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Floristic relations between eastern Africa and the Mediterranean region with special references to northern Somalia*

Abstract

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The paleogeography, geology and climate of the Horn of Africa are presented in outline, and its floristic affinities with the Mediterranean region are discussed. These relations are particularly strong in northern Somalia, where 40 percent of the genera are in common with the Mediterranean region. The *Buxus hildebrandtii* evergreen shrublands and the *Juniperus procera* forests of the Somali highland are characterized by the presence of a noteworthy element of holarctic, particularly Mediterranean, affinity. Migration in opposite directions must have occurred since late Tertiary times, with extensive exchanges during the Mio-Pliocene and the cooler periods of the Quaternary. Some examples of endemic taxa from northern Somalia with close Mediterranean allies are discussed.

The mountain areas of northern Somalia, Djibouti, Harar, and Socotra are characterized by the presence of a noteworthy element of extra-African, principally Mediterranean and West Asiatic affinity, mixed with the Sudano-Zambezian element. The existence of phytogeographical links between the Horn of Africa and some holarctic regions was first pointed out by Balfour (1898) who recognized the striking relationship of endemic Socotran species of *Cleome*, *Brassica*, *Valerianella*, *Teucrium*, *Haya*, *Cystistemon*, *Securinega*, *Carum*, *Dipcadi*, *Urginea* and *Lepturus* with the Mediterranean taxa. In our century this phenomenon has been noticed and discussed by many plant geographers and taxonomists; Collenette (1931) and Gillett (1941) pointed out the existence of similar links in the flora of northern Somalia and Harar, areas that are situated between 8 and 12 degrees of latitude north, at a distance of 2700 km from the southernmost parts of the Mediterranean basin. These relationships were strenghtened as the floristic investigation of the Horn of Africa progressed. Several new taxa with close Mediterranean allies were discovered and described, and species common to the two areas were found, some of which show large gaps in their distribution (Airy Shaw 1952, Moggi 1965, 1967, Hepper 1972, Hillcoat & al. 1980, Thulin 1989, Thulin & Warfa 1989). Lavranos (1975) underlined the presence, in the northern Somali escarpment, of plant communities "with extensive Mediterranean, Macaronesian and, to a lesser degree, Central European and Himalayan elements, ... associated with mesophytic tropical plants".

The same author (Lavranos 1978) stressed the biogeographical conformity of the

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Arabian and African coasts of the Gulf of Aden, which are separated by a distance of less than 30 km at the Bab El Mandeb strait, and he identified these areas as noteworthy centres of refuge, speciation and irradiation of holarctic taxa. Newton (1980) regarded South West Arabia and the Horn of Africa as a single phytogeographical unit, which he named "Mandeb Domain", and noted the strong Mediterranean and European affinities of some *Sedum* and *Umbilicus* species of this area. Zoogeographical relations of the same kind were pointed out in several groups of insects present in Somalia, e.g., *Brentidae*, *Meloideae* and *Cicindelidae* (Bartolozzi & Osella 1988, Bologna 1988, Cassola & Miskell 1988).

Geological and climatic background

Raven (1979) provided an overview of the geological and biogeographical relations between Eurasia and Africa, going back to the Upper Trias and Lower Jura (200 - 180 million years b. p.) when Africa, joined with South America, separated from the northen continental masses. Judging from plate tectonic studies dealing with the origin and evolution of the Mediterranean basin and the surrounding mountains systems, Europe and Africa were separated by the Tethys Sea during much of the Cretaceous and Early Tertiary, although land bridges existed. Between 148 and 80 million years b. p. Africa rotated towards Europe, its northern part being in contact with emerged lands today situated in the central and western parts of the Mediterranean, such as Sardinia, Italy and probably Spain (Vandenberg & al. 1978). The northward displacement of Africa and consequent convergence with Eurasia caused a compression which gave rise to the Alpine system. During the Early Paleocene Africa and Europe again started to drift apart, although connections through the Iberian and the Italian Peninsulas were maintained according to Hsü (1977). During the Miocene Africa shifted northward again by about 10 degrees, reaching its actual position; in this period, about 17 million years ago, remarkable floristic and faunistic exchanges with Europe took place, probably through the Balkans. The Arabian Peninsula became separated from eastern Africa 10 million years ago, as a consequence of the rifting process which, during the Pliocene, gave origin to the Red Sea. The African and Arabian coasts of the Red Sea are considered by several authors as important Quaternary irradiation routes of holarctic taxa, particularly during the glaciation periods which, in East Africa, were pluvial phases. Wickens (1975) reports two comparatively wet periods, following the last Würm maximum (12000 - 7000 and 6000 - 3000 years b. p.), when the vegetation and climatic belts of Sudan shifted northward by 200 - 400 km from their actual position. The same author considers that the Red Sea is basically characterized by a dry Mediterranean-type climate, which, in periods of increased rainfall or cooler temperature, allowed the penetration of temperate taxa from the Mediterranean southward to the uplands of East Africa, through the coastal Ethio-Sudanian hills. As regards the Horn of Africa, Gillett (1941) explained the scattered distribution of several xerophilous woody plants in north-western Somalia by a hypothetical pluvial phase in recent geological times. During this period the sub-desert formations and the "*Commiphora*-bush *Acacia* open deciduous scrub" were replaced by a more mesophytic vegetation such as the evergreen bushland, that is actually restricted to the mountain areas.

