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Cover Page Footnote

Heartfelt thanks to the MacArthur Foundation (Chicago, USA), and the Zimbabwe Department of National Parks & Wild Life Management for their support during this study. This paper was reviewed by Gary Haynes.

**OBSERVATIONS ON AFRICAN ELEPHANTS (*LOXODONTA AFRICANA*),
INCLUDING POSSIBLE URINE DRINKING,
DURING A SEVERE DROUGHT IN ZIMBABWE**

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INTRODUCTION

In Hwange National Park (HNP), northwestern Zimbabwe (Fig. 1), the rainy season of 1994-95 was the second driest in 77 years of record keeping. Main Camp, the headquarters of HNP, recorded 351 mm of rain between July 1994 and June 1995, compared to an annual average of 650 mm from 1918-1994. By late the following dry-season (October 1995) the drought situation was extreme. Our observations of elephant — *Loxodonta africana* — behavior during September-December 1995 revealed several previously unreported aspects of behavior relating to the severe drought conditions.

METHODS

We were resident in HNP from 4 September through 27 December 1995. Observations were made from, or adjacent to, a four-wheel-drive truck, primarily at waterholes within 75 km of Main Camp. Most of these waterholes (in Zimbabwe, some waterholes are called "pans") were fed by diesel-pumps, drawing water from subterranean reservoirs [pans are one form of waterholes; pans are natural depressions that are filled with water, whereas waterholes may be natural depressions, pools in streambeds, or artificially constructed water holding points]. Some of the most interesting observations, however, were made at Nehimba, a natural seep, where there was no pump. Visual observations and dictated notes were supplemented with Hi-8 videotape and 35 mm still-photographs.

RESULTS

By the end of the dry season (September/October/early November 1995), the only surface water in the eastern and southern portions of HNP was at pans where artificial pumping was taking place. Consequently, most of the park's elephants (population estimated at about 23,000) and other large mammals were forced to drink at these few points. Additionally, several hundred elephants — and a few individuals of other species — drank at several natural seeps, such as "Nehimba", where elephants dig holes in the sand (using their feet, trunks, and tusks) and, with their trunks, suck out the water that slowly collects there.

Although some elephants could be present at any time, the largest numbers arrived at water in the late afternoon and remained until shortly after dark. Most of our observations were between 1400 hours and sunset, but some were later on nights of full moon.

GENERAL BEHAVIOR

At pumped pans, males usually arrived singly or in small all-bull groups. Generally, they went first to the pan itself, sprayed a few cooling trunkfuls of muddy water on their chest and ears, and then went directly to the freshwater trough. Here clean, cool water issued from a pipe into a small artificial pool about 5-7 m in diameter. The

