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Dedicated to Prof. dr. LJUDEVIT ILIJANIĆ on the occasion of his 70th birthday.

Some observations on the plant communities of Dungul Oasis (Western Desert, Egypt)

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During a visit to the Dungul Area (Western Desert, SW Egypt), several vegetation records were made. The number of species per plot (25 m^2) was extremely low: mainly monospecific stands were found. A combination of two (or even three) species was reached either in the transition belts of herbaceous species or of one tree species with understory plants. Special attention was paid to the rare palm species *Medemia argun*, endemic to Nubia. A famous old specimen known from literature was encountered in dead state, but several living young specimens were observed.

Key words: Sahara, desert, oasis, vegetation, palm, *Medemia argun*, Nubia, Egypt

Introduction

In the southern part of the Western Desert of Egypt the Nubian Tableland descends to the East in the direction of the Nile Valley near Aswan and Lake Nasser, with a sharp and spectacular escarpment (»Sinn El-Kaddab«) to the Lower Nubian Plain (BUTZER 1965). Within this escarpment, two small, uninhabited oases are situated: Kurkur and Dungul (Fig. 1). In both oases, geological, archaeological and botanical studies have been carried out, but Wadi Kurkur, closer to Aswan (approximately 60 km) has received much more research attention than Dungul (approximately 160 km). As examples, we would like to quote here the following important investigations (where further relevant literature is cited): SHATA (1962), REED (1964), BUTZER (1965), BOULOS (1966), and SHEDED and HASSAN (1998) for Kurkur; ZAHRAN (1968), and BOULOS (1968) for Dungul.

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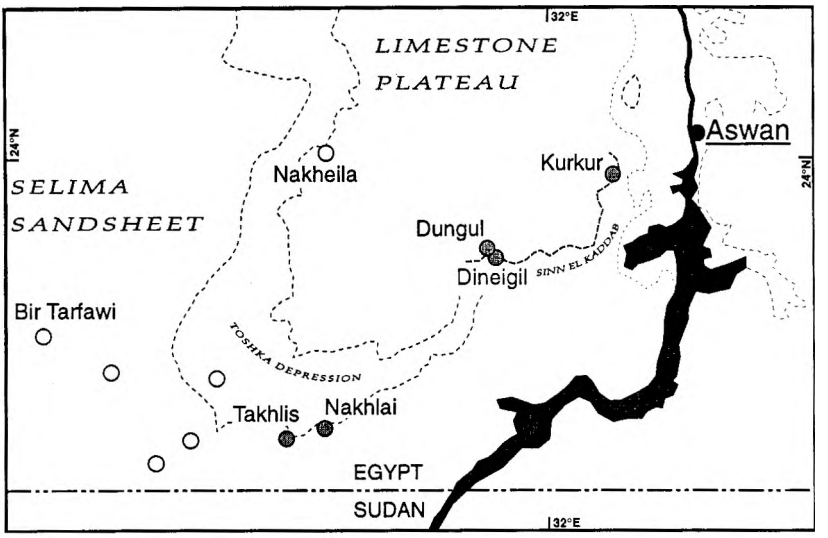

Fig. 1. Map of the Dungul area.

The Dungul Oasis complex consists of two parts: (1) Dineigil Oasis and (2) Dungul Oasis proper (i.e. Dungul South and Dungul North *sensu* ZAHRAN 1968, fig. 2). Dineigil is located at the very edge of the escarpment in a high position at 23°N, 24°6' E, Dungul in the Wadi Dungul already inside the Nubian Tableland (23°26' N, 31°37.3' E) in a lower position (250 m, UHDEN 1930). The geological conditions are described by HENDRIKS *et al.* 1987 (Fig. 11, p. 77), and a litho-stratigraphic section is given by EL SHAZLY *et al.* (1977, plate XXIV). Both Dineigil and Dungul receive their water as a result of the blockage of drainage lines of an artesian aquifer(EL SHAZLY et al. 1977). Soil analyses carried out by ZAHRAN (1968) showed that soils were saline (> 0.5% Cl) under *Tamarix nilotica,* and in the topsoil under *Imperata cylindrica* and *Juncus rigidus,* but practically not saline at all (mostly < 0.1% Cl) under *Stipagrostis vulnerans* and *Alhagi graecorum,* and in the deeper soil layers under *Imperata cylindrica* and *Juncus rigidus.*

