

Wildlife utilization and game ranching

Report on a study of recent progress in this field
in Southern Africa

by

Sue Lee Mossman and Archie S. Mossman

Published with the support of the
World Wildlife Fund
and with the cooperation of
Humboldt State University, Arcata, California

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International Union for Conservation of Nature and Natural Resources
Morges, Switzerland, 1976

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FOREWORD

In Africa as well as in many other parts of the world wild animals have economic value that derives from their direct usefulness to man as a source of food or other products. This value is indeed so high that the future of many species, such as the great whales or the Sumatran rhinoceros, is threatened by unrelenting pressure from those who attempt to realize a profit from the sale of their products. Despite the conservation problems that result from uncontrolled killing of wild animals, it is also possible to realize the economic potential of wildlife in ways that do not threaten the species. A symbiotic relationship between man and certain wild animals has been in existence throughout most of human history, through which man harvested enough wild food for his subsistence, and at the same time improved or created habitats in which wild species could thrive. The development of a modern, scientifically based symbiosis between man and wild animals has been a goal of the wildlife manager during the past half century, and in some parts of the world has been realized.

IUCN has a longstanding interest in substantiating the potential economic value of wildlife, as well as in promoting management schemes that would permit the use of wild animals while still providing full security for their continued survival. It has followed with interest the development of wildlife ranching and wildlife farming enterprises in Africa and other areas of the world. It has also realized that experience gained in one area is often not available to people living in other parts of the world.

It was with enthusiasm therefore that IUCN accepted the offer of Dr. Archie S. Mossman, a pioneer in the establishment of game ranching in Southern Africa, to revisit those areas in which he had earlier worked, to evaluate the success of the various wildlife utilization programmes that had been initiated. In this venture he was accompanied by his zoologist wife, Dr. Sue Lee Mossman. This paper represents the results of their investigations carried out in 1974-75.

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R.F. Dasmann

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INTRODUCTION

For some three million years, mankind and his progenitors have utilized wildlife. Only relatively recently has modern man, Homo sapiens, domesticated some individuals of a few wild species. Most of these species still exist in the wild. Modern man has thus had a much longer interrelationship with wild animals and plants than with domesticated ones. Pre-sapiens man had an even longer history of intimate ecological relations with wild organisms.

Game ranching is concerned with the utilization of a wide spectrum of wild species and is conducted on extensive areas. It involves the application of scientific knowledge to the utilization of wildlife and wild lands for the mutual benefit of all life. Its primary aim is to provide for the long term welfare of man and his environment. In order to achieve this goal, the productivity and diversity of natural communities need to be maintained or enhanced. Multiple-species game ranching best insures high biotic diversity, although we recognize the validity of emphasizing the use of only one or a few species in certain situations. Such instances which involve a smaller number of species, less acreage and require intensive management are activities commonly referred to as game farming. The common connotations of ranching versus farming also apply to game ranching and game farming, and all are based on sustained yield utilization. Just as in conventional farming and ranching, the annual surplus of births over deaths is utilized in some way in game farming and game ranching. As the production of cattle, hogs, sheep and chickens insures the continuation of these species, so also the utilization of game is a means of protecting wildlife.

The ways in which wildlife may be utilized are many. This variety allows for adaptations to the personal inclinations of the people involved and to the changing ecological and social circumstances. In addition to the cropping of surplus animals for meat and other products, game ranching may incorporate live game sales, game viewing, photography and sport hunting as is practised in parts of southern Africa. The operation of such game ranches produces income from recreation provided by wildlife as well as directly from the animals and their products.

A game ranch could also be managed primarily to provide food, clothing, wild vegetable foods, medicines and craft materials directly to people living close to the land rather than primarily for a cash return. Here the operation of the game ranch would improve the welfare of the people directly, rather than indirectly through conversion of such products to cash and then to the goods and services desired. Where the need to provide for maximal numbers of people from marginal lands on a sustained basis is of urgent priority, this type of game ranching (subsistence game ranching) will probably be most desirable. Subsistence game ranching will probably prove to yield the highest returns per unit area in terms of the basic necessities required for the physical and mental well-being of humans. Although there are lands in southern

Africa which have supported hunting and gathering humans for more than 100,000 years, there has been, to date, no scientifically based game ranching practised in this area.

The sale of wildlife has a very long history in most parts of the world. In Europe, it is usually ancillary to sport hunting. In North America, only certain species, or parts of others such as mink (Mustela vison), muskrat (Ondatra zibethica) or deer (Odocoileus spp.), are sold commercially. In West Africa, a substantial trade in bush meat from wild animals is carried on. Springbok (Antidorcas marsupialis), eland (Taurotragus oryx) and others have legally been sold since the settlement of South Africa by Europeans.

In spite of this history, many in the 1950s and 1960s failed to recognize the real and potential values of African wildlife. This resulted in land use decisions that have constantly reduced and often completely destroyed wildlife and their habitat. Ecological studies in the 1950s were beginning to suggest that productivities of natural communities might be high. If this were so, then it was hypothesized that the use of indigenous wildlife, especially on marginal lands, may possibly produce as much or more of the basic necessities for man as would be possible through conventional agricultural methods. Furthermore, this production might be accomplished without the destruction of habitat, productivity and of species, which so often results when conventional agricultural practices are imposed on such areas. With this background, studies of potential wildlife productivity were commenced in Rhodesia in 1959, and favorable results led to the establishment of the first multiple species game ranch in 1960 (Dasmann and Mossman 1961; Dasmann 1962; Dasmann and Mossman 1962; Mossman 1963, 1964 and 1975). That particular game ranching enterprise is still in operation and others have been started. Some have failed, but since then their number and their distribution have shown a general increase.

The present study was undertaken to evaluate the current status of game ranching in southern Africa, recent developments there in this field, and the impact of game ranching on wildlife conservation, so that the prospects for game ranching as a form of land use in developing countries may be assessed. Interviews, questionnaires, on site visits, correspondence, literature reviews and habitat studies were conducted mainly in Rhodesia, the Transvaal and Natal.

More evidence is constantly accumulating which shows the productivity of wildlife to be higher than that of introduced domestic livestock. Other evidence suggests that in many situations wildlife is more profitable than domestic stock if they are allowed to compete on an equal footing. Domestic and wild animals are both being successfully produced on the same land. One can "farm in a zoo". Other successful enterprises are using only wildlife. Their success is all the more striking because there is almost no technical, legal or financial assistance for game ranching, while domestic livestock production receives substantial governmental assistance. Production of wildlife for profit has not led to land abuse, but rather to veld improvement and maintenance of healthy veld conditions. In the past 15 years,

realization of the economic value of game has increased the distribution of wildlife, helping to insure its continued existence. Species such as the white rhino Ceratotherium simum, tsessebe Damaliscus lunatus, nyala Tragelaphus angasi and giraffe Giraffa camelopardalis that formerly were endangered or becoming so, have been widely distributed to private game ranching lands as well as to parks and game reserves. In Rhodesia and South Africa, land with good wildlife populations is bringing more money on the market than does land without wildlife. This attests to the recognition that wildlife is valuable, and also in some cases that utilization of wildlife and domestic stock may be profitably integrated.

HISTORY OF WILDLIFE UTILIZATION IN SOUTHERN AFRICA

Judging from the early records of the first European travellers in what is now the Republic of South Africa, wildlife was very abundant throughout this area; in many instances, the numbers were probably comparable to those of wildlife in the Serengeti at the present time (Wearne, undated; Joubert 1968; and Lundholm 1952). Uncontrolled slaughter took place soon after the settlement of the Cape in 1652 and spread rapidly. "These professional 'big game' hunters went primarily in search of ivory, horns, skins and ostrich plumes" "judging by the sales lists that have survived, this group of adventurers accounted for literally millions of head of game" (Joubert 1968). By the early 19th century, these people were already penetrating beyond the borders of South Africa northward and, with help from those that followed, they had exterminated two species and one subspecies by 1865 and had a further three on the brink of extinction.

The three taxa exterminated were the blue buck Ozanna leucophaea, the quagga Equus quagga and the Cape lion Panthera leo melanochaitus. The three that were nearly exterminated were the black wildebeest Connochaetes gnou, the bontebok Damaliscus dorcas dorcas and the mountain zebra Equus zebra (Joubert 1968 and Zaloumis and Cross 1974). Many other species were much reduced in abundance and eliminated from large parts of their former range.

"Game was not merely a source of food, but developed into a mainstay of the economy of the infant colony (Natal) for the first 40 years of its existence." (Bigalke 1972). Bigalke also provides the following table which compares very well the contribution of a game product, ivory, with the contribution of sugar and molasses to the economy of Natal from 1857 to 1871.

<u>Period</u>	<u>Value of Ivory (£)</u>	<u>Value of Sugar and Molasses (£)</u>
1857-1861	111,431	64,866
1862-1866	119,876	284,663
1867-1871	51,674	599,898

According to Bigalke, almost two million "buck skins" were exported from Durban between 1870 and 1880.

The uncontrolled slaughter of a public resource for private gain finally led to the decline of the economic importance of game by the end of the nineteenth century in this part of Africa. At about this time, the last great trek of springbok occurred in the Cape Province in 1896. The numbers were estimated at 260,000,000 (Lundholm 1952), and undoubtedly many were slaughtered. Most drowned in the Orange River. Also in this same period between 1896 and 1898, the great rinderpest epidemic swept into South Africa from the north and decimated both livestock and game. Then between 1918 and 1952, massive shooting campaigns against game were carried out in Natal to rid parts of the Province of tsetse *Glossina* spp. (Deane and Feely 1974). These were unsuccessful in eradicating tsetse, but they severely reduced game numbers in this area. Even in Umfolozi Game Reserve, only the white or square-lipped rhino was spared (Anon. undated). By this time, farmers had learned that several wildlife species were potential vectors for diseases that their cattle could contact. This led to further removal of wildlife.

As overgrazing becomes more severe with the expansion of farming and cattle ranching, and as towns, roads and factories occupy more land, there has been a gradual decline in wildlife habitat. Severe loss of wildlife habitat is also occurring as populations of Africans and their livestock increase on the reserves and in the "homelands" of South Africa. New attitudes and new people will be necessary to stem the downward conservation spiral on the African reserves and "homelands".

The wholesale killing of wildlife just described did not occur everywhere. Throughout this time, at least two species clearly were saved from extinction only because of the efforts of certain ranchers. These were the black wildebeest and the bontebok (Lundholm 1952 and Zaloumis and Cross 1974). Other species such as oribi *Ourebia ourebi* would be potentially endangered today were it not for the populations protected by ranchers. Thus slowly as the country became settled and the land parcelled into private lands, wildlife began to increase again because landholders began to consider game as essentially a private resource. Most people could no longer go out and shoot large numbers of game without violating trespass laws or game laws. In the last fifty years, as the numbers of game increased so have the numbers of farmers who are selling game. By 1964, there were approximately 2000 to 3000 farms in the Transvaal utilizing one or two species of game as a source of income (Riney and Kettlitz 1964). Most of these are not farms dealing solely in game, but are primarily cattle ranches, maize farms or tobacco farms.

Prior to 1960, wildlife in Rhodesia was also being rapidly destroyed to make room for domestic stock. Ranchers were erecting gameproof fences around waterholes to exterminate game, and such actions were not only condoned but encouraged. That wildlife could only continue to exist in the national parks and zoos of the world was generally accepted. Even in the national forests, elephants were being eliminated at the time. Biltong hunters were encouraged on almost all of the ranches that still had reasonable numbers of game, and it was the ranchers' desire that the hunters shoot themselves out of business. Even on one

of the ranches where the Initial studies that led to multiple species game ranching were being conducted, a biltong operation was begun while the studies were in progress. This effort was meant to rid a portion of the ranch of game - the portion that the owners had decided to reserve for cattle alone.

It was in such circumstances that the first tentative efforts at multiple species game ranching began in 1960. The few landowners who had conserved the wildlife on their lands in the face of pressure from their peers and from the government were among the first to start game ranching. These same people have been extremely important in lending continuity to game ranching over the intervening years to the present. Being established members of the ranching community, they have been able to withstand efforts to discredit and to throw legal impediments in the way of wildlife utilization. These landowners have also been responsible for exerting significant influence to maintain reasonable moral standards in the methodology and conservation relationships of wildlife utilization in Rhodesia.

CURRENT EXTENT OF GAME PRODUCTION

In South Africa, the historical role of conservation departments has been the protection of wildlife, and this is quite understandable in view of the mass destruction of wildlife that occurred there in the past. This historical role has been reflected in the kinds of legislation enacted pertaining to game. As a consequence, very little contact generally occurs between game producers and conservation departments. In most cases, it involves verification of whether or not game laws pertaining to the protection of wildlife have been violated. The records that accompany the enforcement of such game laws provide very little information as to the extent of game production.

To illustrate: according to Nature Conservation Ordinance, No. 17 of 1967 in the Transvaal, the purchaser of game meat for resale must file a report of this purchase with the Director of the Transvaal Provincial Administration, Nature Conservation Division; this report must be filed within 30 days after the 30th of September of each year, and the following information is requested - Name and residential address of the farmer from whose land the game was taken; the species; number of carcasses or carcass parts acquired; and the prices realized for carcasses of each species (see Table III and Tables A-1 to A-3 of the Appendix). This regulation is designed to prevent the sale of poached venison. Since it applies only to purchasers wishing to resell the meat, game meat (except biltong or ground meat) that is sold directly by a landowner or his appointee is never reported. As a result, it is not possible to determine the total amount of game taken or sold.

Under Chapter I Section 20 (a) of the 1967 Ordinance, "the owner of land or any person, except a butcher, authorized for that purpose by such owner...." is permitted to sell game meat other than biltong. If the landowner wishes to sell biltong, he is required to obtain a permit from the Provincial Administrator. Legally sold biltong must be marketed in

a distinctive package chosen by the marketer, but approved by and registered with the Provincial Nature Conservation Division (Kettlitz, pers. comm.). Game biltong sold in any other way is illegal. Although this section of the ordinance probably allows detection of large illegal sales, records kept in connection with its enforcement yield no information concerning the species or the number of head that provided the meat. Ground up meat, (minced), prepared and sold in numerous ways, for example as sausage, is also covered by a special permit from the Administrator of the Province and "each case is considered on its merits" (Kettlitz, pers, comm.).

A new regulation being considered at the moment is one designed to control the illegal sale of hides. Buyers will be required to have a permit, while sellers must show to the buyers evidence that the hides were taken legally (Kettlitz, pers. comm.). Anyone who owns land or hunts while in possession of proper licences may sell game skins; thus, a careful check of the game skin market would provide evidence of the total game crop when this new regulation is passed. However, it would not distinguish game skins obtained by casual hunting from the products of managed game ranches.

The fact that data on game production are not available simply reflects the traditional perception of the role of conservation departments throughout many parts of southern Africa. In the opinion of many, the function of conservation departments is to protect wildlife largely through the traditional means of legal control, law enforcement, and protection within reserves. These departments are reluctant to become involved in game production as a means of protecting wildlife and its habitats.

There are indications of course that some departments are beginning to reconsider their functions with regard to game production. Recently, Dr. Stanley Hirst and Mr. Graham Catto of the Division of Nature Conservation in the Transvaal have completed a survey of game utilization in that Province, Neither they nor the Division, however, were willing to release any data from this survey to us prior to publication. Mostly by default and since they are production oriented, the Department of Agricultural and Technical Services is also attempting to assess game production from game ranches and farms primarily in the Transvaal. The two agencies intend to meet sometime in the near future to formulate an official policy towards game ranching based on the results of their respective surveys.

In Natal also, an assessment of the extent of commercial game production would be difficult to obtain without conducting practically a door to door survey. The Natal Parks, Game and Fish Preservation Board does, however, maintain records of the number and area of what are legally designated as commercial game ranches. A game rancher who wishes to obtain legal recognition as such must apply to the Natal Parks Board for a commercial game reserve licence. He is eligible to apply if he has a game area that has a minimum of 400 ha and is properly game fenced. In 1972, there were 28 such game ranches with game areas totalling 23,467 ha (Berry 1973). With a commercial game reserve licence, a landholder is allowed special hunting privileges and techniques that assist in the cropping of game, and is eligible to purchase

another licence that permits the sale of game. In monitoring the licensing of these game ranches and in the process of selling live surplus game to these ranches, the Natal Parks Board has gathered a certain amount of data in connection with game ranching. These data, as far as can be determined, include mostly initial details as to the numbers and species of game sold to various "commercial game reserves". Records as to the numbers of game killed, sold or removed from such lands are being maintained, but have not yet been fully organized. Thus in spite of these regulations which allow a landowner special hunting privileges on a commercial game ranch, it is difficult to be sure just how much game that is currently being produced by game ranches is marketed or used as rations, and which lands are in fact producing game for sale.

According to statistics given to us by a South African businessman involved in commercial game cropping, game farms and ranches comprised about 2,580,000 hectares in the Transvaal and about 60,000 hectares in Natal in 1974. He further estimates that about 10,000 game carcasses were sold locally in South Africa in 1974 and that another 1900 were exported.

In Rhodesia, an estimation of the game meat production can be obtained through the cropping permit system. In order to take game and to sell the meat legally, the landowner or occupier must apply for a cropping permit. In 1973, the Department of National Parks and Wild Life Management issued 212 cropping permits of which 179 were granted to ranches and farms. The other 33 were issued to various government agencies (Report of the Director of National Parks and Wild Life Management, 1973). All of the 179 permits issued to ranchers and farmers were by no means issued to persons involved in the commercial marketing of game. Some ranches and farms apply for the cropping permits on the chance that they may decide to sell some game meat at a later time. The amount of game meat produced on these permits in 1973 is given in Table I.

In 1974, the Department of National Parks and Wild Life Management in Rhodesia conducted a survey to determine the extent of the game ranching industry there. Table II shows the type of business activities carried on by what Mr. Christopher Lightfoot of the Department of National Parks and Wild Life Management regards as the 17 largest game ranching enterprises. These 17 represent about 9 per cent of the 179 who received cropping permits in 1973. Most of the information in Table II was collected by Mr. Lightfoot; some additional data were collected by the authors. The total area of these ranches is 1,721,845 ha. Of this total, 111,541 ha are utilized for game only, while the remainder is either stocked with game and domestic species or used for agricultural crops. (The statistics quoted here are not actually the same as those given to us because an error in addition was found, and, from one of the ranches, a substantially reduced figure for total property size has been received.)

ECONOMIC VALUE OF GAME

It is difficult to make proper comparisons of the economic returns of different game ranches for several reasons. No two are in the same phase of development. Some have just begun operations within the past one or two years. Others have been operating for at least 10 to 15 years. The accounting system of every ranch is different. Hence, net returns are not very useful indicators of financial success because each ranch has its own idea of what constitutes operating expenses. Salaries are included in the cost accounting of some operations and not in others. We also found that one ranch makes a book entry for the rental of that part of the property used for harvesting game. Whether the others do likewise, we could not determine. Some ranches must pay booking agents for safaris sold by them, while others do their own bookings. Then too, rates of depreciation differ for various types of acquisitions. The income from safari sales may not have been derived entirely from property owned by the ranch in question. In some instances, ranchers take their clients onto other private or public lands, and the proportion of the income derived from these lands is often not kept separate on accounting sheets. Furthermore, safari sales provide much higher financial returns than game sales. Thus the amount of revenue earned could be influenced strongly by emphasis in favor of sport hunting over meat production. Finally the monetary value of the game meat used as rations on the ranch itself, as well as the value of meat obtained by safaris on property elsewhere, are seldom taken into account.

Private Enterprises

In view of the introductory remarks just made, the economics of private game ranching will therefore be considered primarily on the basis of the gross monetary value of game to the game rancher.

To illustrate the types of profits that are being obtained, summaries of income and expenses from five game ranches have been included in the Appendix and will be referred to in specific instances. All monetary figures will be quoted in U.S. dollars. Rates of conversion used are as follows: 1 Rhodesian Pound = \$2.80; 1 Rhodesian Dollar = \$1.89; 1 South African Rand - \$1.46.