The Somali region comprises a vast lowland, formed by Mesozoic and Cenozoic sediments overlying crystalline basement rocks, gradually rising, beyond 8 degrees of latitude north, into high ground facing the Gulf of Aden and reaching 2408 m in Mt. Surud. This high ground includes several mountain ranges running west to east, mainly formed by Cretaceous and Eocene limestone or sandstone covering more ancient schists,

granites and gneiss. The climate of the mountains close to the Gulf of Aden differs from the typical monsoon climate of the Somali plateau: annual rainfall often exceeds 500 mm and is more or less concentrated, varying from area to area, on the cooler season, October to April. At Sheick (altitude 1430 m) the mean maximal and minimal temperatures are respectively 31°C and 18°C in the warmest month (June), and 21°C and 9°C in the coolest month (February). Lavranos (1978) underlined the climatic effects produced by the passage of the intertropical convergence zone in the northern Somali escarpment and Djibouti mountains, which during the winter, leads to increased rainfall and causes frequent mists. These climatic anomalies, attributed to depressions coming in from the Mediterranean via the Red Sea or the Arabian Gulf, have strong ecological effects and make possible, for instance, the survival of several ephemeral winter plants in the mountain belt of northern Somalia.

Vegetation of the mountain belt in northern Somalia

The climax vegetation of the mountain ranges facing the Gulf of Aden, above 900-1000 m, consists of woody communities that are well differentiated, as regards their structure and floristic composition, from the deciduous *Acacia-Commiphora* bushland present at lower altitudes. On the slopes, between 900-2100 m, the vegetation consists of more or less closed evergreen scrub, often reduced and degraded by anthropic activities. These communities, corresponding to the "Gebirgs-busch" of Engler (1904), to the "fruticeto sempreverde montano" of Pichi Sermolli (1957) and to the "fourré sempervirent" of Schnell (1976), are widespread in the East African massifs. The evergreen bushland, known in several areas of northern Somalia, was described in the Libah Helleh range, Al Medo Hills, Mt. Surud and Duwi by Engler (1904), Collenette (1931), Gillett (1941), Gilliland (1952) and Pichi Sermolli (1957). It grows on brown or red soils and black loams overlying limestone, basalt and other basement rocks, often in areas receiving a certain amount of rainfall and atmospheric humidity during the dry season. In northern Somalia the evergreen bushland shows different facies depending on the altitude, nature of the soil and exposure. It is rich in thornless, sclerophyllous shrubs which form a layer 2-5 m high, while deciduous species are rare. *Buxus hildebrandtii* and *Acokanthera schimperi* are usually dominant, and are associated with other characteristic species such as *Cadia purpurea*, *Dodonaea viscosa*, *Olea chrysophylla*, *Pistacia falcata*, *P. aethiopica*, *Rhus natalensis*, *Commiphora playfairii*, *C. ogadensis*, *Grewia tembensis*, *Ziziphus mucronata*, *Stachys hildebrandtii*, *Osyris lanceolata*, *Euriops arabicus*, *Gnidia somalensis*, and succulents such as *Euphorbia abyssinica*, *Croton cliffordii*, *Aloe abyssinica* and *A. somaliensis*. From the shrub layer scattered trees of *Cussonia holstii*, *Ficus vasta*, *F. populifolia*, *Dracaena schizantha*, *Juniperus procera*, *Mimusops kummel*, *Monotheca buxifolia* and some acacias emerge. Epiphytes are limited to various species of lichens, whereas climbers like *Vigna nilotica*, *Cissus schweinfurthii*, *Rhoicissus revoilii*, *Senecio subscandens* and *Asparagus* sp. are well represented. Information on the herbaceous layer of these communities are scanty: Lavranos (1978) in the Al Medo Hills near Galgallo, observed several winter annuals and perennials belonging to the genera *Trifolium*, *Biserrula*, *Geranium*, *Coronilla*, *Drusa*, *Medicago*, *Papaver*, etc.; Gillett (1941) described a discontinuous grass layer under the evergreen scrub at Duwi Pass, on lava soil. Here are frequent some pteridophytes such as *Cheilanthes coriacea*, *Actiniopteris semiflabellata*, *Selaginella phyllipsiana* (Pichi Sermolli 1963, Bizzarri 1975), and variuos mosses. Above 2000-2100 m the evergreen scrub is replaced by forests of *Juniperus procera*. They are known from areas in which annual rainfall exceeds 600 mm and mists

