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PRESERVING AND RESTORING THE FRANKINCENSE TREE
(*BOSWELLIA SACRA*) AT WADI DOKA:
A WORK IN PROGRESS

Mauro Raffaelli, Marcello Tardelli, Stefano Mosti

INTRODUCTION

Dhofar is one of the regions of southern Arabia where *Boswellia sacra* Flueck. (the frankincense tree) grows. Up to the '70s, the collection and commerce of frankincense represented the main source of profit for the inhabitants of the rural areas of this country. The successive development of the oil and fishing industries caused the shifting of the economical interests towards these new activities and the strong reduction, abandonment even, of the collection and commerce of frankincense.

Frankincense is still a part of the history and culture of Oman, and in this last decade the Office for Cultural Affairs of the Sultanate has been promoting the safeguard and valorisation of the natural, archaeological and historical heritage, focusing this initiative towards the development of scientific and naturalistic tourism that can represent a future additional economical resource.

Among the natural heritage of Dhofar, frankincense holds an important place and therefore the interest in preserving and protecting natural *Boswellia sacra* populations is high.

A first step was taken in 2000 when the wadi Doka area was acknowledged as one of UNESCO's World Heritage sites in Oman, because of the abundant presence of the frankincense tree. In that occasion it was decided to institute a Natural Park in wadi Doka dedicated to frankincense

The wadi Doka Natural Park

In 2001 the wadi Doka area became a Natural Park. Situated in the pre-desertic area right behind the coastal chain, the Park is easily reachable being only 42 km North of Salalah, along the main road to Muscat.

Between 2001 and 2002 the plan of the Park was made (fig. 1); it stretches on a 6-7 km² area at an altitude between 680 and 660 m towards North. The Park is located between 17°19.600'-17°21.500'N and 54°03.000'-54.05.000'E and it includes about 1.300 *Boswellia* plants of which at least 100 are of large size (the biggest in Dhofar) and probably are hundred-year old trees. Some of the oldest ones are up to 4-5(-6) m high with a 20-35(-40) m² crown area¹.

In 2003-2004 the survey of the biggest and oldest *Boswellia* plants (ca. 100) was undertaken, in two

¹ RAFFAELLI, TARDELLI, MOSTI 2003; RAFFAELLI, MOSTI, TARDELLI 2003.

