Leopard (Panthera pardus) population and habitat viability assessment

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LEOPARD (*Panthera pardus*) POPULATION AND HABITAT VIABILITY ASSESSMENT

Southern African Wildlife College
10 - 14 April 2005

Sponsored by:

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Department of Environmental Affairs and Tourism

Convened by:

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CONSERVATION BREEDING SPECIALIST GROUP
SOUTHERN AFRICA

Department of Environmental Affairs and Tourism

LEOPARD (*Panthera pardus*)

POPULATION AND HABITAT VIABILITY ASSESSMENT

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WORKSHOP REPORT

Convened by:

CONSERVATION BREEDING SPECIALIST GROUP SOUTHERN AFRICA
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EXECUTIVE SUMMARY

BACKGROUND

Fundamental to the effective management and conservation of any species is a reliable estimation of population size, distribution and trends. This information is generally unknown for the Leopard (*Panthera pardus*) throughout its range in Africa, including South Africa. Despite the fact that accurate information on the status of this species is minimal, decisions regarding its future are frequently taken and the species continues to be hunted, persecuted and forced out of its natural range. In 2004, South Africa and Namibia applied for, and had approved, an increase in their Leopard CITES quotas, effectively allowing an increase in the numbers of Leopards killed for trophies by foreign hunters. Yet it has been proven that estimates of Leopard numbers in South Africa are hopelessly inaccurate and many other organisations and countries, opposing these increased quotas, urged South Africa to undertake Leopard censusing and research as a matter of urgency before allowing the increased off-take to be implemented.

Due to the fact that Leopards are the most widespread of the large cat species and occupy the widest variety of habitats, there is a tendency to believe that they are abundant everywhere. In many regions in South Africa, Leopards are readily persecuted due to the perception that they take livestock or large numbers of antelope, their natural prey, which now have a high commercial value on privately-owned game farms in the country.

The situation facing Leopards is therefore dire and without sufficient data on Leopard population biology, density, distribution and dynamics and ecological carrying capacity, particularly outside formal conservation areas, it is impossible for South Africa to make scientifically-sound conservation or management decisions regarding the fate of Leopards. Neither can we implement effective conservation strategies as long as the relevant stakeholders and role-players do not work cohesively, the available data are not collated and priority knowledge gaps are not addressed. Urgent attention needs to be paid to the fact that, as a country, we know very little about one of our most persecuted species which ironically holds enormous economic value to this country due to its charismatic nature and its profile as one of South Africa's “Big Five”.

The increased CITES quota and a recent rush of conservation activity on Leopards being undertaken by a disparate group of stakeholders prompted the Endangered Wildlife Trust (EWT) to initiate a Population and Habitat Viability Assessment (PHVA) to evaluate the current status of Leopard in South Africa, collate all available data and make informed recommendations on the management and conservation of this species.

For the Leopard, as with most species, habitat loss and degradation is the foremost threat to survival. However our limited knowledge and understanding of Leopard home range requirements in different habitats and forms of land-use, along with the fragmentation of Leopard habitats and our lack of knowledge about the availability, feasibility and use of corridors between fragmented habitats, compounds the threats facing this species. At present no data exist to allow for the determination of an optimal off-take of Leopards. Accurate information on the illegal killing of Leopards is almost non-existent and the impact of current Leopard losses is virtually impossible to determine. This, coupled with insufficient ecological information to guide appropriate decision-making on Leopard utilisation and poor implementation of current legislation, was highlighted as serious issues which require urgent attention.

Participants at the PHVA further identified a lack of scientific data to support methods to determine the most appropriate regional and national quotas and the uncertainty of the effects of removal on the demographics of a population. Aggravating this is continued farmer-predator conflict and the lack of capacity across the country to deal with problem animal management and illegal off-take.

THE CBSG PHVA WORKSHOP PROCESS

Thirty-three people participated in the multi-stakeholder PHVA workshop, representing the conservation NGO community, the Department of Environmental Affairs and Tourism (DEAT), various academic institutions, SANParks, provincial conservation departments, private game reserves and the Professional Hunters Association of South Africa (PHASA). A Briefing Document was made available to all workshop participants a week prior to the workshop which afforded participants the opportunity to get up-to-date on the latest information on Leopard biology, ecology, population dynamics and trends, distribution, threats and conservation status in South Africa.

The PHVA was held at the Southern African Wildlife College bordering the Kruger National Park over three and a half days. The first morning was dedicated to presentations covering DEAT's position on Leopard conservation and the decision to increase the CITES export quota for Leopard trophies and skins, the current status of genetic research, trade in Leopard trophies as well as the current status and distribution of Leopards in South Africa. Thereafter the workshop process, as outlined below, began.

The standard PHVA workshop process comprises a series of plenary and working group sessions in which working groups work through tasks designed to facilitate free thinking, brainstorming, discussion and debate, issue-tackling and finally, consensus building. After an initial group brainstorming session, a list of the key issues facing the survival of the Leopard in South Africa was derived which gave rise to the establishment of the following five working groups:

1. Population Biology Working Group
2. Habitat and Movement Working Group
3. Conflict Management Working Group
4. Utilisation and Policy Working Group
5. Population Modelling and Dynamics Working Group

Working groups then spent the next three days tackling issues specific to their group, and systematically worked through the tasks assigned which included drafting a situation overview, compiling problem statements, developing and prioritising solutions and goals and finally, working out detailed action plans and steps that will result in achieving the goals identified.

Plenary discussion sessions enabled working groups to present the results of their discussions to the whole group and obtain the input of all participants, which resulted in additional debate and insight from members of other working groups.

WORKING GROUP SUMMARIES

1. Population Biology Working Group

The Population Biology Working Group tackled the major issue of insufficient data, which includes data on Leopard genetics, population distribution, dynamics, and density, and ecological carrying capacity. This holds true throughout South Africa, especially in regions outside formal protected areas. Furthermore, a glaring lack of scientific data to support the method of determining quota allocation within Leopard populations, regional quotas and the quota for South Africa exists. Therefore, the effects of removing animals on the long-term demographics of the population are uncertain in the extreme. It was felt that this leads to incorrect decision-making due to misconceptions of Leopard numbers and demographics and therefore permits and quotas are incorrectly allocated. In addition, no reliable census methodology for Leopards, no clear protocols for the capture and management of problem-causing animals, and no cohesive conservation and management plans exist.

To address these issues, the group considered strategies to improve data collection and collation, involving a variety of stakeholders and increased research efforts in areas of the highest utilisation. One of these strategies is the inclusion of a clause into all Leopard hunting permits enforcing the collection of samples and data as required by the authorities. The group explored the possibility of establishing closer ties with academic institutions to utilise the data in applied research projects and to create incentives for the private sector to support these projects in key Leopard areas. One way in which this may work could be for farmers to make their land available and to possibly fund an identified Leopard research project. They may then be eligible for subsidy and / or tax deduction. It was deemed imperative that existing and future knowledge be utilised by decision-making bodies and effectively communicated to all stakeholders. As Leopard census methodologies and protocols are developed, it is also vital that these be coordinated so that studies and results country-wide can be calibrated. All knowledge and research / census results should feed into the development of a national conservation plan for Leopards which could be driven by the National Leopard Forum (NLF) being proposed at this workshop, which will act as a platform to consolidate, and filter data and advise on Leopard related issues.

2. Habitat and Movement Working Group

Issues tackled by this group included the lack of adequate knowledge and understanding of Leopard home range requirements in different habitats with different forms of land-use. Leopard habitat is also highly fragmented which is exacerbated by the extent of land-use practices which are incompatible with Leopard presence and dispersal (e.g. extensive crop farming and game farming). There is furthermore, a lack of knowledge about the availability, feasibility and use of corridors between fragmented habitats

It was felt that coordinated planning of priority areas for Leopard conservation is necessary. The group proposed a large research project around the development of a national GIS-based study to drive planning for Leopard conservation by identifying core areas, i.e. areas of suitable habitat, fragmented habitats, corridors and habitats outside protected areas suitable for home range and movement studies. Also required is a national database detailing current Leopard home range and movement data for South Africa. These data should be incorporated into bioregional plans at various levels of government to restrict further fragmentation in suitable Leopard habitat.

Expanding urbanisation and development increase the disturbance on Leopard movement patterns. Possible impacts of this on Leopard includes an increase in disease transmission between different species and the secondary impact of activities like mining and urbanisation, which may be greater than the footprint of the activity itself. Potential solutions would be to engage with the drivers of disturbance, for example industry and local decision-makers, to create and maintain awareness of the sources of disturbance and to minimise disturbance on Leopard through mitigation measures and legislation if necessary.

Finally, the group dealt with the challenges posed by barriers like fences, national highways and human settlements which cause habitat fragmentation and inhibit the movements of Leopard and / or their prey. A possible solution would be to support, through incentives and enabling legislation, the formation of conservancies over as much Leopard habitat as possible to create corridors which would enable the movement of Leopard and their prey.

3. Conflict Management Working Group

Problem-causing animal management strategies developed by this group were in response to the ongoing conflict between predators and farmers. In addressing this, the group considered the application of irresponsible and inappropriate stock farming practices and the fact that farmers suffer both actual and perceived financial losses due to Leopards. Often, Leopards are incorrectly identified as the cause of losses which leads to non-selective predator killing and the need for revenge often drives problem animal control. This is also compounded by a lack of appropriate problem animal management methods which are legal, humane, selective and economical. There is a lack of scientifically-sound information on the socio-economic impact of predators on farmlands and a perceived lack of empathy by conservation agencies for farmers' stock losses. The lack of follow-through by the authorities in the prosecution of cases involving the illegal killing of Leopards is a contributing factor as is the non-compliance with existing problem animal management policies and strategies.

Solutions to these issues include the development of a training manual on problem animal management as well as the prevention of conflict, through responsible and ethical practices including exclusion techniques. This training manual could be used by landowners, farmers, local and provincial governmental agencies, communities and any other relevant bodies. Education and awareness campaigns of the issues and their possible solutions were considered vital, as was support for improved implementation of the legislation which governs problem animal control. A limiting factor is capacity to provide the training and education, but the development of a National Leopard Forum was proposed as a suitable body to deal with this. It was noted that improved communication and cooperation between all stakeholder groups, including various governmental departments (e.g. agriculture and conservation), farmers, NGOs and landowners must be pursued. Scientific information on the real numbers of Leopards killed, as well as methods for accurately identifying the culprit is to be encouraged. The development of incentives for farmers to conserve, rather than persecute Leopards is also to be encouraged.

4. Utilisation and Policy Working Group

This group identified the concerns that Leopard hunting is negatively perceived by various groups and that the value of Leopard trophy hunting to conservation is not fully understood. Further, baiting and hunting of Leopards with dogs is considered unethical by some and there is perceived to be insufficient ecological information to support the hunting of Leopards. A general perception exists that Leopard hunting has an economic value but no conservation benefit. On the other hand, there is also a perception by game farmers that predation by Leopards on their game is detrimental to the economic activities of the farm. There is also a lack of suitable criteria by which to determine the suitability of Leopards to be hunted and utilisation data are insufficiently administered and disseminated.

