

The status of the southern white rhinoceros (*Ceratotherium simum simum*) on private land in South Africa in 2001

J. Guy Castley^{1*} and Anthony J. Hall-Martin²

¹South African National Parks, PO Box 20419, Humewood 6013, South Africa
email: gcastley@upe.ac.za

²Hall-Martin Consulting, PO Box 73379, Lynnwood Ridge 0040, South Africa
email: hallmartin@worldonline.co.za

*corresponding author

Abstract

A telephone survey to determine the status of the southern white rhino on private property in South Africa was carried out during October and November 2001. White rhino numbers on private land increased from a minimum estimate of 1922 in 1999 to 2534 at the time of the survey. The rhinos occurred on 242 properties, 88 of which were new to our records; together the properties covered a minimum of 14,593 km². The total number of rhinos on new properties was 486 or 19% of the total. Increases in white rhino populations on private property through reproduction at a rate of 21% over the 28-month survey period (or 9% per annum) were higher than those purchased from state wildlife management agencies (14% over the survey period, or 6% per annum), although the latter remain a significant source of animals. The trade in live animals continued to grow, both from the state to the private sector and within the private sector, and average prices were still increasing. Data appeared to support the hypothesis that having only a single bull did not limit the breeding potential in the wild. The stock of reported rhino horns in private ownership has steadily grown although the figures were lower than expected.

Résumé

En octobre et novembre 2001, on a réalisé une recherche par téléphone pour déterminer le statut du rhino blanc du Sud dans des propriétés privées en Afrique du Sud. Le nombre de rhinos blancs dans les propriétés privées a augmenté d'une estimation de 1922 individus minimum en 1999 à 2534 au moment de l'enquête. Il y a des rhinos dans 242 propriétés dont 88 sont nouvelles dans les rapports. Ensemble, elles couvrent un minimum de 14.593 km². Le nombre total de rhinos sur les nouvelles propriétés était de 486, c'est-à-dire 19 % du total. La croissance des populations de rhinos blancs dans les propriétés privées due à une reproduction dont le taux est de 21 % sur les 28 mois de l'étude (ou 9 % par an), était plus élevée que celle due à l'achat d'animaux dans les organes de gestion de la faune de l'Etat (14 % pendant la période en question, soit 6 % par an), mais ces derniers restent une source significative d'animaux. Le commerce d'animaux vivants continue à croître, de l'Etat vers le secteur privé et au sein du secteur privé, et les prix moyens sont encore en augmentation. Les données semblaient soutenir l'hypothèse selon laquelle le fait de n'avoir un seul mâle ne limite pas le potentiel reproducteur dans la nature. Le stock de corne de rhinos que l'on a relevé comme appartenant à des particuliers a augmenté régulièrement quoique les chiffres soient moins élevés qu'on ne s'y attendait.

Introduction

A telephone survey to assess the status of the southern white rhinoceros (*Ceratotherium simum simum* Burchell, 1817) on private land in South Africa was undertaken for WWF International's African Rhino

Programme (WWF-ARP) during October and November 2001. This is the latest in a series of similar surveys undertaken between 1987 and July 1999 (Buijs 1988; Emslie 1994; Buijs and Papenfus 1996; Buijs 1998, 2000). It forms part of an ongoing focus towards rhino conservation in southern Africa and

highlights recent trends within the South African population on private lands.

These surveys have tracked the rapidly increasing numbers of white rhinos on private land in South Africa from about 60 to 100 on properties in KwaZulu-Natal in 1984 to 1922 in 1999 (Buijs 2000). The first survey of this nature was completed by Buijs (1988), who recorded 931 individuals on 103 properties in 1987 and noted that between the period of 1984 and 1987 large numbers of white rhinos had been moved to private land (Buijs 2000). The recovery of the southern white rhino population within southern Africa can be seen as one of Africa's greatest conservation success stories (Emslie and Brooks 1999), and the ongoing monitoring of this population is critical to the development of pragmatic conservation strategies for the future.

The need for undertaking such surveys and long-term monitoring activities has been outlined previously by Emslie and Brooks (1999) as they are essential for sound management and rhino conservation. Survey information can be effectively integrated into national management plans and inform biological management. The benefits to the private sector from such monitoring should not be underestimated as the trends these surveys indicate should ultimately lead to improved rhino management on private lands. Continued monitoring of these populations should lead to improved understanding of white rhino performance in these areas.

Objectives

Survey objectives were to determine the number of white rhinos on various private properties, which excluded all municipal nature reserves and defence force reserves but included rhinos in zoos; to determine the structure of each population, the pattern and number of animals traded or moved between properties, and if the translocations succeeded; to assess population performance; and to estimate the amount of rhino horn stock under private ownership. Secondary objectives were to obtain an understanding of the factors influencing the market in white rhinos, what motivated owners to keep white rhinos, and owner attitude to the possibility of trading in rhino horn.

