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Mediterranean lichens in the tropics: lichens of the mist oasis of Erkwit, Sudan

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Abstract. From the mist oasis of Erkwit (Red Sea coastal plain of Sudan) 25 epiphytic lichen taxa are reported, probably the first lichen floristic report for the country. Most species encountered are widespread in warm and dry areas worldwide, while a few have their center in the Mediterranean region and document a Mediterranean element in this tropical region.

Introduction

Sudan, Africa's largest country, is located in the northeast of the continent. It is about 1,270 miles (2,040 km) long from north to south and about 980 miles (1,577 km) at its widest part from west to east. Five principal vegetation zones can be distinguished: (a) desert, north of 17° N, with mean annual rainfall of less than 2 inches (50 mm); (b) semi-desert *Acacia* scrub and short grassland, 14-17° N, with mean annual rainfall of 2-8 inches (50-200 mm); (c) low woodland, 10-14° N, with mean annual rainfall of 8-30 inches (200-700 mm); (d) deciduous high woodland savanna, 5-10° N, with mean annual rainfall of more than 50 inches (1,250 mm) (Lebon 1965). Within the semi-desert vegetation zone, the Red Sea coastal plain takes a special position, being characterized by halophytic vegetation with *Avicennia marina*, *Halopeplis perfoliata* and *Zygophyllum coccineum* (Fig. 1).

The generally dry climate is probably responsible for a reduced lichen flora. In fact, very little is known about this flora, and Sudan seems to be among the last countries in the world for which no published lichen floristic lists exist. The surrounding countries also are very poorly known lichenologically (e.g., Somalia, Alstrup & Aptroot 1994).

The oldest report of lichens from Sudan we could find was a treatment by Müller Argoviensis (1879) of collections made by Schweinfurth. The text mentions about 10 taxa from "territorium Djur" and "territorium Dar-Fertit" and includes descriptions of some new taxa: *P*armelia *abyssinica* Kremp. var. *nuda* Müll. Arg., *Pyxine meissneri* Tuck. var. *endoleuca* Müll. Arg. and var. *sorediosa* Müll. Arg.,

