

Observations on temporal glands in the African elephant (*Loxodonta africana*)

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Introduction

Short et al. (1967) reported the presence of sticks and other matter in the ducts of elephant (*Loxodonta africana*) temporal glands. This was ancient knowledge to the Wata and other Africans in eastern Kenya, and central and southern Tanzania (and probably elsewhere), to which they attributed magical meanings. Wata folklore, for example, had it that they were charms that enabled elephants to communicate soundlessly over distances of many kilometres—a magical rationalisation of an accurate observation that could not be explained by their prevailing knowledge. Many other powers have been attributed to the twigs/foreign matter e.g. that they enabled elephant to see in the dark. The twigs are much in demand by *wachawi* (witch doctors) and *waganga* (healers, seers) for use in protective amulets in both eastern Kenya and Tanzania. Kingdon (*in litt.* 2015) wrote:-

“I remember our friend George Rushby [a well-known Tanganyika game warden] saying that they were made into good luck fetishes by ivory hunters in what is now the Selous. When he questioned their efficacy the hunters pointed to the Cornish good-luck leprechaun hanging from a chain round his own neck and they all laughed.”

The data on temporal glands reported here were collected as part of a wide-ranging study of elephant biology and management that has been reported elsewhere (see Laws, Parker and Johnstone 1975 for a description and bibliography).

Methods

Between 1965 and 1967 a shot sample of 2,000 elephants was taken from two populations in Uganda’s Murchison Falls National Park: one north of the Nile (MFPN); and the other south of it (MFPS). A further 300 elephant were sampled in Kenya’s Tsavo East National Park (TENP) north of the Sabaki River in the vicinity of Koito. To randomise sampling, the first group or groups of animals encountered each day was taken regardless of their composition, and all members of a group were shot. Temporal glands from sub-samples of 191 (MFPN), 202 (MFPS) and 296 (TENP) were excised and weighed, and, in TENP only, the gland ducts of 281 animals were incised to record the presence of twigs.

Results

While an individual’s left and right temporal gland weights may differ by large amounts, there was no significant difference ($P=0.97$) between the two sides after merging the data from all three populations. For our analysis, we pooled both left and right side weights (Table 1, Fig. 1).

In females the average pooled weights of both glands increases with body size as indexed by shoulder height (Laws et al. 1975.) until the age of between 35–40, after which there is no marked trend until old age (Table 2 and Fig. 2).

In males the weight increases exponentially until the age of between 45–50 after which we have no data. Our data show a strong spike in the 25–30 age class, possibly associated with the overall growth spurt in this age group reported by Laws et al. (Table 2 and Fig 3) and the establishment of musth behaviour as reported by (Moss and Poole 1981)

By far the most striking feature of our gland data

Table 1. The pooled weight of left and right side temporal glands of 318 female and 275 male elephants from three East African populations as the average for each of 12 age classes.

Age class	0-5	>5-10	>10-15	>15-20	>20-25	>25-30	>30-35	>35-40	>40-45	>45-50	>50-55	>55
FEMALES												
n	57	47	35	39	40	34	27	14	11	14	7	2
Weight g	105	261	429	547	791	913	1168	1315	1185	1424	1307	1265
MALES												
n	80	28	34	27	41	42	7	2	11	3	0	0
Weight g	123	279	440	626	887	1531	2673	2275	2861	4334		

