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TSETSE CONTROL HUNTING IN ZIMBABWE, 1919–1958

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TSETSE, *Glossina* spp., are blood-sucking flies and the vectors of trypanosomes that cause sleeping sickness in man and nagana in cattle. Zimbabwe is one of several countries in Africa where attempts have been made to control these flies by eliminating the large wild vertebrate hosts on which they depend for food.

Spread of tsetse (mainly *G. morsitans*) in Zimbabwe in the early 1900s led to public concern as it threatened several cattle-ranching areas. A Chief Entomologist was appointed in 1909 to define the extent of the country-wide problem (Cockbill, 1964) and hunting commenced in the area of the Gwaai and Shangani river confluence in 1919.

The declared aim of this and all subsequent government hunting operations, before 1960, was to eliminate large wild vertebrates (Jack, 1914). This action was taken in the belief that a recent recession in the range of the tsetse had resulted from the rinderpest pandemic that swept through this part of Africa in 1896 decimating wild and domestic ungulates. Summers (1967), supported by Child (1968a) and Campbell and Child (1971), using historical evidence, cast doubt on this assumption, as the continuous ranges of the fly in the southern belt (Zimbabwe, the Transvaal and Botswana) and in the northern belt (Zimbabwe and Botswana) were receding before the rinderpest. Summers goes further and concludes, using early human settlement patterns, that this range had waxed and waned previously.

Tsetse control hunting operations in Zimbabwe have been well documented and provide one of the few early indices of wildlife populations in the country. This article examines these returns between 1919 and 1957/8, especially the more detailed records from 1933, with a view to determining whether the hunting was effective in eliminating large mammals and highlighting points of zoogeographical interest relating to the species that were hunted. A secondary aim is to make this data, with its biological and management implications, more accessible.

The data were extracted from the records of the Branch of the Tsetse and Trypanosomiasis Control of the Department of Veterinary Services. They are

augmented by field studies in the Sebungwe Area* between 1958 and 1964, by interviews with past and present staff of the Branch and by comparisons with similar tsetse control hunting in Botswana (Child *et al.*, 1970).

TSETSE CONTROL HUNTING 1919–1933

Table I summarizes the available returns and shows that early hunting was directed at the full spectrum of large mammals occurring in the hunting areas (Fig. 1). Over 57,000 animals from more than 36 species were shot. They included hartebeest, presumably *Alcelaphus buselaphus*, gemsbok, *Oryx gazella* and wildebeest, *Connochaetes taurinus*, taken in the Sebungwe or Shangani Reserve hunting areas, beyond the species' present range.

Red hartebeest and gemsbok are typical of the Kalahari and do not generally occur in the Zambezi drainage (Child and Savory, 1964; Wilson, 1975; Smithers, 1983). Wildebeest no longer occur in this part of Zimbabwe; the last one was shot on tsetse control in 1936. Hemans (1935) also recorded one on the headwaters of the Mzola river in this general region.

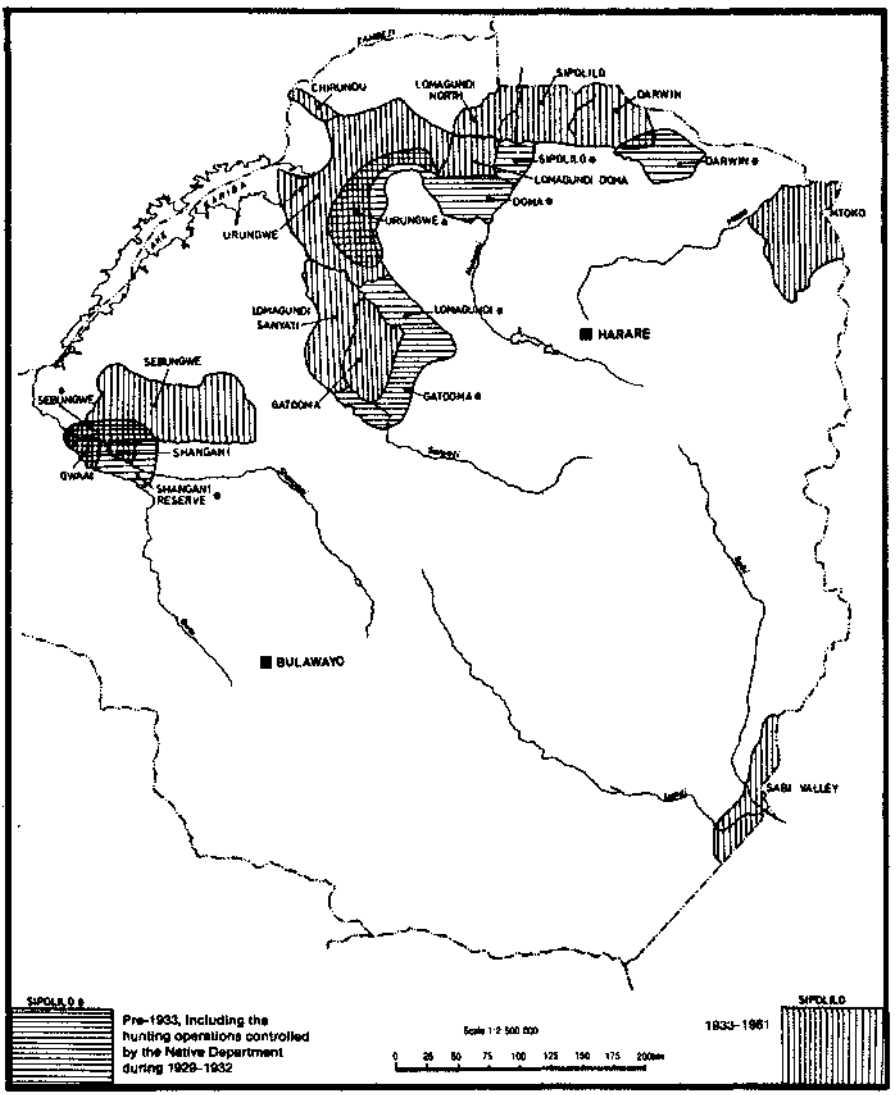
Early hunting returns contain a relatively high proportion of animals that are easy to hunt. For example, black rhinoceros, *Diceros bicornis*, made up 0.29 per cent of the total kill of 57,293 before 1933, but only 0.03 per cent of the 602,041 kills after that date. In the Darwin District, 61 were shot during the first nine years of hunting and two in the subsequent twenty-four years. This species is very sensitive to being hunted, as recruitment to the breeding segment of the population is slow (Roth and Child, 1968). Black rhino are discussed further in the next section.

Other species shot in significantly higher proportions before 1933 include sable, *Hippotragus niger*, (14.5 per cent : 5.6 per cent; $\chi^2 = 2{,}386$; $P < 0.005$), eland, *Taurotragus oryx*, (4.1 per cent : 1.6 per cent; $\chi^2 = 786.4$; $P < 0.005$), and roan, *H. equinus*, (1.9 per cent : 0.8 per cent; $\chi^2 = 260.7$; $P < 0.005$). All are large conspicuous antelope, while eland are highly mobile and well known to avoid disturbances such as those that would have accompanied tsetse control hunting. Bushpig, *Potamochoerus porcus*, (5.4 per cent : 3.1 per cent; $\chi^2 = 311.9$; $P < 0.005$) and kudu, *Tragelaphus strepsiceros*, (15.7 per cent : 13.2 per cent; $\chi^2 = 77.79$; $P < 0.005$), were also taken in higher numbers prior to 1933, although the differences are less marked.

A striking feature of these early hunting returns is the low number of elephant, *Loxadonta africana*, (2) and buffalo, *Synceros caffer*, (32) taken in periods of up to fourteen years in regions where both species are now common. The former is especially noteworthy as elephant are generally held to be important mechanical dispersal agents of tsetse. The scarcity of buffalo is remarked upon by Jack

*Many place-names have been altered in Zimbabwe; those used in this article are those that were in use during the period under review.

Figure 1: TSETSE CONTROL HUNTING AREAS, 1919–1961



Source: D. Lovemore, former head of the Branch of Tsetse and Trypanosomiasis Control.

Table I

THE RESULTS OF TSETSE CONTROL HUNTING BY SPECIES AND HUNTING AREAS BETWEEN 1919 AND 1933

	DARWIN May 1924–Mar. 1933	*LOMAGUNDI Dec. 1925–Dec. 1930*	*DOMA Jan. 1931–Mar. 1933*	*GATOOMA 1927–1930*	*GATOOMA 1931–1933*	*LOMAGUNDI S.W. Dec. 1930–Mar. 1933*	*SIPOLILO July 1924–Mar. 1933*	*SEBUNGWE (1) June 1919–Nov. 1927*	*SEBUNGWE (2) 1930–Dec. 1931*	*SEBUNGWE (3) 1931–1933*	*SEBUNGWE (4) 1930–1932*	*URUNGWE Dec. 1929–Mar. 1933*	*SHANGANI RESERVE 1930–1933*	*TOTAL*
Elephant	—	—	—	—	—	—	—	1	—	1	—	—	—	2
Rhino	61	10	6	1	1	3	8	36	15	4	12	5	7	169
Zebra	76	119	5	105	57	254	109	309	7	55	77	341	65	1,579
Bush pig	158	564	175	152	244	197	663	—	121	137	567	101	20	3,099
Warthog	216	226	161	1,078	1,400	336	164	575	137	584	30	86	256	5,249
Buffalo	8	6	—	5	—	1	—	4	1	—	—	5	2	32
Hartebeest	—	—	—	—	—	—	—	1	—	—	1	—	—	2
Tsessebe	3	31	1	1	1	—	—	209	6	67	33	15	244	611
Waterbuck	142	209	78	187	366	203	451	844	109	373	200	149	190	3,601
Reedbuck	274	213	181	11	85	40	243	281	31	220	71	82	271	2,003
Sable	913	1,012	211	576	649	510	714	281	600	486	990	709	863	8,514
Roan	163	61	16	47	33	39	11	315	7	88	96	41	170	1,087
Eland	262	293	73	104	100	207	120	145	103	25	284	309	317	2,342
Kudu	1,807	435	238	496	825	1,049	919	470	403	525	734	429	679	9,009
Bushbuck	92	166	169	131	274	264	158	194	97	346	75	29	24	2,019
Impala	6	—	—	32	91	34	8	419	48	278	64	17	213	1,210

Duiker	1,201	942	1,011	955	2,140	1,485	1,015	363	491	1,306	485	295	146	11,835
Klipspringer	107	34	58	36	147	44	153	41	45	65	5	6	—	741
Oribi	—	263	139	—	—	3	—	—	6	—	—	21	—	432
Grysbok	158	44	157	127	498	290	49	109	27	127	3	1	—	1,590
Steenbok	5	—	—	19	4	—	91	150	69	179	37	6	4	564
Wildebeest	—	—	—	—	—	—	—	4	6	—	1	—	2	13
Gemsbok	—	—	—	—	—	—	—	1	—	—	—	—	—	1
Baboon	129	69	189	111	15	—	34	133	12	220	58	3	9	982
Monkey	107	—	—	—	5	—	—	2	12	37	—	—	—	163
Hippo	—	2	—	—	—	—	—	1	—	—	—	—	—	3
Giraffe	—	—	—	—	—	—	—	—	3	—	—	—	—	3
Jackal	4	9	6	—	7	1	1	3	2	22	2	—	4	61
Caracal	—	—	—	—	—	—	—	—	—	—	—	—	4	4
Antbear	—	1	2	—	—	5	2	1	—	—	3	—	2	16
Hyena	2	2	—	—	—	—	2	3	—	—	2	—	—	11
Wild dog	11	2	8	1	—	—	4	3	1	8	3	—	5	46
Cheetah	—	—	—	—	—	—	—	1	2	—	—	—	6	9
Leopard	12	3	—	—	—	—	9	7	5	4	10	3	10	63
Lion	2	3	—	—	—	—	—	8	3	—	1	—	2*	19
Cat	63	14	13	—	5	8	—	1	2	13	4	—	—	123
Miscellaneous	5	21	—	4	2	—	9	36	4	—	1	2	2	86
TOTAL	6,087	4,754	2,897	4,179	6,949	4,973	4,937	4,951	2,375	5,170	3,849	2,655	3,517	57,293

(1914), who believed that this species took longer than most to recover after the rinderpest.

Until 1932 tsetse hunting was often supervised by the local Native Commissioner or detached Assistant Native Commissioner, as but one of their many responsibilities. This was considered unsatisfactory and from 1933 the Chief Entomologist and his staff progressively assumed direct responsibility for all hunting operations.

TSETSE CONTROL HUNTING 1933–1957/8

This section is based on the regular monthly hunting returns submitted by the area supervisors. While these data have limitations by virtue of having been assembled over twenty-six years by a number of individuals who were responsible for large areas, they do provide a valuable record of the magnitude of tsetse control hunting during this period. They also give an accurate indication of population trends among the species shot in substantial numbers, especially where this is supported by complementary evidence.

General hunting patterns by areas

Figures 2–11 summarize the total kills from the thirteen areas (Fig. 1) which were hunted between 1933 and 1957/8, inclusive. In many cases the graphs show a similar form over a given sequence of years. Sipolilo (Fig. 2), Mtoko (Fig. 3) and Lomagundi North (Fig. 4) show the early crest followed by a trough in the first two, which is characteristic of most areas, but otherwise these areas, Shangani (Fig. 5) and Gwaai (Fig. 2) are difficult to evaluate. Hunting was either of too short a duration or too few animals were shot for meaningful trends to emerge.

Figure 2: TOTAL KILLS IN THE SIPOLILO AND GWAAI AREAS

Before about 1939 patterns were dominated by the initial crest and trough. In that year four of six major hunting areas showed a trough which is not evident for Gatooma (Fig. 5), while Lomagundi/Sanyati (Fig. 6) showed a small crest. This trough preceded a reorganization of the hunting in the Darwin (Fig. 7), Lomagundi North (Fig. 4), Sebungwe (Fig. 8), and perhaps other, areas in which hunting had been in progress for some years.

Figure 3: TOTAL KILLS IN THE MTOKO AREA

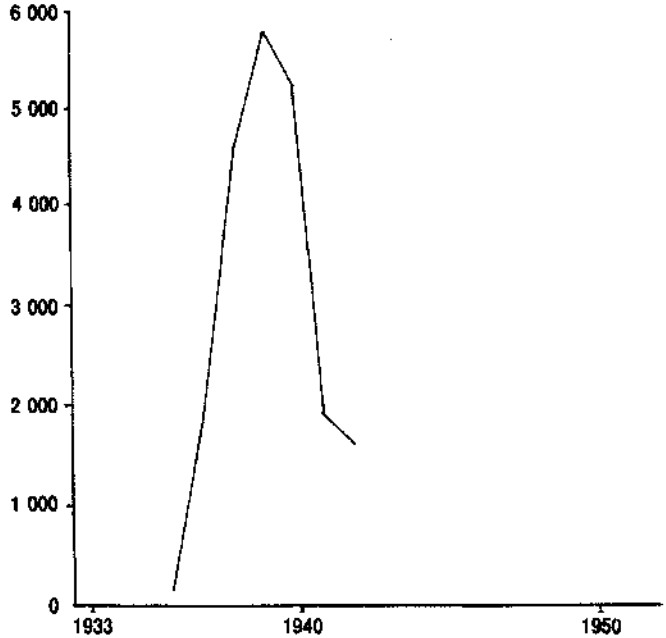
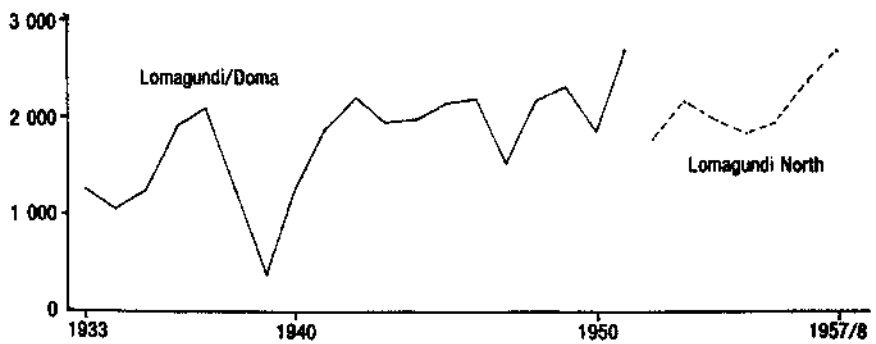


Figure 4: TOTAL KILLS IN THE LOMAGUNDI/DOMA AND LOMAGUNDI NORTH AREAS



A peak in 1945 is evident for most areas, apart from Lomagundi/Sanyati (Fig. 6) and possibly Urungwe (Fig. 9), and is followed by a trough in all areas in 1947. This coincided with a policy decision to cease hunting small antelope: steenbok, *Raphicerus campestris*, grysbok, *R. sharpei*, klipspringer, *Oreotragus oreotragus*, suni, *Nesotragus moschatus*, and oribi, *Ourebia ourebi*. Before that, these antelope contributed around 18 per cent of the total kill.

