

Part II: Auctions and export from Mombasa 1960–1978: elephant ivory, rhino horn and hippo teeth

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Abstract

Elephant conservation policies in the last two decades of the 20th century and into the 21st century have focussed on extinguishing commerce in the illegal ivory trade. Yet in Uganda and Kenya prior to this, such policy was not seen as necessary. Despite a strong conservation paradigm from the very outset of the colonial era, both governments encouraged controlled trade in elephant tusks and in principle saw no conflict between it and conservation. Parts I and II of this paper illustrate aspects of policies prevailing across the colonial period, the better to understand the situation as it is today.

Twenty-three catalogues for auctions of ivory, rhino horn and hippo teeth held in Mombasa between November 1960 and June 1976 are analysed. They cover the sales made for the Kenya Government, Kenya National Parks, the Uganda Government and Uganda National Parks. Trade categories given in Part I allow for both sex and age to be assigned to tusks and yield population information on the elephants from which they came. These data also throw some light on the relative tusk sources: natural mortality, problem animal control and illegal traffic. Estimates of the revenue received are given.

Résumé

Les politiques de conservation des éléphants au cours des deux dernières décennies du 20^e siècle et au cours du 21^e siècle se sont concentrées sur l'extinction du commerce dans le trafic illicite de l'ivoire. Pourtant, en Ouganda et au Kenya auparavant, une telle politique n'était pas considérée comme nécessaire. Malgré un solide paradigme de conservation dès le tout début de l'ère coloniale, les deux gouvernements ont encouragé le commerce contrôlé des défenses d'éléphants et, dans son principe, n'ont vu aucun conflit entre celui-ci et la conservation. Les parties I et II de ce manuscrit illustrent les aspects des politiques en vigueur à l'époque coloniale, pour mieux comprendre la situation telle qu'elle est aujourd'hui.

Vingt-trois catalogues de ventes aux enchères d'ivoire, de corne de rhinocéros et d'hippopotames qui ont eu lieu à Mombasa entre novembre 1960 et juin 1976 sont analysés. Ils couvrent les ventes réalisées pour le gouvernement du Kenya, les parcs nationaux du Kenya, le gouvernement ougandais et les parcs nationaux de l'Ouganda. Les catégories commerciales indiquées dans la partie I permettent d'attribuer à la fois le sexe et l'âge aux défenses et de fournir des informations sur la population des éléphants dont elles sont issues. Ces données éclairent également les sources relatives des défenses: mortalité naturelle, contrôle des animaux problématiques et trafic illicite. Des estimations des revenus perçus sont fournies.

Introduction

In Part I we described how elephant ivory has been as much an African currency as any coinage in history. This did not change during British rule of Uganda and Kenya. Under the Imperial

British East Africa Company, it wanted to profit from ivory, but it also introduced rules for conserving and using wildlife (Kelly 1978). These were expanded when direct British Government rule replaced the Company. At the same time, before 1910, ivory sales

and fees from recreational hunting accounted for more than 50% of what became Kenya's annual income (Kelly 1978).

From the outset preserving nature was stated as an imperial obligation. This is apparent in the proceedings of the International Convention for the Preservation of Wild Animals, Birds and Fish in Africa (Anon. 1900). This was even more forcefully stated in the 6 volumes (Anon. 1906, 1909, 1910, 1911, and 1913) of correspondence presented to both Britain's Houses of Parliament between 1896 and 1913. To protect the latter, tusks under certain weights were banned from trade. Rules were laid down to protect all females and immature game animals including elephants. Recreational elephant hunting was limited to two per person per annum and commercial elephant hunting was prohibited. Sanctuaries where hunting was barred were established and by 1900 >20% of Kenya had been proclaimed game reserve where no hunting was allowed. These policies derived from game keeping as then practised on British estates (and still is) in which conserving went hand in hand with taking regular harvests.

So simple a model from managed temperate farmland was inadequate for managing the complexities of African ecology, politics, societies and history. The ambitious early goals were never supported by adequate staffing or funds and ivory's original importance progressively receded in the face of economic expansion and development in both Uganda and Kenya. As the 20th century progressed, its place where conservation was concerned was overtaken by international tourism. Yet despite the manifest policy defects in both application and philosophy (Graham 1973), at the end of 1969 the situation regarding elephants in both Uganda and Kenya was held as satisfactory. In the former a four decade-long policy of containment to sanctuaries was near completion (with estimates of total numbers of ~40,000 Watson and Parker unpublished). In Kenya the national herd was estimated at ~170,000 (Watson and Parker unpublished; Jarman 1973) and in both countries the issue of concern for elephants was of local overabundance and not scarcity.

While many influences bear on conserving elephants in both East African countries, in Part II we document the quantities and value of ivory, rhino horn and hippo teeth sold through the

Mombasa Ivory Room auctions between November 1960 and June 1976 (while there were similar auctions in previous decades we did not have access to them). We speculate on the contribution income derived may have had in the Uganda National Parks (UNP) economy and provide some information on the role natural mortality (NM)¹ may have played as a source of ivory. Outside of the limited UNP data, the role revenue from ivory, rhino horn and hippo teeth sales played in Game Department funding was not available as many records no longer exist, or such as do were not available to us.

Methods

The contents of 22 catalogues detailing the annual government auctions held in Mombasa, Kenya, between November 1960 and June 1976 and one held in Kampala in October 1971 were analysed for composition in trade terms and numbers and weights of product. Trade categories were those outlined in Part I as were the five sources Kenya Government (KG), Galana Game Management Scheme (GGMS), Kenyan National Parks (KNP), Uganda Government (UG) and Uganda National Parks (UNP). The single ivory auction held by the Uganda Government in October 1976 was similarly analysed.

Revenue was calculated using the prevailing international prices for ivory in USD documented in Parker 1979 Table 106. The price for rhino horn was taken as the price of ivory x 6, being what hunters expected when selling rhino horns lawfully hunted in Kenya, and for hippo teeth as the price of ivory x 0.6, being what was received from hippo culled in Murchison Falls National Park (MFNP 1965–67). Overall revenue was then expressed as a proportion of Uganda and Kenya's GDPs. The UNP income is shown as a proportion of a sample of UNP conservation budgets.