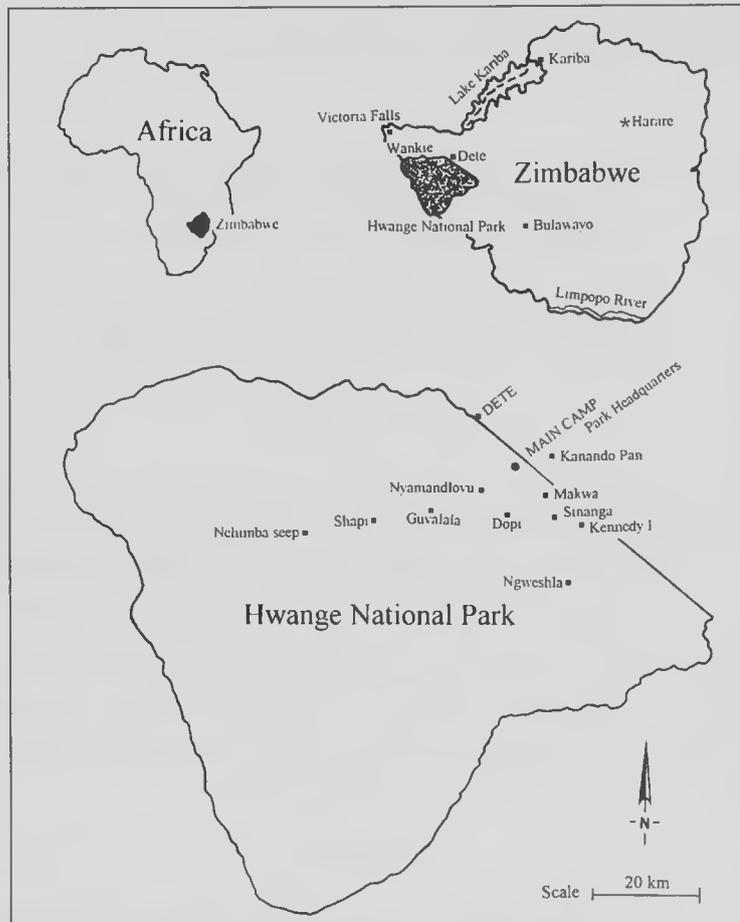


Figure 1. A map of Africa with enlargement of Zimbabwe to show location of Hwange National Park and pans within the park, especially Nehimba natural seep [artwork by Jann S. Grimes].

Figure 3 [right]. Both yellow-billed oxpeckers (*Buphagus africanus*) and red-billed oxpeckers (*B. erythrorhynchus*) perching on the back of an adult male elephant, *Loxodonta africana*. From left to right the birds are: yellow-billed oxpecker (YBO), red-billed oxpecker (RBO), RBO, YBO, YBO, RBO (from a 35 mm color-transparency; Nehimba seep, Hwange National Park, Zimbabwe; 1 October 1995).

dominant bull (usually the largest) drank directly from the pipe, by covering its end with his trunk-tip; lesser elephants either drank from the pool or waited for their turn at the pipe. Subtle threats were frequent, but overt fights were rare and of short duration. Most elephants seemed to know their rank in the social hierarchy. Occasionally, a male in musth arrived; he usually assumed dominance regardless of size, with even larger non-musth males deferring to him without contest.

Females and young usually arrived together in "breeding herds" of a dozen or so animals. They often stopped at the pan itself — a natural depression 100-200 m in diameter, into which the freshwater trough overflowed — and drank and/or mudded for several minutes. After initially quenching their thirst and cooling themselves in the pan, the female-calf groups then often mingled with the bulls at the freshwater trough, but they were usually not successful in drinking the highest quality water — directly from the pipe — as long as larger males were present. Occasionally, a female or calf was able to secure a quick drink from the pipe when the dominant male raised his trunk to swallow.

After drinking, both sexes usually returned to the pan itself for additional mudding (i.e., rolling in the mud and throwing mud on themselves with the trunk) before heading back into the bush to resume foraging. Breeding herds generally drank, mudded, and



Figure 2. A juvenile elephant takes urine directly from the penis of a large male. It then placed its trunk in its mouth and appeared to swallow the urine (from a video-frame; Nehimba seep, Hwange National Park, Zimbabwe; 7 September 1995).



returned to the bush within 20-30 minutes, whereas large bulls often hung around for hours. The bulls, being larger, did drink a larger volume of water; they seemed, however, to remain for long periods primarily in order to socialize with other males. Much time was spent in (what appeared to be) just standing together in loose groups near the freshwater trough, with occasional social interactions, rather than actually drinking.

Behavior at a natural seep was quite different from that observed at artificially pumped pans. Nehimba (Fig. 1) is a large sandy depression, approximately 400 X 200 m in area, and about 2 m below the level of the surrounding land. Here elephants excavate holes another 1-2 m down into the sand and suck up the water that collects there. Scattered over Nehimba are 30-40 holes or "sip wells" that have been dug by elephants. Most of these holes are narrow and deep, with room for the trunk of only one elephant at a time. There was no other water in the area, and competition for the individual wells was intense.

