

## **Comparative profitability of cattle and wildlife ranches in semi-arid Zimbabwe**

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*(Received 8 June 1995, accepted 2 September 1995)*

Cattle, wildlife and mixed ranching in the semi-arid savannas of the Midlands Province of central Zimbabwe were compared. Revenue in cattle enterprises was derived mainly from beef cattle while most income in wildlife enterprises was from plains-game hunting. Cattle ranching became less profitable and wildlife ranching more profitable and widespread during the 1980s. The 1989/90 survey of 50 ranches found that, in areas with abundant wildlife, greatest net revenue ha<sup>-1</sup> was earned by mixed ranches. Profitability of wildlife ranching depended on access to off-ranch wildlife resources but lower capital requirements for wildlife enterprises resulted in less financial risk. The study did not support the claim that in semi-arid savannas wildlife ranching is more profitable than cattle ranching. It was concluded that Midlands ranchers would maximize their profits and spread risk by operating mixed ranches. Sustainable management of such multi-species animal production systems could be enhanced by the combination of individual management of cattle enterprises with a co-operative wildlife management scheme.

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**Keywords:** semi-arid savannas; cattle ranching; wildlife ranching; safari hunting; profitability; capital investment

### **Introduction**

*'In emergent Africa you either use wildlife or lose it. If it pays its own way some of it will survive.'* (Myers, 1981)

In many semi-arid African savannas, options for intensifying agricultural production are limited by the paucity and variability of rainfall (Walker, 1979). Yet, expanding human population pressure is forcing rural people to cultivate more marginal lands and to overstock rangelands (Muir, 1988). Human resource needs are thus increasingly in conflict with the habitat requirements of wildlife, particularly where

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wild animals range beyond the bounds of national parks (Bell, 1987; Parker & Graham, 1989). Since preserving genetic diversity is of low priority to people facing starvation due to depredation by wildlife (Bell, 1987), sustainable rangeland development in semi-arid Africa must focus on reducing both poverty (by increasing the value of products derived from marginal land) and environmental degradation (Eltringham, 1984).

Multi-species herbivore communities tend to defoliate African savannas more uniformly than cattle alone (Walker, 1976, 1979; Taylor & Walker, 1978) either through inter-specific niche separation (Lamprey, 1963) or overlapping and flexible habitat use (Ferrar & Walker, 1974; Walker, 1976). Consequently, it has been argued that wildlife production is ecologically the most rational form of land use in such areas (Child & Child, 1986).

It has also been claimed that wild ungulates can produce more meat ha<sup>-1</sup> than cattle (Dasmann & Mossman, 1961; Hopcraft, 1986) because they use savanna vegetation more uniformly and are better adapted to high temperatures, limited water supplies and endemic diseases (Dasmann, 1964; Brown, 1969; Mossman & Mossman, 1976; Walker, 1979). Some have argued that game-meat production can be more profitable than beef production in semi-arid savannas (Dasmann & Mossman, 1961; Hopcraft, 1970, 1986; Clarke *et al.*, 1986). However, other studies have refuted these claims (Taylor & Walker, 1978; McDowell *et al.*, 1983) stating that high biomass conversion rates, a trait long selected for in cattle, is of little survival value among wild ungulates.

The main economic advantage of wildlife over cattle in marginal lands is generally considered to be their potential for providing multiple products of high value while at the same time reducing ecological pressure (Johnstone, 1975; Muir, 1988; Child, 1988; Cumming, 1989). For instance, safari hunting and photo-tourism have been found to be lucrative in semi-arid savannas with diverse wildlife communities, depending less on high population densities than does meat production (Muir, 1987). Despite claims that African wildlife can generate greater profits than cattle (Joubert *et al.*, 1983; Clarke *et al.*, 1986; Hopcraft, 1986; Child, 1988), the relative profitability of extensive cattle and wildlife has not been well established for semi-arid African savannas with a limited diversity of wildlife.

The commercial ranching sector of Zimbabwe presented a rare opportunity to compare the profitability of extensive cattle and wildlife production systems because there is a long history of cattle ranching and, as allowed by the 1975 Parks and Wildlife Act, landowners may exploit wildlife on their land. Beef exports have long represented a significant source of foreign earnings for Zimbabwe (Cumming & Bond, 1991) and have been subsidized through export incentives and preferential trade agreements with the European Community (Rodriguez, 1985). Due to the high veterinary standards set by the lucrative European market, rigorous disease control is of primary concern in Zimbabwe. Since wildlife has been identified as the primary agent for transmitting several diseases to domestic livestock, the movement of wildlife is subject to stringent veterinary controls. Wildlife on Zimbabwe ranches has thus been exploited primarily through safari hunting, though photo-tourism is on the increase.

