



Niassa Carnivore Project

Monitoring of lion and leopard trophies
in Niassa National Reserve, Mozambique:
2008 Hunting Season

Prepared for:



SRN

(Sociedade para a Gestão e Desenvolvimento
da Reserva do Niassa, Moçambique)

By:

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1.0 Summary

Lion

1. Four lions were taken as trophies in 2008 representing an off-take of 25% of the SRN allocated quota, (36% of the purchased quota) with seven unsuccessful lion hunts.
2. The number of underage lions taken as trophies has decreased markedly with no young lions (< 6 years old) taken as trophies in 2008, compared to 2004 when 75% of trophies were underage.
3. Off-take of lion has dropped sharply from 80% in 2003 to only 25% in 2008 with a particularly large drop between 2007 and 2008 (50% to 25% of the quota).
4. The reason for this decrease in off-take is not caused by a decline in the lion population. Rather it reflects a decrease in the number of underage lions taken as trophies. The number of lions over the age of six taken as trophies taken in the last three years has remained stable at four individuals per year. This off take is now likely to represent a sustainable off-take of lion in NNR based on the current lion population size in the operational hunting concessions.
5. In 2007 we suggested that if PHs wished to find high quality trophies they needed to bait away from the Lugenda River and utilise a higher percentage of their concessions to give the more heavily hunted areas a rest. In 2008 all lions were taken off the Lugenda River. It is hoped that this trend will continue.
6. The SRN Lion Regulations with their associated points system to assign trophies based on the previous year's trophy quality has had a positive effect and at this point the hunting of underage lions is no longer a threat to lions in NNR and lion hunting is believed to be sustainable at the 2008.
7. Five years of data on lion aging have now been collected in NNR from trophy animals as well as radio-marked individuals (n = 12) and these data show conclusively that mane development and nose pigmentation are related to tooth wear (age) and individuals can consistently be placed in broad age categories based on visual aging cues.
8. Professional hunters (PHs), Niassa operators and SRN are to be commended for their commitment to sustainable lion hunting.
9. According to the SRN points system for setting sustainable lion quotas in NNR no change in quotas for the concessions are recommended for 2009 and a quota of 16 lions is recommended for the concessions active in 2008 with an additional two lions provided for each of the two new concessions as a start up quota.
10. However, despite the evidence provided by the Niassa Carnivore Project showing that lion hunting in NNR is sustainable and well monitored, a quota of only one lion per concession has been approved for NNR in 2009 by MITUR. This low quota is certainly sustainable but it negates the SRN lion quota setting system despite its proven track record and provides no incentives for PHs to hunt sustainably by only taking lions over the age of six. .

Leopard

11. In 2008 ten leopards were taken as trophies from 16 leopard hunts, this represents an off take of 33% of the approved quota. No females were taken as trophies in 2008 compared to two in 2007.
12. There was a marked decrease in leopard off-take compared with 2007 (33% compared to 100%). The reasons for this are unclear.
13. In 2009 camera trapping will be used to assess leopard density in a hunted area compared to a unhunted area to investigate whether the lion population in a heavily hunted area has declined significantly..
14. The leopard trophies continue to show a relatively high proportion of young animals (no teeth wear; 40%) in the sample with only one animal showing significant wear on the teeth.
15. Potential visual cues that could be used by PHs to age leopards were assessed. Body measurements (total length, shoulder height, neck circumference) taken by PHs of trophy leopards over the past two years are showing no clear pattern per age category. However, data from captured leopards do suggest that body length and shoulder height might be related to age although sample sizes are still small.
16. Ongoing monitoring of the leopard population is essential given their sensitive position on Appendix I of CITES.
17. Similar to the lions, MITUR approved leopard quotas for 2009 have been substantially reduced for Niassa Operators in 2009 (less 10 animals) despite the national increase in quotas approved by CITES in 2007 from 60 to 120 animals.

2.0. Recommendations for 2009

Based on the results presented in this report, we recommend the following actions for 2009.

1. We strongly recommend that the points system continue to be used to set lion quotas in NNR rather than setting fixed quotas for each concession irrespective of the previous year's trophy quality. The points system has been shown to be an effective way of encouraging sustainable hunting practices and it allows the quota to change as the lion population increases and the number of suitable lions (older than six years) increases. This is not the case with set quotas.
2. We recommend that all other lion regulations (filling in of questionnaires for all lion and leopard hunts, 18 day hunts, providing skulls for aging before leaving the concession, no lions under 6 year's of age) should remain in place and be strictly enforced even if fixed quotas are put in place.
3. We recommend that operators provide email addresses for all PHs operating in NNR so that requirements for monitoring can be sent directly onto PHs not only to operators. This will also allow NCP to send on a newsletter to PHs from NCP during the years.
4. As recommended in 2008, it would be useful for a meeting of PHs to be held in 2009 (perhaps at Mbatamila) to pass on information, new regulations and discuss visual aging cues for trophy animals. Information provided at the SRN operators meeting is still not filtering down to all the PHs.
5. A pamphlet will be produced and distributed to operators, and professional hunters by NCP detailing how to age lions in Niassa based on the previous 5 years of information.

Monitoring

1. The proportion of lion and leopard hunts that are unsuccessful in a season provided important information on hunting effort and density. As for the 2008 hunting season we recommend PHs should fill out the short lion questionnaire for each lion and leopard hunt irrespective of whether a trophy is taken or not and provide reasons why the hunt was unsuccessful.
2. We recommend that PHs continue to fill out questionnaires for each leopard trophy and be required to take the appropriate measurements (head-body length, neck circumference, weight). Weight is particular has not been measured consistently as many PHS did not have an appropriate scale. These measurements are essential if visual aging cues are to be developed and are an important determinant of trophy quality.
3. GPS position data is still being provided in a variety of formats. All GPS positions must be provided in decimal degrees (12.12345; 38. 12345).

3.0 Objectives

A detailed report on lion and leopard trophy monitoring was prepared in 2007 (Begg & Begg 2007) and a comprehensive update will again be provided in 2011. This interim report serves to provide an annual review of the lion and leopard trophies taken in 2008 primarily for SRN, the NNR management authority. Additional information on the Niassa Carnivore Project is provided in its annual report.