Existing legislation is poorly enforced, exacerbated by a lack of national and provincial legislation and policy guidelines in certain sectors, resulting in disagreement between different stakeholders regarding current legislation and policy. There is also no index to allow for determining an optimal Leopard off-take and the quantity, quality (age, sex, area) and distribution of Leopard quotas is not scientifically based. A further concern is the lack of adequate information about the illegal killing of Leopard and the impact that this has on the viability of the population.

The group developed a series of strategies to address these issues which included:

- Banning the trophy hunting of all female Leopards and males under the age of four years;
- Improving efforts to determine Leopard distribution and density in key areas;
- Developing incentives for the declaration of destroyed problem animals to improve data return on illegal off-take;
- Allocating a proportion of the perceived problem-causing animals for trophy hunting, under the CITES quota, whether ultimately increased or not to150;
- Developing policy guidelines on implementing the new quotas i.e. age, sex, area, where animals may be hunted, percentage of the quota in each province etc.
- Educating landowners on methods of identifying specific problem animals;
- Developing incentives for farmers to tolerate Leopards on their farms;
- Encouraging research on the problem of Leopards preying on game / stock;
- Improving law enforcement and compliance by building capacity within provincial government departments;
- Developing mechanisms and procedures to enhance the efficient and responsible administration of permits and quota systems;
- Interpreting utilisation data when setting and allocating quotas, identifying problem areas and making these data available to stakeholders;
- Making the submission of data and biological samples a condition of issuing permits;
- Educating professional hunters on techniques regarding the reliable sexing and aging of hunted Leopards; and
- Using dogs only for following up on wounded animals or during controlled traditional hunts.

5. Population Modelling and Dynamics Working Group

The Population Modelling and Dynamics Working Group tested various management scenarios and proposals as well as to determine if, where and how increased utilisation quotas can be implemented without negatively impacting on the survival of the individual subpopulations.

Computer modelling is a valuable and versatile tool for assessing the risk of decline and ultimately the extinction of wildlife populations. However, participants at the Leopard PHVA felt that the input data could not currently be regarded as accurate but did agree that the modelling process could highlight critical problems and provide an overview of the species' situation and persistence. Once consensus was reached that the baseline data best projected the status quo in South Africa, a number of key areas were identified in a plenary session for further investigation. The baseline data were then used to predict the outcome of different scenarios using the ten key areas identified. Models were then developed to evaluate the effects of alternative management strategies and to identify the most effective conservation actions for Leopards in South Africa.

The distribution of Leopards in South Africa is thought to be widespread across a variety of geographic locations, habitats and management units. Ten core areas were identified and modelled as separate populations: Greater Kruger Area, Northern Limpopo Area, Waterberg / Mpumalanga Area, Northern KwaZulu-Natal Area, Kalahari Area, Orange River Area, Western Cape Area, Eastern Cape Mountain Area, Eastern Cape Valley Area and the Wild Coast Area. The current meta-population in South Africa was set at 4250 animals and the carrying capacity was determined to be 4965 animals. Leopards are removed from the metapopulation each year through a variety of legal and illegal methods, including trophy hunting, legal and illegal local hunting, the removal of problem animals and emigration from the Greater Kruger and Kalahari populations to Mozambique and Botswana. The total number of Leopards lost each year via these methods was estimated by the workshop participants to be 281 animals (with only 61 of the current CITES quota of 75 being utilised) with an estimated 28 animals thought to supplement the population from Mozambique, Zimbabwe and Botswana.

The baseline model represents the best estimates from the PHVA workshop participants on the current biology and status of the Leopard populations in South Africa and therefore the best projection of the future of these populations given our current state of knowledge. Results of the baseline model project that the Leopard metapopulation in South Africa is likely to persist over the next 100 years with relatively little loss in numbers or genetic diversity. Under current utilisation scenarios, there is zero probability of extinction in 100 years, and the mean population size at 100 years is 4025 with 99.7% gene diversity remaining. Despite this however, the fate of individual populations is less positive.

The populations in Kruger, Limpopo and Western Cape fare well (likely due to larger numbers and the influx of new genetic lines from outside of South Africa), and the Kalahari population, although small, is likely being rescued by the immigration of Leopards from Limpopo and Botswana. Although both the Waterberg / Mpumalanga and KwaZulu-Natal populations are also relatively large, they are however estimated to be experiencing fairly heavy harvesting. The remaining four small populations – Orange River, Eastern Cape (Mountains and Valley) and Wild Coast – demonstrate a general reduction in population size and gene diversity and a significant risk of extinction, with mean times to extinction ranging from 28 to 43 years. Specifically, the KwaZulu-Natal, Waterberg, Orange River, both the Eastern Cape and the Wild Coast populations have a higher risk of extinction than considered acceptable. Model projections suggest that the metapopulation goal of zero risk of extinction for Leopards in South Africa is met.

Against the baseline model, various possible scenarios were modelled with the following results:

i. Development in Waterberg / Mpumalanga:

Development in the area was modelled with an estimated net loss of about 15% of carrying capacity for Leopards and an increase in illegal harvest of an estimated 5%. Results indicated an increase in the probability of extinction of the local Leopard population from 8% to 13% over 100 years and a decrease in the mean size of surviving populations from 619 to 460 Leopards. The remaining populations and metapopulation are relatively unaffected.

ii. Distemper Outbreak:

Distemper was modelled as a potential catastrophe, occurring an average of 1 out of 100 years. The inclusion of distemper in the model had little effect on the South African metapopulation except to reduce mean metapopulation size due to loss of smaller populations. Distemper affected the smallest populations by increasing the risk of extinction and reducing population size and gene diversity; however, the effects were smaller when compared with changes in other factors such as survival, reproduction, population size and dispersal.

iii. Corridor Development:

The development of corridors between some populations was modelled by doubling the rate of dispersal among connected populations. The following corridors were modelled:

Corridor 6-7:	Orange River and Western Cape
Corridor 7-8-9:	Western Cape, East Cape Mountain, East Cape Valley triad
Corridor 9-10:	East Cape Valley and Wild Coast
Corridor All:	Combination of all 5 corridors above (6-7; 7-8; 8-9; 7-9; 9-10)

There is little effect on the metapopulation or on local populations in Kruger, Limpopo, Waterberg / Mpumalanga, KwaZulu-Natal, Kalahari or Western Cape in this model. Increased dispersal between Eastern Cape Valley and the Wild Coast does not lower the risk of extinction for the Wild Coast and may have a detrimental effect on the Eastern Cape populations. In contrast, corridors between the Orange River and Western Cape and among the three populations of Western and Eastern Cape dramatically lowers the risk of extinction of the Orange River and Eastern Cape populations. Although these results suggest the benefit of creating corridors between these populations, the actual impact of such a strategy depends on the current degree of movement of animals through these areas and additional mortality factors associated with dispersal.

iv. Management of Small Populations:

Five of the Leopard populations modelled have an estimated carrying capacity of below 100 individuals. Of these, only the Kalahari population is projected to be secure, due to a continuous influx of Leopards from Botswana but the remaining four small populations remain vulnerable. Management strategies explored with the model include increasing carrying capacity by 10%, possibly through securing additional habitat and eliminating harvest in these populations, through increased protection and alternative problem animal management.

Increasing the carrying capacity by 10% does not dramatically alter the fate of these populations. Increased connectivity with adjacent populations does have a significant impact, particularly on the persistence of Leopards in the Eastern Cape. Most significant, however, is the impact of eliminating the loss of Leopards from these populations due to illegal hunting and problem animal removal. Eliminating harvest allows these populations to grow to carrying capacity with little to no risk of extinction. These results recommend that a concerted effort is made to reduce the removal of animals from these populations via both legal and illegal avenues.

v. Harvesting Strategies:

Harvesting Leopards can have major impacts on local populations and the number and distribution of Leopard across South Africa. Eliminating all harvest from the model results in the persistence of all 10 local populations and the maintenance of about 5000 Leopards in South Africa (vs. about 4000 projected by the baseline model with harvest). PHVA participants identified five sources of Leopard take-off: trophy hunting; legal local hunting; illegal local hunting; removal of problem animals; and emigration out of South Africa to adjacent populations. Trophy, legal local hunting and emigration occur in few populations, but illegal hunting and removal of problem animals occurs at some level for all populations. The effects of harvest depend upon the number, sex and location of the Leopards harvested.

Several harvesting strategies were explored with the Vortex model to evaluate these effects.

a. Removing Illegal Harvest

Illegal local hunting accounts for 43% of the annual harvest in the model and affects all Leopard populations. Eliminating illegal hunting from the model has a significant impact on the persistence of local populations; all populations have zero risk of extinction in the next 100 years. Model results suggest that even small populations can withstand the removal of occasional problem animals if illegal hunting is eliminated. Estimates of the rates of illegal hunting are uncertain and thus efforts to document and reduce / eliminate illegal Leopard removal are recommended.

b. CITES Hunting Quota: Number of Leopards

At the 2004 CITES Conference of Parties meeting the South African annual quota for Leopard hunting trophies was increased from 75 to 150 individuals and the potential impact of this increase was of concern to the PHVA participants. The baseline and other scenarios incorporated the effects of the past quota of 75 Leopards, by removing adult Leopards (60% male, 40% female) annually from four populations: Kruger, Limpopo, Waterberg / Mpumalanga and KwaZulu-Natal, although it is estimated that only 61 of the 75 Leopards allotted in this quota are removed annually. Several model scenarios were run to assess the impact of increasing the CITES quota and levels tested were 0, 75, 90, 105, 120, 135 and 150 number of individuals.

The number of Leopards harvested through trophy hunting in the range tested (0 to 150 annually) had no effect on the persistence of Leopards in Kruger, Limpopo, Kalahari and the Western Cape and the risk of extinction over 100 years remains zero for these populations. Orange River, Eastern Cape Valley and the Wild Coast populations remain relatively unaffected, as no Leopards are removed via trophy hunting from these populations. However, the Eastern Cape Mountain population shows a sharp increase in risk of extinction with all levels of trophy hunting due to the constant removal of four Leopards per year under all quota levels. The allotment of just four trophy permits per year to this area increases the risk of extinction in 100 years from 28% to over 60%. Clearly, this population cannot sustain even this minimal level of removal in combination with other threats.

The remaining two populations, Waterberg / Mpumalanga and KwaZulu-Natal are subject to trophy hunting and become smaller and more susceptible to extinction as hunting quotas increase. The probability of extinction for the Waterberg population increases from 16% to 25% with the increase in quota from 75 to 150 Leopards. Of more concern, is the significant decline in mean population size with increased hunting: from over 1000 Leopards with no trophy hunting, to 464 with a quota of 75, to 6 Leopards with the quota of 150. With the annual removal of 42 Leopards from the Waterberg, the mean population size drops below 100, suggesting that increased removal puts this population at a high risk.