In Table III is a summary of the average wholesale market prices obtained for game in Johannesburg from 1971 to 1974. The average wholesale price per carcass for the usual game mammals increased generally during the four year period covered. For details on price fluctuations, see Tables A-1, A-2 and A-3 in the Appendix.

In Rhodesia, game meat at the end of September 1974, was being sold by most game ranchers at \$.40 to \$.66 per kg. wholesale. The \$.40 price has been constant since 1960; the higher price has just been offered to one rancher recently in response to a beef shortage. Whereas the average wholesale price per carcass for impala Aepyceros melampus in Johannesburg was \$28.00 in 1974, the average wholesale price per impala carcass in Rhodesia was \$14.00. The mean weight of impala in both

areas is about 24 kg. Table I is a summary of the approximate gross national revenue obtained in Rhodesia from the sale of meat and hides for years 1964 to 1973. The revenue for 1973 is likely to be an underestimate as the average prices for game skins have increased somewhat from that indicated in the table. For example, game ranchers may obtain anywhere from \$95.00 to \$120.00 for a zebra or lion skin. A dry salted leopard skin may be sold to a tannery for about \$225.00 to \$285.00 and \$5.00 to \$6.00 each may be obtained for most other skins.

The approximate gross revenues earned by the game skin tanning industry in Rhodesia for a six month period in 1974 are presented in Table. IV. The total was about \$236,000.00 (U.S.). The Central Statistical Office reports that in 1974 approximately 280 Africans and 50 Europeans were employed by the tanning industry. Rhodesia Tanning (Pvt.) Ltd., one of the largest firms engaged in tanning and the manufacture of curios from game, employs 25 Africans in the tannery and another 25 in their manufacturing operations.

On a more individual and specific level, economic figures provided by six different game ranches will demonstrate the current value of game in Rhodesia and parts of South Africa. Table V shows the gross revenue obtained by these ranches from game and safari sales. Except for those from the Theunis Bester Game Ranch in Natal, all other figures are from Rhodesian game ranches and represent income from the most recent fiscal years for which records were completed. The earnings reported for the Bester Game Ranch are from a 10-month period only. In spite of the cautions raised earlier regarding the comparison of earnings among different game ranches, we have presented in Table V the gross revenue earned by each ranch per hectare per annum. In calculating these figures, we have used in each case total property size rather than size of the game only area because a section not designated as game only will carry both game and cattle. Also as mentioned previously, there is no way of knowing what portion of a ranch's safari income is obtained from hunting on lands other than that owned by the ranch itself, or what portion of the safari income is derived from the game only area. There is no way of deciding what proportion of a ranch's total gross revenue is derived from the game only section, unless separate accounts were kept for economic returns from different sections of a ranch. This has never been done. So that the figures in Table V may be examined in more proper perspective, we have indicated the proportion of the gross revenue attributable in each case to meat and/or live sales and the proportion to safari sales. Occasional reference to the information in Table II will also help in understanding the full scope of the economic impact of game utilization.

We would like to discuss each ranch briefly in order to bring forward those salient features in each that have bearing on the economic figures presented in Table V and Tables A-4 to A-8 in the Appendix. As shown in Table V, one Rhodesian game ranch (A) that wishes to remain anonymous, reports a gross retail income of \$30,189.00 (U.S.) from the sale of meat for the 1974-75 fiscal year. We do not have specific information regarding the numbers of animals that produced this income. However, we do know the numbers of game cropped in 1973. If we assume that the numbers of animals cropped in 1974 were about the same as those cropped

in 1973, then Tables VI and VII show the approximate proportion of the gross retail income which was derived from the sale of meat and that which was derived from the sale of hides, respectively, in 1974-75. Specific details in Table VI regarding average carcass weights and wholesale and retail prices of game meat per kilogram were provided for us by the ranch and apply to the 1974 cropping season. Virtually all the meat is sold to a local African population of about 100,000. 1974 was the first year in which recreational hunting was sold by this ranch: fees charged for a 10-day safari are given in Table VIII. Like Doddieburn and Iwaba Ranches, which we will take up shortly, ranch (A) receives some of its safari income by hunting on lands other than those which it owns itself. The percentage of the total safari income so earned is unknown. Table A-4 of the Appendix gives a summary of income and expenses from this ranch for two fiscal years 1973 and 1974.

A complete set of economic figures are provided by the well-known Doddieburn-Manyoli Ranch on which some of the initial studies of game and veld productivity were carried out in 1960. Table A-5 of the Appendix is a summary of total revenue and expenditures of the game operation since its inception in 1960 up to 1973-74. The data for 1960-61 cover an 18 month period. Table A-6 details their revenues and expenditures. Although the revenue derived from the game sales fluctuates considerably in the 13 years of operation, it does illustrate the magnitude of the income being earned. These fluctuations in income also roughly reflect fluctuations in the game crop in different years (see Table XIX). Revenue from safari sales has increased since 1967. The fees charged for a 10-day safari with this ranch are presented in Table IX.

We include economic figures from Iwaba Ranch to provide an example of the kind of returns that may be expected by a ranch in the initial phases of developing commercial game operations. In Table A-4 of the Appendix is a summary of income and expenses from Iwaba Ranch for three fiscal years 1972 to 1974. These statistics do not reflect the full potential of the ranch because there has been as yet no cropping or culling. This also explains the large differential between income from meat sales and that from recreational hunting. Although a small amount of sport hunting is carried on, the owner, Mr. Peter Seymour-Smith, is currently most interested in increasing game populations on the ranch. Iwaba is still primarily a cattle ranch. However, Mr. Seymour-Smith is convinced that game on his ranch can provide as much or more financial return as the cattle. His optimism is obvious when he says, "As the game numbers increase, I intend to gradually phase out the cattle and hope to receive as large an income, if not larger, from the game as I am getting at the moment from my cattle". This decision is based on Mr. Seymour-Smith's calculations which show that while the present profit per livestock unit of cattle (1 L.S.U. = 500 kg) is \$25.00 (U.S.) on Iwaba, a profit of \$38.00 per livestock equivalent could easily be obtained from game and safari sales. According to Mr. Seymour-Smith, the present total biomass on Iwaba is about 9653 kg/sq. km, with game forming about 4037 kg and cattle 5616 kg of this biomass. He feels that the carrying capacity of this property could easily be increased by carrying game only. Even if the present carrying capacity of 9653 kg per sq. km is maintained with game, the ranch would still realize \$13.00 more per L.S.U. from game than from cattle.

While the last three game ranches discussed are primarily cattle ranches, Rosslyn Game Ranch is one which has been dealing only in game since 1967 (Johnstone 1973b). Since that time, the ranch has gradually shifted its emphasis from meat production to sport hunting. Table A-7 of the Appendix is a summary of income and expenses for the seven fiscal years 1967 to 1973. This ranch is not listed among the private game ranches in Table II because since expropriation by the government as of 31 December 1973, Rosslyn has been leased as a safari concession by the Rhodesian government. However, the financial figures given to us by Mr. Peter Johnstone, manager of Rosslyn, for fiscal year 1973-74, do provide data regarding the value of game which is managed primarily for safaris. Among the six ranches listed in Table V, Rosslyn shows the highest income per hectare per annum. This figure may be attributed to both the heavy emphasis on sport hunting on this ranch that supports good populations of trophy animals, such as sable antelope Hippotragus niger and lion Panthera leo, much sought after by sportsmen. Mr. Peter Seymour-Smith, whose Iwaba Ranch was discussed earlier, has determined that a profit of approximately \$14.00 (U.S.) per livestock equivalent (L.S.E. = 500 kg) would be possible from game being cropped for meat and hides alone on his ranch. However Mr. Seymour-Smith has estimated that "by having safaris as well, a profit of \$38.00 per L.S.E. could easily be achieved".

Rhodesian Game Ranch B in Table V is also managed for game only and has been since 1963. A summary of income and expenses from this ranch for three fiscal years, 1972 to 1974 is given in Appendix Table A-4. As is shown by the figures in Table A-4, the income from meat and/or live sales has fluctuated in the last three fiscal years. These fluctuations are the result of foot-and-mouth closures which were imposed in 1972-73 and 1973-74 because of foot-and-mouth outbreaks in cattle. These closures lasted from 3 to 9 months and severely restricted cropping in those years. (See below at page 35 for a brief discussion of the implications of foot-and-mouth disease to game utilization.) Income from safari hunting decreased in fiscal year 1974-75 because the Department of National Parks and Wild Life Management apparently found it necessary to restrict the quota for the more desirable trophy species allowed to this ranch. (See page 27 for a discussion of the quota system in Rhodesia.)

The Theunis Bester Game Ranch in Natal, South Africa, is a game and cattle operation as are Doddieburn and many other ranches in Rhodesia. It is rather unique, however, because it is one of the few multiple-species game operations in southern Africa on which meat production is the major commercial undertaking (Arnott 1974). Recreational hunting is sold, but not emphasized. The total area of this ranch is about 42,088 ha, and about 6070 ha are designated for game only. Table X is a 1975 schedule of safari fees charged by this ranch. Table A-8 of the Appendix shows the financial earnings from game on this ranch for a 10-month period in 1974, and the projected earnings for 1975-76.

Of particular interest with regards to the Theunis Bester Ranch is the installation of a meat processing plant on the property in April 1974. Table XI shows the amount of meat processed by the plant from April 1974 to the end of December 1974. The meat plant has passed all veterinary and health regulations. Thus the ranch is able to sell not

only whole high quality carcasses, but also other high grade meat products such as polonies, meat loaves, sausages, sandwich meats, fresh cuts, biltong or pet food. The fresh cuts are seasoned and spiced at the factory and are packaged ready to be cooked. In 1974, most of the meat was marketed in South Africa, some in Swaziland and some in Europe.

A large proportion of the fresh game meat from the Bester Ranch is sold to Europeans in South Africa. Having the facilities to prepare a product acceptable to the European market in South Africa, the ranch is able to command a higher price for its meat. This is not true of the situation with many game ranches in Rhodesia. The animals taken on these ranches are usually dressed on the property and the whole carcasses then sold to mines or other large firms as ration meat. In a few cases, the fresh meat may be sold over the counter directly to Africans. Generally, the only commercial game meat from these game ranches that is available to most Europeans comes in the form of biltong. On occasion urban butcher shops sell small amounts of fresh meat which have been brought in from nearby ranches, but the availability is sporadic.

As can be seen from Table A-8 in the Appendix, gross sales of meat and hides in 10 months of 1974 amounted to \$109,500.00 (U.S.) on the Bester Ranch. This amount is about three times that obtained from safari sales. If the approximate gross income received from skins (see Table XII) is deducted from the \$109,500.00, then gross earnings of about \$92,700.00 were received from meat sales alone. Not all of these earnings were derived from meat cropped on the Bester Ranch. Some were received through the sale of 9750 kg of meat obtained from game cropped on nearby ranches (see Table XI). Mr. Tinley reports that in the first six months of the operation of the meat factory, there was a profit of 32.4 per cent, and that in the month of December 1974 alone, \$18,980.00 worth of meat was sold. Mr. Tinley expects that the cost of the factory, about \$146,000, should be paid off by the end of the 1974-75 fiscal year.

Game is valuable not only to game ranchers and game farmers, but also to people who deal in the commercial cropping and sale of game. One such firm in South Africa crops game for farms and ranches on a contract basis mainly in Namibia (South West Africa), the Cape and the Orange Free State. Most of the meat is sold overseas in Switzerland. This firm is currently offering farmers \$1.30 per kg- for springbok, which is about \$.03 more per kg than farmers are receiving for beef. The demand for African game meat is constantly growing in Europe as is shown by increased exports from South Africa. In 1973, this company exported 70 metric tons of game meat to Europe. According to information we have received, the company expects to export about 250 metric tons of game meat, mostly springbok, to Switzerland in 1975 for about \$1.60 per kg.

On a lesser scale, Kennilworth Ranch in Rhodesia saves approximately \$1890.00 per month by providing game meat for rations. With cattle valued at about \$150.00 per head in 1974, game utilized by Kennilworth is economically equivalent to about 12 head of cattle per month.

As an illustration of the sightseeing value of game, Imiri Game Farm, also in Rhodesia, offers all day game viewing tours for a fee of about \$6.60 per person. Besides the game viewing, this amount pays for two teas, round trip bus transportation of about 200 km and transportation on the farm (size of game area is 405 ha).

Public Agencies

In order to control excessively abundant species, public agencies in Rhodesia and South Africa have found it necessary to reduce game populations either by selling live game or by cropping. Although the principal and overriding aim of these programs is to balance game populations with habitat, sale of live game to private landowners and the sale of meat do generate sizeable revenues. These revenues in turn are used in Natal for acquiring more land for provincial reserves.

Table XIII shows the prices obtained by the Transvaal Provincial Administration for live animals sold. We were unable to determine the numbers of animals translocated to private properties because these data are always included with the numbers of species translocated to other public nature reserves. The prices obtained by the Transvaal Provincial Administration are very low relative to the current market and will probably be raised considerably in 1975. On the present market, the skin of a zebra brings double the price the Administration is receiving for the live animal. Their live animal prices have been in effect since 1966. Because governmental agencies have been unable to meet the demand, private individuals in southern Africa are receiving much higher prices for live animals.

Information as to the prices charged for live game by the Natal Parks, Game and Fish Preservation Board are presented in Table XIV. In fiscal year 1972-73, sale of live game resulted in a profit of \$263,325.57, and the sale of 406 white rhino alone produced a profit of \$144,169.61 (Twenty-fifth Annual Report of the Natal Parks, Game and Fish Preservation Board).

The culling of game in Kruger National Park is necessary in order to maintain healthy animal populations. Data regarding the numbers of animals cropped and the economics of the meat production from 1972 to the end of December 1974 are presented in Tables XV and XVI. Because Kruger National Park is located within a foot and mouth area, the costs of producing meat products here are increased. The meat may not be sold fresh outside of the Park, and additional regulations must be met to market the biltong and canned meat. To meet veterinary restrictions, the installation of meat processing facilities has cost about \$1,460,000. Again we wish to stress that the Park is not managed for meat production. Hence, the economics of meat production in Kruger may not show the large profit margins that a private business venture may maintain. Even so, increasing profits have been realized since 1972.

EFFECTS OF GAME RANCHING ON GAME CONSERVATION

The positive effect of game ranching on the conservation of animal species has been far reaching in two respects. First, game ranching has been instrumental in increasing the distribution of many species by reestablishing them in their former ranges. In addition, game ranching has increased the numbers of animals within many species. The following specific examples are intended to illustrate the extent of game conservation efforts by game ranches.

On Doddieburn-Manyoli Ranch in Rhodesia, the following species have been reintroduced since the beginning of game operations there in 1960: white rhino, tsessebe, sable Hippotragus niger and hippo Hippopotamus amphibius. A herd of domestic eland has also been brought in, although the wild species had never been absent on this property. Don Cowie, the ranch's manager, reports that reedbuck Redunca arundinum were sighted in early 1974 for the first time in about 20 years, and nyala were seen for the first time ever in late 1973. Bushbuck Tragelaphus scriptus have built up to turntable populations so that males were hunted for the first time in 1971. Other species that have increased in numbers include bat-eared fox Otocyon megalotis cheetah Acinonyx jubatus, brown hyena Hyaena brunnea, leopard Panthera pardus and giraffe. The latter are now being sold live mostly to game dealers. Among non-mammal species, upland game birds have increased and the ranch has also restocked dams with large numbers of bass. Both of these are important for recreational uses. Although cheetah, a protected species, are not hunted, their economic value lies in their game viewing potential. We were told that some game ranchers would now rather lose a few head of cattle than shoot cheetah.

On Lone Star Ranch, also in Rhodesia, Lichtenstein's hartebeest Alcelaphus lichtensteini have been protected so that they number now around 150. The owner, Mr. Raymond L. Sparrow, is interested in selling some of these to other ranches for game viewing. The ranch is also raising large numbers of ostriches Struthio camelus. With each crop of chicks, approximately half are sold overseas and the rest are released.

On another Rhodesian game ranch where there have been no reintroductions of species formerly present, the owners report increases in numbers of bushbuck, wildebeest Connochaetes taurinus, Waterbuck Kobus ellipsiprymnus and Warthog Phacochoerus aethiopicus. The owners indicate that they are definitely interested in reintroducing buffalo Syncerus caffer and also possibly giraffe.

Like the game ranches in the lowveld, game ranches and game farms in Rhodesia's middle- and highveld have also contributed to the conservation of many animal species. One of the best known game farms, Imiri Game Farm mentioned earlier, was started by Mr. Norman Travers in 1972. Located about 100 km from Salisbury, it has a game area of about 405 ha. Within the game area, Mr. Travers has reintroduced eland, wildebeest, zebra Equus burchelli, Waterbuck, tsessebe, sable, hippo, impala and crocodile Crocodylus niloticus. He hopes to reintroduce giraffe,

klipspringer Oreotragus oreotragus and ostrich in the near future. The waterfowl population has increased tremendously on this farm through the construction of dams and other types of waterfowl habitat.

As mentioned earlier, Mr. Peter Seymour-Smith is also in the process of building up the numbers of species and their populations on his Iwaba Ranch. White rhino, sable and tsessebe are among the species that have been reintroduced here, and recently in March 1975, Mr. Seymour-Smith announced the birth of the first white rhino calf on this ranch.

There are also many examples of game conservation by game ranchers in South Africa. When game ranching operations began in 1966 on Ubizane Game Ranch in Zululand, Natal, the following species and their numbers were recorded on this ranch: Impala (12), steenbuck (6+), nyala (2-3), kudu Tragelaphus strepsieeros (2), southern reedbuck (10+) and grey duiker Sylvicapra grimmia (12+) (Deane and Feely 1974). Since that time, Ubizane has reintroduced white rhino, zebra, blue wildebeest, Waterbuck, eland, giraffe, blesbok Damaliscus dorcas and Warthog. Impala, nyala and kudu were present in such small numbers that additional ones were also purchased to bring up their populations. Deane and Feely (1974) reported that the numbers of game animals on this ranch had increased to around 3000 head by June 1971. Mr. Norman Deane predicts that the 1975 census will show about 4000 head.

On another northern Zululand ranch, the Theunis Bester Game Ranch, blesbok, wildebeest, giraffe, white rhino and bushbuck have been reintroduced. As of 1st May 1974, there were approximately 18,000 head of game on this property. Impala comprise about 12,200 of this total, while the next two most numerous are wildebeest (about 1250) and mountain reedbuck Radunca fulvorufula (about 1000).

Estimates as to the number of impala, springbok and blesbok present on private lands for 1950 and 1974 in South Africa and Namibia are presented in Table XVII. These estimates were provided by a commercial game cropper, Mr. Tim Jackson, in South Africa. If his estimates are accurate, all three species have shown a strong increase in numbers since 1950.

EFFECTS OF VELD MANAGEMENT PRACTICES

Eighteen step-point transects, similar to those of Riney (1963), were run on four areas in southern Africa. The purpose of this sampling was to assess in quantitative terms the effects of different methods of veld management. We have included data from a private nature reserve so as to provide some basis for comparisons with operating game ranches. The numerical results of these transects should be used not so much for comparing the conservation status of these properties, but more for their heuristic implications.

The areas surveyed were: the Vlakgesicht property on the Timbavati Private Nature Reserve, Transvaal; Ubizane Game Ranch, Zululand, Natal; Theunis Bester Game Ranch, Zululand, Natal; and Mlilwane Wildlife

Sanctuary, Swaziland (see Table XVIII), Ali areas where transects were run were lowveld except Mlilwane which is middleveld. Rainfall is lowest at Vlakgesicht which is located on the western boundary of Kruger National Park, The Ubizane and Bester Game Ranches located near Hluhluwe Game Reserve have about the same annual rainfall, and the highest rainfalls occur on Mlilwane. In the two years 1972-73, rainfall was well above normal in the areas surveyed, and range conditions thus generally improved where burning and grazing were not overly excessive.