The overall goal of the NCP is to ensure that viable populations of the large carnivore populations (lion, leopard, spotted hyaena, African wild dog) are secured in NNR and their status and threats are effectively and systematically monitored. With regards to sport hunting, the NCP aims to:

- a) Ensure that by 2010 less than 20% of the lions taken as trophies in Niassa each year are underage (< 6 years) and that sport hunting of underage individuals is not a threat to the Niassa lion population.
- b) Establish a sustainable and effective SRN trophy monitoring system for lion and leopard that is not researcher driven.
- c) Validate visual aging cues for leopards and lions that can be used by PHs to minimize the number of young and female individuals taken.

2008 TROPHY MONITORING RESULTS

4.0. General Activities

- C. Begg attended the SRN Operators Meeting in Maputo (12-13 June 2008). Particularly emphasis was placed on the quality of the lion and leopard trophies taken in the 2007 season and problems encountered (see Begg & Begg; Feb 2008 Trophy Monitoring report).
- All sport-hunting operators were provided with lion and leopard datasheets for the 2008 hunting season as well as the SRN lion regulations. In 2008 a questionnaire was provided for each lion or leopard hunt even if the hunt is unsuccessful.
- Contact was made with all the new operators (sport hunting and ecotourism) and details provided of information needed on large carnivores (prey, snare wounds, leopard skin trade, conflict, breeding)
- A follow-up e-mail was sent to all operators one week after the meeting to establish email contact and confirm 2008 requirements in a format that could be copied to individual PHs.
- In October -November, all sport-hunting concessions were visited by members of NCP team to collect datasheets, photographs and other carnivore sightings and measure and age all lion and leopard trophies. Convenient dates for the visits were agreed in advance with the operators based on their hunting activities.
- In 2008, A. Jorge (SRN employee) accompanied the NCP trophy monitoring team for training in the aging and measuring of lion and leopard trophies as part of the NCP mentorship and training program. In 2009, A. Jorge will spend 6 months (June to November) with NCP gaining further experience in lion and leopard conservation work. He will remain in the employ of SRN during this period but will have a separate Terms of Reference with NCP.
- Each lion and leopard trophy was independently aged based on tooth wear, closure of the pulp cavity, and in lion's mane development, nose pigmentation and general body condition.
- Additional information on the opportunistic sightings of lions and leopards, visual aging cues and perceptions of lion and leopard hunting was gathered and discussed with PHs wherever possible.

5.0 Lion Trophy Monitoring



L8- Kambako Safaris: PH: Stu Taylor Client: R. Ayala (©Kambako Safaris)



L7- Luwire: PH Paul Davies: Client D. Green(©Luwire Safaris)

Plate 1: The oldest lions taken in NNR during the 2007-hunting season by Kambako Safaris and Luwire

5.1 Monitoring by PHs

- Professional Hunters (PHs) provided information (date, number of individuals, position, condition), photographs for all four of the animals taken as trophies and all the skulls were provided for aging.
- The nose photo of one lion (LI- Safrique) was not acceptable as it was not focused and taken from too far away. The PH was also not aware that a questionnaire had to be filled in at the time of the hunt. However, full information was provided during trophy monitoring visit allowing the required information to be entered. This concession is under new management and this was their first year of operation and a promotional hunt so some leniency was given to the operator.
- Several PHs had not received the information provided to operators at the Lichinga meeting and the follow up email sent to all operators after the meeting with details of the requirements was not sent onto all the PHs.
- Several PHs are still not collecting GPS information in decimal degrees. The aging booklets and printouts provided in previous years were in most cases not easily available in camps for PHs to consult. Few of the PHs operating in Niassa in 2008 were new to Niassa and the majority were familiar with the project.
- Additional information on carnivore sightings was provided by all concessions.

5.2 Off-take

- The Ministry of Tourism (MITUR) assigned a quota of 18 lions to NNR in 2008.
- 16 lions of these lions were allocated to the hunting blocks by SRN based on the Niassa Points System and 2007 trophy quality (2007 Sport hunting Results: Begg & Begg 2008) with a starting quota of two lions provided to each of the new operators L1 (Safrique) and (L3 Metapiri).
- Of these 16 lions, 11 were purchased by the hunting operators (69% of SRN assigned quota; 61% of MITUR approved quota).
- Four lions were taken as trophies in 2008 representing an off-take of 25% of the SRN allocated quota, (36% of the purchased quota; Table 1) with seven unsuccessful lion hunts.
- For the first time since monitoring began in 2004, all the lions taken in 2008 were suitable trophies (over the age of six years) with no young lions taken. The oldest lions were taken in Kambako (18) and Luwire (17) the two concessions that have been hunted the longest in NNR (Plate 1).
- Off-take of lion (as a percentage of the SRN lion quota) has dropped sharply from 80% in 2003 to only 25% in 2008 with a particularly large drop between 2007 and 2008 (50% to 25% of the quota).
- At first glance this would seem to suggest that fewer lions are available and the lion population is declining; a reason for concern. However, a closer look at the last five years of trophy monitoring data collected by NCP (2004-2008) shows this is not the case.
- The decrease in off-take is entirely due to fewer young lions being taken as trophies (Fig. 1). The number of acceptable lion trophies (older than 6 years of age) taken each year since 2005 has remained at a constant four animals per year while the number of young lions (younger than 6 years of age) taken as trophies has dropped from six individuals in 2004 (75% of the off-take) to zero in 2008. .
- The off-take has decreased in quantity but increased in quality. This reflects positively on the PHs and SRN management and it suggests the trophy monitoring and Niassa Points System are having the desired effect of assisting PHs with how to age Niassa lions and providing an incentive for PHs to only hunt lions over the age of six-year minimum.
- In 2008, the number and quality of lion taken as trophies in NNR were unlikely to be having any negative effects on the Niassa Lion Population. The relatively low quotas combined with an off-take where less than 10% of the trophies are young animals ensures that sport hunting of lions is no longer a threat to the lion population in NNR.
- In addition, provided the other threats to the Niassa lion population can be minimized, particularly inadvertent snaring and human-lion conflict, then the number of lion that can be hunted sustainably should increase in future as the lion population recovers in conjunction with recovering prey populations.
- The Niassa Points system provides a way for the quota to increase as the lion population increases and encourages sustainable use of lion in Niassa with no detrimental effects to the population. This is not the case with use of a fixed quota, which stays static despite changes in the lion population.