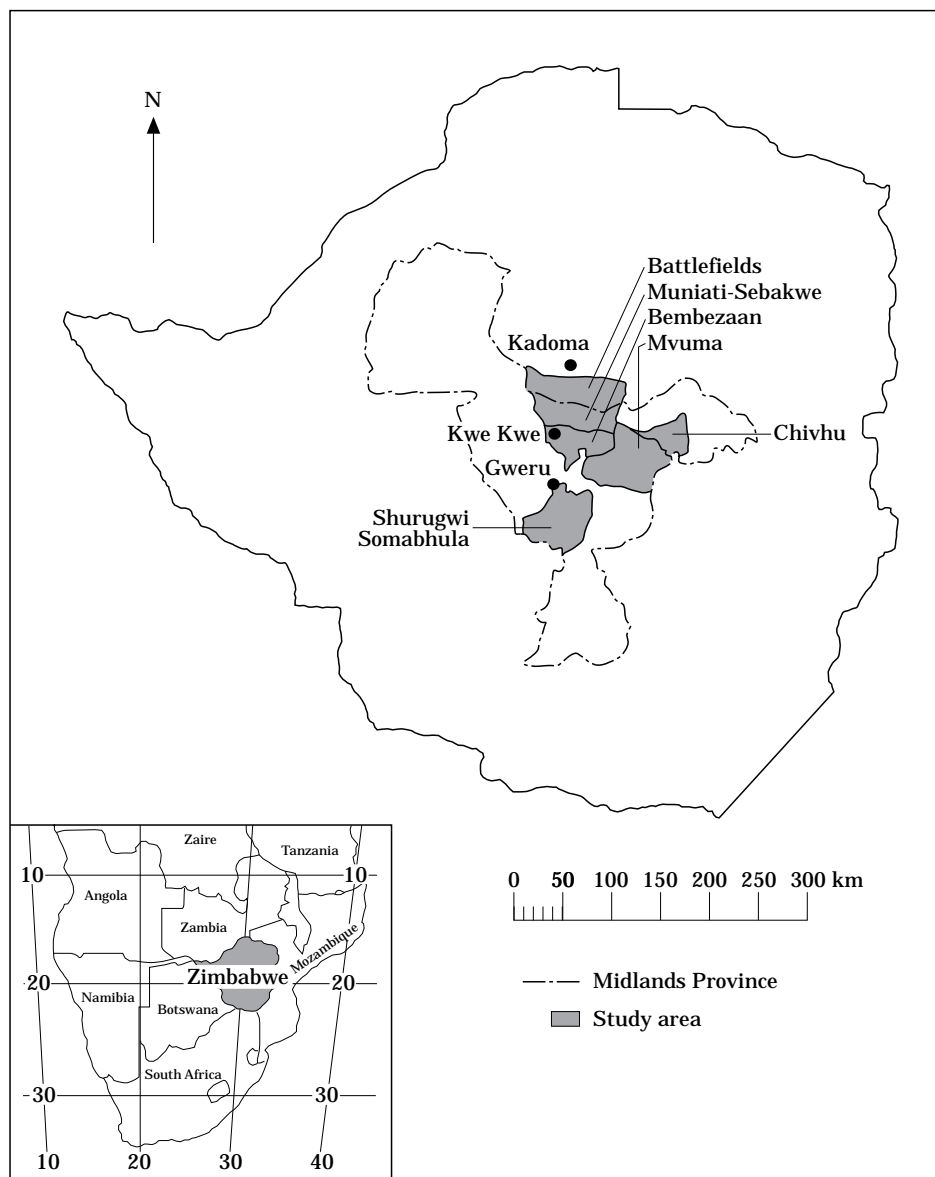
This study focused on the Midlands Province in central Zimbabwe because it was considered to be most suitable for determining economic trade-offs between cattle and wildlife ranching. It has sufficient variety and abundance of species for plains-game hunts but insufficient large species, such as elephants and buffalo, to sustain lucrative big-game hunts. Child (1988) estimated that the Midlands can annually sustain about 50, 7–10 day hunts incorporating either leopard (*Panthera pardus*) or sable (*Hippotragus niger*) as the main trophy species and several other species (mainly ungulates) as secondary trophies.

This paper presents an overview of ranching trends in the Midlands during the 1980s. It also compares the revenue, cost, financial profit and capital investment

structures of 50 cattle, wildlife and mixed ranches during the 1989/90 production season. Finally, the implications of the results for managing cattle and wildlife in semi-arid savannas where megaherbivores are generally not abundant are discussed.

### Study area and survey sample

The Midlands Province lies in the semi-extensive central region of Zimbabwe (Fig. 1). It ranges in altitude from 920 to 1475 m and the topography is gently undulating, becoming broken towards the eastern and western drainage systems (Vincent &



**Figure 1.** The Midlands Province of Zimbabwe and the study area.

Thomas, 1960). Mean annual rainfall varies from 650 to 800 mm along an east-west gradient and occurs mainly during summer storms. The dominant vegetation is *Miombo* woodland savanna dominated by *Julbernardia globiflora* and *Brachystegia bohemii* but *Colophospermum mopane*, *Terminalia sericea* and *Burkea africana* occur in poorly drained areas. Mixed *Combretum* and *Acacia* woodlands often dominate along the great dyke running north-south through the Midlands. In the Chivhu and Somabhula areas, plateau grasslands, particularly *Hyparrhenia* species, displace the woodlands. Due to erratic rainfall and sandy soils, the Midlands is generally suited only to drought-tolerant crops and range-based animal production (Vincent & Thomas, 1960).

Of the 239 Midlands ranches on record in 1989/90, 90.8% (84% by area) derived income mainly from cattle and 9.2% (16% by area) mainly from wildlife. The study population was restricted to independent ranches exceeding 1200 ha (c. 70% of all ranches) because smaller ranches cannot sustain 240 livestock units (i.e. animal units of 450 kg), the likely minimum herd size for commercially viable beef cattle enterprises. The study area was further restricted to the six ranch areas (Fig. 1) with the highest concentration of ranches exceeding 1200 ha. Four of these areas were dominated by *Miombo* woodland savanna with abundant wildlife, while the other two consisted of mainly open, *Hyparrhenia*-dominated grasslands, with low densities of wild ungulates.

Fifty ranches deriving revenue from cattle, wildlife, or both, and ranging in size from 1424 to 132,840 ha were selected for study. In the four areas with abundant wildlife, data were obtained from about 80% of the relevant ranches, including 15 cattle ranches, 7 wildlife ranches and 13 ranches with both cattle and wildlife enterprises. In the two areas with sparse wildlife, no revenue was derived from wildlife, and 15 cattle ranches (c. 25%) were randomly selected for study.