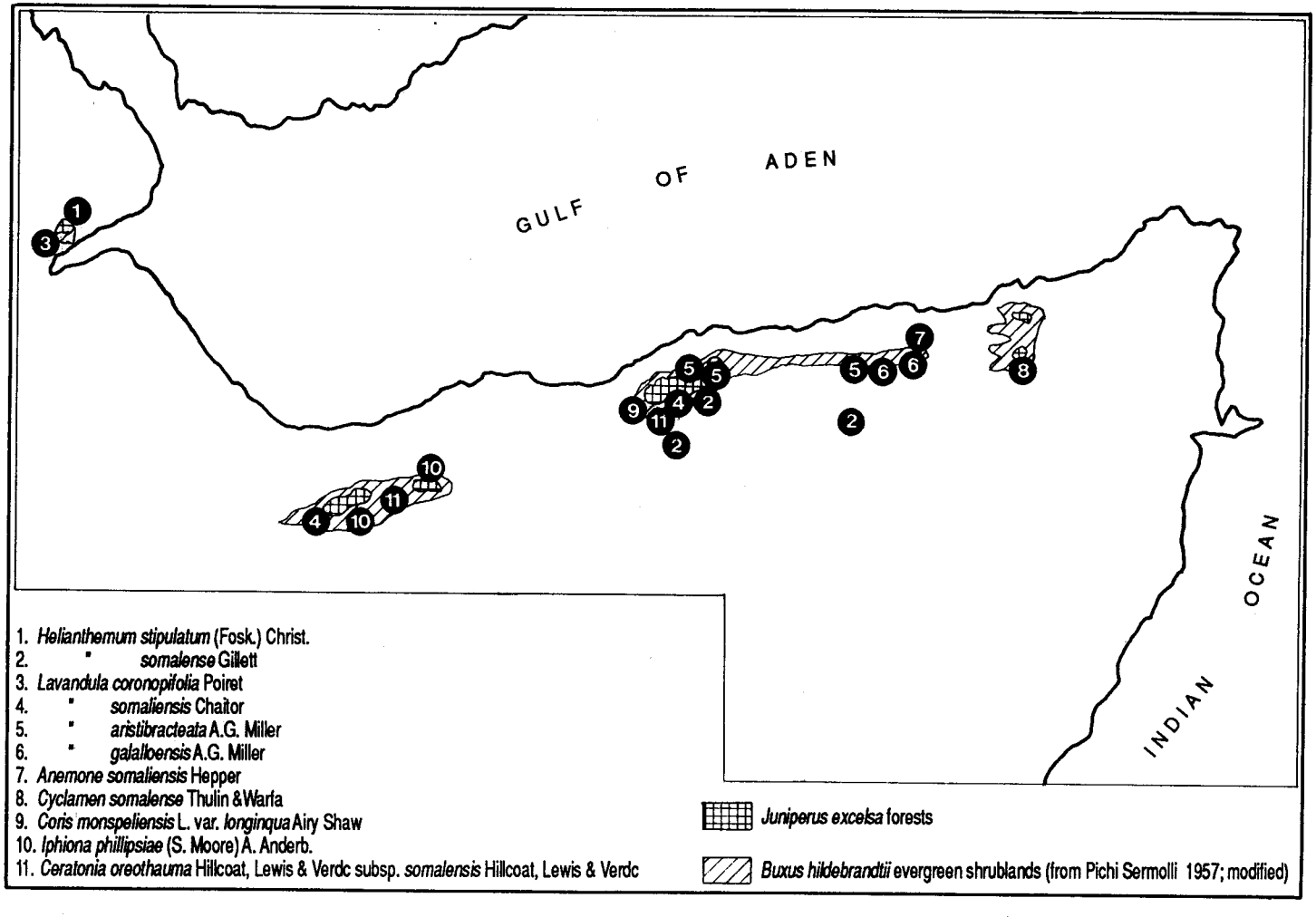
are frequent, on well developed, slightly acid soils. In northern Somalia the *Juniperus procera* forest is present at higher elevations in several mountain ranges like Surud, Libah Helleh, Al Medo, Wagger, Golis, Bahaja, where it is often restricted to a narrow belt. Gillett (1941) described the Libah Helleh forest, with a tree layer dominated by *Juniperus procera* with few other species such as *Monotheca buxifolia* and *Olea chrysophylla*; frequent shrubs are *Rhus natalensis*, *Pittosporum viridiflorum*, *Cadia purpurea*, *Carissa edulis* var. *tomentosa*, *Ephedra alte*, *Teclea nobilis*, *Salvia somalensis*, etc. The herbaceous layer is more continuous and richer than in the evergreen scrub, with pteridophytes, grasses and other perennial and annual species such as *Umbilicus botryoides*, *Galium* cf. *aparine* and *Eragrostis* sp. In the Dalo Forest Airy Shaw (1952) reported the endemic *Viola somalensis*, *Lasiosiphon somalensis* and *Vernonia cryptocephala*.