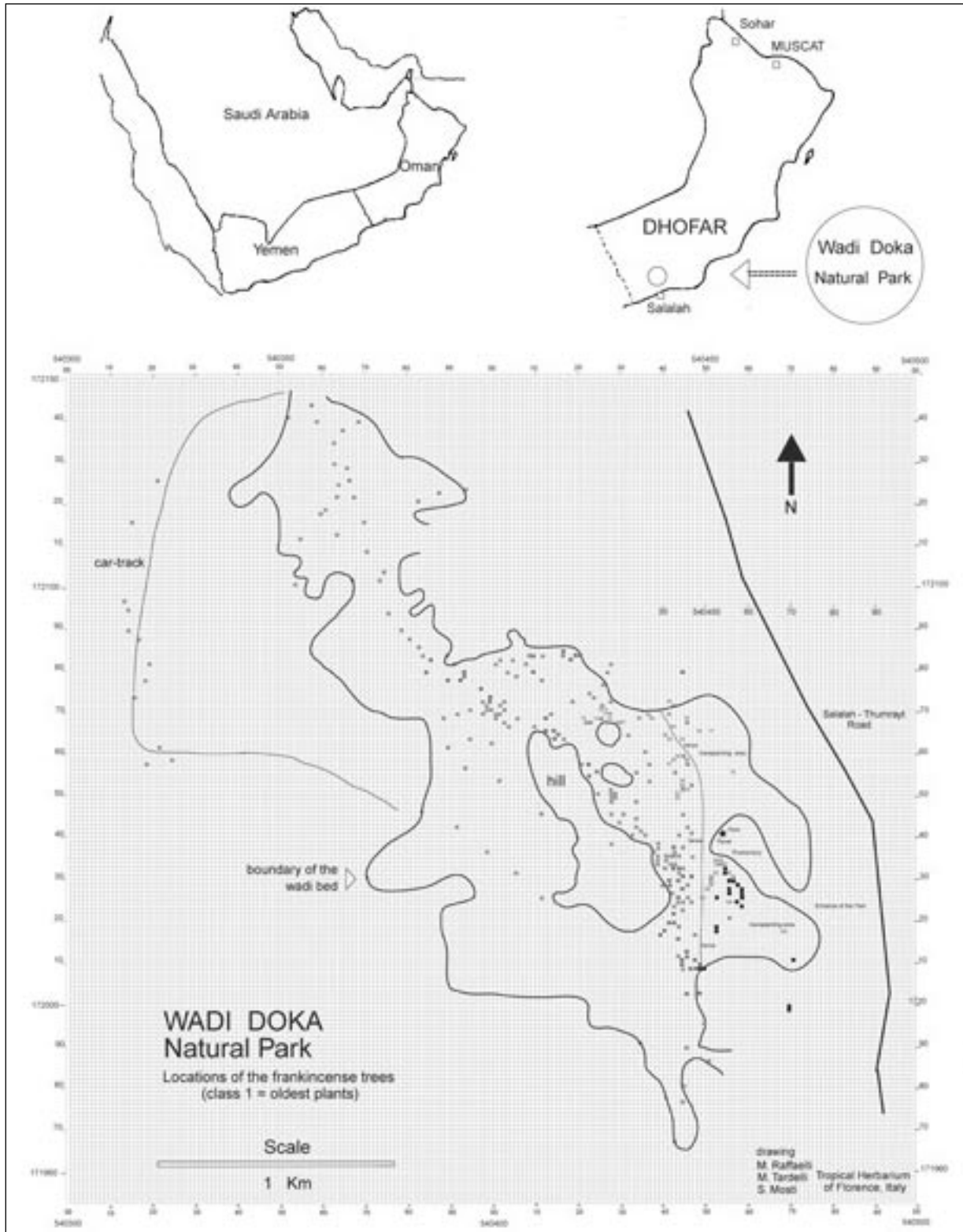


Figure 1 – The boundary of wadi Doka Natural Park (Dhofar, Oman). The dots point to the locations of the biggest and oldest trees of *Boswellia sacra*. On the right, the fenced transplanting area isolated from the remaining part of the Park.

PLANT NUMBER: N. 60	iron label n° 3415
Date: 21 March 2004 Coordinates (by G.P.S.)	17° 20.59' N, 54° 04.43' E
PHOTO N. 60	Alt. 668 m (GPS)
PLANT MORPHOLOGY	
Height	1,5 m
number of basal branches	> 10
circumference at the base of the trunk	1,8 m
crown leaves surface	2,5 mq
crown morphology	oval-cone
presence of new branches	no
length of the new branches	new branches browsed
size of the old leaves	4-5 x 1,5 cm
presence of flowers	no
presence of fruits	no
size of the new leaves	absent
condition of the leaves	few, browsed and rolled up
HEALTH CONDITION	
insect attacks	no
animal grazing	much
cuts of branches (by men)	no
roots excavated by water flow	yes
GENERAL CONDITION OF THE PLANT	in danger

Figure 2 – Index Card used to record the biometric characteristics and the health conditions of the plants of the Park.

successive periods, including the indexing (fig. 2) of the biometric characteristics of each plant and the health conditions for comparison and aid in future check-ups. All of the documentation is archived at the Office for Cultural Affairs of Muscat and Salalah.

After the initial phase of delimitation of the Park perimeter and monitoring of *Boswellia* plants, the safeguard and recovery of the wadi Doka area were initiated.

Thanks are due to the Office of Adviser for Cultural Affairs, Sultanate of Oman, for the assistance during our visit to Dhofar.

SAFEGUARD INTERVENTIONS IN THE WADI DOKA PARK

Root protection

The first safeguard intervention concerned the oldest and heaviest *Boswellia* plants; the bases of the trunks were earthed and the big superficial uncovered roots were covered with stones. The plants of the Park grow on a graveley and detrital sediment and their roots are superficial and tend to develop horizontally. In occasion of sudden meteoric events, like floods or wind storms, roots get uncovered. This causes instability and suffering of the plants and sometimes their fall and death (fig. 3: a, b).



Figure 3 – a,b): The exposed roots (a) are covered (b) with stones and pebbles from the wadi bed – c) An old tree of Boswellia sacra fallen on the ground after an exceptional water flow. – d) A dromedary browsing a plant. – e, f) Plants cut (e) and burned (f) by the local shepherds. – g) The trees of Boswellia sacra are concentrated in the rocky wadi bed.