Methods

Either the landowner or the manager on the various properties identified were asked pertinent questions

in a structured questionnaire format. In all cases accurate data or an authoritative opinion was sought from owners or managers, and sometimes from third parties (for example, wildlife dealers and conservation officials) with relevant knowledge (property registers, permit applications, sale records, and similar data) pertaining to the specific property. The database of 183 properties that had been produced in the 1999 survey was used as a starting point for the survey. Nine properties were deleted from the 2001 database as they had no record of rhinos since 1996, were duplicated elsewhere in the database or had been amalgamated with other properties listed. New properties were identified during the course of the survey with the aid of private landowners and conservation authorities. Focus included a review of not only the rhino population but also the properties on which these animals were kept.

Included were auctions in the private sector as well as those of South African National Parks (SANParks) and Ezemvelo KwaZulu-Natal (EzKZN) Wildlife. SANParks, the North West Parks and Tourism Board and Mpumalanga Parks Board also sold white rhinos on tender and these records were examined as well. Many details of transactions and translocations were derived from the records of game-capture operators and wildlife dealers in the private sector. These latter sources had not been used in the previous Buijs survey (2000).

Data were incorporated in a database that helped set population performance parameters and status indicators.

Results

Information quality

Information on rhino populations is regarded as sensitive, even confidential, by many landowners. Although the nature of this survey (by telephone or fax) may have made owners wary of responding to questions, previous face-to-face interviews in surveys also met with resistance. There is, however, a general desire on the part of the surveyors to retain the confidentiality of this type of data, and the increased response may be indicative of the confidence landowners have placed in researchers to ensure that this remains the case. Potential reasons for not providing information could include the high value of the transactions, tax implications, and security

concerns about rhinos and rhino horn stocks. Although the majority of owners provided precise information on rhino numbers based on detailed records, several property owners gave only vague information, and five refused to give any information at all. The estimate of the number of white rhinos on private land in South Africa in this survey is therefore to be regarded as an absolute minimum.

The properties

Of the 22 properties that no longer had rhinos in 1999, 20 were excluded from the analysis after contact with 6 revealed that their status had remained unchanged. Two had reintroduced rhinos and were included. Targeted for the telephone survey were 258 properties comprising those previously identified and new ones; 224 provided information, 8 were contacted but their information is still outstanding, and 23 that are known to have rhinos could not be contacted. The remaining 3 are the greater Kruger National Park (KNP) reserves (Sabie Sand, Klaserie and Timbavati/Umbabat) on the western border of Kruger National Park, whose information was provided by the Agricultural Research Council game ranch monitoring project (M. Peel pers. comm. 2001) (fig. 1). The figures for the greater Kruger reserves are derived from aerial surveys that may inherently have an undercounting bias and should therefore be seen as minimum figures. The inability to contact the 23 properties was because information in the 1999 database had changed or was

originally incorrect. Extensive efforts to trace these properties or their managers (through provincial agencies, telephone company enquiries and the Internet) proved unsuccessful. Several additional properties reported to have rhinos were also identified after the survey was completed but they could not be contacted. Estimates of their rhino numbers, however, were available either from the 1999 survey (as a minimum number) or in some cases from third parties.

Out of the 161 properties that had rhinos during the 1999 survey, 151 still had rhinos. Rhinos from the remaining 10 properties had either been transferred to other properties belonging to the same owners or sold. Of the 151 populations still extant, 68 (45%) have increased, 34 (23%) have decreased and 49 (32%) show no change, although some of these figures may represent an unwillingness to divulge information.

The present survey identified 88 properties holding white rhinos that were not listed in the 1999 database. Of these, 70 were contacted, and 18 could not be contacted. White rhinos from two properties were incorporated into other areas while a further four properties are currently managed as two single entities but are listed in the database as separate properties. Of the 88 new properties in the database, 19 (22%) had rhinos at the time of the 1999 survey, and these clearly had been overlooked in the previous survey.

Rhino numbers

In South Africa in 2001, 1969 white rhinos in private ownership were accounted for on surveyed properties (excluding the greater Kruger reserves) that provided information. A further 280 rhinos were listed from 31 properties in the 1999 and 2001 databases where information was still outstanding or where these properties could not be contacted. In these cases the 1999 figure or estimates provided by third parties were used to give a minimum total of 2249 animals in November 2001. There has, therefore, been an increase of at least 593 animals or 36% in the rhino population on private properties (excluding the greater Kruger reserves) between August 1999 and November 2001. The number of white rhinos sold to the private sector during this period was 238 : 117 from Kruger National Park, 102 from EzKZN Wildlife and 19 from other provincial reserves. These account for an increase of 40% in private holdings. Three animals were imported: two from private property in Namibia, and one from a private reserve in Swaziland, account-