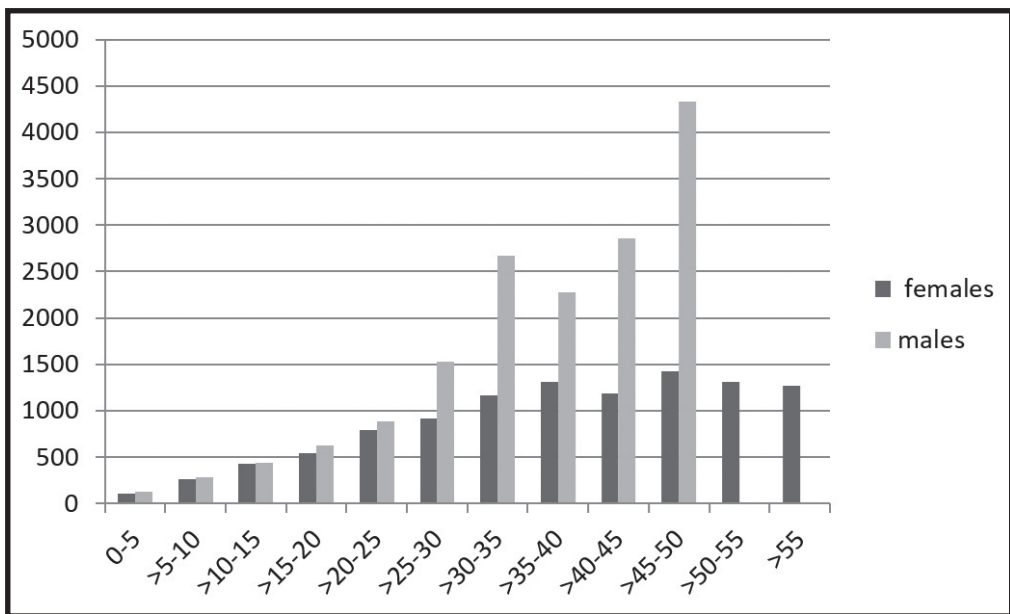


Figure 1. Temporal gland average weight at age in 327 female and 275 male elephants from 3 East African populations.

Table 2. The pooled left and right side temporal gland weights of 318 female and 275 male elephants from 3 East African populations as the lowest and highest weight recorded in each of 12 age classes.

Age class	0-5	>5-10	>10-15	>15-20	>20-25	>25-30	>30-35	>35-40	>40-45	>45-50	>50-55	>55
FEMALES												
n	57	47	35	39	40	34	27	14	11	14	7	2
Lowest wt g	24	87	177	295	210	455	430	805	840	855	916	1180
Highest wt g	306	588	760	1425	1602	2575	3650	2535	1800	3400	1780	1350
MALES												
n	80	28	34	27	41	42	7	2	11	3	0	0
Lowest wt g	38	14	175	105	450	180	375	1150	1140	1827		
Highest wt g	494	590	1115	1265	1975	2900	6260	3400	5485	7490		

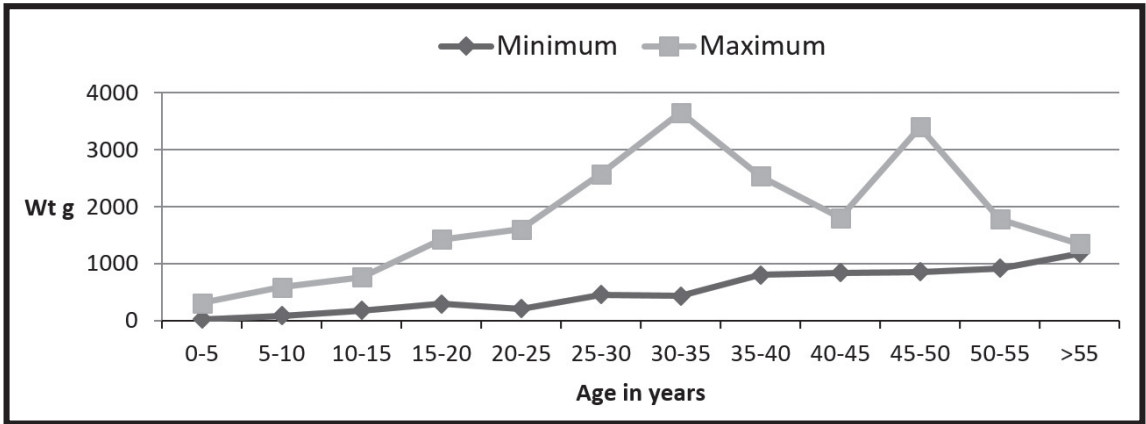


Figure 2. Maximum and minimum temporal gland weights in 327 female elephants from three East African populations

Table 3. The incidence of twigs in the temporal gland ducts of 285 elephants from Tsavo as the proportion (%) in each of 12 age classes.

