Impacts of Trophy Hunting on Lions in East and Southern Africa: Recent offtake and future recommendations

BACKGROUND PAPER FOR THE EASTERN AND SOUTHERN AFRICAN LION CONSERVATION WORKSHOP, JOHANNESBURG, SOUTH AFRICA, 11-13 JANUARY 2006

Craig Packer, Karyl Whitman (Dept. Ecology, Evolution and Behavior, University of Minnesota), Andrew Loveridge (Dept of Zoology, Oxford University), John Jackson III (Conservation Force), Paul Funston (Tshwane University of Technology, Pretoria)

Background

The 2004 proposal to CITES to upgrade the conservation status of the African lion was partly motivated by concerns over potential impacts of trophy hunting. The recent surveys by Chardonnet (2002) and by Bauer & van der Merwe (2004) both suggested that lion numbers were lower than had generally been recognized, raising the possibility that any commercial offtake might be detrimental to remaining populations. Lion populations are particularly vulnerable to excessive male offtake owing to the potential impact of social disruption and infanticide following the removal of a breeding male (Bertram 1975, Packer & Pusey 1984, Pusey & Packer 1994, Packer 2001). However, Whitman et al. (2004) published the results from a detailed simulation model demonstrating that the impact of infanticide could be largely avoided by restricting trophy hunting to males that are at least 6 yrs of age.

The surveys of Chardonnet and Bauer/van der Merwe provide an opportunity to evaluate the harvest rates of lions in each of the range states of eastern and southern Africa. In this article, we present preliminary estimates of the magnitude of hunting offtake that suggest quota sizes have probably been too small in almost every country to contribute to any decline in lion numbers in the past 20-30 yrs, and we provide detailed analyses of the one exceptional country, Zimbabwe. We also summarize the rationale for replacing the current quota system with age restrictions on trophy lions and provide several criteria for estimating lion age in the field. We show how an age-based hunting system would minimize any detrimental impacts from trophy hunting while conserving vast areas of lion habitat that might otherwise be converted to agriculture or rangeland.

Impacts of lion trophy hunting: 1977-2004

We were unable to obtain comprehensive information on lion quotas and harvests for this paper, thus we can only report on the export data. Lion trophy exports for 12 countries in eastern and southern Africa are presented in Table 1, along with the lion population estimates for each country. Figure 1 shows the proportion of the estimated population that was shot by hunters each year since 1977; these data are plotted separately according to the population estimates of Chardonnet (Fig. 1a) and of Bauer and van der Merwe (Fig. 1b). Regardless of the population estimate, it is clear that most countries harvest only a small proportion of their lions each year (<2% per year by Chardonnet's estimates; <4% by Bauer & van der Merwe's estimates). However, Zimbabwe apparently harvested a far higher proportion of lions from 1988 to 2004 than any other country, and its offtake rate has been 2-3 times higher than most other countries from 1998-2004. Offtake in South Africa also appears to be quite high in the past few years, but these numbers have largely been inflated by "captive-bred hunting" in privately owned game ranches (whose lions were not included in the countrywide population total). Some of these trophies may also have originated in other African countries and then sent to South Africa for taxidermy whereupon they were re-exported. Finally, the number of lions hunted in Zambia fluctuated widely in the past 17 yrs and may have occasionally reached 8-9% of the population per year.

Note that our estimates are made to indicate a rough order of magnitude of lion hunting offtakes on a national basis, and have several shortcomings. First, we have not attempted to correct for any long-term trend in lion numbers over the past 30 yrs. If lion populations have significantly declined over this time span, our estimates of proportional offtake would be too high in the earliest years for each respective country. Second, the population estimates include all of the lions in each country, including lions that enjoy complete protection from humans inside the National Parks. Thus the proportional offtake of local populations in hunting areas is far higher than indicated by Figure 1. Third, we have used the annual national CITES export data only for the category "Trophy"; exports of "Skins" and "Skulls" are also reported (Chardonnet 2002), but not included here. Actual offtakes may have been higher on a national basis than the Trophy category alone indicates due to non-standardized reporting.

In the past five years, Zambia (2002), Botswana (2001-4) and Zimbabwe (2005-6) all imposed temporary bans on lion hunting in response to international concerns over lion conservation. In the case of Botswana, the trophy hunting ban was part of an overall moratorium that included an attempted ban on problem animal control. Zimbabwe's hunting ban resulted from widespread recognition of their excessively high quotas.

A case study of lion trophy hunting in western Zimbabwe

Analysis of long-term (1974-2004) hunting records from Matetsi Safari Area in northwestern Zimbabwe and from a study based in Hwange National Park (1999-2005) provide details of the extent and consequences of Zimbabwe's high off-take. Quotas for lion hunts on state-controlled land in Zimbabwe exceeded 140 per year in the early 1990s, but were reduced to around 120 by the late 1990s. The majority (40%) of the lion quota was from northwestern Matebeleland, and it was suggested that these quotas should be reviewed (Grobbelaar and Masulani 2003). About 65% of Zimbabwean lion trophies recorded in the Safari Club International trophy book were from western Zimbabwe (Matetsi Safari Area, the safari concessions around Hwange National Park and forestry land), 19% from the Zambezi valley and the remainder from either the Zambezi escarpment or South East lowveld (Safari Club International 2005).

Quotas were substantially reduced in the Zambezi Valley hunting concessions in the 1994/5 season due to over-hunting and poor quality of trophies in previous years (Grobbelaar & Masulani 2003). Reduced quotas resulted in reduction in the 'catch effort' in subsequent years and improvements in trophy quality. Similarly harvests of male lions in the Matetsi Safari Area (MSA) reached a peak in 1990 at 11 males/1000km^2 (Figure 2). This harvest is exceptionally high when compared to off-takes in other hunting areas e.g. Selous Game Reserve, Tanzania had off-takes of 1.25/1000km^2 (Creel and Creel 1997). In addition, MSA introduced a hunting quota for females in 1990 (previously females had only been shot as problem animals), so females contribute to the high number of trophies exported from the country in the 1990s.

Van der Meulen (1976) estimated that the Matetsi population contained 175 adults and 73 subadults in 1974. No systematic survey has subsequently been undertaken, but 7-26 males (mean 16.5) were taken off the population each year from 1974 to 2004 and 4-12 (mean 8.3) females were harvested annually from1990-2004. Widely fluctuating harvests during the 1970s and early 1980s reflect poor security and low levels of hunting tourism in the country during the independence war. Harvests of males stabilized after independence at around 8.3/1000km^2. Male lion quotas remained relatively stable at around 10 lions/1000km^2 until 1992 but declining hunting success over a 4 year period in the early 1990's necessitated reducing the male quota by 40% in 1997. Reduced hunting success (around 5.6/1000km^2) after 1992 appears to have coincided closely with the introduction of a female quota in 1990 and yearly harvest of females at around 3.3/1000km^2 (Loveridge et al. unpublished data).

