Immunocontraception: An effective population control in African Elephant

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African Elephant *Loxodonta africana* populations are growing rapidly in southern Africa, to the extent that population control has become essential[1]. Culling excess animals is proposed by managers but is no longer deemed publicly or ethically acceptable[1,2,3]. However, preliminary trials demonstrated that immunocontraception of elephants with porcine zona pellucida (pZP) glycoproteins and an adjuvant is safe, effective, reversible, remotely deliverable, and has no adverse side effects [2,4,5]. We demonstrate complete contraception of a discrete small population of free-roaming elephants at the Greater Makalali Private Game Reserve (GMPGR), Limpopo Province, South Africa. Scaling up to large populations is simply a matter of resource allocation, making contraception a viable population management tool, and an alternative to long-term culling strategies.

Elephant herds, comprising intact family groups with established matriarchs were introduced to the GMPGR from the Kruger National Park in 1994 (13 animals) and in 1996 (24 animals) respectively and 5 adult males have entered the population through break-ins. The animals are habituated, easily accessible and we have exact identifications and relationships for all individuals[4]. In Jan 2004, the population of 66 comprised 28 females aged ≥ 8yrs in four herds (8 – 22 animals) and 11 independent adult males. As births have been recorded in females as young as 9-10yrs, the breeding population has been reclassified as females ≥ 8yrs.

By July 2003, 23 cows had been vaccinated, with the remaining 5 breeding cows unvaccinated in order that they may conceive and produce their first calves.

In May 2000, all the adult females aged > 12 yrs (18 animals) were vaccinated with 600 µg of pZP + 0.5 ml of Freund's Modified Adjuvant [Sigma Chemical Co., St Louis, MO (FMA)][4]. Target animals were identified and darted remotely from foot or the vehicle using drop-out darts (Dan Inject® International, Denmark) with smooth, barbless needles[4]. Darts were recovered in 79% of cases, and where an incomplete vaccine delivery was recorded, the animal was revaccinated[4]. As the vaccination of pregnant elephants with pZP has no effect on gestation, the fetus, or parturition[2,3,4,5], pregnancy status was not a criteria for selection. Following reference 2, the 18 target animals received an initial dose, and two booster vaccinations of the same antigen emulsified in Freund's Incomplete Adjuvant (FIA) each two to three weeks apart[4]. The second booster (June/July 2000) is considered to be the vaccinational birthday of the herds. Treated animals.

In June 2001, the 18 target animals received their first annual booster vaccination (600 µg of pZP + 0.5 ml FIA), and two additional cows were added to the vaccination program under the regime described above[4]. In June/July 2002, all 20 of the target animals received their first or second annual booster (600 µg of pZP + 0.5 ml FIA) respectively, and an additional 3 cows were vaccinated according to the above regime. In 2003, 17 of the 3rd annual vaccinations were administered from a helicopter using Pneu-Darts®, and 6 animals were

vaccinated from the ground or on foot. Four of these individuals were anaesthetized and checked for pregnancy using rectal ultrasonography, and were sampled for Progesterone.

Elephants have an extremely long gestation period (22 months). As the vaccine has no effect on gestation, pregnant animals will carry to full term, the unborn fetus remaining unharmed[4] (Table 2). By the second year of the project (2002), 17 calves were born to 23 vaccinated cows. Based on the vaccinational birthdays of these cows and the known birth dates of their calves, it was concluded that 14 of these target animals were pregnant **prior to contraception**. The remaining 3 target animals were vaccinated for the first time only after they had given birth to their first calves.

In 2003, the third year of the project, 0 births were recorded. None of the four anaesthetized females had conceived (0/4), but 2 were cycling or had recently cycled as evidenced by the presence of follicles or their respective progesterone readings (0.41 - 3.24ng/ml, n=4). Since the program's inception, six additional cows have not calved, so full reproductive control has been achieved in at least 10 animals. However, based on the absence of any births since August 2002, it is evident that full reproductive control has been achieved within all the targeted females (Table 2). The absence of births in 2003 indicates that full reproductive control was achieved in the 3rd year because target animals that were pregnant prior to contraception would have calved and subsequently been contracepted by their annual boosters.

An average inter-calving interval of 56 months was observed on the reserve prior to the program's inception in 2000. The detailed population history[4] allows for the predicted rate of increase (excluding mortalities and introductions) to be determined for the population based on an individual elephant basis. The predicted population size totals 108 animals by 2010 (Table 1). However, the observed rate of increase for the effective population declines significantly from 2003 onwards (Table 1) i.e. the period when full reproductive control is achieved. The effect of the contraception on the population's growth is the difference between the predicted and observed rates of increase. The contraceptive effect over the next 7 years is an average 5.3% decline in population growth, assuming all the original target animals remain on the program and there are no further introductions or mortalities. This estimation includes the addition of 8 calves from the current prepubertal cows that will be contracepted only after they have conceived and given birth to their first calves. The average population growth rate (excluding introductions and mortalities) for 1996-2002 (the period up to which the contraceptive had no effect) was 8.9%. Thus, the contraceptive will effectively reduce the population growth rate by 60% for the period 2003 through 2010.

In the past, managers have been limited to traditional population control methods of culling and translocation[4,6]. Culling maintains the population at the highest potential growth, and the operation's disturbance and longer-term effects of loss of bond group or family members are unknown[1]. In addition the acceptability to the world community of culling as a long-term strategy without exploring alternatives is uncertain. A feasible alternative to managing populations is urgently needed.