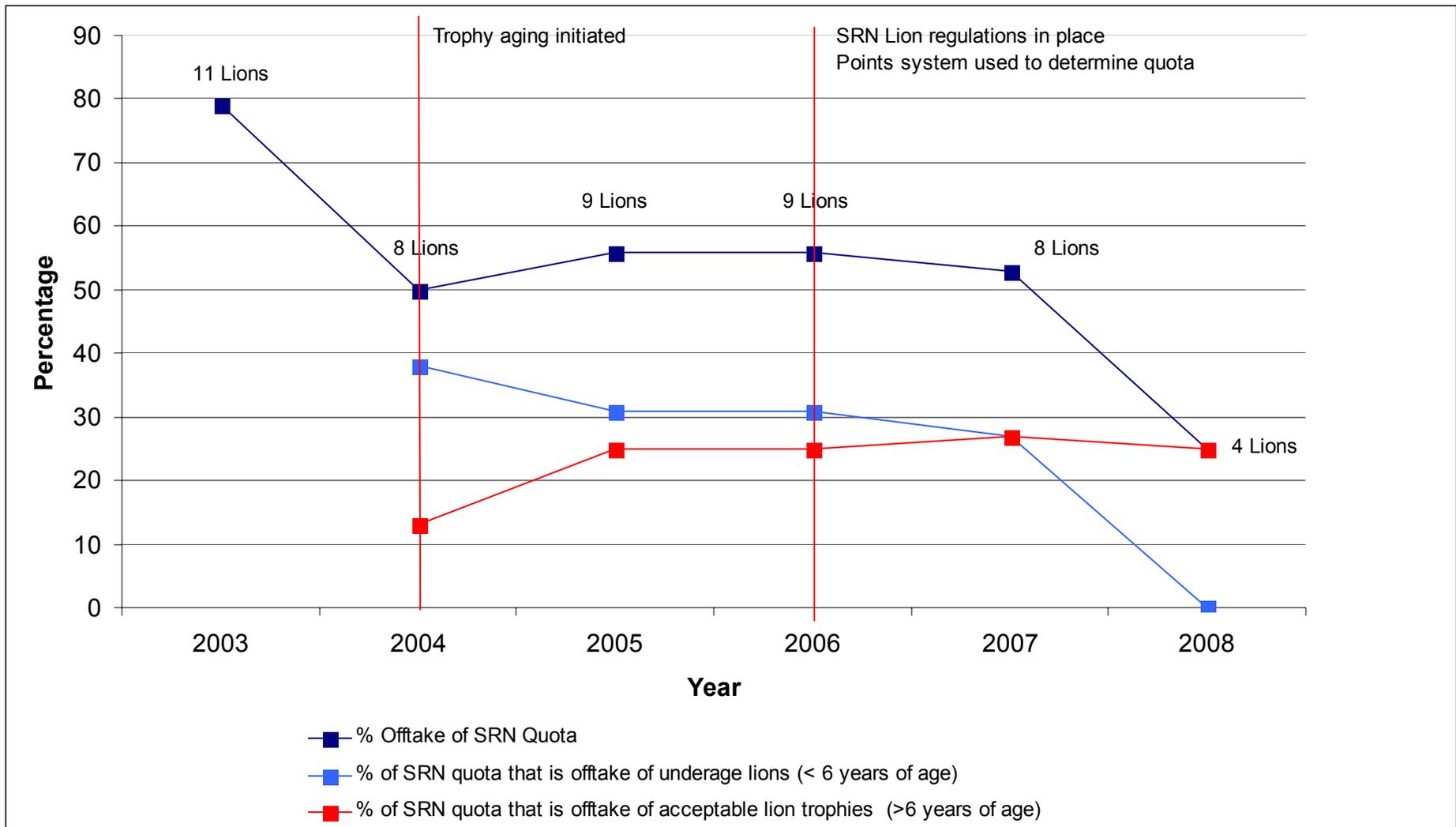


Fig. 1. Changes in off-take and lion trophy quality over the past 5 years (2004-2008) in Niassa National Reserve since trophy monitoring and the SRN lion regulations came into effect. Note the decline in off-take and the decline in the percentage of young lions taken over the past four years, however the number of acceptable trophies taken as trophies has remained constant, at four individuals per year.

Table 1: Lion off-take in Niassa National Reserve per hunting block and overall

Category	Hunting Blocks in Niassa National Reserve							Total
	L9	L8	L7	L1	L2	L3	R1	
2008 Results								
Allocated lion quota 2008	2	3	3	2	2	2	2	16
Number (%) of lion quota used 2008	0	1 (33%)	1 (33%)	1 (50%)	0	0	1 (50%)	4 (25% used)
Percentage of 2008 lion trophies older than six years.	-	100%	100%	100%	-	-	100%	100% acceptable
Overall 2004 – 2008	L9	L8	L7	L1^a	L2	L3^a	R1	Total
Total lion quota allocated 2004-2008	10	15	18	9	11	2	12	77
Total lion quota used (%) 2004-2008	6 (60%)	5 (33%)	13 (72%)	3 (33%)	6 (55%)	0	5 (42%)	38 (49%)

^a Block L1-Safrique was taken off by new management in 2008 and completed on promotional lion hunt.

^b Block L3 – Metapiri is a newly opened concession operating for the first time in 2008, a startup lion quota of two lions was provided but none were taken.