Damage caused by browsing and tree-cutting

Other safeguard interventions aimed to limit the effects of dromedary and goat browsing, stop the tree-cutting for fire-wood, and the use of foliage for fodder.

The animals mainly browse on the young annual shoots (fig. 3: d); this activity impedes the development and growth of the shoots so that the plants remain of the same size year after year and assume a withered appearance with shortened and enlarged branches carrying only few leaves. Browsing also causes the elimination of the young seedlings preventing the natural regeneration of the coenoses.

Tree-cutting for fire-wood (fig. 3: e, f) and the use of foliage for fodder represent further activities that limit the natural growth of the *Boswellia* coenoses.

Blocking the accesses

The major concentration of *Boswellia* plants in the Park area is in the wadi bed (fig. 3: g) that in time dug a wide depression in the surrounding rocky plain. The border between the rocky plain and the wadi bed is

formed by a steep, almost vertical, 4-6 m long slope which prevents the access to animals; however, along the perimeter of the Park there are still some accessible openings which have been progressively closed with rock blockages.

Owing to the wide extension of the Park and the resistance of the local shepherds the elimination of browsing inside the Park was and still is one of the hardest challenges to face.

Creation of a marginal area of growth and transplant monitoring of Boswellia

In autumn 2004 a marginal area located in the eastern area of the Park (on the side of the Salalah-Thumrayt road, from where the tourists enter) was provisionally fenced and secluded to the animals (fig. 4). This ca. 15 ha area, located between the rocky plain and the depression occupied by the wadi, was highly degraded with no herbaceous vegetation and few *Boswellia* plants (about 40) in bad conditions with evident browsing effects.

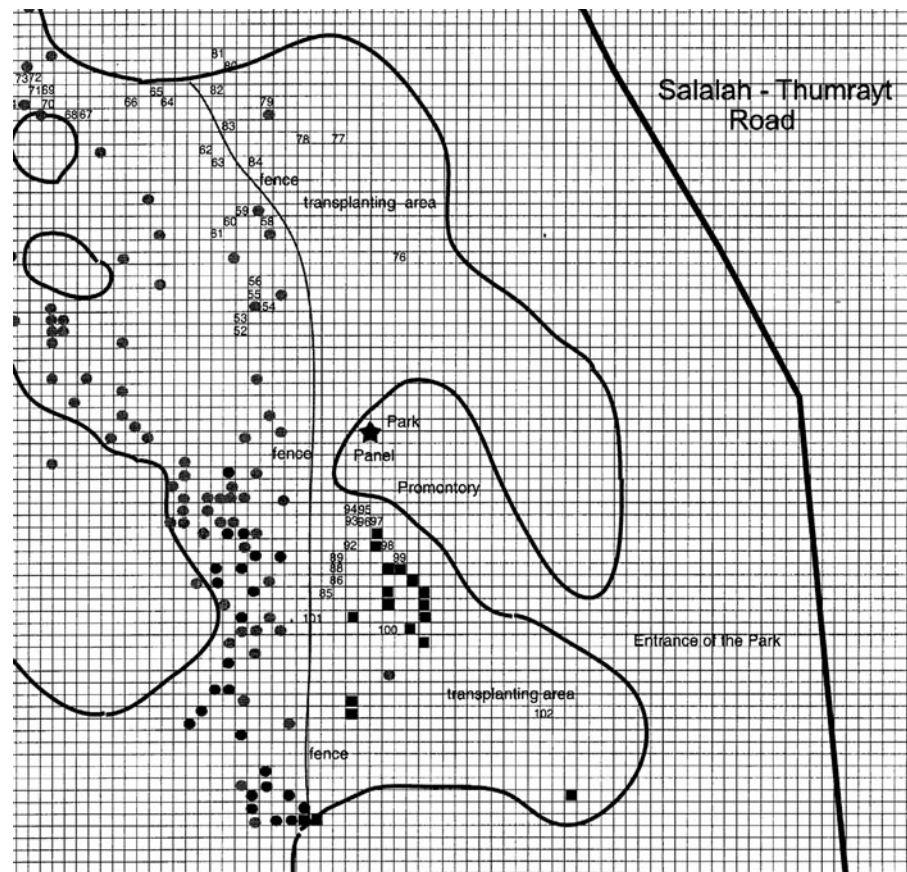


Figure 4 – The transplanting area of the Park: the black squares and the numbers point to the plants of *Boswellia* present before bedding the cuttings.