Increased trophy hunting has the greatest impact on the KwaZulu-Natal population with the risk of extinction rising from 11% with no hunting to 62% under the 150 quota scenario (with 10 animals being hunted in KwaZulu-Natal) and mean population size dropping from 393 to 217. Despite the relatively large population size and estimated carrying capacity, the removal of 2-3 additional Leopards annually puts this population at much greater risk. Increasing the CITES quota from 75 to 150 does not increase the risk of extinction of Leopards throughout South Africa over the next 100 years, but does decrease the overall metapopulation size from a projected 4631 with no trophy hunting, to 3844 with a quota of 75 to 3196 with the 150 quota, representing a decline from 93% to 64% of the carrying capacity. These results suggest that the effects of increased quotas depend on the areas from which Leopards are taken and may lead to local extinctions and reduced population size. These results suggest that the effects of increased quotas will depend in part on the areas from which Leopards are taken and can lead to local extinctions and reduced population size.

c. CITES Hunting Quota: Targeting Males

It would be difficult to restrict local hunting and the removal of problem animals to males only, and some populations might not be able to withstand the loss of many males each year given the already female-biased sex ratio. However, it may be more feasible and desirable to target adult males for trophy hunting. The effects of only male trophy hunting are however modest. Waterberg and Eastern Cape Mountain populations have a lower risk of extinction but few Leopards persist in these areas. The risk of extinction for the KwaZulu-Natal population is substantially lower and mean population size is higher, suggesting that a male-biased sex ratio of trophy hunting may be beneficial in this area. Mean population size is slightly higher for the entire metapopulation with male-biased trophy hunting.

d. CITES Hunting Quota: Targeting Problem Animals

Workshop participants estimated that about 50 problem Leopards are removed annually from South Africa due to conflict with humans. One potential harvest strategy is to target these problem animals when hunting Leopards under the CITES quota and thus reduce the number of Leopards removed from the population while satisfying both needs. Therefore the 150 quota scenario was tested with 30 of the 150 leopards hunted being problem animals in Limpopo (11), Waterberg (11), KwaZulu-Natal (7), and East Cape Mountain (1), with 60% of them being males. Hunting of problem Leopards for trophies has a small effect in most areas except for KwaZulu-Natal, where the risk of extinction drops from 62% to 14% and mean population size almost doubles. There is a small increase in the metapopulation under this strategy. The effectiveness of this strategy will depend heavily upon the population area(s) from which problem-causing Leopards are removed.

e. Sustainable Harvest for Local Populations

The baseline model was used to vary annual harvest levels in each population separately to estimate the maximum level of annual harvest that would meet the PHVA workshop population goals of zero extinction risk for Kruger, KwaZulu-Natal, Kalahari and Western Cape populations and probability of extinction is < 5% for the remaining six populations.

In this case, harvest includes the loss of Leopards from all sources outside of normal mortality, including trophy hunting, legal and illegal local hunting, removal of problem animals and Leopard emigration out of South Africa. In this scenario, it is estimated that up to an absolute maximum of 350 adult Leopards (53% males) can be removed each year without unacceptable risk to the metapopulation - all local populations have a low risk of extinction in 100 years, and all populations except Wild Coast maintain high levels of genetic variation. Current estimates include an annual loss of 77 animals through emigration and problem animal removal and another 143 Leopards removed through legal and illegal local hunting, leaving approximately 130 animals potentially available to be harvested through trophy hunting Of this remaining 130 animals 61 Leopards are currently known to be taken annually under the current CITES quota of 75 animals. This suggests that a maximum of another 69 animals may be hunted should the CITES quota be increased to 150, before extinction risks become unacceptable. This assumes that our estimates of current Leopard losses are correct at 281 in total as the maximum harvest model suggests that no more that 350 animals can be removed from the total population per annum without severely negatively affecting long-term survival. Should the figure of actual losses be higher than the estimated 281, the number of Leopards “available” to be hunted must be reduced accordingly.

It is important to note that with no off-take through trophy hunting, the metapopulation size remains relatively stable at current baseline model values. Thus any CITES quota off-takes are projected to result on average in overall population reduction due to local declines and extinctions (but not increased risk of extirpation of Leopards from South Africa within the 100 year timeframe modelled).The maximum harvest level depicted by the model also emphasises the importance of careful selection of the geographic area from which Leopards are harvested. It is imperative that these figures are treated with caution due to the paucity of reliable data available. It is recommended that concerted efforts and adequate resources are committed to filling these data gaps and revision of the modelling is undertaken before quota increases are implemented.

SUMMARY

The baseline population model for Leopards developed at the PHVA is based upon best estimates of Leopard biology and threats to South African Leopard populations and, unless otherwise indicated, assumes that these conditions will remain constant over time. Because our understanding of Leopard population biology and current status is incomplete and conditions are not likely to remain constant, it is difficult to produce accurate population projections over 100 years. However, this model is useful for predicting population trends and evaluating the relative effectiveness of various management and harvest options.

With current estimated rates of legal and illegal harvest of Leopards and movement of Leopards among populations and across international borders, model results indicate that there is little risk of extinction of Leopards in the areas of Greater Kruger, North Limpopo, Western Cape and Kalahari and therefore no risk of extirpation of Leopards from South Africa. Populations in other areas of the country (specifically, Waterberg / Mpumalanga, North KwaZulu-Natal, Orange River, East Cape Mountain and Valley, and Wild Coast) are at some risk of extinction depending upon population size and carrying capacity, demographic rates, dispersal rates among populations and harvest rates. Populations in Eastern Cape Valley and the

Wild Coast in particular are highly vulnerable to extinction in the next few decades. Potential strategies to promote the persistence of these six populations include augmentation of natural corridors among adjacent populations and minimizing harvest of Leopards from these populations.

The Vortex Leopard model suggests that some level of controlled harvest can be sustained without unacceptable risk to the metapopulation. It is currently difficult however, due to a paucity of reliable data, to determine the exact level of harvest that is sustainable as this is dependent on demographic rates, population size and distribution, available habitat and the sex and location of harvested animals. The maximum harvest model suggests that no more than an additional 69 Leopards and possibly less, can be removed from the South African metapopulation. If these are restricted to male animals, this may have a slightly less negative impact on the smallest, most isolated populations. An increased off-take (should an increased CITES quota be implemented) can, only be sustained in four of the populations and in the smaller populations even a slight increase in individuals taken vastly increases the possibility of local extinction.

Eliminating illegal hunting has a significant positive impact on survival of local populations, all of which will then have zero risk of extinction in the next 100 years. Improved protection of Leopards (see chapters dealing with conflict resolution and utilisation) may in the long-term potentially allow an increase in legal hunting quotas. All efforts should therefore be made to minimise illegal hunting in all areas and to prevent the killing or removal of any Leopards from small, fragmented populations to reduce the risk of local extinction.

Increased population monitoring and data gathering is imperative to assess the impact of harvesting and to allow harvesting rates to be adjusted as needed. As better data on Leopard biology and populations become available, the Leopard population model can be revised to improve the ability to project the impact of harvesting on Leopard populations throughout South Africa.

FINAL PLENARY SESSION: THE WAY FORWARD

The outcome of this workshop includes a peer-reviewed, collaborative conservation strategy for Leopards with a number of realistic, achievable conservation actions and recommendations for improving the current status, utilisation and management of Leopards in South Africa. Another significant outcome was the establishment of the National Leopard Forum with a steering committee of 11 workshop participants selected by a voting process, to coordinate the continued conservation, research and management of Leopards in the region. This Forum will:

- provide a communication forum / portal to disseminate information on Leopards and collate available existing data;
- spearhead the implementation of the Leopard PHVA report;
- acts as a filtering and clearing house for Leopard research and data;
- network and collaborate with other relevant organisations to identify all stakeholders;
- provide a watchdog role that can identify problem areas and negative impacts; and
- identify and address the gaps in knowledge and understanding of Leopards.

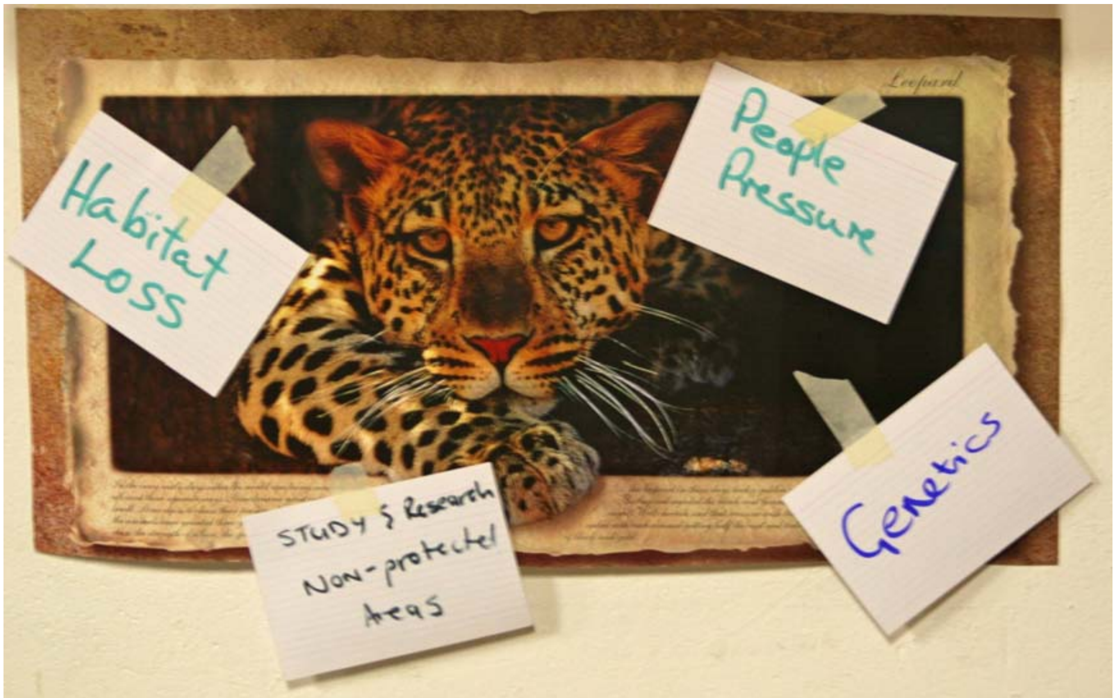
Participants in the Leopard PHVA Workshop 2005

LEOPARD POPULATION AND HABITAT VIABILITY ASSESSMENT

10 - 14 April 2005

Southern African Wildlife College

WORKSHOP REPORT



SECTION 2

PRESENTATIONS

DEAT's POSITION ON LEOPARD CONSERVATION AND THE RECENT CITES APPROVAL TO UP THE LEOPARD EXPORT QUOTA FOR HUNTING TROPHIES AND SKINS

MULESO KHARIKA – DEPARTMENT ENVIRONMENTAL AFFAIRS AND TOURISM

DEPARTMENT: ENVIRONMENTAL AFFAIRS AND TOURISM
REPUBLIC OF SOUTH AFRICA

INFORMATION SHEET

LEOPARD POPULATION AND HABITAT VIABILITY ASSESSMENT (PHVA)

The department identified the need for a population and habitat viability assessment for Leopard after the adoption of the South African proposal to the 13th meeting of the Conference of Parties (CoP) to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to increase the annual quota for Leopard hunting trophies and skins for personal use[1] from 75 to 150.