At any given time, most of the productive wells were dominated by large males, with smaller males, females, and young waiting patiently behind a drinking male or wandering from well to well. When a large male drank his fill and vacated a well, a smaller elephant may have had a few minutes to drink before being displaced by yet another large male. Sporadically, an unusually

Table 1. 1995 trips to Nehimba Pan, Hwange National Park, Zimbabwe.

Visit No.	Date	Times of Visit	Urine Use Observed (Table 2)	Oxpeckers on elephants Observed (Table 3)
1	4 SEP 95	1632-1922	yes	yes
2	7 SEP 95	1602-2040	yes	yes
3	18 SEP 95	1530-1832	no	yes
4	22 SEP 95	1518-1833	yes	yes
5	1 OCT 95	1515-1900	no	yes
6	12 OCT 95	1402-1830	no	yes
7	20 OCT 95	1345-1810	no	yes
8	4 NOV 95	1447-1948	yes	yes
9	12 NOV 95	1605-1801	no	yes [on dead only]
10	25 NOV 95	1450-1615	[no living elephants present]	

Table 2. Urine use by other elephants at Nehimba Pan, Hwange National Park, Zimbabwe.

Occurrence no.	Date (time)	Urine donor	Urine recipient	Use of urine
1	4 SEP 95 (710 hours)	adult male	10± yr. juvenile male	takes from puddle, throws on chest/ears
2	7 SEP 95 (700 hours)	young adult male	10± yr. juvenile	drinks, from puddle
3	7 SEP 95 (817 hours)	adult male	5± yr. juvenile	drinks, from penis (see Fig.2)
4	7 SEP 95 (817 hours)	adult male same as no. 3	2± yr. calf	drinks, from puddle 4 times
5	22 SEP 95 (c. 1730 hours)	adult male	8± yr. juvenile	drinks, from puddle
6	22 SEP 95 (c. 1730 hours)	adult male (same as no. 5)	8± yr. juvenile (another individual)	taken from puddle (disposition not seen)
7	22 SEP 95 (c. 1800 hours)	adult male	8± yr. juvenile	drinks, from puddle
8	22 SEP 95 (c. 1800 hours)	adult male (same as no. 7)	8± yr. juvenile (another individual)	drinks, from puddle
9	4 NOV 95 (c. 1600 hours)	adult female	2± yr. calf	drinks, from vulva (probably of mother)
10	4 NOV 95 (c. 1600 hours)	adult female (same as no. 9)	10± yr. juvenile	drinks, from puddle
11	4 NOV 95 (c. 1730 hours)	adult female	2± yr. calf	drinks, from puddle and throws on chest
12	4 NOV 95 (c. 1800 hours)	adult male	adult female (tuskless)	takes from puddle throws on chest/ears
13	4 NOV 95 (c. 1800 hours)	adult male (same as no. 12)	adult female	dabbles in puddle with trunk

Table 3. Oxpeckers (*Buphagus africanus* and *B. erythrorhynchus*) observed on elephants (*Loxodonta africana*) at Nehimba, Hwange National Park, Zimbabwe.