5.3. Trophy quality

- Photographs of the four lion trophies and aging criteria are shown in Plate 3 with two of the lions (LI-L7-01-08 (Luwire) and LI-L8-01-08 (Kambako) both between 7-9 years (Plate 1). The other two lions were acceptable trophies but younger (5-6 years old).
- All four of the acceptable trophies showed full manes and noses more than 50% black. All teeth showed significant wear particularly on the enamel ridges of the canines.
- Five years of data on lion aging have been collected in NNR (2004-2009) both from captured individuals (20 captures, 12 individuals; six males; six females) and trophy lions (n = 29 individuals for which full information (nose pictures, tooth wear, mane development) have been provided. The data show clearly that mane development and increased nose pigmentation are related to age (tooth wear and X-rays of pulp cavities) in the Niassa lion population when lions are placed in broad age categories (< 4 years, 4-6 years and older than 6 years). Young lions collared over a three-year period show convincingly that nose darken with age in Niassa (Begg & Begg 2007, Begg & Begg 2008). This has been discussed in detail in previous reports (Begg & Begg 2007) with the 2008 data providing additional support.
- While it is impossible to determine the exact age of lions taken as trophies in Niassa data on tooth wear, mane development and nose pigmentation from trophy animals can be validated from data collected from collared individuals whose behaviour has been monitored over a longer time period (see Begg *et al.* 2009, NCP Progress report). To date six male lions have been radiocollared in NNR (two subadults, two young adults (3-4 years old when first collared and two adult males over the age of six years).
- The six year age minimum for lions was derived from a model developed for lions in savanna habitats (Whitman *et al.* 2004) and other studies have suggested that male lions might require an extra 1-2 years to produce cubs to independence in more wooded habitats (Funston *et al.* 2003). This would suggest that a 7-8 year minimum age for trophy lions might be more appropriate to prevent the consequences of regularly removing territorial males.
- However, preliminary data collected from radio-collared male lions suggests this is not the case for lions in NNR despite this being a wooded habitat (primarily miombo woodland). In fact the opposite may be true with lions younger than six years observed to be holding territories and fathering cubs. This is probably a function of the relatively low density of lions in the area with a lack of competition between males for territories. In one example, three cubs born in 2006 were assumed to have been fathered by a territorial adult male lion believed to be only 4-5 years old (from tooth wear) at the time. All three of these cubs have reached adulthood.
- In NNR coalitions of three or more male lions are rare, with males commonly seen alone or in pairs. In the past three years only two male lions over the age of six (a coalition first seen in 2008) have been seen in the study area in the eastern Lugenda valley despite the presence of at least four different prides.

- The six-year age minimum for lion hunting in NNR is therefore considered sufficient to safe guard the Niassa lion population at present particularly since the aim is not to take six year old lion but to take old lions. It has always been stressed that PHs should endeavor to find the oldest animals in the lion population and not fixate on the six year cut off as it is difficult to tell a five year old from a six year old lion but relatively easy to tell an eight year old from a five year old.
- Some PHs expressed concern over the lack of six-year-old lions coming to baits in 2008 and wondered whether the lion population was in fact declining. However, NCP completed a lion and hyaena call up survey in 2008 to compare with 2005 data and this as well as focused research on lions in the intensive study area suggests that the lion population is currently stable.
- Of particularly interest, was our observation that lions over the age of six came into call up sites on two occasions where no old lions had appeared at sport hunting baits that were active at the same time? It is our view that some of the older lions might be too wily to come into the baits.
- Unlike some other areas (Serengeti, Botswana; Whitman & Packer 2006), young Niassa lions (4-6 years old) generally do not provide high quality trophies as these lions have not yet developed full manes. However, sometimes the oldest lions in the population are also poor quality trophies as the manes become sparse and patchy. In 2008, a client turned down an old male lion that came into bait as the lion has a sparse, unimpressive mane and was not considered of high enough quality. This lion hunt was ultimately unsuccessful and the client went home empty handed, however this same lion was subsequently taken by the next client (see Plate 2a) and proved to be one of the oldest lions taken in 2008. This highlights the problem of marketing old lions to clients who are only interested in trophy quality. The only solution to this is to use marketing to change the expectation of the client from the outset from one of taking the biggest animal to one of taking the oldest animal to ensure hunting is sustainable. This requires a change in the entire sport hunting industry and will not be simple to achieve.
- Aging of lions is most accurately done by taking the whole overall appearance of the lion into account, not by looking at just one feature. A pamphlet to aid PHs in aging lions in NNR will be printed in 2009. Based on 5 years of data NNR lions over the age of six generally show the following characteristics (this will be developed more fully in the pamphlet):
 - Full manes forming a circle around the head (Plate a, b). In some lions the ears may be prominent and the mane may not necessarily be filled in completely on the forehead but the bald spot does not extend behind and below the ears and there is not a prominent mohican extending back over the head (Plate e). The bald spot behind the ears (ear gap) fills in last and seems to be a good indication of a young animal in NNR (Plate e).
 - Within the older than six-year age category there is some variation. Very old male lions may show a thinner, scrappier mane than males that are 6-7 years (Plate c compared to Plate a) but the mane is still filled in behind and frequently between the ears.

- Male lions with dark lines on the back of the legs are generally still pride males as this is a sign of territorial marking and these lions should be avoided as trophies (Plate d).
- In addition lions older than six years of age generally have scars on the face and body and worn down yellow canines (often visible when males yawn).
- If it is possible to see the nose, nose pigmentation is a useful tool for aging lions in NNR. While nose colour can be hard to see in dim light with pink noses showing up better than black noses, nose colour has been consistently shown to be related to age in Niassa. To date all lions with significant tooth wear have been found to have noses more than 50% black (Plate e).
- In 2007 we recommended that if PHs wished to find high quality trophies they needed to bait further afield, particularly away from the Lugenda River and utilise more of their concessions, particularly the inland woodland sections to give the more heavily hunted areas a rest. In 2008 all lion were taken off the Lugenda River, which may also be the reason for high quality trophies being taken. It is hoped that this trend will continue.
- In 2008, one concession (Kambako- L8) successfully used camera traps to assist them in aging lions feeding at baits prior to shooting the animal. Good results were obtained and this may be a useful tool to assist PHs with lion aging.



a) Full mane forming a circle around the head in trophy male lion that is over the age of six years



b) Full mane forming a circle around the head in male over the age of six years



c) Old males frequently have a thinner mane but it still forms a full circle around the head.



d) Black line down the back of the hind legs is a feature of territorial males younger than 6 years. This collared lion was a pride male and 4-5 years old



e) The bald spot behind and below the ears combined with an extended mohican is a sign of an adult male that is not yet over 6 years old (4-6 years)



f) Nose of the lion in Plate (a) compared to the nose of the lion in Plate (e).