One hundred step-points were recorded for each of the 18 transects, and 10 circular plots of 1/1000 acre., located at every tenth step point along each transect, were searched for animal fecal pellets. Within each of these mil-acre plots (about ,0004 hectares each), the range condition and trend were estimated and assigned a value from 0 to 7. These values indicate conditions and trends ranging from excellent and improving to poor condition and declining. Odd numbers indicate deteriorating range, and the poorer the range condition, the larger is the number that is assigned. For further details of the transect procedures, see Appendices B and C. A brief review of recent land use in each of the four areas surveyed follows.

Except for the small garden patches of a few African employees, Vlakgesicht has had neither cultivation nor grazing by domestic stock for 26 years. The entire Timbavati Private Nature Reserve (58,700 ha) has been game fenced for many years, Nearly complete protection is provided for carnivores as well as herbivores: lions, leopards, spotted hyenas Crocuta crocuta and so on are abundant. Poaching within the reserve is apparently not significant, There have been die-offs of herbivores, but game is plentiful (Hirst 1969; McBride and Roos, pers. comm.; and authors' unpublished data). Veld management has been practised by burning and by cutting of bush. In 1972, the areas we surveyed were burned. Because of this history, Vlakgesicht provides a useful basis for comparing management methods with those of operating game ranches.

The 1093 hectare Ubizane Game Ranch, owned and managed by Mr. Norman Deane, had about 45 head of 6 different wild ungulate species when it was purchased in 1966 and a game fence erected (Deane and Feely 1974). Wildlife had been practically eliminated in the unsuccessful attempt to control tsetse that finally had to be removed with insecticides. This ranch had carried cattle from 1922 to 1966, and again for two years from 1967 to 1969. By 1968, there were 14 species on the ranch, and by 1971 the original and introduced animals had increased sufficiently to require a cull of 27,669 kg dressed carcass weight or an equivalent of 25.3 kg per hectare (Table XIX) (Deane and Feely 1974). Controlled burns are used as a veld management tool on the Ubizane Game Ranch.

The Theunis Bester property has an area of about 42,088 ha, and about 6070 ha are game-fenced and used exclusively for game production and safari hunting. Most of the balance (of which 5300 ha are also game-fenced) is used primarily for cattle ranching, and some is under short duration high intensity cattle grazing. Game occurs on almost all parts of the ranch. Mowing and burning have been tried as veld management methods for wildlife, and transects were run on both recently

burned and recently mowed areas. The game ranching operations have been continuing since 1970, under the management of Mr. Charles Tinley. Much game has been introduced, but more remained originally than on Ubizane. Predator control is practised.

Mlilwane Wildlife Sanctuary, located near Mbabane, Swaziland, was established in 1961, and we were told that every animal, even birds and steenbuck, had to be reintroduced. Mr. Ted Reilly who donated part of the land that forms this sanctuary is the manager. Most of the reserve has been severely eroded, and management has been directed at soil stabilization with good results. Fire is used as a veld management tool. The area we surveyed had been part of the Reilly property and had probably not suffered as severe erosion as has much of the more recently acquired property.

A summary of the data obtained from the 18 step-point transects is presented in Table XVIII. Comparisons of mean values for ground cover, range condition, and numbers of pellet groups for the different properties should be made with caution. As stated earlier, our sampling was not designed to permit valid comparisons of conservation status among properties. Even comparisons of differently treated areas of the same property are somewhat risky because we did not have time to stratify our samples or to replicate them sufficiently. Rather our data define the conservation status only of the specific area in which the transect was run.

Nonetheless, the data from these transects certainly suggest that the veld on Vlakgesicht may be in poorer conservation condition than that of the two managed game ranches. From our travels over all three areas, we suspect that this difference is real even though the values indicated in Table XVIII cannot be used as direct measures of the true differences. Although Vlakgesicht has less rain than the others, it is not in a desert area, and such extensive areas of bare ground should not be found there. These results seem to suggest that in this area predatory animals are unable to control herbivore populations in the absence of human predation. The possible effects of fences on animal movements as related to range conditions cannot be ruled out. Certainly however some human predation seems necessary under existing conditions on Vlakgesicht if the improving conditions that have come with increased rains are to be maintained there in the future.

The greatest difference between the properties were seen in the mean values for numbers of pellet groups found per transect. More than 4 times as many pellet groups were found on Ubizane as were found on Vlakgesicht, and the Bester property had about 6 times as many. Wildlife is very abundant on Timbavati of which Vlakgesicht is a part, but game did seem to prefer other areas with different soils during the period of our visit.

This points to some of the problems associated with the use of pellet group counts for estimating animal abundance and habitat selection. There are no objective data to adjust pellet group counts for pellet visibility and pellet losses, and none that indicate the extent to which the presence of pellets is a measure of habitat suitability for wildlife.

We are thus forced to use the unadjusted data as indicators of habitat suitability and animal abundance as other investigators have done. Again in our opinion, the main value of these data is heuristic, and we caution against placing great confidence in such data until the method has been more fully investigated.

Based on the pellet group data, we seem to have evidence that argues against the frequent use of fire to improve veld for wildlife (see Table XVIII, Vlakgesicht, all transects; Ubizane, transects 3, 4, 5; and Bester, transects 2, 3, 4). Transect 2 run on an area of the Bester property that has been untreated for 5 years is especially interesting. "Everyone knows" that game does not prefer old rank grass, yet there were more pellet groups in this area than in the nearby burn on which transects 3 and 4 were run. Although no conclusions can be drawn from these results, the data do suggest the need for further study.

The highest number of pellet groups were found on transects made through a mowed area (see Table XVIII, Bester transects 1 and 5). Between 2 and 4 times as many pellet groups occurred on these transects as occurred on transects 3 and 4 located on a burn less than a kilometer from the mowed area. The mowing and burning treatments were carried out at about the same time on the two areas. The next highest number of pellets was found on the Mlilwane transect which ran through an area receiving a patchy and cool burn about a year previously. These transects are insufficient to do more than suggest that the effects of mowing need further investigation and that perhaps different types of burning do also.

From the range manager's point of view, it would be ideal to transform as much plant growth as possible into animal production and soil formation. The wide spectrum of herbivores among African wildlife, if properly managed, offer intriguing possibilities for approaching this management goal. The basic knowledge required for such management is at present deficient. As such information accumulates, manipulation of animal populations and their distribution will achieve increasing importance, and techniques such as burning and mowing will be used with less frequency on smaller areas and with far greater finesse than at present. The short duration, high intensity methods of managing cattle are achieving considerable success with this approach (see Table XVIII, Bester transects 7 and 6). Similar sophisticated management involving manipulation of existing trees and shrubs could occur with game. Such management is applicable in areas with poisonous plants, e.g. gifblaar or umkauzaan Dichapetalum cymosum, whereas it is not possible with domestic stock on these areas (Joubert 1968).

If the transects summarized in Table XVIII and discussed just previously have shown anything, they have shown how much needs to be learned before the possibilities of game ranching can even be imagined with reasonable chance of accuracy. The populations of many wildlife species are as large or larger on the two managed game ranches as on Vlakgesicht, where wildlife is totally protected. These two game ranches seem to be doing very well in the management of the veld. They are both in areas where animals such as elephant Loxodonta africana and lion would be liabilities at this time. Vlakgesicht, within Timbavati, can and does carry

such animals. For many people, including ourselves, these animals give it an appeal that the two game ranches cannot match. They also give Timbavati the potential to become a veritable conservation showplace if protection is replaced by management.

INTENSITY OF GAME UTILIZATION IN SOUTHERN AFRICA

Closely related to the economics and conservation effects of game ranching are the procedures by which game populations are manipulated so as to approach maximum sustained yield.

The amount of game taken annually by game ranches in Rhodesia has been strongly influenced by the Department of National Parks and Wild Life Management (hereafter referred to as the Department) through the quota system. As stated previously, 179 cropping permits were issued to farmers and ranchers in 1972 and again in 1973. The quotas of animals allowed on these permits and the actual off-takes in 1972 and 1973 are given in Table XX. The procedure by which these quotas and permits are awarded is as follows: 1. a rancher submits to the Department an application in which he has estimated the numbers of each game species on his ranch and the numbers he wishes to take; 2. the Department then compares this request with that of previous years taking into account the Department's estimation of the rancher's knowledge and honesty; 3. on this basis, and using a rule-of-thumb 10 per cent permissible crop (Tebbit, pers. comm.), a permit and quota are awarded. There has been almost no follow-up on these cropping permits.

As indicated in Table II the 17 largest game ranches in Rhodesia have a total area of 1,721,845 hectares. The impala quota set by the Department for these 17 game ranches in 1974 was 10,410 animals (C. Lightfoot, pers. comm.). Since the Department has been using a rule-of-thumb permissible crop of 10 per cent no matter what the species or its ecological situation, the impala population of these ranches must have been estimated at 104,100 animals. The density of impala was thus approximately six per square kilometer.

Calculations of impala-densities in Rhodesia from census data in 1959-60 ranged from 0 to 78.8 per square kilometer.¹ If the 78.8 figure is omitted, the average from these data is 15.4 impala per square kilometer. This is of the same order of magnitude as the year-round density of 16.6 per square kilometer found on the Henderson owned ranch where the most data were available. Since we have had no reason to suspect that impala populations have decreased to between one half to one third of their former numbers, we believe Departmental estimates to be very conservative.

¹ The highest count was obtained from concentrations of impala near water during severe drought conditions.

About 30 per cent of healthy impala populations may be cropped annually. The permitted crop has been 10 per cent, and in 1973, 45.6 per cent of the impala quota set by the Department were actually taken by game ranchers (Table XX). If the same proportion of permitted crop was taken on these 17 game ranches in 1974 as the average take in 1973, and if Departmental estimates of impala densities on these ranches are corrects the take has been 4747 impala or 4.6 per cent of the population. If Departmental estimates of impala abundance are low by 61 per cent as we suspect, the take has been 1.8 per cent rather than 30 per cent of the population. In other words, the crop could have been between 6.5 and 16.7 times as large.

Impala (carcass and skin) were each worth about \$18.30 (U.S.) in Rhodesia in 1974. Thus these 17 ranches took impala worth about \$86,870.00 if they took 45.6 per cent of their quota as did all game ranches together in 1973. This means that had they taken the Impala crop that we suspect they could have taken with no danger to the populations, the ranchers could have realized somewhere between \$477,785.00 and \$1,363,859.00 more from impala alone than they actually did. Few cattle enterprises could afford to forgo such amounts of money through failure to sell surplus animals.

Most species, but not all, in Rhodesia are being undercropped when 10 per cent of the population is taken. In 1973, 75 per cent of the elephant quota and only 5 per cent of the grysbok Raphicerus sharpei quota were actually taken. These were the extremes. The actual mean crop for all game species was 35 per cent of the allowed quotas. Of the herbivorous mammals other than elephants the highest off-take was on wildebeest which was 48 per cent of the allowed quota (see Table XX). The actual cropping rate is therefore less than 5 per cent of the population of each herbivore species with the possible exception of elephant. As a result, the revenue being realized from existing game ranches is almost certainly less than a third of what it could be on a sustained basis.

Where given reasonable protection as on game ranches, the impala populations of Rhodesia could easily support a considerably higher rate of harvest than they are now supporting. The same is true of most other species and especially so of those with a higher biotic potential than impala, such as Warthog and common duiker (for perspective, see Ubizane data page 24, next paragraph, pages 30 and 39, and Table XIX).

In the Transvaal and Natal where there is no system of cropping permits and cropping quotas, each rancher determines for himself the annual off-take of game from his property. Cropping quotas on the two ranches which we visited in Natal are determined each year after very extensive game counts are made. On the Ubizane Game Ranch, game populations are determined annually by aerial counts and road strip counts carried out on foot and by vehicle. The cropping quotas are then based on their population census and the conditions of the animals and the veld. Table XXI presents data showing the annual increases in populations among the four most abundant species on Ubizane. Also given are the numbers of animals of each species removed as a result of cropping and natural causes. In 1971, 27,669 kg of game meat were sold from this

ranch representing a yield of 25.3 kg per hectare (Table XIX) (Deane and Feely 1974). As mentioned previously, Mr. Norman Deane expects that by 1975 there will be about 4000 head of game on this ranch. This is a tenfold increase over the numbers of game that were present when the ranch initiated game operations in 1960. The increases have resulted from both introductions and breeding, but occurred in spite of losses from the populations aggregating 1527 individuals of the four most abundant species impala, wildebeests zebra and nyala through the first part of 1971 (Deane and Feely 1974).

On the Theunis Bester Ranch, game censusing takes place annually. Virtually all counting is done by helicopter, and currently only juveniles are counted, Since Mr. Tinley knows the age and sex composition of the original game populations when game operations were started in 1970, the annual off-take from cropping and sport hunting and the numbers of each species introduced, he feels that juvenile counts are sufficient to determine the annual recruitment to the populations. Tinley also manipulates the composition of the impala crop so that 70 per cent of the crop consists of six month old juveniles, and the rest is made up of older females and whatever older males are brought in from safaris. Most of the older females are not cropped. Mr. Tinley has been operating with this cropping plan for two major reasons. First, the meat of the younger animals is more tender and hence more easily marketable. At the same time, the six month old juveniles have just undergone the largest growth spurt of their life cycle. According to Mr. Tinley, an impala will gain on the average of 2.7 kg per month during the first six months while gaining only another 4.5 to 8 kg total in the following year. Thus most of the forage utilized by the impala is converted into meat production, and a minimum of forage is utilized for maintenance when the bulk of the impala crop is composed of juveniles. The same principle has been previously applied to springbok populations by Mr. Tim Jackson. Here are cases where management of game is just beginning to be approached on the basis that domestic livestock has been for decades. Table XI shows the number of animals removed from this ranch in a 10 month period in 1974. By their most recent census in 1974, this ranch has around 18,000 head of game.

The amount of game meat produced per hectare on the Theunis Bester Game Ranch for 10 months in 1974 was 1.05 kg per hectare. This production is much lower than that calculated for nearby Ubizane Game Ranch. But we must remember that Ubizane is managed entirely for game and rather intensively so, while most of the Bester property (30,010 of 42,080 ha) carries cattle. In calculating the game production of Bester Ranch, we had no alternative but to utilize total property size in our computations because some of the game production also comes off the cattle supporting areas.

Table XIX shows the game meat production in kg per hectare for 5 properties in Rhodesia and South Africa. Production ranged from 0 to 25.32 kg per hectare. The annual mean production, adjusted for ranch size over all 5 properties, was 1.20 kg per hectare. These data may be compared with those of Roth (1966) for 10 Rhodesian ranches. The 10 Rhodesian ranches produced from 0.43 to 6.09 kg per hectare, and probably included 2 of the 3 Rhodesian properties included in Table XIX. The mean production on the 10 ranches (Roth 1966) was 0.84 kg per hectare.

Roth (1966) projected that the potential production of game meat from the 10 ranches would range between 0.74 and 13.09 kg per hectare, and that the mean potential production would be 1.50 kg per hectare of roughly double the mean production (0.84 kg/ha) of 1964.

Norvall (pers. comm., 1975) has estimated the present and potential production of beef in Rhodesia Middleveld as 9.2 and 16.7 kg/ha/annum, and in Lowveld as 7.1 and 11.8 kg/ha/annum respectively. The current production figures are based on the country-wide calving rate of 60 per cent, the animals being slaughtered at 3½ years. The potential production estimates are based on an 85 per cent calving rate and slaughter at 2½ years. On some farms, this level of production has already been achieved. In terms of live weight, the present and potential beef production in the Middleveld is 17.5 and 31.7 kg/ha/annum, while for the Lowveld present and potential production would be 13.5 and 22.4 kg/ha/annum. Supplemental feeding is used to achieve the present beef production level especially in the Middleveld. Supplemental feeding would have to be increased to realize the potential production.

Lüdemann (pers. comm., 1975) has offered the data in Table XXII regarding production in live weight of domestic livestock in the Transvaal bushveld of South Africa. He also states - "An accepted estimate of the production potential for beef from unfertilized natural bushveld is ... 25 kg live mass per hectare per annum."

Since cattle in southern Africa dress out at roughly 50 per cent, the cold dressed carcass yields would have been approximately half of the values given in Table XXII; i.e., 9.4 kg per hectare for Mara Agricultural Research Station, and 4.5 kg per hectare for Messina Agricultural Research Station. For potential production on unfertilized natural bushveld cold dressed carcass yields would be 12.5 kg per hectare.

These data for cattle production compare very favorably with those for game meat production from most game ranches. Moreover, most of the game ranches in Roth's sample (1966) as well as in ours are primarily cattle ranches and secondarily game ranches. The most intensively managed game ranch, Ubizane, formerly held about 230,000 kg live weight of cattle and is expected to hold approximately 270,000 kg of game by 1975 when fully stocked (Deane, pers. comm.). Since its purchase in 1966, game production (kg/ha) of Ubizane has built up to double the estimated potential production of cattle from bushveld and 5 times that obtained at the Messina Agricultural Research Station. The Ubizane game populations and crops had not as yet reached their peak. Ubizane has a higher rainfall than does the bushveld and so could be expected to produce more beef per hectare, but most probably not 5 times more. Also, one must realize that the beef production at the research stations was by rapidly growing young oxen and was not calculated for a breeding herd with many adult reproductive animals, whereas all the yields for wildlife are for breeding herds. We must assume in all cases that veld conditions are being maintained. On Ubizane, veld conditions are improving (see Table XVIII).

The meat production from Ubizane Game Ranch is an affirmation of the meat production potential of wildlife, Mr. Norman Deane's success is

even more remarkable when viewed in light of beef production records on the two Transvaal agricultural research stations. Taken together, the results suggest that there are considerable opportunities for increasing the production of game meat, and are an indictment of the management intensity seen in most examples of game meat production today (Table XIX and Roth 1966).

DISCUSSION

Impediments to Commercial Game Utilization

Game ranching enterprises in southern Africa seldom seem to crop as intensively as optimum management for productivity requires. Most game ranching takes place on lands that are managed primarily for cattle. Often the rancher need not make money from his game, but does so to justify keeping the animals. Most cattle-game ranchers have settled where they are because of their fondness for wildlife, for hunting and for the bush. While these factors have led to game ranching practices that do not approach the intensity of management applied to cattle, and hence to a seeming inferiority of game as opposed to cattle as money spinners, they have also allowed these ranchers to resist and to defuse the opposition to game ranching.

Businessmen, governmental employees and others are calling for game ranching to prove itself as an economic proposition. Success is coming slowly. In addition to the reasons just mentioned, the intricacies of taxation may be having an effect. Well-to-do Americans use conventional agriculture and various tax and other peculiarities of law to "lose" money thus reducing or even eliminating their income taxes while others less rich earn good livings on adjacent farms. Similar things may be possible in southern Africa and should not becloud the evidence for the potential profitability of game ranching there. We cannot say that the tabular data presented in this Paper is influenced by such considerations, but neither can we rule it out.

There are other obstacles in the way of proving the profitability of game ranching. Governmental assistance for the game rancher is a veritable drop in the ocean compared to the assistance received by the rancher of domestic animals, the gallant efforts of a few government employees notwithstanding. Game ranching receives active opposition while conventional ranching receives none. In spite of its unfavorable relative position, game ranching is proving to be profitable. Conventional ranching probably would find it difficult to do so if their relative positions were reversed.

If the potential of game ranching is to be realized, some changes are required. In the following discussion we will refer primarily to commercial rather than to subsistence game ranching. For many areas, commercial game ranching similar to that now practised in southern Africa may be the best course to follow. For some other situations we do not think such large scale, highly mechanized, commercial game meat production and safari hunting will be the best approach. We expect some form of subsistence wildlife utilization to prove superior (see pages 9-10).

Subsistence wildlife utilization could also profit from many of the factors that need to be developed for the promotion of commercial game ranching.

Commercial game ranching needs governmental support similar to that presently provided for conventional agriculture. Examples are biological, sociological and economic research, range and wildlife extension services, changes in the laws, public education, financial assistance of various kinds, market analysis service and assistance from wildlife veterinarians. The rationale for providing such services is basically the same as for providing governmental support for conventional agriculture ... governments need to assure that there will be food for their people. Game ranching is one of the few relatively untapped means for doing so that remain in today's world.