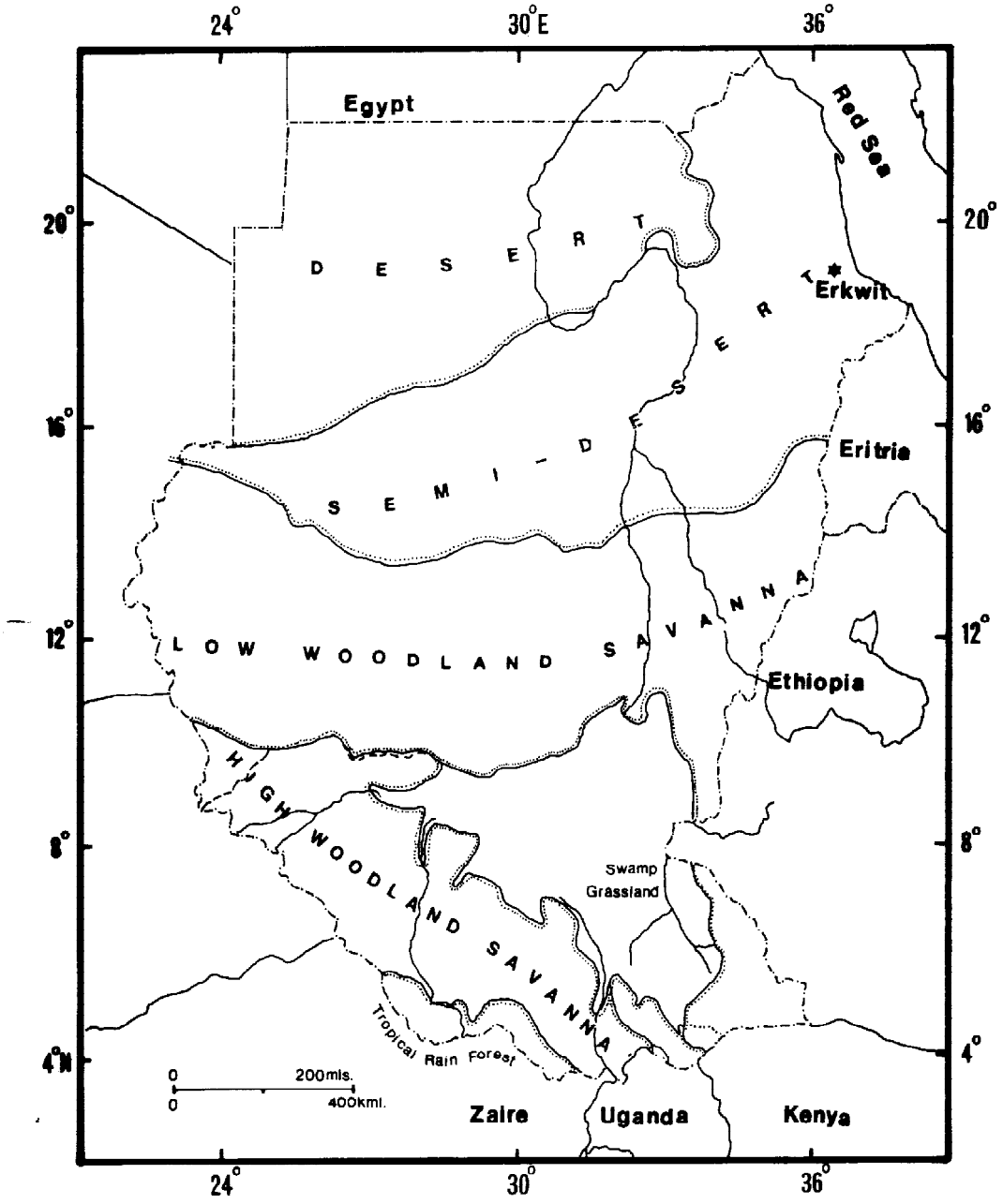

Fig. 1. Sudan with its five principal vegetation zones and the position of Erkwit.

Lecanora subfusca Ach. var. *ferax* Müll. Arg. The first was later given species rank (Müller Arg. 1880) as *Parmelia africana* Müll. Arg. and is now considered as a synonym of *Parmotrema andinum* (Müll. Arg.) Hale (Hale 1965). The second is now treated as a synonym of *Pyxine petricola* Nyl. (Swinscow & Krog 1975). The next publication to include lichens from Sudan is probably Motyka (1936-1938), where about a dozen species of *Usnea* are mentioned. Dodge in his survey of tropical African lichens (1953-1971) adds a few more *Usnea* records (Dodge 1956, 1957) and includes the earlier reports. The only recent record found during the preparation of this text was of *Tornabea scutellifera* (Nimis & Tretiach 1997: 224): an uncertain dot on the distribution map of this species seems to be situated in Sudan.

The study area of this paper, Erkwit, is situated in the coastal plain of NE Sudan, co-ord. 18° 46' N, 37° 07' E. It is a small, green, bowl-shaped plateau of 7 x 5 km with an altitude of 600 to 1200 m. It is unique in its climate and vegetation, which differ strongly from the surroundings. The combination of its altitude, its physiography and its proximity to the Red Sea (45 km) gives it two rainy seasons, one in winter and one in summer. Phytogeographically the area is intermediate between the Mediterranean and the East African highland floras and has links with both (Bullela and Ingrouille 1989). Mists are a characteristic and frequent feature in the area and form a good source of water for plants and lichens.

On the basis of the dominant plant species present in Erkwit, Kassas (1955) distinguished five vegetation zones. But during the drought period of the late seventies and early eighties the flora impoverished and the zones became less distinct. After the end of the drought period in the late eighties, more plants are reappearing in the area.

The scarce investigations done in Erkwit so far have already shown that its vegetation is of great importance as a relict of an ancient vegetation that deserves conservation (Bullela & Ingrouille 1989). It is also a very important source of food, forage and medicinal plants for the poor people living in the area and their sheep, camels and goats.

Lichens (except for the genus *Usnea*) have never been studied or reported from the area, yet they are of vital importance to the people of Erkwit where they are used as medicine, food, cosmetics, perfumery and traditionally offered as gifts during wedding ceremonies.

Materials and methods

The investigated samples were collected by the first author in December 1985 and air-dried. Identifications were based on morphological analysis using stereomicroscope and compound microscope.

Results

A survey of the investigated trees and their elevations is presented in table 1. On these trees, 25 taxa of lichens were recognized, see table 2. These belong to 19 genera, while 15 were identified to species level.

The species marked with § concern small, fragmentary specimens of occasionally observed, crustose lichens. Since the taxonomy of crustose lichens in areas like the Sudan is poorly known, it was not possible to identify this material further. Underlined are the samples which are kept in herbarium B; the remainder is to be found as additions in these samples.

Discussion and conclusions

Because the investigation area lays within the Tropics, an essentially tropical lichen flora is to be expected. Indeed, a comparison with the macrolichen flora of tropical East Africa (Swinscow & Krog 1988) shows that 10 of the 12 macrolichens from Erkwit are equally present more southward. The exceptions are *Parmelina tiliacea* and *Tornabea scutellifera*. The former is widespread in Europe and northern Africa, extending southeastward into Asia until Kashmir (Hale 1976). The latter has a disjunct distribution in cloudy, more or less dry areas in Europe and Northern Africa, the Californian coast and the pacific coast of Peru and Chile, and avoids the

Table 1. Lichen samples, altitude and host trees

Sample No.	Altitude (m)	Associated tree
1	800	*Acacia tortilis* (Forssk.) Hayne
6	1000	*Maytenus luteola* (Delile) F. W. Andrews
7	1000	*Euclea schimperi* (A. DC.) Dandy
8	1200	*Euclea schimperi* (A. DC.) Dandy
9	1200	*Diospyros mespilitiformis* Hochst. ex A. DC.
10	1200	*Euphorbia abyssinica* J. F. Gmel.
11	800	*Maytenus luteola* (Delile) F. W. Andrews
13	600	*Maytenus luteola* (Delile) F. W. Andrews
15	1000	*Euclea schimperi* (A. DC.) Dandy
16	1000	*Euclea schimperi* (A. DC.) Dandy
17	600	*Acacia tortilis* (Forssk.) Hayne
18	800	*Euphorbia abyssinica* J. F. Gmel.
19	800	*Acacia tortilis* (Forssk.) Hayne