The proposal to the 13th CoP to CITES was based on information provided in the data sheet for Leopard in the Red Data Book of the Mammals of South Africa published in 2004 as well as information received from the various provinces relating to projected population numbers based on suitable habitat available within the province and reports relating to Leopard sightings and conflict with farmers and communities. In this instance, Limpopo province provided information indicating that approximately two thirds (±75 000km²) of the total surface area of the province is suitable Leopard habitat and based on that the estimated population size is 3 000 Leopards in the province.

A total of 5.4% (±67 000km²) of South Africa's surface area is under formal conservation, with South African National Parks managing 52% of this area. Leopards occur in most of these protected areas and are formally protected in the national parks and provincial reserves. No hunting or any other form of consumptive utilisation is allowed in national parks.

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[1] The quota allocated in terms of CITES Resolution Conf. 10.14 (Rev.) is for whole skins or nearly whole skins of leopard (including hunting trophies). It therefore includes skins and trophies other than those obtained by international hunters and therefore provinces make provision within the quota allocated to them for the export of skins for personal purposes other than hunting trophies.

According to Martin and De Meulenaer (1988)[2] South Africa contains the greatest number of vegetation types of any country in Africa and much of it is ideal Leopard habitat. Martin and De Meulenaer's 95% confidence intervals for South Africa are as follows:

Predicted Population	Lower Limit	Upper Limit
23 472	12 910	42 954

The study by Martin and De Meulenaer was done in 1988 and since then large numbers of commercial cattle farms have been converted to game farms, increasing suitable habitat available to Leopard and reducing conflict with cattle farmers.

A Leopard population estimate of 10 000 was used by South Africa to determine the viable increase in the export quota. The export quota comprises 1.5% of the population.

The department is responsible for the allocation of the Leopard quota to the various provinces and would like to make an informed decision regarding the allocation of the additional individuals to the quota to ensure the sustainable use and the long-term viability of the species.

The South African Leopard quota is managed as an annual take-off / hunting quota. This means that no more than 75 Leopard may be hunted in South Africa by international hunters / clients within one calendar year. If the whole quota was not utilised within one year it is NOT transferred to the next year. The department submits annual reports relating to the management of the Leopard quota to the CITES Secretariat and since 1992 the quota has not been exceeded (Table 1).

Table 1: Analysis of data received from the United Nations Environment Programme's World Conservation Monitoring Centre based on annual reports submitted by South Africa

Year	Export of skins and trophies
1992	43
1993	73
1994	63
1995	60 - 85[3]
1996	60
1997	60
1998	53
1999	49
2000	71
2001	71
2002	57

It seems as if under-utilisation of the quota has been taking place, but several factors must be taken into account:

- The management of the quota in each province.

[2] Martin, R.B. and De Meulenaer, T. 1988. Survey of the Status of the Leopard (*Panthera pardus*) in Sub-Saharan Africa. Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. Lausanne. Switzerland.

[3] The import data reflect 60 skins and trophies imported in other countries, while the export data reflects 85 skins and trophies exported from South Africa. This is due to the fact that South Africa report on permits issued and not actual exports taking place. For all the other years the export and import data correlates.

- The fact that not all Leopard hunts are successful.
- A Leopard may have been hunted in one year, but are only exported the next year due to the taxidermy process.

The department allocates the quota of 75 to the various provinces (Table 2) on an annual basis, based on the requirements of the different provinces. Provinces allocate quotas based on the:

- distribution of Leopard in any given area
- complaints received from landowners about problem Leopards,
- utilisation patterns in a given area.

Table 2: Leopard quotas allocated to the nine provinces (1996 – 2005)

Year	Province	Leopard quota	Year	Province	Leopard quota
1996	Western Cape	0	2001	Western Cape	0
	KwaZulu-Natal	10		KwaZulu-Natal	7
	Limpopo	41		Limpopo	43
	North West	14		North West	12
	Mpumalanga	10		Mpumalanga	8
	Eastern Cape	0		Eastern Cape	2
	Gauteng	0		Gauteng	2
	Free State	0		Free State	1
	Northern Cape	0		Northern Cape	0
1997	Western Cape	0	2002	Western Cape	0
	KwaZulu-Natal	10		KwaZulu-Natal	7
	Limpopo	45		Limpopo	43
	North West	10		North West	12
	Mpumalanga	10		Mpumalanga	8
	Eastern Cape	0		Eastern Cape	3
	Gauteng	0		Gauteng	2
	Free State	0		Free State	0
	Northern Cape	0		Northern Cape	0
1998	Western Cape	2	2003	Western Cape	2
	KwaZulu-Natal	7		KwaZulu-Natal	5
	Limpopo	40		Limpopo	35
	North West	12		North West	20
	Mpumalanga	8		Mpumalanga	8
	Eastern Cape	3		Eastern Cape	2
	Gauteng	2		Gauteng	2
	Free State	1		Free State	1
	Northern Cape	0		Northern Cape	0
1999	Western Cape	2	2004	Western Cape	0
	KwaZulu-Natal	7		KwaZulu-Natal	5
	Limpopo	40		Limpopo	35
	North West	12		North West	22
	Mpumalanga	8		Mpumalanga	9
	Eastern Cape	4		Eastern Cape	0
	Gauteng	0		Gauteng	2
	Free State	2		Free State	1
	Northern Cape	0		Northern Cape	0
2000	Western Cape	2	2005	Western Cape	0

Year	Province	Leopard quota	Year	Province	Leopard quota
	KwaZulu-Natal	7		KwaZulu-Natal	5
	Limpopo	40		Limpopo	35
	North West	12		North West	20
	Mpumalanga	8		Mpumalanga	9
	Eastern Cape	4		Eastern Cape	4
	Gauteng	0		Gauteng	2
	Free State	2		Free State	0
	Northern Cape	0		Northern Cape	0

In order to monitor Leopard utilisation, provincial conservation authorities keep a database of all Leopard hunts. Nature conservation authorities allocate hunting rights for Leopard hunts based on the number of Leopard hunts that took place in a given area or farm. Hunting is not allowed to take place in consecutive years on the same property / area. Leopard hunts are therefore distributed between various regions in order to prevent over utilisation.

There are however numerous issues to be considered in the management of Leopard and the allocation of hunting quotas for this species.

Due to the secretive and nocturnal behaviour of Leopard it is extremely difficult to determine absolute numbers of Leopard in South Africa. We do know that they have a wide habitat tolerance and while they are generally associated with areas of rocky hills, mountain ranges, riverine or kloof forests, which provide them with shelter, they also occur in semi-desert areas where there is cover in the form of tall grass or underbrush. The Leopard, being the least specialised of the big cats, is successful wherever diversified habitats afford a variety of small to medium sized mammals.

Furthermore, in many areas of South Africa, traditional land-use practices such as livestock farming are no longer viable. Game ranching has become a more viable and lucrative land-use option where vast tracts of land are now stocked with indigenous species of antelope. This phenomenon has created a much improved prey base for Leopards and has possibly made previously unsuitable habitat more suitable for predators such as Leopard.

CURRENT STATUS OF LEOPARD GENETIC RESEARCH IN SOUTH AFRICA

NICOLE MARTINS – THE CAPE LEOPARD TRUST

Leopard Genetics - Past, Present and Future

The first genetic study on Leopard, "Phylogeographic subspecies recognition in Leopards (*Panthera pardus*): Molecular genetic variation", was undertaken by Miththapala, *et al*. in 1996. At the time there was a great need to accurately identify subspecies of Leopard throughout its global range in order to assess the conservation status of certain populations / subspecies.

Prior to this study, 27 subspecies of Leopard had been described globally based on phenotypic and geographical variation, 13 subspecies occurring in Africa alone. In their study they collected 16 samples from 4 different populations / subspecies in Africa. However, none were collected south of the Kruger National Park. The study found 1 subspecies of Leopard occurring throughout Africa and 8 subspecies throughout its global range.

In 2001, Uphyrkina *et al.* revisited Miththapala's data, adding a few more Leopard samples from Asian populations. They found a minimum of 9 subspecies globally. The new subspecies described being *P. p. delacouri* in Southern China, but stated that "because of limited sampling of African populations, this may be an underestimate." The study also showed that modern Leopard lineages originated 470 000 – 825 000 years ago in Africa followed by a migration into and across Asia 170 000 – 300 000 years ago.

In 2000, Goran Spong used genetic variation to investigate the population history of Leopards in Tanzania. The study found an effective population size (hypothetical population in which each individual in a population has equal opportunity of mating) of 38 000 – 48 000 Leopards. It identified a present population size of 100 000 Leopards (compared to 10 000 – 100 000 Leopards estimated by Martin and de Meulenaar, 1988) with no past genetic bottlenecks, no genetic structuring, large migration values (3.3 individuals / generation) and no inbreeding depression.

A study investigating the conservation genetics of Leopards in South Africa, is currently being undertaken by Nicole Martins, Associate Professor Conrad Matthee (Stellenbosch University) and Dr. Lawrence Kirkendall (University of Bergen). This will reveal the possible genetic / geographic partitioning of Leopards in South Africa as well as verify *Uphyrkina* and *Miththapala's* subspecies estimate for South Africa.

The study will look for past genetic bottlenecks that may have occurred within certain populations, migration values between populations as well as possible inbreeding. This will allow insight into the genetic health of Leopard populations in S.A. and ultimately be utilised to improve the conservation and management of the species on a national level. The information will also be used, in conjunction with other camera-trapping studies in S.A., to estimate Leopard population sizes (effective and census).

This study is made possible through contributions from The University of Bergen, Stellenbosch University, Africa Geographic and The Cape Leopard Trust.

THE HEALTH STATUS OF SOUTH AFRICAN LEOPARD POPULATIONS

DR WILLIAM HORSNELL - UNIVERSITY OF CAPE TOWN
DR MARK FOX - ROYAL VETERINARY COLLEGE

It has become apparent that Leopard populations are smaller and more fragmented than previously appreciated. This situation increases the likelihood of a population being threatened by disease outbreaks. A detailed health study of a number of Leopard populations in South Africa was proposed, that will address parasite and endocrine markers of animal health.

The study will address how the fragmentation of Leopard distribution may impact upon population health and viability. The proposed study will aim to complement current ecological research being carried out in the field. There is unique access to an excellent range of sample sources which will enable a rigorous examination of the proposed hypothesis. The samples sources available include:

- Habituated Leopard populations in a number of reserves contiguous with the Kruger National Park for collection of fresh faecal samples along with blood and tissue samples from immobilised individuals.
- All trophy hunted Leopards in the Limpopo province.
- All problem Leopards destroyed by predator control officers in the Western Cape and also Leopards immobilised for radio telemetry.