The sexes and ages of elephants were deduced from the trade categories as shown in Part I. The number of elephants represented by the auctioned ivory was estimated by dividing the number of whole tusks (leaving out Cut Pieces, *Chinai* and Rotten to which the following formula does not apply) by 1.88 (following Rogers et al. 1978) being the average ratio of 1-tusked to 2-tusked elephants. The number

¹Ivory/rhino horn obtained from animals that died from natural causes/mortality, otherwise referred to as "found" in Part I and II.

of elephants represented by whole tusks was analysed over time under their respective sources.

The longevity of ivory from dead animals in environments typically searched was estimated by reference to known-age skeletal material in Kenya, Uganda and Tanzania. In the absence of information on how many rhino horns may have been collected in the field as singles, the minimal number of rhino was estimated by dividing the number of horns sold by 2. No estimate was possible of how many hippo were represented by the teeth sold as those collected from shot animals and from NM varied between the two lower canines and full sets of upper and lower incisors (8) and canines (4) (Kingdon 1979).

Results

Data quality

The results of the auction analyses must be viewed with due caution owing to the likelihood of clerical errors. At the back of all catalogues quantities and weights of ivory, rhino horn and hippo teeth are summarised, but do not tally exactly with the catalogues' contents. We are aware of several dubious attributions that slightly distort tabled numbers by source. The extent of such errors cannot be assessed, and the trends apparent from our analyses must be taken as indicative only.

Value of ivory, rhino horn and hippo teeth auctioned

The prices of ivory, rhino horn and hippo teeth paid at auction for the years in question are shown in Table 1. These were used to generate the values summarised in Table 2.

Between 1960 and 1976 the Mombasa Ivory Room auction sales summed had generated USD 4,910,228 in 1976. In 2020 terms, this figure inflated by a factor of 4.75654 (derived from <https://calculator.net/inflation-calculator.html>), this would be equivalent to USD 23,355,696.

Of Kenya's GDP (USD 3.475 billion) and Uganda's GDP (USD 2.447 billion) in 1976, the auctions contributed respectively 0.1% and 0.05%. The accounts published in a sample of UNP Annual Reports for 1960, 1962, 1963, 1964 and 1968 (Anon. 1960–1968) give the income from ivory, plus rewards paid to staff for finding it, together with

Table 1. Prevailing international prices in USD per kg for ivory, rhino horn and hippo teeth.

Year	Ivory	Rhino	Hippo
1960	4.26	25.56	2.56
1961	5.37	32.22	3.23
1962	5.16	30.96	3.1
1963	5.29	31.74	3.18
1964	5.21	31.26	3.13
1965	6.08	36.48	3.65
1966	6.38	38.28	3.83
1967	5.69	34.14	3.42
1968	5.33	31.98	3.20
1969	5.77	34.62	3.47
1970	7.44	44.64	4.47
1971	10.2	61.2	6.12
1972	14.75	88.5	8.85
1973	27.75	166.5	16.65
1974	30.44	182.64	18.27
1975	31.9	191.28	19.13
1976	35.4	212.4	21.24
1977	38.43	230.58	23.06

Table 2. Summary of the value in USD of ivory, rhino horn and hippo teeth auctioned over the periods shown for each of four sources.

Source and years	Item	Weight kg	Value USD
KG 1960–1976	Ivory	212,838	2,233,058
	Rhino	5,818	425,006
	Hippo	983	6,207
Total			2,664,427
KNP 1960–1976	Ivory	58,757	811,960
	Rhino	3,628	261,970
	Hippo	15	60
Total			1,073,990
UG 1960–71	Ivory	150,687	869,688
	Rhino	223	7,263
	Hippo	1,845	3,278
Total			880,229
UNP 1960–1971	Ivory	43,475	248,673
	Rhino	223	7,618
	Hippo	10,760	35,291
Total			291,582

Table 3. The revenue from auctioned ivory, rhino horn and hippo teeth as proportions of Uganda National Parks' operating costs between 1962 and 1968. (The Wheater collection of UNP annual reports did not include 1965.)

Year	Park expenditure USD	Trophy income USD	Trophy income as % of expenditure
1962	19,940	18,556	93
1963	20,661	17,713	86
1964	42,756	19,653	45
1966	85,195	44,087	52
1967	41,082	33,941	83
1968	50,762	56,661	112
Totals	260,396	190,611	73

overall running costs (Table 3). These data show that while ivory sales were marginal to the national economy, they were a considerable contribution to overall UNP running expenses between 1960 and 1968. While KNP also clearly benefitted from the >USD 1 million received from the auctions, we do not have access to the relevant records and cannot assess the proportion it constituted of their income for that period.

Composition of auctioned ivory by source and trade category

Table 4 summarises the number of tusks, their weights, sexes and the proportion each is of their respective totals, broken down by trade category and source. The KG data only include records up to 1969 as after that date the nature of the sample was no longer comparative as many prime tusks were being sold independently by the Game Department and never reached the auction floor in Mombasa.

Weight of ivory

Fig. 1 illustrates the contribution the numbers of tusks in each trade class made to each of the four sources' total sales. Fig. 2 changes numbers of tusks in fig. 1 to weight of ivory from each trade source. The all-male *Vilaiti* and *Cutchi* are numerically (28%) the smallest trade categories, but constitute most of the ivory by weight (68%). Conversely, the all-female *Maksub* and *Cutchi* plus the mixed sex *Dandia* represent the majority (72.6%) of tusks, but only 31.9% of the ivory by weight.

Numbers of elephants represented by auctioned ivory

Table 5 and fig. 3 show the estimated number of elephants represented by the auctioned tusks broken down by source. *Chinai*, Cut Pieces and Rotten categories are excluded as unsuitable for conversion to elephant equivalents. Any time lags between acquisition in the field and sales on the auction floor will have compromised the precision of the tabled data.

Nevertheless, the estimate of 27,406 elephants contributing to the ivory auctioned is a minimal figure of mortality over the 16-year period in question. It does not include either legally or illegally hunted animals whose ivory was not auctioned, or the NM ivory recovered but sold illicitly, or tusks sold independently by the Kenya Game Department after 1969. We do not doubt that Uganda's and Kenya's combined elephant mortality over the 16 years was much greater than that indicated from the auctions.

