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The age of dead trees at Sossusvlei and Tsondabvlei, Namib Desert, Namibia

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The stand of dead trees at Sossusvlei died out around A.D. 1400 - some 600 years ago. One of these, now fallen, trees started growing in the 11th or perhaps 12th century. The dating appears to correlate with the regionally more humid Medieval Warm Period and the more arid conditions that set in during the subsequent Little Ice Age. The dead trees on the western side of the Tsondabvlei are younger and may have grown during the brief warm, wet 17th century, but died out when it became drier again around A.D. 1700.

INTRODUCTION

At both Sossusvlei (24°45'S, 15°17'E) and Tsondabvlei (23°54'S, 15°22'E) in the central Namib Desert there are stands of dead *Acacia erioloba* E.May (Fabaceae) trees. Samples of several of these trees were collected for radiocarbon dating. The purpose was twofold: (a) to establish how long they survive in the desert environment, and (b) to pinpoint the time when the local moisture conditions changed, an event which may be related to a general decline in rainfall.

Sossusvlei lies at the present-day endpoint of the Tsauchab Stream, which extends some 50 km into the central Namib sand sea. The area is extensively covered with silt deposited from previous floods. In the southwestern corner, silt deposits spread southwards for a considerable distance between two massive linear dunes. Today, this lobe is cut off from the river endpoint by a large transverse dune barrier and further sub-divided into two sections by another transverse dune (*vide* Figure 2).

The southernmost, inner section consists of a completely flat silt surface with a stand of some fifty still upright dead trees in the north-eastern quadrant (*vide* Figure 1 & 2). On the western margin at the dune base a few partially decayed large fallen tree trunks lie on separate pedestals of silt, some 3 m above the silt floor and sloping slightly towards its centre. These trees must have grown when the silt deposits were at a higher level.

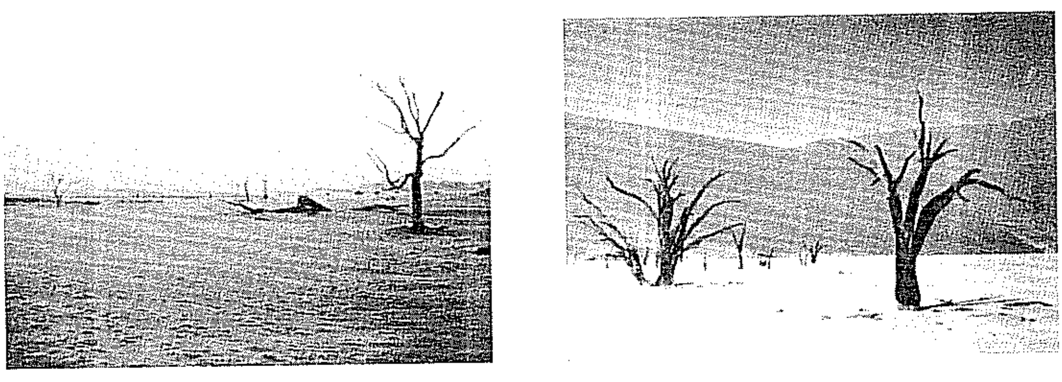

Figure 1. Photographs of some of the still standing dead trees on the silt surface of the inner isolated lobe at Sossusvlei, central Namib Desert, Namibia.

When these silts were removed by wind erosion, the root systems of the trees protected the immediate surrounding sediment to create the now present pedestals. In the southwestern corner of the floor one such tree is still living. It has grown up alongside a fallen trunk of 60 cm diameter from the same rootstock and now has a trunk of 50 cm diameter. On the northern margin of the silt floor a few more trees stand on low, 50 cm, pedestals. In the northwestern corner the wind has eroded the silt surface to a lower level on which there are a few live trees. The outer, northern section of the lobe is extensively wind-eroded, with several dead trees still standing on their now decaying pedestals.

Some 100 km further north, the Tsondabvlei is situated in a similar manner to Sossusvlei, at the endpoint of the Tsondab Stream. The dead trees stand scattered on the flat area directly to the west of the present vlei.