## Methodology

### *Data collection and analysis*

Two sets of data were collected. The first set was obtained for a detailed cross-sectional analysis of the 50 ranches in the study sample. These data consisted of operational details and 1989/90 financial statistics from each ranch. They were obtained through personal interviews (with negligible non-response) based on an extensive, standardized survey questionnaire. The second data set, obtained from seven ranchers who had complete financial records for the 1980-1989 period, was used to conduct a rudimentary time-series analysis of recent trends in the profitability of cattle and wildlife operations. Financial data were extracted directly from the official year-end accounts of the seven ranchers. In addition, secondary data of cattle and wildlife numbers and beef prices were collected for the 1980s.

The small sample sizes of the cattle, wildlife and mixed ranch categories and differences in sample variances required the use of non-parametric statistical techniques. Such techniques are distribution-free, obviating the need for normally distributed data, but they are more prone to incorrect acceptance of the null hypothesis (Sokal & Rohlf, 1995). Specifically, the Wilcoxon and Mann-Whitney two-sample tests were used to compare sample means (Hollander & Wolfe, 1973).

### *Financial profit estimates*

Inflation in Zimbabwe was significant during the 1980s, with an average annual increase in the consumer price index of 12.6% (CSO, 1991). Therefore, net revenues

(income less direct and overhead costs) estimated from ranch records for the 1980–89 period were adjusted to the 1989 Z\$ value to facilitate comparison with the estimates derived in the detailed 1989/90 cross-sectional analysis. Depreciation costs were excluded from income estimates in the time series analysis because ranch records reflect standard book values for capital items rather than actual values. Salaries and other personal drawings by ranch owners/managers were also excluded because the values reported frequently reflect accounting practices for reducing year-end tax liabilities rather than ranchers' actual opportunity costs for running their operation. Non-inclusion of management costs can lead to overestimation of profits but, because of uncertainty concerning the opportunity costs of management and land, profits are often calculated as net returns to management and land (Gittinger, 1982). This was the approach used in the time series analysis.

The 1989/90 financial profits of cattle and wildlife enterprises in the Zimbabwe Midlands were estimated from the values of outputs and direct and overhead costs obtained through the survey. In contrast to the time series analysis, actual depreciation of capital inputs was estimated and ranch profits were calculated both with and without depreciation costs. In addition, 1989/90 net revenues of cattle enterprises were adjusted to eliminate capitalization of profits through herd increases or liquidation of profits through herd decreases. However, these adjustments were not made for wildlife because estimated population changes on individual ranches in 1989/90 frequently reflected migration rather than actual population changes. Where wildlife enterprises derived revenue from off-ranch wildlife resources, financial data were obtained for both the on- and off-ranch segments. Subsidization of on-ranch wildlife enterprises by the use of off-ranch resources was identified and the on-ranch components of wildlife and cattle ranches were compared.

Revenues, costs, financial profits and capital investments were estimated primarily on a per ha basis because land is generally a fixed input in the short-term. Returns to investments in fixed, moveable and livestock assets were also calculated. Land was excluded from fixed assets because inflation and the Zimbabwe government's land redistribution policy during the 1980s were creating a volatile market in which land prices did not accurately reflect productive potential. Similar to the 1980s time series analysis, profits were also estimated as net returns to management and land in the 1989/90 cross-sectional analysis.

## Results

Results are presented in three parts: changes in the number and value of animals and net revenue ha<sup>-1</sup> during the 1980s; revenues, costs and net revenues during the 1989/90 production season; and estimated value and structure of capital assets in 1990. The levels of statistical significance reported are:  $p < 0.10$ ,  $p < 0.05$  and  $p < 0.01$ . The probability levels reported refer to  $H_0: X_i = 0$  for individual means,  $X_i$ , or  $H_0: X_i - X_j = 0$  for the difference between two means,  $X_i$  and  $X_j$ .

### *1980s time series analysis*

#### *Animal numbers and values*

In Zimbabwe, average inflation-adjusted cattle prices fell 24% between 1982 and 1988 (Roth, 1991) and profit margins shrank sharply. As a result, cattle numbers decreased nationwide by 21% during the 1980s and by 32% in the Midlands (from c. 408,000 in 1980/81 to c. 277,000 in 1988/89). By contrast to cattle, the average revenue per animal unit of wildlife used in safari hunting increased by 29% in US\$ terms and by

**Table 1.** Total cattle and huntable wildlife numbers by ranch area in 1989/90

Ranch area	Area surveyed (ha)	Cattle		Wildlife	
		Total	No. ha <sup>-1</sup>	Total	No. ha <sup>-1</sup>
Battlefields	46,244	5221	0.11	13,615	0.29
Muniati-Sebakwe	95,968	8603	0.09	24,678	0.26
Bembezaan	35,801	7361	0.21	7659	0.21
Mvuma	209,338	35,652	0.17	29,783	0.14
Chivhu	50,221	15,735	0.31	5957	0.12
Shurugwi-Somabhula	59,669	14,787	0.25	3404	0.06
Total	497,242	87,359	0.18	85,096	0.17

75% in Z\$ terms from 1984 to 1986 (Child, 1988). In the Midlands, wildlife-related income increased four-fold between 1975 and 1984. Child (1988) found that this led to greater allocation of land to wildlife between 1979 and 1984, a concomitant increase in the populations of 12 huntable species, and increased use of most species. Child concluded, however, that a shortage of trophy animals in the Midlands appeared to be limiting further expansion of the wildlife industry.

The estimated numbers of cattle and huntable wildlife species (listed in Table 2) in 1989/90 in each of the six ranch areas studied are presented in Table 1. Nearly 80% of cattle occurred in the last three areas while almost 90% of the wildlife occurred in the first four areas. The stocking rates of cattle were greatest and those of wildlife were least in the Chivhu and Shurugwi-Somabhula areas due to the greater herbaceous cover and sparsity of diverse wildlife habitats.