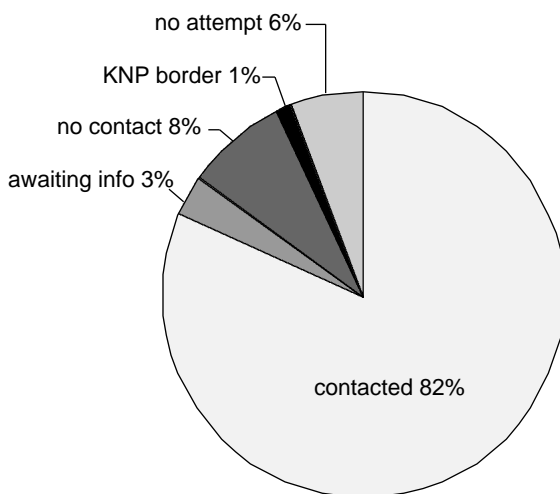


Figure 1. Representation of private properties on the 2001 white rhino survey database.

ing for 0.5%. The remaining increase is made up of recruitment (58%, $n = 346$ rhinos) to both old and new populations, and new populations added to the database (58%, $n = 342$ rhinos). It quickly becomes apparent that the expected increase (926 rhinos) is higher than the observed increase (593). However, after factoring in the mortality within the total population of 183 rhinos (from hunting and natural causes) as well as the 132 rhinos bought by new properties from existing private owners (that is, not an increase in real terms), there is an excess of only 21 rhinos. This could suggest a survey bias in that not all the properties that received rhinos from private transactions have been identified, but it may also indicate that the information supplied by the owners in such surveys is not always accurate. The observed discrepancy in the figures is, however, only a relatively small proportion of the total estimate (0.9%).

A further 285 white rhinos were recorded from the greater Kruger reserves (M. Peel, pers. comm. 2001) during standard aerial survey monitoring. This estimate indicates an increase of 19 animals or 7.1% over the 266 recorded in 1999 by Buijs (2000), or an annual increase of 3.55% (fig. 2). Although there is no physical boundary between KNP and these adjacent areas, the rhinos are owned by the neighbouring private landowners under the current management agreement with SANParks. In the terms

of this agreement any rhinos that cross over onto these properties become the property of the private landowners while those that return to KNP become the property of SANParks once more.

Overall there has been a 32% increase in the white rhino population, from 1922 in 1999 to the present 2534 on all categories of private land (including Sabie Sand, Timbavati/Umbabat and Klaserie). This estimate includes the rhino figures from yet uncontacted properties. There is no compelling reason not to include them, as minimum estimates of these populations were obtained from either 1999 totals or third parties. However this increase does not consider the 19 properties that were overlooked in the previous survey. These properties held an estimated 151 white rhinos in 1999 and if this figure is included in the previous total the real increase would only be 22%.

Although there are white rhinos in all nine provinces in South Africa more than 55% are to be found in Limpopo Province, which together with Mpumalanga and KwaZulu Natal account for over 80% of all white rhinos in private ownership (table 1).

Classified according to the African Rhino Specialist Group criteria, a number of the populations under private ownership are either *Key* or *Important* populations (Emslie and Brooks 1999). Only one reserve is classified as *Key 1*, in which the underlying trend in the population (that is, after accounting for removals) was increasing or stable and exceeded 100

animals, while four were recognized as *Key 2* populations. However, one of these areas is also within the greater Kruger so strictly only three isolated *Key 2* populations are in private reserves.

An additional 22 properties were categorized as *Important*. But this figure is lower than the 27 listed by Emslie (2002). The current survey recognized one additional *Key 2* property and eight *Important* properties since 1999 (Emslie and Brooks 1999). Of the African Rhino Specialist Group rated populations in South Africa, 14 are rated as *Key* and 44 as *Important* (Emslie 2002). Private populations therefore account for 29% and 50% respectively of these rated populations.

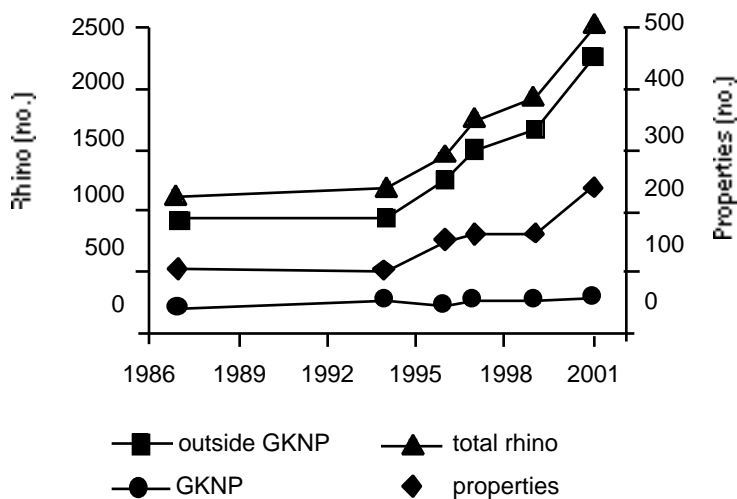


Figure 2. Trends in the total number of white rhinos under private ownership (total excluding greater Kruger area—GKNP) in South Africa as well as the number of properties where these rhinos are held.