This constitutes an excellent and unique opportunity to comprehensively study the health status of Leopards in South Africa.

The project will answer the following questions:

- Which pathogens infect Leopards; at what intensities and does this vary between populations?
- What environmental factors contribute to the level of infection (e.g. habitat, conservation management practices, prey population density, area of habitat available, persecution)?
- Do environmental factors impact on the endocrine state of Leopards?
- Does endocrine state impact on levels of pathogen infection, behavioural patterns and reproductive ability?

CURRENT STATUS OF TRADE IN LEOPARD IN SOUTH AFRICA

CLAIRE PATTERSON - TRAFFIC East / Southern Africa

Leopards are listed on Appendix I of CITES which means that they may not be traded commercially. They may however be hunted for their trophy and the trophy exported to the hunters country of residence. Leopards may also be traded for non-commercial purposes such as that which takes place between zoo's, research institutions or for captive breeding programmes. Permits are, however, required for the import and export of these Leopards and their trophies.

Countries which are a party to CITES are required to compile an annual report and submit this data to the CITES Secretariat. This data is held by the World Conservation Monitoring Centre (WCMC) and is available for analysis and management purposes.

The limitations of this data are as follows:

- Countries are required to submit the data by 31 October of the following year and available data may be a year or two behind actual;
- If a country does not submit data, then no data is available;
- Data generally reflects the total amount for transaction and not the actual amount (i.e. someone applies to export 10 claws but two were damaged and discarded and only eight were actually exported – the permit will reflect 10, not eight);
- CITES permits are normally valid for six months. This may fall over two years in which case the data will reflect the year in which the permit was applied for and not the year that the actual transaction took place; and,
- 'Export' data includes both exports and re-exports. Re-exports are when, for example, a Leopard is hunted in Zimbabwe, and the skin is exported to South Africa for tanning and then exported from South Africa to the hunter's country of residence. This has the effect of making South Africa's trade look larger than it actually is.

Keeping the above in mind, a very brief analysis of the trade in Leopards and their derivatives for the period 1990-2003 is as follows:

- Exports – South Africa exported to a total of 52 countries. A further five transactions were to 'unknown' countries. The main partners were the US (1,347 items), Germany (154 items), Spain (131 items), Italy (74 items) and France (67 items). These were mainly hunting trophies (1,789), scientific specimens (198 items) and personal effects (120 items); and,
- Imports – the main countries reporting imports were the US, Denmark, Spain, Italy and France. On the whole, reported imports were lower than reported exports (e.g. US reported 940 items imported whereas South Africa reported exports of 1,347 items. This could be explained by the limitations above but would need further investigation).

CITES requires that tags be attached to Leopard skins. These tags should be marked with a specific reference number indicating the country of origin, species, year and number of and total quota. For example, a tag number ZA PAR 05 21/150 refers to a Leopard (PAR) being hunted in South Africa (ZA) in 2005 (05). The Leopard was number 21 of a total quota of 150 (21/150). These numbers should never be duplicated and the quota may not be exceeded.

THE DISTRIBUTION AND STATUS OF THE LEOPARD IN SOUTH AFRICA

GUS MILLS - ENDANGERED WILDLIFE TRUST'S CARNIVORE CONSERVATION GROUP AND SANPARKS

The Leopard has the greatest geographic distribution of any felid, occurring from the southern parts of the African continent through the Middle East to the far East, northwards to Siberia and south to Sri Lanka and Malaysia. It exhibits a remarkable degree of flexibility to habitat, surviving in practically every kind of terrestrial habitat from tropical rain forest to desert. It is also very successful at adapting to altered natural habitat and settled environments in the absence of intense persecution.

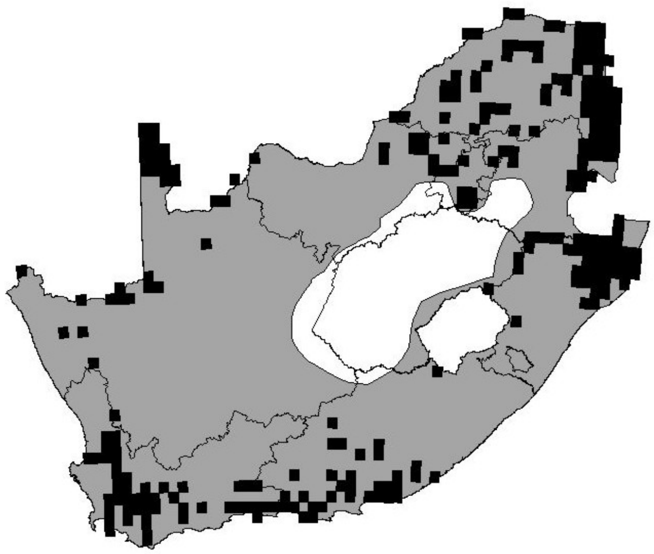

Figure 1: Distribution of the Leopard in South Africa (The black blocks show museum records and personal observations, the grey shaded area extent of occurrence). From Friedmann, Y. and Daly, B. (editors) 2004. *Red Data Book of the Mammals of South Africa*.

From the above figure, it would appear that the Kruger National Park and surrounding private reserves have the largest population – probably over 1 000. The Kalahari Gemsbok National Park as part of the Kgalagadi Transfrontier Park, shares a population in excess of 150 with the Gemsbok National Park in Botswana. These two populations are the most important in South Africa because they are situated in very large protected areas where the Leopard is not managed or hunted and able to play out its full repertoire of behavioural and ecosystem functions.

Northern Zululand with Hluhluwe-Imfolozi Park, Greater St Lucia, Mkuzi, Phinda, Ndumu, and Itala Game Reserves, as well as other numerous private reserves, would appear to have good potential for Leopard conservation. The species is widespread in Limpopo Province and the eastern regions of the North West Province, with the Magaliesberg, Waterberg and Soutpansberg reportedly containing viable populations. The species is widely distributed within the Cape Fold Mountains in the Western Cape. There is also a cluster in the mountains and forest areas towards the Eastern Cape. The Valley Bushveld areas of the Eastern Cape appear to contain another population.

LEOPARD POPULATION AND HABITAT VIABILITY ASSESSMENT

10 - 14 April 2005

Southern African Wildlife College

WORKSHOP REPORT

SECTION 3

WORKING GROUP REPORTS

Population Biology Working Group

WORKING GROUP PARTICIPANTS

1. Cailey Owen:	Karongwe Ecological Research Institute (K.e.r.i.)
2. Juan Pinto:	Royal Malewane
3. Nora Blyth:	Leopard Environment and Protection (L.E.A.P.)
4. Shawn Catterall:	Welgevonden Game Reserve
5. Tycho Thal:	Protecting African Wildlife (PAW) Conservation Trust
6. Gerrie Camacho:	Mpumalanga Parks Board
7. Freek Nel:	De Wildt Cheetah and Wildlife Trust
8. Jannie Parsons:	Shayamanzi Game (Pty.) Ltd
9. Kobus Lee:	Waterberg Leopard Study Group
10. John Power:	Limpopo South Frontiers

PROBLEM STATEMENTS

PROBLEM STATEMENT 1
INSUFFICIENT DATA, QUALITY AND QUANTITY - SUCH AS GENETIC DATA, ECOLOGICAL CARRYING CAPACITY AND POPULATION DENSITY, DISTRIBUTION, POPULATION DYNAMICS (ESPECIALLY OUTSIDE CONSERVED AREAS), LACK OF DETAILED REGIONAL RESEARCH AND DATA ON LEOPARD NUMBERS THROUGHOUT SOUTH AFRICA

Solution 1
Gather and integrate available reliable data and projects (including corporations, NGOs, universities, and private businesses).

Minimum goal: 60%
Maximum goal: 100%

<u>Action Step 1:</u>
Designating individuals responsible to collect the data and obtaining adequate funds.

Resources Needed:	GIS system, person to set up database, telephone, computer, emails, Internet, funding for overheads, general office equipment, access to universities library systems, networking, taxidermist records, government feedback from Parks Boards and conservation offices, accessing previous and current studies.
Responsibility:	Cailey Owen, John Power and Shawn Catterall.
Timeline:	Within a year, April 2006.
Obstacles:	Funding, time constraints (work obligations on part of responsible individuals), difficulty to access data, data input time, researchers not willing to share their information.
Collaborators:	All participants at the workshop, universities, NGOs (such as the EWT), hunting communities, farmers, taxidermists, government conservation departments.

Measurable Outcomes:

- Extent of data collected e.g. all published data prior to the workshop should be collected in one year.
- Collect government records of six provinces: Mpumalanga, Limpopo, KwaZulu-Natal, North West, Western Cape, and Eastern Cape.
- Database development completed in six months.
- Enter gathered data April 2006.

Solution 2

Identify and prioritise key areas in the country that have high levels of consumptive and non-consumptive utilisation. Run more intensive research projects in those areas.

Minimum goal: 50%
Maximum goal: 100%

Action Step 1:

Use the key areas, highlighted in the PHVA workshop to identify hotspots and ascertain necessary research for those hotspots.

Resources Needed: Funds; use interpreted data, GIS, people involved in field research in these hotspots.

Responsibility: Freek Nel for Limpopo and North West province; Gerrie Camacho for Mpumalanga; Andrew Skowno for the Eastern Cape (Juan Pinto in charge of contacting him to ask if he will take task); Quinton Martins for the Western Cape and Guy Balme for KwaZulu-Natal? (Gerrie Camacho will phone Guy Balme and ask if he will take on the task).

Timeline: Three months after completion of the database (1 year and 3 months).

Obstacles: Availability of data, time constraints and rough terrain.

Collaborators: All stakeholders in identified areas.

Measurable Outcomes: Identify hotspots within important areas in 3 months from the workshop, July 2005. Identify necessary research 3 months after Solution 1 (Action Step 1) is completed.

Solution 3

Incorporate a non-negotiable requirement for all permit holders (CITES, problem animals, hunters) to provide the necessary data, stipulated by delegated conservation authorities.

Minimum goal: 60%
Maximum goal: 100%

Action Step 1:

Contact the authorities responsible for issuing permits in all provinces and supply them with a standardised sample collecting form (Gerrie Camacho has a sample of African Large Predator Research Unit - ALPRU form). Permit holders must return data forms to provincial authorities with photographs showing the head, chest and both sides of the animal. Contact the Wildlife Biological Resource Centre (wBRC) for sample collection training for all permit holders. Professional hunters training should include the methods of DNA collection.

Resources Needed:	Telephone, standardised form, email.
Responsibility:	Gerrie Camacho
Timeline:	May 2005.
Obstacles:	No incorporation and no enforcement of such requirement by responsible authorities and lack of compliance by permit holders.
Collaborators:	Permit issuers and permit holders.
Measurable Outcomes:	Data and sample collection incorporated into issuing of permits within 3 months. Training of professional hunter's through wBRC to collect DNA samples.

