in: Newsletter: Nam. Sci. Soc. 2001
Vol. 42 (1-3) pp: 9-15

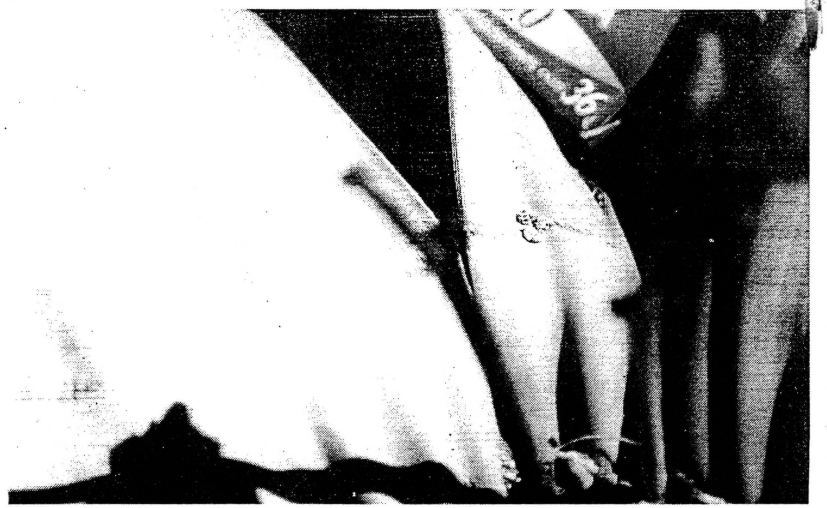
RAPID GROWTH OF WELWITSCHIA MIRABILIS FOLLOWING AN EPISODIC RAINFALL

Timothy O. Osborne [1] and Ellen Gudde [2]
[1] P O Box 22, Okaukuejo, via Outjo, Namibia korie@iafrica.com.na
[2] PO Box 5218 Windhoek, Namibia

Introduction

Welwitschia *Welwitschia mirabilis*, an endemic plant of the Namib desert is known for its ability to grow in areas of extremely low rainfall, around 55mm per annum, mainly by utilizing moisture from coastal fog (Bornman 1972). Its tap root system is shallow and simple and Bornman (1972) thought the primary function of the root was for anchorage and not the uptake of water. The growth of its leaves has been stated at 1-2cm per year (Senger 1989) or at 8-15 cm per year (Bornman 1972) so there appears to be some disagreement on the growth rate.

We visited the Brandberg Monument Area over the Easter weekend from 22-24 April 2000 with the Namibia Bird Club. We camped on the Weyersbrunn Fork of the Numas River and noticed that the area had beer



Growth line showing clear mud line caused by severe flooding

subject to massive flooding following an episodic rainfall. Many plants especially *Commiphora virgata, C. wildii* and *Acacia montis-usti* had been uprooted and sand and gravel were covering others. We observed that several of the Welwitschia plants had their leaves torn off by the flood waters and other plants had a distinctive "high water mark" on the leaves. We noticed that the leaves had grown rapidly from the basal intercalary meristem to the high water mark. Knowing that this was a rare opportunity to measure the growth of the plants which had been naturally marked, we decided to measure the growth of the plants.