'Fixed' versus 'optional' quotas

The quota system in MSA works on the basis of 'fixed' and 'optional' quotas. Trophy fees for 'fixed' quotas are paid regardless of whether the animal is trophy hunted or not, while trophy fees for 'optional' quotas are only collected if the animal is shot. Until 1999 all male trophies were on 'fixed' quota, but thereafter a proportion was placed on an 'optional' quota. Females were always given on 'optional' quota. The system of 'fixed' quotas does not provide any incentive for hunting operators to reject lions that are too young, and this has resulted in poor trophy quality from the hunting area for much of the 1990s. Placing all lions on an 'optional' quota and ensuring that only lions above a threshold age are hunted would improve both trophy quality and ensure a sustainable harvest (see below). Furthermore, it appears that shooting females from the population has a deleterious impact on the number of mature males that could be harvested, presumably because of reductions in the overall population size and breeding success. Females should not be harvested if managers aim to sustain a harvest of high quality, high value trophy males.

Revenue from lion hunts

The overall revenue earned from trophy hunting lions in MSA was reduced by hunting females. Because male trophies are considerably more valuable than female trophies, the revenue derived from hunting females does not appear to have compensated for the revenue lost because of the subsequent reduced male harvests and quotas. If male quotas had remained at the mean of 26 males per year (1974-1996) instead of dropping to a mean of 15 per year (1997-2004) and even if females had not been hunted (and therefore derived no revenue) trophy fees would have earned around US$97,990 more than was actually attained from 1997-2004 (Loveridge et al. in prep).

Impact of trophy hunting around Hwange National Park

A recent study on the impact of trophy hunting on the lion population in the 14,900km^2 Hwange National Park revealed that hunting quotas were unrealistically high in the concessions surrounding the park (Figure 3). Between 2000 and 2003 more lions were on quota around Hwange than were on quota in the whole of Botswana prior to that coun-

try's lion hunting ban in 2000, with quotas in the Gwaai Valley Conservancy exceeding 30 lions/1000 km^2 in some years between 2000 and 2003. Hunting of lions (particularly males) in adjacent hunting concessions had a substantial impact on the park population: >70% of radio-tagged Hwange males were shot in the surrounding areas. Furthermore, 30% of all the males shot were between the ages of 3 - 4 years and therefore classed as sub-adult. The Parks and Wildlife Authority have responded to these findings by reducing quotas in 2004 and temporarily suspending hunting for the 2005 and 2006 hunting seasons (Figure 3). Intensive monitoring of the Hwange population reveals a rapid recovery from over-hunting. For example, there were 9-10 adult males in 7 coalitions in the study site in 2003 and 2004. But after a year of suspended trophy hunting, there were 17 adult males in 11 coalitions by the end of 2005,

Age-based hunting strategies

Using highly detailed individual-based stochastic simulation models, Whitman, et al. (2004) showed that trophy hunting is likely to have minimal impacts on lion populations if offtake is restricted to males that are at least 6 yrs of age (Figure 4). This result can be seen intuitively as follows: male lions cannot successfully gain residence in a pride until they are about 4 yrs old, and their cubs are vulnerable to infanticide until their second birthday. By waiting until he is 6 yrs old, hunters will allow the male to conclude a complete breeding cycle; if he is shot at a younger age, his dependent offspring are likely to die with him. Male lions can reach 15 yrs of age in northern Tanzania, so a 6 yr old male is in prime physical condition. If most males are removed at this age, the younger males in the population can replace the harvested males and remain resident long enough to breed successfully.

Any sexually reproducing population will suffer from excessive removal of breeding-aged males simply due to a lack of mating partners for the females (Fig. 4a), but the lions' social system and associated infanticide greatly increases the population risks from over-harvesting (Fig. 4b). Importantly, there is no fundamental conflict between long-term conservation goals and economic returns from restricting offtake to older males: after thirty years, hunters can expect to maximize their harvest by only shooting males that are 5-6 yrs old (Figs. 4c&d).

Whitman, et al. (in press) also tested for the importance of environmental stochasticity by comparing a 'recovering' population with a population that was at the carrying capacity at the onset of a specific hunting policy. A 'recovering' population began with only half the territories occupied in the initial standardized population. Harvesting 6 yr old males did not hamper the overall recovery of a disturbed population.

The most important lesson from these simulations is that there is no risk of over-harvesting a lion population when hunting is restricted to males that are at least 6 yrs of age – regardless of the quota. The advantages of this harvesting strategy cannot be overstated: lions are inherently difficult (and expensive) to census, and lion numbers may vary dramatically in the same area from one year to the next (Kissui &Packer 2004; Packer, et al. 2005). Thus any policy that encourages hunters to fill a quota can risk overexploitation. The 6-yr minimum, on the other hand, runs no associated population-level risks regardless of population size.

Note, however, that these simulations are all based on "male only" hunting strategies. Removing females is inherently harmful to a population, especially since the successful reproduction of a female lion depends on the size of her pride: large prides out-compete smaller prides and per capita reproduction is lowest in prides of only 1-2 females (Packer et al. 2001).

Finally, the 6-yr rule was derived using demographic data from Tanzania, but male lions require an extra 1-2 years to become effective competitors in South Africa (Funston et al. 2003), implying that a 7-yr minimum would be prudent in some areas. On the other hand, where hunting concessions can distinguish between residents and non-residents, the impact of infanticide could be reduced compared to unhunted populations by selectively removing non-resident males (Whitman et al. 2004). Further simulation models are required to determine the optimal long-term offtake strategies in both of these cases – and empirical data should be collected from representative populations that are subject to trophy hunting to confirm the validity of these models.

Estimating the age of male lions in wild populations

Whitman et al. (2004) showed that the lions' noses become increasingly pigmented with age (Fig. 5), and Whitman et al. (in press) showed that the "6-yr rule" could be achieved by restricting hunting to males with noses that are at least 60% black (Fig. 6). Although the tip of the nose may not be the easiest metric to evaluate in the field, it is a far more reliable indicator of age than the lion's mane (Figs. 7 & 8). Male lions show far greater variation in mane darkness, hair length or extent of mane at a given age (Fig. 7) than in nose coloration (Fig. 5d). Further criteria are currently in development that will hopefully be easier to measure in field conditions, such as cowlicks at the edge of the mane or overall coat condition on the face (Fig. 8).

After the lion has been shot, it will be important to verify its age. Three techniques are currently in development. First, the pulp cavities of lions' teeth gradually fill in with age, and these gaps can easily be measured from dental x-rays. Preliminary analysis by Cheater (2005) suggests that the pulp cavity of the second premolar does not solid-

ify until 6 yrs of age. Second, Cheater (2005) found that lion teeth have regular cementum layers, at least in southern Africa. Third, Spalding et al. (2005) have shown that carbon-14 tests can be used to determine birth dates to the nearest year for any animal born after 1960 due to a pulse of ^{14}C from above-ground nuclear tests in the 1950s. All three of these techniques are currently being validated with teeth of known-aged lions from the Serengeti. Results should be available by the summer of 2006.