PROBLEM STATEMENT 2
LACK OF SCIENTIFIC DATA TO SUPPORT THE METHODS TO DETERMINE QUOTA NUMBERS WITHIN POPULATIONS, REGIONAL QUOTAS, AND THE QUOTA FOR SOUTH AFRICA.

Solution 1
Problem Statement 1 Solution 1 (Action Step 1)

<u>Action Step 2:</u>
Take the appropriate collected data to relevant decision-makers

Resources Needed:	Appropriate data.
Responsibility:	Gerrie Camacho.
Timeline:	One month after data is available (April 2006).
Obstacles:	Data collection not completed.
Collaborators:	CITES, provincial government.
Measurable Outcomes:	Presenting data to CITES. Scientific data should be made available within four years for at least six different provinces to assist in decision making for regional quotas. It was suggested that a single pilot project be conducted to develop a method to determine quotas where after it could be duplicated for each province.

PROBLEM STATEMENT 3
UNCERTAINTY OF THE EFFECTS OF REMOVAL ON THE DEMOGRAPHICS OF A POPULATION.

Solution 1
Problem Statement 1 Solution 3 (Action Step 1)

<u>Action Step 2:</u>
Stop the hunting of females in the trophy hunting industry and monitor the impact of adult male removal on females and cubs in specific populations.

Note: Please refer to the Utilisation and Policy Working Group report for more details.

PROBLEM STATEMENT 4
LACK OF CAPACITY, FUNDING, AND PROPER TOOLS TO IMPLEMENT CENSUS TECHNIQUES AS WELL AS RESEARCH.

Solution 1
Link up with academic institutions so as to utilise post-graduate students to conduct identified research projects within an area.

Minimum goal: 70%
Maximum goal: 100%

<u>Action Step 1:</u>
Liaise with all applicable academic institutions, NGOs and all researchers involved

Resources Needed:	Funding and manpower to approach these organisations.
Responsibility:	If approved, EWT / CBSG, or proposed National Leopard Forum.
Timeline:	One year.
Obstacles:	Recommendations rejected, funding, lack of cooperation by academic institutions.
Collaborators:	Academic institutions, EWT / CBSG, NGOs, proposed National Leopard Forum.
Measurable Outcomes:	At least one approved research study initiated by February 2006.

Solution 2
Cost analysis to determine different reliable tools needed for surveys.

Minimum goal: 100%
Maximum goal: 100%

<u>Action Step 1:</u>
Inventory of equipment and cost

Resources Needed:	Manpower.
Responsibility:	Shawn Catterall.
Timeline:	June 2005.
Obstacles:	None.
Collaborators:	Gerrie Camacho and Cailey Owen.
Measurable Outcomes:	Produce a cost analysis (What, how much, where to acquire the equipment).

Solution 3
Government subsidies and incentives for the private sector e.g. if farmers make their land available and / or fund an identified Leopard research, they will get a subsidy and / or tax deduction. Corporate companies to fund or sponsor recognised research project.

Minimum goal: 30%
Maximum goal: 80%

<u>Action Step 1:</u>
Approaching government and large corporations with formal presentations of important research and funding needs.

Resources Needed:	Accurate data, preparation of presentation, operational funds, manpower and media.

Responsibility:	EWT can appoint the representatives.
Timeline:	Initiate process by January 2006.
Obstacles:	Refusal from EWT to take this responsibility, lack of cooperation from government and large corporations.
Collaborators:	EWT, other NGOs, government, large corporations and the media.
Measurable Outcomes:	Government responses to the proposals compiled at the PHVA workshop.

Solution 4
Fundraising from the private sector (national or international)

Minimum goal: 40%
Maximum goal: 80%

Note: see previous step.

PROBLEM STATEMENT 5
INCORRECT DECISION-MAKING DUE TO THE MISCONCEPTIONS OF LEOPARD NUMBERS AND DEMOGRAPHICS.

Solution 1
Implementation of existing and future knowledge at a governmental level

Minimum goal: 30%
Maximum goal: 80%

<u>Action Step 1:</u>
Provide governing authorities with gathered data and hope they will utilise it appropriately.

Resources Needed:	Data and manpower to provide government with the information.
Responsibility:	Person to be appointed by the proposed National Leopard Forum.
Timeline:	June 2006.
Obstacles:	Government not implementing and data not ready.
Collaborators:	All parties collecting data, government, proposed National Leopard Forum.
Measurable Outcomes:	Data provided to the governing authorities with recommendations from the proposed National Leopard Forum

Solution 2
Implement an education extension programmes for all stakeholders.

Minimum goal: 60%
Maximum goal: 100%

<u>Action Steps 1:</u>
Follow a similar protocol as the SACWG, NCCF, e.g.: targeting rural school education, landowner relations, farm-workers, agricultural unions, conservancies, etc.

Programmes should be translated into relevant regional languages and protocols circulated between other NGOs already undertaking education.

Resources Needed:	Funding and capacity.
Responsibility:	Proposed National Leopard Forum.
Timeline:	Awareness for now to full capacity by December 2006.
Obstacles:	Perceptions, lack of funds, lack of capacity, time constraints, human attitudes, incorrect approaches, intolerance and politics.
Collaborators:	Existing NGOs doing work already, implementers of programmes and broader communities, landowners and funding bodies.
Measurable Outcomes:	Increased awareness and tolerance.

PROBLEM STATEMENT 6
UNRELIABLE AND INADEQUATE CENSUS PROTOCOLS.

Solution 1
Standardise protocols and techniques suitable for different habitats, so as to compare different research results.

Minimum goal: 60%
Maximum goal: 100%

<u>Action Step 1:</u>
Create a benchmark population density estimate for different areas and terrain types. Evaluate existing census protocols for specific areas against the benchmark. Re-test this census with different census procedures to evaluate error.

Resources needed:	Manpower, funding and sponsorship from equipment manufacturers.
Responsibility:	People involved with various techniques.
Timeline:	2 years, April 2007.
Obstacles:	Low response, lack of funding and equipment.
Collaborators:	All researchers in the field and those commencing new projects.
Measurable Outcomes:	A report with standardised census protocols.

PROBLEM STATEMENT 7
THERE IS NO EFFECTIVE CONSERVATION PLAN FOR LEOPARDS IN SOUTH AFRICA.

Solution 1
By incorporating regional variations implement a national conservation plan.

Minimum: 100%

Action Step 1:
Link with the Biodiversity Act and develop a conservation plan to be introduced to government by the proposed National Leopard Forum.

Resources Needed:	Information from database.
Responsibility:	Proposed National Leopard Forum.
Timeline:	2 to 3 years.
Obstacles:	Time constraints, attitudes of stake-holders, politics, perceptions and lack of government implementation.
Collaborators:	Relevant authorities, DEAT and proposed National Leopard Forum.
Measurable Outcomes:	Actual implementation of national conservation plan.

PROBLEM STATEMENT 8
LIMITED ACCESS TO DATA AND INTEGRATION OF RESULTS DUE TO FRAGMENTATION.

Solution 1
Creating a National Leopard Forum (NLF), similar to NCCF and WAG, to act as platform to consolidate, filter, and advise on Leopard related issues.

Minimum: 100%

Action Step 1:
Organise a Leopard symposium for all field researchers to present their results and invite all stakeholders. Identify potential critical contributors to this forum. Organise a first meeting with important role players and create the forum.

Resources Needed:	Venues, sponsors and funds
Responsibility:	Gerrie Camacho, EWT, Shawn Catterall, Tycho Thal, Jannie Parsons, Cailey Owen, Kobus Lee, Juan Pinto and Graham Wallington.
Timeline:	October 2005.
Obstacles:	None.
Collaborators:	All stakeholders.
Measurable Outcomes:	Leopard Symposium and first meeting of potential NLF members within a year.

PROBLEM STATEMENT 9
NO ULITISATION OF EXISTING KNOWLEDGE BY GOVERNMENT AT A POLICY LEVEL AND IN DECISION-MAKING.

Solution included in Problem Statement 5

PROBLEM STATEMENT 10
A LACK OF EDUCATION RESULTING IN PREJUDICE AND PERSECUTION.

Solution included in Problem Statement 5

PROBLEM STATEMENT 11
OUTDATED CAPTURE METHODS.

Solution 1
Undertake research into capture methods available and improvement thereof to avoid death or injury.

Minimum goal: 40%
Maximum goal: 100%

Action Step 1:
Undertake research into humane and sound capture methods and provide the research results to the NLF for implementation.

Resources Needed:	Reference data, e.g.: South African Wildlife Management Association (SAWMA) is also good people to contact for students doing projects as well as a medium to publish result with.
Responsibility:	Freek Nel
Timeline:	October 2005.
Obstacles:	No funding.
Collaborators:	Various groups, such as the South African Veterinary Association's Wildlife Group.
Measurable Outcomes:	A document containing research results and recommended procedures.

Habitat and Movement Working Group

WORKING GROUP PARTICIPANTS

1.	Pat Fletcher:	EWT's Carnivore Conservation Group
2.	William Horsnell:	UCT / Royal Veterinary Collage
3.	Gus Mills:	SANParks and the EWT's Carnivore Conservation Group
4.	Ian Sharp:	Department of Economic Development, Environment and Tourism, Limpopo Province
5.	Villiers Steyn:	Tswane University of Technology – Northern Tuli Leopard Project

PROBLEM STATEMENTS

PROBLEM STATEMENT 1
THE COORDINATED PLANNING OF PRIORITY AREAS FOR LEOPARD CONSERVATION THAT CAN SERVE AS CORE AREAS, NEED TO BE ADDRESSED FOR THE OPTIMAL USE OF LIMITED RESOURCES.

Solution 1
Establish a centralised national coordination body to drive the prioritisation process and other issues regarding Leopard conservation forward.

<u>Action Step 1:</u>
Establish a coordination body

Resources needed:	Home; secretariat and funding.
Responsibility:	Pat Fletcher (EWT).
Timeline:	Convene before end January 2006.
Obstacles:	Funding.
Collaborators:	All stakeholders.
Measurable outcomes:	Agree on aims and objectives.

Solution 2
Identify core areas for Leopard conservation through a number of actions, i.e. surveys and GIS-studies, and consultations with all stakeholders.

<u>Action Step 1:</u>
Conduct a study

Resources needed:	Researcher; access to GIS programmes.
Responsibility:	Pat Fletcher (EWT).
Timeline:	Finished by end 2006.
Obstacles:	Funding and supervision
Collaborators:	Conservation departments of all provinces; Leopard specialists.

Measurable outcomes: Report containing results of the study.

The above mentioned study acts as an action step for four different solutions – see text box at the end of this section.

Solution 3
Prioritise core areas in terms of the compromise between the importance of Leopard conservation management and resources available.

Minimum goal: Prioritise five core areas.
Maximum goal: Prioritise ten core areas.

Action Step 1:
Prioritise core areas.