Plate 2: Visual cues that can be used to age lions in NNR based on data from trophy animals (2004-2008) as well as collared individuals followed over time (n = 6 males).

5.4. Quotas for 2009

- According to the Niassa Points System, quotas for 2009 have been assigned independently for each block based on the total points achieved (Table 2). In 2009, no concessions would receive a change (either an increase or decrease) in quota with a total quota of 16 lions requested. According the Points System a quota of two lions each for the two new sport hunting concessions is also recommended as a starting quota (R2 and R3).
- However, to date, the quotas recommended by SRN have not been approved by MITUR instead a national decrease in lion quotas has been applied with significant decreases in quota for NNR. In 2009 each concession has only received one lion. This negates the points systems for 2009.
- At this stage it is uncertain whether this fixed quota will be the norm for future years. If so the Niassa points system becomes obsolete as a fixed quota will be assigned regardless of trophy quality. However we would recommend that all other aspects of the SRN lion regulations remain in place (monitoring of trophy quality, questionnaire, six year age minimum).
- While this low fixed quota is certainly sustainable with only lion per concession, a fixed quota system does have a number of disadvantages. It does not allow the quota to change based on changes in the lion population in NNR in future and it provides no incentives for good hunting practices such as only taking lions over the age of six years.
- Second only to elephant, lion are a vitally important species for sport hunting operators in NNR to remain viable. Data strongly suggest that the current (2008) lion quotas for NNR are sustainable provided only animals over the age of six are taken as trophies. By placing a mandatory and strongly regulated minimum age on the lions that may be taken as trophies, off take is limited by the actual lion density in NNR (i.e. how many lions over the age of six there are in the population). There is therefore little danger that these quotas could be having any negative effect on the lion population under the current SRN system. It is worth noting that since the SRN lion regulations have been in place, off-take as a percentage of the quota has steadily decreased and the full quota is not utilised. The full quotas are however important for marketing by the operators.
- Niassa hunting operators and SRN have been committed over the past five years to safeguarding the Niassa lion population by reducing the number of underage lions taken as trophies. Reducing quotas negates all their positive efforts to maximise trophy quality and economic returns from lion hunting in NNR while maintaining the viability and growth of the Niassa lion population.

Table 2: Quotas for 2009: Assigned for each hunting concession according to the age of the trophies taken in the 2008 hunting season as calculated by the Niassa Points System and requested by SRN and the set quotas provided by MITUR.

Hunting Block	Quota 2008	Used Quota	Number of lions taken in each age category				Points assigned based on age	Recommended Quota 2009 – Points System	MITUR Approved Quota
			< 4	4-6	> 6	None			
Block L9	2	0	0	0	0	2	$3 + 3 = 6/3 = 2$	2	1
Block L8	3	1	0	0	1	2	$4 + 3 + 3 = 10/3 = 3.3$	3	1
Block L7	3	1	0	0	1	2	$4 + 3 + 3 = 10/3 = 3.3$	3	1
Block L2	2	0	0	0	0	2	$3 + 3 = 6/3 = 2$	2	1
Block L1	2	1	0	0	1	1	$4 + 3 = 7/3 = 2.3$	2	1
Block R1	2	1	0	0	1	1	$4 + 3 = 7/3 = 2.3$	2	1
Block L3	2	0	0	0	0	2	$3 + 3 = 6/3 = 2$	2	1
Block R2	-	Unoccupied	-	-	-	-		2 (new concession)	1
Block R3	-	Unoccupied	-	-	-	-		2 (new concession)	1
TOTAL	16	4	0	0	4	12		20	9

