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Lion predation on the African Black Rhinoceros and its potential effect on management.

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Introduction

Apart from humans, lions are the only other main predator of rhinos. Despite this, there is very little published information describing the effect of lion predation on rhino populations. This paper brings together the references that directly indicate a problem between lions and rhinos, identifies the indications of lion predation, adds new information and considers the effect of lion predation on one population of African black rhinoceros.

Lions are generally thought to prey on medium to large ungulates within the weight range 190-550kg with buffalo, giraffe and zebra among the preferred species but will also prey on smaller species such as warthogs (Hayward & Kerley 2005). There are relatively few references which directly indicate a predation problem between lions and rhinos and this paper reviews those published, adds new information and considers the effect on population performance.

Chronological Review of Recent Literature

Ritchie (1963) stated that young rhinos are sometimes killed by lions. He had also heard of an old bull being killed by two lions but conversely had seen two rhinos drive three lionesses off an ostrich kill.

Lions were seen moving away from rhinos which had deliberately advanced when they had become aware of the presence of the pride (Goddard 1967). Goddard further reported that, in August 1967, a sub-adult lion attempted to attack an 11 month old rhino calf. The mother was close at hand and engaged the lion. The lion bit the females hock and clawed its thigh but was gored twice by the rhino in the centre of the ribs and then in the centre of the neck followed by a blow through the base of the jaw that killed it.

Joubert & Eloff (1971) reported that rhino cows hide their small calves and were only able to find one record, in 1963, of a rhino calf being killed by a lion.

In Amboseli National Park, between 1971 and 1977, a sub-adult black rhino was killed by lions after having separated naturally from its mother (Western 1982). In another three cases the calves of poached females were too young to defend themselves and were killed by predators. Western reported that few calves less than 3 years of age survive predators if separated from their mothers.

In the Hluhluwe/Corridor/Umfolozi complex of Natal, South Africa, Hitchins and Anderson (1983) reported that the only predators capable of killing rhino were lion, hyena and crocodile. However, there were no record-

ings of lion killing black rhinos, only white rhinos.

A freshly killed, black rhino carcass was found with an adult male lion by Elliot (1987) in Umfolozi Game Reserve. There were signs of a struggle and well defined claw and tooth marks on the neck of the rhino which had a horn length of 18-20 cm making it probably two year old. It was concluded that there was strong circumstantial evidence that the lion had killed the rhino.

In 1986/7, the Salient of the Aberdares National Park, Kenya, was home to 12 lions (Sillero-Zukiri and Gottelli, 1991). They reported that rhinos can be killed by lions even when adult up to the age of four months.

In September 1995, three rhinos aged between 3 and 4 years old, were killed by three male lions in the central area of Etosha National Park, Namibia, all by strangulation illustrated by marks on the necks (Brain et al, 1998). On two occasions the lions fed on the dead rhino immediately after killing them. On one occasion the lions left the rhino uneaten. The three rhinos killed were of similar size and age having just left their mothers but were still relatively small. The attacks occurred near waterholes which other rhinos, particularly mothers and calves, frequent. That the lions took the sub-adults rather than the smaller calves suggested a substantial maternal deterrent effect.

Lions and leopards were responsible for the loss of two emaciated and diarrhoea-ridden calves, aged between four and seven months in Matusadona National Park, Zimbabwe (Matipano 2004). The mothers of the calves were also in poor body condition: one cow had diarrhoea and struggled to stand, and the other died five weeks after losing her calf.

A rhino calf was killed by lions in the Ngorongoro Crater, Tanzania in May 2000 and the mother died four months later (Maige 2001). This followed a translocation of two rhinos from the Addo Elephant Park in South Africa where there are no predators. Having calved, the mother had no knowledge of how to defend itself or the calf from lions.