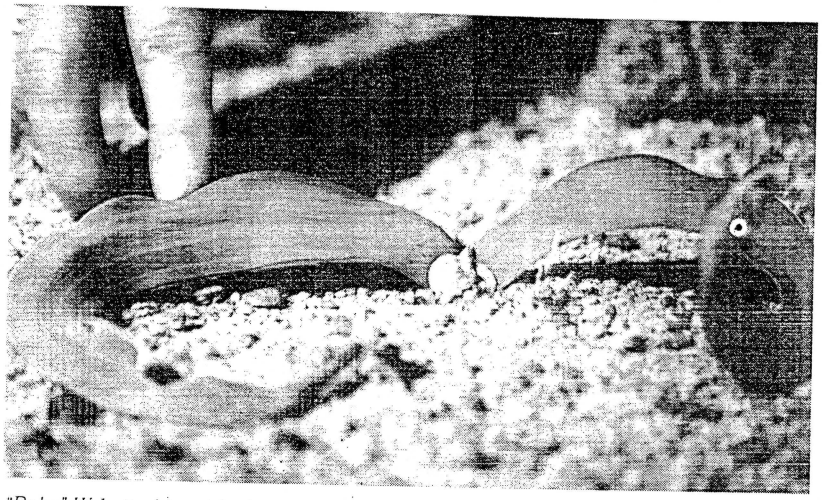
Methods

The study area was in the Weyersbrunn Fork of the Numas River 21 (06.815 S. 14(24.340 E. on the western side of Brandberg Mountain at 1020 m elevation. The area is just on the extreme eastern edge of the coastal fog belt with fog only occurring from 5-10 days per year (C. Du Preez pers. comm.). We randomly selected plants growing either on the floodplain or within the river bed. At each plant we determined the sex by the presence of small salmon-coloured cones in the male or large terminal cones in the female (Bornman 1972). We also visited the north fork of the Messum River on 22 April and 6 August 2000 at 21(14.026S 14(28.879E. We recorded stem diameter (mm) as the distance across the stem between the two leaves. Most plants had a distinct "high water mark" of dried sand where the flood waters deposited sand at the basal intercalary meristem *(Figure 1)*. As the leaves grew the sand marked the point where the growth started. Other plants had their leaves torn off by the flood waters. Growth was measured from the ragged edge to the base using a dial caliper to the nearest 0.1mm. Later growth and stem diameter was measured using a flexible steel tape to the nearest 1mm. At some point growth slowed down and a secondary, sun-bleached, mark was left on the leaf. This was followed by renewed growth. We took two measurements, one was the primary growth from the water mark to the sun-bleached mark and the second was from the sun-bleached mark to the basal intercalary meristem. The sum of the two measurements were total growth.

We obtained rainfall data from Uis, 40 km east of the Brandberg, which was recorded daily during 1999-2000.

Results

During November-December 1999 Namibia experienced wide-spread



"Baby" Welwitschia with clear growth lines

rainfall which produced record amounts for most areas (C. du Preez pers. comm.). The Uis and Brandberg area, however, did not receive any rainfall. Rain only started to fall on 23 March 2000 and ceased on 2 April after 162mm had been recorded at Uis. The amount of rain that fell on the Brandberg is unknown but we estimated it at an equal or greater amount than Uis, based on the extent of erosion to the gravel roads in the two areas. The rain was estimated to be the largest amount to have fallen in the past 30 years (pers. obs.). We estimated that the Weyersbrunn Fork of the Numas River, where we took our leaf measurements, during full flood was 1.5m deep and 15m wide. The water flow in the tributary of the Messum River was estimated at m deep by 8m wide.

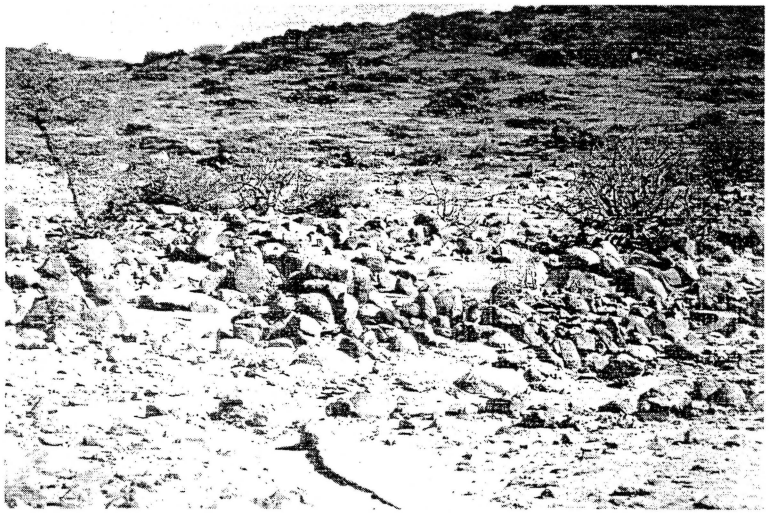
We measured leaves on 102 Welwitschia plants 30 days following the onset of the rains and found an average increase of 83.5mm growth (range: 49.0-129.8) (Table 1, Appendix). We were able to sex 83 plants and found no significant difference in the growth between males and females. We do not know the time period between the onset of the rains and the end of the first growth segment (primary growth) but it was clearly demarcated on the leaves *(see Figure 1)*.

We also measured leaves on 54 plants in the Messum River drainage 4 months after the onset of the rains and found the average growth was 187.5mm with a range from 125-380mm *(Table 2)*. The plants were in a

Table 1. Average growth of 102 *Welwitschia mirabilis* plants 30 days following a episodic rainfall in Brandberg Monument Area, Namibia. All measurements in mm. Primary and Secondary are two growth bands measured from the sand or sun lines to the basal intercalary meristem. Total is the total growth in the 30 day period.