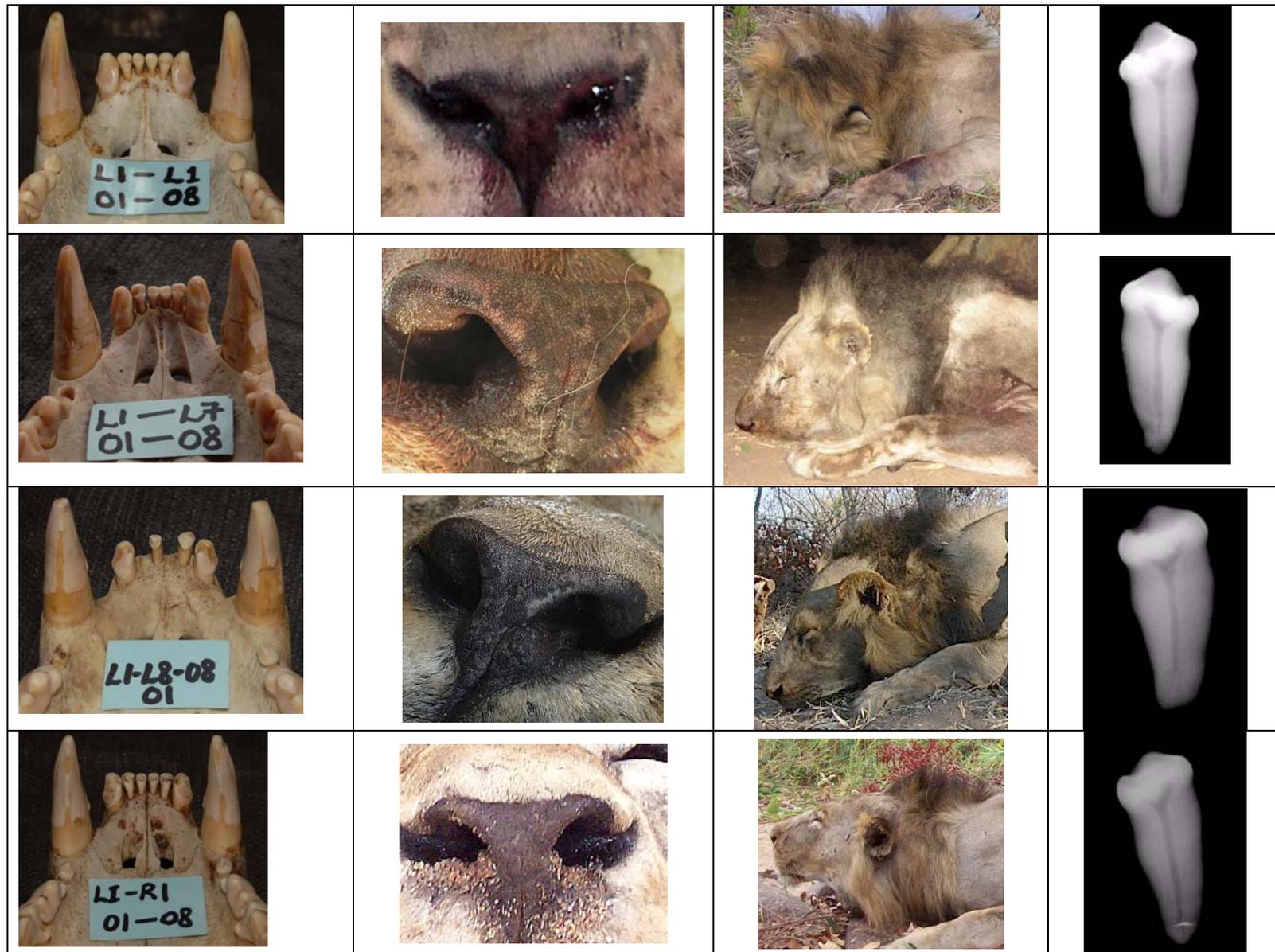


Plate 3: Individual lion trophies taken in 2008 all considered to be over the age of 6 years of age, note the noses more than 50% black, full manes filled in behind but not necessarily between the ears and significant wear on the canines and enamel ridge. Mane development and nose colour correlates with thin pulp cavities that are closed off at the base. Lions LI-L7-01-08 and LI-L8-01-08 are the oldest in this category and LI-R1-01-08 is the youngest.

6.0 Leopard trophy Monitoring

6.1. Monitoring

- This is the third year of leopard trophy monitoring in NNR. PHs also provided information (date, number of individuals seen, position and condition of the trophy and baits) and measurements for all of the leopard trophies. However weights were for the most part estimated by PHs as scales were not available
- All trophies were placed into an age category (<2 years, 2-4 years, > 4 years) based on tooth wear ranked according to a datasheet. A premolar or incisor was taken for pulp cavity X-rays. All skins were examined to ensure the scrotum was attached to confirm the sex of the animal and skin samples were taken for phylogeographic study of leopards conducted by Dr Conrad Matthee (University of Stellenbosch).
- Data from the past three years of trophy monitoring as well as examination of captured animals suggest that canine wear, chipping of the enamel ridge and pulp cavity x-rays allow leopards to be placed in three age categories corresponding to little to no teeth wear, medium teeth wear, and obvious / apparent tooth wear and these have provisionally been placed in actual age categories (< 2 year, 2-4 years and over 4 years) based on data from known age leopards in other studies. Visual aging cues for NNR leopards are still being developed.

6.2. Offtake

- In 2008, ten leopards were taken as trophies in Niassa National Reserve from a total of 16 leopard hunts (six hunts were unsuccessful). This represents an off-take of 33% of the approved quota (30 animals; Table 3).
- None of the active concessions took their full quota in 2008. This is in sharp contrast to 2006 and 2007 where active concessions purchased and utilised 100% of the leopard quota.
- The reasons for the decline in off-take are unclear. It is unlikely to be due to more discerning hunting, as while no females were taken this year the number of leopards taken in each age category was similar to that of 2007 (see section 5.3; Begg & Begg 2008).
- The reasons given for the six unsuccessful hunts were no leopard activity at baits, and only young males and females seen on baits. One PH expressed concern about the leopard population and suggested they may have been over hunted in some areas.
- However during the 19 leopard hunts (including three courtada hunts), 20 male leopards and 12 females including one female with 3 cubs were seen on the baits. On average six baits were set per hunt (ranging from 4 to 14 baits) and leopard hunts varied from 14 to 24 days.

Table 3: Leopard quotas, off-take and ages of trophies taken in the 2008 hunting season

Category	L9	L8	L7	L1	L2	L3	R1	R2	R3	Overall
2008 Approved quota	3	5	5	3	4	3	3	2	2	30
2008 Off-take	1	3	3	1	0	0	2	0	0	10 (33%)
2008 leopard < 2 years	0	1	1	1	0	0	1	0	0	4 (40%)
2008 leopard > 4 years	0	0	1	0	0	0	0	0	0	1 (10%)
2008 leopard 2-4 years	1	2	1	0	0	0	1	0	0	5 (50%)
2009 Approved Quota	2	2	3	2	3	2	2	2	2	20

6.3. Trophy quality

- Nine of the ten Niassa leopard trophies were provided for aging and measuring before they were removed from NNR. One of the animals was injured and when the carcass was found hyaenas had eaten it so no trophy was recovered. An additional three leopards were taken in the Kambako Courtada and these data were added to the Niassa database.
- No females were taken as trophies in 2008, a marked improvement compared to 2007. All trophies were confirmed as males by inspecting the skins and in all cases the scrotums were attached as requested.
- Four of the ten (40%) NNR trophies were very young showing no wear on the canines and no noticeable chipping of the enamel ridge (Table 3; Plate 4) and are likely to be under the age of two years. All of these leopards showed noticeably broad pulp cavities different from older individuals.
- Only one of trophies taken in 2008 showed significant wear on the teeth and is believed to be over four years at age, with 50% of the trophies falling in the 2-4 year old age category. This is similar to the proportions of leopards taken in each age category in 2007 (33% < 2; 56% 2-4; 19% over four years).