In these evergreen shrublands and forest several taxa occur that are of great phytogeographical interest because of their holarctic affinities or otherwise peculiar distribution, such as *Anemone somaliensis*, *Cyclamen somalense*, *Coris monspeliensis* var. *longinqua*, *Ceratonia oreothauma* subsp. *somalensis*, *Coronilla somalensis*, *Helianthemum* sp. pl., *Lavandula* sp. pl. and *Hyoscyamus grandiflorus*, some of which are discussed below (Fig. 1).

Floristic affinities

The presence in the mountain areas of eastern Africa of plants of holarctic affinity has been reported by several authors, and by Lavranos (1978) particularly for the area of the Gulf of Aden. There have however been few, if any, discussions of the quantitative incidence, in the whole flora of this area, of taxa with a disjunct occurrence in the northern hemisphere, e.g. in the Mediterranean area. The recent checklist of Somali vascular plants (Kuchar 1986) has made possible a preliminary analysis of the floristic affinities between Somalia and the Mediterranean region. 99 families and 291 genera of phanerogams turned out to be common to the two areas; this represents 67 per cent of the families and 32 per cent of the genera of the total Somali flora. The corresponding values for northern Somalia alone, beyond 8 degrees of latitude north, are 76 per cent and 40 per cent respectively. The latter area, characterized by the predominance of mountain ranges, lacks several predominantly tropical groups, e.g., *Connaraceae*, *Melastomataceae*, *Lecythidaceae* and others; conversely some remarkable families in its flora, such as *Cistaceae*, *Geraniaceae*, *Primulaceae*, *Globulariaceae*, *Linaceae*, etc., are absent further south. Northern Somalia and the Mediterranean Region have several species in common, such as *Cressa cretica*, *Urtica urens*, *Seddera latifolia*, *Blepharis ciliaris*, *Verbena officinalis*, *Peristrophe paniculata*, *Grewia tenax*, *Phyllanthus rotundifolius*, *Ononis sicula*, *Crotalaria aegyptiaca*, *Indigofera articulata*, *Conium maculatum*, *Ferula communis*, *Pimpinella anisum*, *Erica arborea*, *Calotropis procera*, *Pergularia daemia*, *Dicoma tomentosa*, *Pavonia arabica*, *Cordia sinensis*, *Ipomoea cairica*, *Cistanche phelypaea*, *Reichardia tingitana*, etc. Some of these species have a continuous range between East Africa and the Mediterranean Region, often extending to Eurasia and the Middle East, while others show marked disjunctions. Migration trends in the two opposite directions may have occurred during several periods since the late Tertiary, allowing the contact of elements of different historical source. Genera such as *Calotropis*, *Cadaba*, *Balanites*, *Blepharis*, *Volutaria*, *Aerva*, *Fagonia*,

Fig. 1. Distribution of some taxa of phytogeographical interest in northern Somalia and Djibouti. A, *Juniperus excelsa* forests. B, *Buxus hildebrandtii* evergreen shrublands (from Pichi Sermolli 1957; modified)


GULF OF ADEN
INDIAN OCEAN
1. Helianthemum stipulatum (Fosk.) Christ.
2. " somalense Gillett
3. Lavandula coronopifolia Poiret
4. " somaliensis Chaitor
5. " aristibracteata A.G. Miller
6. " galalbensis A.G. Miller
7. Anemone somaliensis Hepper
8. Cyclamen somalense Thulin & Warfa
9. Coris monspeliensis L. var. longinqua Airy Shaw
10. Iphiona phillipsiae (S. Moore) A. Anderb.
11. Ceratonia oreothauma Hillcoat, Lewis & Verdc subsp. somalensis Hillcoat, Lewis & Verdc
Juniperus excelsa forests
Buxus hildebrandtii evergreen shrublands (from Pichi Sermolli 1957; modified)

Grewia, etc., largely represented in the Afroriental flora and confined to the drier parts of the southern and eastern Mediterranean basin, support the hypothesis of recent exchanges between the xerophilous floras of the Sudano-Zambezian region on one side, and northen Africa and the Middle East on the other. Wickens (1975) considered the Nile valley as an important route of northwards penetration of tropical savannah species. Several taxa belong to genera that reach the southern limit of their distribution in northern Somalia, e.g., *Ephedra*, *Coris*, *Lavandula*, *Jurinea*, *Globularia*, *Umbilicus*, *Matthiola*, *Cyclamen*, *Hyoscyamus*, *Iphiona* and *Aeonium* (Fig. 2). Most of them migrated southward during cool periods of the quaternary trough the Red Sea coasts, via the Arabian swell or the Ethio-Sudanian highlands, while for others, such as *Ceratonia* and *Helianthemum* (Fig. 2) a more ancient presence in this area may be supposed (Gillett 1954, Schnell 1976, Newton 1980, Hillcoat & al. 1980).