Rhino horn

Of the total 6,015 horns sold, 60% came from KG, 38% from KNP, 2% from UG and 1% from UNP (Table 6 and fig. 4). No distinction was made in the catalogues between black and white rhino horns. As white rhino did not occur in Kenya at that time (Kingdon 1979) all KG and KNP horns are assumed to be from black rhino. As UNP had only black rhinos apart from a few white rhino introduced into MFNP in 1961 and 1964 (Wheater and Parker 2019), and as UNP horns fell within the weight range of Kenya's black rhino (1.1–1.7 kg av. 1.4 kg) we assume they were also from black rhino. The heavier UG rhino horns ranging between 1.7–2.6 kg we attribute to white rhino west of the Nile, as the horns of this species are heavier at age than in black rhino.

Hippo teeth

The number of hippo teeth auctioned and their weights (Table 7) show that 82.7% came from the hippo reduction programme in the Queen Elizabeth National Park (QENP), 11.3% came from KG sources, <0.01% from KNP and 6.0% from UG. The teeth auctioned cannot be used to calculate the number of hippo deaths for the reasons already given under Methods above.

Leaving out the UNP data whose origin in park management is well documented (Laws 2014), and the negligible KNP quantity, the KG and UG quantities indicate rising trends in production (fig. 5 and fig. 6).

Longevity of found ivory and rhino horn

There are no published records of how long a known-age tusk or rhino horn can remain findable (undamaged) under natural conditions. We know of three records of ivory in dense, cool forest lasting intact for up to 40 years (Graham and Laws (1974), Hall-Martin pers. comm. 2010), but these observations are irrelevant for the present analysis, which only considers ivory in hot savannah exposed to sun, rain, fire and scavengers. The available observations are of known-age skeletal material, which being generally less dense than ivory will not last as long, but which allow an approximation of ivory longevity to be inferred. We considered 6

observations of known age skeletal material (Table 8) from which we tentatively conclude that dense bones, and by inference marketable ivory, remains findable for ~20 years (fig. 7) in savannah receiving <500 mm rain annually, which accounts for most Kenyan elephant range. In savannah receiving >1,000 mm rain annually, as well as humidity, which accounts for most Ugandan elephant range, marketable ivory lasts only ~5 years. The small size of hippo teeth means that they will remain findable for probably ≤ 3 years at best.

Keratinous rhino horn not only weathers rapidly but is also eaten by dermestid beetles, which means it will remain findable for less time than the parent skeleton, and far less time than ivory. We arbitrarily estimate a maximum of two years even in arid localities.

Table 4. Numbers of pieces and weights of ivory auctioned in the Mombasa Ivory Room between November 1960 and June 1976 (excluding trade categories Cut Pieces and *Ganda*). All categories shown are whole tusks, except *Chinai*.

	TRADE CATEGORY									
	<i>Vilaiti</i> All-male	<i>Cutchi</i> All-male	<i>Fankda</i> All-male	<i>Calasia</i> All-female	<i>Maksub</i> All-female	<i>Dandia Male</i> & Female	Sub- total	<i>Chinai</i>	Rotten	Totals
KENYA GOVERNMENT and GALANA GAME MANAGEMENT SCHEME										
Pieces	2,732	3,526	2,780	3,702	4,182	4,368	21,290	1,008	2,806	25,104
% whole tusks	12.8	16.6	13.1	17.4	19.6	20.5	100			
% + Chin & Rot	5.9	7.6	6.0	8.0	9.0	9.4	45.9	2.2	6.0	100
Weight (kg)	71,884	47,111	19,142	25,737	14,921	5,631	184,426	6,673	15,852	206,950
% of weight	39.0	25.5	10.4	14.0	8.1	3.1	100			
% + Chin & Rot	34.7	22.8	9.2	12.4	7.2	2.7	89.1	3.2	7.7	100
KENYA NATIONAL PARKS										
Pieces	577	441	258	1,667	699	1,608	5,250	599	1,342	7,191
% whole tusks	11.0	8.4	4.9	31.8	13.3	30.6	100			
% + Chin & Rot	8	6.1	3.6	23.2	9.7	22.4	73	8.3	18.7	100
Weight (kg)	17,424	6,341	1,843	12,537	2,757	1,756	42,656	4,079	8,113	54,848
% of weight	40.8	14.9	4.3	29.4	6.5	4.1	100	7.4	14.8	22.2
% + Chin & Rot	31.8	11.6	3.4	22.9	5	3.2	77.8	7.4	14.8	100
UGANDA GOVERNMENT										
Pieces	1,006	3,126	3,289	4,794	5,419	2,986	20,620	13	836	21,469
% whole tusks	4.9	15.2	16	23.2	26.3	14.5	100			
% + Chin & Rot	4.7	14.6	15.3	22.3	25.3	13.9	96.1	0.1	3.9	100
Weight (kg)	23,602	38,814	21,904	29,864	18,250	4,019	136,453	160	6,438	143,051
% of weight	17.3	28.4	16.1	21.9	13.4	2.9	100	0.1	4.5	
% + Chin & Rot	16.5	27.1	15.3	20.9	12.8	2.8	95.4	0.1	4.5	100
UGANDA NATIONAL PARKS										
Pieces	429	693	592	1,071	1,114	1,020	4,919	238	203	5,360
% whole tusks	8.7	14.1	12	21.8	22.6	20.7	100			
% + Chin & Rot	8	12.9	11	20	20.8	19	91.8	4.4	3.8	100
Weight (kg)	11,699	9,107	3,941	7,466	3,652	1,298	37,162	1,802	2,300	41,265
% of weight	31.5	24.5	10.6	20.1	9.8	3.5	100	4.4	5.6	100
% + Chin & Rot	28.4	22.1	9.6	18.1	8.8	3.1	90.1	4.4	5.6	100
ALL SOURCES COMBINED										
Pieces	4,744	7,786	6,919	11,234	11,414	9,982	52,079	1,858	5,187	59,124
% whole tusks	9.1	15	13.3	21.6	21.9	19.2	100			

