

The Decline of the Bankouale Palm in Djibouti: El Niño and Changes in Architectural Fashion

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1. A group
of *Livistona
carinensis*.



The Bankouale palm, *Livistona carinensis*, is in serious decline in Djibouti. This paper documents the current status of the palm and discusses possible conservation measures.

In 2004 a partial survey of the Bankouale palm, *Livistona carinensis* (Chiov.) J. Dransf. & N.W. Uhl, was undertaken (Ford & Bealey 2004). It is very limited in its worldwide distribution having been reported from only two other areas, the Yemen and Somalia, and is currently classed as "vulnerable" in the IUCN/WCMC World List of Threatened Species. The Somali population consisted of 38 plants in 1998, and the Yemeni population was described as being replaced by a date plantation (Welch & Welch 1998).

In Djibouti the palm exists, typically, in populations of from 3–50 plants, as shown in Figure 1, as populations of closely grouped individuals in a wadi bed or spring side. These populations are distributed amongst three wadi systems, each on the upland plateau of the Goda Massif (1700 m) to the sea of the Gulf of Tadjoura to the east and south. The 2004 survey revealed an overall decline of some 23–30% in those populations measured. The

populations were found to be over-mature, consisting of adults and few juveniles and rosettes, though they flower and fruit freely. Most populations had no juveniles at all. It was therefore decided to make a complete survey of all the extant populations in Djibouti and to collect samples for genetic analysis with a view conserving the palm for the future.

Results and Discussion:

Our survey revealed that there was a total of 314 adults, 20 juveniles, 134 rosettes, 210 small rosettes (more than six leaves) and 465 seedlings (<3 leaves) living in the Bankouale area of Djibouti. These are distributed unequally amongst three valley systems (Fig. 2). From Table 1 and Figure 2, one can see that most of the plants occur in the Bankouale valley. In percentage terms, 65% of the adults, 85% of the juveniles, 75% of the rosettes, 76% of the small rosettes and 93 % of the seedlings were found in the Bankouale valley.

Table 1: Numbers of individuals in life history classes of all populations of *Livistona carinensis* in Djibouti with % change since 1985 where applicable (* since 1990, ** since 1988, *1987). Site numbers refer to Fig 2.**

	<3 lvs	<6 lvs	Rosette	Juvenile	Adult	% change
Randa						
Santaba (25)	23	7	2	0	15	
Randa (17,18,19,20)	13	11	8	1	18	-25
Eewali (21,22,23,24)	0	2	1	0	5	-55
Ribtaleh (26,27,28)	5	5	31	0	21	
Total	41	51	20	1	59	
Bankouale						
Satabou Lower (13)	3	3	3	2	6	-50
Satabou Upper (11,12)	42	10	10	0	32	77
Aggorogouba* (4)	37	0	12	1	22	-12
Disay (3)	175	106	35	7	22	-43
Ribta Aibole* (16)	9	0	2	0	25	-20
Ribta** (15)	0	0	0	0	3	-62
Bankouale (5–10, 14)	173	42	53	1	91	-54
Total	439	161	105	11	201	
Ditilou						
Wer (2)	0	0	9	2	39	-23
Ditilou*** (1)	0	0	0	0	10	-28
Total	0	0	9	2	49	

Table 2: Life history class structures in garden and non-garden sites.

	<3 lvs	<6 lvs	Rosette	Juvenile	Adult
Garden sites	459	199	109	14	171
Non-garden sites	54	13	25	6	151

Table 2 and Figure 3 show the population structures associated with garden and non-garden sites. The majority of the seedlings were in or associated with gardens, but the numbers of adults in garden and non-garden sites are similar.

Site Descriptions.

Randa Valley:

Randa (sites 17, 18, 19, 20, Welch sites 1–6): The site is in four parts. A couple of plants are situated in the village, with a juvenile by the school. A dramatic cliff population making up most of the plants in the area is found by the tourist camp. This has an associated spring and small tank acting as a reservoir. A second cliff population is on the road some 400 m west of the tourist camp. This seems to be in an incongruous position, being very dry and not near any other palms but up a shallow side valley from this last population are two individuals in a wadi by some gardens.

Santaba: (site 25) This site had not been visited by the Welchs. The palms are situated around small spring some 20 m above the wadi bottom facing south. There are no gardens near by but the area is grazed.