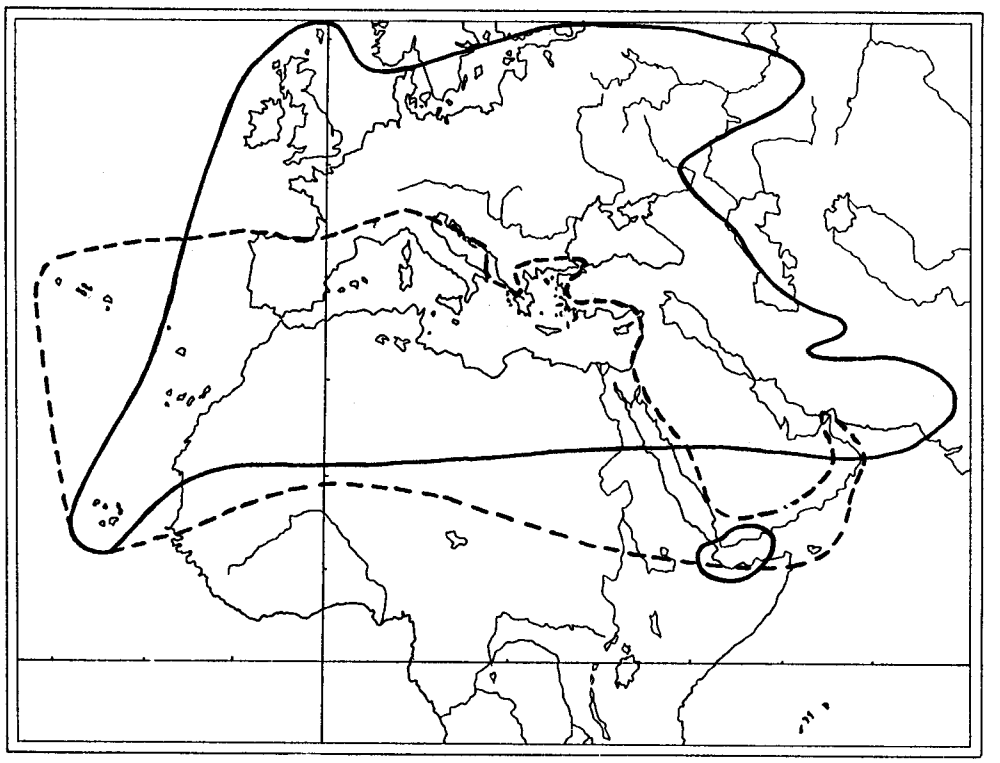


Fig. 2. Distribution of *Helianthemum* (—), and *Lavandula* (- -) in Europe, western Asia and Africa.

The survival of these taxa in restricted mountain areas whose vegetation is characterized by evergreen scrubs of *Buxus hildebrandtii* or by forests of *Juniperus procera* is probably due to the climatic anomaly produced by the intertropical convergence zone, which along the north-facing slopes of the Somali escarpment causes winter rainfall. Various other genera widespread in the Mediterranean and northern temperate regions, like *Urtica*, *Parietaria*, *Silene*, *Stellaria*, *Anemone*, *Brassica*, *Trifolium*, *Coronilla*, *Fumaria*,

Geranium, *Rosa*, *Reseda*, *Salvia*, *Galium*, *Centaurium*, *Plantago*, *Scabiosa*, *Thesium*, *Viola*, *Erica*, *Berberis*, and *Pistacia*, are also represented in the mountain flora of northern Somalia. They often constitute an important element of the afro-alpine and afro-subalpine belts of tropical African massifs at lower latitudes than the area here examined. The ancient Abyssinian mountain ranges constituted the main route of irradiation of these taxa into tropical Africa (Schnell 1976). *Juniperus excelsa*, for instance, migrated during the Miocene Pliocene from Asia Minor to Arabia and East Africa, from where it penetrated into the austral parts of the continent (Kerfoot 1975; Fig. 3). According to Kerfoot (1975) *Juniperus procera* is one of the "species" to be referred to "the variable taxon *J. excelsa*", which in his opinion migrated during the Miocene or Pliocene from Asia Minor to Arabia and eastern Africa, from where it penetrated into the austral parts of the continent (Fig. 3). The same age was hypothesized for the irradiation of *Pistacia*, today widespread in tropical Africa southward to Tanzania, and for the relict Mediterranean elements of Tibesti and Hoggar (Hillcoat & al. 1980). A different explanation has been given for the present distribution of the *Ericoideae*, a group of Gondwanian origin widespread in Africa during the drier periods of the Tertiary, currently represented in the Cape Region, in several refuge mountain areas of Tropical Africa, in the Mediterranean and Macaronesian Regions. East Africa has been assumed to be the centre of origin of *Erica arborea*, a species which characterizes the "Ericaceous belt" in many sub-saharian massifs and extends to Tibesti, the Mediterranean basin and Macaronesia .