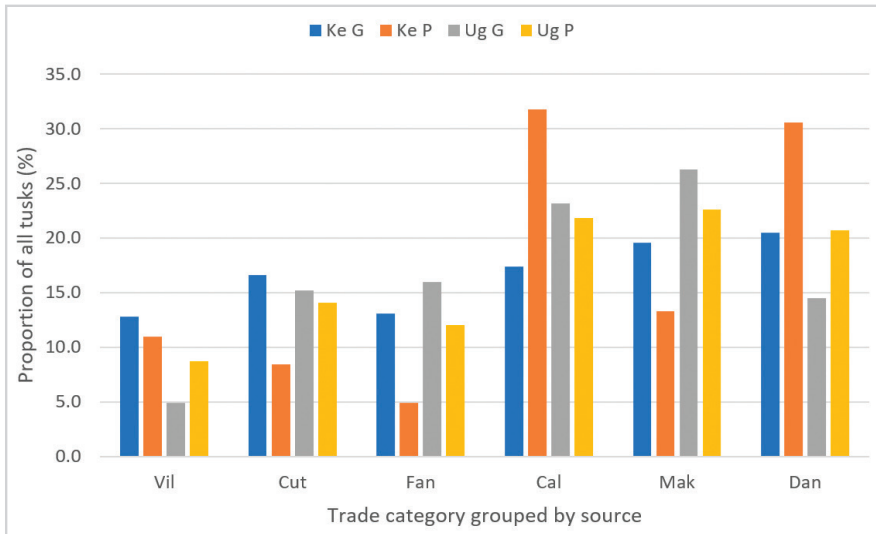


Figure 1. Number of auctioned tusks by trade category and source

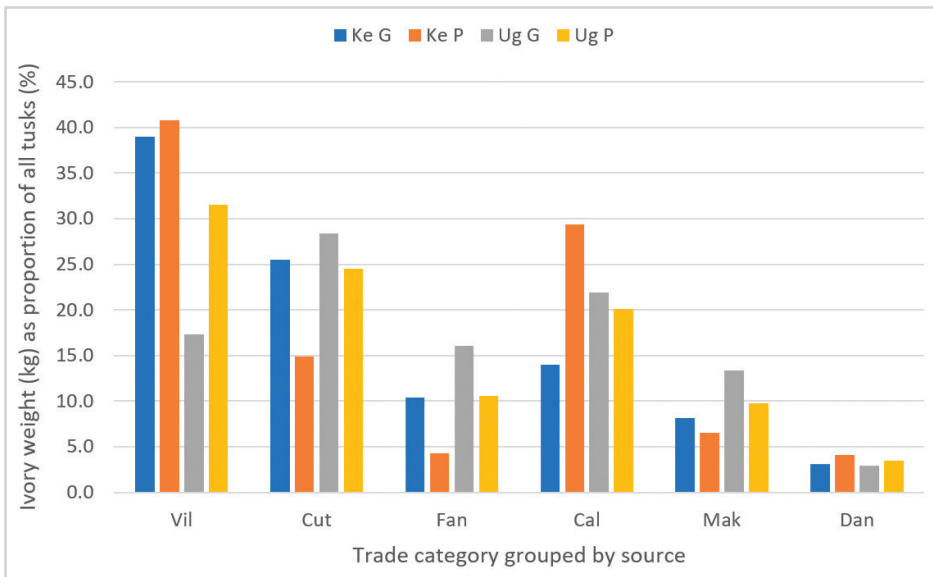


Figure 2. Weight of auctioned tusks by trade category and source

Table 5. The estimated number of elephants derived from tusks auctioned in Mombasa under their respective sources (the January 1962 figure would have been sold in 1961 but for floods delaying deliveries).

Year	Month	EQUIVALENT ELEPHANTS			
		KG and GGMS	KNP	UG	UNP
1960	November	163	135	564	115
1962	January	591			126
1962	June	239	96	721	45
1962	November	343		899	110
1963	June	543	196	369	39
1963	November	381		595	207
1964	June	516	82	1,135	39
1964	December	319		877	365
1965	May	264	62	544	165
1965	December	462	28	1,560	290
1966	June	140	184	627	72
1966	December	485		1,723	
1967	June	527	149	1,188	484
1967	December	668		166	
1968	June	366	96		371
1968	December	412			93
1969	June	280	91		
1970	June	326	93		95
1970	December	495	131		135
1971	June	526	200		
1975	July	1,015	1,248		
1976	June	1,835			
Totals		10,896	2,791	10,968	2,751

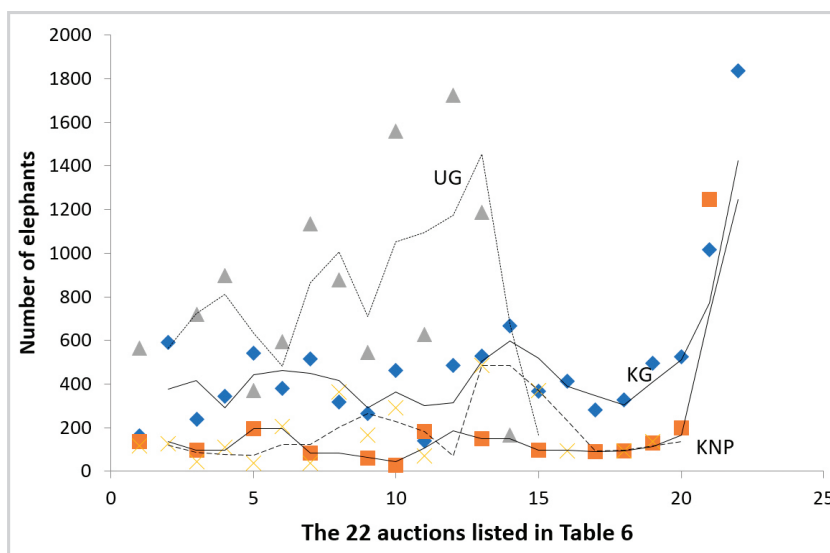


Figure 3. Number of elephants represented by the tusks sold at 22 auctions between 1960 and 1976. The four sources in Table 6 are shown separately. (Dashed line = UNP)

Table 6. Number and weight of rhino horns auctioned between November 1960 and June 1976. The number of rhino contributing the horns approximated by pieces (divided by two).