The population size, off-take rate and trophy fees for each huntable species are shown in Table 2. The most numerous animals were impala followed by warthog, baboon, kudu and duiker. Together these five species comprised approximately 74% of huntable animals in the study area. The off-take rates were similar to the 2% for ungulates and 6% for felines recommended by Zimbabwe's Department of National Parks and Wildlife Management (Child, 1988; Russell D. Taylor, pers. comm.). Only oribi appeared to be hunted in excess of the recommended rate. Most were, in fact, taken from populations outside of the study area.

The average 1984 and 1989/90 trophy prices are usually quoted in US\$ for the sake of predominantly foreign clients, and the species in Table 2 are ranked according to their trophy values. In 1989/90, access to leopard or sable could increase the value of a hunt from US\$1750 to US\$3500 (excluding trophy fees) because hunts could be increased from 7 to 10 days, and the daily rate from US\$250 to US\$350. In addition, the average US\$ value of trophies increased by about 17% between 1984 and 1990 which together with a 42% increase in the Z\$/US\$ ratio during the same time period resulted in *c.* 67% increase in the average Z\$ value of trophies (*c.* 9% per year).

#### *Net revenue*

In his 1984 comparison of cattle and wildlife ranches in the Midlands, Child (1988) estimated that the average net income ha<sup>-1</sup> was over 50% greater for cattle than wildlife (Z\$4.52 and Z\$2.94, respectively), due to the higher stocking rates for cattle. However, the net income kg<sup>-1</sup> biomass, which reflects the earning power of livestock, was 2.4 times higher for wildlife than cattle (Z\$0.17 and Z\$0.07, respectively). In addition, Child estimated that, depending on the assumptions made about capital

investment needs, returns to investment were from 3.8 to 10.9 times higher for wildlife than cattle and that the returns to investments in cattle were negative in real terms.

The 1980–89 net revenues for seven Midlands ranches surveyed in 1990 are presented in Fig. 2. Six ranchers derived income from cattle throughout the 1980–89 period while one ceased livestock production in 1983 to focus on safari hunting. The average net revenues for cattle reported here exclude this rancher's income from cattle because his records did not distinguish between operational income and liquidated livestock capital. Only one other rancher in the sample systematically derived income from wildlife between 1982 and 1985 after which two more ranchers added wildlife enterprises to their operations. Since sample sizes were unavoidably small and inconsistent between years, statistical comparison of values was not possible and results are discussed only in general terms.

Average net revenue ha<sup>-1</sup> from cattle (based on 1989 Z\$ values) in 1980–1982 was over twice the average value for the rest of the 1980s. This is consistent with the significant decrease in inflation-adjusted cattle prices between 1982 and 1988 reported by Roth (1991).

The average net revenue ha<sup>-1</sup> from wildlife includes data from one rancher who, after 1984, had access to a big-game hunting area outside of the Midlands study area. His net revenue ha<sup>-1</sup> is represented in Fig. 2 by vertical lines through each average revenue bar for wildlife. It appears that average net revenue ha<sup>-1</sup> from wildlife increased after 1982 and exceeded cattle values in 1985 and 1989. After 1984, these

**Table 2.** Estimated 1989/90 wildlife populations, percent shot during 1989/90, and 1984 and 1989/90 average trophy values of hunted species in the Midlands study area

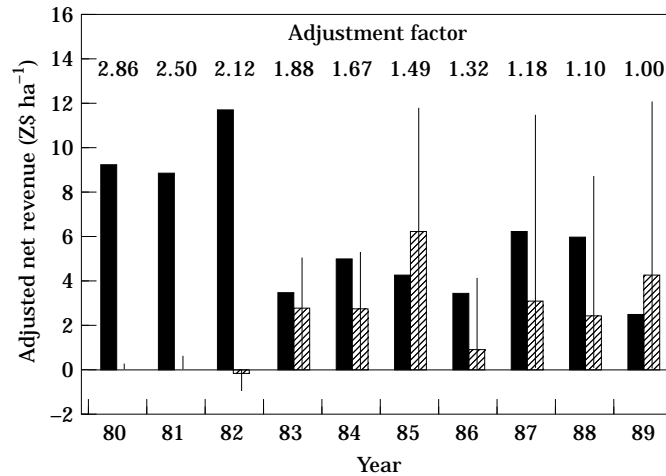
Species	Scientific name	Number in 1989/90*	% shot in 1989/90†	Trophy fee (US\$)		
				1984‡	89/90§	%diff
Leopard	<i>Panthera pardus</i>	185	6.0%	–	1375	–
Sable	<i>Hippotragus niger</i>	1618	2.2%	800	1164	46%
Eland	<i>Taurotragus oryx</i>	1579	1.9%	560	683	22%
Waterbuck	<i>Kobus ellipsiprymnus</i>	540	2.2%	440	564	28%
Kudu	<i>Tragelaphus strepsiceros</i>	9024	1.1%	440	499	13%
Tsessebe	<i>Damaliscus lunatus</i>	2042	1.2%	440	480	9%
Zebra	<i>Equus burchelli</i>	2802	2.6%	440	427	–3%
Wildebeest	<i>Connochaetes taurinus</i>	3894	1.8%	320	355	11%
Reedbuck	<i>Redunca arundinum</i>	1484	2.6%	220	250	14%
Bushbuck	<i>Tragelaphus scriptus</i>	395	2.0%	220	244	11%
Klipspringer	<i>Oreotragus oreotragus</i>	519	1.4%	140	158	13%
Oribi	<i>Ourebia ourebi</i>	38	6.7%	–	142	–
Impala	<i>Aepyceros melampus</i>	24,501	0.7%	80	96	20%
Warthog	<i>Phacochoerus aethiopicus</i>	12,671	1.1%	80	87	9%
Bushpig	<i>Potamochoerus porcus</i>	3217	0.6%	80	80	0%
Steenbok	<i>Raphicerus campestris</i>	3487	1.4%	56	73	30%
Grysbok	<i>Raphicerus melanotis</i>	245	0.6%	56	71	27%
Duiker	<i>Sylvicapra grimmia</i>	7330	1.3%	–	71	–
Baboon	<i>Papio ursinus</i>	9525	0.2%	–	36	–
Average difference 1984–90						17%

\*Anecdotal information from survey ranchers.