Table 1

Plants of *Boswellia* growing in the transplanting area: comparison of the growth parameters before (March 2004) and after (February 2006) the positioning of the protection fence against the grazing and the cutting of the plants.

Plant number			2004 Mar	2006 Feb.
87	height	(m)	1,3	1,5
	surface	(sq.m)	3,1	3,9
	new brahch	(cm)	no	30
88	height (m)		1,6	1,7
	surface (mq)		5,8	6
	new brahch		no	15-20
89	height (m)		0,9	1
	surface (mq)		1,2	1,4
	new brahch		no	15
90	height		1,9	2
	surface		5	5,6
	new brahch		no	35
91	height (m)		2,6	2,7
	surface (mq)		5,7	6
	new brahch		no	25
92	height (m)		1,7	1,8
	surface (mq)		2,2	2,8
	new brahch		no	30-50
93	height		1	1,1
	surface		4,3	4,6
	new brahch		no	20
94	height		2,1	2,3
	surface		5,4	6
	new brahch		no	30-50
95	height		1,8	1,9
	surface		3,7	3,9
	new brahch		no	35
96	height		2,7	2,8
	surface		9,3	10
	new brahch		no	25
97	height		1,8	2
	surface		8	8,7
	new brahch		no	20
100	height		1,8	2
	surface		5	5,5
	new brahch		no	25

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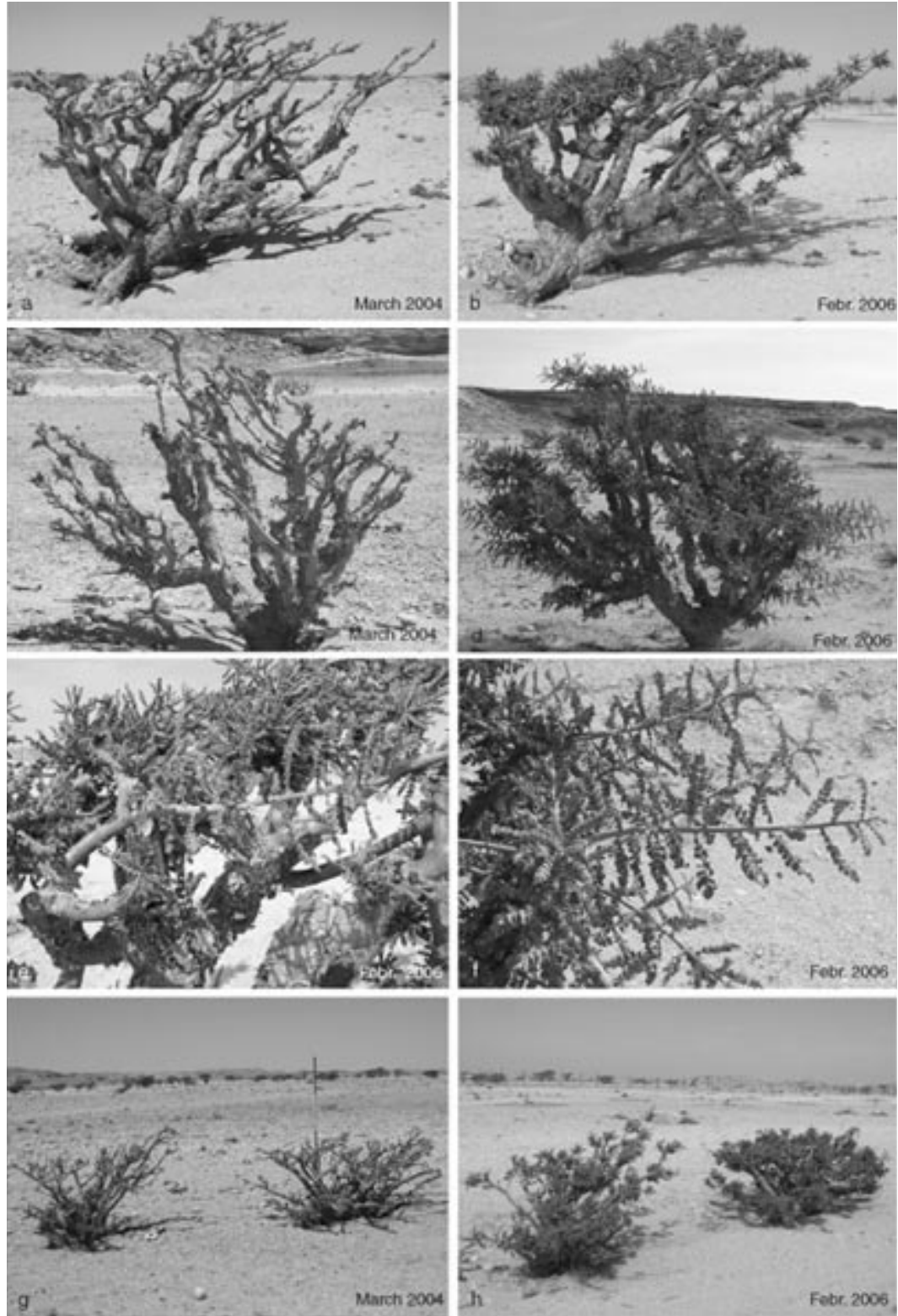