Opposition to game ranching needs to be reduced. The strongest opposition comes from people involved in agriculture, many of them government employees. Among these, the veterinarians appear to have been the most obdurate. Their opposition is based in part on their concept of their role as defenders of the domestic livestock industry. It appears their position is partly related to fear of animal disease and partly to fear of economic competition with domestic stock that might endanger their livelihood. In statements made to one of us, some admitted their unwillingness to undertake the study that would be necessary to become competent wildlife veterinarians and therefore feared for their jobs if game ranching spread. Fortunately, some veterinarians in southern Africa are now said to be reconsidering this stance.

Other significant opposition to game ranching comes from those who fear animal extinction through exploitation. Human attitudes toward any natural resource, except perhaps such things as sun energy, determine whether the resource will be exploited destructively or conserved. Religious, philosophical or legal factors may protect a public resource from destructive exploitation for personal gain. If not, the resource will be exterminated or depleted to the level of non-profitability. For resources whose values increase with scarcity, extinction is likely. On the contrary, a private resource used for the private gain of the owner, and legally protected from exploitation by others, or a public resource legally protected and used for the recognized benefit of the public will be conserved. The principle is related to the parable, attributed to Aesop, about the goose that laid the golden eggs. Thinking he would get at once all the golden eggs the goose would lay, the man killed and opened it finding nothing. One does not kill the goose that lays the golden eggs.

By increasing the abundance and distribution of wildlife, game ranching increases sport hunting opportunity, but the hunting becomes somewhat more costly. In the United States, public hunting grounds and other publicly owned lands provide hunting opportunity for those that cannot afford to hunt on private hunting preserves. Hunting opportunity is important to many people so other governments may wish to consider the establishment of areas primarily managed for public hunting opportunity. (Subsistence wildlife utilization would automatically provide such opportunity.) By doing so, some of the complaints and much of the poaching could probably be avoided.

Some opposition to killing animals is based on the argument that too much energy is lost when meat is eaten instead of the plant material that fed the meat animal. This is valid in part, especially in the case of grain fed livestock. It is not valid in other instances. Much plant growth that is inedible for humans provides excellent forage for certain herbivores. Some such plant material is deadly poisonous if consumed by humans. These plants can provide food for people indirectly through feeding animals that we then consume. The amino acids thus provided are frequently missing or deficient in human diets. Game ranching can augment the production of animal protein for human consumption in many areas where its need is great, and where conversion to cropland is not feasible.

Assistance Available to Game Ranchers

In Kruger National Park and other public game reserves in South Africa and Rhodesia, research has provided the factual basis for management decisions. Population and habitat studies of herbivores and carnivores have helped administrators determine management policies. Occasionally management policy may include the removal of certain proportions of selected animal populations. Again research has assisted in the development of techniques for the removal of animals. As a result, much information useful to game ranchers has been obtained, and a large proportion of it is available through publications such as Koedoe and Lammergeyer. The first is the research journal for National Parks in the Republic of South Africa, P.O. Box 787, Pretoria 0001. Research conducted in Natal parks and game reserves is published in Lammergeyer which may be obtained from the Natal Parks, Game and Fish Preservation Board, P.O. Box 662, Pietermaritzburg. Examples of potentially useful articles that have been published in these journals include those by van Rooyen and de Beer (1973), de Vos, van Rooyen and Kloppers (1973) and Densham (1974). Research related to game management and conducted by parks personnel and others such as those of the Mammal Research Institute of the University of Pretoria are also published in the Journal of the South African Wildlife Management Association. Of special interest to game ranchers should be the series of articles by M.T. Mentis (Natal Parks Board) published in Farmer's Weekly of South Africa since May, 1972. These articles as well as the booklet entitled Ungulate Management on Private Lands in Natal edited also by Mentis (1972), are designed to provide the potential game rancher with some basic practical information for setting up a game ranch. The latter publication may also be obtained from the Natal Parks Board. On occasion, research and work related to game utilization may be reported not only in the popular publication Farmer's Weekly, but also in the Afrikaans newsletter Landbounuus and its English version Agricultural News. The latter two are published by the Department of Agricultural and Technical Services, Pretoria.

All business enterprises should maintain up-to-date records of financial standing and inventories. A game ranch is no exception. A private publication that would be useful in this respect is that by Johnstone (1973a). It could serve as a model for individual game ranches in setting up a record keeping system.

An excellent and costly meat processing facility has been constructed in Kruger National Park. Since management there is based on removing only the surplus animals that absolutely must be taken to maintain the health of biotic communities, there are times when the facility is not running at all, and other times when it is operated at much below capacity. The National Parks administration is willing to process wildlife culled on nearby private lands through this facility if the proper arrangements can be made. Similar arrangements might be contemplated by others elsewhere.

In the absence of such governmentally financed facilities, there is much that game ranchers themselves could do by pooling some of their assets. Since construction details of meat processing facilities that meet veterinary codes are now known, construction of smaller facilities by private persons is possible. In South Africa use of the Kruger Park plant and/or the construction of new processing units could bring rather large amounts of land into game meat production and in so doing, insure the conservation of these lands as prime wildlife land.

Areas of Needed Research

Game ranching in Africa is still in its infancy, although it is basically a modern version of the hunting and gathering way of life. The scientific foundation for its development has only just begun, and in the following list are some areas where research would provide valuable data:

1. Study of veld management techniques and the effects of these on vegetation, game populations of various species, resistance of such species to disease, and on parasites of game such as ticks.

- The energy budgets of domestic livestock ranching enterprises should be compared with those of game ranching. With an impending worldwide shortage of energy, particularly that from oil and natural gas, these studies could help determine land use decisions. The results could be especially useful for countries that may find it difficult to import quantities of petroleum products as costs soar.
- 2.

- Studies of animal biology are needed to establish the biological baselines for their management. It is important
3. to establish the biological factors that influence animal densities, mortality and natality rates of different species, their food habits and nutritional needs, their water requirements, and movement patterns as well as other aspects of their behavior.

4. More data are also needed of plant-animal relationships such as the responses of individual plants to different types and intensities of animal use and veld management.

5. Studies are needed that will lead to mathematical models allowing computer analysis of potential management strategies and help to predict those practices that will prove to be optimal.

6. Among the innumerable wild species in southern Africa and elsewhere, there are certain to be many potentially useful to man that are not now being utilised. In some cases, only examination and reevaluation of present knowledge will be sufficient to bring such organisms into use; wider use of some of the known medicinal and fiber plants could thus result. In other instances, the identification of new uses or new sources will be necessary first and then the techniques for management devised (see Evans 1973).
7. Investigations of carcass composition of many wildlife species and studies of meat quality and the effects of various feeding, handling and other techniques on meat quality.
8. Cropping techniques have improved since the first game ranching efforts, but there is still considerable room for innovation. There is much that could be adapted from commercial abattoirs which handle domestic meat. In game ranching, the animals are killed in the field rather than being herded, loaded onto transport vehicles and transported to an abattoir. As a consequence, cropping and handling techniques on a game ranch will affect surviving animals. These disturbances should be evaluated in terms of their effects on the movements, the excitableness and the overall activity patterns of game. The same considerations apply to live capture of wildlife.
9. Wildlife are susceptible to diseases and parasites. Although an enormous amount is known about diseases that may be transmissible to domestic stock and to humans, relatively little is known concerning the control or treatment of these diseases among wildlife species. The research should include ecological parameters that will lead to practical means of disease control. Foot-and-mouth disease, because of its political and economic overtones, certainly requires not only research but also public dissemination of research findings. An illustration of the illogical restrictions set up as a means to control foot-and-mouth is seen in the incident reported in The (Johannesburg) Star, 25 November, 1974. "Because of the fear of foot-and-mouth disease among local elephants, Mr. Uwe Schultz, director of a game park ... near Paarl (near Capetown) has bought four elephant calves from West Germany. They ... will spend 30 days in quarantine before being taken to the game park." This incident occurred while elephant were being culled in Kruger National Park where admittedly some have been found to have foot-and-mouth. But foot-and-mouth of different strains also occurs in Europe. When one realizes that foot-and-mouth is apparently not a serious disease in any species, including domestic stock, such absurd actions illustrate the extent of the misinformation concerning this disease.

10. Marketing research for wildlife products is definitely needed.
11. Closely related to market research, but of much broader context, is the need for sociological studies related to both commercial and to potential subsistence wildlife utilization. Sociologists and economists interested in rural populations could well expand their scope of investigations. Such persons together with human ecologists could conduct the research needed to predict the optimum courses for development of wildlife utilization in various areas of the world. Their continuing studies could also serve to assist planners in guiding the directions of wildlife utilization developments.

Proposed New Wildlife Legislation in Rhodesia

The new wildlife legislation proposed in Rhodesia is patterned somewhat on that of Namibia (S.W.A.). It will allow virtual ownership of wildlife on private lands by the landholder. Of particular concern are the potential problems that will ensue with species that are either migratory or have large home ranges. The legislation in these cases might allow private overexploitation of a public resource without public control. This situation is possible in the version of the legislation available for public inspection in late 1974. In such circumstances, species such as elephant could be exterminated on private lands unless there are legal means to control this. The fact that elephants are very valuable for meat, ivory, skins and other trophies could work against their survival under such legislation.

Some areas in southern Africa potentially suitable for Game Ranching

In South Africa, Botswana and Rhodesia, there are lands that at least to an outsider appear especially suited for game meat production. With proper management, these areas could be enhanced from an aesthetic point of view while being maintained as superb wildlife areas. Examples are the Timbavati Private Nature Reserve near Kruger Park in the Transvaal, and the ranches that border the Tuli Circle and the Limpopo River in Botswana. At the present time, the only management being practised on these areas is some bush control. Other examples include areas recently taken out of meat production by the Rhodesian government and designated as controlled hunting areas in part to further the safari industry.

GAME RANCHING AS A FORM OF LAND USE

Introduction

The utilization of game in southern Africa has been a means of furthering wildlife conservation on privately owned lands. Game ranching can achieve similar goals in many developing areas. It is a form of land use capable of being woven into the cultural fabric of many societies. Scientifically based utilization of wildlife and wild lands through game ranching intelligently implemented can provide social and financial as well as ecological benefits without causing drastic cultural upheavals.

Millions of people in developing countries are starving or obtaining inadequate nutrition. They constantly require and demand more land for crops and domestic livestock as their populations increase and formerly productive land is subjected to erosion. The problems of surviving from day to day must be a principal concern, and wildlife conservation is viewed as an occupation of the wealthy, as another means of depriving the masses. Wildlife conservation will never have social or political support unless people see that it helps them improve the level of existence. The failure of national parks to show sufficient direct tangible benefits to surrounding people accounts in part for the resentment parks and their personnel often engender. Game ranching can conserve wildlife and habitat while providing the immediate, substantial and tangible benefits that are required.

In the following sections, we present information on game ranching that we feel is of most interest to persons involved in land use decisions and who generally have not had any direct experience with the theory or practice of game ranching. The purpose here is to present a general overview rather than a definitive treatment of the subject matter.

Conservation of wildlife and its habitat through Game Ranching

The practice of game ranching is closely akin to the ranching of domestic animals and plants. There are no rare and endangered species among those raised as domestic animals to be used as food for man. In 1972 and 1973, about 75 to 82 per cent of the entire population of domestic pigs (*Sus scrofa*) in the United States was slaughtered (calculated from data in U.S.D.A. Statistical Bulletin No. 522). About 39 per cent of the pigs slaughtered in 1972 were sows, and many of these were pregnant. Pigs dying from other causes are not included in these figures. The same intensity of harvesting probably takes place with the domestic pig population of Europe and in fact in most places of the world where domestic pigs are raised on an intensive commercial basis. The same principles operate ensuring the continued existence of every domestic meat animal from guinea pigs, chickens, and rabbits to cattle and camels. The underlying social principle that protects them is that the people who care for them are also the people who will gain from the efforts they expend on their care. If this same principle can be applied to wild species whose value is recognized, then the existence of these species is also guaranteed. The underlying biological fact is that although it is a rare pig individual that survives more than two years, the survival of the pig population is assured.

Factors to be considered in deciding whether to Game Ranch

(i) Biological and cultural

Except for some mountain tops, a few islands and some high arctic and antarctic areas, almost all parts of the globe have the potential for supporting some humans through use of the existing wildlife. The use of aquatic organisms and terrestrial vegetation increases this ability. This does not mean that game ranching is a suitable form of land use for many areas nowadays, even though the potential may still exist. Any decision should be based on cultural as well as biological realities. Equally objective analyses should be applied to other existing and

and contemplated forms of land use. For any analysis to be truly realistic, aesthetic considerations also need to be included and the possible long term effects carefully examined.

Both biotic and human factors are involved in deciding whether one, two or several species should be raised for game ranching. Generally the more moist and warm environments have supported biotas of greater diversity than have cold or dry areas, so, in general, greater numbers of species could probably be ranched in the former than in the latter. For most human uses, larger species or species that aggregate in large numbers appear most suitable. In Africa, the larger species seem to succeed better in the moist savanna rather than in rain forests. Human factors that need consideration in a wildlife utilization scheme include personal inclinations, fear of certain species and religious or cultural taboos and requirements (see below pp. 39-40).

The suitability of a piece of land for game ranching will be influenced by its conservation status. If the land has eroded to bedrock, the amount of time needed to restore its productivity must be measured in geologic terms. If all the topsoil is gone and application of fertilizer from other sources is not feasible, the time for full restoration will be measured in terms of human lifetimes. Less time would be required to restore productivity, however, in the subhumid warm regions of the world. If some topsoil is still present, restoration can be very rapid in the subhumid tropics, but very slow in arctic environments: in the tropics substantial improvement can be seen in two to four years, while a single fire through lichen tundra that removes the lichens upon which caribou feed may easily cause damage requiring about 50 years for plant succession and growth to repair. In each case maximum carrying capacity for wildlife and hence for people dependent on it will probably be achieved later, but there are few data to define how much later in either case.

Some return from game ranching on ecologically disturbed land can be realized well before complete restoration is achieved. Early successional species of plants and animals occur on every land mass, and these may be reintroduced first. Many are useful to man and some are highly productive of useful materials. The quickest return can come from early successional species with high biotic potential. Some vertebrate examples are: most rabbits, certain game birds and many rodents. These can form the basis for an early return on ecologically damaged land while the occupants are reestablishing species diversity and productivity. Of the larger mammalian species, early successional forms in Africa include greater kudu, common duiker, impala, and gerenuk Litocranius walleri. Other species successfully inhabit biotic communities at several successional stages. Examples are: elephant, buffalo, Burchell's zebra and blue wildebeest. Thus at the early stages of succession, these types of species will form the basis for early production from a game ranch.

Most of the species mentioned are polygynous; that is, a single male may breed with more than one female. In such species, a surplus of males is produced very quickly. Some of this surplus may be removed. Normally the animals to be taken would be males that were unsuccessful in obtaining mates, but this is a complex manipulation in terms of animal behavior and genetics. The behavioral ecology is somewhat

different in each species and our understanding is very limited. For these reasons, the best practical approach at this time will probably be to remove the lowest number of surplus males economically necessary.

There is a risk in this approach, however, and it is a sociological rather than a biological one. People are tempted to continue a precedent of removing only the males of a polygynous species even after removal of females is necessary to balance population numbers with available forage. Where this risk is even moderate, no animals should be removed until it is biologically appropriate and feasible in practice to remove members of both sexes.

Ubizane Game Ranch in Natal serves as a useful example of how monetary return is possible while game populations are being increased. When the ranch was purchased, the property was nearly devoid of game (only about 45 head of game were present on the 1093 hectares). The veld, however, was in quite good condition from a vegetational point of view. Through extensive stocking, this ranch realized a small return one year after the initial stocking, and the return has been increasing steadily since (see Table XXI and pages 24, 28 and 30).

On areas where some species are still reasonably abundant, the cautious removal of surplus males may start as soon as the initial analyses of vegetation and animal abundance and conditions have been completed. It may even be necessary to depress animal numbers by taking both males and females in order to restore the vegetation upon which they feed. This was the situation on Doddieburn Ranch in Rhodesia, and a profit was realized in the first 18 months of game operations (see Tables A-5 and A-6 of the Appendix). Under such circumstances, the numbers of animals must be lowered to less than what the vegetation can support. The vegetation then is allowed to increase so that higher populations can be supported in the near future.

The minimum size for a game ranch that relies on the production within its boundaries is determined mostly by the sizes of the home ranges of the animals involved. When many animals are fenced into a small area as in some deer farms, that is not a game ranch just as a cattle feed-lot is not a cattle ranch.

Probably the smallest game ranch would be about eight hectares. A small pond and surrounding slopes in the northern hemisphere could contain, for example, a population of muskrats and a fish population as well as many edible and otherwise useful plants. With intense management and perhaps occasional restocking, the problems associated with such "island populations" could probably be overcome. Tropical examples of this type of game ranch might include as the principal mammalian meat animals cane rats (Thryonomys spp.) in Africa or nutria (Myocastor coypus) in tropical America.

(ii) The use of game meat relative to domestic meats

To feed protein hungry people, game meat in Africa is nutritionally superior to domestic meat because of its higher protein to fat ratio (Ledger 1963). Game is also ecologically more desirable because more of its growth is in the form of protein rather than fat. Because of the

high caloric content of fat, more forage is needed to grow a kilogram of fat than to grow a kilogram of muscle. Wildlife species tend to deposit more fat in temperate and colder climates, but usually not to the extent that domestic animals do. In the high arctic, considerable fat is deposited, but in these areas humans living on wildlife also require a higher percentage of fat in their diet to obtain the calories needed to maintain body heat. The fat content of maize fed Hereford beef would be about adequate for an Eskimo in winter on Barter Island, but beef is neither raised nor consumed there.

Game meat is less likely than domestic meat to contain materials of questionable effect on humans, such as hormones administered to cattle in feeds and in skin implants, and high concentrations of insecticides and of other drugs associated with modern farming methods. Many consider the relative lack of such substances an important advantage of wildlife meats.

Under proper health and veterinary inspection, game meats are as safe and nourishing as domestic meats. For centuries, gourmets have revelled in their diversity, while, for the rest of us, it is difficult to imagine a person who enjoys the taste of beef that would not also enjoy the taste of eland. People who are not accustomed to eating game meat tend by habit and by natural conservatism to consume only domestic meats. This buyer resistance is confronted by every new product on the market. High quality meats with flavors resembling a favorite domestic meat are most likely to please such consumers. If the meat they taste is "gamey" because of poor carcass handling, they may never again purchase game meat.

Persons who prefer large amounts of fat in the meat they consume will find that most tropical game meats are too lean to suit their tastes. These meats may be larded with fat from domestic animals. By mixing the two kinds of meat in the diet, better use is made of the surplus fat from domestic meats.

Some people, when they have consumed only game meat for several days, complain of the lack of variety compared with domestic meats. However this is probably because meat from only a single species has been available for several days at a time. Few realize that this seldom occurs where domestic meats are readily purchased. Suffice it to say that among the 15 or more species of big game that may be found on a single African game ranch, there are at least that many different flavors. Many additional flavors are to be found in potential food birds and small mammals.

(iii) Data and time required for determining game ranching potential

Relatively little time would be needed to complete a survey designed to determine the potential of an area for meeting the demands of private consumption. If a purely biological evaluation is desired, less time would be required than one that included evaluation of potential markets and other human factors. Obviously, the size of an area and the amount of wildlife still present will also influence the time required. The availability of historical records, especially photographs of habitats,

will help in assessing the success or potential success of reintroductions. In evaluating a piece of land for game ranching potential, one should determine the level of knowledge that would be satisfactory. In a business venture it will be a gamble just as any other business venture, and the level of preliminary feasibility will depend primarily upon the economic circumstances of the group concerned.