Little information was available until ZAHRAN (1968) gave a description of the vegetation. He found in Wadi Dungul the community types of *Salsola imbricata, Tamarix amplexicaulis, Tamarix aphylla,* and *Stipagrostis vulnerans,* in Dungul Oasis the community type of *Imperata cylindrica,* and in Dineigil Oasis the community types of *Alhagi graecorum, Juncus rigidus,* and *Imperata cylindrica.* The highlight of the floristic characters is the occurrence of the palm species *Medemia argun* DC. which grows together with the date palm (*Phoenix dactylifera)* and the doum palm (*Hyphaene thebaica),* and is known in Egypt outside Dungul only from the nearby Nakheila Oasis (BOULOS 1968). It was, however, an important tree in ancient Egypt (TÄCKHOLM and DRAR 1950; BOULOS 1968; SCHOSKE et al. 1992). During a recent visit to the Dungul oases (December 6–8, 1998) we tried to get a first impression as to which combinations of species occurred, and especially which understory plants were combined with the three palm species.

Methods

For vegetation analysis a standard plot size of 25 m^2 was used. As in former investigations (BORNKAMM and KEHL 1990) the shape of the plots could vary according to the shape of the stand, but not the size. This made a direct comparison of the number of species per plot feasible. In each plot the cover (%) of dry and green parts of every species was recorded, likewise the height (dm) of the green parts. The species names follow BOULOS (1995).

Results and Discussion

The main part of the vegetated area is open and is dominated by either *Juncus rigidus* or *Alhagi graecorum*. The records of Dineigil are presented in Table 1. In a few cases, in burnt areas, *Imperata cylindrica* is the most frequent although not the dominant species at present, because above-ground only stubble has survived the disturbance (rec. 1–4). According to the ordinary zonation around wells (KEHL 1987) *Juncus rigidus* grows closest to the water holes, whereas here in an *Alhagi* stand a recently dug water hole shows a seepage of more than 3 m below surface!

Four tree species were observed. *Phoenix dactylifera* was found just becoming established in an *Alhagi* stand, but a mature date grove showed *Imperata* as understory species (Fig. 2). *Acacia raddiana* was accompanied by *Alhagi, Acacia ehrenbergiana* by *Alhagi* and *Imperata. Hyphaene* was found in the juvenile stage in a *Juncus* stand. The large grove of *Hyphaene thebaica* at the Ain El-Gaw spring showed *Sporobolus spicatus* in the ground layer. Here it was already mentioned by ZAHRAN (1968).

Tab. 1. Records from Dungul Oasis. R = number of records; C = total cover (%); N = number of species; l = cover of living, green parts (%): d = cover of dead parts (%); h = height (dm).

	R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	C	60	60	22	70	100	90	80	80	90	90	100	100	100	100	100
	N	1	1	1	1	1	2	1	2	2	2	2	2	1	1	2
Imperata cylindrica	l	30	20	2	20		20		3	3	1	2				
	d	40	40	20	50		30		3	5	1	5				3
	h	12	6	8	7		8		6	8	2	7				
Hyphaene thebaica	l					50	30	50								
	d					50	40	30								
	h					100	120	80								
Medemia argun	l								80	90						
	d								20	10						
	h								80	100						
Phoenix dactylifera	l										75	80				
	d										25	20				
	h										100	110				
Tamarix aphylla	l												70			
	d															
	h												50			
Tamarix nilotica	l												40	100	100	70
	d													10		20
	h												22	60	60	35