Figure 5 – a,c,g) March 2004: appearance of some plants before fencing the area. – b,d, h) Febr. 2006: the same plants after fencing the area. – e,f) Febr. 2006: Note the annual sprouts of the new branches 30-40 cm long. It is clear that animal grazing is the principal cause of limited plant growth.

The fencing allowed the beginning of a monitoring activity of the *Boswellia* plants present in this area, in absence of the damage caused by animals and shepherds; at the same time, in the fencing area the soil was prepared (with 40 cm deep holes with gravels in the bottom for drainage) for the transplant of *Boswellia* cuttings, obtained from the Park plants.

PRELIMINARY RESULTS

Monitoring of the plants in the peripheral area

In February 2006 the biometrical characteristics (height, crown surface, amount and length of annual shoots) of 12 of the 40 *Boswellia* plants present in the fenced area (fig. 4) were examined and filed. The new data was compared with the data collected in March 2004 for the same plants, before the fencing was set up.

The documentation (see tab. 1 and fig. 5) shows that *Boswellia* plants, after the isolation of the area, regained a normal growth habit, with production of 20-50 cm long annual shoots and abundant and well developed leaves on the new and old branches.

Transplant of Boswellia cuttings

In autumn 2004, about 2000 *Boswellia* cuttings obtained from plants in the Park were transplanted in the fenced area (fig. 6) with the aim to recover the natural vegetation of a highly degraded area. The cuttings developed in phytoclimatic cells at the nursery of the Frankincense Land Museum (Salalah); then they were transplanted in the fenced area of the Park. To favour the sprouting, a water tank was set up for watering of the young seedlings (once a week in the first months). In autumn 2005, the seedlings that did not survive the first transplant were substituted with new cuttings.

In February 2006, the transplant intervention showed a positive result of over 75-80% (fig. 6). The young seedlings had reached a 20-40 cm height; they had new ramifications and abundant new leaves.

In a following control in November 2006, the success of the transplant was confirmed with the recording of growth rises above expectations (fig. 5). Some plants were up to 80-90 cm tall, with numerous and enlarged basal ramifications (with branches up to 3-4 cm of diameter), and abundant production of new shoots and leaves.

CONCLUSIONS

The *Boswellia sacra* populations of wadi Doka Natural Park can be safeguarded with measures intended to prevent animal browsing, tree cutting for firewood, and leaf use for fodder production. The observations on the annual growth increases of *Boswellia* plants after the fencing are the evident proof that grazing is one of the principal causes of plant degradation. Even the lack of natural renewal inside the Park is fundamentally due to browsing which strongly affects the young seedlings in their first developmental stages. The rapid growth of the *Boswellia* cuttings in the fenced area confirms the good natural regenerative capability of the plant. The good result obtained with the growth of these cuttings determines the possibility of their future re-utilization in vegetation recovery operations in Park areas that have been isolated from the effects of browsing and other activities.

Finally, constant monitoring of the oldest and heaviest plants is necessary, especially aimed to earth the roots that get uncovered and control the presence of infestations and parasite infections. Many of the *Boswellia* plants of wadi Doka Park are unique to Dhofar in behalf of their imposing size and therefore form a naturalistic heritage that should be safeguarded and preserved also in the future.