Table 1. White rhino numbers in each of the nine South African provinces

Province	Rhino numbers	Percentage of total	Mean density \pm SE
Limpopo Province	1326	54.77	0.247 \pm 0.025
Mpumalanga	371	15.32	0.500 \pm 0.114
KwaZulu-Natal	250	10.33	0.401 \pm 0.081
North West Province	133	5.49	0.391 \pm 0.088
Gauteng	100	4.13	0.441 \pm 0.097
Northern Cape	95	3.92	0.121 \pm 0.034
Eastern Cape	74	3.06	0.199 \pm 0.082
Free State	68	2.81	0.370 \pm 0.114
Western Cape	4	0.17	0.183 \pm 0.103

Age and sex structure

Demographic information that was of value (that is, sex and age structures were known) and could be used in analysing the sex and age structure of the white rhino population in general was obtained from 211 properties that supported 65% of the population. This was similar to the 68% of the population assessed in the previous survey (Buijs 2000). Animals at least seven years old and mature were taken as adults; younger animals and calves were considered as subadult, in the same way as was done in the previous surveys. A more detailed classification would have been of little value as most owners regard any animal that still associates with its mother as a calf. The ratio of adult males to adult females is 1 : 1.78, while that of subadult males to subadult females is 1 : 1.01. The ratio of subadults to adults is 1 : 2.10. In addition to these figures, unsexed calves made up 14.5% of the total population from these 211 properties, and the sex of 37 adult rhinos was not determined.

Recruitment and mortality

At least 346 white rhino calves were born between August 1999 and November 2001, of which 96 were male (28%), 84 female (24%) and 166 were unsexed at the time of the survey (48%). Recruitment to existing populations through purchases (from state and private sector) accounted for 367 rhinos. Of these 152 were males (41%), and 208 females (57%), 1 was unsexed, and information was not provided for 6 animals.

Reductions in existing populations occurred through the sale of 226 rhinos, although these were not lost to the greater population. These were 86 males (38%), 90 females (40%), 4 unsexed calves (2%), and 46 for which information was not provided. Hunting accounted for the death of 57 animals (55 males and 2 females). Many of the bulls purchased were hunted within a year of arriving on the property of the purchaser.

Natural mortality and post-translocation deaths accounted for 126 rhinos (50 males, 60 females, 13 unsexed calves, information not provided for 3). A number of factors were listed as the cause of mortality in the rhino populations on private land but the cause for a large proportion was unknown. Known causes ranged from conflict with other animals (rhinos, elephants) to capture-related mortalities and to a number of natural and accidental causes (old age, lightning strikes, drowning) as indicated in table 2. Among the calves and subadults, conflict with resident bulls and other adult rhinos was a dominant contributing factor to mortality while within the adult population illness and poaching were also major contributors. The 10 poaching incidents reported by four properties were marginally lower than the 12 reported for the 1999 survey. The maximum number of poaching incidents from a single property was 7 animals.

Table 2. Causes of mortality within the white rhino population on private land in South Africa, excluding the 57 that were hunted commercially

Cause of death	Percentage	Adults	Calves	Total
Conflict rhinos	22.2	12	16	28
Natural	9.5	6	6	12
Illness or injury	8.7	10	1	11
Poaching	7.9	10	0	10
Capture	7.1	6	3	9
Conflict-elephant	5.6	6	1	7
Lightning or drowning	5.6	4	3	7
Unknown	33.3	33	9	42

Conflict relates to conflict with both rhinos and elephants and includes orphaning of calves that died subsequently; natural causes include old age, complications during birth, starvation; capture-related deaths are either direct or indirect, such as from post-release stress.

Property size and population size

Size information was provided for 245 of the 275 properties identified. The mean was 6314 ha with a range from 200 ha to 92,000 ha. The minimum total area of private land on which white rhinos occur in South Africa is 1,459,329 ha.

An analysis of populations in relation to property size revealed that rhino populations fared better in the larger properties. The mean area of properties from which rhinos were removed during the past two years was smaller ($n = 10$, ha = 2895 ± 585 SE) than areas where populations were decreasing ($n = 34$, ha = 5213 ± 989 SE), while properties where rhino numbers were increasing had the highest mean area ($n = 68$, ha = 8530 ± 1593 SE) (fig. 3).

Most properties (68%) had fewer than 5000 ha and only 12% were over 10,000 ha. Most properties (70%) supported rhino populations of 10 or fewer animals with only 13% having populations of more than 20 animals (fig. 4). White rhino density on private land ranged from 0.009 to 2 rhino km⁻², with a mean of 0.30 ± 0.02 km⁻².