Age class years	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	45-50	>50
Female	2.5	10.4	4.3	16.7	22.7	22.2	37.9	40.0	20.0	50.0	9.0
Male	2.0	12.8	13.0	9.1	30.8	37.5					

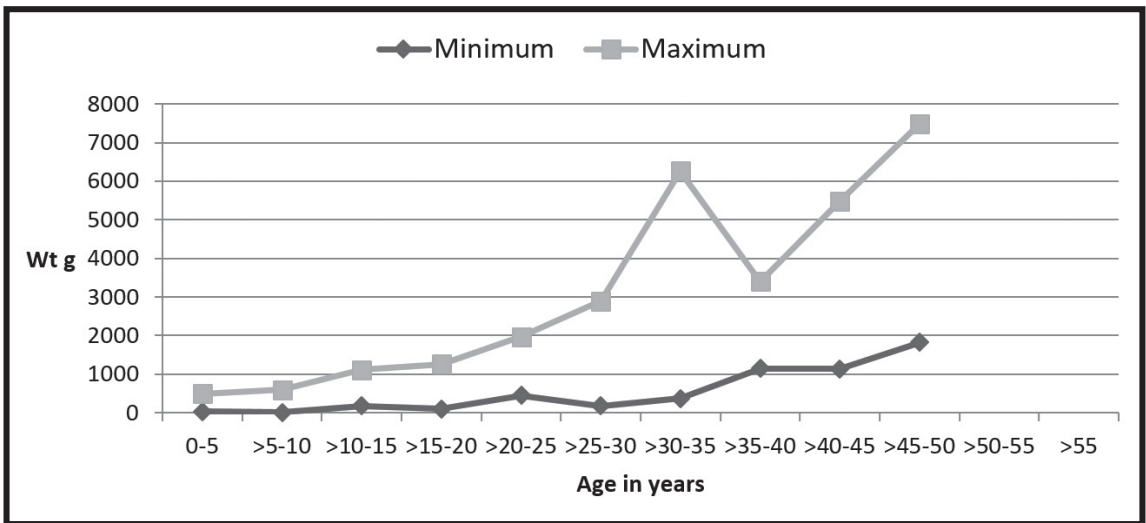


Figure 3. Maximum and minimum temporal gland weights in 275 male elephants from three East African populations.

is the enormous differences in weights-at-age in both sexes of all ages until at least the last decade of life in females, and to at least age 45-50 in males (Table 2).

The temporal gland’s central duct was examined for extraneous matter in 281 of the 296 TENP elephants sampled. Twigs were found in

the ducts of 36 (12.8%) animals, of which 32 (88.9%) had them in only one duct, and 4 (11.1%) had them in both. Of those with twigs in only one duct, more (61%) were in the right-hand duct than in the left (39%). Twig frequency broken down by sex and 5 y age class is shown in Twigs ranged in length from 1–2cm and 2–3mm in diameter. They were mostly

>1cm from the orifice, usually as a single twig, though one animal had 19 and another 16. No other extraneous material was recognised.

In females, the frequency of twigs in the temporal gland duct increased with age up to 50 years declining sharply thereafter. In males, the frequency rose to age 15, and then fell from 16 to 25, after which it rose sharply to age 35. No males older than 35 were sampled in TENP, and, in general, sample sizes for individual adult age classes were too small for these trends to be taken as definitive.

Discussion

The African elephant temporal gland was described in some detail by, among others, Sykes (1971). The gland discharges a liquid (Sykes termed temporin) visible as little more than a moist stain on the cheek below the duct's external orifice to a copious stream down the face. Discharge was observed in live animals of both sexes and all ages, but was less obvious in immatures. Within five minutes post-mortem the discharge from a mature female was recorded as 400ml of a clear, watery fluid. However, in specimen GMU 150, a male, aged 30 with a combined temporal gland weight of 1,550g the secretion was a dark, brown-buff paste, showing that its composition is variable, as reported by Poole (1987). This may be intrinsic to musth, described in the African elephant by Poole and Moss (1981), Hall-Martin and van der Walt (1984) and by Poole (1987).

The great range of temporal gland weights at age in both male and female elephants far exceeds normal variation around a mean. We regard it as more likely to reflect an active change in weight than an instantaneous sample would capture at various stages if such a change was neither seasonal nor synchronous. The TENP sample was taken over 18 days in August 1966 and we treat it as 'instantaneous', while the MFPN and MFPS samples extended over several months. As all were equally varied we regard our data, as far as it goes, as consistent with an a seasonal, asynchronous cycle of increasing and decreasing temporal gland weight that itself indexes a cycle of gland secretory activity.

This interpretation is consistent with Poole's (1987) description of cycling in the appearance of the temporal gland region in musth males. Poole recognised four stages: no obvious swelling; slight swelling; swelling pronounced; and extremely swollen and rounded puffiness beginning behind the eye and extending well beyond the skull. It is highly likely that these outward changes reflected corresponding changes in the size of the underlying gland.