Recommendations

Zimbabwe, Zambia and South Africa have all permitted the offtake of female lions on their quotas. No records were kept on the sex ratio of lion trophies in most cases, so it is impossible to evaluate the potential impact of this practice, but lion hunting has traditionally been restricted to males and the inclusion of females only occurred recently. It would be especially worrying if the inclusion of females was motivated by an inability to fill quotas on males.

1. Zimbabwe should lower their hunting quotas to levels comparable to other countries when lion trophy hunting is resumed in 2007. All lions should be placed on an 'optional' quota
2. Range states should permanently cease all trophy hunting of female and subadult lions. The need for removing problem lions is undisputed, but several countries (Zambia, Namibia, South Africa and Zimbabwe) allow these lions to be hunted as trophy animals. This practice runs the risk of rendering all quotas meaningless, and it also puts local people at risk of further harm. Selling "problem-animal hunts" may also provide a perverse incentive for poor animal husbandry that is ultimately detrimental to lion conservation.
3. Hunting associations in Tanzania and Botswana have already endorsed the 6-yr age-minimum for lion hunting on their concessions. Similar protocols should be adopted in all other range states in eastern and southern Africa.
4. Photographs of the nose, face and mane of all trophies should be taken and at least one second premolar tooth should be extracted to permit evaluation of and improvements in age-estimation techniques.
5. Detailed demographic data should be collected on at least 1-2 representative populations that are subject to trophy hunting to validate the predictions of the simulation models. More extensive simulation modeling should also be undertaken to estimate the impact of trophy hunting in areas where males may not become effective competitors until 5-6 yrs of age and where resident males can be reliably distinguished from non-residents.
6. Range states where lions are trophy hunted should maintain and publish data on lion quotas and trophies, including sex and origin of harvested animals.
7. We strongly endorse South Africa's Panel of Experts recommendation that "in general, the practice of hunting captive-bred animals should be disallowed" (Anonymous 2005). Captive-bred hunting undermines the conservation credibility of the hunting industry and does nothing to preserve lion habitat.

Despite these deficiencies, the level of lion trophy hunting has been prudent in most countries over the past 30yrs, tourist hunting provides an important incentive to conserve wildlife habitat in 8 of the 12 countries in Fig. 1, and the total amount of land set aside for hunting exceeds the total area of the national parks (Table 2), potentially doubling the amount of land available for wild lions. The hunting industry should be encouraged to take the lead in lion conservation, especially since hunting areas often serve as buffer zones around national parks, and hunting companies should be actively recruited as essential partners in reducing human-lion conflict and preventing habitat loss.

References

Anonymous 2005. Panel of Experts on Professional and Recreational Hunting in South Africa. Final draft report to the Minister of Environmental Affairs and Tourism, Oct. 25

Bauer, H. & S. Van Der Merwe (2004). Inventory of free-ranging lions *Panthera leo* in Africa. *Oryx* 38, 26-31.

Bertram, B.C.R. (1975), Social factors influencing reproduction in wild lions. *Journal of Zoology* 177, 463-482.

Chardonnet, P. (2002). *Conservation* of *the African lion: Contribution to a status survey.* International Foundation for the Conservation of Wildlife, France, and Conservation Force, USA.

Cheater, A. (2005). Master's thesis, Tshwane University of Technology, Pretoria.

Creel, S. & N.M. Creel (1997). Lion density and population structure in the Selous Game Reserve: evaluation of hunting quotas and offtake. African Journal of Ecology 35: 83-93.

Funston, P.J., M.G.L. Mills, P.R.K. Richardson, & A.S. van Jaarsveld (2003). Reduced dispersal and opportunistic territory acquisition in male lions (*Panthera leo*). *J. Zool., Lond*. 259, 1-12.

Grobbelaar, C. & R. Masulani (2003). *Review of offtake quotas, trophy quality and 'catch effort' across the four main wildlife species elephant, buffalo, lion and leopard*. WWF SARPO.

Kissui, B.M. & C. Packer (2004). Top-down regulation of a top predator: lions in the Ngorongoro Crater. *Proc. Roy. Soc. Series B* 271, 1867-1874.

Loveridge, A.J., G. Moyo, F. Murindagomo & D.W. Macdonald (in prep). Impact of trophy hunting on lions in Matetsi Safari Area, Zimbabwe.

Packer, C. (2001). Infanticide is no fallacy. *American Anthropologist* 102, 829-857.

Packer, C. & A.E. Pusey (1984). Infanticide in carnivores. *In* Infanticide: Comparative and evolutionary perspectives, G. Hausfater and S.B. Hrdy, eds. Pp. 31-42 (New York, Aldine)

Packer, C., A.E. Pusey & L. Eberly (2001). Egalitarianism in female African lions. *Science* 293, 690-693.

Packer, C., R. Hilborn, A. Mosser, B. Kissui, J. Wilmshurst, M. Borner, G. Hopcraft & A.R.E. Sinclair (2005). Ecological change, group territoriality and non-linear population dynamics in Serengeti lions. *Science* 307, 390-393.

Pusey, A.E. & C. Packer (1994). Infanticide in lions. *In* Protection and abuse of young in animals and man. S. Parmigiani, B. Svare & F. vom Saal, eds. London, Harwood.

Roulet, P.A. (2004). *« Chasseur Blanc, Coeur Noir? » La chasse sportive en Afrique centrale. Une analyse de son rôle dans la conservation de la faune sauvage et le développement rural au travers des programmes de gestion de la chasse communautaire*. Thèse de Doctorat de Géographie, Laboratoire Ermes IRD / Université d'Orléans, 563 p.

Safari Club International (2005). *SCI Record Book of Trophy Animals: Africa Field Edition*. (XI edn). Tucson, Arizona: Safari Club International.

Spalding, K.L., B.A. Buchholz, L.-E. Bergman, H. Druid & J. Frisén (2005). Age written in teeth by nuclear tests. *Nature* 437, 333-334.

van der Meulen, J. H. (1976). *Aspects of the lion (Panthera leo L.) population of the Matetsi Game Area*. Certificate in Field Biology. University of Rhodesia. Salisbury, Rhodesia. 113pp.

West, P.M. & C. Packer (2003). Sexual selection, temperature and the lion's mane. *Science* 297, 1339-1343.

Whitman, K., A. Starfield, H. Quadling & C. Packer (2004). Sustainable trophy hunting in African lions. *Nature* 428, 175-178.