AUCTION	KG			KNP			UG			UNP		
	PCS	WT KG	AV KG	PCS	WT KG	AV KG	PCS	WT KG	AV KG	PCS	WT KG	AV KG
Nov-60	148	107.5	0.7	42	57.4	1.4	6	15.3	2.6	11	11.5	1.0
Jan-62	448	654.6	1.5	100	156.5	1.6				19	23.8	1.3
Jun-62	160	221.8	1.4	448	577.6	1.3						
Nov-62	54	65.9	1.2							6	8.4	1.4
Jun-63	110	141.6	1.3	170	215	1.3				6	8.3	1.4
Nov-63	75	97.5	1.3				4	7.1	1.8	5	7.1	1.4
Jun-64	137	192.0	1.4	70	105.3	1.5						
Dec-64	91	129.4	1.4							12	14.7	1.2
May-65	125	152.8	1.2	66	105.3	1.5				11	16.8	1.5
Dec-65	156	229.4	1.5	70	98.2	1.4	22	36.4	1.7			
Jun-66	149	216.1	1.5	123	204.2	1.7						
Dec-66	256	381.0	1.5				1	2.0	2.0			
Jun-67	124	156.6	1.3	193	282.5	1.5	77	162.7	2.1	10	19.28	1.9
Dec-67	189	274.2	1.5									
Jun-68	96	123.2	1.3	76	123.7	1.6						
Dec-68	284	301.3	1.1									
Jun-69	158	225.5	1.4	176	215.3	1.2						
Jun-70	58	76.7	1.3	42	62.6	1.5						
Dec-70	60	62.8	1.0	96	167.3	1.7				0	0	0
Jun-71	137	167.3	1.2	141	228.7	1.6						
Jul-75	69	36.9	0.5	489	845.1	1.7						
Jun-76	668	985.9	1.5									
TOTALS	3,623	4,824.7	1.3	2,302	3,444.7	1.5	110	223.6	2.0	80	109.9	1.4
Rhinos	1,812			1,151			55			40		

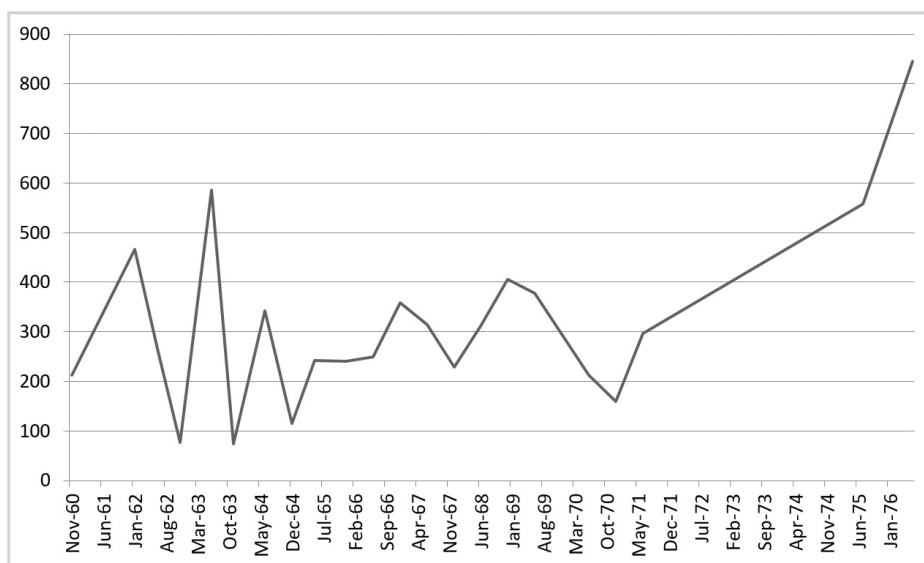


Figure 4. Number of rhino horns auctioned. All sources combined

Table 7. Number and weight of hippo teeth auctioned between November 1960 and June 1976. *An approximate number obtained by dividing the January 1962 weight by the average weight of all other UNP teeth.

AUCTION	KG			KNP			UG			UNP		
	PCS	WT KG	AV KG	PCS	WT KG	AV KG	PCS	WT KG	AV KG	PCS	WT KG	AV KG
Nov-60	111	36.2	0.3				48	30.8	0.6	742	465.3	0.6
Jan-62	47	20.9	0.4							1,246*	830.6	
Jun-62	12	4.5	0.4				30	17.7	0.6	1,207	606.0	0.5
Nov-62	295	91.2	0.3				30	17.7	0.6	1,169	620.1	0.5
Jun-63	87	32.7	0.4							560	312.5	0.6
Nov-63	0	0	0				132	60.3	0.5	488	259.5	0.5
Jun-64	85	22.7	0.3							6,776	3,055.1	0.5
Dec-64	14	7.1	0.5				184	122.5	0.7	2,022	869.1	0.4
May-65	4	1.9	0.5							284	155.6	0.5
Dec-65	4	1.9	0.5				206	89.6	0.4	1,875	814.7	0.4
Jun-66	116	62.3	0.5				237	135.4	0.6	1,171	668.0	0.6
Dec-66	117	40.4	0.3				3	1.1	0.4			
Jun-67	119	33.0	0.3				501	223.5	0.4	70	49.44	0.71
Dec-67	237	85.0	0.4				256	119.3	0.5			
Jun-68	84	27.2	0.3							3,260	1,482.9	0.5
Dec-68	0	0	0							2,675	1,106.4	0.4
Jun-69	176	57.0	0.3									
Jun-70	315	116.4	0.4	11	5.3	0.5				187	57.0	0.3
Dec-70	262	71.1	0.3	22	5.1	0.2						
Jun-71	518	147.5	0.3									
Jul-75	353	97.5	0.3									
Jun-76	109	29.8	0.3									
TOTALS	3,065	986	0.3	2,302	3,444.7	1.5	110	223.6	2.0	80	109.9	1.4