To provide an illustration, one of the first multiple species game ranches in Rhodesia began operations after a year of intensive work by two wildlife management specialists. It had the benefit of almost an additional year of full time assistance and guidance from one of them, and part time assistance from a member of the game department. This game ranch is still in operation. Similar areas in the same country certainly could now be adequately evaluated much more rapidly by people with appropriate experience in the field.

In evaluating game ranching potential, information as to what species are present and also what could be present if the area were entirely or partially restocked to its former condition are needed. Few places in the world have anything approaching their complete prehistoric complement of animals. Some of the local extinctions have occurred very recently, others as long as ten to twenty thousand or more years ago. In some cases, it would be theoretically possible to replace some of the organisms lost even as long ago as that. For example in the American Southwest, the extinct Camelops sp. could probably be replaced today with the closely related modern camels; the saiga antelope Saiga tatarica, long extinct in North America, could be replaced with the Eurasian saiga that has been returned to abundance through protection and game ranching in Russia. More likely of practical importance will be the replacement of recently lost species that survive nearby. Some of the Natal game ranches actually restocked from sources less than 200 kilometers away.

Where wildlife has been eliminated from a property, historic records of former range and abundance are valuable for estimating the possibilities for restocking and the potential carrying capacities. Evaluation of habitats and soils for changes that might influence prospective reintroductions are also necessary.

Where wildlife is already present in reasonable abundance, an estimate of the recruitment to the population for each species and also the losses from each population needs to be made on an annual basis. To assess recruitment, an estimate of the numbers born and immigration into the population of each species is made. Since animals may travel beyond the boundaries of an area under consideration for game ranching, measures of these movements and the reasons for them are important, likewise measures of mortality rates and their causes.

Data as to the numbers in each species reaching reproductive age are also obtained, since they are closely related to the anticipated population performance. In wild animal populations, the probabilities of mortality usually change more than once from the time of conception to old age. When sophisticated studies and management are applied to animal populations, these instantaneous mortality rates are used to indicate where in the life cycle of a species the population is most vulnerable. For

evaluating game ranching potential, this type of approach may not be necessary although for optimum management it is.

As a rule we can safely crop a little less than the recruitment to the breeding population of a healthy, well situated wildlife species. As cropping of an uncropped animal population proceeds, compensatory ecological, population and individual physiological adjustments come into play, and the recruitment to the breeding population usually increases. The same phenomena are seen if we compare the maintenance of a large subsistence herd of semi-starved cattle with an intensively managed smaller herd of highly productive cattle. In the latter case, the annual offtake in meat and milk is substantially higher than in the former. It is this productivity that needs to be enhanced through wildlife and range management efforts.

Where populations are below the long term carrying capacity of the habitat for a species, it is desirable to increase their numbers if doing so will be consistent with other goals of the potential game ranch. In such circumstances usually no animals are cropped or only an occasional male that is surplus to the breeding needs of the population.

Along with determining the productivity of the animal populations on the prospective game ranch, estimates of the food, cover, water and mineral resources that influence productivity are also required. The spatial distribution of these, that is their degree of interspersion, should also be established as well as their successional and seasonal changes. Some information should also be obtained concerning what could be accomplished through the manipulation of these resources to favor wildlife species. If the area appears fully stocked, we need to determine vegetational productivity and succession, that is, which forage types or species are being over-utilized, which under-utilized; and to identify the effects of fire, domestic animals and agricultural cultivation. Table XVIII summarises results from some vegetation analyses we conducted in southern Africa. These were done with a rapid survey technique (Appendix pp. 92-93).

The choice of survey techniques employed will rest on the time and money available as well as many other factors. For surveying vegetation, topography, and water distribution of very large areas, land use planners should consider for the initial stages the use of ERTS (Earth Resources Technology Satellite) imagery (Williamson 1974). For less extensive studies, aerial photography especially that using multiple spectrum imagery will provide sufficient information when combined with adequate ground truth data (Colwell 1967). For smaller areas, existing aerial photographs, topographic and soil maps, and ground study will often be adequate. In all cases, adequate ground level vegetation studies will be necessary to estimate vegetative productivities and level of animal use. Where vast areas must be considered, extrapolation will be necessary. As all planners must realize, extrapolation can be risky and the uncertainties involved should be recognized.

Another consideration for a prospective game ranch is the extent to which emphasis will be placed on either production for financial return or the production of food and products for the support of people living on and around it. If financial return is paramount, as has been the

case in game ranches to date, then adequate market analysis is essential. For game ranching, there are few official data to assist in this effort. For some data that are available from governmental and private sources, see Appendix Tables A-1, A-2 and A-3 and Tables III, IV, VI and VII.

Recreational potential via photographic, viewing, and shooting safaris may be large on game ranches (see Tables V, VIII, IX, and X and Appendix Tables A-4 to A-8) and needs to be examined. Here there is much more assistance available through government tourist boards, private tourist agencies and the experience of safari operators. Planners should realize both the great potential of tourism for earning foreign exchange and also its dependence on world economic and political circumstances; they should also recognize the political problems that may develop when emphasis on tourism neglects the interests of local inhabitants (Davis *et al.* 1973).

(iv) Some legal considerations

As stated earlier the principle behind the conservation of wildlife and its habitat through wildlife utilization, including game ranching, involves rewarding persons for their efforts in assuring the continuance of a resource. This is the same principle that guarantees the survival of domestic animals as species while every year large numbers of them are used for food. If game ranching is to be a viable form of land use, the legal regulations for game ranching should be similar to those set up for agriculture.

As a generality, communal use of a renewable natural resource must operate in such a way that no individual of the community is allowed to gain extra personal rewards by exploiting the resource more heavily than others. In addition, total exploitation pressure must reflect the biotic realities. The high seas fisheries of the world are classic examples of how not to exploit such resources. By contrast, the return to abundance of saiga antelope in Russia and northern fur seals Callorhinus ursinus off Alaska are positive examples of the quite successful application of these principles. For further discussion of these relationships, see Hardin (1968 and 1972) and Mossman (1974). Assistance with the drafting of laws that will encourage conservation, including details of the legislative background of the Alaskan and Russian successes, can be obtained through the legal branch of IUCN.

Recent legal innovations in Namibia (South West Africa) have given landowners virtual ownership of wildlife on their properties. We are told that wildlife conservation through game ranching there has taken a sudden spurt. Rhodesia has patterned its new wildlife regulations on the Namibian ones. It is too soon to know what the consequences of these new laws will be. Problems, especially with migratory and wide-ranging species, will have to be considered. There is concern that such laws may mean the end of these species or at least a drastic decrease in their numbers. However, early reports are encouraging. Other countries may wish to consider how a similar approach within their social systems might work. The proper management of wide-ranging species offers special legal difficulties when their movements carry them across lands independently owned by many persons or groups of individuals. These difficulties are certainly not insurmountable given a general

recognition of the animals' worth and a resulting willingness to maintain or increase their abundance.

Other statutes such as those that require fencing may also have important effects on the possibilities for game ranching. Where size of an area is small, such laws will be very deleterious to species with large home ranges. If the fencing requirements are extreme, their cost may become so excessive that game ranching could become financially impractical.

Health and veterinary regulations may obstruct game ranching when they are so strict that compliance is impossible. For example, in one area in southern Africa all meat animals must be processed through certain authorized and licensed abattoirs. Furthermore, all animals must be alive when brought to the abattoir. This of course nearly makes game ranching legally impossible, although in this particular case loopholes in the regulations were allowing game operations to continue. However, before too many people become involved in game meat production, laws need to be enacted that are consistent with the biology of the species concerned and which provide some guarantee that such production is recognized as a legitimate form of land use. At the moment, probably the greatest impediments to game ranching are the laws and regulations that were either designed to cover only domestic livestock production or were specifically promulgated to protect it from the competition of wildlife products. The extent to which such legislation has been enacted is really a confirmation that the livestock interests and the veterinarians who usually identify very closely with them are apprehensive that wildlife can do better than the domestic livestock industry if given a chance. There is no need for such concern in a protein hungry world if its institutions are designed as much or more for human welfare as for the accumulation of capital.

Game ranchers should be very much aware of the international concern for rare and endangered species and with their legal status. The Red Data Book published by IUCN lists the rare and endangered species of the world. By international agreements, the export, import or sale of some of these species is now stringently controlled or prohibited (in particular by national legislation arising from the ratification of the Washington Convention on Trade in Endangered Species of Wild Fauna and Flora). Regulations of home and foreign governments regarding disease control are also pertinent if meat or live animals are to be exported so that consultation of the Veterinary Departments is essential. There are also other foreign regulations of which one should be aware. For example, in California there are state regulations against the importation of many species which United States Federal regulations do not cover. Since some major ports are in California, it will be important for the exporter to arrange for his shipments to enter some other port if products from such species are included in the shipment. Otherwise special permits or "in bond" shipments need to be arranged to allow passage of these species through California without confiscation.

Rehabilitating land for wild and domestic species

Rehabilitation includes protection against erosion and restoration of soil fertility. The establishment and maintenance of a vigorous

vegetation cover is almost without exception the best means to achieve this. Often some fertilisation may be useful to speed vegetative development especially on severely eroded sites. Since land properly managed does not wear out, the cost of land rehabilitation is rightfully assigned to the previous method or methods of land use that made the rehabilitation necessary. The specifics of land rehabilitation techniques such as construction of water spreaders, fencing, salt placement, control of water sources, burning, cultivation, seeding, planting, fertilization, the species to use, their spacings and the timing of rehabilitation actions vary from site to site. As a result, expert advice will often prove useful. Truly amazing improvement is possible in some cases. Not only does land rehabilitation increase the carrying capacity for wildlife, that for domestic stock is usually increased as well. As on land newly opened for settlement, the settlement pattern on rehabilitated land also can strongly influence the man-wildlife-domestic organism interrelationships. When settling or resettling land, villages could often be located more advantageously than they often have been in the past. For example, it may be worthwhile to locate the villages and gardens at a distance away from water sources and away from the game trails leading to the water in order to reduce disturbance to game that come to drink and decrease wildlife interference with gardens. The water needed could be carried in a tank wagon instead, or piped, or wells dug. It may also be advantageous for the people to concentrate their homes in one or a few restricted sites rather than scattering themselves over the area. This would be another means of reducing the disturbance of wildlife and would in turn result in better protection for domestic stock and gardens. The overall effect would be reduction of pressure to eliminate wildlife, and hence more return from wildlife, as well, as from domestic stock and gardens.

As long as domestic animals are necessary within the social framework of the people on a game ranch and so long as they cannot be replaced by wild animals for ceremonial purposes, these animals need to be allowed. A portion of the area could be set aside for the raising of them. If there is danger that their populations will increase and overgraze or overbrowse the area, it will be important to devise methods for rapid detection of this condition and its correction. As long as proper control of domestic animals is assured, there are many good reasons for having them. People on subsistence game ranches should be able, if they wish, to pursue their old familiar ways of life as long as these do not again destroy the ability of the land to support them; or to hunt and gather as before as long as they do not endanger future opportunities to do so. This is where game ranching fits in. By studying plant and animal productivities, it will be possible to determine each year the allowable crops of each species that will not endanger possibilities of obtaining at least as large crops in subsequent years. As long as the number of people who try to live on the land is not increased beyond the ability of the land to support them, a rehabilitated area can support humans virtually indefinitely. However, if the biotic capabilities of the land are exceeded, all the rehabilitation efforts will accomplish nothing in the end. It is really the responsibility of each group to decide honestly whether the land in question can be protected from abuse under each of the land use options open to them. The option selected must be ecologically sound or sometime later they or someone else will have to pay for their actions.

Seeking assistance

Most potential game ranchers to date have considered themselves competent to make their own feasibility analyses. Many of the pioneers in this field have been people with a wealth of practical field experience who could readily work out comparisons between their own situations and the already operating game ranches.

Thus for advice on game ranching, one could contact local game ranchers associations in Rhodesia, in the Transvaal and in Natal. Governmental wildlife agencies and national and international wildlife oriented organizations could provide assistance in locating persons with game ranching expertise. Examples are The Wildlife Society (U.S.A.), IUCN/WWF, Food and Agriculture Organization of the United Nations, The Wildlife Society of Rhodesia, The Wildlife Protection and Conservation Society of South Africa, The Southern African Wildlife Management Association, The East African Wildlife Society, and Peace Corps (U.S.A.).

Since there has been no demand for private experts to survey game ranching potential, it is not possible to estimate the costs for such assistance except to suggest that they would probably be comparable to those for agricultural consultants.

Establishment of a Game Ranch

(i) Capital required

If the ranch needs restocking, and if it is to be a commercial operation yielding a quick satisfactory return on investment in competition with others, then the amount of capital needed is quite large. Reintroductions on Doddieburn-Manyoli in Rhodesia have up to 1974 cost about \$15,400 (U.S.). The Ubizane Game ranch in Natal paid about \$50,000 for stock in one year. According to Mr. Charles Tinley of the Theunis Bester Game Ranch in Natal, the cost of acquiring stock in the first three years of operation was about \$146,000.

Where meat production for commercial sale is to be the primary emphasis, the amount of capital required will depend upon the prospective market and on the veterinary and health regulations of the country concerned. In dry weather, the meat from animals may be obtained, cut into thin strips, dried, transported and sold with very little equipment other than what can be obtained directly from the bush. This is the way it is done today over much of Africa, although usually illegally. On the other hand, processing facilities may be very sophisticated and include canning factories and buildings that permit special disease control techniques.

In Kruger National Park, as already noted (p. 34), animals are removed where necessary to balance population numbers with food and water supplies. A large capital outlay (equivalent to 1.5 million U.S. dollars) was required to construct a canning and biltong facility in the Park because of its location in an endemic anthrax and foot-and-mouth area. This facility meets every veterinary and health requirement. For private game ranches, a similar but smaller facility could now be built, but the cost of construction might still be beyond the financial capabilities of most individual ranchers unless they pooled their

resources. An example of such a facility is to be found on the Mkwesine Game Ranch in Rhodesia. In Natal, the Theunis Bester Game Ranch has a plant for preparing fresh cuts, sausages or biltong (see pages 19 and 20). The cost of construction, we were told, was about \$146,000.

In some locations, game ranches are required to be game-fenced, which may be a major expense. Fencing cost about \$1,044 per kilometer in South Africa in 1974, according to Mr. Charles Tinley. In the first three years of their operations (1970-73), the Bester Ranch paid about \$23,000 per year for fencing and control of poaching. Approximately 12,140 hectares are game-fenced on this ranch. About \$56,600 was spent on game-fencing by the Mkwesine Game Ranch (24,124 ha).

Both Mkwesine and Theunis Bester Game Ranches indicate that control of poaching is one of the largest expense items in the initial phases of operation. Where it is necessary, water development can also be another major item of expense; there is no doubt that in many instances it can increase productivity especially on the larger game ranches, but very little evaluation has been undertaken of the effects of manipulating temporary water supplies. Potentially it is an inexpensive way of retaining natural animal movement patterns and associated grazing rotation while increasing the utilization of existing plant growth.

Other items that may require considerable capital, depending upon the size of the operations, include four-wheel drive vehicles, guns, ammunition, knives, steels and facilities for salting hides. An indication of capital outlay may be obtained from the summary of income and expenses for Doddieburn-Manyoli Ranch in Rhodesia in Appendix Table A-6 and also from the figures quoted by Johnstone (1973). To answer specific questions regarding necessary equipment, a prospective game rancher should discuss possibilities with those already in the business, or obtain the services of a knowledgeable consultant. Considerable financial return may be had through the intelligent use of good equipment.

Building requirements depend upon the type of game ranch being proposed. For a ranch designed to feed and support the residents, little more than housing for the inhabitants is necessary. Safari hunting and photography may take place on such an establishment with only the addition of a few grass sheds or tents for trophy preparation, and tents or other relatively minimal housing to accommodate clients in camp-type conditions. On game ranches at present, safari accommodations vary from good spacious tents to thatched rondavels and, in at least one instance, to very luxurious accommodation in a country hotel complete with all the amenities of the best metropolitan hotels. Obviously, potential clients will have different preferences and, hitherto, most game ranches have not attempted to cater for all tastes. The Mlilwane Wildlife Sanctuary in Swaziland is, so far as we know, unique in offering visitors the opportunity of staying in an authentic Swazi house: the fact that the Swazi huts are booked constantly, while more conventional accommodations sometimes are not, suggests that a similar idea could be used to attract visitors elsewhere. If day tours of school children or other groups are to provide an important part of the income, suitable facilities for feeding and otherwise handling large numbers of people will of course be necessary.

A small laboratory building with room for reference collections may be well worth constructing. Such a facility tends to attract the researchers who can help provide knowledge needed to improve management on game ranches. This will be most feasible on the large, well capitalized game ranches. Reference collections of plants, parasites, diseased tissues, identified field signs left by animals, vegetation photographs at fixed points, skulls and lower jaws of game species, will be of interest not only to biologists but also to visitors, and also valuable for training personnel and monitoring food habits and vegetational changes.

Where the game ranch is set up primarily to serve as a means to feed the people who live on it or close to it, and if restocking is not required initially, the capital outlay need not be very large. However, we can quote no specific examples and the establishment of a ranch of this type will probably require an entirely different approach to those used to date. Thus, the measure of its success will have to be made in terms of human welfare rather than in terms of cash production. The intimate involvement of the people concerned in all aspects of the establishment and operation of the game ranch is another requirement. External assistance should probably be restricted to advice and education and perhaps minor financial help only. The reason for this is that provision of large sums only result in the failure of efforts to prove that people can accomplish such things for themselves.

(ii) Personnel needed for a game ranch

Where the game ranching operation is commercial, cropping and all aspects of carcass processing require close supervision. To illustrate, we have listed in Appendix D some sources of loss to a commercial project that occur when supervision is inadequate. None are listed for which we do not have either personal experience or well corroborated evidence. As can be seen from this list, adequate reliable personnel, properly trained and motivated, are needed in a well operated commercial game ranch.

On one large game and cattle ranch that we visited, one capable but overextended person was in charge of both the cattle and the game operations. The book-keeping of the ranch was mostly the responsibility of others, and general policy was formulated by the owners. His game ranching duties included supervision of two or more professional hunters who guided safari clients. He personally did most of the game cropping during the safari season (cropping is done then because it is the coolest and driest time of the year): this involved responsibility for estimating populations of wildlife, range conditions, most day to day wildlife management decisions, and supervision of the processing of game meat and skins. There is no doubt that he needed one or more reliable and well-trained assistants. This game ranch was almost certainly running at well below capacity in terms of numbers of wildlife taken and the amount of meat sold per carcass. The quality of the product could have been much higher. On the other hand, the safari operation seemed to be well handled.

Where the purpose of the game ranch is mainly to provide subsistence for a large number of people, labor intensive methods are desirable. As fossil fuels increase in cost and human populations continue to expand,

labor intensive methods will probably be adopted in more instances, even where emphasis is placed on a cash return. Most commercial game ranches ignore the potential production of smaller game species such as steenbok, grysbok, common duiker and many game birds. On a subsistence game ranch, the task of managing just these species could easily provide a person and his immediate family with adequate food while increasing the total yield of the ranch. In the meantime, the conservation of more wild species would be assured.

Some of the categories in which people may be employed to advantage are data collection, analysis and implementation of management decisions in respect of the numbers, distribution, reproductive biology and growth/age relationships, especially those affecting productivity and utilization; habitat management and animal management techniques; processing techniques; new products and new ways of using old products; markets and marketing; equipment and construction; personnel relationships; political and cultural relationships and legal matters. In some cases if professional level wages must be paid for the information on a continuing basis, the costs may become excessive. This would be especially so when products have to compete with those of conventional agriculture which receives substantial government support. Governments might well provide similar assistance for game ranching.