Figure 5: **TOTAL KILLS IN THE GATOOMA AND SHANGANI AREAS**

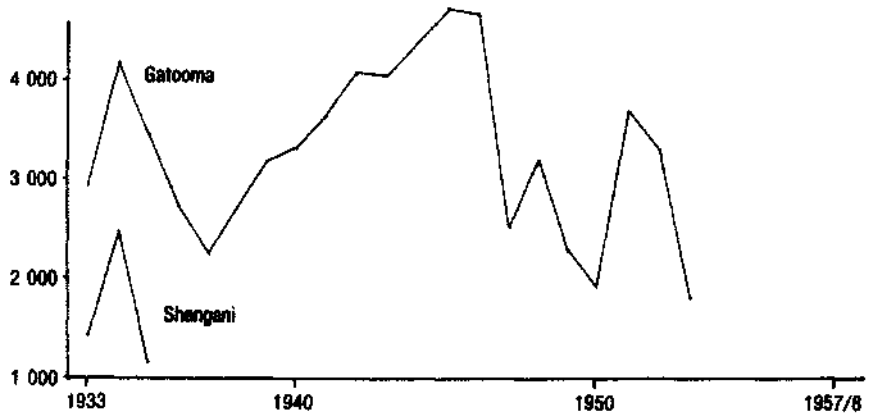


Figure 6: **TOTAL KILLS IN THE LOMAGUNDI/SANYATI AREA**

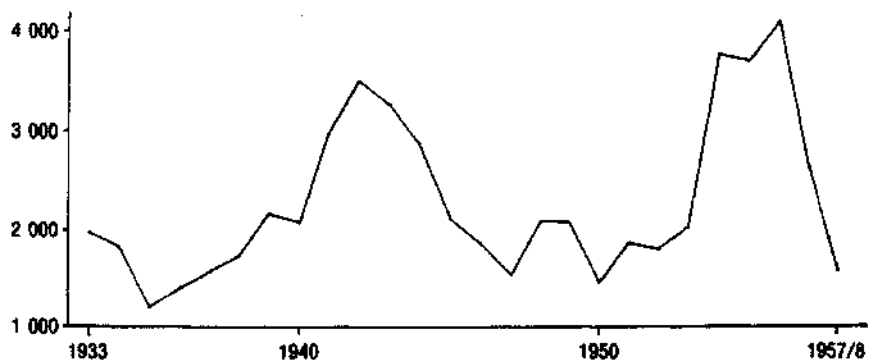


Figure 7: TOTAL KILLS IN THE DARWIN AREA

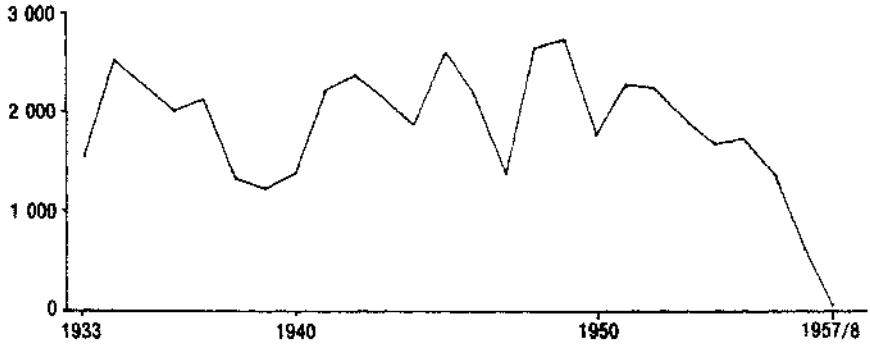


Figure 8: TOTAL KILLS IN THE SEBUNGWE AREA

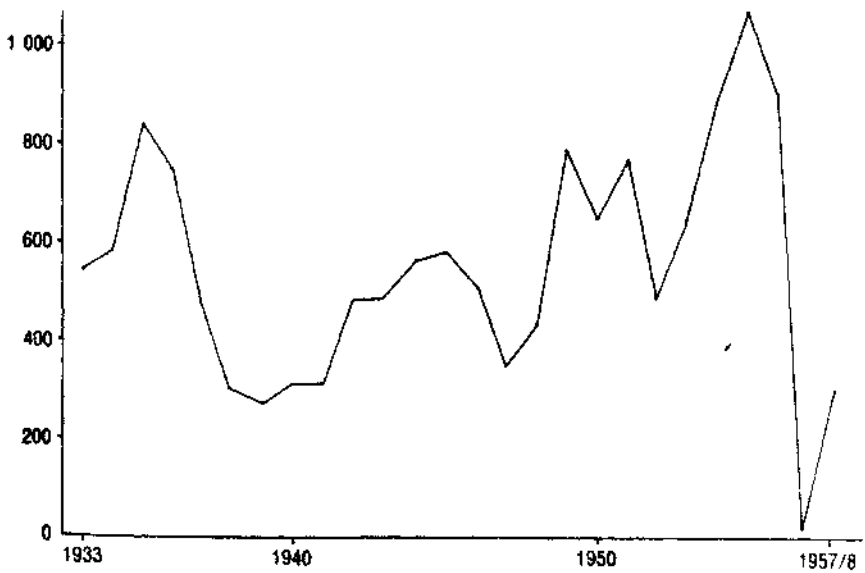


Figure 9: **TOTAL KILLS IN THE URUNGWE AREA**

Figure 10: **TOTAL KILLS IN THE CHIRUNDU AREA**

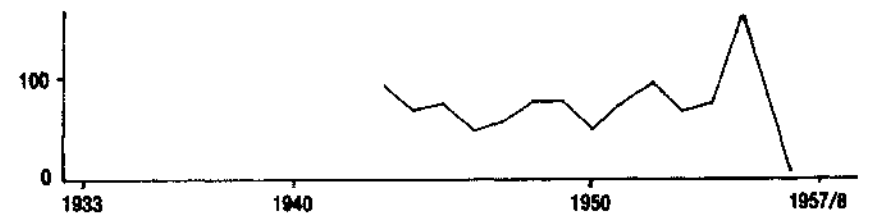
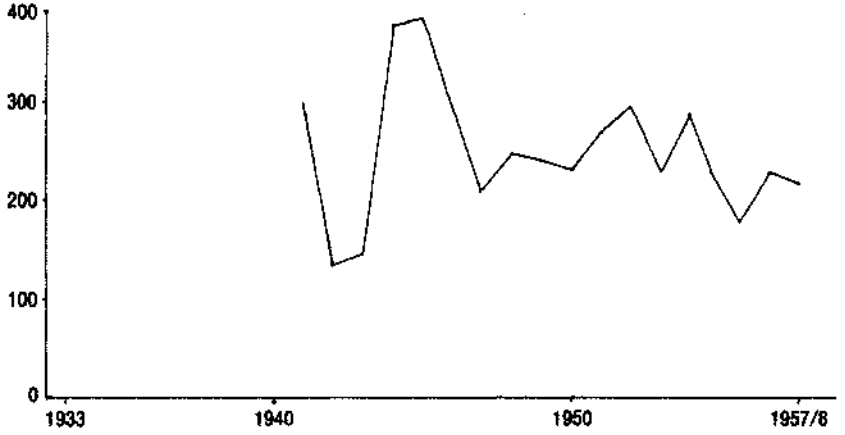


Figure 11: TOTAL KILLS IN THE SABI VALLEY AREA



All areas had a peak in 1948 and 1949, followed by a dip in 1950 and a crest in 1950/1. The 1950 low resulted from a change in the recording year so that the returns from that year were from only nine months, while the subsequent crest represented 15 months.

High kills in all but two areas from 1953/4 to 1955/6 reflected a general intensification of the hunting effort. In the Chirundu area (Fig. 10), for example, the number of hunters was doubled. The crest is absent for the Sabi Valley (Fig. 11), the only area in the south of Zimbabwe, and from Darwin (Fig. 7), where, according to Cockbill (1964), hunting was being phased out prior to its suspension during 1957.

A rapid drop-off in kills in all areas, except the Sabi Valley, during the last few years followed a Commission of Inquiry (chaired by E. Thomas) into tsetse and trypanosomiasis (Federation of Rhodesia and Nyasaland, 1955). This recommended smaller hunting areas and more emphasis on fencing to create game-free/cattle-free corridors. Many hunters were diverted to fence building. Hunting was suspended in most areas in favour of attempts to destroy tsetse habitats, through cutting of riverine vegetation in particular, and the use of insecticides such as DDT and dieldrin, but was resumed in 1964.

The sychronous behaviour of these graphs and an ability to explain many of the major fluctuations in the number of kills in terms of recorded decisions

Table II

THE RESULTS OF TSETSE CONTROL HUNTING BY SPECIES AND YEARS BETWEEN 1933 AND 1957/8

Species	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946
Elephant	2	1	6	—	—	1	—	2	1	—	2	13	12	15
Rhino	8	5	28	25	1	—	2	2	1	—	—	14	25	19
Buffalo	5	6	28	29	20	106	28	116	226	334	302	418	465	276
Zebra	273	450	370	319	280	227	221	338	353	367	385	423	391	227
Eland	424	544	484	390	233	205	153	263	475	393	356	415	342	310
Kudu	2,152	2,898	2,334	1,959	1,665	1,463	1,342	1,786	2,577	3,345	3,257	3,281	3,551	3,269
Roan	204	245	123	178	84	73	84	112	213	267	197	151	159	100
Sable	1,726	2,016	1,568	1,458	1,124	891	664	851	995	1,266	1,245	1,160	940	854
Waterbuck	707	668	534	355	397	266	303	352	543	628	589	572	496	361
Hartebeest	—	—	—	—	—	—	—	—	65	71	50	101	89	70
Wildebeest	3	11	10	1	—	—	—	—	—	—	—	—	5	9
Tsessebe	153	220	148	131	65	49	20	49	72	78	55	52	59	61
Nyala	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Impala	396	610	585	380	319	292	503	751	1,079	1,371	1,651	1,612	1,595	1,603
Reedbuck	810	966	1,035	800	759	540	459	399	548	661	592	668	761	627
Bushbuck	848	944	882	597	657	682	653	574	1,386	2,024	1,674	1,893	1,688	1,619
Duiker	4,222	5,906	7,121	7,319	5,992	4,503	4,152	3,981	4,841	6,022	6,089	6,596	7,518	6,282
Steenbok	313	431	515	680	314	65	85	97	137	129	106	237	165	203
Grysbok	990	1,316	1,399	1,268	1,763	1,385	1,612	1,542	2,224	2,531	2,585	3,456	3,177	2,275
Klipspringer	349	422	417	459	612	414	542	758	1,090	1,265	1,317	1,383	912	517
Oribi	108	93	106	110	227	186	171	145	212	191	225	182	167	104
Suni	—	—	—	—	—	—	—	—	—	7	16	47	40	33
Warthog	1,519	1,425	1,247	1,971	936	1,026	1,077	1,372	1,666	2,157	2,011	2,347	2,738	2,886
Bushpig	469	548	496	445	429	255	283	215	395	460	474	435	506	516
Baboon	599	669	1,337	1,262	1,168	1,234	1,338	1,596	1,376	1,549	1,927	1,794	2,029	1,844
Lion	3	14	6	6	5	3	2	4	5	7	7	3	2	9
Leopard	31	13	13	4	16	15	12	12	18	16	16	20	20	23
Cheetah	2	1	3	2	—	—	2	1	1	—	4	1	1	1
Hyena	9	3	7	2	1	—	1	5	4	2	4	10	17	6
Wild dog	21	20	24	17	9	2	2	1	4	2	2	4	6	9
Cat	143	224	585	463	—	1	7	3	1	—	5	—	—	2
Jackal	98	136	244	247	—	1	—	—	—	—	1	—	—	—
Lynx	2	1	7	1	2	—	—	—	—	—	—	1	—	1
Monkey	137	494	824	682	—	1	—	—	—	—	11	—	—	—
Antbear	2	6	3	2	—	—	—	1	—	—	1	—	—	—
Unclassified	144	163	150	53	—	—	6	1	—	—	1	—	—	—
TOTAL	16,871	21,687	22,616	21,825	18,060	13,906	13,724	15,329	20,510	25,143	25,157	27,269	26,086	24,351

affecting the hunting patterns suggests that the overall kill was influenced largely by prevailing policy. This is reinforced by the similarity in the form of these graphs and the patterns of kills from individual species.

Hunting by species

Table II summarizes the kills throughout Zimbabwe of individual species between 1933 and 1957/8 when some 602,041 animals from over thirty-six species were shot. Before discussing the species shot in high numbers it is interesting to examine the returns of those taken in low numbers.

Elephant: Elephant kills by area and in five- or six-year periods are summarized in Table III. As noted earlier, only two had been shot prior to 1933 and kills were low before 1943, when numbers were generally low in the Zambezi basin in Zimbabwe (Cockbill, 1964). From 1943 onwards numbers increased (Fig. 13)

Table II (continued)

Species	1947	1948	1949	1950	1950/1	1951/2	1952/3	1953/4	1954/5	1955/6	1956/7	1957/8	TOTAL
Elephant	6	33	42	5	6	20	27	55	90	121	94	54	612
Rhino	17	10	3	6	6	5	6	6	8	4	—	—	205
Buffalo	276	343	393	335	489	345	346	377	480	426	117	141	6,407
Zebra	150	314	226	219	256	259	276	313	338	304	135	75	7,461
Eland	274	287	254	225	335	267	224	291	304	266	83	54	7,851
Kudu	3,277	3,853	3,953	3,143	4,489	3,425	3,631	4,937	4,639	4,247	1,830	1,641	77,972
Roan	156	175	268	142	202	151	240	306	190	179	56	65	4,330
Sable	917	1,062	1,005	891	1,098	1,056	1,049	1,351	1,539	1,168	427	317	28,637
Waterbuck	323	371	479	340	425	305	245	301	295	343	90	61	10,371
Hartebeest	96	103	39	45	133	80	38	50	71	28	7	—	1,134
Wildebeest	—	—	—	—	—	—	—	—	—	2	1	1	43
Tsessebe	69	92	104	56	78	57	91	80	78	236	4	7	2,166
Nyala	—	—	—	—	—	—	1	8	1	—	—	14	24
Impala	1,181	1,943	2,477	2,170	2,366	1,990	2,004	2,273	2,302	1,903	447	539	34,322
Reedbuck	776	720	663	476	730	849	825	787	728	615	158	114	16,844
Bushbuck	1,475	1,711	1,841	1,297	1,988	1,611	1,623	1,794	2,066	2,252	1,194	1,047	36,380
Duiker	3,262	4,935	6,749	5,280	6,126	7,186	8,977	12,711	13,660	9,239	6,265	5,180	173,136
Steenbok	—	14	—	—	—	—	160	277	384	60	1	4	4,377
Grysbok	6	2	—	—	—	23	300	1,207	1,945	548	—	4	31,559
Klipspringer	—	—	—	—	—	14	314	969	1,385	316	1	—	13,456
Oribi	25	1	—	—	—	—	12	134	137	7	44	71	2,858
Suni	—	—	—	—	—	1	2	—	—	1	—	—	147
Warthog	2,846	3,296	3,629	2,836	3,871	3,731	3,578	4,503	4,751	4,704	3,060	2,712	67,897
Bushpig	557	737	813	595	807	575	1,124	950	1,365	1,721	1,267	683	17,140
Baboon	1,072	2,079	1,884	1,394	1,838	1,771	2,503	3,219	5,015	5,414	2,592	2,071	50,794
Lion	3	3	7	1	7	1	1	4	2	1	—	2	108
Leopard	17	19	16	13	23	10	14	19	20	23	11	6	420
Cheetah	—	2	1	3	1	3	—	—	2	2	1	—	34
Hyena	14	11	9	9	13	15	24	35	42	36	25	18	322
Wild dog	10	6	15	6	38	27	44	61	79	39	21	30	501
Cat	—	10	—	—	—	—	—	—	—	—	—	—	1,444
Jackal	1	12	1	—	—	3	—	—	—	—	—	—	744
Lynx	—	—	—	—	—	—	—	—	—	—	—	—	15
Monkey	—	—	—	—	—	—	—	—	—	—	—	—	2,159
Antbear	—	—	—	—	—	—	—	—	—	—	—	—	15
Unclassified	—	6	—	—	—	—	—	—	—	—	—	—	526
TOTAL	16,602	22,160	24,871	19,491	27,329	23,580	27,461	37,000	41,886	34,207	17,969	14,911	602,041

and authority was given for the species to be hunted, even in areas where it had previously been scarce.

Most elephant were shot by the area supervisors, who were paid a bounty of £5 for each animal killed between 1952 and 1956. This encouraged hunting outside the prescribed hunting areas and one former supervisor admitted doing so after having had to search for many miles to find elephant where they had become numerous by the late 1970s.

With improved communications and supervision of hunting at all levels, excursions outside the hunting areas became more difficult and the bounty system was abandoned. Despite this the annual off-take continued to rise, reflecting the greater availability of elephant, either inside or in close proximity to the hunting areas. This is indicative of increasing numbers of elephants in the Zambezi Valley from about 1944. This increase is supported by historical evidence (e.g.

Cumming, 1981) and has been traced by Child (1968a) and Campbell and Child (1971) for adjacent parts of Botswana, where it started around 1945.

Hunting commenced in the Sabi Valley in 1941 and the first elephant (12) were shot in 1944. None were taken between 1945 and 1952/3, but from then on the annual off-take amounted to 10, 9, 25, 50 and 37. This is a region in which elephant were not common in 1931, but where the species is now numerous and where several thousand head have been culled since 1971 to protect the woody vegetation in the Gonarezhou National Park.

Table III

ELEPHANT SHOT ON TSETSE CONTROL THROUGHOUT ZIMBABWE BY FIVE- AND SIX-YEAR PERIODS BETWEEN 1933 AND 1957/8

	Period					
Hunting Area	1933–1938	1939–1943	1944–1948	1949–1952/3	1953/4–1957/8	Total
Sebungwe	3	0	0	13	81	97
Urungwe	6	0	19	18	59	102
Gatooma	1	0	8	7	0	16
Lomagundi/Sanyati	0	3	0	0	4	7
Lomagundi/Doma/North	0	1	15	22	12	50
Chirundu	0	1	1	1	22	25
Sabi	0	0	12	0	.131	143
Darwin	0	0	6	2	1	9
Mtoko	0	0	20	39	104	163
TOTAL	10	5	81	102	414	612
Kill per 10,000 animals shot	1.06	0.6	8.4	2.3	30.1	–

Cumming (1981) shows that elephant numbers in the less-densely-peopled parts of Zimbabwe have increased dramatically from an estimated country-wide population of the order of 4,000 head in 1900 to between 50,000 and 55,000 by 1981.

Black rhinoceros: The relatively high proportion of black rhino in the total kill prior to 1933 has been noted. Of the 205 rhino shot in the next twenty-six years, 149 (72 per cent) were in the Urungwe, with 40 being killed between 1933 and 1938, as hunting operations became established, and 82 between 1944 and 1948. In 1944, and again in 1946, the Urungwe hunting area was extended into areas of good rhino habitat, where the species is still well represented, having apparently recolonized parts of the former hunting area. No rhino were trapped on islands along the eastern shores of Lake Kariba when the dam filled between 1958 and 1963, and Child (1968b) attributes this to tsetse control hunting that took place there between 1946 and 1956.

Elsewhere in the north of Zimbabwe, rhino kills declined from 27 between 1933 and 1938 to between 3 and 13 animals in subsequent five-year periods. The 13 coincided with the general intensification of hunting between 1953/4 and 1957/8, when at least one was shot well outside a hunting area by a recently recruited supervisor intent on securing a trophy. The species was apparently already locally extinct in the Sabi Valley hunting area when operations commenced there in 1941.