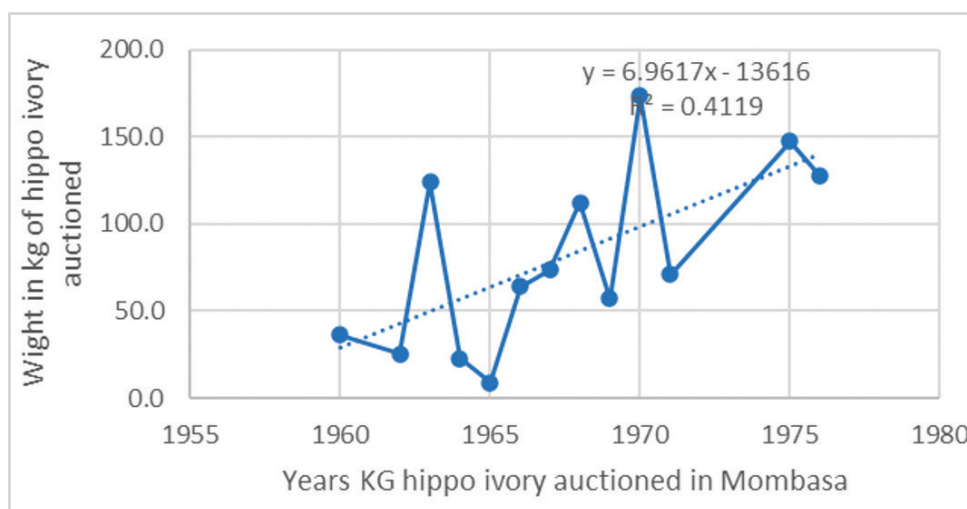


Figure 5. The weight of Kenya government hippo ivory sold between 1960 and 1976 through the Mombasa auctions

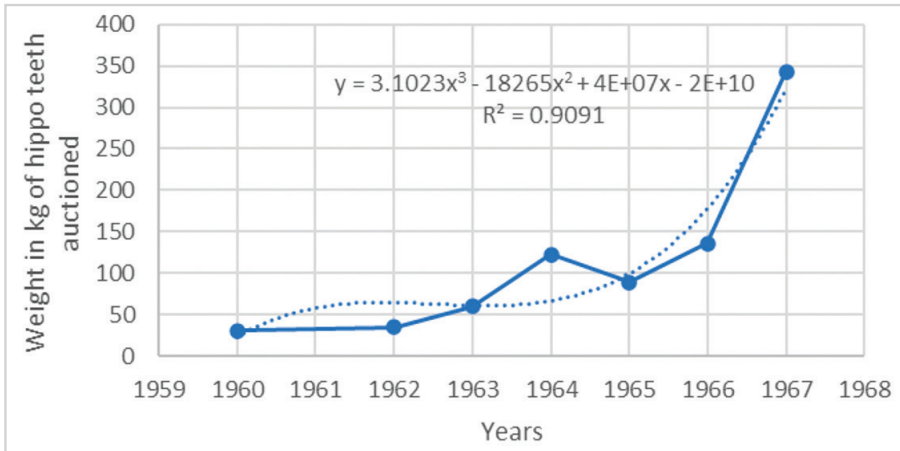


Figure 6. The weight of Uganda government hippo teeth sold between 1960 and 1967 though the Mombasa auctions

Table 8. Six examples of known longevity of dense bones in exposed situations receiving <500 mm to >1000 mm rain annually in Kenyan, Ugandan and Tanzanian localities.

MATERIAL AND CONDITIONS	LOCALITY AND RAINFALL	OBSERVATIONS
Elephant jaws placed on a rock, fully exposed, protected from fire and large scavengers.	Central Mkomasi, Tanzania. Placed on exposed rock. Rainfall <500 mm	Photographed 5 years later, little weathered.
Elephant skulls and other bones of varying ages since death. Exposed, unprotected.	Tsavo East National Park. Placed at a road junction in 1948. Rainfall <500 mm	After 15 years larger bones remained, but weathered, grey, crumbling surfaces. Lesser bones decomposed, broken or absent.
A large number of elephant bones fully exposed, unprotected.	Placed in 1966 on the border of Tsavo East National Park. Rainfall <500 mm	Photographed 15 years later (Fig 7). Intact but weathered, grey and chalky surface. Revisited after 25 years. Still evident, advanced decomposition. After 35 years only fragments remained. After 44 years nothing remained.
800 tonnes of elephant bone lightly wooded grassland, fully exposed, unprotected.	Pajero Hill, Murchison Falls National Park, 1966. Rainfall >1000 mm	Nine years later in 1976, difficult to find, mostly decomposed.
Several hundred hippo jaws. Shaded, close to water. Protected from fire and large scavengers.	On island in the Nile, Murchison Falls National Park, 1965. Rainfall >1000 mm	Three years later only fragments remained.
Black rhino jaws fully exposed, protected from fire and large scavengers.	Tsavo Research Unit in 1961–1966. Rainfall <500 mm	Photographed 7–13 years later in 1974, little weathered.



Figure 7. Elephant bones 15 years post-mortem ex-Tsavo East National Park

Discussion

Elephant Ivory

Bearing in mind the caution with which the catalogued data must be received owing to unquantifiable errors, some trends in the origin and quantity and of the auctioned material are apparent. The miniscule respective contributions of 0.1% and 0.05% to Kenya's and Uganda's GDPs in 1976 might be a reason why governments latterly took so little interest in wild animal management. Yet this parsimony was also apparent in the earliest days when ivory was contributing so much to the country's income. While KNP and UNP benefitted directly from the auction revenues, KG and UG receipts always went to general revenue and never directly invested in managing the resource. This must have contributed to the game departments' cursory and ineffectual administrations. That the auction revenue was important to national parks of both countries' during the 1960s is incontestable. In Uganda over the limited period for which we have data, it provided between 9.2% and 14% of annual running costs. While it would have been similarly beneficial to Kenya National Parks we had no access to their records, if these still exist.

The plot of elephant numbers represented by auctioned tusks (fig. 3) will encompass four different sources of elephant mortality over the period:-

- PAC (problem animal control) replaced 'control work' formerly used in East Africa, and here including the Uganda policy of only conserving elephants in designated sanctuaries and eliminating them elsewhere.
- Official culling that involved Kenya's GGMS, and UNP's elephant reduction by 2,000 in MFNP, and 300 culled in Kenya's Tsavo Park.
- Confiscations of contraband ivory from poachers in the field or from traders in illegal possession.
- NM—tusks recovered from elephant dying other than by human hand.