Rhinos born into each population (recruitment) expressed as percentages appeared to peak in intermediate-sized populations whereas detected mortality was higher in smaller populations (fig. 5). These figures were adjusted for size of the total rhino population in each of the size categories as the total numbers born into each population may be a function of the total numbers within each size category. The ratio of birth to known death was lowest in the smallest size category (1.09 : 1) and was highest in the 21–50 size category (5.36 : 1).

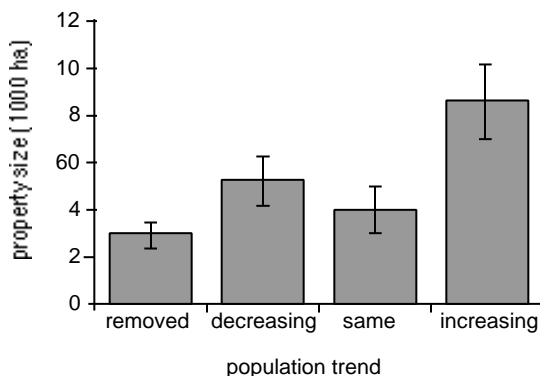


Figure 3. The trend in white rhino populations on private land in South Africa as a function of property size.

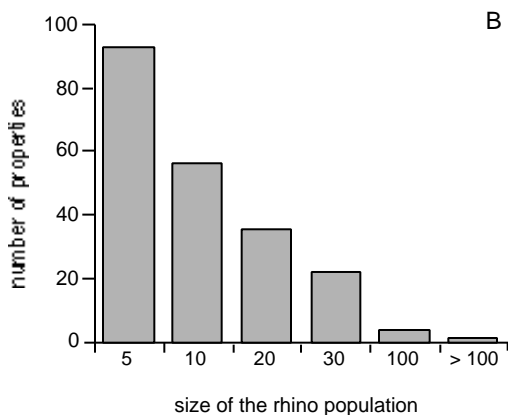
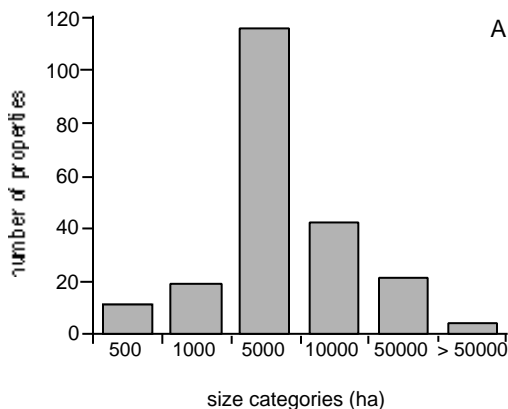


Figure 4. Relationship between property size and number of properties (A), and size of rhino populations and number of properties (B).

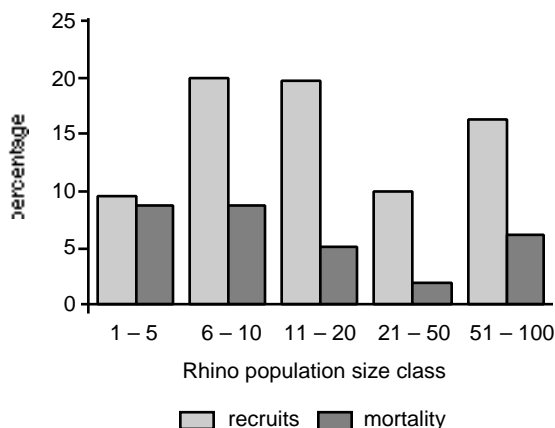


Figure 5. Rhino recruitment and mortality in relation to population size categories on private land in South Africa.

Land use

Most of the landowners or managers interviewed were asked what were their primary objectives in managing their properties. Only 11.6% of the respondents cited what could be termed ethical or aesthetic reasons (conservation, education, recreation) for keeping the rhinos. The overwhelming majority of properties are managed as commercial operations, to which rhinos contribute the most. Almost all of these properties were in the past used for cattle production. Some form of ecotourism is now the leading form of land use,

and trophy hunting is also a primary objective. This does not necessarily mean, however, that rhino hunting takes place on the properties as some only allow hunting of other animals. Another large component is made up of properties that focus on breeding and ranching, and they derive their benefits from the sale of live animals (table 3).

Trade in live rhinos

A summary of prices is provided in table 4 for rhinos traded in the private sector between late 1999 and

Table 3. Management objectives of private properties where rhinos are held in South Africa. The number of properties reflects the total number that offers some form of a specific activity. Subcategories indicated in *italics* are those not repeated within the primary management category