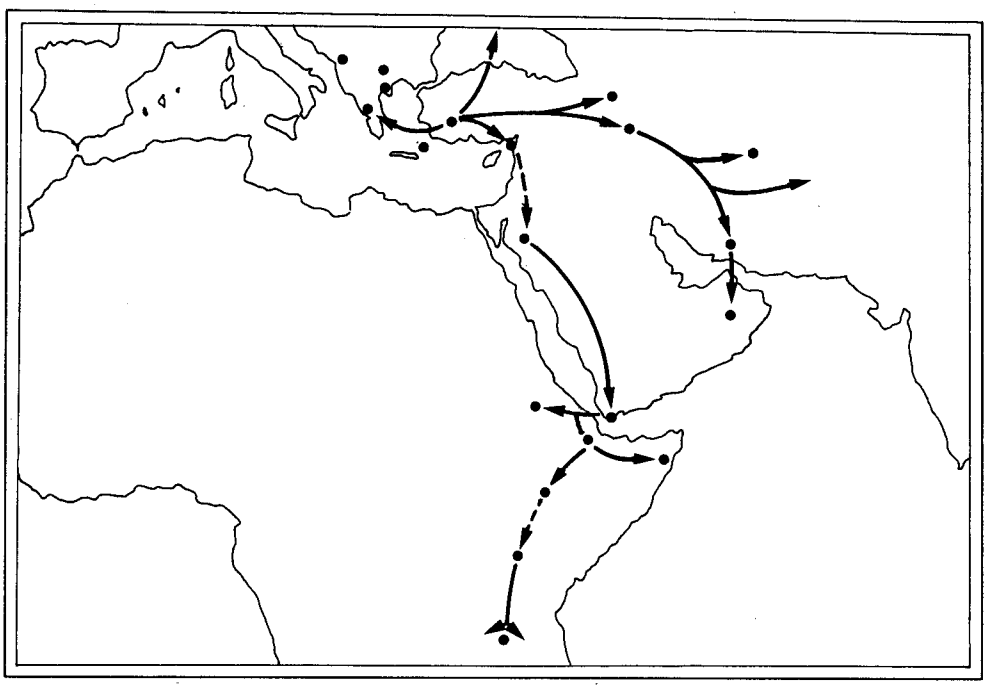
Some case studied

Anemone somaliensis Hepper (1972) is a steno-endemic known from few gatherings collected in the *Buxus*, *Acokanthera*, *Olea* and *Dodonaea* evergreen scrub of the northern slopes of the Al Medo Hills, at 1000-1300 m altitude. In this area Lavranos (1978) reported considerable rainfall and mists during the cooler season, and observed several winter annuals in the herbaceous layer of the bushland. This taxon, included in *A.* sect. *Anemone*, is related to the Mediterranean *A. hortensis* and *A. pavonina*, differing in the larger, divided involucral leaves and in the smaller mauve petals.

Coronilla somalensis Thulin (1989), an annual species, is the only member of the genus *Coronilla* so far known from Somalia. It was described from the Surud Range and Al Medo Hills, at 1150-2050 m altitude, and is close to *C. cretica* L., an East Mediterranean species, from which it differs in the indumentum, stipules, flower colour and shape of the standard. On the basis of the more recent subdivision of *Coronilla*, this taxon could be transferred, together with its Mediterranean allies, to *Securigera* (Lassen 1989).

Ceratonia oreothauma Hillcoat & al., including subsp. *somalensis* Hillcoat & al. (1980), is the second species of *Ceratonia*, previously a monotypic genus, and was recently described from Oman (subsp. *oreothauma*) and northern Somalia (subsp. *somalensis*). *C. oreothauma* is characterized by the multifoliolate leaves with reduced segments, by a lobed and pubescent disk, 3-colporate pollen grains, and smaller fruits and seeds. Subsp. *somalensis* is reported from Sheick and Tabah Gap, on bare limestone ground at 1500-2000 m altitude. The discovery of this species, regarded as more primitive than *C. siliqua*, provided new insights into the probable evolution of the genus; its geographical range supports the hypothesis that *Ceratonia*, together with *Olea*, *Myrtus*, and *Laurus*, is a relict of an ancient xeric Indo-Malesian flora of the Tethys coasts (Zohary

1973). The thermophilous, autumn-flowering *C. siliqua*, today widespread in the Mediterranean Region, may have differentiated in the Arabian area from the original stock of the genus, as had been hypothesized by Schweinfurth with reference to wild populations in the Yemen.