Ribtaleh: (sites 26, 27, 28) Not visited by the Welchs this is a site of three parts. In the lower site, the palms occupy a wadi site with the young in the adjacent gardens. In the upper site there are three palms remaining round a well. Three large rosettes are in the gardens just downstream on the northern side.

Eewali: (sites 21, 22, 23, 24) This is a scattered site along a long shallow valley. Downstream, around an abandoned tourist camp site area, is a group of three juveniles, an adult and another adult up a side valley. Upstream (Silbili) by gardens are three more living palm trees (two very mature) with three stumps and two dead trunks. The gardener has protected the base of one of the trees.

Bankouale Valley:

Agorogouba: At the spring site the palms share an elevated position above the wadi with dense *Phoenix reclinata*.

The Welchs' lower three sites are subsumed into the garden site, which therefore includes several adults in the wadi bottom. The rest of the palms are scattered in and around the gardens downstream of the spring site, where we recorded two adults in the wadi, six adults and 36 seedlings were found in the gardens, a solitary palm further down and a seedling some 300 m downstream.

Disay: In this site the gardens extend either side of a sharp ravine which is quite difficult to explore. The adults and juveniles are mainly in the ravine and rosettes and seedlings scattered around. Neither the Welchs nor HF in 2004 fully explored the ravine, and the numbers do not represent an increase over previous years but reflect a proper search. Two dead adults were found in 2006, yet the adult numbers have declined markedly in 20 years.

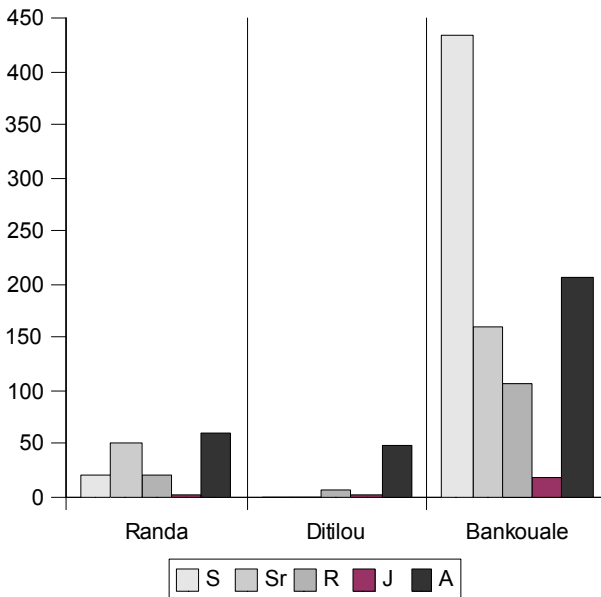
Bankouale:

Cascade and Gardens (sites 5, 6, Welch sites 1–6): This site is at the side of a spring situated a little above the wadi. Originally the palms spread on both sides of the wadi but they are now restricted to garden side (SW). Seedlings and rosettes are found in the gardens, and a few seedlings were found by the spring. Site 6 is a cluster of six palms at the entrance to a side wadi some 50 m downstream from the cascade.

Main (site 7, Welch 7, 8): This site is of some 30 adults situated in the middle of the Wadi opposite Houmet Ali's Tourist camp. A few seedlings were present at the beginning of our visit, but very few were left two weeks later, presumably grazed.

Side (site 8, Welch 9, 10, 11, 13): This site is primarily a linear site some 100m long on the south side of the wadi adjacent to the gardens with over 30 adults. The Welchs reported rosettes in the gardens of site 11 that we think are the same plants that we record as the south gardens. They do not mark them on their map nor count the plants but do mark the garden. The South gardens are particularly important as they have a developing population of juveniles, rosettes and seedlings. We did not record these in 2004. The North Garden plants were not recorded by the Welchs and represented a new site in 2004.

Valley Systems



2. Life history structures of populations within each of the main valley systems of the Goda Massif.

Satabou Lower (site 13): A cluster of six palms adjacent to and in two gardens by the entrance of the Satabou Wadi. The Ethiopian gardener asked us "Why are you interested in these palms? They don't do anything."

Satabou Upper (sites 12, 11): This site is a linear site along the upper part of the wadi. There must have been a miscount at some stage as the Welchs counted 18 adults and we counted 28 in 2004 and 32 in 2006. The seedlings and small rosettes were found in the garden, opposite our overnight camp.

Ribta Aibole (site 16): The Welchs did not visit the site but counted the adults from the road. The site is centered on a spring and several pools, but there are no adjacent gardens. There were five young adults included in the 29 adults recorded. Grazing is a particular problem.