Whitman, K., A. Starfield, H. Quadling & C. Packer (in press). Integrating long-term data and simulation models for sustainable harvest of the African lion. *Conservation Biology.*

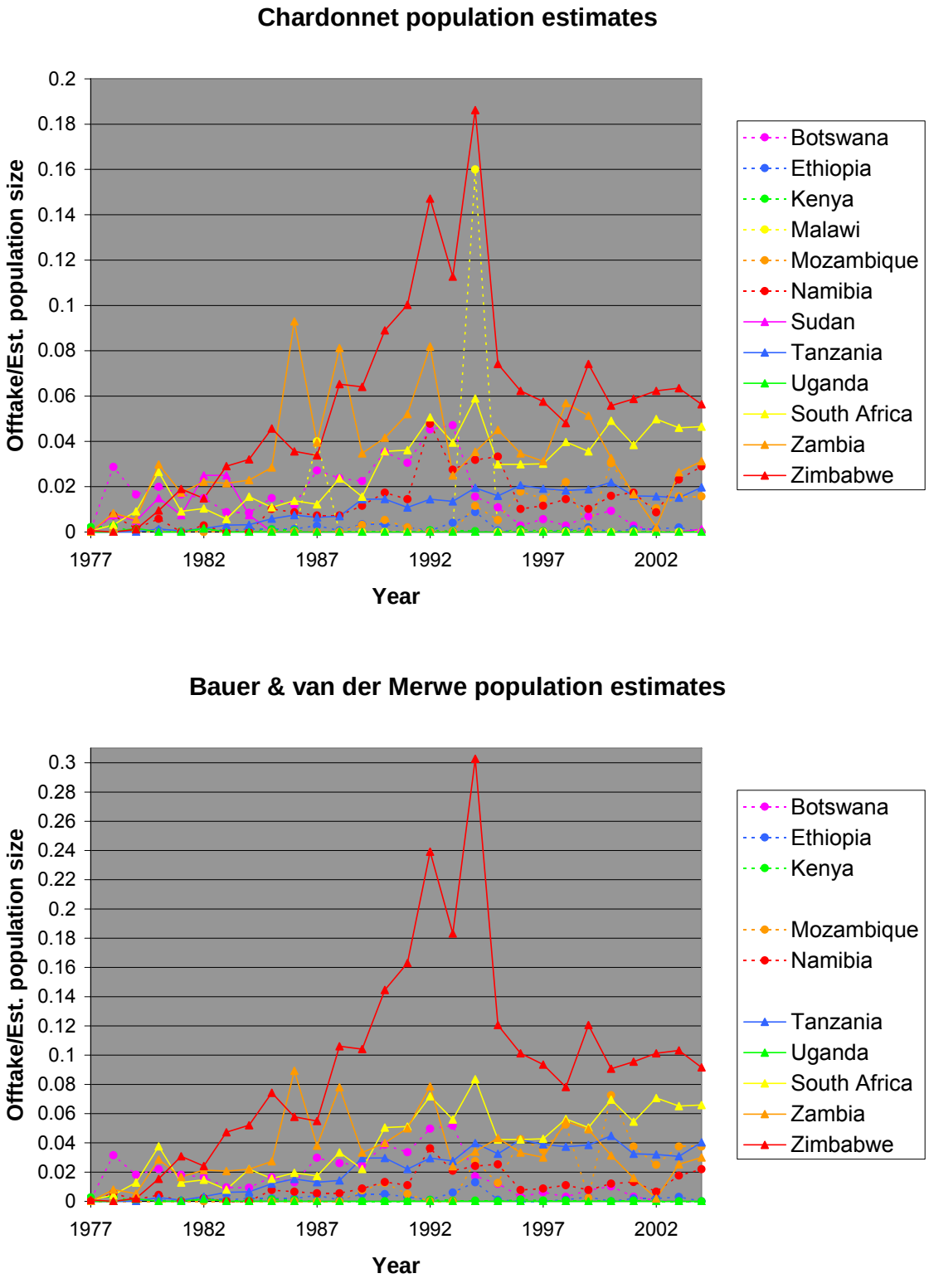


Figure 1. Estimated proportion of the lion population in each country removed annually by trophy hunting. Top graph uses population estimates from Chardonnet and the bottom graph is from Bauer & van der Merwe.