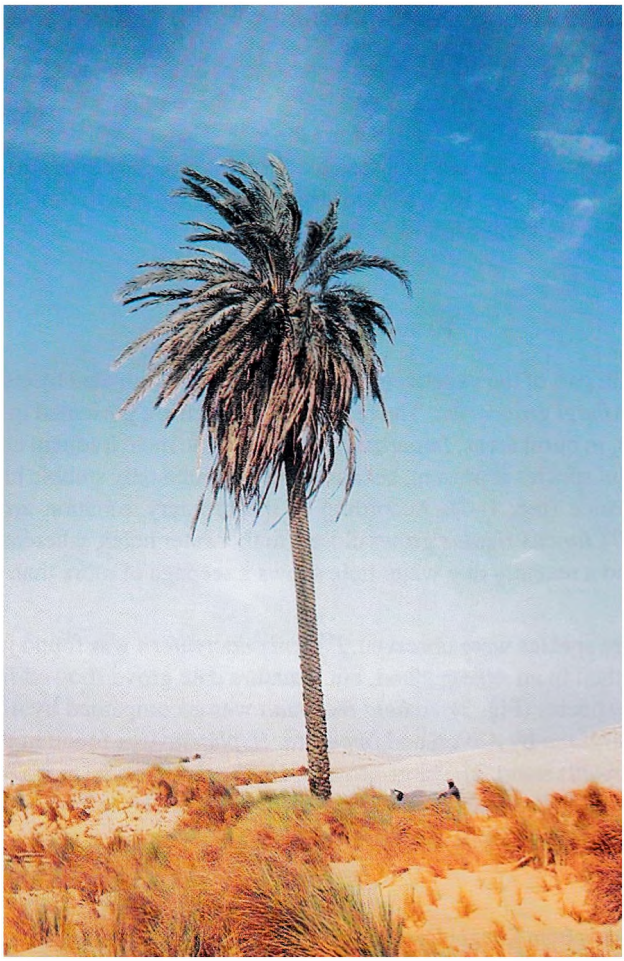

Fig. 2. *Phoenix dactylifera* and *Imperata cylindrica* in Dineigil Oasis

In Dungul we visited Dungul Oasis but not the other parts of the very extended Wadi Dungul. Our records are presented in Table 2. In the Dungul Oasis, *Imperata cylindrica* was the dominant species. Here too, in some burned areas it was still the most frequent species without being dominant. Three tree species were observed, all of them palms. As far as a ground layer was developed it was made up exclusively of *Imperata cylindrica* (Fig. 3). The eastern end of the vegetated area was made up of a very dense scrub of several *Tamarix* species devoid of any herbaceous plants. It seemed that vegetation had not changed very much since the investigation of ZAHRAN (1968).

The Argun Palm needs special comment. The species *Medemia argun* was described by P. G. VON WÜRTTEMBERG in WENDLAND (1881). In taxonomic literature it is sometimes regarded as a member of the genus *Hyphaene: Hyphaene argun* (JACKSON 1893, 1894). The similarity is, indeed, striking. The species was detected in Dungul by Boulos, Täckholm and Zahran in November 1963, and in

Tab. 2. Records of Dineigil Oasis. Abbreviations as in Table 1.

	R	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	C	100	90	90	90	70	17	50	40	90	10	80	100	100	90	80	90
	N	1	2	2	2	2	2	3	2	1	1	2	2	3	3	2	2
Juncus rigidus	l	90	50	45	90	25											
	d	10	20	25		10	15	5									
	h	16	14	16	20	12	0	8									
Imperata cylindrica	l							20	10					3			20
	d							20	10					10	5		20
	h							8	7					8	0		8
Alhagi graecorum	l		5	5		35	1	3	10	75	5	15	0.5	0.5	2		
	d		5	5		5	1	8	10	15	5	15			1		
	h		6	6		6	2	2	2	12	4	3	1	2	1.5		
Phoenix dactylifera	l						5										80
	d						5										
	h						20										150
Acacia raddiana	l											70	100				
	d																
	h											45	80				
Acacia ehrenbergiana	l													100	80		
	d																
	h													70	55		
Hyphaene thebaica	l															80	
	d																
	h															100	
Sporobolus spicatus	l															15	
	d															5	
	h															5	

