Reproductive management of the white rhino population (*Ceratotherium simum simum*) in Australasia – problems and potential solutions.

S Stephens[1, 2], E Cheadle[1]; V Smith[1]
Hamilton zoo, Brymer Rd, Hamilton[1] ASMP coordinator Southern white rhino[2]
email mojodog@orcon.net.nz (Samantha Stephens)

Abstract

The Australasian white rhino program is facing a housing crisis, as an apparent birth sex ratio bias towards males and a lack of regional space is resulting in surplus young bulls with nowhere to go. Several options are explored in an attempt to address this problem; dispersal to other regions, restricted breeding and the consequent potential health issues, bachelor groups, the effect of diet on birth sex ratios, selective abortion and euthanasia.

Introduction

In the late 1890's the world's population of Southern white rhino (*Ceratotherium simum simum*) was reduced to less than 20 animals. The species has since made a remarkable comeback, recognised today as one of the great conservation success stories (Emslie and Brooks 1999). The current wild population of Southern white rhino is now over 11,300 (IRF website), and the latest published International studbook list 747 Southern white rhino (Ochs 2006).

Currently the living Australasian population totals 41 animals (21.20.0) (S Stephens 2007, unpubl.) The two most recent imports of wild caught animals occurred in 1999, when 3.9.0 animals were imported to the region, and then in 2002 with 3.4.0 animals brought in. These new animals revitalised the population, and there have been 10.5.0 calves born since 1999 (7.5.0 surviving), although not all founders have bred. Unlike their predecessors, who were generally kept in pair situations and tended to develop sibling relationships, these new animals are kept in larger herds, often with more than one adult male on site to stimulate breeding.

We are now in a position where we have seven young bulls heading towards sexual maturity, and options for their future are seriously limited. In a small region such as ours, some of the challenges of species management can be magnified in a short time period. We have a limited number of institutions holding the species, and even smaller number planning to acquire. This means that when changing master plans or unforeseen financial constraints force zoos to modify or put back their exhibit plans, it has a big impact on the population. Alternate plans are difficult to put in place for specimens already on the ground, and the current global captive situation means that spaces outside the region are nearly impossible to find.

In an attempt to find some short term solutions, the ASMP program and other researchers are investigating the following areas.

Dispersal to other regions or back to the range state.

Much time and effort has been put into investigating this option. Repatriating animals to Africa, while an attractive thought, is probably unrealistic. The cost and resources required to relocate animals from Australasia would be prohibitive; private game concerns wanting rhino can source them far more cheaply and easily from within the continent and the addition of captive born animals to managed wild populations would at best be problematic and at worst detrimental to the wild populations (pers comm. R Emslie).

Species coordinators for the EAZA and AZA populations have stated they do not have the spaces available to take surplus males from our region (pers comm, K Tomasova and M Fouraker). The American population has a strong male birth sex ratio bias, and are aiming to provide more spaces to their Indian and Black rhino programs, there are surplus males requiring places in Europe as well.

Restricted / targeted breeding

In the current and upcoming rhino CMP, only female white rhino who have not yet bred will receive a breeding recommendation. This policy will hopefully be short term, as although space restrictions mean that any calves produced do not have a destination, the benefits of pregnancy, especially early pregnancy, as a 'buffer' to reproductive tract disease is too important to disregard (Hermes et al 2004). Recent research shows that restricted breeding of this species (as with many) can give rise to asymmetric reproductive aging which then leads to the female reproductive cycle shutting down (Hermes et al 2004). There is also concern that reduced behavioural opportunities for young animals to observe mating and rearing behaviour will have an effect on later reproduction. Also, despite our current regional 'overpopulation' problem, the global captive white rhino population breeds very poorly, for reasons not yet properly understood. Very few F1 (captive born first generation) females produce calves, despite exhibiting oestrus and mating behaviour (Swaisgood et al 2006). With continued restricted breeding and no resolution of the F1 reproduction problems, the Australasian population cannot be self sustaining in the long term.

It is also worth noting that many rhino managers feel there may be some sort of suppression mechanism occurring – some zoos have one cow, with a 'dominant' personality, breeding successfully and one or more other cows not cycling or exhibiting any breeding behaviour. This theory has yet to be substantiated by research, and some of these non-cycling animals have been seen to 'spontaneously' begin cycling.

Rather than the more usual one large paddock with limited off display holding, breeding institutions in Australasia are now encouraged to develop facilities focused around a cow herd paddock, with multiple satellite bull territories. This will allow for more targeted breeding – cows with breeding recommendations can be moved into the bull territories for mating opportunities rather than the bull housed with and potentially covering all females in the herd. Institutions should also plan to hold an equal sex ratio so as to better accommodate the male population. Most zoos are not currently set up in this way - a significant time lag will occur before all regional holders have this type of facility.

This method of taking specific females to the male is also more in line with the natural history of the species; in the wild adult males maintain territories in which they try to detain any oestrus females who move through (Estes 1991).

Bachelor Groups

Many polygynous species lend themselves to this form of male management. In a territorial species such as rhino, these groups can be more problematic and the potential for serious aggression need to be carefully managed.

The bachelor rhino grouping that seems most likely to succeed would consist of 2 or 3 subadult males bonded together at approx 3 or 4 years of age; or an adult male and one or two of his offspring. To have the greatest chance of success no female rhino should be housed in the vicinity – ideally there would be none in the zoo, but certainly not within scent or hearing distance.