Child (1968b) describes how two black rhino that were in the Nagupande hunting area broke out through the perimeter game fence within a few months of the start of hunting in this area in October 1961. It is safe to conclude that tsetse control hunting decimated local black rhino populations, although the above observations suggest that a few escaped by leaving the prescribed hunting areas.

Tsessebe and hartebeest: All 1,134 Lichtenstein's hartebeest, *Alcelaphus lichtensteini*, recorded in Table II were from the Sabi Valley on the edge of the species' range, where it extends into Zimbabwe from Mozambique. After about 1949, fluctuations in hartebeest kills showed little relationship to the total kill from the area and may have been due to changes in local hunting policy.

Hartebeest seem sensitive to both habitat changes and hunting. It is now an endangered species within Zimbabwe, and 66 head were reintroduced into the Gonarezhou National Park from Mozambique in 1972 (Rhodesia, 1973). These animals were liberated to the north of the Lundi river into a portion of the former hunting area.

Although tsessebe, *Damaliscus lunatus*, occupy a similar niche to that of the two species of hartebeest (*A. lichtensteini* and *A. buselaphus*), the three species tend to replace each other geographically (Dowsett, 1966; Child *et al.*, 1972). All but eight of the 1,516 tsessebe shot on tsetse control from 1937 onwards came from the Sebungwe. It is a conspicuous and easily hunted species. Figure 21 indicates a similar sequential pattern of annual kills to that of other species from the Sebungwe with a marked peak in 1955/6, a response to intensified hunting due to the posting of a supervisor to Chiware (Cewali) for the first time in 1955.

By 1964 there were few tsessebe in the Sebungwe hunting area. This may have been due to the modification of their habitats by the seasonally early burning of the range that accompanied tsetse control hunting (Riney, 1963b). Child *et al.* (1970) have indicated that the bush encroachment that results from such burning can be detrimental to tsessebe populations.

Wildebeest: Wildebeest shot in the Sebungwe (16) and Shangani (9) prior to 1936 have been discussed. In addition 18 were taken in the Sabi Valley between 1945 and 1957/8 where the species still occurs in small numbers with a patchy distribution.

Nyala and suni: The ranges of nyala, *Tragelaphus angasi*, and suni extend into the

south-eastern lowveld of Zimbabwe from Mozambique, and 24 and 147, respectively, were shot in the Sabi Valley. In addition there are two suni skulls in the National Museum, Bulawayo, from tsetse control operations in the Gache Gatche area of Urungwe. These and the horns of two males taken in about 1939 by the late A. H. Pingstone in the Dande, midway between the Zambezi river and the southern escarpment, are the only known records of this small antelope from the Zambezi Valley in Zimbabwe.

Steenbok, grysbok, klipspringer and oribi: As already noted, these small antelope were not shot as a matter of policy between 1947 and 1951/2. Grysbok was shot in highest numbers and is discussed again below.

When the hunting of these species was resumed after 1951/2, kills were high in areas with suitable habitats, indicating that the number shot was a direct reflection of the hunting effort against them. Wilson and Child (1965) suggest that similar tsetse control hunting over a two-year period in Zambia may have stimulated population growth leading to the early stages of over-population of klipspringer.

Most oribi were taken from Urungwe (74 per cent), Lomagundi/Doma (11 per cent), and the Sabi Valley (7 per cent), with smaller numbers from Gatooma, Lomagundi/Sanyati, Darwin and Sipolilo. This pattern of kills conforms with the range of the species described by Child and Savory (1964).

Large predators: The distribution by time and area of lion, *Panthera leo*, leopard, *P. pardus*, cheetah, *Acinonyx jubatus*, hyena, probably all *Crocuta crocuta*, and wild dog, *Lycayon pictus*, shot on tsetse control are summarized in Table IV. With few exceptions, these animals were taken in all the hunting areas.

Main species hunted: Fourteen species were shot in high numbers in all or most of the hunting areas during the twenty-six-year period. The annual kills of these animals and elephant, tsessebe and grysbok are graphed in Figures 13–29. Where the off-take of a given species was high and might have influenced the shape of the graph of the total kills (Fig. 12), it is compared with the total kill less the off-take from the species under consideration.

These graphs show a remarkably consistent form for all species. Many of the common deflections also appear in the total kills from the various hunting areas and are readily explained in terms of recorded changes in hunting intensity or alterations in the limits of hunting areas.

Graphs for twelve of the sixteen species show a clear initial crest and trough, and to these may be added tsessebe (Fig. 21). This pattern is similar to that found for the total kills from individual hunting areas and is to be expected after the reorganization of the hunting in 1933 or after its introduction into new areas. A similar pattern has been reported by Child *et al.* (1970) for both the off-take and the hunter success rate for most species during the first few years of hunting in a

Table IV

THE NUMBER OF LARGE PREDATORS, INCLUDING HYENA, SHOT ON TSETSE CONTROL BY HUNTING AREAS BETWEEN 1933 AND 1957/8

		Lion		Leopard		Cheetah		Hyena		Wild dog		All	
Hunting Area	Years hunted	Total	No. per year	Total	No. per year	Total	No. per year	Total	No. per year	Total	No. per year	Total	No. per year
Chirundu	15	3	0.2	11	0.7	0	—	9	0.6	20	1.3	43	2.9
Darwin	26	6	0.2	48	1.8	7	0.3	38	1.5	56	2.2	155	6.0
Gatooma	21	7	0.3	24	1.1	2	0.1	3	0.1	10	0.5	46	2.2
Lomagundi/ Doma/North	26	5	0.2	30	1.2	3	0.1	10	0.4	10	0.4	58	2.2
Lomagundi/ Sanyati	26	6	0.2	35	1.3	3	0.1	21	0.8	30	1.2	95	3.7
Mtoko	7	1	0.1	16	2.1	1	0.1	59	8.4	50	7.1	127	18.1
Sabi	18	8	0.4	7	0.4	3	0.2	11	0.6	10	0.6	39	2.2
Sebungwe	26	45	1.7	24	0.9	7	0.3	90	3.5	155	6.0	321	12.3
Shangani Reserve	3	5	1.7	5	1.7	0	—	0	—	30	10.0	40	13.3
Sipolilo	8	1	0.1	4	0.5	0	—	1	0.1	0	—	6	0.8
Urungwe	26	21	0.8	214	8.3	8	0.3	78	3.0	113	4.3	434	16.7
Other		0	—	2	—	0	—	2	—	17	—	—	
TOTAL	—	108	—	420	—	34	—	322	—	501	—	—	

Figure 12: TOTAL KILLS IN ALL HUNTING AREAS

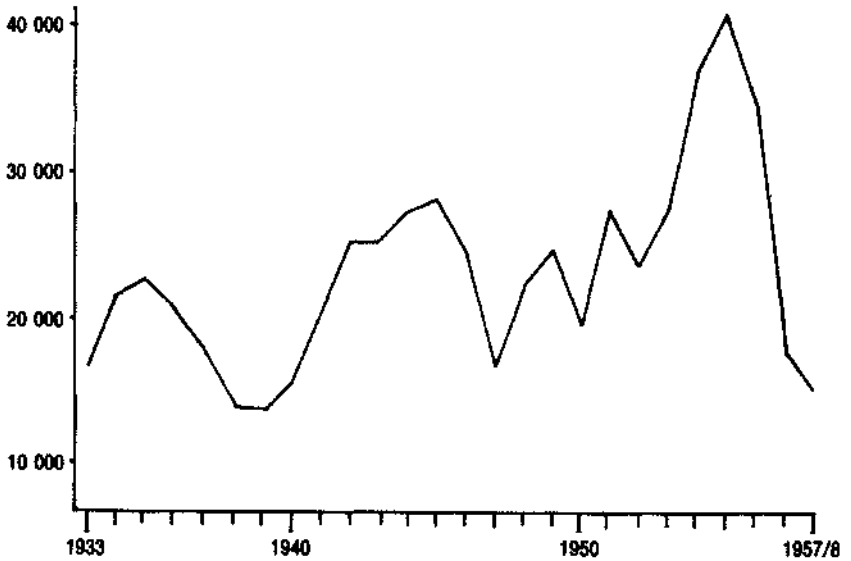


Figure 13: ELEPHANT KILLS IN ALL HUNTING AREAS

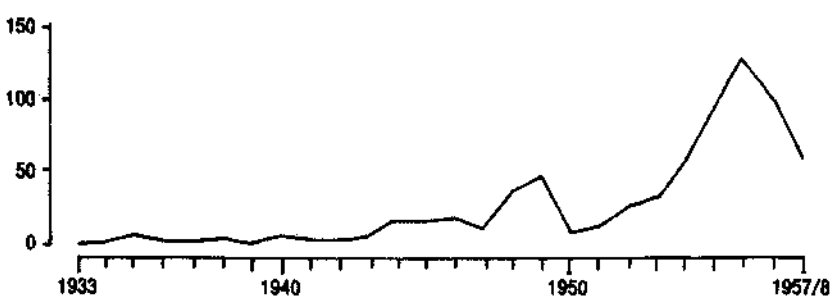


Figure 14: **BUFFALO KILLS IN ALL HUNTING AREAS**

Figure 15: **ZEBRA KILLS IN ALL HUNTING AREAS**

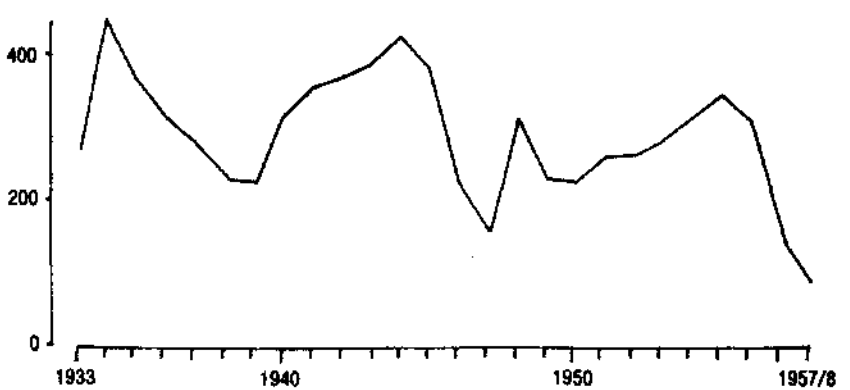


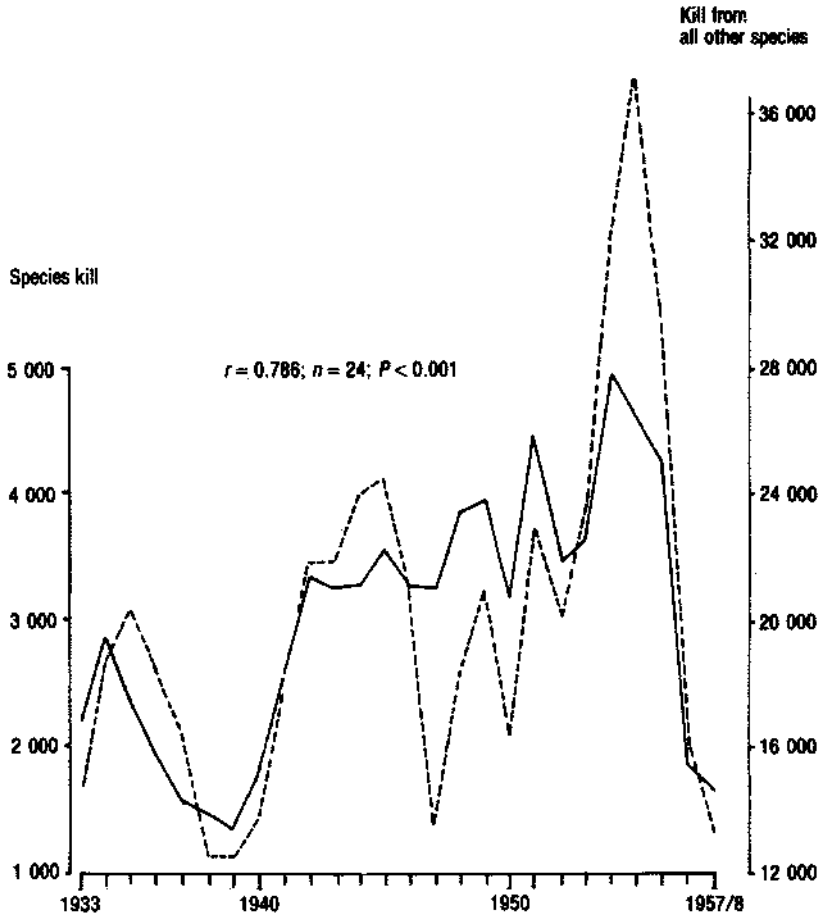
Figure 16: ELAND KILLS IN ALL HUNTING AREAS

tsetse control area in Botswana. Baboon, *Papio ursinus*, (Fig. 26) was an exception and these deflections were poorly-developed for elephant (Fig. 13), buffalo (Fig. 14) and grysbok (Fig. 29). The first two were, however, shot in low numbers before 1940, while baboon and grysbok would have been less-favoured prey while hunting remained relatively easy. Apart from this exception, grysbok kills showed a close correlation with those of other species before the hunting of these small antelope was suspended in 1946. .

The characteristic crest between 1940 and 1946 was only partially due to the introduction of hunting in the Sabi Valley and Chirundu areas, as it is evident for most of the major hunting areas where it was attributable to some reorganization of the hunting. The crest is present for all sixteen species, but the following low in 1947 is weak in kudu (Fig. 17) and warthog, *Phacochoerus aethiopicus*, (Fig. 27), and absent for sable (Fig. 20), roan (Fig. 18), reedbuck, *Redunca arundinum*, (Fig. 23), and bushpig (Fig. 28). Returns for 1941 for several species are a mean of the 1940 and 1942 figures and should be used with caution as it is possible that some data were lost.

The change in the recording year in 1950 led to a dip followed by a crest for

Figure 17: KUDU KILLS IN ALL HUNTING AREAS



all species, similar to that noted for total kills by areas. Increased hunting intensity around 1954 produced the expected response from all species with record kills achieved in nine of the sixteen species. Of the remainder, sable kills (Fig. 20) were highest at the beginning of the twenty-six-year period; reedbuck (Fig. 23) were high then, but more so in 1945 and 1947, while the highest impala, *Aepyceros*

Figure 18: **ROAN KILLS IN ALL HUNTING AREAS**

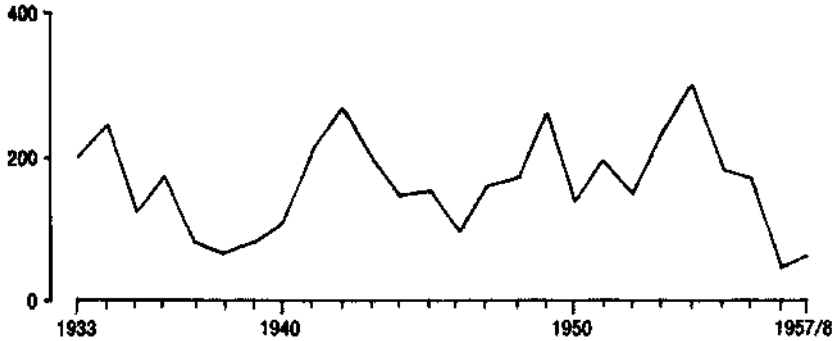


Figure 19: **WATERBUCK KILLS IN ALL HUNTING AREAS**

Figure 20: SABLE KILLS IN ALL HUNTING AREAS

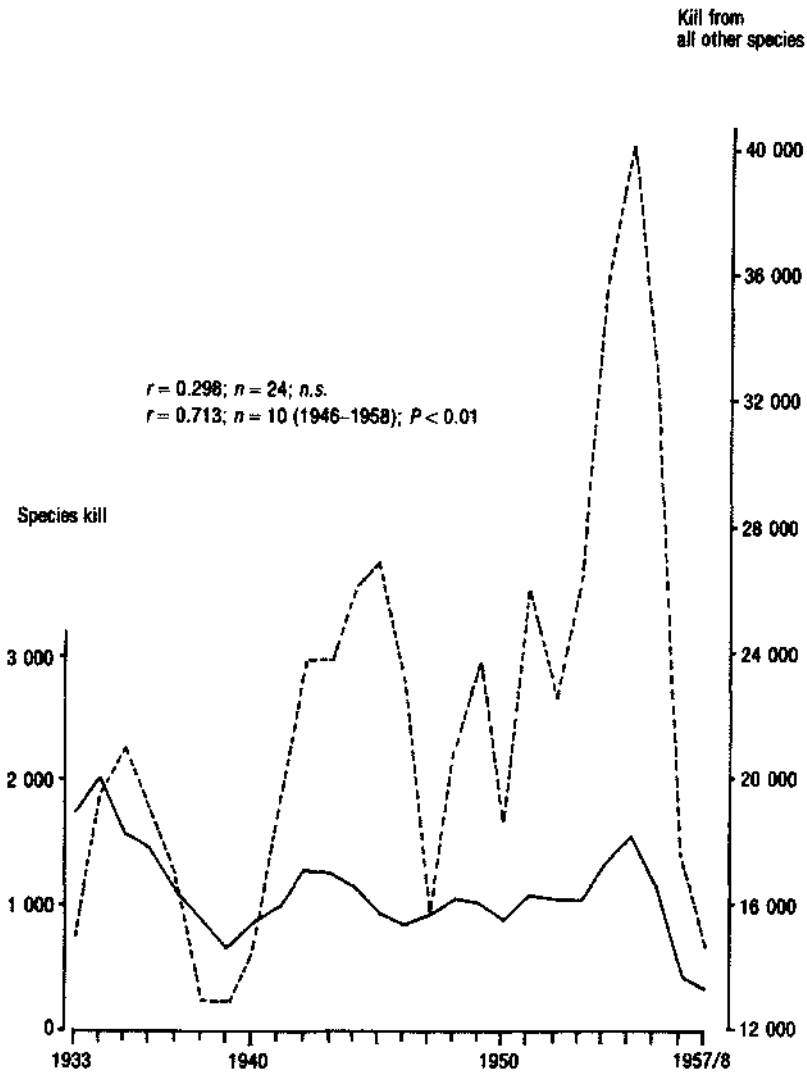
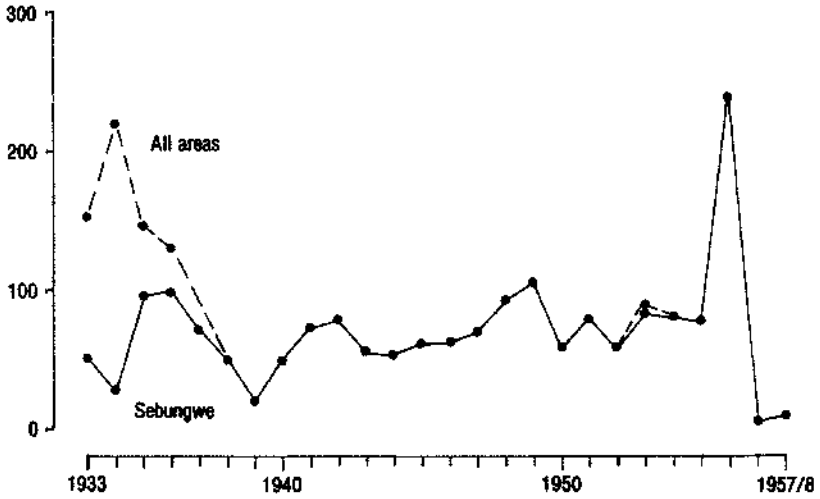


Figure 21: **TSESSEBE KILLS IN ALL HUNTING AREAS**



Note: With the exception of eight tsessebe recorded from the Gatooma Area in 1952/3, these records came exclusively from the Sebungwe Hunting Area.

melampus, (Fig. 22), and buffalo (Fig. 14) kills were between 1948 and 1950/1, and between 1945 and 1950/1, respectively. Eland (Fig. 16), zebra, *Equus burchelli*, (Fig. 15), and waterbuck, *Kobus ellipsiprymnus*, (Fig. 19), while reflecting the immediate crests and troughs common to other species, were generally shot in diminishing proportions towards the end of the twenty-six-year period. Implementation of some of the recommendations in the Thomas Report (Federation of Rhodesia and Nyasaland, 1955) resulted in a dramatic decline in the kills from all sixteen species (apart from bushpig and elephant in the penultimate year), similar to the overall kills from areas in the Zambezi basin.