In February 2002 at Lake Nakuru National Park, Kenya, a rhino calf was killed by a lion despite the mother putting up a considerable fight. This was

Female	Calf	Birth	Death	Age
Mama Ngina	Luck	11/07	04/08	5m
Classic	May	05/08	08/08	3m
Yasa	Ijumaa	07/08	01/09	5m
UID	UID	05/09	09/09	4m
Kolio	Gachembe	07/09	10/09	3m
Lamuria	Pati *	06/08	10/09	16m
* injured 02/09 at 8m, died of injury at 16m				
Classic age 37 yrs, died 2 months after death of calf May				

Table 1:
Black rhino deaths attributed to lions at Solio Game Reserve in 2008 and 2009. The average age of calves of under six months old killed was 4 months (n=5, range 3-5 months).

BENCHMARKS	2007 Before translocation		2007 After translocation (i)		2008		2009	
Growth rate per annum (1)	7.10%	Mod - good	12.10%	Good - excellent	7.5% *	Mod - good	10.0% *	Good - excellent
% cows with calves of that year (2)	23.30%	V poor - poor	40.90%	Good - excellent	27.8% **	V poor - poor	45.0% **	Good - excellent
ICI (3) (**estimated** months)	39.5m	Poor - mod	38.6m	Poor - mod	45.8m	V. poor	34.9m	Mod - good

Table 2: Key benchmarks of the development of the Solio black rhino population

(i) for details of the translocation see Patton et al (2008); the after translocation figures show an exceptional improvement due to the removal of non-breeding females to a new location to attempt to motivate breeding

(1) growth rate per annum is shown as birth rate less natural deaths (not including poached rhinos or those killed by predators

* the actual growth rate 2008, due to 3 deaths, is only 4.5% but 2 deaths were unnatural (lions) so have been excluded, births only growth rate is 9.0%; the actual growth rate 2009, due to 5 deaths, is only 3.0% but 5 deaths were unnatural (lions and poaching) so have been excluded. Births only growth rate is 10.0%

(2) cows with calves of that year include calves killed by predators

** the actual rate in 2009 including 2 deaths by lions was 35%

(3) ICI stands for intercalving interval; of the 7 calves born – two intervals are estimates and five are more accurately known

exemplified by savage wounds on the shoulder and breast of the rhino and scratch marks on the flanks. The mother, Suzie, was considerably distressed by the incident. Despite the wounds being treated, it died a few months later.

In July 2002 at Sweetwaters Game Reserve, Laikipia, four lion cubs were observed "fighting" with a rhino at around 7pm for one hour. There appeared to be no actual contact, with the lions charging but withdrawing at the

last minute. Further problems with lion predation were experienced at Sweetwaters Game Reserve when a pride of some nine lions was considered responsible for the death of an old female rhino in poor condition in March 2007.

Plotz and Linklater (2009) reported the death of an eight month old black rhino calf from injuries caused by lions in the Hluhluwe-iMfolozi Park, South Africa in August 2008. There were puncture and tear wounds on the neck of the calf, tissue trauma, severed tail and claw marks on the anogenital region. The calf's tail was amputated at around one third of its original length.

New Data

Following the introduction of a black rhino monitoring system, based on the photo-identification of individuals, at Solio Game Reserve in 2007, it was possible to subsequently analyse births and deaths (Patton et al 2007).

Lion censuses were carried out in 2008 and 2009 based on individual identification using muzzle spot patterns. Prior to this, it was believed that there were five to seven individuals. The census showed that births in 2007/8 had led to at least 14 individuals.

Table 1 shows the number of black rhino deaths attributed to lions at Solio Game Reserve in 2008 and 2009.

The key measure of population performance is the 'biological growth rate' defined as the natural increase in population size from births and mortalities as a percentage of the population size at the start of the year (Emslie and Brooks 1999) The strategy of the Kenya Wildlife Service is to manage all black rhinoceros populations in Kenya for rapid population growth while preventing overstocking and resultant sub-optimal population performance (Okita-Ouma et al 2007). The growth rate of a population as defined in the strategy is "the natural increase in a population size being the net result of additions from breeding and losses from natural mortalities expressed as a percentage of the population size at the start of the year.