<p>LE-L9-01-08 (2-4 YEARS)</p>		<p>LE-L8-01-08 (2-4 YEARS)</p>	No X-Ray
<p>LE-L8-02-08 (2-4 YEARS)</p>		<p>LE-L8-01-08 (2-4 YEARS)</p>	
<p>LE-L7-01-08 (2-4 YEARS)</p>		<p>LE-L7-02-08 (> 4 YEARS)</p>	
<p>LE-L7-03-08 (< 2 YEARS)</p>		<p>LE-L2-01-08 (< 2 YEARS)</p>	
<p>LE-R1-01-08 (2-4 YEARS)</p>		<p>LE-R1-02-08 (< 2 years)</p>	

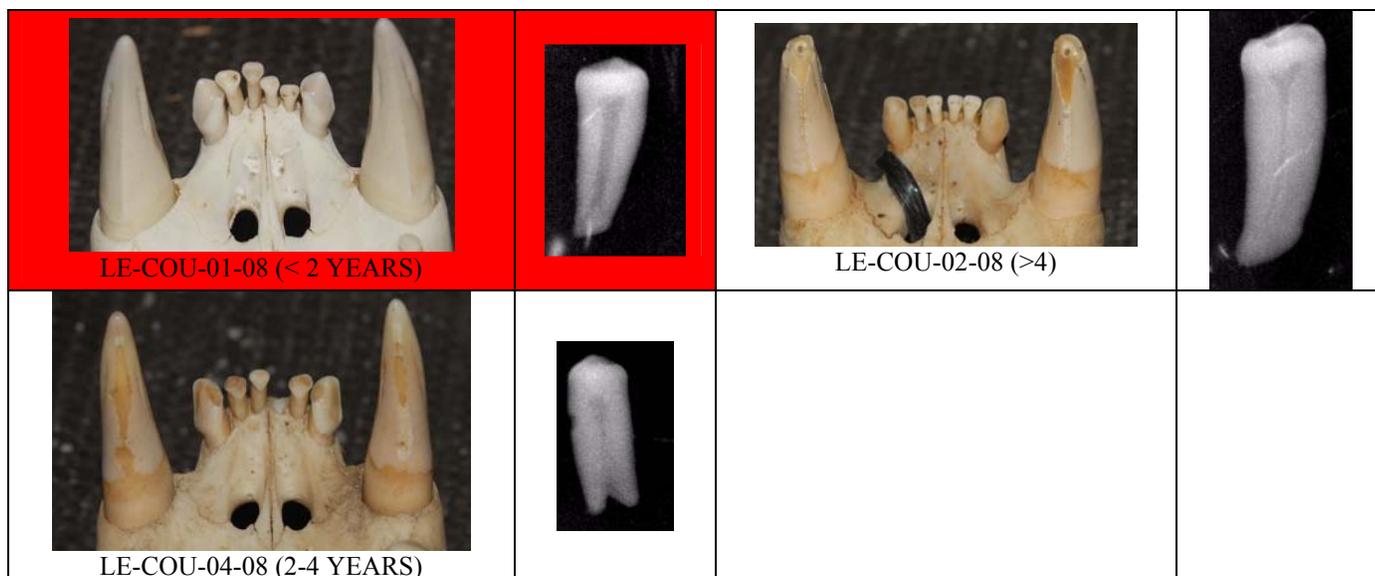


Plate 4: Tooth wear and X-rays of pulp cavities from 2008 Niassa leopard trophies (n = 14). All the teeth highlighted in red show minimal tooth wear and are considered 2 years or young based on lack of tooth wear. This is supported by the obviously broad pulp cavities in the teeth of these individuals.

6.4. Aging cues

- The average SCI (Safari Club International) “measurement” for Niassa leopards is 14, ranging from 12.4 to 14.6. In 2008, three leopards were below the SCI record book minimum of 14 and all but one of the trophies was smaller than the Roland Ward minimum of 15.
- As with lions the overall skull size does not appear to have any bearing on age in adult leopards.
- One of the aims of this project is to develop visual aging cues for Niassa leopards that PHs can use to more accurately age leopards before they are shot. With this in mind, PHs were asked to take basic body measurements of all the trophies and these were then correlated with tooth wear and its associated age category.
- Body measurements (total length, shoulder height, neck circumference) taken by PHs of trophy leopards over the past two years are shown in Table 4. At this stage results per age category are inconsistent showing no clear pattern although neck circumference and shoulder height do show a trend of increasing in the older the four age category. The weights should be treated with caution as leopards weight was frequently estimated as no scales were available and weight can be biased by the amount of bait eaten by the leopards.
- NCP initiated a study of leopards (late 2007 –Dec 2010) to assess leopard density in NNR through camera trapping and GPS radio collaring. In addition data are being collected on developing visual cues that can be used by PHs to age and sex leopard before they are taken as trophies. Eight leopards have been radio collared (5 males; 3 females). Teeth wear and body measurements from these individuals

show a similar pattern to the trophy monitoring data. Further details of the leopard research project are provided in the NCP annual report (2009) and are not provided here.

- Measurements of the collared male leopards are consistently smaller than the trophy animals (Table 4). However it is unclear whether this is because the captured sample is more random than the trophy sample with PHs preferentially shooting larger animals, whether it is due to differences in measuring technique or whether it is due to the small sample size of captured animals (five males). This difference is particularly obvious in the weight measurements where no leopard weighing more than 51kg has been captured compared to trophy animals weighing 70 kg.
- The data from the captured animals do suggest that there may be an age related difference in total body length, shoulder height and neck circumference but more data need to be collected to confirm this, as the data sets are currently too small and are strongly biased by single individuals.
- This would support the view of Niassa PHs that older leopards are more thickset than younger leopards and certainly camera trapping images do suggest there is a distinct difference between male leopards (Plate 5). However to date none of the thick set leopards have been caught and it is therefore impossible to assess whether they are consistently older than the more slender leopards. Three of the collared male leopards show significant tooth wear but none of them are thickset and the heaviest amongst them only weighs 51kg.