The high degree of synchronization in the pattern of annual kills of the sixteen main species hunted on tsetse control, and between these and the total annual kill from the individual hunting areas, indicates that the results of the hunting were a reflection of the pattern and intensity of the hunting. It is now appropriate to examine the kills from individual species from two selected hunting areas to establish whether or not they conform to these patterns.

Figure 22: **IMPALA KILLS IN ALL HUNTING AREAS**

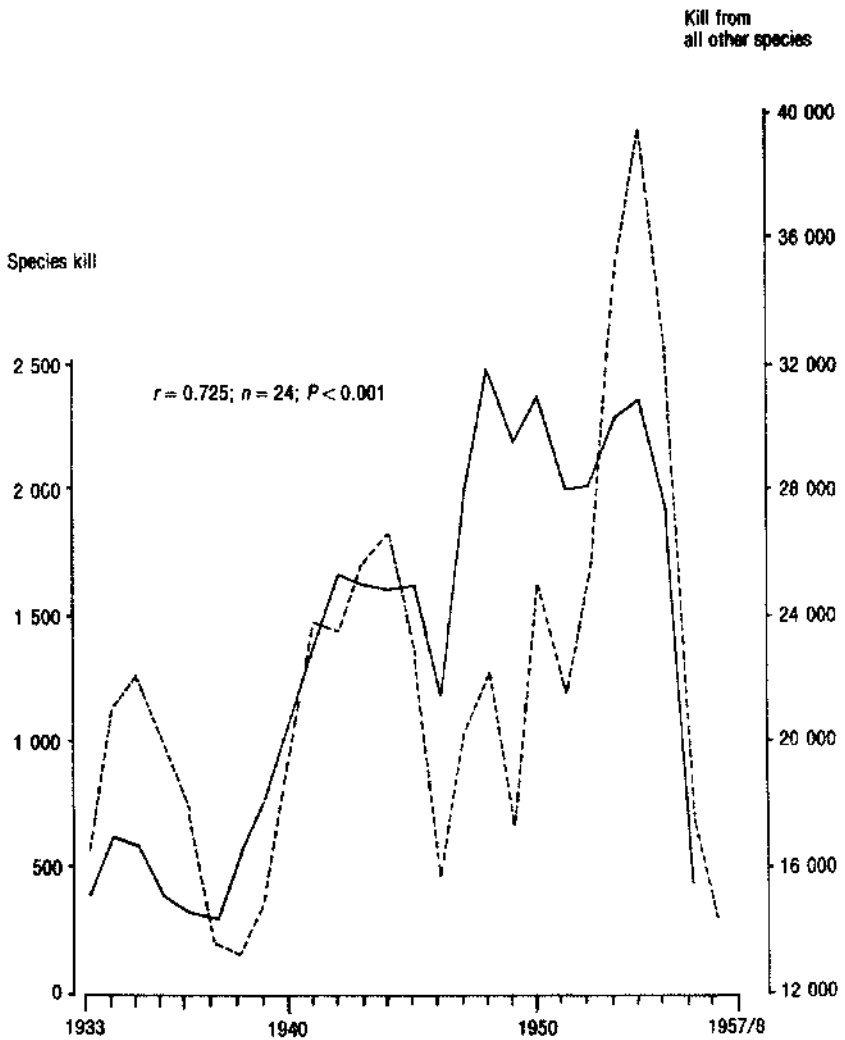


Figure 23: **REEDBUCK KILLS IN ALL HUNTING AREAS**

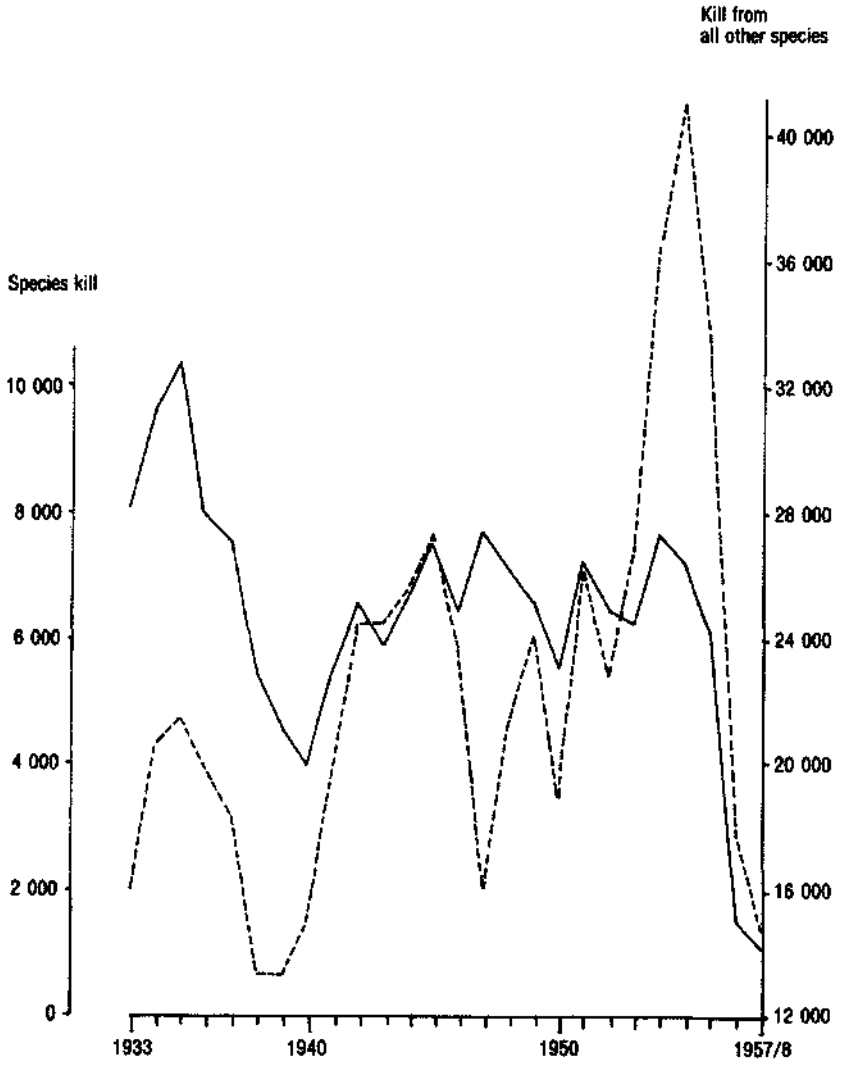


Figure 24: **BUSHBUCK KILLS IN ALL HUNTING AREAS**

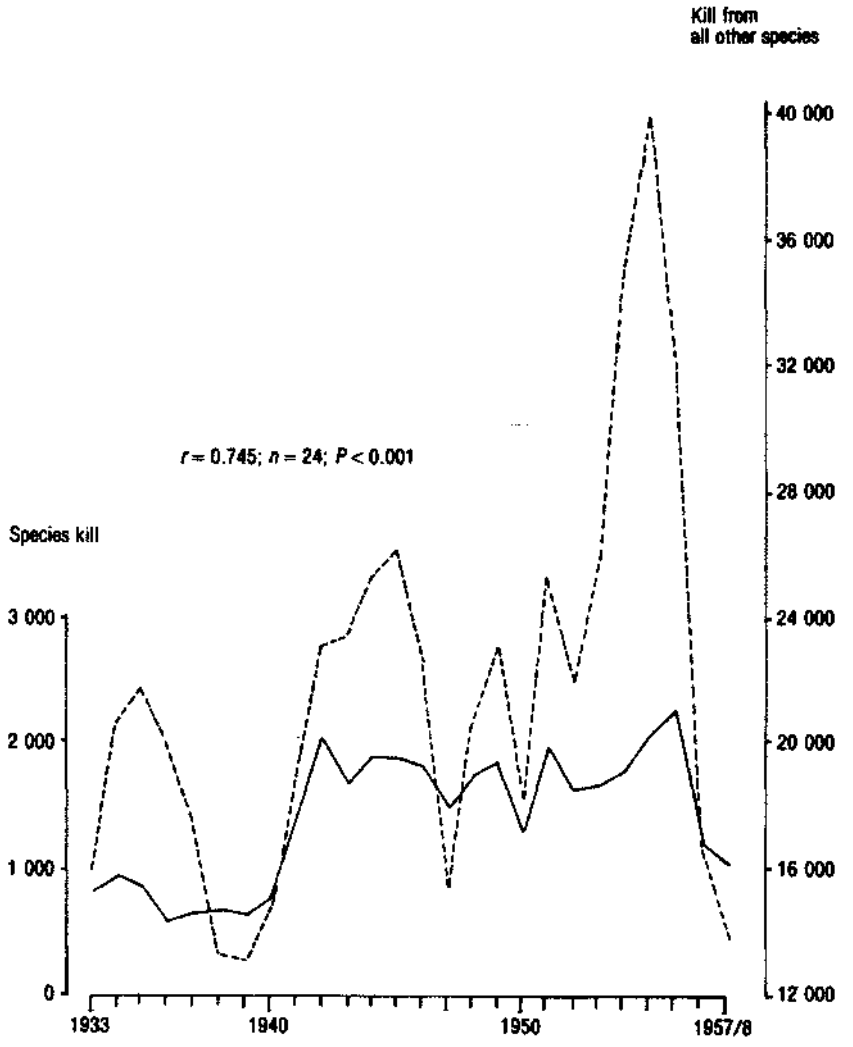


Figure 25: **DUIKER KILLS IN ALL HUNTING AREAS**

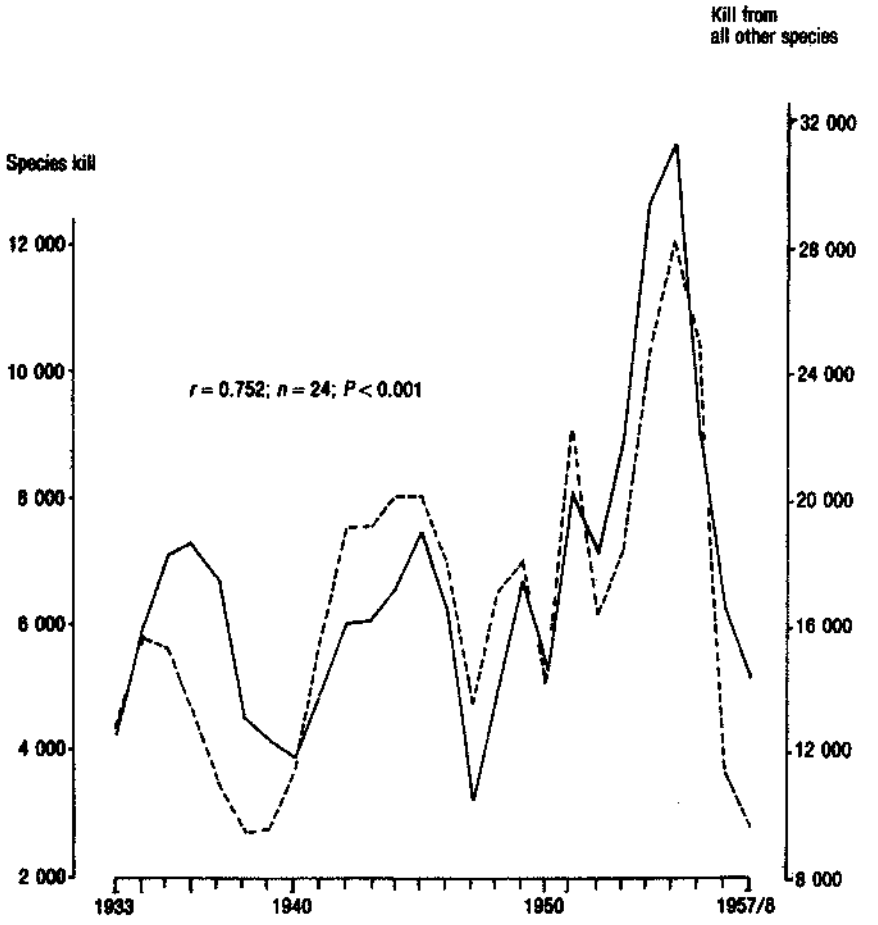


Figure 26: **BABOON KILLS IN ALL HUNTING AREAS**

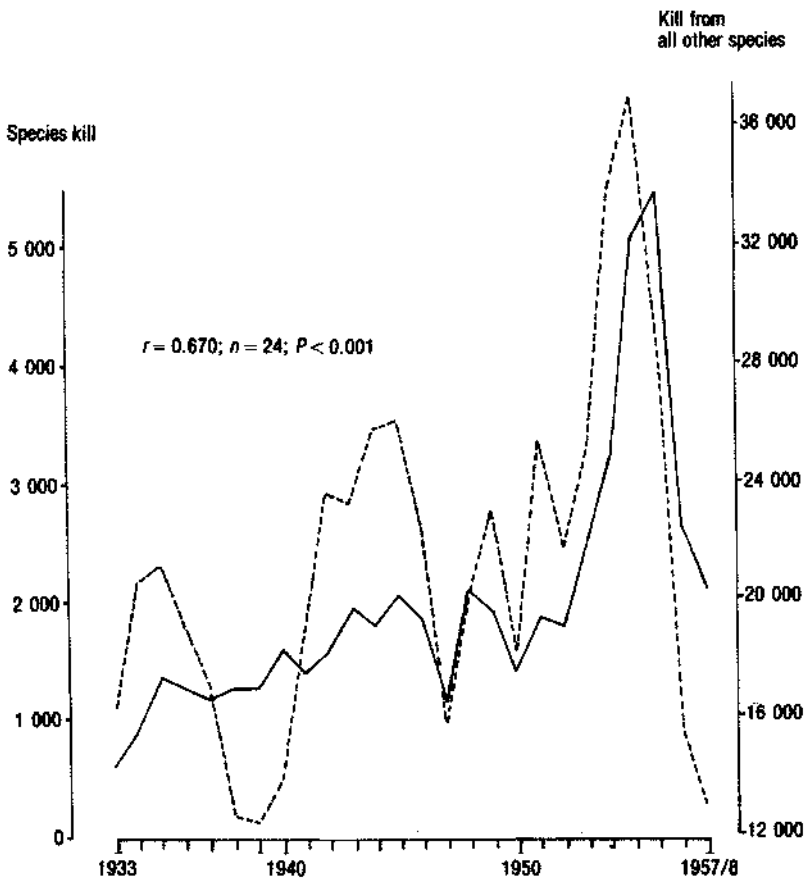


Figure 27: **WARTHOG KILLS IN ALL HUNTING AREAS**

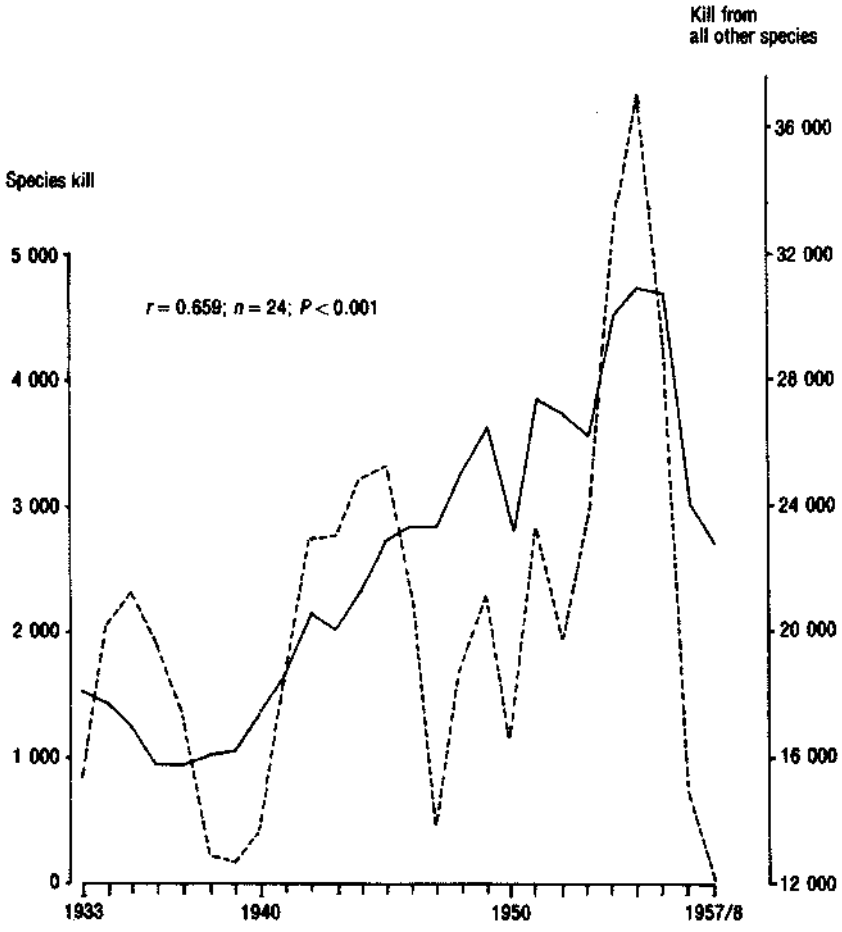


Figure 28: **BUSHPIG KILLS IN ALL HUNTING AREAS**

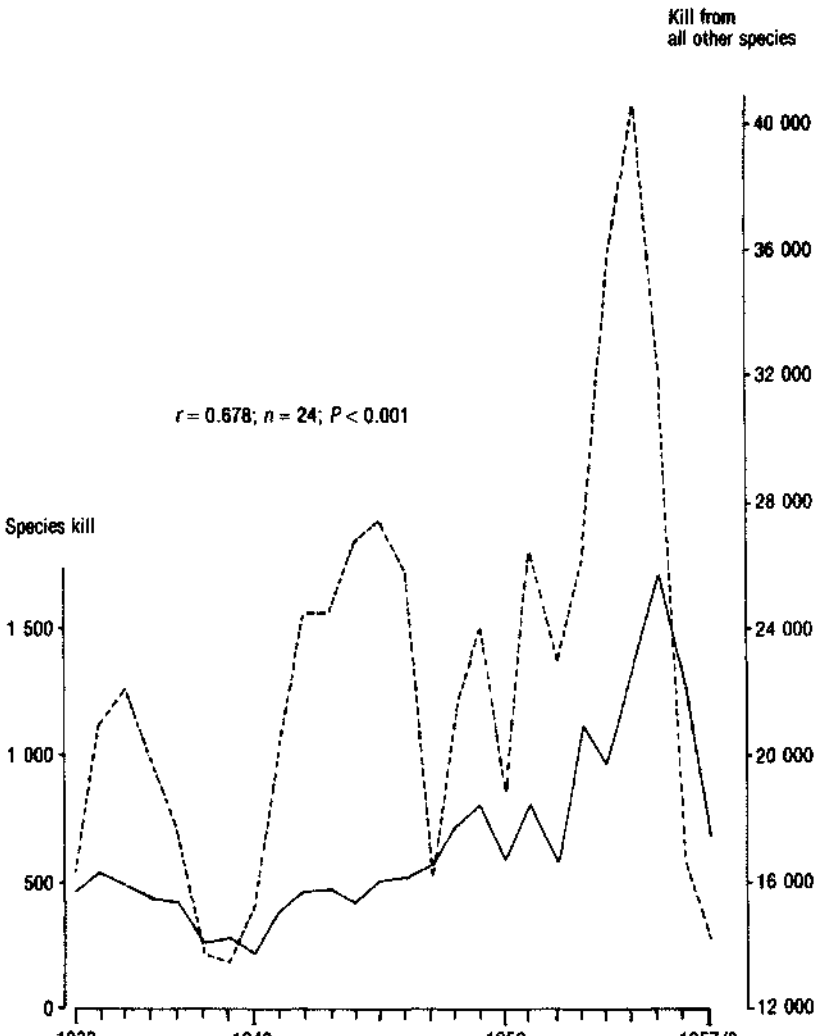
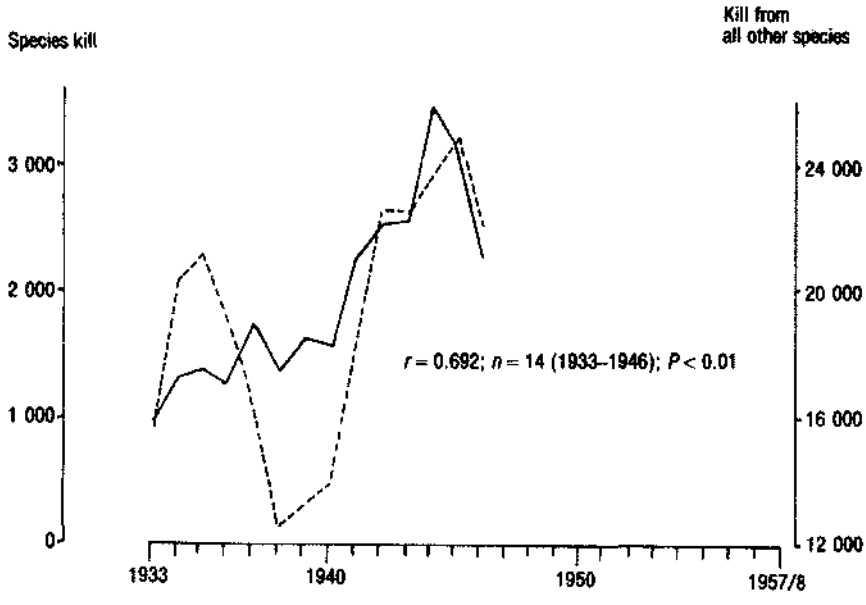


Figure 29: **GRYSBOK KILLS IN ALL HUNTING AREAS**



Note: Hunting of small antelope was suspended in 1946.

Results of tsetse control hunting in two areas

This section deals mostly with the Urungwe and Sebungwe areas, both of which are in the Zambezi drainage. The Branch of Tsetse and Trypanosomiasis Control considered the hunting returns from these two areas, particularly those from Urungwe, to be most complete. In addition, the authors were able to collect ancillary information from the Sebungwe from late 1958 until early 1960 and from the Nagupande hunting area between 1962 and 1964.

The total country-wide annual kills from all species are compared in Figure 30 with those of the species shot in substantial numbers in the Urungwe and Sebungwe during the twenty-six-year period. Obviously, in this and subsequent graphs (Figs. 30–44), a relatively high kill-rate from one area or of a particular species could influence the form of the graph of the total kill with which the area or species kill is being compared. To obviate this, the area or species kills are deducted from the total kills for comparative purposes.

Even had hunting intensity remained uniform in the areas, fluctuations in

annual kills would be expected in reponse to such obvious variables as annual rainfall. Despite these variables, the pattern of kills of most species over given periods of time were remarkably similar to each other. The main exceptions in the Urungwe were baboon (Fig. 44), particularly before 1945, zebra (Fig. 32) before 1939, eland (Fig. 33) and reedbuck (Fig. 39).

In the Sebungwe the main divergencies were again baboon (Fig. 44) before 1945, and eland (Fig. 33). Although the pattern of eland kills was similar to that in other areas it showed a poor relationship to that in the Urungwe and to the total kill. In both areas buffalo (Fig. 31) were shot in low numbers during the first eight to ten years. Bushpig (Fig. 43) were taken in relatively uniform numbers before 1951/2 and the kills of this secretive species, which is especially difficult to hunt, did not show the marked fluctuations in later years which are evident for most species.