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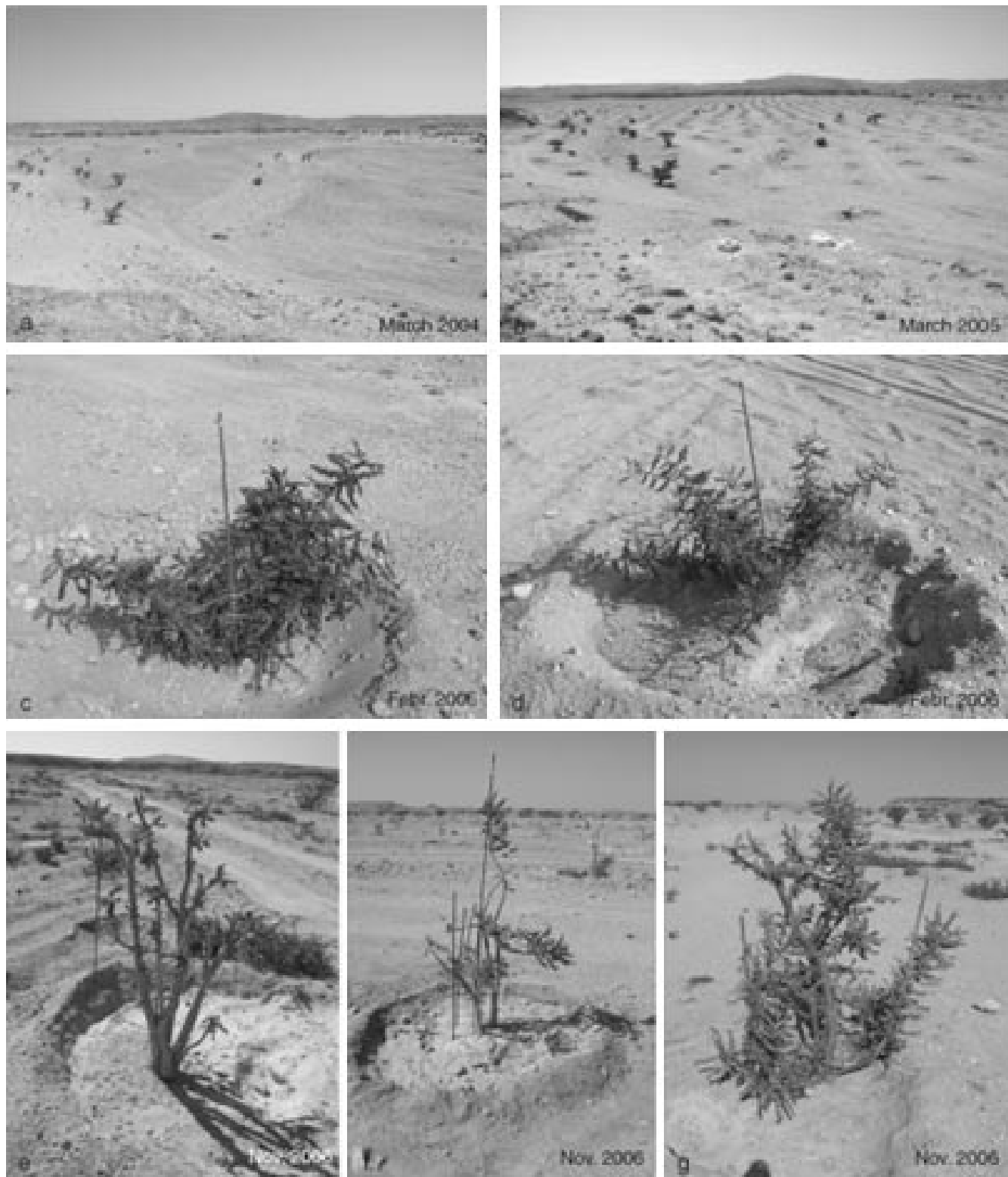


Figure 6 – a) The transplanting area in March 2004. – b) The same area in March 2005, six months after bedding the Boswellia cuttings. – c,d) Feb. 2006, two new young plants of Boswellia, 12 months after their bedding in the area. – e,f,g) Nov. 2006, three plants of Boswellia after 20 months: note the exceptional growth rate.