Management objective, primary	Properties		Management objective, subcategory	Properties No.
	No.	%		
Ecotourism	83	37.2	<i>Pure ecotourism</i>	33
			Ecotourism, hunting	29
			Ecotourism, breeding	8
			Ecotourism, conservation	4
			<i>Ecotourism sustainable use</i>	3
			Ecotourism, breeding and hunting	6
Hunting	66	29.6	Exclusively hunting	18
			Ecotourism, hunting	29
			Ecotourism, breeding and hunting	6
			Breeding, hunting	11
			<i>Photographic safari, hunting</i>	2
Breeding	48	21.5	<i>Pure breeding, ranching</i>	19
			Breeding, hunting	11
			Ecotourism, breeding and hunting	6
			Ecotourism, breeding	8
			<i>Breeding, live sales</i>	2
Conservation	9	4.0	<i>Pure conservation</i>	5
			Ecotourism, conservation	4
Recreation, education	10	4.5	<i>Recreation</i>	6
			Education	4
Private, shareblock	7	3.1	<i>Private, shareblock</i>	7

Table 4. Prices fetched for white rhinos on the South African market during 2000/2001 based on prices received from private landowners (in South African rand)

Rhino purchase category	1999	2000	2001
Adult male	139,167	159,990	156,000
Adult female	143,333	179,706	185,833
Subadult (male or female)	126,000	124,600	118,733
Adult female with calf or pregnant	none recorded	373,333	319,273
Average price (for all animals)	138,353	164,447	171,014

USD 1 = (South African rand) ZAR 6.12 in 1999; 6.95 in 2000; 8.63 in 2001. Exchange rates are an annual average of monthly averages.

November 2001. These data are derived from the figures provided by property owners and as far as possible have been verified with records from EzKZN Wildlife and SANParks. Over the survey period conservation agencies supplied 238 rhinos into the market and private owners supplied 226. However, private owners reported buying only 173 rhinos from state conservation agencies such as SANParks and EzKZN Wildlife and a further 194 on the private market. These figures represent only 73% and 86% of the respective sales. At least 63 rhinos (14%) were purchased by expatriates owning property in South Africa. Analysis of the records from conservation agencies has revealed that a number of private landowners who purchased rhinos had not yet been contacted at the time this study was completed, introducing a degree of error into the population estimate. Recently another 16 animals have been identified from the SANParks auction and tender records for 2000 and 2001 that were not included in the survey figures.

The price of white rhinos in the private market for the past two years was calculated from figures provided by rhino owners. The prices fetched varied considerably depending on the animals offered. Single young animals tended to fetch lower prices on auctions than did adult cows with calves or that were certified pregnant. Similar variations in prices according to sex and age could be seen from 1999 through to 2001 where young animals and subadults fetched the lowest prices; next were adult bulls and then adult cows. Adult cows that had a calf at foot or were pregnant (or both) consistently fetched the highest prices. These were on average about twice that received for adult bulls. The average white rhino price (for all sex and age classes combined) was ZAR 138,353 for the last two months of 1999, ZAR 164,447 for 2000 and ZAR 171,014 for 2001 (until November).¹ Prices have increased steadily since the 1999 survey when Buijs (2000) reported that the average price paid for a white rhino was ZAR 127,130. The average price of ZAR 200,238 that Emslie (2000a) reported in 2000 refers only to the average for selected animals sold at the Hluhluwe auction and not to the overall market price. The most recent records for a few late-season sales indicate that

prices and demand may have fallen, but this will be verified with subsequent surveys.

Rhino horn stock

Although 92 owners reported they did have rhino horn stock on their property (three times as many as in the previous survey—Buijs 2000), little additional information was provided in terms of the number of pieces or their size and weight. Another 85 owners said they had no rhino horn stock. It is also possible that there are private landowners in South Africa who possess rhino horn but who are not rhino owners (such as trophy horns), and this horn stock would not have been accounted for in the current survey. Most of the horns that owners held came from animals that had died. Some came from animals whose horns had been docked to prevent injury to other rhinos or from animals that had lost their horns while being transported. Only 30% of the horns were registered with the respective nature conservation authorities of each province although some owners were still waiting for officials to register horn stock. Some 64% of owners with horn stock did not provide information on registration or did not know if the horns were registered. In many cases horns had been micro-chipped.

Interest in trading in these horns was keen, with 79% of owners with stock willing to sell should a legal market be opened. The perception is that the revenue generated from a well-controlled trade in rhino horn could contribute significantly to rhino conservation and management on private land in South Africa. Despite this overwhelming interest a number of owners (18%) felt there should be no trade in rhino horn as this could fuel poaching. This contrasts with the findings of Buijs (2000) in the previous survey where *all* respondents supported a legal trade in rhino horn.

Half the owners felt that a privately run organization should handle rhino horn sales, and only 9% felt that a state-run organization (nature conservation or otherwise) should operate the process. A further 9% felt that a combination of both private and public sectors should control such an initiative. These feelings originated from lack of confidence in the current

¹ Exchange rates against the US dollar (USD): 1999 average for Nov/Dec, USD 1 = ZAR 6.15; 2000 average for year, USD 1 = ZAR 6.95; 2001 average for year USD 1 = ZAR 8.63.

provincial conservation agencies as well as the need to have representation of the private owners in any body that would affect private concerns. The remaining 32% of owners did not have any strong feelings about who should be in charge of running such trade initiatives.