Both areas showed a general upward trend in the annual kills of baboon (Fig. 44), bushpig (Fig. 43), warthog (Fig. 42), duiker, *Sylvicapra grimmia*, (Fig. 41) and impala (Fig. 38), culminating in the 1952/3 to 1955/6 crest, which coincided with the intensification of hunting before aspects of the Thomas Report were implemented. Similar upward trends are also evident for the Urungwe reedbuck (Fig. 39), bushbuck (Fig. 40) and buffalo (Fig. 31) kills and for the Sebungwe kudu (Fig. 34) and, perhaps, roan (Fig. 35) kills. This pattern cannot be reconciled with populations being hunted to local extinction.

No obvious trends emerge from the zebra (Fig. 32), reedbuck (Fig. 39), bushbuck (Fig. 40), eland (Fig. 33), tsessebe (Fig. 21), or buffalo (Fig. 31) returns from the Sebungwe, or from the figures for sable (Fig. 36), roan (Fig. 35) and kudu (Fig. 34) from the Urungwe. On the other hand, zebra (Fig. 32), waterbuck (Fig. 37) and eland (Fig. 33) from the Urungwe, and waterbuck (Fig. 37) and, perhaps, sable (Fig. 36) from the Sebungwe were killed in declining numbers towards the end of the twenty-six-year period. It is possible that the numbers of these species were being gradually reduced, although none had been eliminated by the hunting.

Similarities in the patterns of most of these graphs of the kills from individual species in the Urungwe or the Sebungwe hunting areas and those from the same species, and the total off-take from all other areas, are further evidence that major deflections in hunting successes were due to changes in country-wide hunting policy.

Hunting in the Sebungwe

The area: Hunting in the Sebungwe commenced in 1919 and from then until 1933 it was divided into four units (Table I), before the hunting was reorganized as a single entity (Fig. 1). Its limits were slightly modified without changing the area significantly when a second supervisor was assigned to the area in 1949. By 1956 there were three supervisors responsible for subdivisions of the area.

Figure 30: **TOTAL KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM TOTAL KILLS IN ALL AREAS**

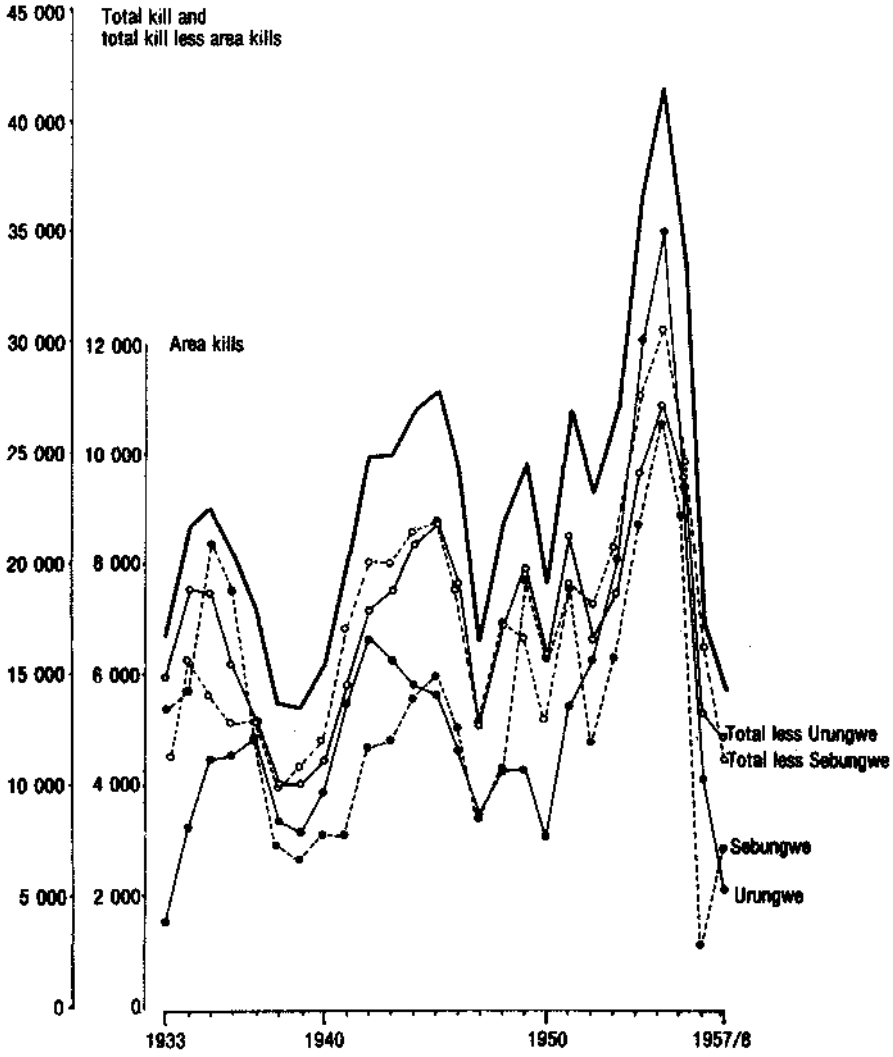


Figure 31: BUFFALO KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM BUFFALO KILLS IN ALL AREAS

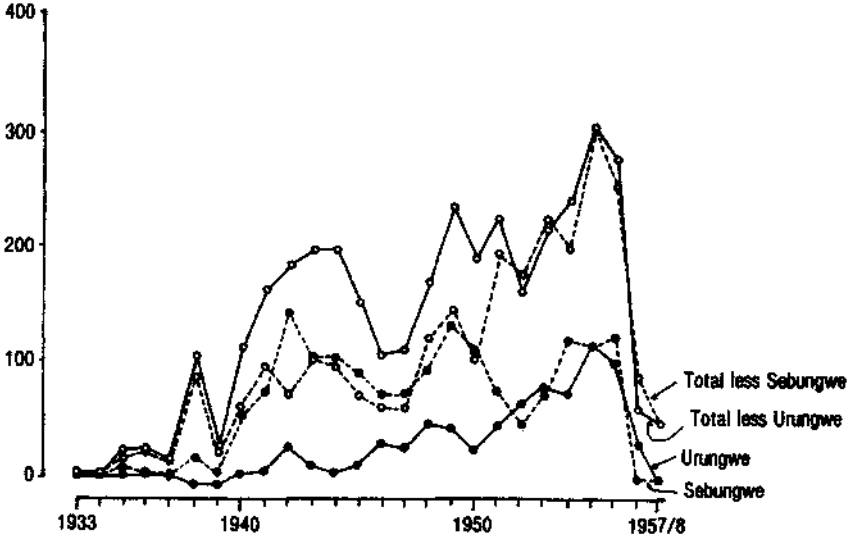


Figure 32: ZEBRA KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM ZEBRA KILLS IN ALL AREAS

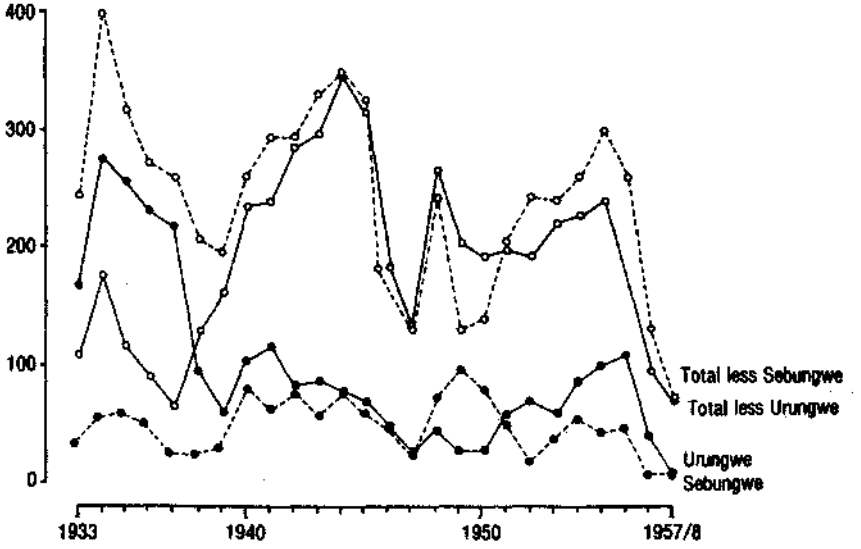
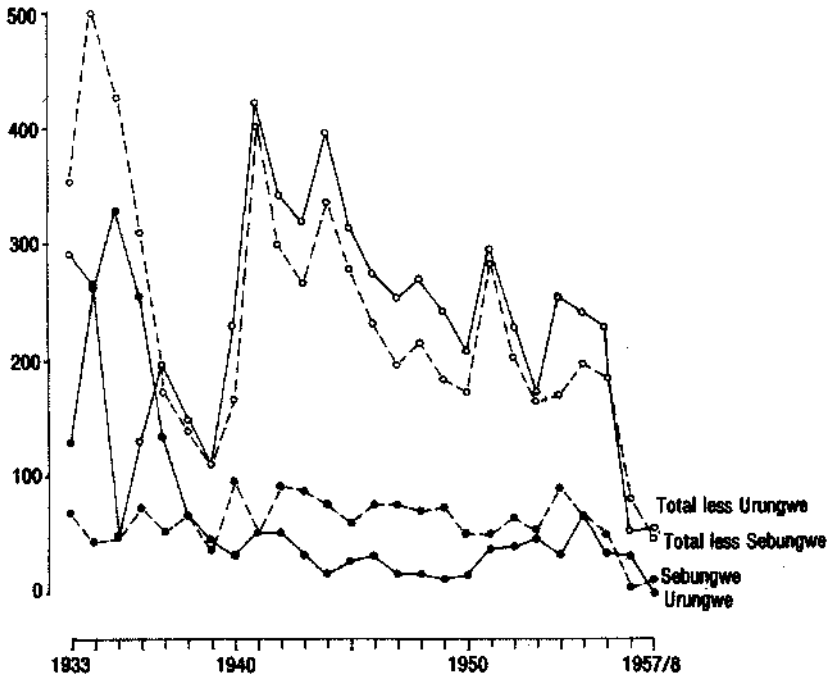


Figure 33: ELAND KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM ELAND KILLS IN ALL AREAS



The game fence was surveyed and constructed in 1957, and hunting operations, which had been sporadic during the year, were resumed between this fence in the north and a cattle fence in the south (Fig. 45) in terms of the Thomas Report (Federation of Rhodesia and Nyasaland, 1955) — the aim being to create a game-free/cattle-free corridor; but even this hunting was suspended in 1960.