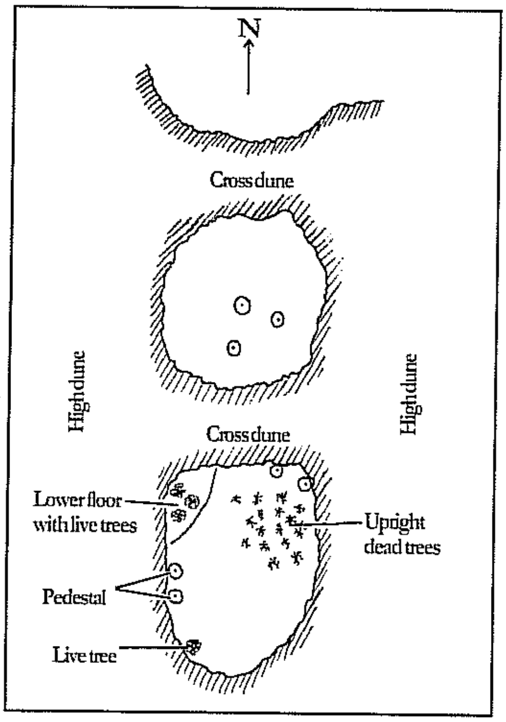

Figure 2. Sketch map of the isolated lobes of Sossusvlei, central Namib Desert, Namibia, with the appropriate position of the trees on the silt floor.

METHOD & RESULTS

The outer annual rings of the trunks were sampled in order to determine when the trees died. In the cases where trunks have fallen, the first annual rings at the core of the bole could be collected to determine the date when the tree started growing.

The results of the survey are listed in Table 1. The radiocarbon ages can now reliably be converted to historic dates by means of the Pretoria calibration program (Talma & Vogel 1993). It is based on the internationally agreed tree-ring calibration data, INTCAL 98 (Stuiver *et al.* 1998), and appropriately adjusted to the Southern Hemisphere and to best match the Pretoria dating equipment (Vogel 2002; Vogel & Fuls 1999). The appropriate section of the calibration curve is shown in Figure 3. Due to the irregularities in the curve, the conversion does not always give a very distinct historical date. For instance, samples dating to between A.D. 1300 and A.D. 1400 shall all have a radiocarbon age close to 650 B.P. (Before Present). The one-sigma range (68% confidence level) is considered the best estimate of the historical date for the samples, and these values are listed in the last column of Table 1.

DISCUSSION

SOSSUSVLEI

The five dead trees in the inner section of the silt lobe all apparently died around A.D. 1400 or early in the 15th century. This suggests that the trees on the silt floor have been standing there, dead, for nearly 600 years. The date for the inner wood of the large fallen trunk on the western margin (S5), with a diameter of 1 m, shows that the tree was about 350 (or perhaps 250) years old when it died, while the one on the northern margin (S8/9), with a stem diameter of 40 cm, lived for 100 years or so. The dead trunk of the still living tree (S6/7), with a diameter of 60 cm, apparently survived for some 250 years or less probably for about 100 years, which would make the secondary living trunk about 400 years old by now. The two trees in the outer section of the lobe (S13 & S14) appear to have died before A.D. 1400, as is the case with S3 and S8.

Table 1. Radiocarbon age of trees at Sossusvlei and Tsondabvlei, central Namib Desert, Namibia (Pta = the analysis code of the Pretoria Radiocarbon Laboratory).

Sample code	Description	Locale	Analysis No.	Age Yrs B.P.	Calibrated date (1 sigma range)
	Sossusvlei, inner lobe				
S 1	Outer rings of erect trunk, 20 cm diameter	NE quadrant	Pta-1489	560±45	A.D. 1404-1431
S 2	Outer rings of erect trunk, 40 cm diameter	NE quadrant	Pta-1495	520±35	A.D. 1419-1441
S 3	Outer rings of erect trunk, 30 cm diameter	NE quadrant	Pta-1496	670±45	A.D. 1294-1398
S 4	Outer rings of fallen trunk, 100 cm diameter	W margin on 3 m pedestal	Pta-1487	550±40	A.D. 1409-1433
S 5	Centre wood of same		Pta-1497	920±45	A.D. 1051-1091, or A.D. 1147-1214
S 8	Outer rings of fallen trunk, 40 cm diameter	N margin on 50 cm platform	Pta-1505	650±40	A.D. 1301-1403
S 9	Centre wood of same		Pta-1504	740±40	A.D. 1277-1298
S 6	Outer rings of fallen trunk, 60 cm diameter of living tree	SW corner on platform	Pta-1488	420±45	A.D. 1449-1518 or A.D. 1584-1624
S 7	Center wood of same		Pta-1490	610±50	A.D. 1312-1417
	Sossusvlei, outer lobe				
S 13	Outer rings of large fallen Tree	E side of stand on platform	Pta-1555	690±50	A.D. 1288-1393
S 14	Outer wood of erect trunk 30 cm diameter	Centre of stand on platform	Pta-1506	680±50	A.D. 1291-1397
	Tsondabvlei				
T 2	Outer wood of large fallen Tree	E side of stand	Pta-1510	300±45	A.D. 1635-1663
T 3	Outer wood of large fallen Tree	E side of stand	Pta-1509	240±45	A.D. 1654-1680 or A.D. 1742-1805
T 5	Outer rings of one of three trunks, 30-40 cm diameter	SW side of stand	Pta-1531	150±45	A.D. 1680-1742 or after A.D. 1805
T 4	Outer rings of erect tree 25 cm diameter	E side of stand	Pta-1511	130±40	A.D. 1688-1730 or after A.D. 1811