	All plants n=102	Male n=47	Female n=36	T-test[1]
Stem [2]	305	331	255	0.0631
Primary	39.2	40.6	37.0	0.086
Secondary	44.3	44.8	45.2	0.896
Total	83.5	85.4	82.3	0.445

[1] test between male and female plants.
[2] Stem is the diameter of the plant measured across the top between the two leaves.



Riverbed with displaced bolders and uprooted plants after heavy floods in March 2000. Brandberg east

river course and many had leaves which were damaged by the flooding water.

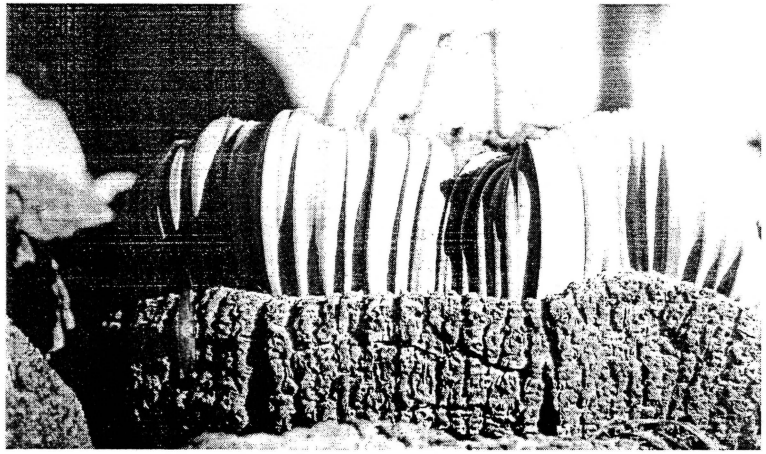
Our results show that Welwitschia leaves can grow rapidly following an episodic rainfall and perhaps the tap root system, of plants growing at the edge of the fog belt, is more developed and capable of efficient water transport.

We thank Rudi Gudde for entering the data and Flip Schoonbee for the Uis rainfall data. Laurel Osborne helped collect data in August.

Literature Cited

Bornman, C. H. 1972. Welwitschia mirabilis: paradox of the Namib Desert. Endeavour 31, No.113:95-99.

Senger, H. 1989. Die Sebelwüste Namib und ihr pflanzliches Paradoxon: Welwitschia mirabilis. Jb. Nass. Ver. Naturk. 111:67-93.



Leaf of Welwitschia sheared off - most probably by flood water, with clear growth lines.

Table 2. Average growth of 54 *Welwitschia mirabilis* plants 4 months following a episodic rainfall in the Messum River drainage, Brandberg Monument Area, Namibia. All measurements in mm.

Males	Females	Unknown	T-test[1]
180	261	161.6	0.98161

[1] test between male and female plants.

Appendix Stem and leaf growth measurements in mm for 102 *Welwitschia mirabilis* plants at Brandberg, Namibia, April 2000.