KG ivory auctioned came from all four sources, PAC, GGMS culling, confiscations and NM through the rewards system, but not the Tsavo culled ivory, which was sold privately. However, by the time tusks were on the auction floor it was impossible to separate them into their categories of origin.

UG ivory auctioned came overwhelmingly from PAC. No data are available on UG confiscations and recoveries from NM were very small. The much higher elephant mortality indicated by the UG data compared with the Kenya data, when Uganda's total population was estimated at ~40,000 (Watson and Parker, unpublished), or 66% less than Kenya's, reflects the four decades of government reduction efforts outside park land.

KNP ivory from the period covered by the auctions was almost exclusively from NM. After the anti-poaching campaign of 1955–57 illegal hunting in and

around the parks was minimal until after 1971.

UNP ivory auctioned, like the counterpart KNP source, was from animals found dead in the parks (MFNP, QENP and Kidepo Valley NP). The 1966–67 spike in the production pattern partly reflects the added recovery of ivory by the Wata who were experienced in this activity and were working there at the time as part of the UNP culling programme (ivory from which was not sold by auction).

Strikingly, while KNP and UNP ivory was recovered in the same manner (i.e. fortuitously in routine patrolling) and might be expected to reflect similar patterns, this is not the case. The UNP ivory content is similar to the UG pattern, inferring that it held an element of PAC ivory. This was so. Laws et al. (1975 pp. 229) document that up to 1,000 elephant annually were killed on PAC close to the MFNP south-west border, with a wounding rate of ~20% of those killed. Further, 87% of ivory found in the park was in its south-west sector in the same season that PAC took place. Thus, the UNP data were swelled by these wounded elephants that died in the park.

Knowing KNP ivory was from NM, the similarity between KNP and KG patterns implies that NM contributed substantially to KG sales as might be expected given the prevailing reward system. The two patterns share a relatively steady annual production rising abruptly towards the end of the period. In the case of KNP the huge spike was caused by the Tsavo elephant population crash in 1971. That KG shows the same spike reflects the causal drought influenced a wider area. The delay of the 1971 KG and KNP spikes not appearing on the auction floor until four years later was the consequence of holding the ivory back for administrative reasons.

NM is of particular interest, if only because while seldom mentioned it is a source of ivory and rhino horn that will exist for as long as there are elephants and rhinos. Though the early colonial administrations were aware of it, that knowledge became progressively submerged by the dogma that illegal hunting was the sole source. While hunting—lawful or unlawful—might, at least theoretically, be stopped, NM will continue and that fact needs recognition in conservation policies.

The auctioned grades of *Chinai* (broken tusks) and Rotten are particularly relevant.

Chinai results from elephant mishaps and fighting while Rotten results from NM, plus some from deaths following wounding by a hunter. While the latter is unquantifiable, for all practical purposes neither *Chinai* nor Rotten were hunted products. All sources produced both categories with their combined proportions of *Chinai* totalling 2.8% and Rotten 7.3%—a total of 10.1% of all ivory auctioned. This not only showed that NM ivory was entering via the reward system, but that NM sound tusks will have increased that proportion substantially. In this respect it is worth noting that 23% of 20,000 tusks examined in Hong Kong in 1979 were attributed to NM (Parker 1979), and only 5% of 80 tons of ivory examined in Burundi in 1985 (Parker unpublished).

Of the KG ivory, 10.9% was *Chinai* and Rotten, while for KNP it was 22.2%. UG ivory included very little *Chinai* and Rotten as would be expected because UG staff only sought live elephants and did not patrol any estate. UNP ivory contained only 10% of these categories—half that of KNP. Given the similar circumstances of finding ivory in KNP and UNP the difference is not unexpected for several reasons. In the humid climates of UNP tusks and bone do not last as long and are thus not available for as long as they are in arid Tsavo—KNP's major source. The elephant density (4/km²) of UNP was higher than in Tsavo making tusks more concentrated. UNP deployed greater manpower than KNP: 1/100 km² against 1/133 km². In comparison with MFNP and QENP where water was everywhere within 5 km, much of Tsavo is waterless through most of the year. Patrols primarily search for human trespassers who tend to stay within reach of water. Consequently, much of Tsavo was rarely covered by patrols. Finally, the rewards UNP paid their staff for finding ivory (Table 3) averaged 16% (9.8%–24.5%) of its value at auction, which was higher than the 10% paid by KNP, and ergo a greater incentive to look for it.

In MFNP the annual NM rate of tusk-bearing animals in the 1960s was approximately 5% of the population (Graham and Laws 1974). This estimate was derived from the actual age structure of the both park populations north and south of the Nile. The latter is likely to have been skewed by deaths following wounding by hunters outside the Park. In an unhunted population the NM rate may be less than 5%, but as virtually all existing populations outside parks (and some inside them) are hunted we have taken the observed rate in MFNP as the most practicable rate for

the present purpose. Merely to establish a general order but not a precise estimate, the elephant population of Kenya in the 1960s was 172,000. Assuming a similar rate of NM for Kenya, some 8600 animals per annum were dying naturally, releasing over 65,000 kg of findable ivory. How much of this was never found and how much disappeared down illegal outlets is moot. If the Tsavo recoveries were only 3.6% (Graham and Laws 1974) the bulk of what had been available was lost. Outside KNP where collection was open to whoever cared to search for it, recovery may have been far greater.

Other data indicate that was indeed the case and true finding rates from NM may well have been >20%. The coast hinterland between the Tana and Sabaki Rivers extending east–west to the Tsavo National Park supported a large elephant population contiguous with the Tsavo population. Some 7,000 km² of this area became the GGMS. This land had been used for centuries by the Wata whose culture revolved around hunting elephant. However, the Wata said (Parker 2017) that most of the ivory they traditionally acquired was found, not hunted. Successful hunters, they claimed, were a minority, and most men, plus women and older children were searchers, not hunters.