If subsistence ranching is the primary emphasis, human and animal labor may replace the use of fossil fuels and costly equipment in many ways. After 10 years of work, oxen may be consumed. Their "fuel" is grown on the ranch, while their feces help to fertilize it. For subsistence purposes, no manufactured vehicle can match that type of increase in value. For personal transport, bicycles come close to matching horses and donkeys, especially if one is reluctant to sacrifice the animal when the time to do so arrives. On a subsistence operation, it is not necessary to maximize profit. This makes cropping and handling techniques feasible that would not otherwise be economical. On a commercial game ranch, a single hunter may need to crop well over 1000 head of game each year to keep a team of butchers and hide care specialists employed. Very few people enjoy such a cropping job, and many cannot tolerate it. On a subsistence enterprise, the hunter and his family will likely also be the butchers, the hide care specialists, the transporters and the consumers. Even if he is an excellent hunter and specializes in supplying the demands of several families, one person's annual kill on a subsistence ranch need seldom be as much as 100 head of big game animals. Thus a subsistence ranch could provide for the employment of at least 10 hunters who would probably obtain more satisfaction from their activities than the same number of people with specialized tasks on the commercial ranch.

Subsistence ranches can employ another whole class of workers not readily employed on a commercial ranch. These are people such as women, children and the elderly, those with special knowledge of medicinal and other uses of plants and animals, and those with specialized crafts. They are well suited to continuing the activities of tribal peoples living in remote areas today, such as the collection of edible and medicinal plants and insects, the construction of homes, garden fences, food storage bins, and the craftsmanship of clothing, pottery, basket, ornament, tool, trap,

and musical instrument making. In other words, subsistence game ranches are capable of accommodating local cultural traditions and practices and, in so doing, providing employment of a kind which makes a positive contribution to the maintenance of that culture for people of all ages and both sexes.

(iii) Wildlife species available for stocking

The availability of stock for translocation onto game ranches varies from place to place and time to time. In southern Africa when this Paper was being prepared (1974) there was a shortage of some items such as female eland and probably a surplus of others such as impala. Occasionally surplus animals must be removed from public lands. These animals have formed the nuclei of breeding stocks on a number of game ranches in Natal. Because of acquisition of understocked new wildlife lands by the Natal Parks Board, made possible in part by sale of surplus animals, there were sufficient outlets for most of the surplus game for the immediate future. As a result, this source of animals was unlikely to be available to private ranchers for some time. While such a situation increases the difficulty of obtaining stock, it also increases the value of wildlife species on ranches already well stocked. Information as to the game species currently available and their prices is given in Tables XIII and XIV as well as in Mentis (1972). Conservation departments, game ranching associations, and journals such as Farmer's Weekly in South Africa also provide information regarding private sources for stock.

The choice of species for stocking will depend in part on what are available and their cost and in part on the emphasis of the proposed game ranch, whether it is meat production or sale of live animals or safari recreation. Other factors for consideration will include personal and cultural preferences. If the principal aim is to obtain food production as soon as possible, then species with high reproductive potential should be emphasized initially. As production continues, species with lower reproductive potential, but with other advantages such as high growth rates and complementary feeding habits, could be included. For example, Warthog have a much higher reproductive potential than impala. Both produce excellent meat. If there is no cultural objection to either and one had to make a choice, the Warthog would be a better selection initially than the impala. This of course assumes that the habitat is satisfactory for both and that, perhaps because of financial reasons, only one could be selected. Conversely zebra have a low reproductive rate, but have very valuable skins and great aesthetic value. This species might be one of the first to be restocked where cash production and safari reproduction are of prime consideration. If funds for fencing are minimal, zebra might be superior to either of the other two species because they are much easier to enclose. The highest reproductive potentials will be found in game birds. With adequate food and cover, many have the potential to quadruple their populations in a single year.

Marketing of game meat

Game meats may be marketed in every way that domestic meats are marketed. The choice will depend on personal preferences, health and veterinary

restrictions (see pages 43-44), and on prevailing economic conditions, facilities, and transportation options. The manner in which the meat is handled during dressing of the carcass will of course influence meat quality and its price. The Theunis Bester Game Ranch in Natal retails very nicely prepared game meats, ready for cooking (oven-ready, larded and spiced joints, and so on) through its own butchery on the ranch and also sells to hotels and other outlets. Too much game meat tends to be marketed in a condition unacceptable to most housewives, so that the example of high quality products set on this ranch helps the entire game meat industry.

Much game meat is marketed in bulk to mines for rationing their labor. Sometimes agents do the marketing on commission. Ranchers may also sell their game to cropping companies who crop and sell the product. Landowners may also lease property to companies that conduct safaris, and crop and sell surplus animals. In the sugar producing area of south-eastern Rhodesia, most game meat is sold to the local wage-earning Africans. Game ranches in many areas have found a sufficient local market to justify at least one retail outlet of their own on or near the ranch.

Benefits to local people from Game Ranching

The most important ultimate benefit of game ranching is that it allows productive use of lands while maintaining and enhancing options for their future use.

An important immediate benefit of game ranching in today's context is that it offers a means by which marginal lands can produce food of high nutritional quality on a sustained basis. Game ranching is not a panacea that will solve the world's food problems. However, its potential contribution is so large and so little realized, and potential areas where this is suitable are located so close to the people who need the protein, that game ranching should receive far more emphasis than it has heretofore.

The productivity of wildlife has been shown to be as high as that obtainable with domestic stock. For example, according to the Agricultural News (South Africa) (6 Dec. 1974), productivity from springbok (6.8 kg per hectare) was shown to compare favorably with beef production (6 kg per hectare) under the same conditions at Omatjenne Experimental Research Station (see also pages 29-31). Much more data on productivity are still needed, but the available information suggests that as many people can be supported over the long term by wildlife as can be supported by domestic stock. The domestic stock raising industry has the benefits of more than 70 years of scientific research and very substantial financial support. We can expect that as similar research and other support are directed at wildlife production, the relative position of the two activities will improve even more in favor of wildlife.

In most cases where intensive agriculture is possible, the production of wildlife will for the time being serve as a means of utilizing areas that are rocky, steep, excessively wet and which otherwise would be of little use for human support. The aesthetic values of such areas need not be compromised to achieve such production.

It is entirely possible that under subsistence conditions in the sub-humid tropics, a game ranch of 10,000 hectares of marginal land could support 1,000 people, as soon as optimum productivity is attained. It should be able to do so without benefit of energy input from other lands or waters for as long as people wished or were permitted to live in this way. Game ranches on more arid lands, in cold climates, on deficient soils or soils high in toxic substances such as selenium, will be able to support proportionately fewer people.

In addition to providing food for local inhabitants, a large number of other game ranch products are either important for support of their daily activities or are saleable as a source of revenue. Practically all birds and mammals, some reptiles, almost all fish, certain insects and some wild plants are consumed by someone. What is objectionable to some people may be considered a delicacy by others. We have met Africans who prefer zebra meat over that of eland, and others who consider the jaw muscles of dassies the most delectable of all. These preferences are not surprising when we consider that to some people of European origin, gamelost and limburger cheese are delicacies.

Many mammal skins are useful for leather and are saleable as such, kudu skin, for example, for making shoe uppers; crocodile skin is exceptionally valuable, ostrich and elephant leather bring very high prices. Horns, hooves, tails, skins tanned with hair on, hair, feet, claws, feathers, and teeth, with elephant ivory being the prime example, are all used, some for curios, others for medicinal purposes. The alleged aphrodisiac properties are well-known and, among many Chinese, a broth made from the tendons of the lower legs of deer and other running artiodactyls is considered to be effective in the treatment of leg infirmities. The high protein content of such a broth may be one reason for its use among people existing on a low protein diet. Although the game rancher may have no faith, for instance, in the medicinal properties of the heart fat of eland, others do and are eager to obtain it. The efficacy of some medicinal plants has been scientifically established. In indigenous psychosomatic medicine, natural medicinal preparations are effective.

Other beneficial products include grass, palm and other material for thatching, wood for house construction, for heating and cooking and for a host of other uses, fish for food, wild honey, edible wild greens, nuts, fruits, and basketmaking materials. Edible insects such as termites, several locusts, certain longhorn grasshoppers and several caterpillar species are very important food items for many people in Africa. Other products include wild marula fruit (*Sclerocarya caffra*) and the sap of the mlala palm used in the making of wines. Marulas are also a source of edible nuts. Still other possibilities are the supply of plant material to the garden flower trade, as now practised in such far separated places as the north-west coast of North America and the eastern side of southern Africa. Biological supply houses, universities, research institutes, and zoos are more of the possible outlets for game ranch products.

Some ranchers who raise both cattle and game in southern Africa use the game as a buffer during droughts. The abundance of grazing wildlife is reduced relieving some of the pressure on the vegetation, allowing the

owners to avoid destocking cattle at a time when prices for cattle may be low. This of course reflects the present situation where the two classes of meat do not really compete in the same market; otherwise no financial advantage would be gained by such a strategy.

Game ranches can provide aesthetic rejuvenation as may wild land anywhere. Game ranchers sensitive to this aspect will be more successful than those who are not. High, unsightly game fences may be necessary in many instances, but they are aesthetically objectionable. Unless the enclosure is extremely large, the atmosphere within it smacks more of a zoo than a wilderness. Straight roads, severe overgrazing, dams mostly of mud, with mired animals rotting in them, surrounded by bare dead trees and dust, can hardly promote a significant aesthetic experience. Such situations can and should be avoided.

Safari hunting is often conducted on game ranches. These hunts provide recreation primarily for the hunters, but most game ranches also provide recreational opportunities for the rest of the tourist family. Existing game ranches may include sport fishing, game viewing and special photographic safaris as part of their program. A game ranch provides the thrill of seeing wild animals in their natural habitat. Because of the individual attention given to visitors on a game ranch, these experiences are often not accessible to tourists in national parks and game reserves. To watch an elephant from a Land Rover is not the same as approaching it carefully on foot in the mopane scrub. As people learn more about the wild organisms they are viewing, they derive more enjoyment from watching them. The ability of guides to describe and explain some of the behavior and biology of these wild species will greatly enhance the enjoyment of visitors.

Game ranches also provide opportunities for people to see how members of other cultures live, to study local history, to learn about biological communities, to study fossil history and to view archaeological sites. Since game ranching is often combined with conventional domestic livestock raising, visitors have the opportunity to observe and possibly participate in some aspects of conventional livestock raising,

All such activities are of great educational value because, in such a setting, the learning is nearly pure joy. Game ranches, in fact, also participate in conventional education. In Rhodesia, university level wildlife ecology courses have included field trips to game ranches. Students in teacher education programs have made ecological reconnaissances of game ranches, and primary and secondary school children have also toured game ranching operations. The tremendous opportunities for biological research are another important potential of game ranches.

A very serious deficit in world food production may occur well before 1981. In the world today there remains little wild land that can logically be converted to agricultural crop production (Brown 1975). More intensive management of existing croplands can help only a little because most of the relatively inexpensive methods of increasing their yield have already been applied. Larger applications of fertilizer now yield smaller and smaller crop increments per monetary unit invested (Brown 1975). This relationship is being exacerbated because fertilizer prices are rising rapidly. More intensive harvesting of the sea is unlikely to solve the

imminent food shortage. The ocean fisheries, lacking ownership by anyone, are now and have been plagued by severe overfishing and declining stocks of one species after another.

World food reserves have dwindled rapidly although erratically over the past 14 years. In 1975, there was a calculated reserve of about 35 days of world grain consumption, as compared with 105 days in 1961 and 1962 (Brown 1975). Much formerly productive agricultural land has lost part or all of its productivity through mismanagement leading to erosion and salinization. Some agricultural lands have been removed from production by urbanization, flooding, strip mining and so on.

In these circumstances, almost the only place left for us to obtain additional food to support our increasing populations is the remaining uncultivated land with its wildlife products. Game ranching has laid some of the practical groundwork for such wild land utilization but its potential goes far beyond use of the species usually recognized as "game" in the developed countries. Much remains to be learned.

We feel that the most significant contribution of game ranching will prove to be the supply of food to local people very much in need of it. This contribution will be best measured in terms of human welfare rather than in monetary terms. To date the direct provision of food and other products to local people has been a minor aspect of game ranching. People faced by potential food shortages, especially shortages of high quality protein, may find in game ranching a partial, temporary solution to this problem. The ultimate solution can only be the balancing of human population and technology with the ability of the earth to support their combined impact.

TABLES

Table I. Amount of meat and revenue derived from game cropped in Rhodesia from 1964 to 1973 (in U.S. dollars)¹

Year	Number of permits issued to ranchers and farmers	Amount of meat produced (kg)	Gross revenue from meat products ²	Gross revenue from skins ³	Total Gross Revenue
1964	49	806,038	\$319,858	\$32,150	\$352,008
1965	59	1,436,410	570,007	54,226	624,233
1966	85	1,165,815	462,626	38,657	501,283
1967	108	1,216,297	482,659	64,178	546,837
1968	133	1,088,427	677,700	99,819	777,519
1969	123	714,037	444,589	79,091	523,680
1970	135	728,288	453,462	64,351	517,813
1971	150	719,370	448,664	72,872	521,536
1972	179	806,215	501,983	66,619	568,602
1973	179	875,475	545,108	67,857	612,964

1. Data from Attwell and Tebbit (1969) and Report of The Director of National Parks and Wild Life Management (1973).

2. 1964-1967, based on average price per kg at \$0.46; 1968-1973, average price per kg at \$0.62,

3. 1968-1973, based on average prices for leopard at \$113.00, lion and zebra at \$38.00, various buck at \$3.80.

Table II. Extent and types of game utilization on some Rhodesian Game Ranches¹

Ranch	Approximate total size (ha)	Approximate size of game only area (ha)	Principal activity	Type of game utilization ²
Central Estates	121,852	none	cattle	limited meat sales; safaris on royalty
Crown	39,285	none	cattle	meat sales in excess of rations; safaris begun in 1974 on royalty
Devuli	307,800	none	cattle	meat for rations only
Doddieburn-Manyoli	57,467	31,185	cattle	meat sales; major live sales for first time in 1974; safaris
Eaglefont	17,010	none	cattle	limited meat sales; safaris on royalty
Hippo Valley	6,075	none	sugar	meat used principally as rations; some meat sales
Inhlaba	23,085	8,505	cattle	some meat sales; some live sales; preparing chiefly for safaris and wilderness trails
Iwaba	9,713	1,012	cattle	some meat sales; no cropping yet; safaris
Kennilworth	93,150	(1,500) proposed	cattle	meat for rations only; game section proposed for recreation only

Liebig	518,910	(8,100) proposed	cattle	cropping done by others on royalty plus rations basis; safaris begun in 1974 on royalty
Lone Star	40,469	25,250	cattle	intends to sell meat and live game; mainly safaris at present; plans to expand for tourists
Merrievale	19,440	none	cattle	live sales; meat sold only as drought buffer to avoid reducing cattle numbers
Mkwasine	24,124	24,124	game	sale of fresh and processed meat; safaris
Nuanetsi	364,500	(8,100) proposed	cattle	some meat sales; game sanctuary proposed
Sarvo	13,770	river banks	cattle	meat sales, safaris; plans for motel
Sentinel	32,805	12,150	cattle	meat sales; safaris on royalty
Anonymous	32,400	9,315	cattle	meat sales; safaris begun in 1974

1. Most of the data provided by Mr. Christopher Lightfoot of the Department of National Parks and Wild Life Management.
2. Game used as rations is indicated only if this is the principal use; otherwise, ration meat is not listed since all ranches utilize game meat for this purpose.

Table III. Comparison of average wholesale market price for game during month of highest sales in Johannesburg, June, 1971-1974 (in U.S. dollars)

<u>Species</u>	Average wholesale price per carcass ¹			
	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>
Blesbok	\$20.10	\$15.32	\$28.81	\$33.81
Springbok	13.84	10.99	12.18	18.10
Impala	20.64	28.08	22.08	28.03
Kudu	64.04	15.33	62.53	117.53
Warthog	15.75	10.59	21.90	-
Black wildebeest	32.24	-	40.95	-
Guineafowl	1.53	1.62	1.56	1.28

1. Compiled from information provided by Division of Nature Conservation, Transvaal Provincial Administration.

Table IV. Estimated gross income of tanning industry in Rhodesia for 6 month period ending 30 December 1974 (in U.S. dollars)¹

<u>Skins</u>	<u>Number tanned</u> ²	<u>Charge per unit</u>	<u>Estimated av. size</u>	<u>Gross income per skin</u>	<u>Gross income</u>
Crocodile	72	\$1.42	20.3 cm	\$ 11.32	\$ 815.04
Elephant	864	1.42	36576 sq.cm	141.51	122,264.64
Antelope	7504	0.23	127.0 cm	11.32	84,945.28
Zebra	593	0.42	203.2 cm	33.21	19,693.53
Cats	140	0.47	177.8 cm	33,02	4,622.80
Furs ³	402	0.47	58.8 cm	9.43	3,790.86
				TOTAL	236,132.15

1. Gross income estimated from charges for tanning published by Rhodesian Tanning (Pvt.) Ltd. September, 1974. No consideration was given to the trophy preparation and manufacturing side of the tanning industry.
2. Data from Central Statistical Office, Salisbury, Rhodesia.
3. Charges for tanning estimated to be same as those for cats.

Table V. Gross income derived from meat/live sales and safaris on five Game Ranches in southern Africa (in U.S. dollars)¹

	Rhodesian				Theunis Bester ²
	<u>Game Ranch</u>	<u>Doddieburn</u>	<u>Iwaba</u>	<u>Roslyn</u>	
A. Meat/Live Sales	\$30,189.00	\$28,203.00	\$1092.00	\$ 28,009.00	\$109,500.003
B. Safaris	27,170.00	56,021.00	8226.00	76,650.00	36,500.00
C. Total	57,359.00	84,224.00	9318.00	104,659.00	146,000.00
D. Size of Property (ha)	32,376	57,467	9713	23,060	41,684
E. Gross Income per ha per annum	1.77	1.47	0.96	4.54	3.50
F. Proportion of (E) from Meat/Live Sales	0.93	0.49	0.12	1.21	2.63
G. Proportion of (E) from Safaris	0.84	0.98	0.85	3.32	0.88

1. Economic figures are from the most recent fiscal year for which completed records were available.
2. Financial figures are for a 10 month period in 1974.
3. Includes earnings from approximately 500 impala cropped on nearby ranches. Thus figures for items for (E) and (F) are somewhat higher than if income per hectare were based on off-take from Bester property alone.