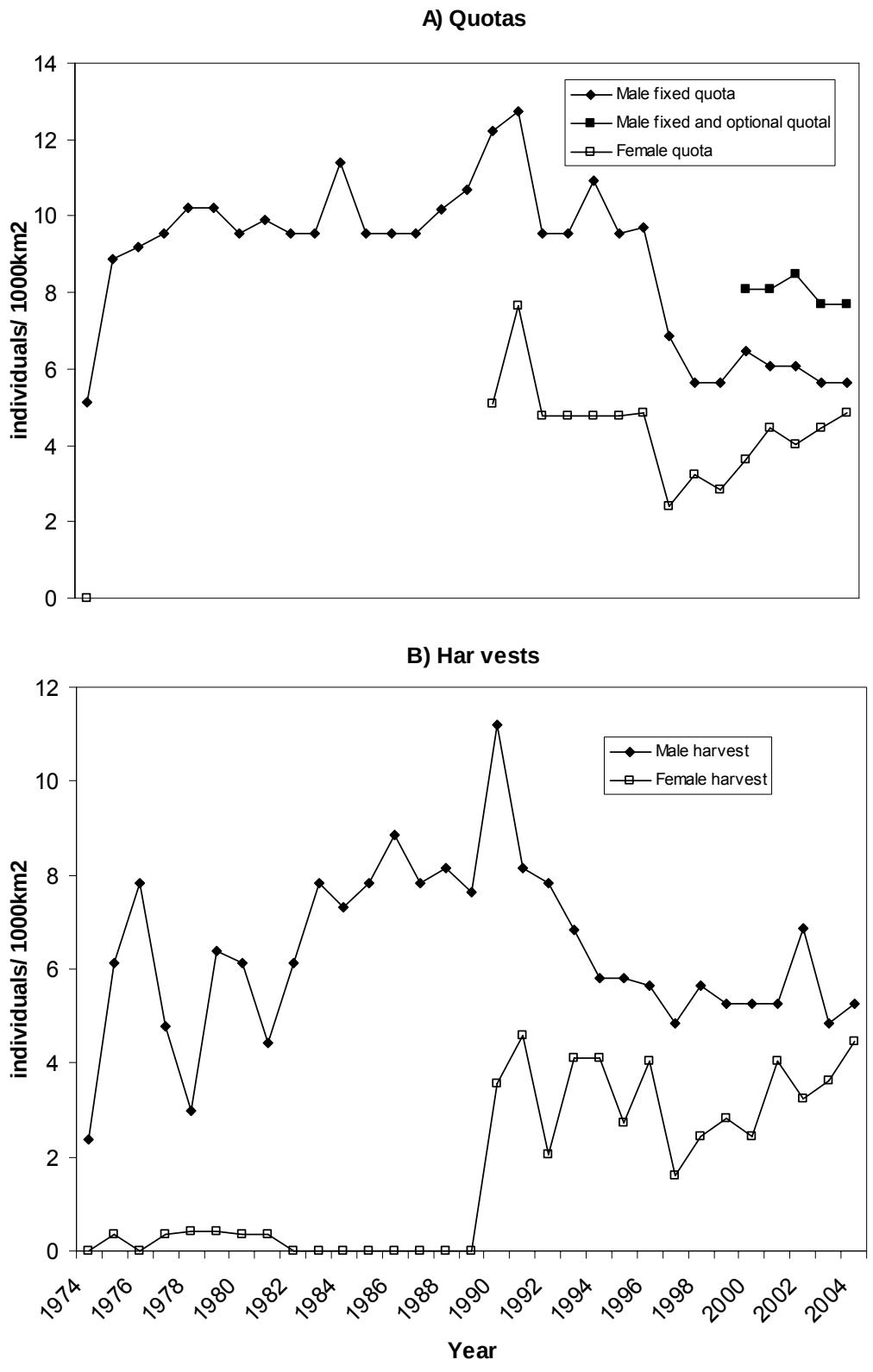
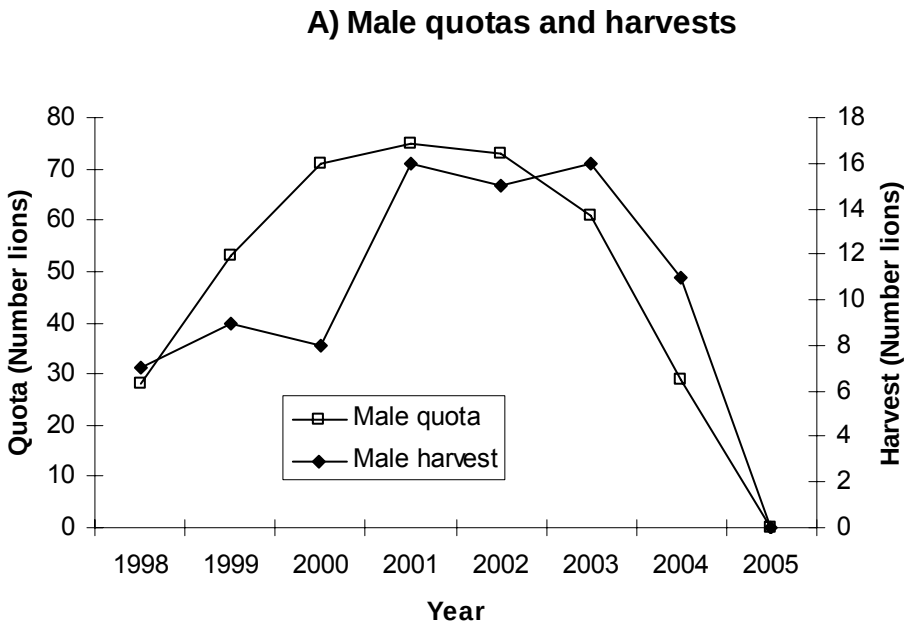


Figure 2: Quotas and harvests of male and female lions in the Matetsi safari area, Zimbabwe, 1974 to 2004. A) Quotas set by Parks Authority B) Harvest of male and female lions in the Safari area. From : Loveridge, Murindagomo, Moyo & Macdonald (in prep).



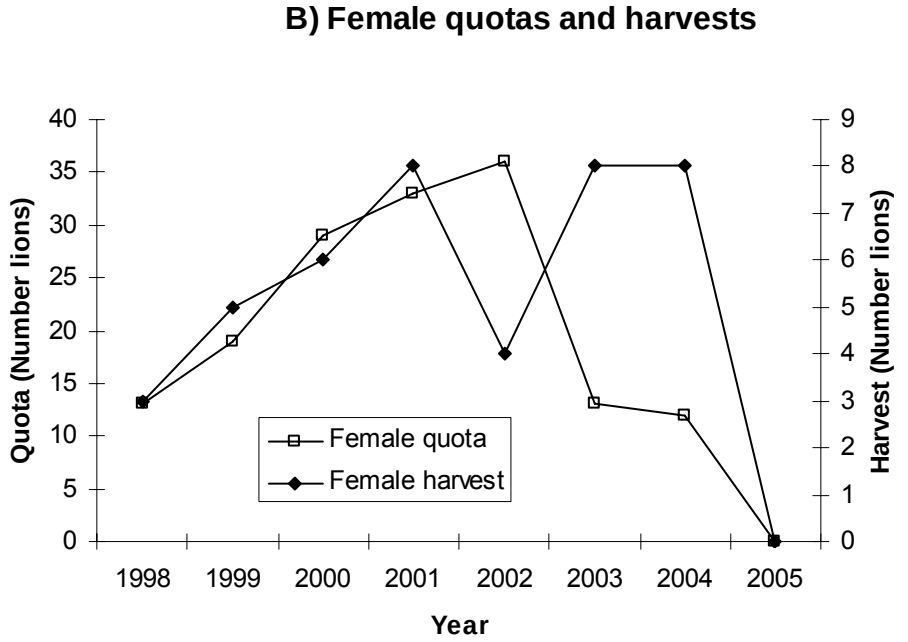


Figure 3: Quotas and Harvests of male lions (A) and female lions (B) in the hunting concessions directly adjacent to Hwange National Park, Zimbabwe, 1998-2005. From: Loveridge, Searle, Murindagomo & Macdonald (in prep.).