Occurrence No.	Date	Unidentified oxpecker	Yellowbilled oxpecker	Redbilled oxpecker	Comments
1	4 SEP 95	3	—	—	On adult male
2	7 SEP 95	—	1	—	On adult male
3	18 SEP 95	1	—	—	
4	18 SEP 95	1	—	—	On adult female
5	18 SEP 95	—	1	—	On adult male
6	18 SEP 95	1	—	—	On calf
7	18 SEP 95	2	—	—	On adult male
8	18 SEP 95	1	—	—	On adult male
9	18 SEP 95	2	2	—	On adult male
10	18 SEP 95	2	—	—	On adult male
11	18 SEP 95	1	—	—	On adult male
12	22 SEP 95	—	2	—	On adult male
13	22 SEP 95	—	2	—	On adult male
14	22 SEP 95	—	3	—	On adult male
15	22 SEP 95	2	—	—	On adult male
16	22 SEP 95	—	3	—	On calf
17	1 OCT 95	—	4	1	On adult male
18	1 OCT 95	1	—	—	On adult male
19	1 OCT 95	—	4	3	On adult male (1)
20	1 OCT 95	1	—	—	On adult male
21	12 OCT 95	—	2	—	On 8± yr. juvenile
22	12 OCT 95	—	1	—	On adult male
23	12 OCT 95	—	1	—	On adult male
24	12 OCT 95	—	1	—	On adult male
25	12 OCT 95	1	—	—	
26	12 OCT 95	2	—	—	
27	20 OCT 95	2	—	—	On adult female
28	20 OCT 95	—	6	—	On dead elephant
29	4 NOV 95	—	1	—	On adult female
30	4 NOV 95	1	—	—	On adult male
31	4 NOV 95	2	—	—	On adult male
32	4 NOV 95	—	7	—	On adult male
33	4 NOV 95	4	—	—	On adult female (2)
34	4 NOV 95	2	—	—	
35	4 NOV 95	1	—	—	
36	4 NOV 95	—	3	—	On dead elephant
37	12 NOV 95	—	4	2	On dead male

(1) See photo (Fig. 3); (2) Feeding, possibly on sore [see text].

assertive smaller animal may be successful in defending a hole against a larger one; these levels of assertiveness may depend on level of thirst as well as individual temperament.

Juveniles and calves were rarely successful in obtaining a drink from a well because of competition from larger elephants. Large males were observed — gently but firmly — pulling with the trunk or pushing with a foot to move a calf away from a well so that the bull could drink. These younger individuals sometimes succumb to starvation and thirst, after wandering for days around the area without success. They often become separated from their mother or social companions and without the necessary moisture, they do not attempt to leave the area to feed. Several dead and dying elephants — mostly juveniles and females — were seen in the area on each visit (Table 1) during September-November 1995.

URINE USAGE BY OTHER ELEPHANTS

In the Kalahari sand substrate, a puddle of urine remained on the surface for only about 40 seconds. On thirteen occasions

(Table 2) in September and November, 1995, young elephants, mostly between 2-10 years old, were observed (and video-taped) rushing up to an adult that was urinating and taking up the urine in their trunks. On two occasions, the elephant took up urine from a puddle on the ground — under a bull that was urinating — and then sprayed it on its chest and ears, apparently for the purpose of thermoregulation. On other occasions, elephants took the urine either from the ground, or directly from the penis (Fig. 2) or vulva of the urinating adult, and placed their trunk-tip in their mouth, apparently drinking the urine. These individuals seemed attracted by the sound of the urination and came quickly, often from several meters away, to collect the liquid.

OXPECKERS ON ELEPHANTS

Another observation unique to Nehimba seep was the presence of two species of small starling-like birds, yellow-billed oxpeckers (*Buphagus africanus*) and red-billed oxpeckers (*B. erythrorhynchus*), riding on or feeding from elephants (Table 3). Oxpeckers (one or both species) were seen riding on the backs of

living elephants on 35 occasions during eight visits to Nehimba between 4 September and 4 November 1995. On our ninth trip to Nehimba (12 November 1995), both oxpeckers were observed on — and in the body cavity of — a dead elephant, apparently eating flies that had gathered at the carcass. On our tenth and last trip to Nehimba (25 November 1995), no living elephants were present, and no oxpeckers were observed.

Oxpeckers were observed riding on both apparently healthy and ill elephants of both sexes and various ages. Most were observed on apparently healthy adult males. At times, both species of oxpecker shared the same elephant (Fig. 3). Generally, oxpeckers appeared to be merely riding on the elephant, perched on or near the spine in the lumbar region just behind the "sway-back". Once (Table 3: occurrence no. 33 on 4 November 1995), oxpeckers appeared to be feeding on something — possibly a sore — adjacent to the spine of an adult female. On one occasion, several oxpeckers were observed on an obviously ill (probably dying) calf about 2 years old. This elephant had several open sores and a missing tail — probably the result of hyaena bites; the oxpeckers, however, were not observed to visit these areas.