Table 2. List of observed species

Bacidia§	17
Caloplaca§	7
Caloplaca§	19
Heterodermia diademata (Tayl.) Awas.	6, 7, 8, 9, 10, 13, 15b, 16b
Heterodermia leucomela (L.) Poelt	7, 8a, 13a, 16
Hyperphyscia syncolla (Nyl.) Kalb	1, 17, 19
Lecania§	13
Lecanora horiza Ach.	6, 7b, 11, 13, 16
Lecanora flavidomarginata Bouly de Lesd.	8, 9, 10, 15, 16
Lecanora§	1, 18
Lecidella§	8, 16
Lepraria§	9, 13, 16
Parmelina tiliacea (Hoffm.) Hale	7, 10a, 15a
Parmotrema austrosinense (Zahlbr.) Hale	1a
Pertusaria§	10
Phaeophyscia hispidula (Ach.) Moberg	8b
Physcia aipolea (Humb.) Fürnr.	7a, 8c, 13
Physcia biziana (Massal.) Zahlbr.	1, 7
Physcia§	9, 10, 13, 15, 16, 17
Pyxine cocoes (Sw.) Nyl.	19
Rinodina§	1
Teloschistes chrysophthalmus (L.) Th. Fr.	11a, 16
Tornabea scutellifera (With.) J. R. Laundon	7, 11, 13b, 16, 18
Usnea complanata (Müll. Arg.) Mot.	16a, 19a
Xanthoria parietina (L.) Th. Fr.	7, 17, 18, 19

tropics (Nimis & Tretiach 1997). Both can be considered as representatives of a Mediterranean element in the lichen flora of Erkwit. The floristic affinity with the Mediterranean Basin can be further demonstrated by a comparison with the recent lichen list for Italy (Nimis 1993). This shows that 10 of the 15 fully identified species are known from that Mediterranean country. However, it concerns mostly species with a wide distribution in warm and dry areas worldwide, which are not restricted to the Mediterranean.

The strong representation of the lichen families Physciaceae (genera *Heterodermia*, *Hyperphyscia*, *Phaeophyscia*, *Physcia*, *Pyxine*, *Rinodina*, *Tornabea*) and Teloschistaceae (genera *Caloplaca*, *Teloschistes*, *Xanthoria*) indicate a eutrophication of the tree bark. This is a common phenomenon in dry areas, caused by intense cattle grazing and dust. It affects all trees, and this probably explains why there is little host specificity or elevation preference in the sampled lichens. The number of lichen species per tree ranges from 2 to 10, and the more frequent taxa have been found on most tree species. Only *Acacia tortilis* seems to have a somewhat different flora, in particular *Hyperphyscia syncolla* shows a preference for this tree. Some preference for lower elevations is indicated for *Hyperphyscia syncolla*, while *Parmelina tiliacea* seems to prefer higher elevations. The other species have either a wide altitudinal range or are known from few samples (Table 2).

The dominance of foliose and fruticose species and the scarce representation of crustose lichens in the list suggest that the lichen flora is incompletely known and that in particular more crustose species can be expected.

For a comparison with similar habitats in other parts of the world, the best information is available from the fog oasis of Fray Jorge National Park, Chile. Follmann & Redón (1972) present a lichen list of this area, while Redón & Lange (1983) treat ecological aspects of its lichen vegetation. With about 120 epiphytic lichen species this area appears to contain a much more diverse lichen flora than Erkwit, including endemic taxa. Several causes seem available to explain this difference. 1. The search effort at Erkwit was smaller and the inventory is probably much less complete, cf. preceding remark. Even an endemic component may show up in Erkwit after further investigations, because it is still present in the lichen flora of the nearby coastal area of the Arabian Gulf, e.g., on Socotra (Mies & Printzen 1997). 2. A more intense human interference may have reduced the lichen flora of the area. 3. A very probable cause is also, that the Chilean fog oases receive more humidity than Erkwit. This is indicated by the presence in Fray Jorge of many humidity-demanding lichens like Stictaceae, Collemataceae, which are absent from Erkwit. 4. Moreover the area is situated at a much higher latitude, 30° S. From more northerly mist oases in Chile, which would be more comparable to Erkwit, no sufficiently detailed information is available.

At species level there is only a small similarity with the Chilean fog oasis: three rather ubiquistic species are shared, *Heterodermia leucomela*, *Teloschistes chrysophthalmus*, and the above-discussed *Tornabea scutellifera*. A notable difference is the rich representation of the genus *Ramalina* in Chile. This genus tends to be diverse in arid coastal areas with abundant fog, e.g. in Baja California, Chile and the Canary Islands. Its absence in Erkwit would be surprizing and is probably due to incomplete collecting. Another conspicuous difference, the rich representation of the genus *Pseudocyphellaria* in Chile reflects the importance of the southern temperate element in its lichen flora.

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