The total number of horns reported was 291. Only 13 owners reported rhino horn weights; 118 horns reported weighed an approximate total of 277 kg. A further 5 owners indicated that they had only small fragments of horn. Using the average weight per horn of 1.74 kg, as calculated from the known horn stock, the weight for the remaining 173 horns can be derived, which totals 301 kg. A total of 578 kg is therefore estimated from private land in South Africa. This figure is, however, significantly lower than the confidential figure TRAFFIC reported for private rhino horn stocks, suggesting that 1) private owners are not willing to divulge such information, 2) the estimate may be an underestimate by using lower average horn weights (EzKZN Wildlife average horn weight is 2.2 kg), 3) provincial authorities may have a more complete record of such stocks in South Africa and 4) a number of properties may have been overlooked in the survey. The current study did not assess the horn stock from provincial authority records as a means of verifying information received from properties during the survey. Gathering of these data may be improved in future surveys.

African Rhino Owners' Association

Of the 106 (63%) owners who knew of the African Rhino Owners' Association (AROA), 53 claimed to still be members, 9 were uncertain of their membership, and 44 said they were not members. As there were only 45 AROA members in 1999, it seems that some owners may have been confusing AROA with other associations. While most owners knew of AROA the general feeling received was that AROA was generally inactive so that retaining membership in it was no longer of value. Many of the owners had let their membership lapse, while others said that the membership fees were too expensive to warrant joining the association. The fact that AROA has been rather dormant in recent years contributed to owners' lack of faith in the association, and many owners had opted to join local rare game or conservancy groups instead. The isolated and fragmented nature of the private white rhino owners in South Africa may require greater coordination than can be achieved through local conservation groups, and it

may be worthwhile to consider restructuring AROA to be more mindful of the needs of private rhino owners.

Discussion

Rhino populations

The results show an increase in the number of private properties in South Africa holding white rhinos. At least 69 properties (88 new properties were added to the rhino database during 2001; however, 19 of these already had rhinos in 1999) had acquired white rhinos in the 25 months between September 1999 and November 2001. This indicates a minimum rate of expansion of about 35 properties per annum. This far exceeds the rate (about 5 per annum) at which owners are disposing of their rhinos.

The increasing numbers of white rhinos on private property continues the trend seen since 1987 of a consistent rate of increase in excess of natural births alone (Buijs 2000). A major source of rhino increase on private land has been purchase from the state authorities. The early concerns expressed over acquiring and managing white rhinos on private land (Buijs and Anderson 1989; Anderson 1993) appear to a substantial degree to have been overcome. While there may still be management problems, it is clear that since rhinos can be purchased only at market-determined prices, and not at state-subsidized prices as in the past, private owners have shown greater responsibility in managing them.

The white rhino population on private property increased through reproduction at a rate of 21% over the 28-month survey period (9% per annum). This indicates that the rate at which rhinos are increasing in private populations through breeding is more important as a source of increase than purchases from the state wildlife management agencies (14% over the survey period, or 6% per annum).

The increase in the rhino population in the greater Kruger reserves (Sabie Sand, Klaserie and Timbavati/Umbabat) adjoining KNP at 3.5% per annum is lower than might be expected. The birth rate in Umfolozi Game Reserve is about 9.6% per annum (Owen-Smith 1988), and in KNP it is 9% per annum (Viljoen 1993). The increase in the greater Kruger reserve populations between 1995 and 1997 was 22.77% (see Buijs 2000), indicating a rate of about 11.3% per annum. Since 1997 the rate has been consistently about 3.5–3.6% per annum. The habitat of the private reserves is very similar to that of KNP and similar rates of recruitment

would be expected, as shown in 1995–1997. The western boundary of these reserves is fenced, while the eastern boundary is open to the park. This raises the possibility that if the recruitment is actually as good as expected, white rhinos could be moving from private reserves into KNP. The Sabie Sand Reserve in particular may be at its carrying capacity. Anderson (1993) records 176 white rhinos in the reserve in 1990. The current estimate is 184, at a time when no animals have been sold or hunted for some years. The lower population estimate may also be that these populations were undercounted during routine aerial monitoring.

The latest estimate (2001) of the total number of southern white rhinos in South Africa is 10,988 (International Rhino Foundation 2001) from a global population of 11,670. This figure is lower than the estimate derived from the 1999 figure of 9754 rhinos, which could have potentially increased at a rate of 8.8% per annum, calculated from the estimates given by Emslie (2000b) for the period 1993–1999, which would have resulted in a total of 11,546 rhinos. The actual growth is closer to 6%, which still represents a good growth within the population. The total number of southern white rhinos on all categories of land managed by the private sector in South Africa at present (2534 animals) therefore represents 23% of the national population but possibly more importantly 22% of the global population.