Table VI. Value of game meat on a Rhodesian Game Ranch in 1974 (in U.S. dollars)

Species	Average C.D.W. ¹ (kg)	Wholesale price to butchery (per kg)	Carcass + offal wholesale value ²	Minimum retail price (per kg)	Carcass + offal, retail value	No. taken	Wholesale income	Retail income	Gross retail profit
Bushbuck	30	\$0.51	\$ 16.60	\$0.75	\$ 24.53	2	\$ 33.21	\$ 49.06	\$ 15.85
Common duiker	9	0.51	5.13	0.75	7.54	3	15.40	22.64	7.25
Eland	270	0.51	146.98	0.75	216.98	2	293.96	433.96	140.00
Impala	24	0.51	13.59	0.75	20.00	885	12,022.64	17,700.00	5,679.25
Kudu	165	0.51	89.72	0.75	133.02	3	269.15	399.06	129.91
Sable	100	0.51	56.60	0.75	83.96	1	56.60	83.96	27.36
Warthog	50	0.45	22.64	0.66	33.02	32	724.53	1,056.60	332.03
Waterbuck	157	0.45	76.75	0.75	112.17	2	153.51	224.34	70.83
Wildebeest	134	0.51	73.92	0.75	109.62	2	147.85	219.25	71.40
Zebra	170	0.38	64.15	0.57	96.23	34	2,181.13	3,271.70	1,090.57
1. Cold dressed weight					TOTAL	966	\$15,897.13	\$23,460.57	\$7,375.79
2. Offal values per kg or item as follows:			hearts, livers, kidneys	(per kg)	Wholesale	\$.42	Retail	\$.62	
			lungs	(per kg)			.21	.38	
			rough tripe	(per kg) and impala heads	(ea.)		.28	.47	
			impala and bushbuck feet	(ea.)			.009	.02	
			wildebeest, buffalo and eland feet	(ea.)			.13	.19	

Table VII. Values of most important hides on a Rhodesian Game Ranch in 1974 (in U.S. dollars)

Species	Hide values ¹ av. value in parentheses	Numbers taken	Gross value
Bushbuck	\$2.36-\$2.74 (2.55)	2	\$ 5.09
Common duiker	1.42	3	4.25
Eland	9.43-11.32 (10.38)	2	20.75
Impala	<u>4.72</u>	885	4174.53
Kudu	9.43-18.87 (14.15)	3	42.45
Sable	18.87	1	18.87
Warthog	9.43	32	301.89
Waterbuck	13.21-15.09 (14.15)	2	28.30
Wildebeest	7.55-9.43 (8.49)	2	16.98
Zebra	<u>113.21</u>	34	3849.06
	TOTAL	966	8462.17

1. The values underlined are those quoted by this ranch; the others are approximated from those quoted for Doddieburn.

Table VIII. Charges for a 10-day safari on a Game Ranch in Rhodesia
(in U.S. dollars)

<u>Species</u>	<u>Number allowed</u>	<u>Trophy fee per animal</u>
Sable	1	\$141.51
Kudu	1	141.51
Eland	1	141.51
Waterbuck	1	141.51
Zebra	1	122.64
Wildebeest	1	94.34
Bushbuck	1	37.74
Impala	5	18.87
Duiker	1	9.43
Grysbok	1	9.43
Warthog	2	18.87
Leopard	1	566.04
Hippo	1	188.68
Crocodile	1	141.51

1 hunter - 1 guide \$160.38/day

2 hunters - 2 guides 283.02/day

Non-hunting companions 37.74/day

Table IX. Charges for a 10-day safari with Matabeleland Game Safaris, Rhodesia (in U.S. dollars)¹

1 hunter - 1 guide	\$3584.91/10 days
Concession area fees	69.81/day
Non-hunting companions	47.17/day

<u>Species</u>	<u>Number allowed</u>
Buffalo	1
Kudu	1
Zebra	1
Giraffe	1
Eland	1
Impala	2
Duiker	1
Steenbok	1
Warthog	1
Game birds	no limit

1. Information supplied by Matabeleland Game Safaris.

Table X. Charges for a 10-day safari on the Theunis Bester Game Ranch, Natal (in U.S. dollars)¹

<u>Species</u>	<u>Bag limit</u>	<u>Trophy fee per animal</u> ²
Impala X	2	\$ 35.04
Wildebeest X	2	73.00
Zebra	1	146.00
Common reedbuck	1	52.56
Red Bush duiker	1	37.96
Warthog	1	32.12
Impala W	1	39.42
Wildebeest W	1	102.20
Blesbok	1	55.48
Bushpig	1	29.20
Mountain reedbuck	1	58.40
Nyala X	1	87.60
Steenbok	1	26.28
Grey duiker	1	21.90
Baboon	1	17.52
Suni	1	58.40
Kudu	1	146.00
Nyala	1	197.10
White rhino (when available)	1	1971.00

1 hunter - 1 guide
 Non-hunting companions
 Vehicle hire on ranch

\$80.30/day
 7.30/day
 7.30/day plus \$0.18/km

1. Information provided by Theunis Bester Game Ranch.
2. Does not include licence fees.

Table XI. Amount of game meat processed through meat factory on Theunis Bester Game Ranch from end of April, 1974 to end of December, 1971¹

Kinds and numbers of game from Bester property		Average C.D.W.	Total (kg)
Impala	1000	50% 24 kg, 50% 15 kg	19,500
Wildebeest	200	82 kg	16,400
Zebra	50	130 kg	6,500
Warthog	50	28 kg	1,400
<u>Numbers of game from other nearby ranches</u>			
Impala	500	50% 24 kg, 50% 15 kg	9,750
			TOTAL 53,550

1. Data provided by Mr. Charles Tinley.

Table XII. Estimated gross income from hides obtained by Theunis Bester Game Ranch for 10-month period of 1974 (in U.S. dollars)

Species	Numbers	Approximate value per hide ¹	Approximate total value
Impala	1000	\$ 5.84	\$ 5840.00
Wildebeest	200	10.00	2000.00
Zebra	50	113.00	5650.00
Warthog	50	9.40	470.00
<u>Game from other nearby ranches</u>			
Impala	500	5.84	2920.00
TOTAL			16,880.00

1. Information on value of impala skins from Norman Deane and others have been estimated from prices obtained in Rhodesia.

Table XIII. Price schedule for live game, 1974. Division of Nature Conservation, Transvaal Provincial Administration (in U.S. dollars)¹

<u>Mammal species</u>	<u>Cost</u>	<u>Mammal/Bird species</u>	<u>Cost</u>
Blesbok	\$ 14.60	Nyala	\$146.00
Blue Wildebeest	43.80	Oribi	73.00
Grey Duiker	11.68	Southern Reedbuck	51.10
Kudu	58.40	Cape Hartebeest	109.50
Impala	21.90	Red Duiker	36.50
Zebra	43.80	Mountain Reedbuck	29.20
Springbok	14.60	Sable	292.00
Steenbok	11.68	Vaal Rhebuck	51.10
Black Wildebeest	87.60	Waterbuck	73.00
Roan	365.00		
Tsessebe	219.00	Coot	0.51
Bushbuck	29.20	Francolin	1.46
Buffalo	146.00	Guineafowl	1.10
Eland	146.00	Ostrich	14.60
Gemsbok	146.00	Red-and Yellow-billed Teal	0.73
Giraffe	292.00	Egyptian Goose	0.88
Klipspringer	58.40	Spurwing Goose	1.10

1. These prices have been in effect since 1966; 1975 prices likely to have been raised.

Table XIV. Schedule of charges for live game to Natal landowners, Natal Parks, Game and Fish Preservation Board (in U.S. dollars)¹

<u>Mammal species</u>	<u>Cost per animal</u>
Eland	\$292.00
Impala	14.60
Nyala	43.80
Warthog	14.60
Blue Wildebeest	29.20
White Rhino	686.00 (average) ²
Zebra	73.00

1. Data from Mentis (1972) and Geddes Page and Rall (1973).
2. Based on sale of 406 white rhino which produced a gross revenue of \$278,367.00 in 1972-73.

Table XV. Numbers of animals culled in Kruger National Park, 1972-75¹

	<u>April, 1972 to March, 1973</u>	<u>April, 1973 to March, 1974</u>	<u>1 April to 31 December, 1974²</u>
Elephant	761	577	640
Buffalo	1315	2417	1700
Wildebeest	78	-	-
Zebra	15	-	-
Impala	1922	1427	-
Hippo	-	17	98

1. Data provided by Mr. John Marais.

2. Estimates derived by calculating about $\frac{3}{4}$ of the quota for 1974-75.

Table XVI. Summary balance sheet for culling operations in Kruger National Park, 1972-75 (in U.S. dollars)¹

	<u>April, 1972 to March, 1973</u>	<u>April, 1973 to March, 1974</u>	<u>1 April to 31 December, 1974</u>
Fresh meat	\$ 60,588.54	\$ 26,645.00	\$ 34,918.41
Biltong	91,845.68	252,264.64	188,035.82
Cans	38,478.30	168,935.14	163,958.46
By-products	261,994.08	267,597.56	190,500.74
Decrease/ Increase in stock	- <u>18,965.40</u>	+ <u>56,418.78</u>	+ <u>110,534.86</u>
Gross Income	433,941.20	771,861.12	687,948.27
Expenditure	323,756.46	440,309.72	312,796.75
Difference	110,184.74	331,551.40	375,151.52
Depreciation	<u>109,500.00</u>	<u>131,400.00</u>	<u>146,000.00</u>
Profit/Loss	+ 684.74	+200,151.40	+229,151.52

1. Data provided by Mr. A.E. Kuschke.

Table XVII. Estimated numbers (in thousands of animals) of Impala, Springbok and Blesbok on private lands in South Africa and Namibia.¹

	Impala		Springbok		Blesbok	
	<u>1950</u>	<u>1974</u>	<u>1950</u>	<u>1974</u>	<u>1950</u>	<u>1974</u>
Transvaal	12	120	8	10	6	40
Natal	?	40	-	-	3	8
Orange Free State	-	4	15	60	10	30
Cape	-	5	60	200	2	8
Namibia (S.W.A.)	1	1	40	120	?	2
TOTAL =	<u>13</u>	<u>170</u>	<u>123</u>	<u>390</u>	<u>21</u>	<u>88</u>

1. Data supplied by private businessman in game cropping field.

Property	Notes	Transect number	Bare Litter	Stndg. veg.	Condit. and trend total	Plots improv.	Plots declin.	Pellet groups
VLAKGESICHT ^a	4,9	1	36	52	47	5	5	9
	4,9	2	34	58	37	5	5	5
	4,9	3	39	50	51	3	7	0
	4,9	4	26	57	30	8	2	1
	4,9	5	26	62	27	7	3	1
		mean	32.2	55.8	38.4	5.6	4.4	3.2
			18	71	34	10	0	19
UBIZANE ^b	8	2	15	75	24	10	0	18
	8	3	8	85	6	10	0	5
	5	4	28	56	44	10	0	15
	6	5	1	90	0	10	0	5
	2	mean	14.0	75.4	21.6	10	0	10.4
			4	87	12	10	0	36
BESTER ^c	3,7,11	2	2	87	4	10	0	17
	1,11	3	37	57	43	9	1	16
	6,11	4	26	66	44	6	4	10
	6,11	5	1	96	18	10	0	41
	3,7,11	6	11	78	25	7	3	3
	1,13	7	1	96	0	10	0	11
	1,14	mean	11.7	81.0	20.9	8.9	1.1	19.1
MLILWANE ^d	6,10,12	1	11	79	26	10	0	32

a. Private nature reserve located in N.E. Transvaal, game closely protected, full complement of predators.

b. Commercial game ranch located in Zululand, Natal. Held cattle 1922-1969. Predators very scarce.

- c. Commercial game and cattle ranch located in Zululand, Natal. Predators low, black-backed jackal the most important.
- d. Wildlife sanctuary located in Swaziland. Large predators scarce.

NOTES:

1. Last burned 1969 or before.
2. Last burned 1970.
3. Last burned 1971 or before.
4. Last burned 1972.
5. Last burned 1973.
6. Last burned 1974.
7. Mowed 1974.
8. Harvester termite populations reduced 1970-71. Ground bare until 1972.
9. Game only since 1948.
10. Game only since 1969.
11. Game only since 1971.
12. Cattle holding area before 1969.
13. Cattle holding area in 1974. 14 cattle droppings in pellet group plots.
14. Cattle on short duration high intensity grazing since 1969 or before.

Table XIX. Approximate game meat production in successive years on 5 Game Ranches in southern Africa (in kg/ha to nearest hundredth kg).

Property	Year										Total ¹	Mean ²	
	1	2	3	4	5	6	7	8	9	10			11
Rossllyn ³ 1967-1973 (23,060 ha)	1.33	1.30	1.08	0.78	0.79	1.03	1.34					7.65	1.10
Ubizane 4 1967-1971 (10,927 ha)	0.00	0.52	6.31	17.39	25.32							49.54	9.91
Doddleburn- Manyoli 5 1960-1968 (57,467 ha)	0.44	1.26	1.91	3.30	2.47	0.86	0.85	0.00	0.71			12.02	1.34
Anonymous ⁶ 1961-1973 (32,400 ha)	0.25	0.47	1.83	1.84	1.33	0.73	0.28	0.36	0.75	0.80	2.16		
Anonymous (continued)													
Bester ⁷ Ten months 1974 (42,080 ha)	1.05											1.05	1.05

1 and 2. Total and Mean calculated by summing all meat taken and dividing by number of hectares (Total) and again by number of years (Mean).

3. Data supplied by P.A. Johnstone and from Johnstone (1973); ranch with game only.

4. Data from Deane and Feely (1974): 1971 data estimated by them; ranch with game only.

5. Calculated from data supplied by Henderson & Sons (Pvt.) Ltd.; ranch with cattle and game.

6. Calculated from Ranch data plus our estimates for bushpig, grysbok and hippo weights; cattle and game.

7. Calculated from data supplied by Charles Tinley; ranch with cattle and game.

Table XX. Permitted quotas and actual off-take of game species in Rhodesia, 1972 and 1973¹

Species	Quota allowed		Off-take		Off-take as percentage of quota allowed	
	1972	1973	1972	1973	1972	1973
Buffalo	494	636	139	227	28.1	35.6
Bushbuck	321	323	76	48	23.6	14.8
Duiker	3,071	2,796	669	441	21.7	15.7
Eland	547	584	193	228	35.2	39.0
Elephant	264	170	38	128	14.3	75.2
Giraffe	57	110	16	37	28.0	33.6
Grysbok	432	318	16	16	37.0	5.0
Hippopotamus	58	166	19	50	32.7	30.1
Impala	13,483	15,113	6,580	6,901	48.8	45.6
Klipspringer	102	104	10	20	9.8	19.2
Kudu	2,963	2,599	1,096	907	36.9	34.8
Reedbuck	371	392	113	138	30.4	35.2
Sable	641	698	257	302	40.0	43.2
Steenbok	1,614	1,331	345	255	21.3	19.1
Waterbuck	341	342	140	133	41.0	38.8
Warthog	1,238	1,350	347	401	28.0	29.7
Wildebeest	1,449	1,187	614	570	42.3	48.0
Zebra	1,562	1,519	490	617	31.3	40.6
Crocodile	67	79	8	18	11.9	22.7
Leopard	91	117	22	26	24.1	22.2
Lion	29	42	10	23	34.4	54.7
Ostrich	140	153	9	24	6.4	15.6
Guineafowl	3,255	3,395	546	621	16.7	18.2
Francolin	2,712	3,007	400	636	14.7	21.1
Sandgrouse	-	115	-	-	-	-

1. Data from Report of the Director of National Parks and Wild Life Management (1973).

Table XXI. Annual populations of 4 most abundant species and numbers removed on Ubizane Game Ranch, Natal, 1967-1971¹

	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u> ²	<u>1971</u> ^{3, 4}
Impala	226(10) ⁵	696(61)	1,454(151)	1,811(436)	2,065(425)
Wildebeest	4(1)	54(14)	278(28)	398(117)	407(77)
Zebra	14(1)	47(8)	145(19)	187(64)	207(3)
Nyala	35(1)	89(2)	188(15)	199(87)	222(7)

1. From Deane and Feely (1974).

2 and 3. No animals introduced in 1970 and 1971.

4. Figures for 1971 are the half-year averages; the annual averages will be about 10% less.

5. Numbers in parentheses include those shot, natural deaths, and losses through fence.

Table XXII. Productivity of domestic livestock on Mara and Messina Agricultural Research Stations, Transvaal, 1975¹

<u>Location</u>	<u>Animals</u>	<u>Lick salt and phosphate</u>	Production live weight (kg/ha/year)			Mean
			<u>Year A</u>	<u>Year B</u>	<u>Year C</u>	
Mara	Yearling oxen of 4 breeds	Yes	23.1	14.5	-	18.8
Messina	18 month oxen	No	10.8	4.1	12.1	9.0
Messina	Improved Boer goats	No	4.4	4.4	4.4	4.4

1. Lüdemann (personal communication, 1975).

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APPENDICES

APPENDIX ATable A-1. Wholesale prices paid for game by Johannesburg Market, 1971-1972; per carcass (in U.S. dollars)¹

<u>Species</u>	<u>Month</u>	- 1971			- 1972 -		
		<u>Low</u>	<u>Average</u>	<u>High</u>	<u>Low</u>	<u>Average</u>	<u>High</u>
Blesbok	May	\$13.87	\$19.89	\$25.70	\$21.90	\$24.15	\$26.28
	June	10.22	20.10	40.15	17.52	15.32	36.50
	July	13.14	23.20	30.60	16.79	19.08	29.20
	August	7.30	22.60	33.12	-	-	-
Springbok	May	10.95	12.60	14.89	-	-	-
	June	5.11	13.84	16.43	3.65	10.99	18.25
	July	7.30	12.15	21.17	8.03	10.22	16.79
	August	6.94	11.36	15.33	7.30	9.49	11.68
Impala	May	5.84	12.09	23.00	8.76	21.45	35.04
	June	14.60	20.64	31.03	11.68	28.08	67.16
	July	7.30	21.68	30.66	6.57	13.96	30.66
Kudu	May	46.72	60.77	87.60	-	-	-
	June	35.04	64.04	102.20	15.33	15.33	15.33
	July	61.32	80.05	110.96	-	-	-
Warthog	May	17.52	17.52	17.52	-	-	-
	June	9.13	15.75	27.01	7.30	10.59	13.87
Black wildebeest	May	23.36	25.30	36.50	-	-	-
	June	30.30	32.24	33.22	-	-	-
Vaal rhebok	June	-	-	-	11.68	13.51	15.33
	July	-	-	-	7.30	8.95	11.68
Guineafowl	May	1.46	1.46	1.46	1.46	1.46	1.46
	June	0.88	1.53	1.75	1.31	1.62	2.77
	July	1.46	1.69	1.83	1.10	1.59	2.56
	August	1.90	1.90	1.90	1.17	1.84	2.92
Swainson's francolin	June	-	-	-	1.02	1.24	2.19
	July	-	-	-	0.73	1.08	1.90
	August	0.73	0.73	0.73	0.66	1.15	1.75
Other francolins	June	-	-	-	1.24	1.24	1.24

1. Information provided by Division of Nature Conservation, Transvaal Provincial Administration.

Table A-2. Wholesale prices paid for game by Johannesburg butcheries in 1973 (in U.S. dollars)¹

Species	Month	Numbers purchased	per carcass		
			Low	Average	High
Blesbok	April	5	\$ 25.92	\$ 35.26	\$ 39.42
	May	122	11.68	38.53	46.72
	June	382	5.84	28.81	45.26
	July	239	7.30	21.87	48.18
Springbok	April	3	15.91	17.46	18.25
	May	18	19.35	22.98	26.28
	June	235	5.84	12.18	18.98
	July	28	10.22	14.02	20.44
	August	13	11.32	15.55	20.08
Impala	May	1	39.42	39.42	39.42
	June	61	10.22	22.08	36.50
	July	13	20.44	28.70	29.20
	August	4	29.20	29.20	29.20
Kudu	April	1	145.27	145.27	145.27
	May	1	143.81	143.81	143.81
	June	20	21.90	62.53	116.80
	July	5	40.88	72.42	146.00
	August	2	51.10	51.10	51.10
Eland	June	2	208.05	213.53	219.00
Warthog	June	11	16.06	21.90	29.20
	July	2	8.76	17.52	26.28
Black Wildebeest	June	13	40.15	40.95	51.10
Swainson's Francolin	June	24	0.73	0.93	1.02
	July	21	0.73	1.07	1.31
	August	6	0.73	0.98	1.10
Other Francolin	June	4	0.44	0.82	0.95
Guineafowl	May	16	2.41	2.41	2.41
	June	203	1.46	1.56	2.34
	July	119	1.61	1.61	1.75
	August	164	1.46	1.66	1.75
	September	39	1.46	1.46	1.46

1. Information provided by Division of Nature Conservation, Transvaal Provincial Administration.

Table A-3. Wholesale prices paid for game by Johannesburg butcheries in 1974 (in U.S. dollars)¹

Species	Month	Numbers purchased	per carcass		
			Low	Average	High
Blesbok	May	80	\$ 18.98	\$ 36.65	\$ 47.45
	June	182	14.60	33.81	46.72
	July	67	32.12	39.60	47.75
Springbok	June	18	13.51	18.10	22.63
	July	42	7.30	18.44	24.82
Impala	May	24	22.63	33.58	45.99
	June	37	10.95	28.03	45.26
	July	34	18.25	40.46	67.89
	August	15	17.52	26.53	40.15
Kudu	May	2	89.06	92.71	96.36
	June	5	65.70	117.53	178.12
	July	2	55.48	100.74	146.00
	August	1	116.80	116.80	116.80
Bushbuck	July	2	17.52	23.36	29.20
Francolin	May	2	0.88	0.88	0.88
	July	14	0.88	1.14	1.39
Guinea fowl	May	182	1.31	1.40	2.04
	June	473	1.17	1.28	1.46
	July	327	1.31	1.39	2.34
	August	582	1.31	1.31	1.31

1. Information provided by Division of Nature Conservation, Transvaal Provincial Administration.

Table A-4. Income and expenditure for two Game Ranches in Rhodesia
(figures rounded to nearest U.S. dollar after conversion)¹

<u>Ranch</u>	<u>Items</u>	<u>1972-73</u>	<u>1973-74</u>	<u>1974-75</u>
Iwaba ²	Animal Products Income	135	—	526
	Safari Income	3,541	555	8,225
	Expenditure	1,371	471	2,887
	Profit-Loss	+2,170	+ 84	+ 5,864
	Approx. value of wildlife used for rations, domestic consumption, gifts etc.	283	94	566
Anon. ³	Animal Products Income	—	37,547	30,189
	Safari Income	—	2,453	27,170
	Expenditure	—	47,736	49,623
	Profit-Loss	—	- 7,736	+ 7,736
	Approx, value of wildlife used for rations, domestic consumption, gifts etc.	—	none recorded	none recorded

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1. Data from mail questionnaires.
 2. Increase in numbers of animals on ranch was large each year.
 3. Anon. gave depreciations of \$2,321 and \$2,566 for 1972-73 and 1973-74, respectively. We assume these were included in expenditure. The profit and loss shown are those reported in the returned questionnaire. Depreciation rates here were 5 per cent higher than those quoted by Iwaba in every case but one.