No.	Stem diameter	Total growth	Primary growth	Secondary growth	Sex	Topography notes
1	986	70.6	29.1	41.5	unk	river course
2	1003	71.8	38.7	33.1	unk	river course
3	148	89.1	59.5	29.6	unk	river course
4	700	73.1	38.4	34.7	unk	river course
5	430	84	34.6	49.4	unk	river course
6	340	60.5	48.7	11.8	m	river course
7	75	76.4	46	30.4	m	flood plain
8	791	72.9	39.3	33.6	m	flood plain
9	532	77.4	42	35.4	f	flood plain
10	155	107.5	43.5	64	f	protected shade
11	222	75.1	40.5	34.6	m	flood plain
12	865	115.3	48.2	67.1	m	flood plain
13	411	52.8	26.5	26.3	m	less leaves flood plain
14	189	94.8	40.5	54.3	unk	shade
15	150	107	70.1	36.9	unk	shade
16	90	79.4	50.4	29	unk	flood plain
17	385	112	60.2	51.8	m	shade
18	443	98.8	40.5	58.3	m	
19	314	80.3	48.8	31.5	f	flood plain
20	350	96.8	51.6	45.2	m	flood plain
21	30	96.2	44.2	52	unk	river course
22	415	101.1	48.1	53	unk	flood plain termites
23	444	121.8	44.1	77.7	m	flood plain termites
24	675	70.6	30.8	39.8	unk	river - very battered
25	265	49	40.5	8.5	unk	flood plain
26	295	103.2	43.7	59.5	f	flood plain
27	171	93.7	79.8	13.9	m	stone on top - river
28	85	77.7	36	41.7	m	flood plain
29	330	74.6	34	40.6	m	flood plain
30	90	82.5	39.8	42.7	m	flood plain
31	225	82.2	38.5	43.7	m	edge of river
32	777	88.8	39	49.8	m	edge of river
33	542	69.8	28.2	41.6	f	edge of river
34	425	79	28.2	50.8	m	edge of river
35	703	77.4	39.8	37.6	m	edge of river
36	510	104.5	49.4	55.1	unk	buried in sand
37	105	80.3	39.2	41.1	f	flood plain
38	375	82.6	50.1	32.5	f	flood plain
39	743	81.8	38.5	43.3	f	flood plain
40	114	61.2	36.5	24.7	f	flood plain
41	235	90.5	52	38.5	m	flood plain
42	185	61.1	39.1	22	m	flood plain
43	491	79.2	29.2	50	m	flood plain
44	450	80.2	39.3	40.9	m	flood plain
45	75	102.5	43.9	58.6	f	flood plain
46	190	102.5	63	39.5	m	flood plain
47	255	84.6	34.5	50.1	m	flood plain
48	343	67.9	28.1	39.8	f	flood plain
49	240	83.9	33.6	50.3	unk	flood plain
50	164	62.8	28.1	34.7	m	flood plain

No.	Stem diameter	Total growth	Primary growth	Secondary growth	Sex	Topography notes
51	298	129.8	33.6	96.2	m	flood plain
52	154	93.2	30.6	62.6	f	flood plain
53	325	84.2	35.6	48.6	f	flood plain
54	225	107.8	49.6	58.2	m	flood plain
55	159	111.8	41.5	70.3	f	flood plain
56	305	69	23.4	45.6	f	flood plain
57	185	104.4	37.9	66.5	f	flood plain
58	125	49.6	31.4	18.2	f	flood plain
59	109	75.2	38.8	36.4	unk	flood plain
60	124	88.2	29.2	59	f	flood plain
61	186	80.5	42.4	38.1	f	flood plain
62	680	87.8	28	59.8	m	flood plain
63	121	94.6	23	71.6	unk	flood plain
64	134	92.8	35.5	57.3	m	flood plain
65	416	62.2	27.2	35	m	flood plain
66	648	116.4	28.7	87.7	f	flood plain
67	590	82.2	31.8	50.4	f	flood plain
68	250	72.6	26.9	45.7	f	flood plain
69	475	99.9	43.8	56.1	f	flood plain
70	475	102	33.5	68.5	m	flood plain
71	370	84.2	33.2	51	m	flood plain
72	450	81.8	52.8	29	m	flood plain
73	185	105	57.5	47.5	m	flood plain
74	120	52	40.2	11.8	f	flood plain
75	91	85.8	37.8	48	f	flood plain
76	79	90	33	57	f	flood plain
77	145	84.8	40.4	44.4	f	flood plain
78	99	70.2	38.1	32.1	m	flood plain
79	125	79.3	40.3	39	f	flood plain
80	132	89.4	37.5	51.9	m	flood plain
81	85	63.8	27.7	36.1	m	flood plain
82	128	88.2	43.5	44.7	f	flood plain
83	284	71.2	36.1	35.1	m	flood plain
84	305	55.7	34	21.7	m	flood plain
85	255	76	35.8	40.2	m	flood plain
86	240	73.6	37.8	35.8	unk	flood plain
87	121	61.1	34	27.1	f	flood plain
88	236	72.6	43	29.6	f	flood plain
89	395	80.2	35.5	44.7	m	flood plain
90	226	56	25.3	30.7	m	flood plain
91	316	120.2	35.7	84.5	m	flood plain
92	218	129.2	59	70.2	m	flood plain
93	285	105	46.5	58.5	f	flood plain
94	210	74.6	44.9	29.7	f	flood plain
95	59	72.4	27.7	44.7	unk	flood plain
96	370	93	44	49	m	flood plain
97	315	96.3	47.2	49.1	m	flood plain
98	135	64.2	21.5	42.7	f	flood plain
99	240	58.6	34.8	23.8	m	flood plain
100	235	68.5	27.8	40.7	f	flood plain
101	175	71.5	36.4	35.1	f	flood plain
102	26	53.3	21.8	31.5	unk	flood plain