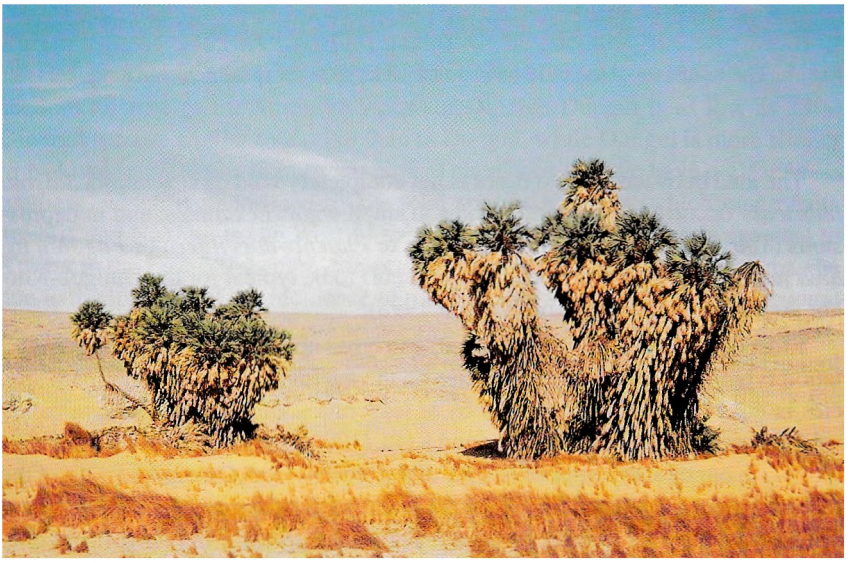

Fig. 3. Two groups of *Hyphaene thebaica* with *Imperata cylindrica.*

Nakheila by Issawy in December 1964 (BOULOS 1968). In 1963 one large tree was developed, surrounded by seven »baby palms« (ZAHRAN 1968). During our visit we counted 37 shoots. One of them, apparently the mother tree, was dead

and broken (Fig. 4); it had reached a height of ca 10 m. Seven other shoots attained a height of > 3 m. Among the largest specimens of them (ca 8 m) were 1 female and 3 males; the remaining 29 shoots were only ca 1–2 m high. As also reported by BOULOS (1968), an enormous number of fruits were lying on the ground.

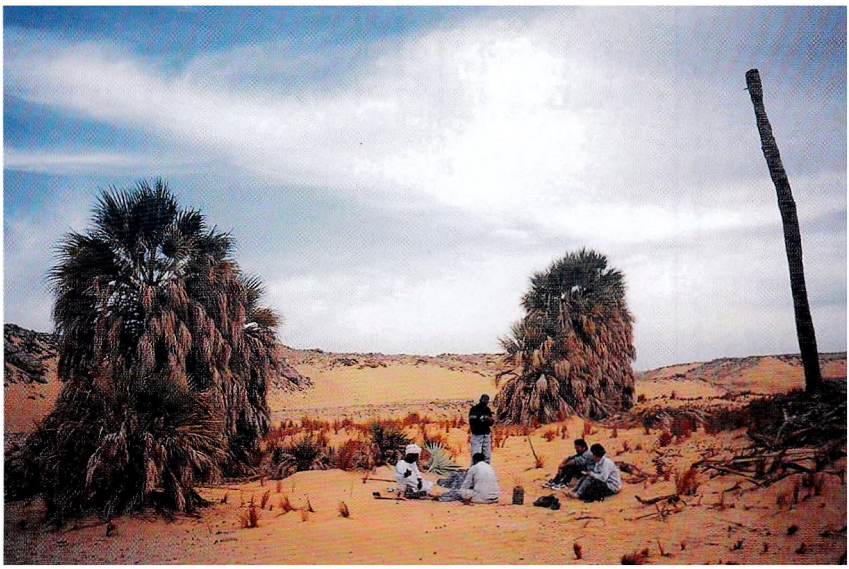

Fig. 4. The remnants of the old *Medemia* tree and younger specimens in Dungul Oasis.

The area between the two oases is not completely void of vegetation. *Salsola imbricata* occurred at favourable sites in small wadis or runnels, and in depressions (Tab. 3). Eventually other species like *Phoenix dactylifera* or *Fagonia indica* may occur. This scarce vegetation seems to be typical for the Dungul–Kurkur area at large (SHEDED and HASSAN 1998).