Table 2 shows the development of the black rhino population at Solio between 2007 and 2009 and considers the effect of the predation of lions on population growth rates which remains one of the best indicators of population performance (Knight 2001). Benchmarks are those proposed by Du Toit (2001).

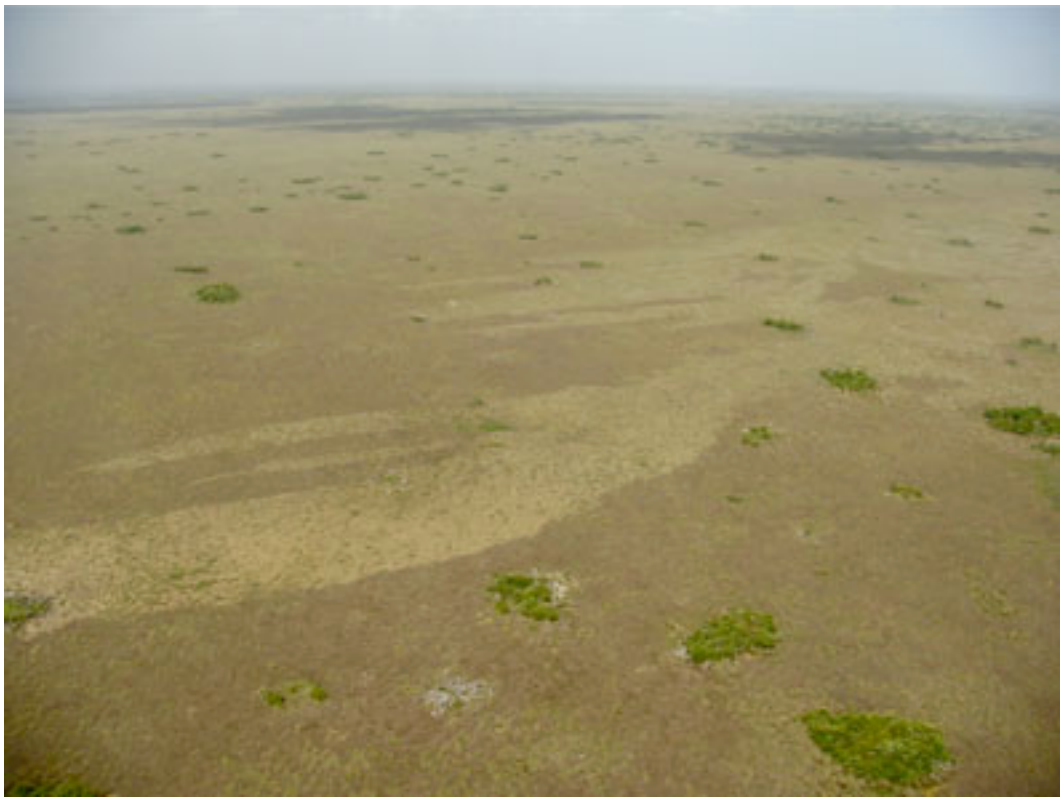
Discussion

Detecting lion predation

According to Plotz and Linklater (2009), predation on black rhinoceros juveniles might be under reported because both births and carcasses are rarely detected. New born calves are small and mothers tend to calve in dense bush remaining secretive until the calf has grown and strengthened at around 3 months. Mortality during this period is hard to detect and often, if a carcass is found, it has deteriorated to such an extent that the cause of death cannot be determined.

The carcass of Ijumaa was found mostly whole but only skin and bones remained. The unidentified calf carcass was around 50% whole with a long cut in the skin down the back which is considered typical of a lion attack. Some meat was missing from the rump and remains of the two rear legs were found nearby suggesting there had been more than one predator. The carcass of Gachembe was mostly whole with some of the meat of the rump having been eaten. This suggests that lion predation is mostly opportunistic and not due to hunger. The carcasses of Luck and May were not found which was probably due to scavengers, such as striped hyena and jackals, removing the remains. Scavenging of the small carcasses of rhino calves explains why lion predation may often go undetected.