†Includes only the trophy off-take, and excludes animals shot for meat.

‡From Child (1988).

§Average values from 1990 survey.



**Figure 2.** Average net revenue ha<sup>-1</sup> (adjusted to 1989 Z\$ values) from six cattle enterprises (■) and four wildlife enterprises (▨) during the 1980s. Vertical lines represent net revenue ha<sup>-1</sup> for one wildlife rancher with a big-game hunting concession after 1984. The adjustment factors reflect the cumulative annual inflation rates in Zimbabwe and were used to convert annual net revenues ha<sup>-1</sup> to 1989 Z\$ values.

differences were, however, largely due to the off-ranch income derived by one rancher from an external hunting area. But, in 1983 and 1984, when only Midlands wildlife resources were used, his net revenue ha<sup>-1</sup> was greater than the average net revenue ha<sup>-1</sup> from cattle. While these results must be treated with caution because sample sizes were small, they do not support the contention that, when only Midlands wildlife resources are considered, wildlife ranching was consistently more profitable than cattle ranching during the 1980s. The following analysis of 1989–90 financial statistics examines the profitability of cattle and wildlife ranches in more detail.

#### *1989/90 cross-sectional analysis*

##### *Revenues and costs*

In the 1989/90 season, virtually all income derived from cattle was obtained from the sale of beef cattle either to abattoirs, through livestock auctions or through on-ranch meat sales. Among wildlife enterprises, 84% generated revenue through the sale of safari-hunting opportunities, 25% from hunting leases and 25% from game meat sales. Of the hunting clients, 49% were American, 40% European and 6% Australian.

Average revenue structures and cost structures (excluding depreciation) of cattle and wildlife enterprises are presented in Tables 3 and 4. The greatest proportion (57%) of cattle revenue was derived from sales to the Cold Storage Commission (CSC, Zimbabwe's parastatal organization responsible for exporting meat) which provided the highest average prices. Auction sales, private live sales and sales to private abattoirs provided 18, 12 and 10% of the total revenue, respectively. Auction prices were Z\$154 per head lower than CSC prices because there was low demand for the mainly young stock during the foot-and-mouth disease epidemic during the study period.

Almost 70% of all wildlife revenue was derived from safari hunting, but in most wildlife enterprises the proportional income from hunting was greater than 70% since the 18% from live animal sales was almost all from one large ranch. Income obtained



**Table 3.** Average revenue structures of cattle and wildlife enterprises during 1989/90

<b>Cattle (N=43)</b>			
Revenue source	Head sold	Z\$ head <sup>-1</sup>	% of total
Cold Storage Commission	10,291	576.92	56.6%
Auction sales	4544	423.43	18.4%
Private live sales	2718	455.24	11.8%
Private abattoirs	1865	564.73	10.0%
Ranch butchery	552	412.95	2.2%
Sheep and goats	767	83.54	0.6%
Other			0.4%
Total earnings			Z\$10,482,765
<b>Wildlife (N=20)</b>			
Revenue source	Days sold	Z\$ day <sup>-1</sup>	% of total
Day rate hunting	983	633 (=US\$285)	36.2%
On-ranch trophies			26.9%
Off-ranch trophies			6.4%
Sub total hunting			69.5%
Live game sales			18.0%
Game meat			5.3%
Non-hunting day rate	340	206 (=US\$92)	4.1%
Sale of hunting rights			2.2%
Other			0.9%
Total earnings			Z\$1,717,272

**Table 4.** Average cost structures of cattle and wildlife enterprises during 1989/90

Category	Cattle (N=43)	Wildlife (N=20)
Live animal purchases	28.7%	4.1%
Feeds	21.2%	3.2%
Veterinary & dips	6.2%	0.0%
Hunting right fees	0.0%	10.1%
Capture and culling	0.0%	13.0%
Safari consumables	0.0%	6.9%
Promotional travel	0.0%	4.6%
Hired labour	15.8%	15.4%
Repairs and maintenance	8.4%	15.9%
Fuels	4.1%	8.6%
Power & water	1.3%	2.0%
Administration	4.6%	8.6%
Financial	5.7%	4.4%
Other	4.0%	3.2%
Total costs	Z\$8,034,064	Z\$1,265,779

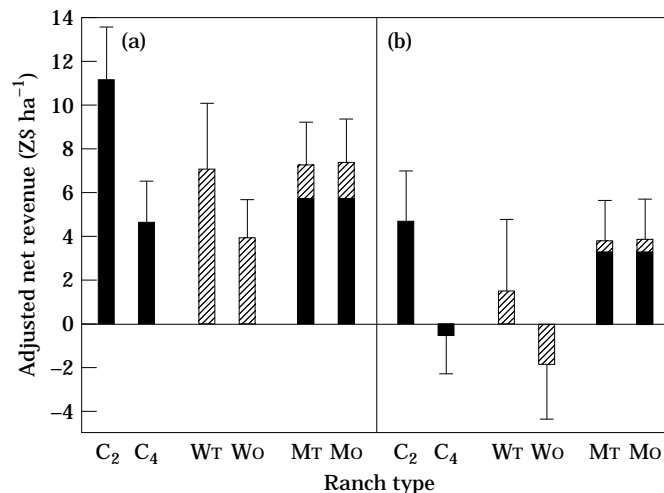
from game animals shot either on other Midlands properties or outside of the study area comprised 6.4% of total wildlife income. The average daily rate for hunters was Z\$633 (US\$285) while that for hunter companions or non-hunting clients was Z\$206 (US\$93). Sale of game-meat was the only other significant revenue source.