Ribta West (site 17): This is a group of 3 palms with two dead trunks on the ground situated in a valley similar to and adjacent to Aibole.

Ditilou Valley:

Wer (site 2): The site is immediately above the gardens, but unlike the Welchs visits, we found no seedlings. Gardens are well tended and there is a large water reservoir between the gardens and the Palm grove.

Ditilou (site 1): The site, called Toha by the Welchs, is to the north side of the wadi and

by the gardens. No seedlings or young plants were found. This spring, storm waters took away considerable areas of the bank both opposite and downstream.

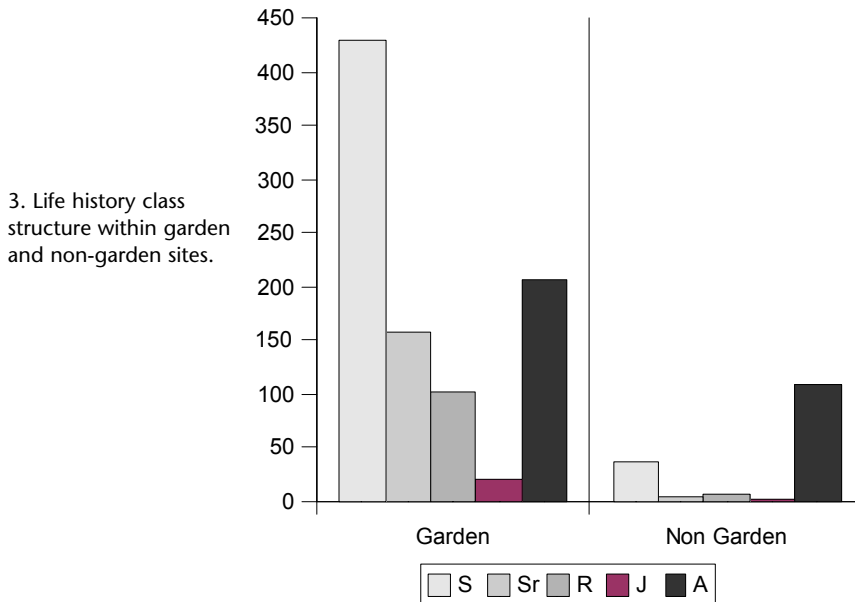
Factors Controlling the demography:

Flowering and Fruiting: All populations were flowering abundantly while we were there. We saw no floral visitors, in contrast to the swarms of bees that visited the flowers of *Phoenix reclinata*, but the plants fruit abundantly according to the locals, and this is evidenced by the large numbers of seedlings occasionally observed. The fruits are hard and pea-like (Monod 1955).

Germination and Establishment: The large number of seedlings occasionally recorded shows that germination is a frequent if not annual occurrence. Some of this variation may be accounted for by differences in the timing of the observations as it is clear that the seedlings are very susceptible to grazing. This susceptibility may account for the frequent association of *Livistona carinensis* and *Phoenix reclinata*, as the latter forms dense thickets impenetrable to the primary grazers, fat-tailed sheep, goats, cattle, camels and donkeys, and may thus provide shelter during early stages.

Seedlings and small rosettes will also be taken away in flash floods which occur with regularity. Adults can sustain damage as boulders are brought down by such floods,

Site Type



and these floods are further discussed below. The gardens, which are constantly tended and protected from grazing, also provide a vital refuge for the developing seedlings and rosettes. They illustrate the second feature of establishment: seedlings here are mainly found along irrigation channels suggesting the requirement for water for good establishment as well as possibly dispersal. Very few seedlings are found away from spring sites or gardens.

Small Rosettes and Juveniles: The transitional stages are heavily grazed outside the garden sites, but once the plants make the transition from rosette to juvenile the leaves are lifted out of the reach of grazers. Juveniles in Eewali, and Randa show that this can occur. However, the majority of sites have no juveniles.

Adults. Once the plants reach adulthood they appear to be fairly resistant to damage, and major flash floods are probably their only threat until they reach senility and natural death.