In the short term, culling is the only option that will solve the problems of immediate overabundance in populations as contraception will not reduce population size[1,7]. pZP immunocontraception has been demonstrated to be safe, reversible, ethical and humanely acceptable. Most importantly, through responsible management, it can successfully control and manipulate population numbers in the future. Immunocontraception is a tool that can be molded to conform to unique management objectives, simultaneously stabilizing or reducing population growth. Because it is safe to dart pregnant females, contraception can be implemented by mass-darting of unknown groups from the air. Contraception in larger populations is simply a matter of scaling up the effort expended at Makalali, and is thus a matter of resource allocation rather than any technical constraint. Managers of larger reserves now need to assess contraception as a realistic alternative management tool, particularly as part of a longer-term management strategy.

References

1. Whyte IJ, van Aarde R and Primm SL.. Managing the elephants of Kruger National Park. *Animal Conservation* 1 77-83 (1998)

2. Fayrer-Hosken, RA, Grobler D, Van Altena JJ, Bertschinger HJ & Kirkpatrick JF. Immunocontraception of African elephants. *Nature* **407**, 149. (2000)

3. Fayrer-Hosken RA, Bertschinger HJ, Kirkpatrick JF, Grobler D, Lamberski N, Honeymann G & Ulrich

T. Contraceptive potential of the porcine zona pellucida vaccine in the African elephant (Loxodonta africana). *Theriogenology* **52**, 835-846 (1999).

4. Delsink AK, van Altena JJ, Kirkpatrick JF, Grobler D. and Fayrer-Hosken RA. Field applications of Immunocontraception in African Elephants *(Loxodonta africana). Reproduction.* **60** 117-124 (2002).

5. Fayrer-Hosken RA, Bertschinger HJ, Kirkpatrick JF, Turner J W & Liu IKM. Management of African elephant populations by Immunocontraception. *Wildlife Soc. Bulletin* 25, 18-21 (1997).

6. Whyte IJ, Biggs HC, Gaylard A and Braack LEO. A new policy for the management of the Kruger National Park's elephant population. *Koedoe*. 42(1): 111-133 (1999)

7. Whyte IJ. The feasibility of current options for the management of wild elephant populations. In: The proceedings on Control of Wild elephant populations. Faculty of Veterinary Medicine, Utrecht University, The Netherlands. (2003)

Table 1: The effect of contraception on the GMPGR Elephant Population, with a predicted effect through 2010 when the full effects of the programme will be evident.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total population size (Januaru...	45	47	53	62	66	66	66	68	70	71	71	72
Calves born during the	2	5	8	4	0	2	2	2	1	0	1	0
New Introduc...	0	3	2	0	0	0	0	0	0	0	0	0
Mortalitv	0	2	1	0	0	0	0	0	0	0	0	0
Effective population siz	45	47	52	60	64	64	66	68	70	71	71	72

	45	47	51	60	66	70	72	81	90	96	99	108
Predicted population numbers based on ICI of 4.7 yrs with												
Predicted rate c of increase based on ICI of 4.7 yrs wit hou.	45	1.04	1.09	1.18	1.10	1.06	1.03	1.13	1.11	1.07	1.03	1.09

Observed rate of Increase (excluding new introductions an	1.04	1.11	1.15	1.07	1.00	1.03	1.03	1.03	1.01	1.00	1.01
% Effect of contrace	0	-2.13	2.262	3.333	6.061	-0.27	9.47	8.17	5.238	3.125	7.682

[a] Total population size for 2004 through 2010 includes 8 births to uncontraceived prepubertal cows that will be allowed to produce their first calves. Age of first calving is based on that observed on the reserve prior to

contraception)

[b] Effective population size excludes five adult males that broke into the reserve (3 in 2000 and 2 in 2001), and three calf mortalities (2 in 2000 and 1 in 2001) as these should be excluded when considering the effect of the contraception programme.

[c] Predicted rate is that expected if contraception had not taken place, and assumes no mortality and an inter-calving interval of 56 months (average of that observed on the reserve prior to contraception).

[d] Figure excludes mortalities.

Table 2: GMPGR Calving history

Cow	Vaccinational birthday	Calf born	Calving interval after vaccination (months)	Stage of pregnancy when first vaccinated (months)
Kwatile^	Jul-00	n/a	n/a	0
Yvonne^	Jul-00	n/a	n/a	0
Plain Jane^	Jul-00	n/a	n/a	0
Queeny^	Jul-00	n/a	n/a	0
Tiny^	Jul-00	n/a	n/a	0
Pokerhontas^	Jul-00	n/a	n/a	0
Anna	Jul-00	Sep-00	2	20
Stripper	Jul-00	Sep-00	2	20
Dracula	Jul-00	Oct-00	3	19
Holey Ear	Jul-00	Aug-00	1	21
Smelly	Jul-00	Dec-00	5	17
U-Boat	Jul-00	Feb-01	7	15
Waves	Jul-00	Mar-01	8	14
Markina	Jul-00	Sep-01	14	8
Cheeky	Jul-01	Oct-01	3	19
Knop-kop	Jul-00	Oct-01	15	7
#2	Jul-00	Nov-01	16	6
Connie*	Aug-02	Dec-01	-8	0
Toni	Jul-00	Dec-01	17	5
Friendly	Jul-00	Apr-02	21	1
Cindy*	Aug-02	Jun-02	-2	0
Madame M	Jul-01	Aug-02	13	9
Enigma*	Aug-02	Aug-02	0	0

*3 cows vaccinated after parturition

| ^6 cows have not conceived nor calved since program's inception | |