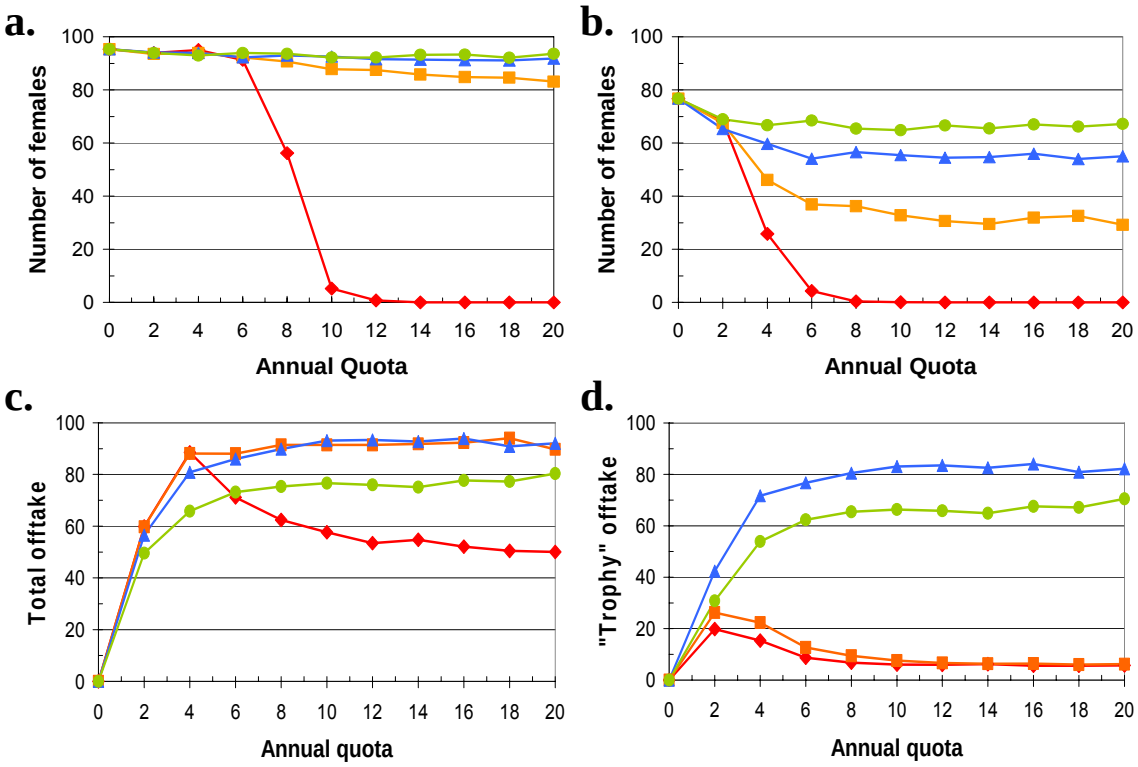


Figure 4. Effects of trophy hunting as a function of quota size and male age (Whitman, et al. 2004). Red indicates average outcome after 100 runs from shooting males ≥3 yrs, orange restricted to males ≥4 yrs, blue is ≥5 yrs, and green is ≥6 yrs.
A. Number of adult females after 30 yrs in hypothetical populations where males are non-infanticidal.
B. Number of females in infanticidal populations; note that infanticidal populations are smaller and more vulnerable to trophy hunting.
C. Total number of males harvested over 30 yrs in infanticidal populations.
D. Total number of 5-6 yr old high-quality “trophies” harvested in infanticidal populations.

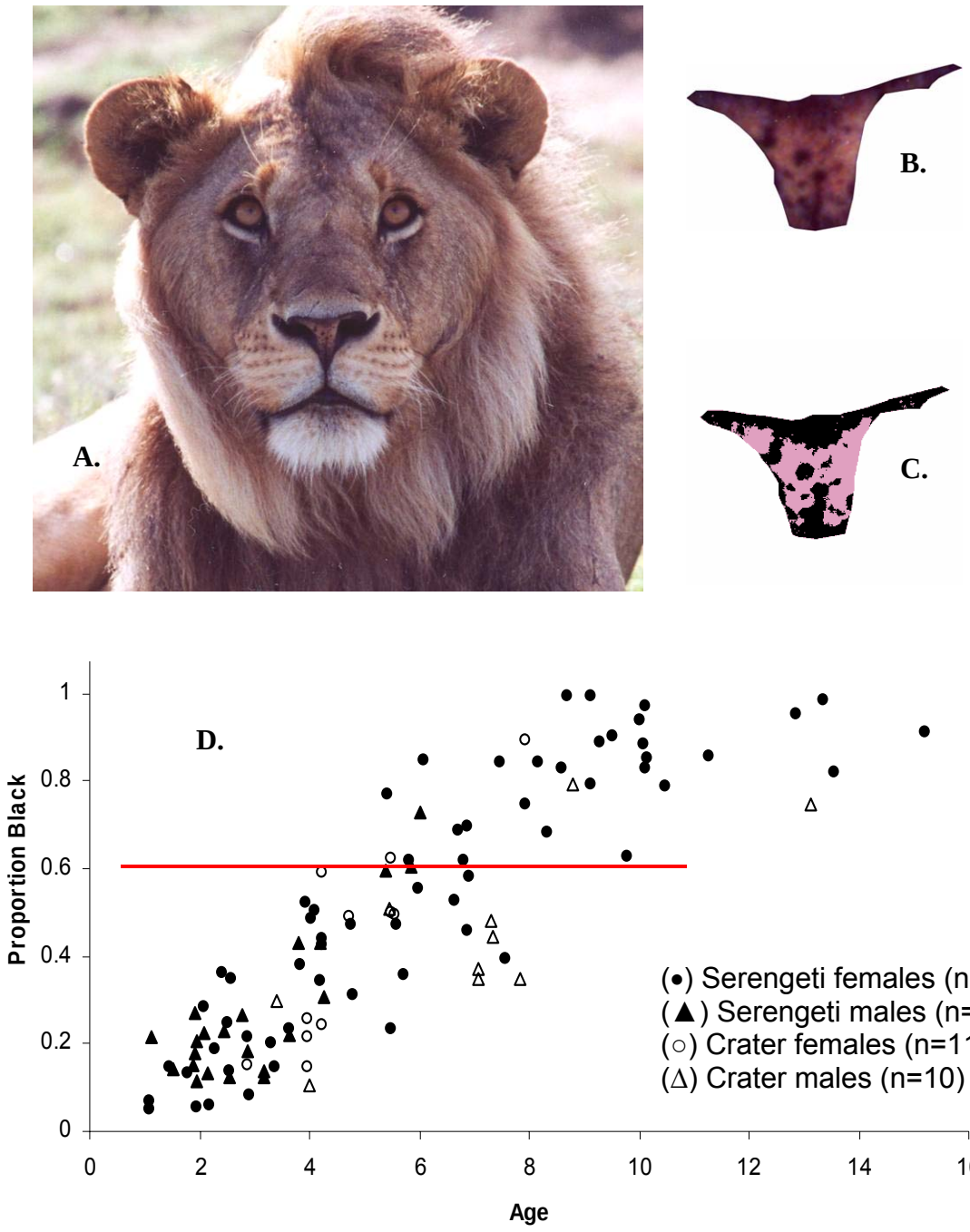


Figure 5. Age-estimation for adult lions using nose colouration (Whitman, et al. 2004)
A. Identification photograph of a 3 yr old male.
B. Excised photo of nose tip.
C. GIS rendering of nose colouration.
D. Age-change of nose colouration for males and females in two separate populations. Horizontal red line indicates the recommended 60% minimum.