In order of value, the major cost categories in cattle enterprises were livestock purchases, feed, labour, and repairs and maintenance. Together they accounted for 74% of the total cattle costs. In wildlife enterprises, repairs and maintenance, labour, capture and culling, fees for the rights to hunt on other properties, fuels, and administration were the main cost categories and together accounted for 72% of total cost. Capture and culling costs were incurred primarily by one large wildlife operation.

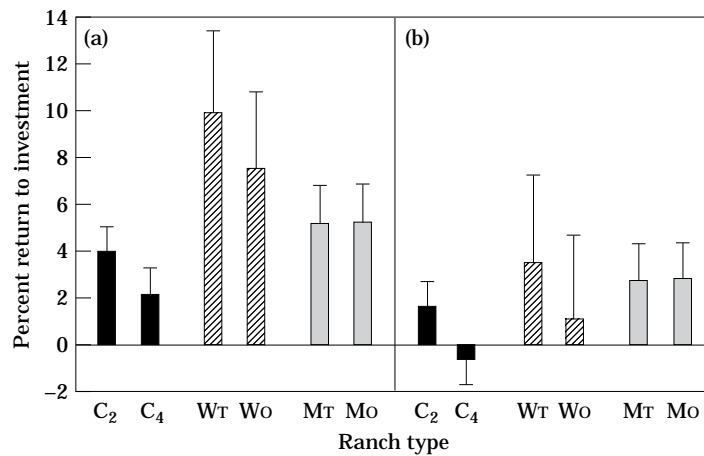
#### Financial profits

The financial profits of cattle, wildlife, and mixed ranches are presented in Figs 3 and 4. The following abbreviations are used to denote ranch types and enterprise components:  $C_2$  = 15 cattle ranches in two areas with sparse wildlife;  $C_4$  = 15 cattle ranches in four areas with abundant wildlife;  $W_T$  and  $W_O$  = total (including off-ranch income) and on-ranch components of seven wildlife operations, respectively;  $M_T$  and  $M_O$  = total (including off-ranch income from wildlife) and on-ranch components of 13 mixed ranches, respectively. On mixed ranches, cattle enterprises contributed just over 75% of the total net revenue  $ha^{-1}$  (Fig. 3(a,b)).

When depreciation costs were excluded, all ranch types provided positive net returns  $ha^{-1}$  (Fig. 3(a):  $C_2$  = Z\$11.18,  $p < 0.01$ ;  $C_4$  = \$4.53,  $p < 0.05$ ;  $W_T$  = Z\$6.91,  $W_O$  = Z\$3.79,  $p < 0.10$ ;  $M_T$  = Z\$7.11,  $M_O$  = Z\$7.20,  $p < 0.01$ ) and positive returns to investment (Fig. 4(a):  $C_2$  = 3.86%,  $p < 0.01$ ;  $C_4$  = 2.03%,  $p < 0.10$ ;  $W_T$  = 9.85%,  $W_O$  = 7.42%,  $p < 0.05$ ;  $M_T$  = 5.09%,  $M_O$  = 5.16%,  $p < 0.01$ ). When depreciation was included, financial profits of all categories were significantly reduced ( $p < 0.01$ ). Only  $C_2$  cattle and mixed ranches provided statistically significant positive net revenues  $ha^{-1}$  (Fig. 3(b):  $C_2$  = Z\$4.50,  $M_T$  = Z\$3.79,  $M_O$  = Z\$3.88,  $p < 0.10$ ).



**Figure 3.** Net revenues  $ha^{-1}$  in 1989/90 (a) excluding and (b) including depreciation costs.  $C_2$  and  $C_4$  represent cattle ranches in areas with sparse and abundant wildlife, respectively;  $W_T$  and  $W_O$  represent the total and on-ranch components of wildlife ranches, respectively; and  $M_T$  and  $M_O$  represent the total and on-ranch components of mixed ranches, respectively. (■) = cattle enterprise; (▨) = wildlife enterprise.



**Figure 4.** Percent return to investment in 1989/90 (a) excluding and (b) including depreciation costs. C<sub>2</sub> and C<sub>4</sub> represent cattle ranches in areas with sparse and abundant wildlife, respectively; W<sub>T</sub> and W<sub>O</sub> represent the total and on-ranch components of wildlife ranches, respectively; and M<sub>T</sub> and M<sub>O</sub> represent the total and on-ranch components of mixed ranches, respectively.

and only mixed ranches provided statistically significant positive returns to investment (Fig. 4(b): M<sub>T</sub> = 2.71%, M<sub>O</sub> = 2.78%  $p < 0.10$ ).

Due to the small sample sizes and the large variance within ranch categories, few inter-category differences were statistically significant. When depreciation was excluded, net revenue ha<sup>-1</sup> for C<sub>2</sub> cattle ranches was greater than for C<sub>4</sub> cattle ranches ( $p < 0.05$ ) and the on-ranch component of mixed ranches (M<sub>O</sub>,  $p < 0.10$ ) (Fig. 3(a)). Percent returns to investment were, however, greater for wildlife ranches than for C<sub>4</sub> cattle ranches ( $p < 0.10$ ) (Fig. 4(a)). When depreciation was included, the net revenue ha<sup>-1</sup> for C<sub>2</sub> cattle ranches remained greater than for C<sub>4</sub> cattle ranches ( $p < 0.10$ ) (Fig. 3(b)), and percent return to investment for mixed ranches was greater than for C<sub>4</sub> cattle ranches ( $p < 0.10$ ) (Fig. 4(b)).

These results imply that, in areas with sparse wildlife, the C<sub>2</sub> cattle ranches remained financially profitable when depreciation costs were deducted. However, approximately 16% of their income was from adjustments for increased herd sizes (due to foot-and-mouth related sales restrictions in 1989–90). In reality, several C<sub>2</sub> cattle ranchers were experiencing cash flow problems during the survey period.