Resources needed:	National Leopard coordinating body.
Responsibility:	Carnivore Conservation Group – EWT (Pat Fletcher).
Timeline:	June 2007
Obstacles:	Lack of coordinating body.
Collaborators:	EWT; All Leopard specialists; all other stakeholders; Researcher same as Solution 1 (Action Step 1).
Measurable outcomes:	Rank of importance of core areas for Leopard conservation.

PROBLEM STATEMENT 2
THERE IS LIMITED KNOWLEDGE AND UNDERSTANDING OF LEOPARD HOME RANGE REQUIREMENTS IN DIFFERENT HABITATS WITH DIFFERENT FORMS OF LAND-USE.

Solution 1
Compile a database of current Leopard home range and movement data for South Africa.

Action Step 1:
Compile database

Resources Needed:	Publications, reports and unpublished observations
Responsibility:	Villiers Steyn
Timeline:	December 2005
Obstacles:	None
Collaborators:	Leopard researchers and libraries
Measurable outcomes:	Report and electronic database

Solution 2
Identify areas where knowledge is lacking on Leopard home range requirements focussing outside protected areas in a range of different habitats and land-use systems.

Minimum gaol:	Identify at least 30% of areas where knowledge is lacking outside protected areas.
Maximum goal:	Identify all areas where knowledge is lacking outside protected areas.

Action Step 1:
Conduct a study (Problem Statement 1, Solution 2, Action Step 1).

Resources Needed:	Researcher; access to GIS programmes.
Responsibility:	Pat Fletcher (EWT)
Timeline:	Finished by end 2006
Obstacles:	Funding and supervision
Collaborators:	Conservation departments of all provinces and Leopard specialists
Measurable Outcomes:	Report containing results of the study.

PROBLEM STATEMENT 3
THE EXTENT OF LAND-USE PRACTICES INCOMPATIBLE WITH LEOPARD PRESENCE RELATING TO DISPERSAL, E.G. EXTENSIVE CROP FARMING AND GAME FARMING CONTRIBUTE TO FRAGMENTATION OF LEOPARD HABITATS.

Solution 1
Identify land-use practices which are incompatible with Leopard conservation and are restricting Leopard movements using GIS technology.

Action Step 1:
Conduct a study (Problem Statement 1, Solution 2, Action Step 1)

Resources Needed:	Researcher; access to GIS programmes.
Responsibility:	Pat Fletcher (EWT)
Timeline:	Finished by end 2006.
Obstacles:	Funding and supervision.
Collaborators:	Conservation departments of all provinces; Leopard specialists.
Measurable Outcomes:	Report containing results of the study.

Solution 2
Incorporate GIS results into bioregional plans at various levels of government to restrict further fragmentation in suitable Leopard habitat.

Action Step 1:
Dissemination of GIS information for bioregional planning.

Resources Needed:	Data from the study.
Responsibility:	Pat Fletcher (EWT)
Timeline:	End of 2008
Obstacles:	Attaining the data.
Collaborators:	DEAT through the WG1: Biodiversity and National Leopard coordinating body.

Measurable Outcomes: Incorporate Leopard conservation issues in bioregional planning.

PROBLEM STATEMENT 4
EXPANDING URBANISATION AND DEVELOPMENT HAS INCREASED DISTURBANCE ON LEOPARD MOVEMENT PATTERNS AND MAY INCREASE THE LIKELIHOOD OF DISEASE. THE IMPACT OF CERTAIN ACTIVITIES, FOR INSTANCE MINING AND URBANISATION, MAY BE GREATER THAN THE FOOTPRINT ITSELF.

Solution 1
Identify possible key Leopard health issues such as infectious diseases, nutrition, fertility, genetic fitness, etc.

Minimum goal: Awareness of potential Leopard health problems.
Maximum goal: Regular monitoring of Leopard health issues.

Action Step 1:
Conduct a study on Leopard health issues.

Resources Needed: Biomaterial from Leopards.
Responsibility: William Horsnell (UCT / RVC)
Timeline: Open-ended
Obstacles: Lack of cooperation from field workers to attain samples.
Collaborators: University of Cape Town; Royal Veterinary College; Leopard researchers; all other institutions who can provide biomaterial sources.
Measurable Outcomes: Publication on health status and threats to Leopards.

Solution 2
Negotiation with management, where necessary, to promote and maintain awareness of different sources of disturbance, e.g. mines and industry. Ways by which operations could be improved to minimise disturbance on Leopards should then be addressed. Apply legislation where necessary.

Action Step 1:
Negotiation with development companies causing disturbance.

Resources Needed: None.
Responsibility: National Leopard Forum.
Timeline: Ongoing.
Obstacles: Lack of cooperation from relevant parties.
Collaborators: Concerned conservation authority; National Leopard coordinating body members; DEAT; relevant parties.
Measurable Outcomes: Cooperation by the relevant parties.

PROBLEM STATEMENT 5
THE LACK OF KNOWLEDGE ABOUT THE AVAILABILITY, FEASIBILITY AND USE OF CORRIDORS BETWEEN FRAGMENTED HABITATS.

Solution 1
Within the framework of the prioritised core areas, identify possible corridors between fragmented habitats and attempt to verify them on the ground. Once verified as

suitable, preserve these corridors. Areas that are identified as important corridors, but are not yet functional, would need to be established.

Minimum goal:	Identify and establish at least five corridors within or between prioritised areas as a total.
Maximum goal:	Identify and establish all possible corridors within or between prioritised core areas.

Action Step 1:
Conduct a study (Problem statement 1, Solution 2)

Resources Needed:	Researcher; access to GIS programmes.
Responsibility:	Pat Fletcher (EWT).
Timeline:	Finished by end 2006.
Obstacles:	Funding and supervision.
Collaborators:	Conservation departments of all provinces; Leopard specialists; De Wildt (Freek Nel).
Measurable Outcomes:	Report containing results of the study.

PROBLEM STATEMENT 6
BARRIERS, E.G. FENCES, NATIONAL HIGHWAYS, AND HUMAN SETTLEMENTS, CAUSE HABITAT FRAGMENTATION, INHIBITING THE MOVEMENTS OF LEOPARDS AND / OR PREY.

Solution 1
Initiate a concerted effort to promote the formation of conservancies as large as possible for less restricted movement of Leopards and their prey, lobbying with government to assist by providing financial incentives.

Minimum goal:	Establish at least one substantial conservancy.
Maximum gaol:	Establish a conservancy in each prioritised core area.

Action Step 1:
Negotiate and promote the formation of conservancies with stakeholders.

Resources Needed:	None
Responsibility:	Pat Fletcher (EWT)
Timeline:	Open-ended
Obstacles:	Attitudes and politics.
Collaborators:	National Leopard coordinating body; DEAT; landowners; National and provincial conservancy associations.
Measurable Outcomes:	Establishment of conservancies.

Proposed Study

(Action step for: Problem Statement 1, Solution 2; Problem Statement 2, Solution 2; Problem statement 3, Solution 1; Problem Statement 5, Solution 1.)

A national GIS-based study to help planning for Leopard conservation by identifying core areas, i.e. areas of suitable habitat, fragmented habitats, corridors, and habitats outside protected areas suitable for home range and movement studies.

Conflict Management Working Group

WORKING GROUP PARTICIPANTS:

1.	Andrew Skowno:	Wilderness Foundation Eastern Cape
2.	Thys de Wet:	Private Consultant, Problem Animal Control
3.	Nicole Martins:	The Cape Leopard Trust, Cederberg
4.	Quinton Martins:	The Cape Leopard Trust, Cederberg
5.	Jaco van Deventer:	CapeNature, Leopard / Farmer Conflict resolution West Coast

PROBLEM STATEMENTS

PROBLEM STATEMENT 1
LACK OF CAPACITY TO IMPLEMENT REACTIVE PROBLEM MANAGEMENT PROCEDURES AND SOCIO-ECONOMICALLY VIABLE STRATEGIES.

Solution 1
Training

- Training of the government agencies, farmers and general public in a holistic approach to problem animal control.
- Training of the government agencies, farmers and general public in correct problem animal identification.
- Training of the government agencies, farmers and general public in correct capture techniques.

Action Step 1:
Compile a training manual for government agencies which can be used as an educational and training tool for farmers and the general public.

Resources Needed:	Collate and synthesize available information.
Responsibility:	Responsible government agencies in conjunction with NGOs and institutions.
Timeline:	January 2006 – July 2006
Obstacles:	Differences in legislation and policies between provinces.
Collaborators:	Government agencies, NGOs and institutions.
Measurable Outcome:	Professional training manual on problem animal management.

Action Step 2:
Implementation of training programme

Resources Needed:	Training an officer (at least one) in each of the core areas to train ground staff who in turn will train / educate farmers and the public.

	General problem animal control equipment (cages, traps, educational equipment, vehicle, etc.). Make use of available expertise to speed up the process.
Responsibility:	Respective conservation authority.
Timeline:	As soon as the training manual is published.
Obstacles:	Funding Trainees and trainers availability Red tape
Collaborators:	Different organisations with various expertise.
Measurable Outcome:	Professionally trained personnel

Solution 2
Funding

<u>Action Step 1:</u>
Letter of inquiry for funding addressed to appropriate government, corporate and conservation based NGOs.

Resources Needed:	Appoint one person on the National Leopard Forum to draw up a letter of inquiry – comments for the committee on completion of the document.
Responsibility:	Government budgeting and NGOs
Timeline:	One financial year for government and once the National Leopard Forum committee is set up.
Obstacles:	Red tape; no response to the letter of inquiry and lack of coordination between NGOs.
Collaborators:	Government budgeting NGOs (Hunting Associations, Conservancies, etc.)
Measurable Outcome:	Sufficient funds to co-ordinate projects

Solution 3
Identify relevant research projects and obtain cooperation and communication between them.

<u>Action Step 1:</u>
Compile a list of existing research projects and collate available data.

Resources Needed:	Information databases
Responsibility:	National Steering Committee NGOs
Timeline:	July 2005 - ongoing As soon as the National Steering Committee is set up
Obstacles:	Red tape; lack of response and coordination
Collaborators:	SANParks, Provincial conservation authorities, EWT, Universities, etc. and PHVA participants.
Measurable Outcome:	Sufficient information to coordinate the projects

Solution 4
Public awareness campaigns identifying problems in predator conservation.

<u>Action Step 1:</u>
Design an awareness campaign.

Resources Needed:	Helpdesk, flyers, information posters, articles, media exposure.
Responsibility:	The Cape Leopard Trust, Researchers, EWT, Conservancies, Farmers Associations and Tourism outlets.
Timeline:	Current and ongoing
Obstacles:	Funding; lack of media interest; lack of availability of scientific data and sharing through popular articles.
Collaborators:	Conservation Authorities; NGOs, Researchers, EWT, Conservancies, Farmers Associations and Tourism outlets.
Measurable Outcome:	Well compiled information resources to educate and inform the general public as well as change attitudes.

PROBLEM STATEMENT 2
IRRESPONSIBLE AND INAPPROPRIATE STOCK / GAME FARMING PRACTICES.