While the changes associated with musth may partially account for our observations in the corresponding male age classes, the suggestion of a pronounced cycle in juvenile males and females of all ages is more consistent with a general, poorly understood scent-marking function. If the data are adjusted for the heavier body weights at age of males the cycle is of similar magnitude in both sexes.

The presence of twigs in the temporal gland ducts of Tsavo elephants of both sexes and all ages suggests that the gland functions throughout life, with the possible exception of extreme old age. We draw this conclusion because inserting a twig into a duct *post mortem* is not easy, requiring some pressure and manipulation. While Poole (*ibid*) has observed mature males actively rubbing the duct orifice against vegetation, our twig data show that the behaviour is also performed by both sexes and at all ages. They do not unequivocally indicate whether or not the twigs are deliberately inserted, as has been observed in other mammals (e.g. Thomson's gazelle *Gazella thomsoni*, Kingdon 1982), or are simply incidental. We suggest that twigs must normally be extruded fairly quickly because it is rare to encounter more than one, even though the frequency rises with age. We offer no suggestion as to whether or not the twigs are functional.

Communication between elephants at individual and all social units within a population visually, chemically, and with sound has been extensively researched. This, *inter alia*, is illustrated when local elephants periodically aggregate temporarily into large loose herds (Fig. 4; see colour plates: page vii) and revert to basic social units with the implication that there is brought about through communication between them. That they do so vocally over long distances using infrasound is well established (Moss et al. 1988), and is but one aspect. That olfaction also plays a role is supported by the observations of rubbing temporal gland orifices against vegetation to deposit temporin; our evidence of twig presence in the

gland ducts further supports this.

Olfactory deposition leaves information about the depositor and is additional to visual display and vocalising as a means of communicating within species. Using common pathways as loci for olfactory messages is widespread among mammals. Herein may be the primary reason why elephants make 'roads.' Widely commented on in popular literature, their presence in mountainous terrain has been accepted as evolving from selection of least gradients as easiest routes. Yet while this may indeed be contributory to elephant roads where there are steep slopes or broken ground, it does not explain them where the terrain is flat and there is no physiographic reason why elephants should use common pathways.

Fig. 5 & 6 (see colour plates: page vii) present two aerial photographs of elephant roads in Kenya's Tsavo East National Park, in the vicinity of Koito on the north bank of the Sabaki River. These were taken in 1964 before the collapse of the Park's elephant populations in 1971 that disrupted their social patterns. Both sets led to two drinking sites in a stretch of 20 km of seemingly homogenous and easily accessible river bank and where there were no obvious physical grounds why elephants should communally and selectively drink at them. The land for at least 40 km northward away from the river was virtually flat. The vegetation was homogenous *Commiphora/Acacia* woodland through which, given their bulk, elephants could pass easily, as might not be the case in forest with large trees, tangled lower branches and understory. In such circumstances devoid of physiographic causes for elephants to use paths, the fact that they did so is striking. We posit that whatever physical grounds there might be for their existence elsewhere, elephant roads are olfactory highways, playing a strong role in social communication and coherence.

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References

- Kingdon J. 1982. *East African Mammals: An Atlas of Speciation in Africa*. Vol IIIID. Academic Press. London.
- Hall-Martin AJ, LA van der Walt. 1984. Plasma testosterone levels in relation to musth in the African elephant. *Kodoe* 27(1)
- Laws RM, Parker ISC, Johnstone RCB. 1975. *Elephants and Their Habitats: the Ecology of Elephants in North Bunyoro, Uganda*. Oxford University Press.
- Poole JH. 1987. Rutting behaviour in African elephants: the phenomenon of musth. *Behaviour* 102:283–316.
- Poole JH and Moss CJ. 1981. Musth in the African elephant, *Loxodonta africana*. *Nature*, 292 no 5826:830–831.
- Poole JH, Payne K, Langbauer WR, Moss CJ. 1988. The social contexts of some very low frequency calls of African elephant. *Behavioural Ecology and Sociobiology* 22(6):385–392
- Short RV, Mann T, Hay F. 1967. Male reproductive organs of the African elephant, *Loxodonta africana*. *Journal of Reproduction and Fertility*, 13:517–536.