In October 2009, the author ob-



served a female lion catch and kill a warthog about the same size as a three month old black rhino calf. The lioness eventually ate a small amount from the rump of the warthog but left the majority of the carcass untouched. On inspecting the carcass, there were no signs – such as scratches, tears or puncture marks - that the warthog had been killed by a lion apart from the bites in the rear. This outcome might also explain how lion predation might not be wholly obvious on rhino calf carcasses.

The injuries to Pati included the tail being bitten off at the base and some damage to the rear stomach which led to a swelling. No scratch marks were visible on either the calf or the mother suggesting there was no significant fight or defence from the predator. The absence of signs such as claw scratch marks or bite marks on bodies of the females, suggests that, in all cases, the calves had not been defended by their mothers. While black rhino mothers have killed lions in defence of their calves (Goddard 1967; Owen-Smith 1988, p126-127), maternal inexperience may result in failure to defend calves. In the case of Solio rhinos, there had not previously been an observed problem with what had historically been a low density of lions of less than seven individuals (E. Parfet, personal communication) suggesting that the females were ill prepared to defend their offspring when the density increased.

The 37+ years old female Classic was distressed after its calf was killed by lions. Its health deteriorated rapidly over four months and it drowned in a river without the strength to get out. This could be considered as indirect predation by lions.

The Effect on Population Performance

Poor population performance in black rhino populations has largely been attributed to density dependence (Plotz and Linklater 2009). It should be remembered that individual year figures for small populations (around 50 indi-

viduals) should be viewed with caution and three year rolling averages used. When considering the three benchmarks for 2007 before translocation (for further details see Patton et al 2008), 2008 and 2009, there is clear evidence of a general improvement following the removal of 26 poor breeding and other individuals and reducing the density of rhinos from 92 to 65. This represented a reduction in density, with Solio Game Reserve being 69 sq km, of 1.33/sq km to 0.94/sq km rising to 1.04/sq km in 2009.

Brain et al (1998) concluded that it might become increasingly important to consider the impact of large predators on breeding rhinoceros populations and that it would also be desirable to be familiar with both predator and prey and to make certain of the causes of each death in a rhinoceros so that the appropriate management actions can be made. The new data and analyses supports this conclusion.

The growth rate before predation was 2008 – 7.5% and 2009 – 10.0%. When predations is included the figures are dramatically reduced to 2008 – 4.5% and 2009 – 3.0%. The latter figures are those used officially and are significantly below the Kenya Wildlife Service target for private rhino reserves of 6.0%. If predation is taken into account, the effect of reducing the density of the rhinos is largely hidden and could even be interpreted as having had a negative effect.

The benchmarking description for the data would show the 'with-predation' growth rate in 2008 as 'poor to moderate' compared to the 'without-predation' growth rate of 'moderate to good'. Similarly, for 2009, the change is from 'poor to moderate' to 'good to excellent'. For the percentage of females with calves of that year, the benchmarking description changes from the with-predation 'moderate to good' to the without-predation 'good to excellent'. This further demonstrates that the population performance of the rhinos was better than the "official" record including predation, which cannot be attributed directly to the breeding success of the population.

An important implication of this analysis is that the sub-optimal growth rate recorded with predation included could lead managers to conclude that the Carrying Capacity of the reserve had been reached or exceeded thereby unnecessarily undertaking costly and stressful population reduction through translocating individuals to other sanctuaries.

Despite the high density of rhinos in 2009, the population growth rate before predation was in the top benchmarking category suggesting that the breeding performance of the Solio black rhino population was good even though the actual growth rate was not. It may therefore be appropriate to add breeding performance as a benchmark rather than simply using growth rate. Where any natural calf deaths occur due to disease, malnutrition and injury, these should be included in the growth rate calculation while unnatural deaths due to poaching should be considered as predation.

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