In 1957, responding to the Wata assertion that ivory was readily found, Frank William Woodley, carried out two large-scale ivory finding exercises (Holman 1978). He made two transects totalling 140 km north of the Sabaki river deploying 90 experienced men searching for ivory—not in conventional patrols of six or more men, but in pairs and singly. They found ~1,300 elephant skeletons of which ~31% still had tusks, in spite of the recent presence of large numbers of searchers as evidenced by the 117 camps also found. Clearly, the people who made them (and presumably others) had already found at least 900 of the carcasses (and removed the tusks) later reported by Woodley. It is impossible from these limited data to estimate the proportion contributed by dead elephants that had accumulated, unfound, from previous years' mortality, or the fraction they comprised of the total mortality from the population concerned. Yet they clearly confirmed Wata claims that ivory was available for finding in large quantities. At the time, Woodley assumed that he was finding

ivory from hunted animals that had been wounded and lost. Years later Woodley acknowledged that much of the ivory his patrols found could have been from NM, saying “Obviously. We just didn't think of it then.”

What did emerge from this exercise is that much of the ivory already found had been disposed of illegally. The 117 camps contained many cut-off tusk tips and butt-ends, conclusively proving the tusks were destined for the illegal market, because the latter stipulated this practice at the time, whereas legal buyers did not. However, both hunted and found ivory is prepared in this way, meaning that the tusks in question could have been found or hunted. Again, the extent of hunting cannot be estimated, but whatever it was there is little doubt that ivory from NM, just as the Wata said, was being exploited, both illegally and legally for Government rewards. Between 1960 and 1964 >50% of the GGMS tusks auctioned were found ivory (fig. 8) which supports the Woodley findings and the Wata claims.

Yet a further, independent source of information was Parker's finding that 23% of >20,000 tusks examined in Hong Kong (Parker 1979) were attributable to NM.

Low NM recoveries in national parks—MFNP 26.6%, Tsavo 3.6%, Serengeti 1% (Graham and Laws 1974)—are subjectively matched by similar rates prevailing in Tanzania's Ruaha, Zambia's Luangwa, Zimbabwe's Hwange and South Africa's Kruger, all large parks with abundant elephant. This calls for explanation. In the 1960s few parks met the IUCN criterion at the time for effective management. In areas with human densities of <50/km² patrol staff should be 1/100 km² of park. In areas of higher human densities, staffing should be proportionately greater. Staffing may give some insight into NM ivory recovery.

MFNP's patrol staff in 1970 was 30 men or 1 man/100 km² in a 3,000 km² park with an elephant density of >4 km². Further the park was well watered with no part >5 km from water. In Tsavo in 1979 the ranger patrol force was 1 man/133 km² of a 20,000 km² park with an elephant density of 1 km². However, despite being close to the IUCN standard at 1/133 km², yet the official found ivory rate was only 3.6% from a population of 23,000 elephants (Laws 2014). Most of Tsavo was >15 km from water. As patrolling in both MFNP and Tsavo was primarily oriented towards apprehending trespassers, and as such people stay within reach of water, in the latter lack of water limited the scope of patrols severely, which was not the case in MFNP. Such speculative factors may explain



Figure 8. Galana Scheme ivory prior to sending to the Ivory Room 1963. Items marked with red dots were found. Whole tusks and the rhino horns are assumed to be from natural mortality, the cut pieces were left by hunters or ivory seekers from tusks that had gone into the illegal trade and were seven or more years old. Note the colouring of some found tusks matches that of cut pieces in the foreground and likely to have been of a similar age before being found.

the disparity in NM recovery rates between the two examples and elsewhere as well.

Rhino Horn

In respect of rhino horn the Kenya Game Department in 1959 began translocating rhino from settled areas to national parks (e.g. Carter 1965 and King 2001). From that point on few rhino were shot on PAC. Thus, the auctioned KG horns were all ostensibly NM, illegally hunted and handed in as found, or confiscated.

KNP horns came primarily from Tsavo National Park which, even after a major die-off in 1961 (Laws 2014), had an estimated population of 7,000 rhino in 1968 (Goddard 1969). This should have yielded ~700 horns annually from NM, assuming a similar rate to that of elephants. The actual average finding rate of 177 annually is ~7.7% of the available horns—twice that of elephant ivory. As rhino horn is much less findable than ivory this suggests that the rhino population had been massively underestimated at 7,000. The spike in horns sold in 1962 and 1963 both by KG and KNP was caused by a severe drought in 1961. There was another drought in 1971 that caused the spike in that year and 1976 (the gap between collection and sale caused by bureaucratic intervention).

The numbers of UG horns and their high weights suggests that they are likely to have originated from white rhino west of the Nile as by

the 1960s outside UNP, Uganda had few if any black rhino left. By 1965 the only black rhino in UNP were in the MFNP population north of the Victoria Nile and ~15 in Kidepo Valley National Park (Iain Ross, Warden of KVNP at that time, pers. comm.). The average of seven horns (four rhino) seems high and if the finding rate was the same as that for elephants at 27% implies an MFNP population of around 200 in the mid-1960s.

Hippo Teeth

Concerning hippo teeth, those from KG and UG resulted from PAC, while those from UNP came from a management programme in Queen Elizabeth National Park. Hippo ivory is not as highly prized as elephant tusks, being harder and more brittle, and we know of no hippo being hunted solely for their teeth. Those collected were ancillary products from hippo killed for their flesh or in crop protection. The relatively small size of hippo teeth from NM do not last long and most deaths are probably in water and not found. We attribute the bulk of both KG and UG hippo teeth auctioned to PAC from rising human numbers creating more competition between the two species.

Conclusion

The foregoing emphasises the puzzling fact that no National Park was recovering the full potential of natural mortality ivory or rhino horn. With large

mammals' skeletal material is long-lasting. Even though tusks and rhino horns are no longer being sold we do not believe that patrol staff finding them will leave them unreported in the field. While this might account for the absence of trophies, the bones would still remain. Two explanations for not finding them suggest themselves. One is that some or most of it is actually found, either by staff or trespassers or both, but disposed of illegally. The other and more likely given limited manpower and resources, is that such surveillance as is carried out is inadequate and both commodities rot in the field. Either way, the implication is that a large lacuna exists widely in African National Park management. Either way, the implication is that surveillance of National Parks is of an altogether lesser order than generally believed.

Acknowledgements

We are indebted to the late Robin Pereira, past warden of the Ivory Room, for giving us the auction catalogues we have analysed in this paper, Roger and David Wheeler for access to their personal copies of Uganda National Park records, and to Chris Parker for proof reading and editing this text. We thank anonymous reviewers and our editor for constructive criticism.

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