Age and sex structure

The ratio of adult male to adult female white rhinos in a large natural population in Umfolozi in 1969 was 1 : 1.24 (Owen-Smith 1988). The divergence from this standard in the current ratio (1 : 1.78) as reported clearly has two main causes: fewer males than females were sold at auction (1 : 1.39) and trophy hunting removed mostly males (1 : 0.036). The sex and age figures from the present survey are similar to those reported previously by Buijs (2000), although the ratio of adults to subadults is lower, suggesting that the population has become younger since 1999, which is indicative of an increasing population.

Number of males and reproductive success

The findings of Lindemann (1982) that breeding success in captive groups of white rhinos with only one male was significantly lower than in groups with two or more males has been widely commented upon.

Anderson (1993) found evidence from the records of white rhinos on private land in South Africa up to 1990 that supported these findings but Buijs (2000) cast doubt on these assertions. Of the properties in the present survey, 99 had only a single adult bull, and 76 had two or more bulls. On the 99 properties with only one adult bull 100 calves were born in contrast to the 176 born on the 76 properties where two or more adult bulls were present. This may, however, have been a consequence of the number of females in each population. There were 143 adult cows on properties with only one bull, indicating that 70% of the cows calved, whereas there were 272 cows on properties with more than one bull, which gives a 66% calving rate. It appears, therefore, that the effect of having more than a single adult bull in the population is slight. Other factors that may complicate these indications, however, need to be assessed, such as the length of the acclimatization period after translocation or the function of population size.

Mortality

Buijs (2000) reported 20 rhino deaths caused by fighting or by a calf getting in the way of a bull trying to mate with the calf's mother. The current survey accounted for 35 rhino deaths in conflict encounters—28 caused by rhinos and 7 by bull elephants (table 2). The elephants had been translocated to private land as youngsters, and the killing of the rhinos appeared to be in incidents similar to those reported by Slotow and van Dyk (2001).

Trade

The three largest state agencies selling rhinos to the private sector (SANParks, EzKZN Wildlife and North West Parks) see these sales as an important source of income. All income from the sale of rhinos in SANParks is deposited in a park development fund that is used exclusively to acquire land for new national parks or to consolidate existing ones. The other two agencies use the funds for their operating budgets. All three agencies are likely to continue selling white rhinos even if prices decline significantly as they would still be high-value animals, making important budget contributions. Private sellers may be more put off by lower prices, and indeed at a private auction in September 2001 four white rhinos were withdrawn when the reserve prices were not met.

The economic value of white rhinos largely determines the attitude of private owners towards them. The commercial approach to wildlife management on private land (Anderson 1993) is still the driving force behind the white rhino market. This is clear from the fact that the majority of the private owners in the current survey were using their land for ecotourism or hunting, and few kept rhinos solely for conservation or aesthetic purposes. Although ecotourism and conservation are not necessarily mutually exclusive, financial benefits rather than conservation principles appeared to drive white rhino management. The cost of importing rhinos from other countries indicates that sale prices are probably lower in them than in South Africa.

Awareness in the private sector of the need for effective monitoring and control to regulate the trade in rhino horn appears to be limited, although many owners may not have provided information in this regard. It was also unclear what proportion of the owners knew what restrictions were currently imposed by CITES and how these restrictions would be addressed. Should the trade in rhino horn be permitted in the future there would be a clear need for effective monitoring, registration and control to regulate the trade. Private owners were hesitant to allow such an operation to be coordinated entirely by state institutions because they lacked confidence in their capability. The information that these state organizations currently hold, however, would be invaluable in implementing any trade in rhino horn efficiently. Consequently, effort between the private sector and conservation agencies should be coordinated.

Hunting

We are not convinced that this survey has produced an accurate estimate of the number of rhinos hunted in South Africa, and some of the discrepancies in the figures reported above may be that hunted animals are not being reported. Buijs (2000) was of the opinion that the hunting industry had stabilized and was unlikely to grow as sale prices increased. Buijs reported that 47 rhinos were hunted over two hunting seasons (1998 and 1999). This figure included a minimum of 31 rhinos reported as hunted, plus 16 sold by KZN Wildlife for hunting purposes. Whether the latter 16 animals were all shot during the survey period was not recorded. It is also possible that more animals could have been hunted after July 1999, when Buijs ended his survey. The present survey could

account for 57 rhinos, also over two hunting seasons, indicating a probable increase in hunting activity contrary to Buijs's opinion. Trophy prices are quoted in US dollars and were in the range of about USD 25,000 to 35,000 per animal. As the rand has lost 30% of its value against the dollar since January 2001, and 21% between 11 September and 7 December of that year, this will push up the value of trophy animals in rand terms. It could well be, therefore, that more rhinos will be offered for hunting by landowners in 2002.

At least four properties allowed green hunting (where rhinos are darted, often to perform other procedures, but not killed) of rhinos for an average price of ZAR 40,000 per 'hunt', while a further two were interested in initiating green hunts. The consequences of green hunts that concentrate on single animals that are repeatedly darted are as yet undetermined and may be detrimental to these animals.

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