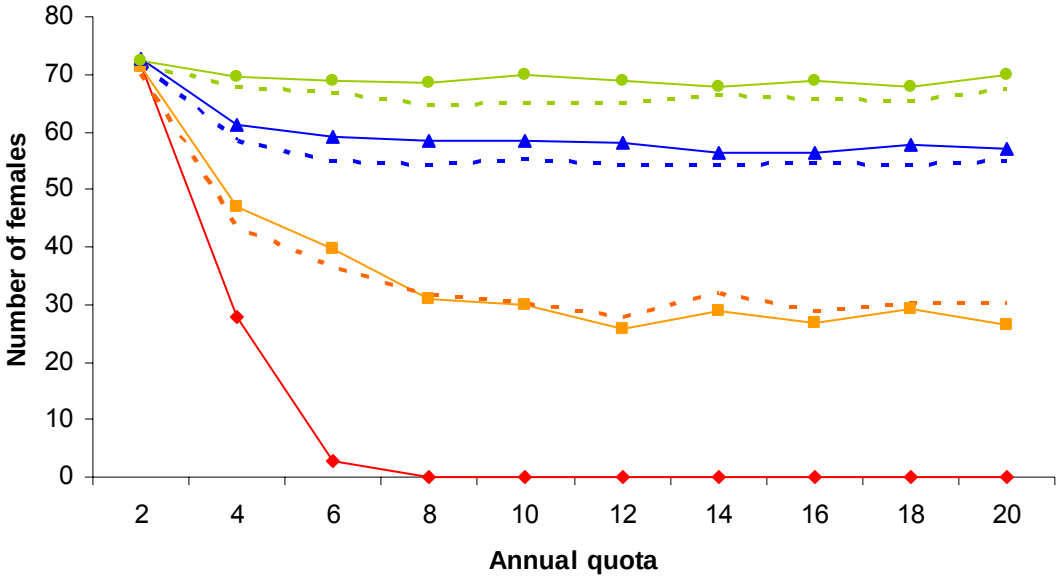


Figure 6. Effects of trophy hunting after 40 yrs on female population size as a function of quota size and male age (Whitman et al. in press). Red indicates average outcome over 100 runs from shooting males ≥3 yrs, orange is ≥4 yrs, blue is ≥5 yrs, and green is ≥6 yrs. Dotted lines use nose coloration as a measure of male age: orange is restricted to males with noses that are ≥40% black (≡ 4yrs), blue is ≥50% (≡ 5 yrs), and green is ≥60% (≡ 6yrs).

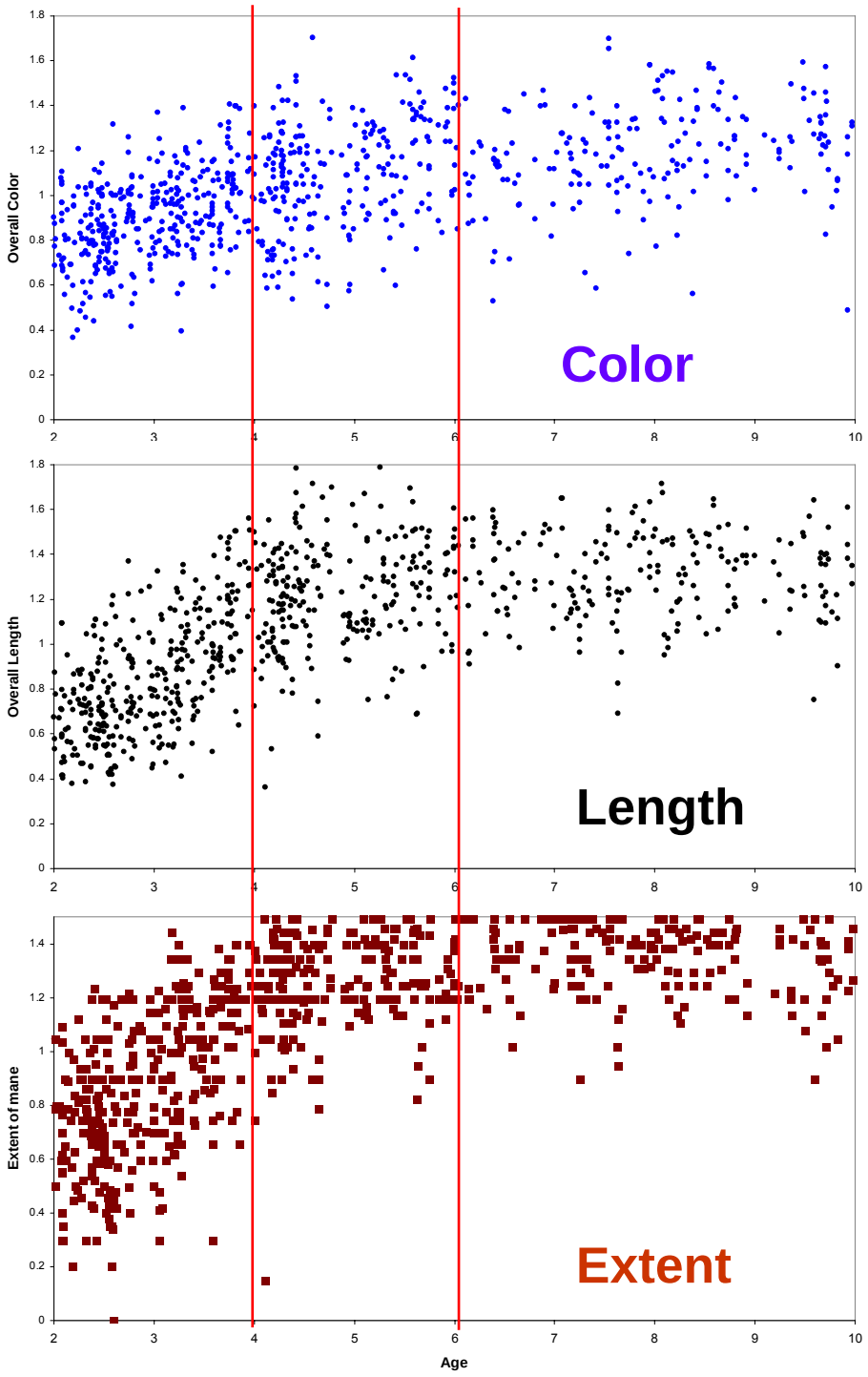


Figure 7. Mane dimensions for known-aged males in the Serengeti and Ngorongoro Crater: mane color/darkness (top), hair length (middle) and the extent of the mane over the male's head, neck, chest and shoulders (bottom). Vertical lines emphasize the lack of change in these traits between the ages of 4 and 6 yrs. Manes were scored from photographs by a panel of undergraduates; for details see West & Packer (2003).