Hunting directed against warthog, bushpig, kudu, bushbuck, buffalo and elephant recommenced in the 540 km² Nagupande area in October 1962 (Child *et al.*, 1965; Child *et al.*, 1968). This rectangular area overlapped the old game fence into the northern fringe of the Chiware (Cewali) subdivision of the former game-free/cattle-free corridor that had not been hunted for eighteen months. The rest of the Nagupande area was within the pre-1957 Sebungwe area and had not been hunted for about six years. The area was visited frequently during the first

Figure 34: KUDU KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM KUDU KILLS IN ALL AREAS

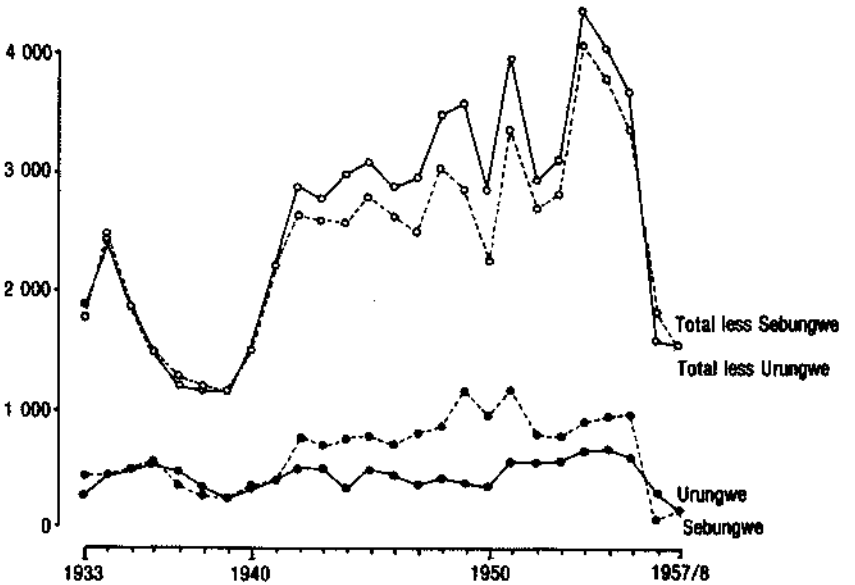


Figure 35: ROAN KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM ROAN KILLS IN ALL AREAS

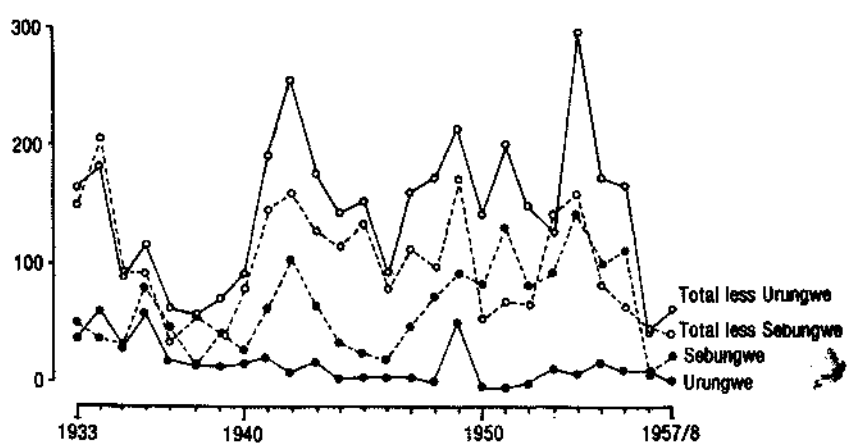
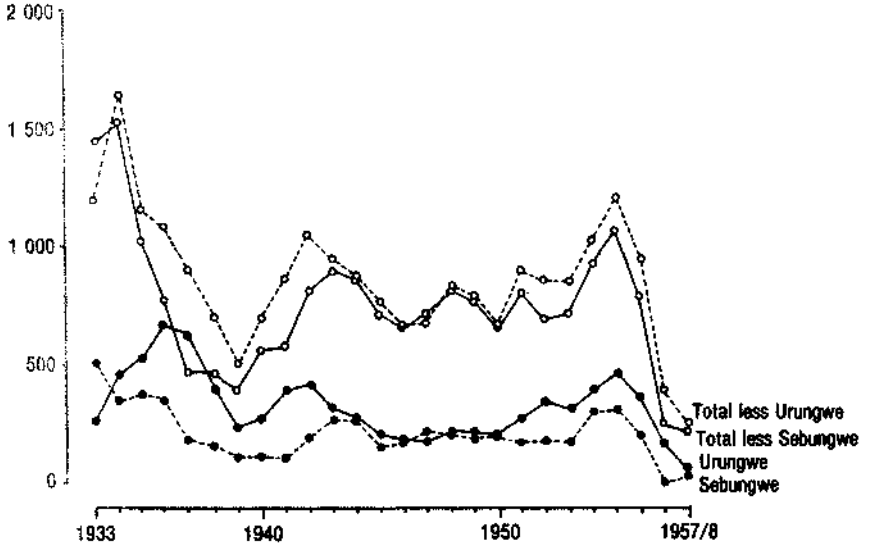


Figure 36: **SABLE KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM SABLE KILLS IN ALL AREAS**

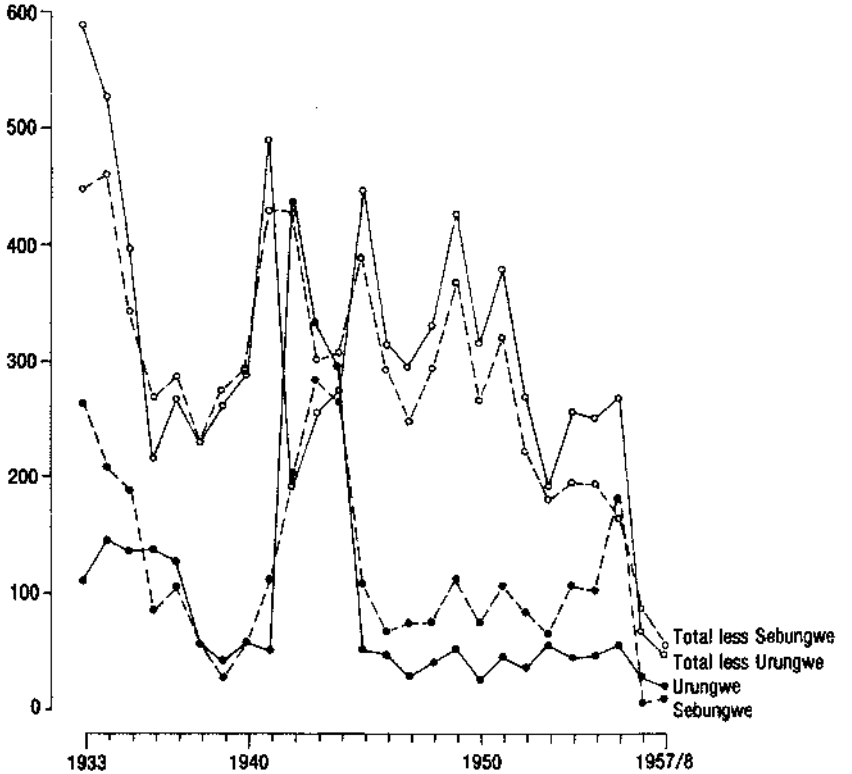


two and a half years of resumed hunting and this provided a useful opportunity to assess the residual effects of the hunting that had taken place between 1933 and 1957/8.

Hunting techniques and their effect on game populations: The following account of the organization of tsetse control hunting is based on the arrangement in the Chiware subdivision from 1958 to 1960, but was fairly typical of that in all tsetse control areas. Information obtained on the ground was supplemented from the records of the Branch of Tsetse and Trypanosomiasis Control and by interviewing serving and former employees of the Branch.

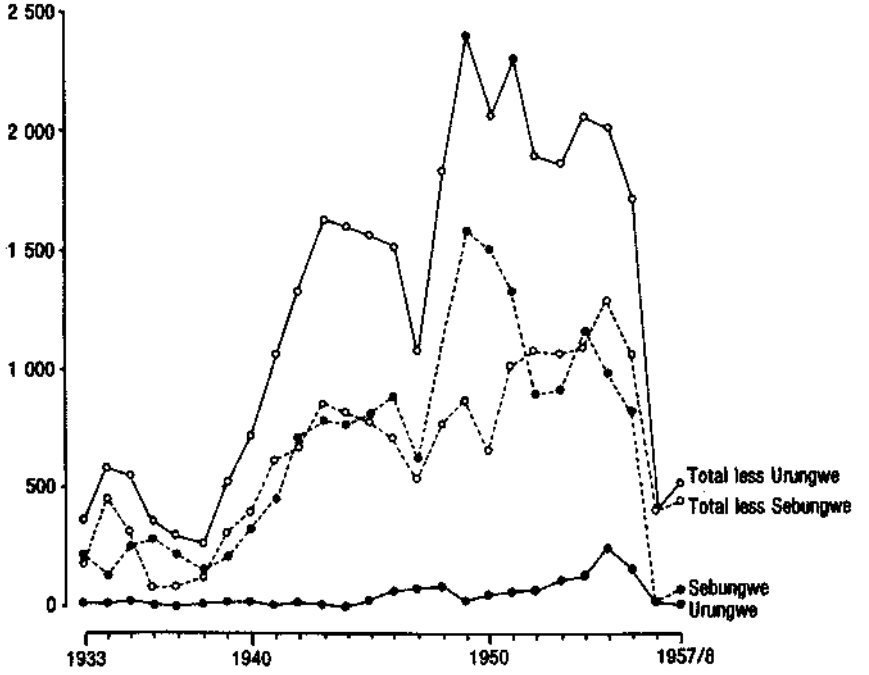
A force of hunters was deployed in rotation in groups of two or three to fixed camps, located so as to achieve optimum coverage of the area but taking into account places likely to be attractive to animals. Hunting took place on about twenty-five consecutive days each month, before the hunters reported to their supervisors and proceeded on time off. They were permitted to sell the meat from the animals they shot and this and their poor wages were intended as an inducement to greater hunting effort.

Figure 37: WATERBUCK KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM WATERBUCK KILLS IN ALL AREAS



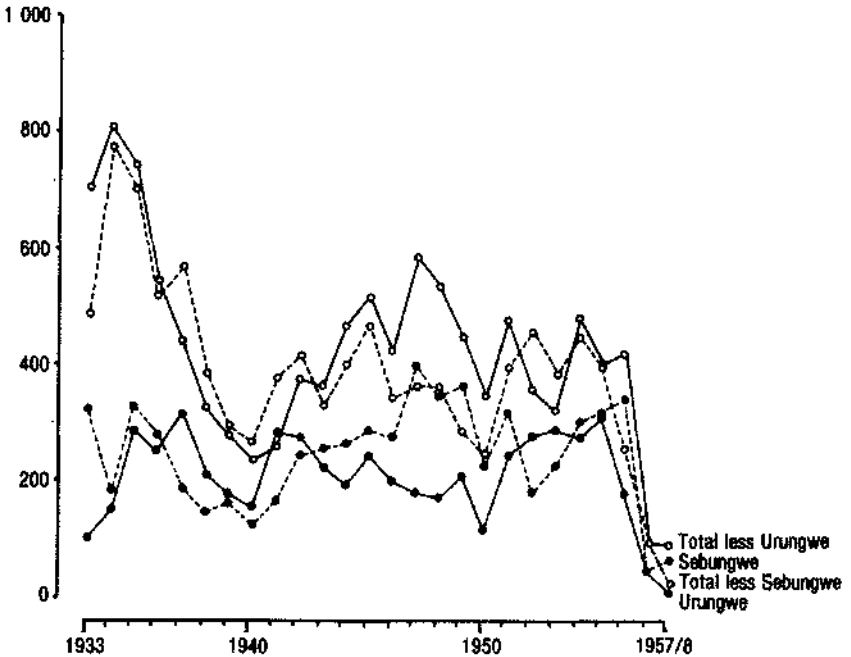
The game fence was about two metres high and consisted of high-tensile steel wire on wooden posts with wooden droppers. White metal discs suspended along the wires, against which they rattled, were designed to make the fence more conspicuous to animals, but its effectiveness was limited. This is not surprising as Child *et al.* (1965) and Child *et al.* (1970) indicate that warthog in the Nagupande, and most species hunted on tsetse control in Botswana, crossed through such fences. Lewis and Wilson (1977) present numerical data of the effectiveness of a similar fence in eastern Zambia. They found that such fences are of little hinderance to small species like warthog and duiker, although they may inhibit movements of large animals such as sable, roan and eland.

Figure 38: IMPALA KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM IMPALA KILLS IN ALL AREAS



Wildebeest were apparently never common in the Sebungwe region and seem to have been eliminated from the tsetse control hunting area by 1936. No other species, with the possible exception of black rhinoceros, was eliminated from the hunting area, although waterbuck and possibly sable were shot in diminishing numbers towards the end of the twenty-six-year period. This evaluation is supported by observations in the Nagupande area, at least in that portion rested from hunting for six years. Of the fourteen more numerous species in the 1933 to 1957/8 returns, waterbuck were scarce and zebra were seen in only small numbers. Eland, sable and roan were reasonably common north of the old game fence, where sable and roan, at least, were associated with preferred habitats (Child and Wilson, 1964b; Joubert, 1976). As noted, there were also at least two black rhinoceros.

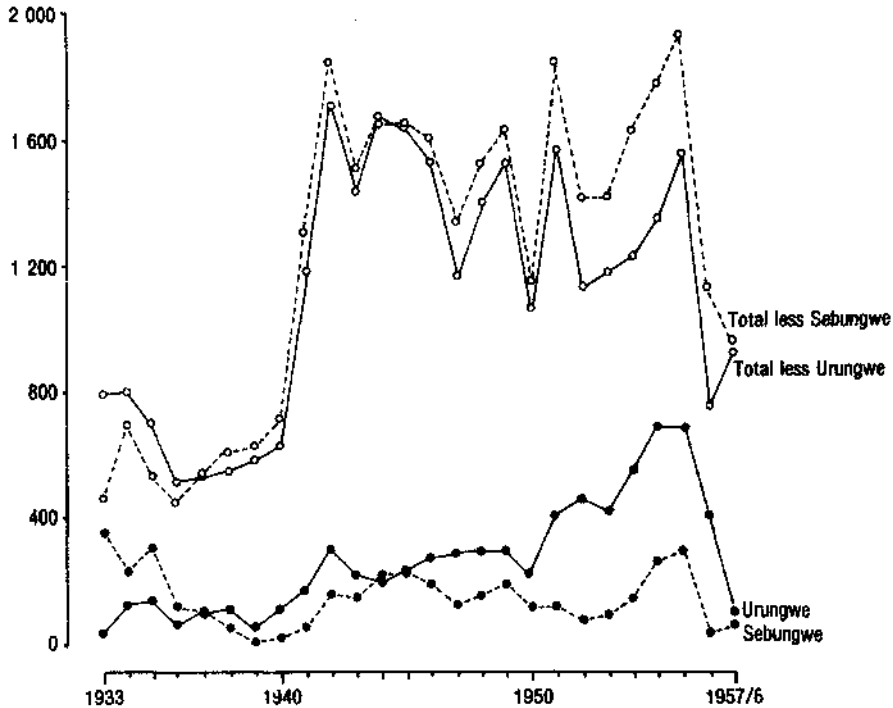
Figure 39: REEDBUCK KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM REEDBUCK KILLS IN ALL AREAS



The distribution of reedbuck was limited to the rather restricted areas of suitable habitat, but here the species was numerous even after a respite of only eighteen months from being hunted. Baboon, grysbok, impala and duiker were noted in numbers after six years without hunting. During the first twelve months of the resumed hunting in the Nagupande area 85 bushpig, 1,357 warthog, 33 bushbuck, 169 kudu, 45 elephant and 22 buffalo were shot. Immediately prior to this hunting five parties of sportsmen were permitted to hunt the area and killed an additional 16 elephant, 17 buffalo and a range of lesser species. The elephant and buffalo had apparently penetrated from the north, but a fair proportion of the other species were taken in the south where previous hunting had ceased in 1960.

Child and Wilson (1964a) examined the duiker population in the Chiware area twenty-eight months after hunting had ceased and concluded that the species was exceptionally numerous with a high proportion of young animals. The

Figure 40: **BUSHBUCK KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM BUSHBUCK KILLS IN ALL AREAS**



hunting returns suggested an expanding population and the later evidence was consistent with this postulation. Steenbok were also very common in the same area, although it is on the fringe of the species' geographical range (Child and Savory, 1964) and tsessebe were not uncommon in appropriate habitats.

As hunting had clearly been unsuccessful in eliminating the large mammals against which it was aimed, it is useful to examine possible reasons.