Even with an 8% downward adjustment to income for reduced average herd size during 1989–90, mixed ranches in areas with abundant wildlife were still profitable when depreciation costs were deducted. By contrast, both C<sub>4</sub> cattle and wildlife ranchers were, on average, living off depreciation (Workman, 1986) or on borrowings to survive financially. Moreover, when depreciation was deducted, wildlife ranches appeared to be profitable only when off-ranch wildlife income was included. This suggests that on-ranch wildlife resources alone were, on average, insufficient to financially sustain wildlife-only ranches.

#### *Capital assets in 1990*

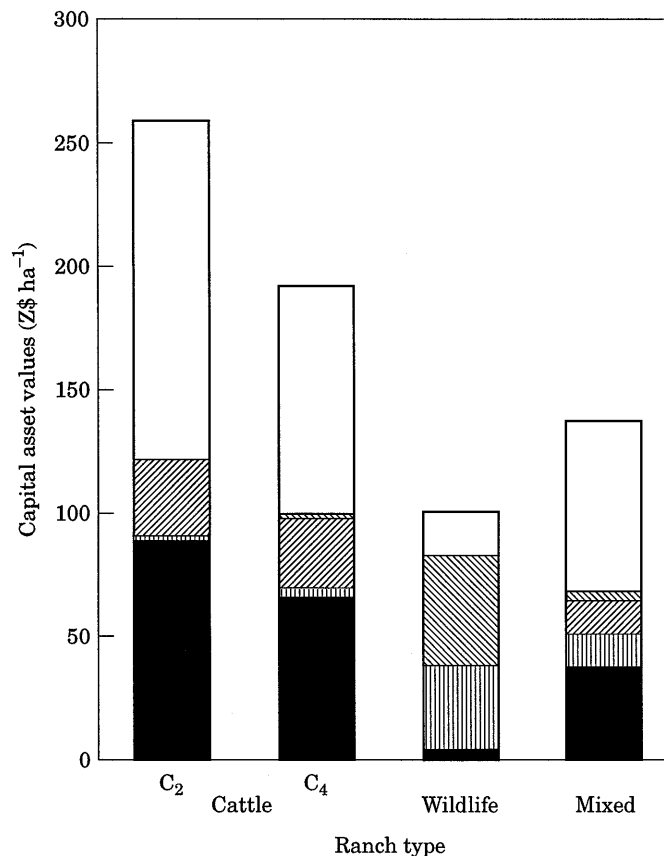
Reducing investments may be as important to producers as maximizing profits when the availability of capital is restricted. The average fixed, moveable and livestock investments ha<sup>-1</sup> on cattle, wildlife, and mixed ranches are presented in Fig. 5. Total and on-ranch components of capital items used in wildlife enterprises are not

differentiated because off-ranch operations generally did not require significant extra capital investment.

Total capital assets (excluding land) varied significantly ( $p < 0.01$ ) between all ranch categories.  $C_2$  cattle ranches had the highest capital investments while, in areas with abundant wildlife,  $C_4$  cattle ranches had more capital investments than wildlife ranches and mixed ranches were intermediate.

Approximately 50% of all capital investments on cattle and mixed ranches were in cattle. Livestock investments on wildlife ranches reflect the remnants of cattle enterprises or cattle used for domestic consumption. Jansen *et al.* (1992) allocated the value of the trophy component of each species (*c.* 2% and 6% of populations of ungulates and felines, respectively) as the capital value of wildlife. However, wildlife was not assigned an asset value for several reasons. Population estimates were subjective and sometimes uncertain due to migratory behaviour, revenue other than trophy sales can be derived from wildlife, and wildlife is owned only once it is captured.

Fixed assets were significantly greater ( $p < 0.05$ ) on cattle than on wildlife ranches. Although average investment  $\text{ha}^{-1}$  in moveable assets was greatest on wildlife ranches (mainly due to more vehicles being needed for safari hunting), differences between



**Figure 5.** Fixed, moveable and livestock assets  $\text{ha}^{-1}$  on cattle, wildlife and mixed ranches in 1990.  $C_2$  and  $C_4$  are cattle ranches in areas with sparse and abundant wildlife, respectively. (□) = livestock: cattle; (▨) = moveable assets: wildlife; (▧) = moveable assets: cattle; (▨) = fixed assets: wildlife; (■) = fixed assets: cattle.

ranch categories were statistically insignificant. The seemingly lower investments in fixed and moveable assets on mixed ranches than on C<sub>2</sub> and C<sub>4</sub> cattle ranches may be a survey artifact due to under-allocation of capital assets to cattle and wildlife enterprises on five mixed ranches (38%) with cropping operations.

The average fixed and moveable asset structures of cattle and wildlife enterprises are presented in Table 5. The greater proportion of investments in buildings on wildlife enterprises was due to safari camps. Since internal fencing is undesirable for wildlife, investment in fencing was proportionately less on wildlife than cattle enterprises. Vehicles comprised the greatest proportion of moveable assets in both cattle and wildlife enterprises. Cattle enterprises had greater investments in machinery and wildlife enterprises in equipment, especially weapons and safari camp equipment.

### Discussion

Child (1988) concluded that net revenue per unit biomass and returns to investments (1980–84) were greater for wildlife than cattle in the Midlands. He cited three main reasons for the greater profitability: growing demand for safari hunting, safari operators became more efficient, and decline in value of the ZS against all major currencies thereby raising export-orientated income in local terms. However, Child also found that the average net income ha<sup>-1</sup> was greater for cattle than wildlife.

In our 1990 survey, cattle ranches in the areas with sparse wildlife provided the greatest adjusted net revenues ha<sup>-1</sup> but, in areas with abundant wildlife, only mixed ranches produced positive net revenues ha<sup>-1</sup> when depreciation was included. Assuming that production levels of cattle in the Midlands are ecologically sustainable, these latter findings appear to refute claims that wildlife ranching is consistently more profitable ha<sup>-1</sup> than cattle ranching in semi-arid African savannas. The profitability of wildlife ranching appears to be area specific and depends on the availability of diverse wildlife populations.