Plate5. Camera trapping images of two male leopards in the intensive study area showing the difference in body build. The radio-marked male leopard on the left (LECM04) shows obvious tooth wear and is believed to be older than four years (51 kg) but does not show the same thick necked build of the unknown male on the left, whose age is unknown.

Table 4: Measurements of 2007 and 2008 male leopard trophies taken by Professional Hunters in NNR from all age categories

Measurement	<2 years	2-4 years	> 4 years	Total Range	Total Sample Size (N)
	Mean (N)	Mean (N)	Mean (N)		
Trophy Animals					
Nose- tail tip body length (cm)	200 (8)	205 (11)	205 (5)	178-290	24
Weight (kg)	49 (8)	49 (11)	66 (5)	44-70	24
Shoulder Height (cm)	51 (8)	63 (13)	65 (5)	53-84	26
Neck Circumference (cm)	52 (6)	50 (11)	55 (5)	48-56	22
Collared males					
Nose- tail tip body length (cm)		194 (2)	227 (3)	187-265	5
Weight (kg)		35 (2)	42 (3)	30-51	5
Shoulder Height (cm)		43 (2)	53 (3)	39-68	5
Neck Circumference (cm)		43 (2)	46 (3)	39-50	5

7.0 Selected References

- Begg, C.M & Begg, K.S. 2007. Trophy monitoring in Niassa National Reserve, Mozambique: lion, leopard, buffalo, hippo and crocodile. Unpublished Internal Report for SRN, Maputo. 79pp
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Appendix A: SRN Lion Regulations



LION HUNTING IN NIIASSA NATIONAL RESERVE

Revised Lion Hunting Rules – 26th April 2006

In order to manage African lion hunting in the Niassa Reserve, SRN has established the following revised criteria and rules that should be strictly adhered to by all safari operators. These replace all previous criteria and rules concerning lion hunting and take effect from the date of this document unless otherwise indicated. The aim is to maximize trophy quality and economic returns from lion hunting in Niassa Reserve (NR), while maintaining the viability and growth of the Niassa lion population.

1. General Rules

1.1 Elected trophies:

- Only male lions may be hunted.
- Only adult males, which are a minimum of 6 years old, may be hunted as the hunting of young lions can cause severe disruption to pride structure and, if excessive, can cause a population to collapse.
- Lions may only be hunted on a minimum of an 18 day safari (effective 2007).
- As a rule no problem lions (e.g. man eaters) should be sold as trophy animals. However, should a client be in a position to hunt a problem lion (and specifically man eaters) the issue of the operator/client retaining and exporting the trophy will be assessed by SRN on a case by case basis. Furthermore, if an operator/client does shoot a problem lion this must be reported to SRN within 48 hours to allow for further investigation by the Reserve Warden or an SRN representative.

1.2 Trophy monitoring:

- For each lion on quota, a monitoring kit will be provided by SRN containing a disposable camera, map, datasheet and blood sample paper.
- For each lion trophy, the Professional Hunter is expected to take photographs (side view, front view of head and shoulder, nose and full body), and a blood sample from bullet wound while in the field.
- All questions on the datasheet must also be completed.

2 Trophy Quality Control

2.1 Responsibility: monitoring of trophy quality shall be conducted by the SRN representatives, currently K & C Begg.

2.2 Procedure: the safari operator shall notify representatives before lion trophies are removed from the Hunting Block at the end of the hunting season so that the SRN representatives can arrange a visit to collect trophy kits (photographs, blood samples and datasheets) and measure and age the skulls.

3. Assigning of Quotas:

3.1 Niassa Points System:

- Quotas will be assigned independently for each concession dependant on the age of lion trophies taken in the previous hunting season according to the Niassa Points System.
- The points system is self-regulating; it rewards ecologically sound hunting by allowing an increase in the quota to a maximum of five. Hunting of young lions under the age of six years is penalized. PH's receive no decrease in quota for not shooting a lion.
- Using this system, the off-take in each block will increase or decrease in accordance with real densities in each concession, accounting for hunting effort, anti-poaching measures (i.e. decreased illegal off-take) and natural population fluctuations (disease, drought etc.).
- The maximum of five lion for each concession is in place initially to ensure that the quota remains within 2 - 4% of the predicted adult male population. It is considered unlikely in the foreseeable future that more than five male lions of appropriate age will be available in each block. However this can be reassessed in the future.
- New concessions will be awarded an initial quota of two lions.
- If the quota is reduced to zero (i.e. only young lions are shot in the previous year), no quota is provided for the next year, but the quota will start at one lion the following year.
- Details of all trophies (datasheets, photographs of mane, teeth and nose) will be kept on file with SRN. If any disputes arise about a particular lion's age, a premolar can be sent for aging by Carbon-14 analysis at the cost of the concession holder (\$500). It is recommended that a premolar be made available from each trophy so that field aging techniques can be fine-tuned over time.

3.2 Procedure:

The Niassa Points System is a three-step process:

Step 1:

At the end of each hunting season (November) each lion trophy taken is aged by SRN representatives (currently K & C Begg) based on teeth, nose colour, mane development and general body condition.

Step 2:

Points are assigned to each trophy according to the following system.

Quota	Number of Points for each trophy				
	> 6 yrs	No trophy	4-6 yrs	< 4 yrs	Incomplete info
For Quotas of 3 or more	4	3	2	-3	0
For Quotas of 2	4	3	2	0	0
For Quotas of 1	6	3	0	0	0

For each concession, points are tallied for that year, divided by 3, rounded up to next whole number up to a maximum of 5 lions and that is the quota issued for the next hunting season. See examples in Appendix 1

Step 3

SRN will endeavor to inform operators of the new quota to allow time for marketing at safari shows in January.

- 3.3 Unethical Behaviour:** in case of Safari Operations or Professional Hunters behaving unethically (according to the applicable law in Mozambique), SRN may apply more severe actions, which might include trophy confiscation or PH License confiscation or cancellation of the lease agreement with the operator.

4. Trophy Export

The standard operating procedures apply.