In the wild, calves are pushed away from their dams when her next calf is born (at about 2 or 3 years of age) and will find another rhino to bond with – preferably a similar aged same sex calf (Estes 1991). There have been examples in South Africa of bonded adult males caught together, housed in the same boma together and moved as a pair (S Stephens pers. comm).

Territorial males are also known to tolerate juvenile males in their territory as long as they show submissive behaviour (Estes 1991).

There are limited examples of bachelor groups in captivity. The Jerusalem zoo has the remarkable instance of two unrelated bulls put together as adults, housed in a relatively small multi species paddock and with no serious aggression issues (Noam Werner, unpubl). Ramat Gan in Israel has a very large (100 acres) enclosure with a breeding bull and 4 of his male offspring in with their cow herd. The younger males generally keep their distance from the territorial male and females, but there are occasional challenges resulting in superficial injuries (pers comm. Amelia Terkel, curator).

In Australasia a 3 year old and a 5 year old male were bonded together at Tipperary Sanctuary and lived together for 13 years seemingly without problems, although once again in a very large enclosure. A year and a half after the pair were transferred to another facility one animal died of injuries – it was unclear if these were caused by the other bull or from a fall.

Hamilton and Auckland Zoo's are in the process of moving 3 related males (father and two sub-adult sons) out of Hamilton's breeding herd to be housed as a bachelor trio at Auckland Zoo. These three will be alternated on the display exhibit with a captive bred adult male.
Auckland's exhibit is typical of a city zoo in size, and presents more challenges than would be found with an open range zoo sized enclosure. The animals will be closely managed to avoid potential aggressive situations. Experience gained from this venture will provide valuable husbandry knowledge which will aid in creating and maintaining bachelor groups in the future.

Diet and birth sex ratio research
Ongoing research by Dr Wayne Linklater and Elizabeth Berkeley is investigating a link between excess circulating glucose (due either to stress or diet) and male biased birth sex ratios. High blood glucose levels may result in early death of female foetus' (Linklater 2006), resulting overall in more male calves on the ground. There is great potential for this research to make a positive difference in our ability to breed, and all regional holders are encouraged to participate in the upcoming dietary research conducted by Elizabeth Berkeley.

Selective abortion or euthanasia
These can be very emotive subjects, especially for such a charismatic species as rhino. But as responsible animal managers and conservationists these tools need to be considered for many of our managed breeding programs, in order to better maintain the reproductive and behavioural health of our populations.
Euthanasia is not an easy thing to perform, and requires consultation with many and varied stakeholders, especially in larger zoos. The option of selective abortion can be a more palatable option in some ways, and recent research into gender determination has the potential to assist managers in this area.
There are many considerations before using abortion as a management tool – maternal safety, the effect of an early termination on the long term reproductive health of the mother etc. To even begin to consider it, we first need a method of determining the sex of a foetus. Ultrasound is one option for this, a specialist equine ultrasonographer should be able to determine the sex of a rhino foetus. However there is a relatively small window of opportunity quite early in the pregnancy to do this, between days 64 and 75 (pers comm T Roth).
Rhinos can easily be conditioned to stand for transrectal ultrasound exams, but this does involve an investment of time, and specialist resources for the series of exams that would be required.
Interesting research by Monica Stoops is currently underway at Cincinnati zoo, using a blood sample from a pregnant rhino to determine the sex of her foetus. Although there is no transfer of actual blood between foetus and dam, there appears to enough transfer of material to allow Y chromosomes from a male foetus to be detected in the mother's blood. The absence of detectable Y chromosomes therefore suggests the calf is a female (pers comm M Stoops). Hamilton zoo has sent a serum sample from our currently pregnant cow (due to calve this month) to be included in this study. This research is ongoing and has yet to be validated, but has great potential to assist with captive breeding management.

References

Emslie R, Brooks M. 1999 Status survey and conservation action plan: African rhino. IUCN Switzerland.

Estes RD 1991 The behaviour guide to African mammals. University of California Press, Berkeley and Los Angeles.

Foose TJ, Wiese FJ, 2006. Population management of rhinoceros in captivity. Int Zoo Yb 40; 174 - 196

Fouraker M, Wagener T. 1996. AZA rhinoceros husbandry resource manual. Fort Worth Zoological Park, Texas. 8-11.

Hermes R, Hildebrandt TB, Göritz F. 2004. Reproductive problems directly attributable to long term captivity – asymmetric reproductive ageing. Anim Reprod Sci 82-83:49-60.

Hermes R, Hildebrandt TB, Walzer C, Göritz F, Patton ML, Silinski S, Anderson MJ, Reid CE, Wibbelt G, Tomasova, Schwarzenberger F. 2006. The effect of long non-reproductive periods on the genital health in captive female white rhinoceroses (*Ceratotherium simum simum*, *C. s. cottoni*). Theriogenology 65:1492-1515.

Linklater WL, 2006. Does excess circulating glucose in pregnant females drive male-biased birth sex ratios? – beginning a study of the world herd funded by the IRF. Proceedings of the 2006 ARAZPA conference.

Ochs, Andreas 2005. International studbook for the African white rhinoceros, Vol 10 Zoologischer Garten Berlin AG

Swaisgood RR, Dickman DM, White AM, 2006 A captive population in crisis; testing hypotheses for reproductive failure in captive-born southern white rhinoceros females. Biological Conservation 129; 468 – 476