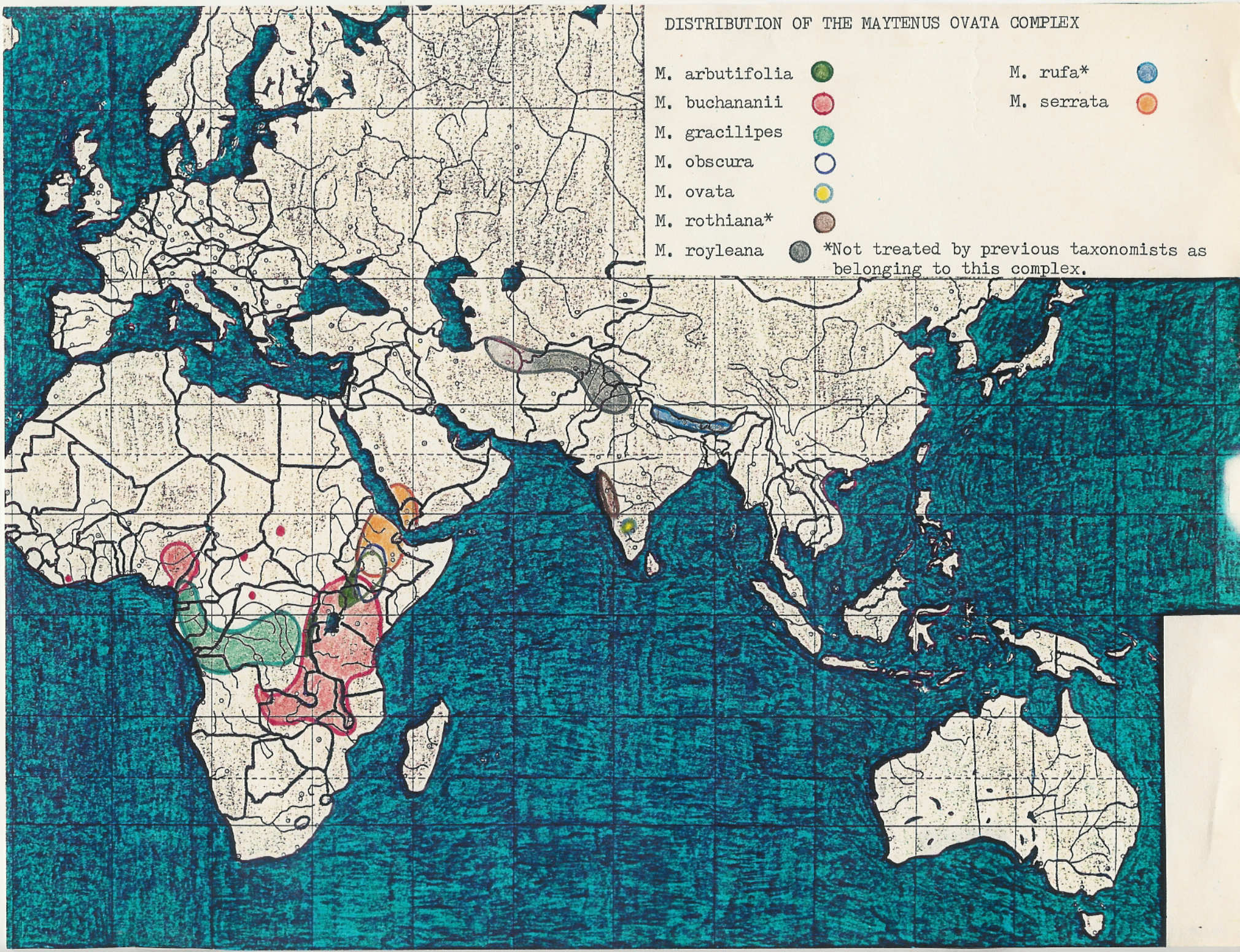
DISTRIBUTION OF THE MAYTENUS OVATA COMPLEX
M. arbutifolia
M. buchananii
M. gracilipes
M. obscura
M. ovata
M. rothiana*
M. royleana
M. rufa*
M. serrata
*Not treated by previous taxonomists as belonging to this complex.