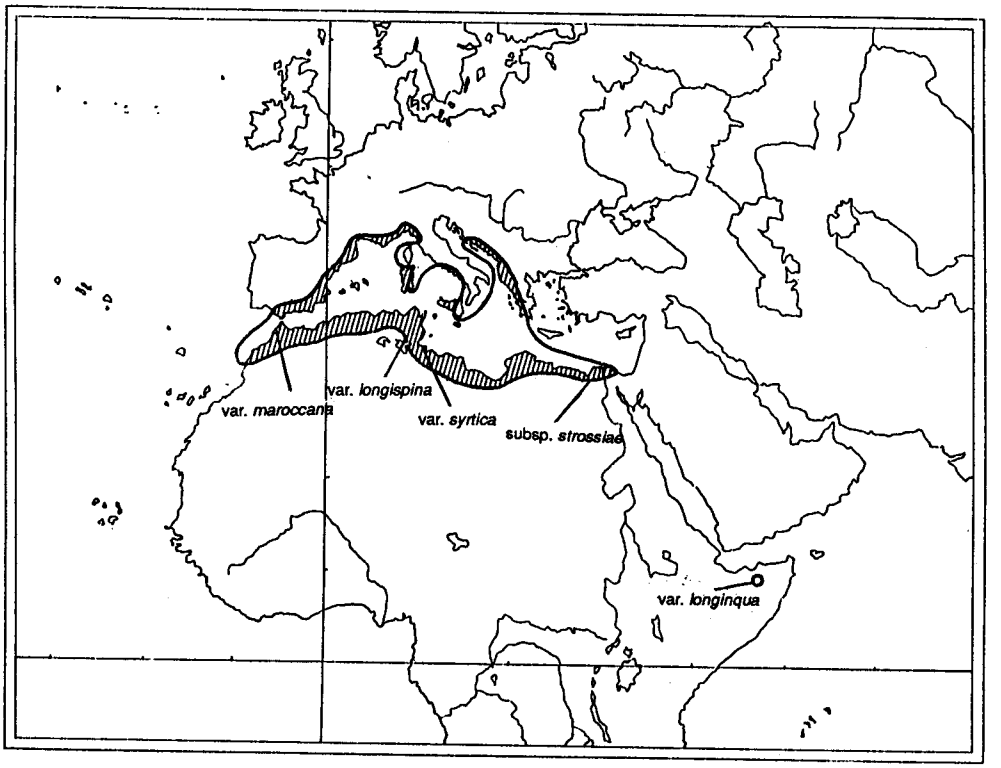


3. Probable irradiation routes of *Juniperus excelsa* during the Miocene and Pliocene (from Kerfoot 1975).

Helianthemum somalense Gillet (1954) was described from northern Somalia, which constitutes the southernmost extreme of the range of the genus in Africa (Fig. 2). *Helianthemum* is represented in northern Somalia by some endemics, as the genus *H. humile*, *H. cylindriflorum*, *H. hadedense* and *H. somalense* (Verdcourt 1966, Thulin 1983-84), while *H. stipulatum*, reported from Djibouti, is also found in the Mediterranean Region and in the Saharian massifs. *H. somalense*, belonging to *H.* sect. *Eriocarpum*, is remarkable because of its taxonomic isolation and its adaptation to arid tropical conditions. Gillett considered this plant as a relict taxon testifying the presence of *Helianthemum* in tropical Africa previous to the holarctic irradiations that occurred during the ice age.

Coris monspeliensis L. var. *longinqua* Airy Shaw (1952) was described on specimens collected by Collenette and Gilliland in the *Juniperus procera* forests of the Surud Range, above 2000 m altitude (Bizzarri 1970). The distance between this locality in the Horn of Africa and the closest localities of the main geographical range of *Coris monspeliensis*, in Egypt, is about 2700 km (Fig. 4). The new taxon, showing pink-purple pigmentation, reduced corolla and subglobose calyx, is similar to var. *maroccana* f. *denticulata*, found at the opposite end of the distributional range of *Coris*.

Cyclamen somalense Thulin & Warfa (1989), a steno-endemic described from the Al Miskat Mts., is the only member of the genus known from tropical Africa. *C. somalense* grows in the north-exposed limestone slopes at 1250 - 1600 m altitude, with rainfall and mists concentrated on the cooler season. This species is closely related to the Mediterranean *C. persicum*, differing in the size and shape of the tubers and leaves, and in the shorter pedicels and smaller flowers. Grey-Wilson (1988) hypothesized that *C. somalense* is a high polyploid, $2n = 72$ or higher, while the chromosome number of *C. persicum* is $2n = 48$.



4. Distribution of *Coris monspeliensis* L.

Conclusions

The present contribution confirms the existence of strong biogeographical links between the Horn of Africa and the Mediterranean region. Phytotaxonomic and floristic research carried out during the last decades in northern Somalia has contributed to strenghtening these relations through the description of taxa such as *Ceratonia oreothauma* subsp. *somalensis*, *Coris monspeliensis* var. *longinqua*, *Anemone somaliensis*, *Cyclamen somalense*, etc. It is remarkable that most of the taxa examined occur in the upper

vegetation belts of the Somali escarpment, under climatic conditions anomalous for tropical Africa. Ecological, palynological and citogenetic investigations might add substantially to our understanding of the history of this flora.