Grazing:

The opening of the Suez canal in 1869 accelerated the development of the colony the French had established in Obock in 1862. The capital of the colony was moved to Djiboutville in 1892. Over this period, the demands and opportunities provided by a large trading city have resulted in the decrease in traditional nomadic practices, whereby grazing

was migratory moving from the hills of Goda and Mabla in November and May to the Ethiopian foothills in June and October. Nomadism is now rarely practiced and grazing by cattle, fat tailed sheep, goats, camels and donkeys is continuous in the Goda Massif in general. The palm is particularly vulnerable to grazing in its young stages and over 80% of the seedlings in the wadi had disappeared in three weeks

Flood Years and El Niño:

In 1973, the village of Ribta, some 3 km downstream from Bankouale, and its associated terraces were washed away. The event remains in local history as a villager ran down the valley to warn the inhabitants and there was no loss of life or livestock. There no trace of the village remains and the site has not been repopulated. Subsequently there have many bad floods. Villagers describe how the agricultural land has been taken away. The Palms in Bankouale Wadi were in fields, and now they lie in the middle of the boulder wadi. The Bankouale cascade, currently 1 m high, was 5 m high, and the wadi filled up with boulders after heavy rain in 1997 when many of the gardens in the valley were destroyed. The wadi was dramatically widened and filled with boulders, whereas it had previously been lined with alluvial deposits. The wadi is 50 m across in many places. We asked the locals for the major rain years and in particular they

mentioned 1983. The years 1973, 1983 and 1997 correspond to the three major El Niño events in the last 40 years (University of Illinois Online Meteorology Guide). Though we have no weather records on site, this is indicative of a global effect. The ability of palms to withstand boulder damage is illustrated in Fig 4 but several palms were washed away in Bankouale in 1997 (Welch & Welch 1998), and though adults may survive, seedlings will not.

Architectural Fashion:

The disruption of the Ethiopian economy during the rule of the Derg, and then Mengistu following the famine in Wollo province (1974–1991) led to an influx of Ethiopian migrants. The Afars and Somalis are primarily nomadic peoples and many of the gardens stem from the employment of the migrant Ethiopian farmers. The traditional Afar winter house consists of a beautiful upturned coracle-like framework covered with matting woven from the leaves of Doum Palm. This can be erected by four women in eight hours. The summer houses and pavilions are a loose framework of Acacia poles with branches laid across for shade. The Ethiopian fashion was for a round house of poles about five feet (1.5 m) high, with a thatched conical roof supported on longer poles. The only suitable material for this was the Box (*Buxus hildebrandtii*) and each house requires the cutting of about 300 Box shrubs. We were told that for about ten years the valley was stripped of its Box bushes, and this cutting was stopped when the locals realized the increase in runoff that was resulting in worse flash floods. Box is recovering well in the valley, and little is being cut at the present.

Conclusions

It is clear that the Bankouale palm is under considerable threat in Djibouti. All populations are in decline, most populations have no seedlings, rosettes or juveniles and even those populations that have replacement potential are declining. Most populations have a bias towards mature individuals, which is typical of the age structure of populations which are fully stocked in the first year of recruitment resulting in an even-aged stand with doomed juveniles (Harper 1977). Throughout the site numbers of adults have declined 12–62%, with only one site showing an increase in numbers, which we believe is due to earlier miscounting. The restricted distribution of this palm may reflect a relict status from a wider distribution, but the current decline has more specific

causes associated with the occupation of the spring sites by gardens since the 1970s, the increase in devastation caused by flooding in rain years (possibly related to El Niño), which is exacerbated by removal of the Box understorey, and no doubt increased grazing since the founding of Djibouti in the 1880s.

However, the trees are long lived (Welsh & Welch 1998) and prolific. The gardens are well tended and could provide nurseries for palms as part of a conservation and education program. The gardeners also protect the palms from the worst of the flooding by banking boulders round their bases, so there is clear evidence of an awareness of the importance of the palm to the local environment, if not its global rarity. The school at Arbo, the Bankouale tourist Camp, the Arbo Association and the various gardens together provide an infrastructure which with appropriate help can be harnessed to conserve the palm.

We hope to organize such a conservation program and have been awarded a Darwin Initiative Scoping grant for the conservation of the Dai Forest, of which the conservation of the Bankouale Palm forms an important part. To initialize this effort, 3.5 kg of seeds have been collected for the Millennium Seed Bank at Wakehurst Place from an expedition funded in part by the International Palm Society. Good germination has been reported. Seed has been distributed to six botanic gardens around the world, and we hope that palm has been saved in cultivation.

Full details of the expedition, a photographic record of each palm site and tables of life history stages for all sites from 1985 to 2006 can be found at www.djiboutiflora.org by selecting Bankouale Palm from the menu.

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