DISCUSSION

Competition for water was intense, but hostile encounters and overt fights were surprisingly uncommon among elephants in HNP. Elephants lined up and drank in an orderly fashion, with a hierarchy that seemed to be based primarily on size. Large males generally drank first, then smaller males, followed by the more assertive females. Less assertive females and juveniles drank last, if at all. Unweaned young often were unable to drink for themselves, but they apparently fared well if their mothers were successful in obtaining enough moisture for milk production. It was usually those mid-sized juveniles — too old to nurse, yet too small to compete for wells — that fared the worst. And it was these which were seen sucking up urine from adults (Fig. 2).

Urine from other elephants was sometimes thrown on the chest and ears, presumably as a mechanism of evaporative cooling. At other times, it appeared to be ingested. Under these conditions of severe moisture deprivation, the availability of urine was apparently preferable to no water at all.

Oxpeckers are common symbionts on many species of African mammals, but they are rarely found on elephants (Attwell 1966; Grobler 1980). It is often surmised that oxpeckers avoid elephants because of their sensitive skin and their intolerance of the birds (Moreau 1964; Siegfried and Brooke 1985). Before our observations at Nehimba in late 1995, I [MPK] had spent many hundreds of hours observing elephants in eastern and southern Africa without once seeing an oxpecker "on board". During 1991-1995, in an estimated 1,245 hours of elephant observations in southern Africa, we have occasionally seen several species of starling and dove riding, briefly, on elephants, but no oxpeckers. In 1992 and 1993, I [MPK] spent about 10 hours during the dry-season observing at natural seeps, such as Nehimba, without seeing oxpeckers associated with elephants; those years, however, were not under such severe drought conditions.

In Haynes (1991), the photographs on pages 173 and 174 show oxpeckers riding on elephants at Shabi Shabi ["Shabi" is a Tyua word referring to a small mushroom] seep, in HNP. Mundy and Haynes (1996) discuss these observations further, pointing out that the oxpeckers were mainly on elephants in poor condition, owing to drought. Most of the oxpeckers that we observed at Nehimba in 1995 were perching or riding on apparently healthy elephants, many of them large males. This raises the question of why oxpeckers choose to ride elephants at

seeps in HNP but are seldom seen on elephants elsewhere. Perhaps elephants at seeps during drought are so preoccupied with obtaining water that they are less intolerant of the birds. Another factor may be that at these seeps the substrate is sand only, whereas at other waterholes, mud is present. If an elephant throws a trunkful of damp sand on a bird, it is of little consequence. If mud is thrown, however, it tends to stick to the plumage and might damage it sufficiently to hinder flight. On several occasions at Nehimba, elephants were observed throwing sand at the oxpeckers on their back; sometimes the birds flew away, at other times they seemed to ignore the sand. It was apparent that, when just hitching a ride, oxpeckers usually perched on the lumbar region of the spine, just out of reach of both tail and trunk.

CONCLUSIONS

Symbiotic relationships between elephants and other species have long been observed (e.g., Rice, 1963; Quick, 1965; Sikes, 1971; Shoshani, 1992), and the data reported here augment, corroborate, and provide a new insight on elephant and oxpecker commensal, and possibly mutual, symbiotic relationships. Another class of observation is that of possible urine-drinking (uriposia) observed in young elephants. If indeed the elephants observed were drinking the urine [which contains about 2 kg of solids in the urine per day (Benedict, 1936)], there must be some mechanism in the elephant's digestive and urogenital systems to filter these salts, making the water available for absorption. Obviously the physiology of elephants is far from being understood. These observations open a host of new questions, addressing yet further adaptability of elephants under extreme drought conditions which may have been present during their long phylogenetic history.

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