Most of the hunting was done by locally recruited tribesmen who lived at no great distance from the hunting area. Many had been employed as hunters for many years, when the effectiveness of the hunting techniques was evaluated over a fifteen-month period in 1959 and 1960. They were generally good hunters and trackers but poor marksmen, and their shooting ability was not improved by the

Figure 41: DUIKER KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM DUIKER KILLS IN ALL AREAS

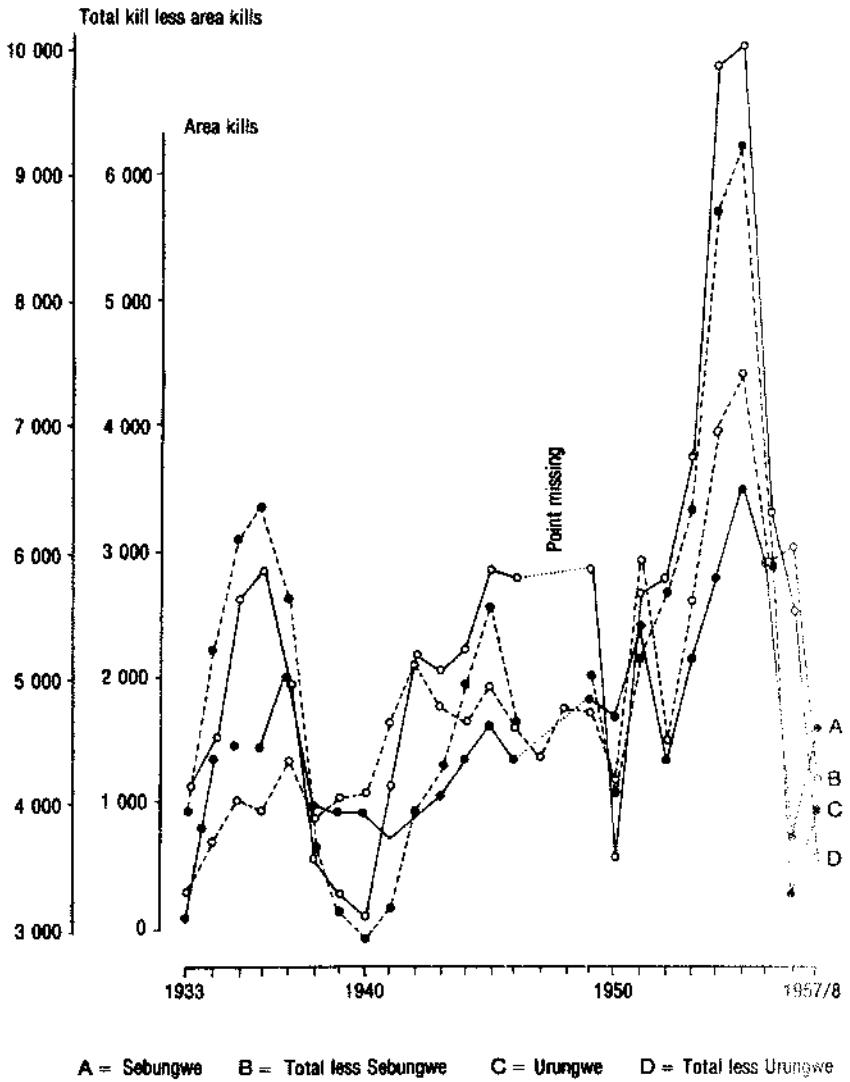


Figure 42: **WARTHOG KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM WARTHOG KILLS IN ALL AREAS**

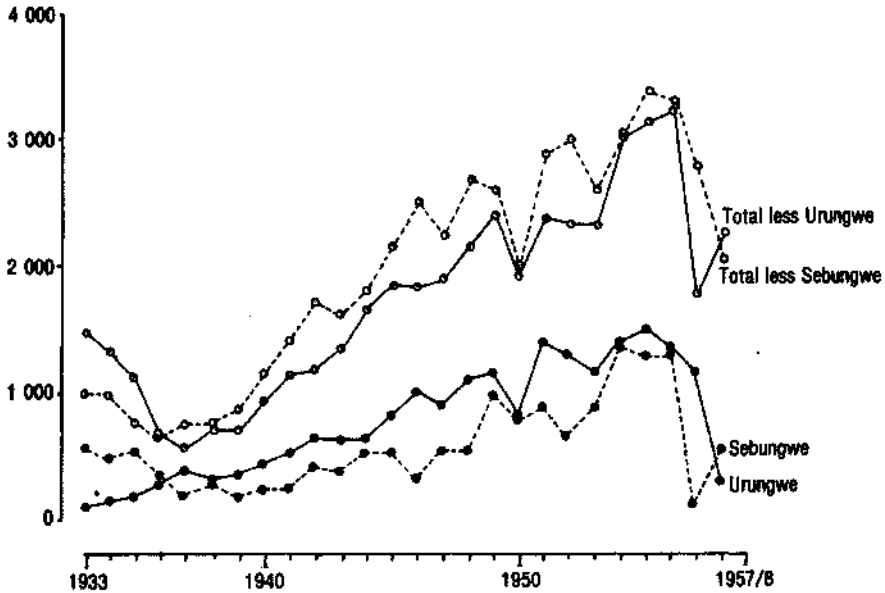


Figure 43: **BUSHPIG KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM BUSHPIG KILLS IN ALL AREAS**

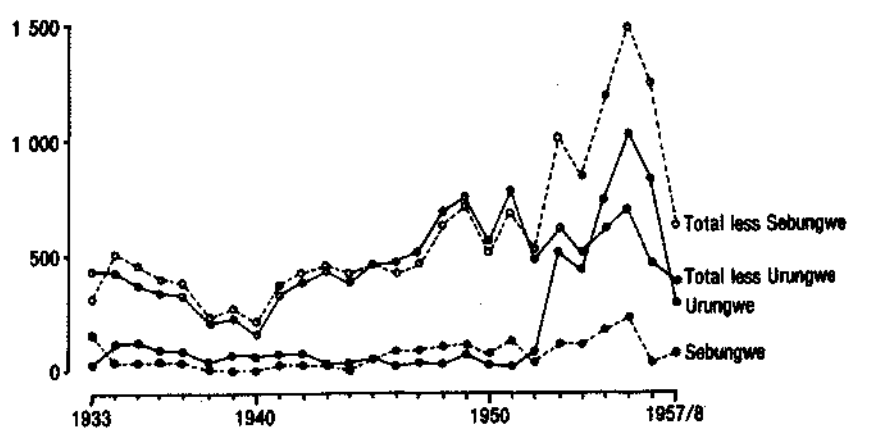
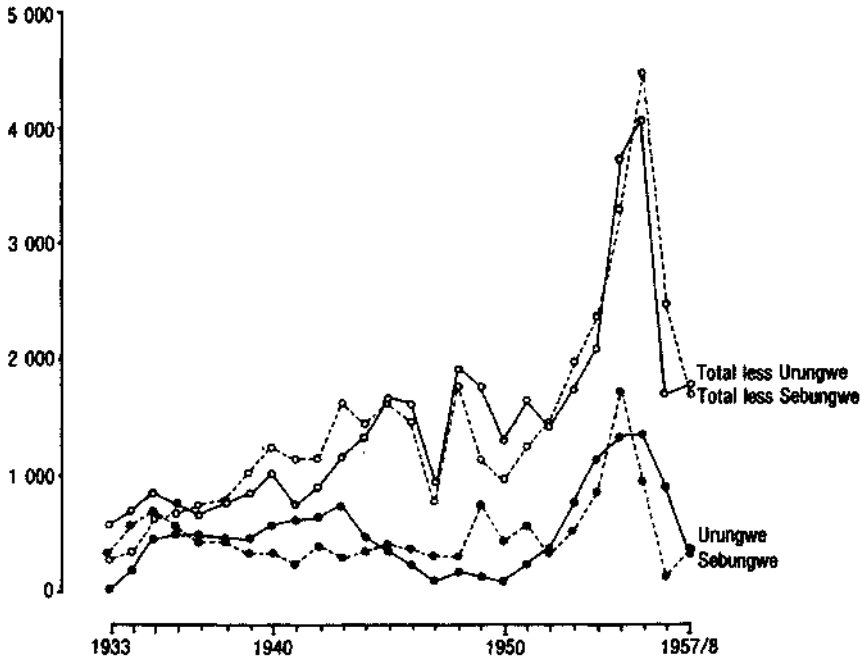


Figure 44: BABOON KILLS IN THE SEBUNGWE AND URUNGWE AREAS ISOLATED FROM BABOON KILLS IN ALL AREAS

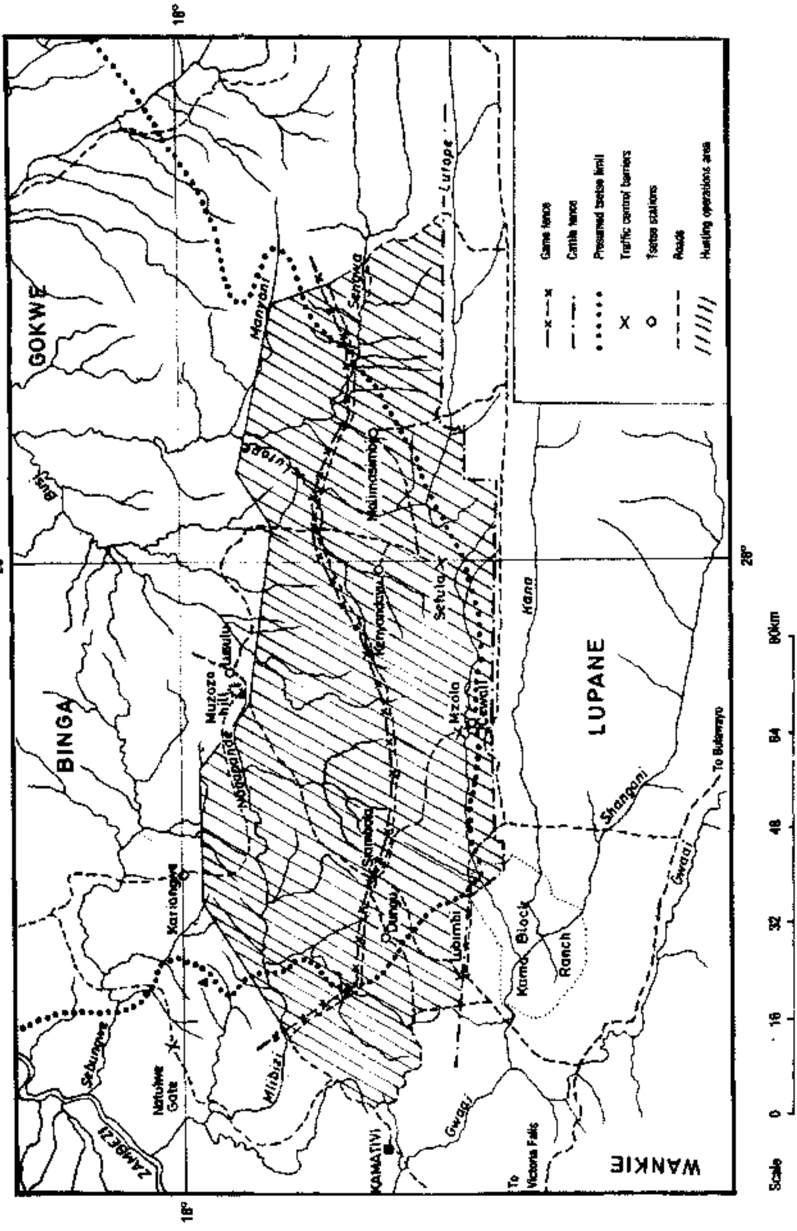


worn state of the ex-military 0.303 rifles with which they were issued. A 45 cm grouping of shots from 25 metres was considered reasonable and few claimed to be able to hit a 30 cm diameter tree at 100 paces with confidence. Most did not attempt to shoot even large antelope at ranges of over 75 to 100 metres.

These hunters usually left their semi-permanent camps at dawn, returning for a meal around midday before hunting again from about 14.00 hours until dusk. Small species like grysbok, steenbok, duiker and bushbuck were located by sight, baboons by their vocalizations, while larger species were tracked, sometimes for many kilometres. This hunting pattern meant that most effort was within five kilometres of the camps, except when the spoor of larger animals was being followed, with the hunting intensity in the intervening areas being light but variable, depending on species.

The kill-rate was also heavily influenced by the number of hunters employed at any given time and by their meat requirements. One supervisor recorded the

Figure 45: **THE SEBUNGWE TSETSE CONTROL HUNTING AREA**



day in the twenty-five-day monthly hunting period when particular animals were shot. A regular pattern emerged in which hunters tended to shoot two or three small animals early in the month, so as to justify their employment and satisfy their immediate food requirements in the field. One large animal was usually killed towards the end of the twenty-five-day period so as to provide a good supply of meat to take home to sell.

The situation that arose in the Chiware subdivision in December 1959 accorded with these observations. With the approach of the festive season it was decided to permit the hunters to return home as soon as each camp had fulfilled its assessed quota, based on past performance. Several camps achieved this in eight or nine, instead of the usual twenty-five, days.

Table V compares the kills and the average dressed carcass weight that they represented, based on Roth (1966), for the twenty-four months before and after the hunter strength was doubled from twelve to twenty-four men in the Chirundu subsection of the Urungwe area. According to Goodier (1956), the hunting area remained unchanged. With the exception of waterbuck, impala and kudu, the kills increased in number by 80 per cent or more, in spite of the influx of less-experienced hunters, indicated by the marked rise in the mean number of shots per kill. Doubling of the number of hunters led to an increase in the total number of animals shot and in the mass of meat harvested of almost 70 per cent. A drop of 15 per cent in the mass of meat per hunter still allowed 270 kg of dressed carcass per man per month.

Night-hunting with spotlamps and shotguns was introduced within the fenced corridor in the Sebungwe in November 1958. It led to higher kills of certain species which is further evidence that the regular hunters had not been effective in curbing these populations. Hunters for this exercise were selected from among the best regular hunters. They were organized into teams which were moved about the area so as to provide better coverage between camps. Hunting took place from last light until 23.00 hours and the results of twelve months of this hunting are compared with those from regular hunters in Tables VI and VII.

In terms of the number of animals shot per hunter and the number of shots per kill, night-hunters were more efficient, but as to be expected they shot few large animals or diurnal warthogs. Duiker, steenbok and grysbok contributed 88 per cent of the kills compared to 61 per cent by regular hunters. The main tsetse hosts in this area were bushpig, warthog, kudu and bushbuck (Cockbill, 1964) and they made up only 3.4 per cent of the animals shot at night, as opposed to 22.5 per cent of those killed during daylight hours. This means that despite the greater efficiency in harvesting meat (116 : 84 kg per month; from Roth, 1966) each night-hunter shot an average 4.25 head of primary tsetse host animals while his regular counterpart shot 11.5 head during the twelve-month period.

Besides the small antelope mentioned above, night-hunting was also

Table V

HUNTING IN THE CHIRUNDU AREA IN THE 24 MONTHS BEFORE AND AFTER THE HUNTING STRENGTH WAS DOUBLED

Species	Average dressed weight (kg)	24-Month period Oct. 1952–Sept. 1954 Kill	Meat (kg)	Oct. 1954–Sept. 1956 Kill	Meat (Kg)	Change in kill (%)
Zebra	190	21	3,990	55	10,450	+162
Bushpig	36	24	864	71	2,556	+196
Warthog	32	300	9,600	541	17,312	+80
Duiker	10	113	1,130	224	2,240	+98
Sable	105	29	3,045	55	5,775	+90
Waterbuck	105	30	3,150	28	2,940	−7
Grysbok	5	4	20	32	160	+700
Impala	27	409	11,043	580	15,660	+42
Bushbuck	20	100	2,000	191	3,820	+91
Kudu	114	190	21,660	241	27,474	+27
Eland	273	35	9,550	64	17,472	+83
Buffalo	295	87	25,665	169	49,855	+94
TOTALS						
Kill		1,342		2,251		+68
Meat			91,717		155,714	+70
Main tsetse host		614		1,044		+70
Average meat per man per month (kg)			7,643		6,488	−15
Ammunition rounds per kill		1.96		3.28		+67
Hunters per month		12		24		+100

particularly effective against reedbuck and, perhaps, impala. All adapted quickly to this new form of hunting, however, and within a few months were difficult to locate from a vehicle using a powerful spotlamp before the hunters went to bed. Later at night they were located in numbers.

The 1958/9 kill (excluding elephant) from the Chiware subdivision of the fenced corridor of some 1030 km² is indicated in Table VI. It represented an off-take of some 7.1 animals per km². There was no significant selection in favour of males or females by night-hunters, although in impala ($\chi^2 = 2.639$) the higher number of females taken approached significance at the 10 per cent level. Likewise there was little selection in favour of either sex by regular hunters except in the case of baboon (178 males : 100 females) and warthog (132 males : 100 females), where more males were taken, and steenbok (81 males : 100 females) where a greater proportion of females were shot.

The warthog sex ratio of 132 males : 100 females compares with a ratio approaching parity in Senegal (Bigourdan, 1948), two populations in Zimbabwe, including one sampled by the first six weeks of hunting in the Nagupande area (Child, 1968b; Child *et al.*, 1968), and a preponderance of females in another Zimbabwean population sampled by Cumming (1975) over seven years. A selective hunting pressure favouring females would serve to raise the reproductive potential per unit of surviving population and so set the stage for a population increase, as Child (1968b) has described for a number of species.

A sample of 1,552 duiker skulls collected from hunting operations in the Sebungwe were sexed according to Riney and Child (1964) and aged according to the criteria developed by Riney and Child (1962), as modified by Wilson *et al.* (1984). About 658 (42 per cent) of the animals were in their first year, 388 (25 per cent) were yearlings, and 506 (33 per cent) were adults over two years old. Duiker in this area may conceive for the first time when eight to ten months old (Child and Wilson, 1964a) and calve seven months later (Wilson, *pers. comm.*). About 58 per cent of the yearlings were females and of these about 168 were old enough to have calved. Some 55 per cent of the adults were females, giving a total of about 446 (168 + 278) females that could have calved. Duiker breed throughout the year in this area (Riney and Child, 1962) giving a maximum reproductive potential of about 160 calves : 100 females per year, allowing for the six-week post-partum oestrus observed by Wilson (*pers. comm.*). The calf to female ratio in the sample of skulls was 148 : 100.