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References

Airy Shaw, H. K. 1952: *Coris* (*Primulaceae* ?) in Somaliland. — Kew Bull. **6:** 29-31.
Balfour, I. B. 1898: Botany of Socotra. — Edinburgh.
Bartolozzi, L. & Osella, G. 1988: Notes on the distribution of the Somalian *Brentidae*. — Abstr. 27. Congr. Soc. Ital. Biogeogr. Firenze.
Bizzarri, M. P. 1970: Adumbratio Florae Aethiopicae. 21. *Primulaceae*. — Webbia **24:** 635-698.
— 1975: Adumbratio Florae Aethiopicae. 27. *Selaginellaceae*. — Webbia **29:** 545-594.
Bologna, M. A. 1988: Zoogeography of *Meloideae* (Coleoptera) from Somalia. — Abstr. 27. Congr. Soc. Ital. Biogeogr. Firenze.
Cassola, F. & Miskell, J. 1988: Somaliantiger beetles: Faunistic and biogeography (*Coleoptera, Cicindelidae*). — Abstr. 27. Congr. Soc. Ital. Biogeogr. Firenze.
Collenette, C. 1931: North-eastern British Somaliland. — Bull. Misc. Inform. **1931:** 401-414.
Engler, A. 1904: Über die Vegetationsverhältnisse des Somalilandes. — Sitzungs-Ber. Künigl. Preuss. Akad. Wiss. **10:** 355-416.
Gillet, J. B. 1941: The plant formations of western British Somaliland and the Harar Province of Abyssinia. — Bull. Misc. Inform. **1941:** 37-199.
— 1954: The genus *Helianthemum* (*Cistaceae*) in Somaliland.— Kew Bull. **9:** 493-494.
Gilliland, H. B. 1952: The vegetation of eastern British Somaliland. — J. Ecol. **40:** 91-124.
Grey-Wilson, C. 1988: The Genus *Cyclamen*. — Kew.
Hepper, F. N. 1972: A new species of *Anemone* (*Ranunculaceae*) from Somalia. — Kew Bull. **26:** 57-58.
Hillcoat, D., Lewis, G. & Verdcourt, B. 1980: A new species of *Ceratonia* (*Leguminosae, Caesalpinioideae*) from Arabia and Somali Republic. — Kew Bull. **35:** 261-271.
Hsü, K. J. 1977: Tectonic evolution of the Mediterranean basins. — Pp. 29-75 in: Nairn, A. E. M., Kanes, W. H. and Stehli, F. G. (eds.), The ocean basins and margins, **4A**. — New York.
Kerfoot, O. 1975: Origin and speciation of the *Cupressaceae* in sub-saharan Africa. — Boissiera **24:** 145-150.
Kuchar, P. 1985: The plants of Somalia: an overview and checklist. — CRDP Techn. Rep. **16**. — Mogadishu.
Lassen, P. 1989: A new delimitation of the genera *Coronilla, Hippocrepis*, and *Securigera* (*Fabaceae*). — Willdenowia **19:** 49-62.
Lavranos, J. J. 1975: Note on the northern temperate element in the flora of the Ethio-Arabian region. — Boissiera **24:** 67-69.
—, 1978: On the Mediterranean and western Asiatic floral element in the area of the Gulf of Aden. — Bot. Jahrb. Syst. **99:** 152-167.
Moggi, G. 1965: Osservazioni tassonomiche e corologiche sulle *Hesperideae* (*Cruciferae*). — Webbia **20:** 241-273.
—, 1967: Note di floristica africana. III. Altri ritrovamenti di *Helianthemum stipulatum* nella costa dei Somali. — Webbia **22:** 527-530.
Newton, L. E. 1980: Phytogeographical associations of the succulent plant flora of South-West

Arabia and the Horn of Africa. — Nat. Cact. Succ. J. **35(4):** 83-88.
Pichi Sermolli, R. E. G. 1957: Una carta geobotanica dell'Africa orientale (Eritrea, Etiopia, Somalia). — Webbia **13:** 15-132.
— 1963: Adumbratio Florae Aethiopicae. 10. *Actiniopteridaceae.* — Webbia **17:** 317-328.
Raven, P. H. 1979: Plate tectonics and southern hemisphere biogeography. — Pp. 3-24 in: Larsen, K. & Holm-Nielsen, L. B. (eds.), Tropical botany. — Chatham.
Schnell, R. 1976: Introduction à la phytogéographie des pays tropicaux. (La flore et la vegetation de l'Afrique tropicale, **4**). — Paris.
Thulin, M. 1983-1984: A new species of *Helianthemum* (*Cistaceae*) from N Somalia. — Garcia de Orta, Sér. Bot., **6(1-2):** 69-72.
— 1989: New or noteworthy species of *Leguminosae* in NE tropical Africa. — Nord. J. Bot. **8(5):** 457-488.
— & Warfa, A. M. 1989: *Cyclamen* (*Primulaceae*) in Tropical Africa. — Pl. Syst. Evol. **166:** 249-252.
Vandenberg, J., Klootwijk, C. T. & Wonders, A. A. H. 1978: Late Mesozoic and Cenozoic movements of the Italian Peninsula: further paleomagnetic data from the Umbrian sequence. — Geol. Soc. Amer. Bull. **89:** 133-150.
Verdcourt, B. 1966: The family *Cistaceae* in Tropical Africa. — Bol. Soc. Brot., Sér. 2, **40:** 55-61.
Wickens, G. E. 1975: Changes in the climate and vegetation of the Sudan since 20000 B.P. — Boissiera **24:** 43-65.
Zohary, M. 1973: Geobotanical Foundations of the Middle East. — Stuttgart.

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