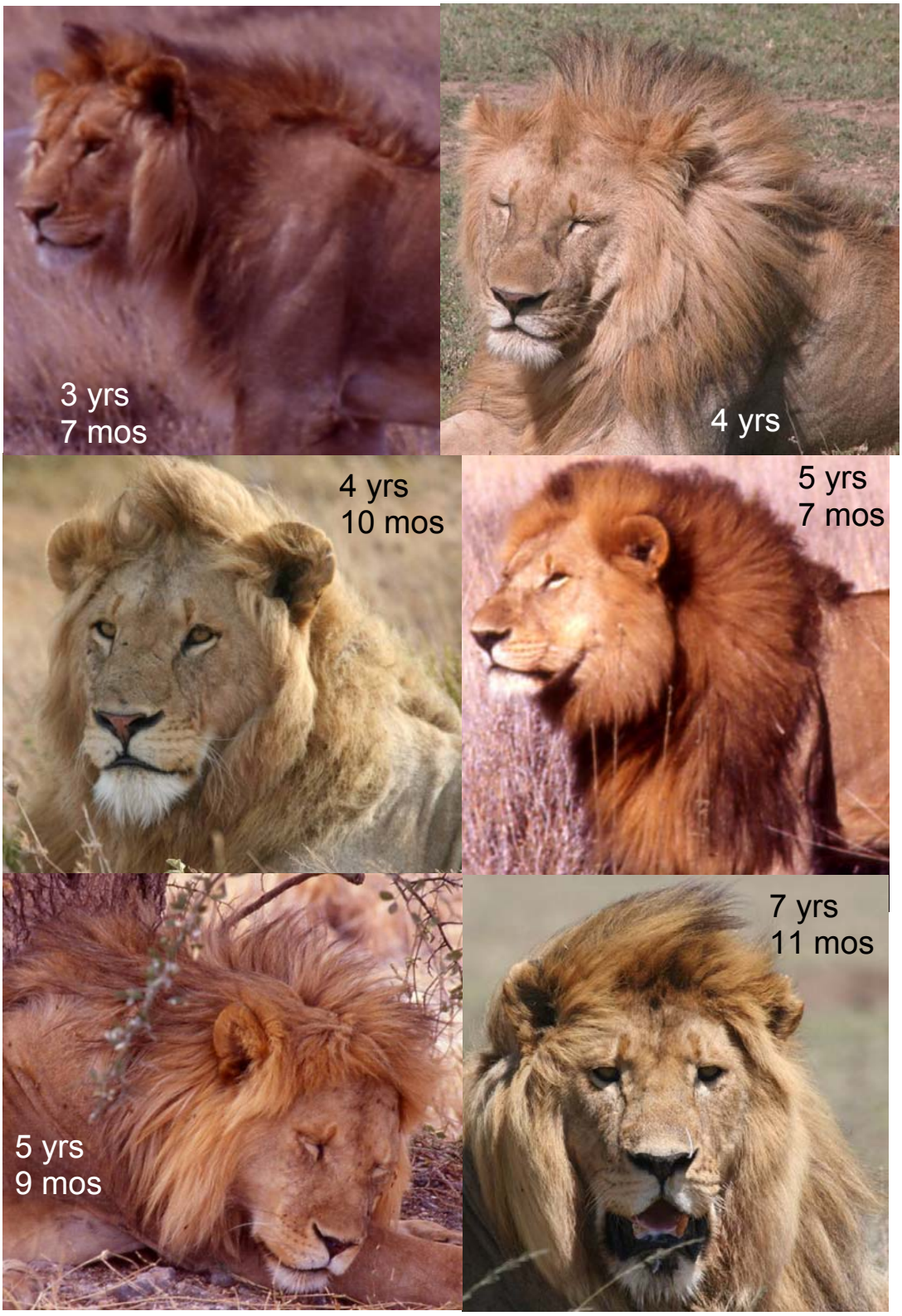


Figure 8. Known-aged males from the Serengeti.

Country➔	**Botswana**	**Ethiopia**	**Kenya**	**Malawi**	**Mzmbque**	**Namibia**	**Sudan**	**Tanzania**	**Uganda**	**S. Africa**	**Zambia**	**Zimbabwe**
Chardonnet➔	3207	1472	2749	25	955	691	800	14432	618	3852	1441	1686
Bauer/van der Merwe➔	2918	1000	2280	N.A.	400	910	N.A.	7073	575	2716	1500	1037
1977	3	0	6	0	0	0	0	0	0	2	0	1
1978	92	0	7	0	0	5	6	0	0	12	12	0
1979	53	0	0	0	0	1	4	1	1	35	8	2
1980	64	1	0	0	0	4	12	19	0	102	43	16
1981	53	0	1	0	0	0	6	6	0	35	25	32
1982	48	2	2	0	0	2	20	23	1	40	32	25
1983	28	1	0	0	0	0	20	44	0	22	31	49
1984	27	2	1	0	0	0	6	46	0	60	33	54
1985	48	2	3	0	0	7	0	85	0	42	41	77
1986	38	2	2	0	0	6	0	108	0	53	134	60
1987	87	4	0	1	0	5	0	93	0	47	57	57
1988	76	1	0	0	0	5	0	101	0	91	117	110
1989	72	5	0	0	3	8	0	209	0	60	50	108
1990	113	5	0	0	5	12	0	210	0	137	60	150
1991	98	3	0	0	2	10	0	156	0	139	75	169
1992	145	1	2	0	0	33	0	209	0	195	118	248
1993	151	6	1	0	0	19	0	195	0	152	36	190
1994	50	13	1	4	11	22	0	282	0	227	51	314
1995	35	1	0	0	5	23	0	230	0	115	65	125
1996	9	0	3	0	17	7	0	298	0	115	50	105
1997	18	0	1	0	14	8	0	276	0	116	45	97
1998	9	1	1	0	21	10	0	264	0	153	82	81
1999	22	3	1	0	1	7	0	272	0	137	74	125
2000	30	0	0	0	29	11	0	317	0	189	47	94
2001	9	2	1	0	15	12	0	230	0	148	24	99
2002	2	2	0	0	10	6	0	227	0	192	3	105
2003	0	3	0	0	15	16	0	218	0	177	38	107
2004	0	0	0	0	15	20	1	285	0	179	45	95

Table 1. Estimated lion populations (Chardonnet 2002; Bauer & van der Merwe 2004) and number of trophy lions exported each year.

Table 2: Areas of the National parks and reserves and of hunting areas in Eastern and Central Africa (after Roulet 2004)

Country	Size of country (km²)	Parks & Reserves	Hunting Areas	
		km ²	km ²	% total
Botswana	600,370	103,953	121,000	53.79%
Ethiopia	1,221,000	32,403	60,000	64.93%
Kenya	582,650	44,855	-	0%
Malawi	118,480	12,622	-	0%
Mozambique	783,080	36,500	56,750	60.86%
Namibia	824,290	107,125	72,725	40.44%
South Africa	1,221,037	56,500	160,000	73.90%
Sudan	2,505,810	95,870	-	0%
Tanzania	945,090	134,881	185,750	57.93%
Uganda	236,040	17,968	-	0%
Zambia	752,610	59,451	160,488	72.97%
Zimbabwe	390,580	49,418	40,000	44.73%
Totals	10,181,037	751,546	856,713	53.27%