In areas with abundant wildlife, cattle ranchers were surviving by living off

**Table 5.** Average fixed and moveable asset structures of cattle and wildlife enterprises during 1989/90

Category	Cattle (N=43)	Wildlife (N=20)
Fixed assets		
Buildings	34.3%	44.8%
Water facilities	41.0%	39.2%
Fencing	20.6%	11.2%
Power facilities	3.7%	4.7%
Other	0.4%	0.1%
Total investment	Z\$22,313,047	Z\$4,963,395
Moveable assets		
Vehicles	73.4%	74.4%
Machinery	16.0%	6.2%
Equipment	9.0%	19.4%
Other	1.6%	0.0%
Total investment	Z\$7,195,509	Z\$2,871,237

depreciation or liquidating assets, neither of which are sustainable in the long-run. The greater profitability of cattle ranches in areas with scarce wildlife was probably due to greater grass cover and less bush encroachment. However, both cattle ranch categories faced financial risks from foot-and-mouth related marketing constraints. Wildlife ranches were, on average, financially profitable only when off-ranch wildlife resources, especially big-game species, were included. They were thus surviving financially from external revenues or by living off depreciation. Wildlife operations did, however, have the lowest capital investments  $\text{ha}^{-1}$  and thus represented less of an investment risk than cattle operations in the prevailing uncertain economic climate.

The conclusions of this study must, however, be tempered for several reasons. During the 1989/90 production season, both output and input prices for cattle and wildlife operations were distorted by government policy interventions (Kreuter & Workman, 1994a). In addition, on average only the mixed ranches were stocked at levels close to estimated carrying capacity in 1989/90 while cattle ranches (especially those in areas with little wildlife) were overstocked and wildlife ranches appeared to be understocked (Kreuter & Workman, 1994b). Since Child (1988) estimated that the profitability per unit biomass was greater for wildlife than cattle, it might be argued that wildlife ranches would have been relatively more profitable  $\text{ha}^{-1}$  if stocking had been higher.

While it appeared that some wildlife enterprises were underdeveloped in 1989/90, prospects for increasing stocks of huntable species were limited. Reasons for this were the shortage and high cost of breeding animals and the reluctance of ranchers to invest in difficult-to-contain animals which they do not legally own. In addition, due to greater territoriality among wild than domesticated animals, and because of the greater need of high species diversity rather than large populations of a few species for safari tourism, wildlife are usually stocked at lower levels than cattle.

In areas with abundant wildlife, the greatest financial profits  $\text{ha}^{-1}$  were generated by mixed operations. Wildlife resources generally appeared to be insufficiently large or diverse to sustain independent wildlife ranches. This, together with the uncertain economic climate, foreign currency shortages, and widespread overstocking of cattle at the time of the study, made it financially and economically sound for cattle ranchers to reduce their herd sizes and diversify into wildlife. Cattle were privately owned and could be independently managed while wildlife reduced capital investment needs and provided an opportunity to earn scarce foreign currency through the sale of hunting opportunities to foreign clients. The disadvantages of cattle ranching were declining prices and disease-related movement constraints. By contrast, safari-oriented wildlife ranching faced risks from tourist preferences, socio-political instability and external economic factors (Heath, 1990). The combination of cattle and wildlife operations thus spread risk.

The management requirements for cattle and tourist-orientated wildlife ranching are, however, quite different. While cattle movement can be easily controlled, many wild species are difficult to contain. Moreover, many wild species, including eland, zebra, wildebeest and sable, are biologically predisposed to moving over areas greater than the size of most Midlands ranches (Skinner & Smithers, 1990). In addition, the relatively few high value trophy species, such as sable, tend to be overused by individual Midlands ranchers in order to offer lucrative hunts. The skills required to manage cattle and wildlife operations also differ. While successful cattle ranchers may be insular, safari operators require good public relations skills in order to attract and entertain hunting clients. Both should have good business and range management skills, but cattle ranchers also require animal husbandry skills while safari operators require tracking and hunting experience and knowledge of the habitats and behaviour of huntable species.

Thus, the land and management needs for cattle and wildlife ranching do not readily coincide. While cattle can be managed independently by each rancher, landowners

could pool their ranches for the limited purpose of safari hunting. Pooled properties could expand the total area available for hunting operations, by including ranches where wildlife is not being used. Since individual ranches are frequently game-fenced, pooled ranches would also increase the probability of providing suitable habitats for animals requiring larger home ranges (Huffman, 1995). Pooled areas can also be game-fenced less expensively than individual properties. In addition, ranchers could combine their resources to obtain professional assistance to implement sustainable wildlife management and hunting programmes, to effectively market the hunting operation, and to enhance the standards of a tourist-orientated operation. A co-operative arrangement would also reduce individual investments in lodgings, vehicles and weapons.

While mixed ranches were most profitable in areas with relatively diverse and abundant wildlife during 1989/90, the conclusions drawn should be tempered by uncertainty about their validity over time. Since relative profitability of alternative animal production systems on semi-arid African savannas vary not only with geographic location but also with time, long-term broadly representative economic studies should be conducted to reach more comprehensive conclusions. This study did not support the contention that wildlife ranching *per se* is financially more profitable than cattle ranching. Rather it suggested that the combination of cattle and wildlife enterprises, with separate management operations for each type of operation, was the most financially profitable and operationally manageable strategy for using the rangeland resources in the Zimbabwe Midlands.

The authors express their gratitude to Dr David H.M. Cumming of WWF-Zimbabwe, for providing research facilities, and to the World Wide Fund for Nature (Switzerland) and Rothmans of Pall Mall (Zimbabwe) for providing the required research funds. Thanks also go to Dr Robin N.B. Kay and an anonymous reviewer for their constructive comments about an earlier draft.

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