Most of the species observed are able to build up monospecific stands. Vegetation types with less than two species on the average, where the dominant species is not regularly accompanied by at least one additional species, are called »stands« according to BORNKAMM and KEHL (1990); they are not plant »communities«. In our case this applies to 19% of the records from Dineigil, to 47% of the records from Dungul, and to 67% of the records from the area between the oases. The average species number per plot is 2.1 in Dineigil; 1.5 in Dungul; and only 1.3 in the area in between. A higher number of species (in our records not more than 2 or 3) can be reached in two ways: (1) In the herbaceous vegetation frequently a transition belt is developed between two monospecific stands. (2) In the woody vegetation frequently a tree layer and a field layer are developed, thus creating a savanna-like structure. Further studies are needed to find out how far the performance of species (e.g. cover, height, vitality) in the mixed stands differs from that in the monospecific stands.

Tab. 3. Records from the area between the oases. Abbreviations as in Table 1.

	R	1	2	3	4	5	6	7	8
	C	100	60	95	70	7	10	2	0.5
	N	1	1	1	1	2	2	1	1
Phoenix dactylifera	l	80							
	d								
	h	150							
Salsola imbricata	l		60	95	40	0.1			
	d		10		30	5	10		
	h		10	15	7	7	4		
Fagonia indica	l								
	d							2	0.5
	h							2	2

Already the earlier investigations in small, uninhabited oases of the Western Desert led to the result that every one of them has its peculiar traits (BORNKAMM 1986). Great differences between Dineigil and Dungul were found, with *Acacia* species and relatively large *Alhagi* stands occurring in Dineigil (Tabs. 1, 2), whereas in Dungul in addition to palm groves stands of *Tamarix* woodland are developed, and larger areas are covered by *Imperata cylindrica* (Fig. 3).

This means that–according to the results of the soil analyses by ZAHRAN (1968)–Dungul exhibits a more saline character than Dineigil. Quantitatively, the difference between Dineigil and Dungul can be elucidated by computation of the similarity index (SØRENSEN 1948) of the species lists of the oases. In Table 4 similarity values are presented for Dungul (species list from the present paper included additional species found by ZAHRAN (1968), Dineigil (present paper), Kurkur (SHEDED and HASSAN 1998) and the two neighbouring oases in the Western Desert, Nakhlai and Takhlis (EL HADIDI 1980; BORNKAMM 1986). Taking into account all species the Sørensen value for Dineigil/Dungul is as low as 33%. Dineigil is more similar to Kurkur than to Dungul, while Dungul is more similar to Nakhlai and Takhlis than to Dineigil. This means that we have a clear W–E gradient, which is underlined by the total species numbers, which range from Takhlis and Nakhlai in the West (4 species, comprising 2–3 woody species) to Kurkur in the East (20 species, comprising 6 woody ones). This gradient may be due to the increase of the incidence of rainfall from W to E. Taking into account the woody species only, higher Sørensen values were achieved. Here the similarity between Dineigil and Kurkur amounts to 80%, between Dineigil and Dungul to only 40%. Otherwise no clear differences exist which is probably due to the extremely low number of species involved.

Tab. 4. Floristic similarities according to SØRENSEN (1948) between the Dungul, Dineigil, Kurkur, Nakhlai and Takhlis Oases (in%). Upper half: all species; lower half: woody species only. N = number of species.

	Kurkur	Dineigil	Dungul	Nakhlai	Takhlis	N
Kurkur	x	43	31	17	25	20
Dineigil	80	x	33	17	33	10
Dungul	67	40	x	43	43	8
Nakhlai	50	33	50	x	50	4
Takhlis	67	57	50	33	x	4
	6	4	6	2	3	

The present state of the vegetation is influenced by human activity. As long ago as 1930 UHDEN mentioned several groups of doum palms and some feeble date palms which suffered from charcoal-burning by the Bedouins. Nevertheless HOFFMAN (1979, p. 55, Fig. 14) regarded the vegetation of Dungul as »one of the last remnants of the vegetation that covered Sahara during pluvial periods«. This evaluation stresses the historical, archaeological and ecological importance of the Dungul area. The ecosystems here are rare, to some extent even unique, vulnerable and endangered–typical traits that make protection necessary. In the same way as the need for protection has been expressed for parts of the Eastern Desert (SPRINGUEL 1997), the Dungul–Kurkur area is also very well worth being protected, also at a national scale. A firm basis for the understanding of the ecosystems involved during the process of protection should be obtained by careful studies in the near future

References

BORNKAMM, R., 1986: Flora and vegetation of some small oases in S-Egypt. Phytocoenologia 14, 275–284.