An unexpectedly high proportion of young animals was also observed in the shot sample of other populations. There were 74 male, 64 female and 32 unsexed skulls in a sample of 170 steenbok, of which 43 per cent had immature dentition. Of the sexed adults with all permanent teeth, 37 were females, giving a ratio of 195 juveniles per 100 adult females. Of the 90 grysbok skulls, 38 were male, 43 female, and 9 unsexed animals with fully adult dentition, for a ratio of 380

Table VI

THE FIRST 12 MONTHS OF NIGHT HUNTING COMPARED WITH DAY HUNTING

0.303 Rifles (Day Hunting) Nov. 1958–Oct. 1959

Species	Sex	N	D	J	F	M	A	M	J	J	A	S	O	TOTAL	Mean
Baboon	m	21	26	21	20	37	48	30	24	29	41	27	39	363	
	f	14	10	4	8	9	16	19	17	17	22	26	42	204	
	T	35	36	25	28	46	64	49	41	46	63	53	81	567	
Bushpig	m	9	24	15	19	18	14	10	6	6	11	10	8	150	
	f	15	13	5	29	14	22	18	18	8	9	7	13	169	
	T	24	37	20	48	32	36	28	22	14	20	17	21	319	
Warthog	m	32	65	73	53	49	34	20	21	19	20	29	38	453	
	f	23	60	59	49	30	20	14	15	10	20	20	22	342	
	T	55	125	132	102	79	54	34	36	29	40	49	60	795	
Duiker	m	144	157	132	111	98	82	81	90	91	152	145	193	1,476	
	f	158	174	158	119	119	11	85	114	120	156	172	214	1,700	
	T	302	331	290	230	217	193	166	204	211	308	317	407	3,176	
Steenbok	m	10	14	16	5	9	13	5	6	9	21	23	22	153	
	f	19	15	18	6	16	6	5	6	15	25	28	30	189	
	T	29	29	34	11	25	19	10	12	24	46	51	52	342	
Grysbok	m	20	26	16	14	6	9	12	16	22	24	26	29	220	
	f	25	15	17	5	5	14	7	12	13	14	25	35	187	
	T	45	41	33	19	11	23	19	28	35	38	51	64	407	
Reedbuck	m	6	12	10	5	—	1	3	5	6	6	9	13	76	
	f	7	7	4	2	1	1	3	4	3	6	4	17	59	
	T	13	19	14	7	1	2	6	9	9	12	13	30	135	
Impala	m	5	2	20	9	9	4	8	2	1	5	8	6	79	
	f	2	5	17	19	5	11	5	2	3	5	2	4	80	
	T	7	7	37	28	14	15	13	4	4	10	10	10	159	
Bushbuck	m	4	9	3	4	3	5	—	6	8	8	11	7	68	
	f	8	8	4	2	3	3	—	8	11	18	8	18	91	
	T	12	17	7	6	6	8	—	14	19	26	19	25	159	
Kudu	m	6	11	6	5	9	10	7	10	3	6	8	3	84	
	f	6	5	11	10	12	13	5	4	6	4	3	8	87	
	T	12	16	17	15	21	23	12	14	9	10	11	11	171	
Others	T	23	22	17	23	16	15	14	10	10	13	13	11	187	
TOTALS	m	272	358	321	254	247	227	182	191	198	298	305	365	3,218	
	f	285	322	305	263	221	225	169	203	212	289	298	407	3,199	
	T	557	680	626	517	468	452	351	394	410	587	603	772	6,417	
Hunters		123	126	130	130	130	128	126	124	124	122	121	123		125.6
Kill		514	623	579	486	441	429	334	381	390	568	583	748	6,076	
Ammunition (×10)		158	199	179	146	137	140	116	137	139	183	180	210	1,924	
Ammunition per animal		3.1	3.2	3.1	3.0	3.1	3.3	3.5	3.6	3.6	3.2	3.1	2.8		3.17
Animals per hunter		4.2	4.9	4.5	3.7	3.4	3.4	2.7	3.1	3.1	4.7	4.8	6.1		4.64

Shotguns (Night Hunting) Nov. 1958–Oct. 1959

Species	Sex	N	D	J	F	M	A	M	J	J	A	S	O	TOTAL	Mean
Baboon	m	—	—	—	1	—	—	—	2	4	2	1	4	14	
	f	—	—	—	—	—	—	2	—	3	—	2	3	10	
	T	—	—	—	1	—	—	2	2	7	2	3	7	24	
Bushpig	m	—	—	—	1	—	—	—	—	1	1	1	1	5	
	f	—	—	—	—	—	—	—	—	—	3	3	1	7	
	T	—	—	—	1	—	—	—	—	1	4	4	2	12	
Warthog	m	—	1	—	—	—	—	—	—	1	—	4	3	9	
	f	—	1	3	—	—	—	—	1	2	—	1	—	8	
	T	—	2	3	—	—	—	—	1	3	—	5	3	17	
Duiker	m	3	12	10	13	14	13	15	24	42	49	65	70	330	
	f	2	18	18	17	22	20	12	28	41	53	58	84	373	
	T	5	30	28	30	36	33	27	52	83	102	123	154	703	
Steenbok	m	1	1	—	2	1	4	5	2	2	3	9	11	41	
	f	—	4	—	4	3	3	1	3	1	11	16	14	60	
	T	1	5	—	6	4	7	6	5	3	14	25	25	101	
Grysbok	m	—	1	2	—	—	—	1	5	1	6	12	9	37	
	f	—	4	1	—	—	—	1	6	3	6	8	9	38	
	T	—	5	3	—	—	—	2	11	4	12	20	18	75	
Reedbuck	m	1	3	1	1	1	2	—	—	—	1	—	3	13	
	f	4	1	2	2	2	—	—	1	1	1	—	8	20	
	T	5	4	3	3	3	2	—	1	1	2	—	9	33	
Impala	m	—	1	—	3	—	—	—	—	—	—	—	—	4	
	f	—	3	2	1	—	—	—	—	—	1	—	5	12	
	T	—	4	2	4	—	—	—	—	—	1	—	5	16	
Bushbuck	m	—	—	—	—	—	—	—	—	—	—	—	—	0	
	f	—	—	—	—	—	—	—	—	1	—	1	—	2	
	T	—	—	—	—	—	—	—	—	1	—	1	—	2	
Kudu	m	—	—	—	—	—	—	—	—	—	—	—	1	1	
	f	—	—	—	—	—	1	—	—	—	—	—	1	2	
	T	—	—	—	—	—	1	—	—	—	—	—	2	3	
Others	T	—	—	—	—	—	—	—	1	—	3	—	—	4	
TOTALS	m	5	19	13	21	16	19	21	33	51	62	92	102	454	
	f	6	31	26	24	27	24	16	41	52	77	89	123	536	
	T	11	50	39	45	43	43	37	74	103	139	181	225	990	
Hunters		6	6	5	6	5	6	6	12	12	12	12	12		8.0
Kill		11	50	39	45	43	43	37	74	103	139	181	225	990	
Ammunition (×10)		2	7	6	7	6	7	6	15	19	23	33	40	170	
Ammunition per animal		1.6	1.4	1.4	1.6	1.4	1.7	1.5	2.0	1.9	1.6	1.8	1.8		1.72
Animals per hunter		1.8	10.0	7.8	9.0	8.6	8.6	7.4	6.2	8.6	11.6	15.1	18.8		12.38

Table VII

SUMMARY OF THE SPECIES AND SEX RATIOS OF KILLS DURING THE 12 MONTHS OF NIGHT HUNTING COMPARED WITH DAY HUNTING

Species	0.303 Rifles				Shotguns			
	Kill	Percentage of total kill	Sex ratio (males : 100 females)	Animals per hunter	Kill	Percentage of total kill	Sex ratio (males : 100 females)	Animals per hunter
Baboon	567	8.8	178	4.5	24	2.4	140	3.0
Bushpig	319	5.0	89	2.5	12	1.2	71	1.5
Warthog	795	12.4	133	6.3	17	1.7	112	2.0
Duiker	3,176	49.5	87	25.2	703	71.0	89	87.9
Steenbok	342	5.3	80	2.7	101	10.2	69	12.6
Grysbok	407	6.3	116	3.2	75	7.6	97	9.4
Reedbuck	135	2.1	129	1.1	33	3.3	65	4.1
Impala	159	2.5	99	1.3	16	1.6	33	2.0
Bushbuck	159	2.5	75	1.3	2	0.2	—	0.3
Kudu	171	2.7	97	1.4	3	0.3	—	0.4
Subtotal	6,230	97.1	—	—	986	99.5	—	—
Others	187	2.9	—	—	4	0.4	—	—
TOTAL	6,417	—	100.6	—	990	—	84.7	—

juveniles per 100 adult females. The 59 reedbuck skulls consisted of 27 males, 26 females, and 6 unsexed animals. Of these, 32 had sub-adult dentition and 12 were adult females in which tooth replacement was complete, giving a ratio of between 213 and 267 juveniles per 100 adult females, depending upon the number of unsexed animals that may have been adult females.

The 71 impala specimens were aged according to Child (1964) and included 18 calves under twelve months old, 8 yearlings, and 26 females old enough to have calved, judging from the month in which they were shot (Child, 1968b). This gives ratios of 69 calves and 131 calves and yearlings per 100 breeding females; 6 calves were small but 10 were over six months old so that there was a high proportion of well-grown sub-adults in the sample.

While such data have limitations, they were collected by some 140 hunters over a fifteen-month period of concentrated hunting in an area that had been hunted for twenty-six years. They suggest either a bias towards shooting young animals, including many that would have appreared adult-sized under field conditions, or populations with potentially high rates of recruitment into the adult class. The latter would be consistent with phase one of the eruptive cycle for ungulates described by Riney (1963a) and conforms with the high duiker and steenbok population densities observed by Child and Wilson (1964a) in the Chiware area twenty-eight months after the hunting ceased.

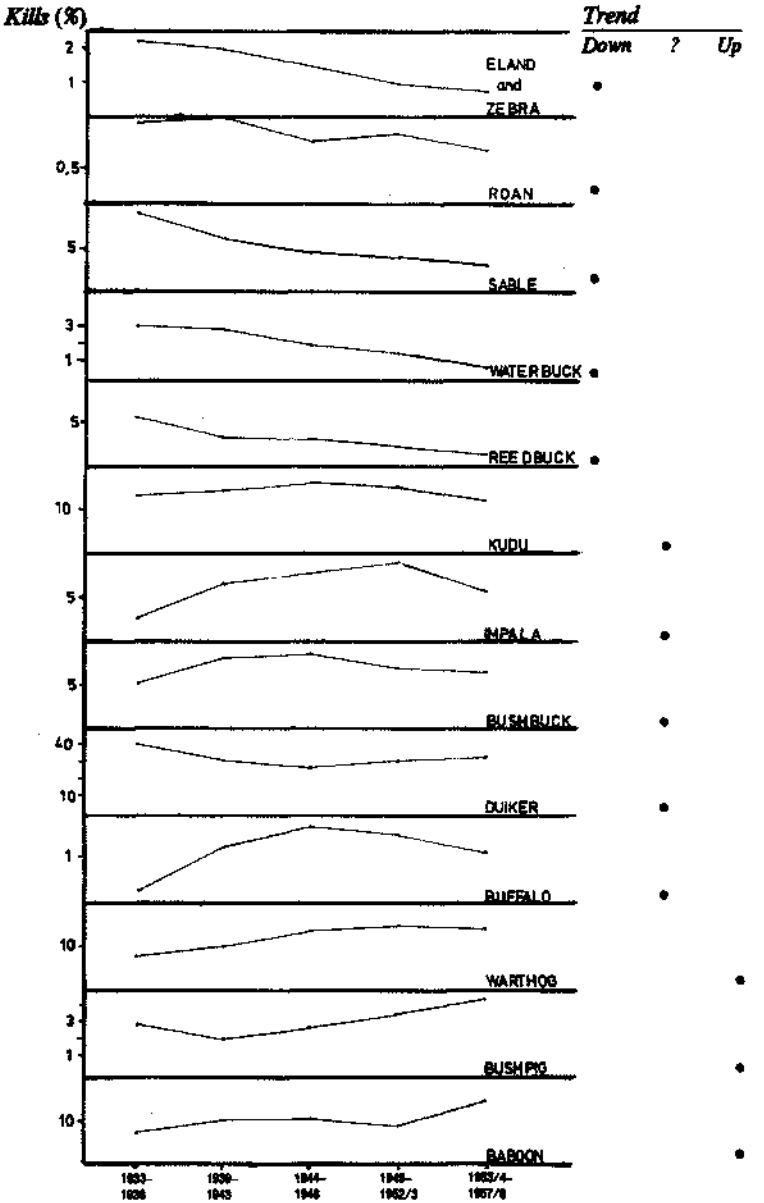
DISCUSSION

Tsetse control hunting was designed to eliminate the wild vertebrates on which the fly depends naturally for food. Returns of the animals shot in the hunting areas is of historical and zoo-geographical interest to the management of wildlife in a large portion of Zimbabwe. Here discussion is limited to the effectiveness of the hunting operations in achieving their aim of game elimination. The possibility exists that the hunting, as practised during the period under review, was not achieving its stated objectives and that it was counterproductive to them.

There is good circumstantial evidence that declining densities of fly in several areas coincided with hunting operations and yet wildebeest in the Sebungwe and black rhinoceros generally were the only species apparently eliminated by the hunting. Sable, roan and eland were shot in relatively higher numbers throughout the country before 1933 and contributed a declining proportion of the kill from then until 1957/8 (Fig. 46). This was also true of zebra, waterbuck and reedbuck after 1933. With the exception of reedbuck these are all large, rather gregarious species, which are conspicuous and relatively easy to hunt, providing the successful hunter with a good return in meat for his efforts. Apart from eland they are all essentially grazing species.

The lack of a persistent trend in the proportions of duiker, impala, bushbuck, kudu and buffalo in Fig. 46 probably relates to changes in hunting policy,

Figure 46: **GROSS TRENDS IN SPECIES KILLS**



Note: The total kill of each species is shown as a percentage of the total kill of all species in all hunting areas over successive five- or six-year intervals.

particularly as to whether or not small antelope were shot. The high numbers taken of such species as duiker would tend to buffer obvious trends. Nevertheless, all these species were shot in increasing numbers until the Thomas Report (Federation of Rhodesia and Nyasaland, 1955) led to the constriction of the hunting areas. This evidence, supported by that from the Urungwe and Sebungwe with some variations, cannot be reconciled with declining populations. If anything, these populations were increasing, judging from the trends in annual kills and the high proportion of young well-grown juveniles in the skull collection from the Sebungwe in 1958 to 1960.

Buffalo and kudu are both large species, but like bushbuck and duiker they become very secretive when persecuted. Duiker, bushbuck and kudu are almost exclusively browsers, while both buffalo and impala will graze when grass is available. On the other hand, both tend to do well when the range has been suppressed and woody vegetation has prospered at the expense of the perennial grass cover.

Baboon, elephant, bushpig and warthog were killed in consistently higher proportions on a country-wide basis from 1933 to 1955/6 and this trend was sufficiently strong so as to mask the effects, to the total kill, of the changes in hunting policy. With the possible exception of elephant, where annual samples were small, this pattern was also manifest for the Sebungwe and the Urungwe, indicating that these species increased in spite of being hunted. Baboon and bushpig are somewhat specialized mixed feeders, while warthog are grazers depending heavily on rooting. All three are highly adaptable and usually become very difficult to hunt after being subjected to sustained disturbances.

Table VIII summarizes these trends in the dominant animals shot on tsetse control and relates them to the species gross feeding and movement patterns. The results are presented as percentages of the overall kill by time intervals in Table IX. Possible relationships between the total kill and gross movement patterns are inconclusive, but there was a decline in the proportion of grazers shot in later years, which is marked if warthog is excluded. This is compensated for mainly through an increase in mixed feeders, as the relative proportion of browsers remained fairly stable, especially after 1944.

While hunting may have been one factor affecting the species composition of the fauna, the possibility exists that changes in the relative proportions of kills was a reflection of habitat changes, especially as Riney (1963b) described such changes in the Sebungwe. He attributed the changes to the annual early burning of the range associated with tsetse control hunting. It is well known that regular burning early in the dry season in areas of low rainfall and low soil fertility will favour bush encroachment at the expense of the perennial grass cover. This is precisely what Riney found in the unsettled Sebungwe, where the suppression of

Table VIII

THE NUMERICAL TRENDS IN ANIMAL KILLS COMPARED WITH THE GROSS FEEDING AND GROSS MOVEMENT PATTERNS OF THE VARIOUS SPECIES HUNTED IN HIGH NUMBERS BETWEEN 1933 AND 1957/8

Species	Trend in percentage kill			Species classes					
				Feeding			Movement		
	Up	?	Down	Grazer	Browser	Mixed feeder	Local	Semi-local	Mobile
Baboon	x					x	x		
Elephant	x					x			x
Zebra			x	x				x	
Bushpig	x					x	x		
Warthog	x			x			x		
Duiker		x			x		x		
Waterbuck			x	x			x		
Reedbuck			x	x			x		
Impala		x				x	x		
Roan			x	x				x	
Sable			x	x				x	
Bushbuck		x			x		x		
Kudu		x			x		x		
Eland			x		x				x
Buffalo		x				x			x
Population Trend									
Up	4	–	–	1	–	3	3	–	1
?	–	5	–	–	3	2	4	–	1
Down	–	–	6	5	1	–	2	3	1

Table IX

THE PROPORTION OF ANIMALS SHOT IN SUCCESSIVE TIME INTERVALS, BY FEEDING AND MOVEMENT PATTERNS

Animal Class	Period				
	1933–1938 (%)	1939–1943 (%)	1944–1948 (%)	1949–1952/3 (%)	1953/4–1957/8 (%)
Feeding					
Grazers	28.3	25.4	25.8	24.8	21.8
(excluding warthog)	20.7	15.4	12.3	10.2	7.4
Mixed feeders	12.8	18.4	19.5	22.5	27.2
(excluding baboon)	5.9	9.0	11.1	14.7	13.9
Browsers	59.0	55.2	53.8	53.5	53.7
Movements					
Localized	84.9	87.6	89.7	91.2	92.9
Semi-localized or mobile	15.1	12.4	10.3	8.8	8.1

the grasses in some areas was so marked that it had resulted in accelerated soil erosion, leading to gully formation.

It may also be significant that, although warthog is a grazing species, Mitchell (1963) has described how such burning practices and the resultant changes in the species composition of the grasses can favour the species, at least temporarily, in the same way that Petrides (1960, *pers. comm.*) demonstrated with overgrazing in Uganda. Child (1968a) also indicated that roan and sable are among the first species to decline, even in the absence of any significant hunting, where similar but more arid habitats to those of the Sebungwe are subjected to the type of burning regime practised to facilitate tsetse hunting. A reduction in roan numbers, in association with such changes in the physiognomic structure of the vegetation, conforms with Joubert's (1976) analysis of the characteristics of essential roan habitats.

While tsetse may feed on a wide range of vertebrates, analysis of its blood-meals generally shows a preference for the suids and such species as bushbuck and kudu. In the Nagupande area warthog and bushpig contributed 64.8 per cent of the blood-meals analysed, with kudu and bushbuck at 11.5 per cent, the next most favoured hosts (Cockbill, 1964).

It is perhaps ironic that these four species were shot in greater numbers after twenty-four years of tsetse control hunting, with warthog and bushpig, at least, apparently increasing in the hunting areas. While Cockbill shows a strong negative correlation between tsetse numbers and the cumulative warthog kill during the first few months of intensive hunting in the Nagupande area from 1962 to 1964, this could hardly have applied in areas where there was protracted hunting prior to 1957/8. Here any relationship between the animals killed and a decline in fly populations must have related to factors other than the mere killing of animals, which is in line with what Child *et al.* (1970) found in Botswana. They suggest that hunting may have influenced the behaviour of the host species, making them less accessible to the tsetse, for, as noted, species like duiker and other small antelope soon adjusted to changes in the hunting pattern, such as the introduction of night shooting.

If this hypothesis holds, then the net result of the hunting would have been to increase the potential availability of tsetse food animals when hunting ceased and the animals resumed their normal behaviour patterns. Even had a host population been reduced, a rise in numbers above a critical threshold could have led to an increase in the tsetse population (Bursell, 1961). This would explain the reported deterioration in the tsetse situation after the reduction in the size of the hunting areas, recommended in the Thomas Report (Federation of Rhodesia and Nyasaland, 1955), when hunting was suspended in 1960.

It also underlines the importance of having clearly-defined objectives in any control measure such as hunting, and of systematically evaluating whether or not

these are being achieved. In the present case, protracted costly hunting operations, over twenty-six or more years, may actually have compounded the problem they sought to alleviate. For game elimination, or selective game elimination, to be effective it is essential that it is properly monitored against the aims to be achieved (Bursell, 1961; Vale and Cumming, 1976).

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