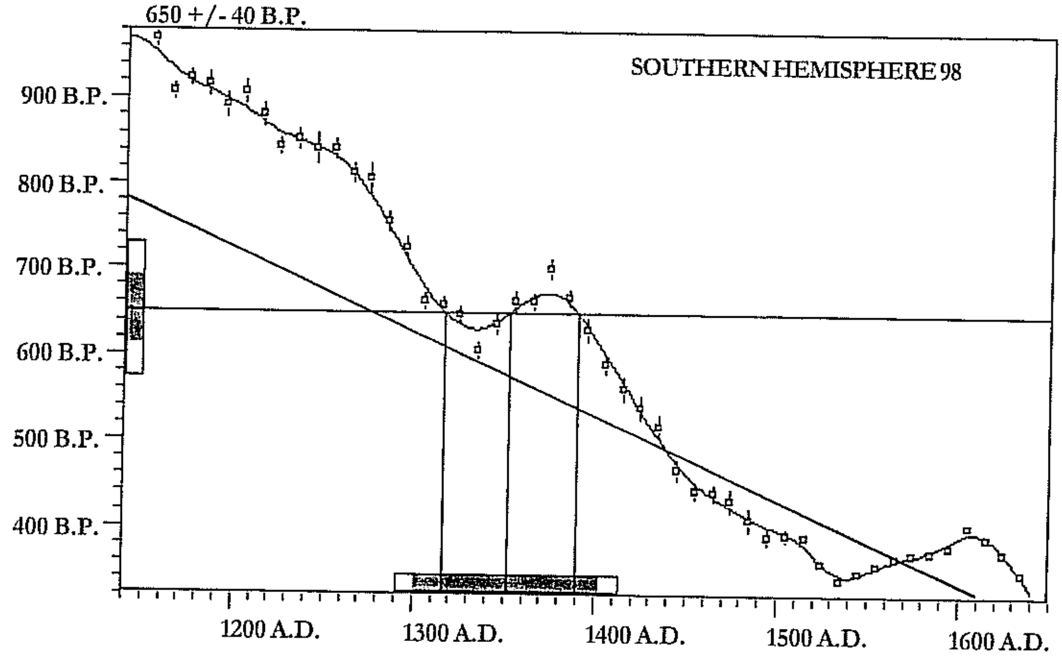

Figure 3. A section of the calibration curve with which radiocarbon ages can be converted to historical dates. The straight diagonal line represents the correlation if no calibration were necessary. As an example, the calibration of the age 650 ± 40 years B.P. for sample S8 is shown. The horizontal bar along the χ-axis gives the 1 σ and 2 σ ranges of possible dates for the sample.

The reason for the stand to die out could have been a decline in rainfall further inland, with a corresponding lowering of the water table under the silts. The other option, that the silt floor on which the stands developed was frequently subjected to flooding at the time and dried out when the lobe became isolated from the vlei by the transverse dunes is not feasible because the silt floor has been dated to the early Holocene and was not an active part of the vlei during the past millennium (Vogel & Visser 1981: 71).

A.D. 1400 falls within the Little Ice Age of Europe, which has been identified with a dry period in the summer rainfall region of southern Africa (Tyson & Lindesay 1992; Vogel *et al.* 2001). The ground water level would only gradually have become adjusted to the more arid conditions that set in around A.D. 1300. The findings presented here provide further evidence of this increased aridity.

TSONDABVLEI

The four trees sampled on the west side of the Tsondabvlei date to a later period than those at Sossus. They probably all four died in the latter part of the 17th century, or around A.D. 1700. The hydrologic situation there is not clear, but the dieing out of the stand may have occurred during the declining stages of the warm, wet phase within the Little Ice Age that set in around A.D. 1600.

CONCLUSION

The dead trees at the Sossusvlei and Tsondabvlei are extremely old and need to be conserved. The stand at Sossusvlei apparently was established during the relatively humid conditions of the Medieval Warm Period and died out after the more arid conditions of the Little Ice Age set in during the 14th century. The dead trees west of the

Tsondabvlei may have established themselves when the brief warmer and wetter spell set in around A.D. 1600, but did not survive the drier condition of the 18th century.

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