BORNKAMM, R., KEHL, H., 1990: The plant communities of the Western Desert of Egypt. Phytocoenologia 19, 149–231.

BOULOS, L., 1966: A natural history study of Kurkur Oasis, Libyan Desert, Egypt. IV. The Vegetation. Postilla Peabody Museum of Natural History, Yale University (New Haven, Connecticut, USA) 100, 1–22.

BOULOS, L., 1968: The discovery of *Medemia* Palm in the Nubian Desert of Egypt. Bot. Not. 121, 117–120.

BOULOS, L., 1995: Flora of Egypt - checklist. Al Hadara Publ., Cairo.

BUTZER, K. W., 1945: Desert landforms at Kurkur Oasis, Egypt. Ann. Ass. Amer. Geogr. 55, 578–591.

EL HADIDI, M. N., 1980: Vegetation of the Nubian Desert (Nabta Region). In: WENDORF, F., SCHILD, R. (eds.), Prehistory of the Eastern Sahara. Studies in Archaeology, Appendix 5, 345–351. Academic Press, New York.

EL SHAZLY, E. M., ABDEL HADY, M. A., EL KASSAS, A., EL SHAZLY, M. M., ABDEL MEGID, A. A., TAMER, M. A., 1977: Geology and groundwater conditions of Tushka basin area, Egypt, utilizing Landsat satellite images. Remote sensing center, Academy of Scientific Research and Technology, Cairo.

HENDRIKS, S. F., LUGER, P., BOWITZ J., KALLENBACH H., 1987: Evolution of the depositional environments of SE–Egypt during the cretaceous and lower tertiary. Berliner Geowiss. Abh. (A) 75, 49–82.

JACKSON, B. D., 1893: *Hyphaene. Index Kewensis*, part II, 1195. Clarendon Press, Oxford.

JACKSON, B. D., 1894: *Medemia. Index Kewensis*, part III: 182. Clarendon Press, Oxford.

KEHL, H., 1987: Zonation and establishment of vegetation in selected uninhabited Egyptian and Sudanese oases. Catena 14, 275–290.

REED, C. A., 1964: A natural history study of Kurkur Oasis, Libyan Desert, Western Governate, Egypt. I. Introduction. Postilla Peabody Museum of Natural History, Yale University (New Haven, Connecticut, USA) 84, 1–20.

SCHOSKE, S., KREIßL, B., GERMER, R., 1992: »ANCH«. Blumen für das Leben. Pflanzen im alten Ägypten. Staatl. Samml. Ägyptischer Kunst, München.

SHATA, A., 1962: Remarks on the geomorphology, pedology and ground water potentialities of the southern entrance to the New Valley. Part 1. The Lower Nubia area, Egypt, U.A.R. Bull. Soc. Géogr. Egypt 35, 273–299.

SHEDED, M. G., HASSAN, L. M., 1998: Vegetation of Kurkur Oasis in SW Egypt. J. Union Arab Biol., Cairo 6 B, Botany, 129–144.

SØRENSEN, T., 1948: A method of establishing groups of equal amplitude in plant sociology based on similarity of species content. Biol. Skr. K. danske Vidensk. Selsk. 5, 1–34.

SPRINGUEL, I., 1997: Vegetation, land use and conservation in the SE Desert of Egypt. In: BARAKAT, H. N., HEGAZY, A. K. (eds.), Reviews in ecology: Desert conservation and development, 177–206. Metropole, Cairo.

TÄCKHOLM, V., DRAR, M., 1950: Flora of Egypt 2. Bull. Fac. Sci. Cairo Univ. 28, 296–302.

UHDEN, R., 1930: Reise von Debôt in Unternubien nach den Oasen von Kurkur und Dungul. Petermanns Mitt. aus J. Perthes Geogr. Anstalt 76, 184–188.

WENDLAND, H., 1881: Beiträge zu den Borassineen. Botanische Zeitung 39, 91–96.

ZAHRAN, M. A., 1968: Ecological study of Wadi Dungul. Bull. Inst. Désert Egypte 16: 127–143.