Table A-5. Summary of income and expenses of Doddieburn-Manyoli Ranches, Rhodesia, for 13 fiscal years from 1961-74 (in U.S. dollars).

Year	Revenue		Total	Expenditure	Profit/Loss
	Safari	Game			
1960-61	-	7,883.41	7,883.41	7,827.67	+ 55.74
1961-62	-	18,852.35	18,852.35	12,954.26	+ 5,898.10
1962-63	-	31,089.66	31,089.66	23,391.97	+ 7,697.69
1963-64	-	40,874.70	40,874.70	22,919.55	+17,955.15
1964-65	-	15,452.93	15,452.93	17,522.04	- 2,069.11
1965-66 ¹	-	16,011.28	16,011.28	18,321.89	- 2,310.62
1966-67 ¹	-	6,968.58	6,968.58	16,548.48	- 9,579.90
1967-68	808.15	13,136.47	13,944.62	12,944.68	+ 949.94
1968-69	-	6,917.59	6,917.59	12,694.83	- 5,777.24
1969-70	5,205.75	4,016.60	9,222.36	20,862.98	-11,640.62
1970-71	25,323.60	3,038.87	28,362.47	42,715.06	-14,352.58
1971-72	26,961.92	638.09	27,600.02	46,728.68	-19,128.47
1972-73	33,136.74	6,096.43	39,233.17	58,971.66	-19,738.49
1973-74	56,020.70	28,202.79	84,223.49	54,130.19	+30,093.30

1. Foot-and-mouth restrictions halted cropping for parts of these years.

Table A-6. Income and expenditure for Doddieburn-Manyoli Ranches, Rhodesia for years 1960-1974 (in U.S. dollars)¹

	1/4/60 to 30/9/61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67
EXPENDITURE							
Packing materials		152.54	136.29	393.83	233.10	380.86	186.78
European salaries	2,970.80	3,144.40	4,796.87	3,994.22	3,048.99	2,399.25	2,739.80
Transport and mileage	2,270.80	2,735.69	6,335.50	6,505.70	3,778.86	2,119.23	1,819.57
African wages and rations	1,260.00	3,102.49	4,557.65	3,398.93	2,952.03	4,072.69	4,019.83
Rent			3,360.00	3,360.00	2,520.00	3,080.00	3,850.00
	305.66	807.11	1,363.06	1,542.60	706.31	1,027.15	387.22
Ammunition and knives	282.42	505.04	1,255.67	939.60	697.59	607.26	417.49
Snares	148.52	508.87					
Salt and seasoning	150.62	484.12	233.60	341.66	183.91	401.85	58.04
Overalls, capes, boots		206.28	51.87	113.19	95.76	106.45	
Repairs and maintenance-	283.42	265.32	231.97	203.01	496.83	771.86	413.15
Depreciation		246.79	311.10	415.05	681.51	499.91	674.15
Printing and stationery	17.36	136.20	68.33	34.29	27.50	22.68	6.66
Medical aid contributions		50.40	16.80	40.60	49.28	52.92	122.22
Sundry expenses	133.08	609.01	673.26	124.87	706.38	1,287.65	341.57
Water and power							
Administration fee					504.00	616.00	672.00
Legal expenses					840.00	840.00	840.00
Insurance and Prov. Fund						36.16	
Advertising							
Licences							
Food and consumables							
Telephone							
Wildlife acquisition							
Proportion written off							
	7,827.67	12,954.26	23,391.97	22,919.55	17,522.04	18,321.89	16,548.48

INCOME									
Sales, venison, biltong	7,883.41	18,852.35	26,159.74	22,536.48	13,317.41	11,307.02			
Sales, hides			4,929.93	18,338.23	2,135.53	4,704.26			
Sales, venison, biltong, hides									6,968.58
Safari sales									
Captured game sales									
Filming of giraffe									
Stock of hides on hand									
	7,883.41	18,852.35	31,089.66	40,874.70	15,452.93	16,011.28			6,968.58
	+	+	+	+	-	-			-
PROFIT/LOSS	55.74	5,898.10	7,697.69	17,955.15	2,069.11	2,310.62			9,579.90

1. Data provided by Mr. Dudley Nicholas.

Table A-6 (continued). Income and expenditure for Doddieburn-Manyoli Ranches, Rhodesia for years 1960-1974 (in U.S. dollars)¹

	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74
EXPENDITURE							
Packing materials	2,194.50	1,560.00	2,526.02	2,365.57	3,007.17	6,150.28	8,811.02
European salaries	1,655.70	1,047.60	879.42	2,063.91	3,084.83	4,949.42	5,509.94
Transport and mileage	3,212.65	2,772.40	2,609.47	5,854.47	5,789.23	4,878.11	7,201.04
African wages and rations	3,360.00	3,360.00	4,528.30	12,075.47	12,075.47	12,075.47	4,528.30
Rent ²	591.65	247.92	292.83	700.79	724.53		
Commission	366.44	306.41		307.21	168.87	469.70	913.58
Ammunition and knives							
Shares							
Salt and seasoning	54.60	8.03	119.38	86.94	154.23	264.30	483.32
Overalls, capes, boots							
Repairs and maintenance	156.02	753.49	557.53	435.83	1,377.45	1,620.57	1,963.23
Depreciation		628.34	1,228.23	4,439.09	4,339.62	4,212.47	3,323.02
Printing and stationery	3.13	5.88	5.79	44.81	22.64	37.36	
Medical aid contributions	75.74	84.00	133.96	187.55		379.25	452.83
Sundry expenses	150.72	147.08	399.83	2,336.70	2,046.66	4,573.49	1,581.08
Water and power	333.54	672.00	905.66	679.25	110.62	857.87	585.38
Administration fee	840.00	840.00	1,509.43	3,396.23	3,396.23	3,396.23	11,279.28
Legal expenses					107.55		
Insurance and Prov. Fund		196.28	256.98	343.87	902.66	765.49	806.09
Advertising			3,010.62	2,902.11	3,580.11	1,157.51	447.17
Licences		57.40	1,013.21	1,473.21	2,526.42	3,289.62	888.68
Food and consumables			886.32	3,022.06	3,314.40	4,491.21	4,253.62
Telephone						246.72	322.06
Wildlife acquisition							
Proportion written off						5,156.60	780.55
	12,994.68	12,694.83	20,862.98	42,715.06	46,728.68	58,971.66	54,130.19

INCOME								
Sales, venison, biltong		6,917.59	4,016.60	3,038.87	638.09	6,096.43	17,731.09	
Sales, hides	12,716.47							
Sales, venison, biltong, hides			5,205.75	25,323.60	26,961.92	33,136.75	56,020.70	
Safari sales	528.15						9,433.96	
Captured game sales	420.00							
Filming of giraffe	280.00							
Stock of hides on hand							1,037.74	
	13,944.62	6,917.59	9,222.36	28,362.47	27,600.02	39,233.17	84,223.49	
	+	-	-	-	-	-	+	
PROFIT/LOSS	949.94	5,777.24	11,640.62	14,352.58	19,128.47	19,738.49	30,093.30	

1. Data provided by Mr. Dudley Nicholas.

2. Rents 1970-71 and 1972-73 include \$7,547.17 each year for lease of Matetsi safari hunting area.

Table A-7. Income and expenses of Rosslyn Safaris for seven fiscal years 1967-1974 (in U.S. dollars)¹

	Phase I ²		Phase II ³		Phase III ⁴				Total
	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74		
1. Safaris	377	581	9,796	30,169	28,566	44,079	76,649	190,218	
2. Live game	-	-	-	-	-	-	12,641	12,641	
3. Fresh meat	14,977	12,222	5,707	1,388	1,724	1,539	2,539	40,100	
4. Skins and trophies	6,234	8,113	6,071	290	1,952	5,341	3,934	31,938	
5. Biltong	426	615	4,511	5,874	4,489	7,136	8,894	31,945	
6. Sundry	60	151	-	147	28	626	5,341	6,355	
7. Total	22,075	21,683	26,086	37,869	36,760	58,722	110,000	313,197	
8. Operational costs ⁵	11,250	15,313	16,422	21,353	21,133	21,022	25,283	131,779	
9. Net profit	10,824	6,370	9,664	16,516	15,626	37,700	84,716	181,418	
10. Mean profit/phase	8,596		9,664			38,640		18,967	
11. Net profit/kg of carcass	0.38	0.38	0.55	1.10	1.06	1.30	1.85		
12. Mean of 11/phase	0.38		0.55			1.33			
13. Net. profit/hectare	0.50	0.50	0.60	0.87	0.84	1.35	2.52		
14. Mean of 13/phase	0.50		0.60			1.40			

1. Data from Johnstone (1973) and personal communication (1975).

2. Phase I: meat production only.

3. Phase II: meat production and safaris.

4. Phase III: some meat production, mostly safaris.

5. Excluding salaries.

Table A-8. Income and expenses of Theunis Bester Game Ranch for 10-month period in 1974 and projections for fiscal year 1975-76 (in U.S. dollars)¹

	<u>1974</u>	<u>1975-76</u>
Gross income from sale of meat, hides	109,500	204,400
Gross income from safari sales	36,500	65,700
Total	146,000	270,100
Operating expenses	81,760 ²	85,000 ³
Net profit	64,240	185,100

1. Data supplied by Mr. Charles Tinley.
2. Excludes cost of meat processing plant but includes salaries, depreciation, and all usual running expenses.
3. Operating expenses are not expected to rise much beyond those for 1974-75, the first year in which major expense items such as fencing, control of poaching and purchase of stock have not figured prominently.

Appendix B. Methods used for step-point transects.

Areas to be sampled were stratified based on knowledge of management that had been applied to them and/or of their soil, slope or other characteristics. If the area of interest was relatively small, i.e. 50 to 150 hectares, the distance through it on a road or across country was determined. (If the area was large, a decision to stop at some set distance was made before the trip was started.) If this distance across the area was e.g. 0.7 km, the vehicle stopping point would then be determined by flipping a coin, with one of us flipping and the other calling "heads" or "tails". The first call would determine whether the stop would be at an odd or even number on the tenths kilometer odometer. Assuming the odometer was at 0 tenths and the call indicated odd numbers, another toss of the coin would be made to indicate .1 and .3 vs. .5 and .7. The next flip would determine the actual tenths kilometer at which to stop. A final coin toss decided on which side of the vehicle the transect would be run.

We then walked as nearly as possible at right angles to the truck for 100 meters. At that point, we turned and faced the vehicle. A 3.7 foot (113 cm) long stick was thrown high behind one of us and made to spin horizontally. The direction along the ground indicated by the stick after landing was taken as the direction of the transect. If the direction of the transect would eventually cross a road or track, the transect was run in the opposite direction.

While taking a sight on some feature in the distance, we would walk ten paces along the indicated line of transect, thus placing the first "point" of the transect about 20 meters from the spot where the tip of the stick landed. The rest of the transect continued along the same line of sight.

The "points" along this transect are determined by a 2 mm wide line marked on the toe of a tennis shoe. This line on the shoe can be sighted along, to increase accuracy in determining where the "point" falls. Categories of basal cover include litter, annual or perennial grass, forb, and tree or shrub (see Appendix C). One hundred points are recorded in groups of ten points along a straight line which, as stated earlier, is determined by pacing towards some landmark. Since a point is read every time the right foot comes down, the first and last points are approximately 198 meters apart.

The point is always read at ground level, as this technique measures basal cover. A leaf, twig or stem lying on the ground may lie under the point. If the leaf, twig or stem is part of a living plant and is not rooted somewhere beyond the step-point along its length, bare ground is recorded. If this were not done, pressing down of vegetation with the foot would erroneously increase the amount of litter and live plants recorded. Litter is recorded even if only a single charred grass stem, e.g. 1 mm x 5 mm, lies under the step-point. Litter also is recorded if matted dead vegetation, 5 to 8 cm deep, lies under the point. The effects of the two types of litter on the soil are very different.

This technique used in the dry season underestimates the abundance of annuals and perennials whose above ground parts die back and/or are

burned off or consumed by living organisms. It does, however, still show current soil surface-vegetation relationships rather well.

When a woody plant forms a canopy over a step-point within about 15 cm of a line extended vertically above the step-point, the woody species is identified and the height of the canopy or each successive canopy recorded.

At every tenth step-point, a mil-acre circular plot centered on the point is searched for mammal droppings, and these are identified and counted. A pellet group is not counted if it is situated so that more than half of the group is outside the circular plot. Single droppings of hare and cane rat are recorded, but not single ones of ungulates unless they constitute most of a bowel movement. When two or three cane rat or hare droppings of apparently the same age occur together, these are recorded as a single set. The circular plot is circumscribed by rotating the 3.7 foot long stick horizontally around the step-point.

Within the same mil-acre plot, range condition and trend are recorded by using an 8 point numerical scale with a range from 0 to 7. If the plot is in excellent condition and improving, it is given a 0 rating; that is, no erosion greater than normal geological erosion and 75 to 100 per cent of the potential forage production is evident. The plot is in poor condition and declining if there is severe erosion, and it is producing only 0 to 25 per cent of its potential forage. This would then constitute a rating of 7. The other ratings of range condition are good (2 and 3) and poor (4 and 5). In this system, all even numbers and 0 indicate improving range, and odd numbers indicate declining range conditions.

Since this rating system is being applied on a great number of widely scattered areas with diverse herbivores feeding on them, no effort is made to judge relative forage values of different plant species. The judgement of forage production is made on the basis of the robustness, abundance and biomass of the plants present, taking into account signs of forage removal through grazing and browsing.

After the transect is completed, a photograph is taken along the transect. A person holds a small blackboard on which are recorded the transect number and date. The person holding the board stands on the transect about 10 meters from the first step-point. The photographer stands about 4 meters to one side of the transect line and frames the photograph so that the blackboard and most of the transect will be shown. The photo is taken with a 50 mm lens on 35 mm film.

Appendix C. Step-point transect form (trial modification No. 2 -ASM)

Point Nos.	Bare	Litter	Grass		Forb	Shrub/Tree Height (ft.)
			Annual	Perenn.		
- 10						
11 - 20						
21 - 30						
31 - 40						
41 - 50						
51 - 60						
61 - 70						
71 - 80						
81 - 90						
91 -100						
Sums						

Transect identification: Date
Location

No.

Photo.

General Habitat Description

- soil
- vegetation
- slope direction
- slope steepness

Personnel

History

- fire
- animal use
- cultivation

Range condition and trend and pellet groups on 1/1000 acre
Circular Plots (Trial Modification No. 1) (This form goes with
the step point transect form)

Transect Identification: Date		No.	(These should be the same as on the step point transect form)
Cond./			
Plot No.	Trnd. 0-7*	Number of pellet groups by species, hare size and larger	
10			
20			
30			
40			
50			
60			
70			
80			
90			
100			
Sums			

Comment on factors such as rain that may have influenced the number of
pellet groups found along this transect:

Personnel:

* See ASM4 directions; 0 is excellent improving and 7 is poor
declining.

Appendix D. Sources of loss to a commercial game ranching enterprise.

1. Unduly frightening wildlife will cause excitability in game, and increase the difficulty of counting or cropping game.
2. Wounding of game may result in the creation of dangerous animals, in poor carcass quality or in loss of animals that die subsequently and cannot be located. If the latter survive, they tend to be very excitable and cause other animals to be likewise.
3. Careless use and inadequate maintenance of equipment may be costly. Examples are damaging vehicles, firearms, telescopes and binoculars through unnecessary hard use or lack of regular servicing. (A saddle horse was killed once when a rifle thought to be unloaded was fired accidentally.)
4. Unauthorized fires damage veld and other property.
5. Failure to transport carcasses as quickly as possible or under sanitary conditions to the butchery will produce meat of lower quality.
6. Valuable hides will be damaged by careless loading and transport. Poor skinning techniques will also damage hides.
7. Lack of attention to the handling of carcasses will reduce meat quality. For example, the following have been observed:
 - a. hair, scent gland secretions, dirt and intestinal contents on the carcass;
 - b. on the dressed carcass, portions of the colon, fecal droppings and damaged meat;
 - c. failure to chill carcasses promptly.
8. Theft by employees may be considerable. This may occur at the following times:
 - a. immediately after animals are killed or before the animals are entered into books upon arrival at the butchery;
 - b. when large carcasses such as giraffe must be cut up in the field before loading and transport to the butchery (10 to 15 kg may easily be removed from each cut portion without noticeable loss);
 - c. when fresh cuts are sold (some weight loss does occur from drying and consequently small amounts of meat removed from many carcasses may be difficult to detect);
 - d. during storage or en route to market;
 - e. overcharging customers and pocketing the difference after a sales transaction.
9. Poor public relations developed by employees or others can discredit the owners resulting in loss of permits and opening opportunities for take-over by others.
10. As indicated on page 47, poaching not only by employees, but also by persons from adjacent areas may be very costly.

11. Lack of attention to storage requirements may result in losses due to insect damage.
12. Wasteful use of ammunition also increases expenditures.

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The International Union for Conservation of Nature and Natural Resources (IUCN) is an independent international body, formed in 1948, which has its headquarters in Morges, Switzerland. It is a Union of sovereign states, government agencies and non-governmental organizations concerned with the initiation and promotion of scientifically-based action that will ensure perpetuation of the living world - man's natural environment - and the natural resources on which all living things depend, not only for their intrinsic cultural or scientific values but also for the long-term economic and social welfare of mankind.

This objective can be achieved through active conservation programmes for the wise use of natural resources in areas where the flora and fauna are of particular importance and where the landscape is especially beautiful or striking, or of historical, cultural or scientific significance. IUCN believes that its aims can be achieved most effectively by international effort in cooperation with other international agencies, such as UNESCO, UNEP and FAO.

The World Wildlife Fund (WWF) is an international charitable organization dedicated to saving the world's wildlife and wild places, carrying out the wide variety of programmes and actions that this entails. WWF was established in 1961 under Swiss law, with headquarters also in Morges.

Since 1961, IUCN has enjoyed a symbiotic relationship with its sister organization, the World Wildlife Fund, with which it works closely throughout the world on projects of mutual interest. IUCN and WWF now jointly operate the various projects originated by or submitted to them.

The projects cover a very wide range, from education, ecological studies and surveys, to the establishment and management of areas as national parks and reserves and emergency programmes for the safeguarding of animal and plant species threatened with extinction, as well as support for certain key international conservation bodies.

WWF fund-raising and publicity activities are mainly carried out by National Appeals in a number of countries, and its international governing body is made up of prominent personalities in many fields.