Solution 1
Training

Action Step 1:
Refer to Problem Statement 1, Solution 1 (Action Step 1)

Solution 2
Policy and legislation must be made clear on farming techniques with regards to when and if permits can be issued in problem animal situations.

Action Step 1:
Clarify and adapt current legislation as well as draw on corporates to pressurise farmers to farm more responsibly.

Resources Needed:	Corporate investment into conservation efforts.
Responsibility:	National Steering Committee to liaise with corporate and the Department of Agriculture.
Timeline:	January 2007 - ongoing
Obstacles:	Lack of funding, response and coordination.
Collaborators:	Euopgap, Natures Choice, Woolworths, Woolgrowers Association, Red meat producers, SCI, PHASA, Potato Board, National Department of Agriculture, etc.
Measurable Outcome:	Incentives for sustainable farming practices.

Solution 3
Multi-disciplinary approach to eradicate inappropriate or irresponsible livestock / game farming practices.

Action Step 1:
Refer to Problem Statement 2, Solution 1

Solution 4
Effective and practical legislation for environmentally-friendly farming practices.

Action Step 1:
Implement existing legislation on farming practises

Resources Needed:	Policies already exist; dedicated personnel needed to enforce legislation.
Responsibility:	National Department of Agriculture
Timeline:	Present - ongoing
Obstacles:	Lack of funding, response and coordination; Apathy
Collaborators:	National Department of Agriculture and Farmers Associations
Measurable Outcome:	Sustainable farming practices where both the farmer and environment can co-exist.

PROBLEM STATEMENT 3
THE INCORRECT IDENTIFICATION OF PROBLEM ANIMALS LEAD TO UNSELECTIVE KILLING.

Solution 1
Provide training in the correct identification of problem animals.

Action Step 1:
Organise Workshops

Resources Needed:	Relevant expertise e.g. agricultural, extension officers, funding.
Responsibility:	National Leopard Forum steering committee.
Timeline:	March 2006 – ongoing.
Obstacles:	Lack of funding, response and coordination.
Collaborators:	Provincial conservation, national Department of Agriculture, conservancies.
Measurable Outcome:	More sustainable and Leopard-friendly farming practises.

Solution 2
Communicate policy and legislation to the farming communities.

Action Step 1:
Improve communication between conservation bodies and farming communities.

Refer to Problem Statement 1, Solution 1 and 4.

PROBLEM STATEMENT 4
FARMERS SUFFER ACTUAL AND PERCEIVED STOCK LOSSES DUE TO PROBLEM ANIMALS.

Solution 1
Farmers to practice proper animal husbandry techniques when farming with either livestock or game animals.

Action Step 1:
See Problem Statement 1

Solution 2
Effective problem animal control (i.e. identification of the correct problem animal as well as the use of humane and selective forms of control techniques) need to be practiced in situations where farmers report acts of depredation on their stock.

Action Step 1:
See Problem Statement 1

Solution 3
Collect scientific information to establish perceived livestock losses.

Action Step 1:
Implement recommendations from research findings in this field.

Resources Needed:	Compile existing data and appoint a student to analyse the data.
Responsibility:	National Leopard Forum steering committee
Timeline:	January 2006 – ongoing.
Obstacles:	Lack of funding, available data and coordination.
Collaborators:	Provincial conservation, researchers, tertiary institutions and the Cape Leopard Trust.
Measurable Outcome:	A report on actual versus perceived losses.

Solution 4
Incentives for farmers who follow suitable (environmentally-friendly) farming techniques.

Action Step 1:
Green labelling whereby a farmer benefits financially from the use of prescribed or suitable farming techniques (e.g. a "Leopard friendly" farmer will receive more money / kg for the meat he produces and sells if farming in this way).

Refer to Problem Statement 2, Solution 2.

Action Step 2:
Implement / investigate insurance scheme possibilities whereby farmers may receive compensation for their stock losses.

Resources Needed:	Cooperation or sponsorship from insurance companies / agencies.
Responsibility:	National Leopard Forum steering committee and Conservancies.
Timeline:	Immediately after the National steering committee is formed.

Obstacles: Lack of funding, interest and coordination.
Collaborators: Provincial conservation, insurance companies, National Leopard Forum steering committee.
Measurable Outcome: Farmers practice sustainable farming practices and are awarded with incentives.

PROBLEM STATEMENT 5
REVENGE DRIVES FARMERS TO UNSELECTIVE KILLING.

Solution 1
Education pertaining to the importance of our natural environment and reasons why we should protect it.

Refer to Problem Statement 1

Solution 2
Trust and communication

Refer to Problem Statement 1

Solution 3
Legislation: strong legal precedent needs to be set so as to allow for effective prosecution of farmers who practise illegal killing of animals.

<u>Action Step 1:</u>
Ensure that existing legislation is enforced.

Resources Needed: Conservation personnel.
Responsibility: Provincial conservation agencies and DEAT.
Timeline: Present – ongoing.
Obstacles: Lack of funding, personnel and negative relationship towards conservation.
Collaborators: Provincial conservation, DEAT and conservancies.
Measurable Outcome: Increased respect towards conservation agencies and decrease in illegal activities.

PROBLEM STATEMENT 6
LACK OF SCIENTIFIC INFORMATION ON THE SOCIO-ECONOMIC IMPACT OF PREDATORS ON FARMLANDS.

Solution 1
Refer to Problem Statement 4

PROBLEM STATEMENT 7
LACK OF EMPATHY BY CONSERVATION AGENCIES FOR FARMERS STOCK LOSSES.

Solution 1
Refer to Problem Statement 1

PROBLEM STATEMENT 8
THERE IS A LACK OF APPROPRIATE REACTIVE PROBLEM ANIMAL MANAGEMENT METHODS:

- **ILLEGAL, INHUMANE, UNSELECTIVE AND UNECONOMICAL METHODS; AND**
- **IRRESPONSIBLE USE OF "APPROPRIATE METHODS".**

Solution 1
Refer to Problem Statement 1

PROBLEM STATEMENT 9
THERE IS A LACK OF FOLLOW THROUGH BY THE AUTHORITIES IN THE PROSECUTION OF ILLEGAL CASES.

Solution 1
Refer to Problem Statement 5, Solution 3

PROBLEM STATEMENT 10
POOR AGENCY COMPETENCY IN THE IMPLEMENTATION, COORDINATION AND MANAGEMENT OF PROBLEM ANIMAL SITUATIONS.

Solution 1
Refer to Problem Statement 1, Solution 1 and 2

PROBLEM STATEMENT 11
NON-COMPLIANCE OR LACK OF IMPLEMENTION OF EXISTING PROBLEM ANIMAL MANAGEMENT POLICIES / STRATEGIES.

Solution 1
Refer to Problem Statement 1, Solution 1 and 2

PROBLEM STATEMENT 12
THERE IS A LACK OF EVIDENCE BASED PROBLEM ANIMAL MANAGEMENT AND CONTROL BY THE AUTHORITIES.

Solution 1
Refer to Problem Statement 1, Solution 1 and 2

PROBLEM STATEMENT 13
UNREASONABLE DIFFERENCES BETWEEN PROVINCIAL CONSERVATION POLICIES AND LEGISLATION – LACK OF COORDINATION AND DIRECTION.

Solution 1
Refer to Problem Statement 1, Solution 1 and 2

Utilisation and Policy Working Group

WORKING GROUP PARTICIPANTS:

1. Stephen Barber: Farmer / Chairman of Leopard WG of SA / PHASA
2. Errol Pietersen: Associated Private Nature Reserves
3. Ellery Worth: Balule Nature Reserve
4. Muleso Kharika: Department of Environmental Affairs and Tourism
5. Christiaan Blignaut: Provincial Government Section Biodiversity Limpopo
6. Claire Patterson: TRAFFIC East / Southern Africa
7. Paul Funston: Tshwane University of Technology

PROBLEM STATEMENTS

PROBLEM STATEMENT 1
THERE IS NO INDEX TO ALLOW FOR THE DETERMINATION OF AN OPTIMAL OFF-TAKE OF LEOPARD.

Solution 1
The harvesting of only a certain segment of the population (i.e. by not hunting females and only hunting males above a certain age threshold) will result in two indices:
1) Difficulty with which these animals are located; or,
2) A decrease in the age of hunted animals.

These indices will indicate a limit to the sustainability of the off-take. (For males, a minimum of 80% should be above four years of age but preferably all should be above say four years of age).

Action Step 1:
Organise a stakeholder workshop, to explain / workshop the solution above.

Resources Needed:	Sponsors e.g. Safari Club International.
Responsibility:	Nature conservation agencies and the proposed National Leopard Forum.
Timeline:	By March 2006 at the latest.
Obstacles:	No buy-in for the process.
Collaborators:	Academics, PHASA, NGOs and TRAFFIC.
Measurable Outcomes:	At least two workshops held, preferably in hotspot areas.

Action Step 2:
From 2006 / 2007 hunting season, ban the hunting of all females.

Resources Needed:	Within the Provincial Legislative Process
Responsibility:	Provincial nature conservation authorities.
Timeline:	2006 / 07 season.
Obstacles:	No buy-in for the process
Collaborators:	Hunting industry, PHASA, NGOs and TRAFFIC
Measurable Outcomes:	Compliance with action step within two years

Action Step 3:
Have legislation in place specifying that at least 80% of male Leopards hunted need to be over the age of 4 years.

Resources Needed:	Provincial legislative process.
Responsibility:	Provincial nature conservation authorities.
Timeline:	2006 / 07 season.
Obstacles:	No buy-in for the process.
Collaborators:	Hunting industry, PHASA, NGOs and TRAFFIC.
Measurable Outcomes:	Compliance with action step.

Action Step 4:
Evaluate compliance and re-evaluate the system after 5 years (2011 / 2012) through workshops and data analysis.

Resources Needed:	Capacity and funding.
Responsibility:	Provincial government to make this a condition of permit.
Timeline:	2011 / 2012.
Obstacles:	Lack of funding for review and evaluation.
Collaborators:	All stakeholders.
Measurable Outcomes:	Compliance with the system.

Solution 2
Monitor effort versus success of hunts, using hunt returns, as this information can be used as an indicator of Leopard densities and population trend. These data should be published. (There should be a 100% return of data).

Action Step 1:
Analyse the hunt returns to determine rate of hunt success versus effort.

Resources Needed:	Funding and access to hunt returns.
Responsibility:	Provincial and national conservation agencies.
Timeline:	By January 2007.
Obstacles:	Capacity and political will.
Collaborators:	PHASA and proposed National Leopard Forum.
Measurable Outcomes:	A document needs to be published demonstrating Leopard densities and population trends based on hunt effort versus success ratios.

Action Step 2:
Establish and disseminate data to stakeholders through appropriate media i.e. websites, *SA Wild en Jag*, *Magnum*, etc.

Resources Needed:	Within the existing conservation authorities.
Responsibility:	Proposed National Leopard Forum, provincial and national conservation authorities.
Timeline:	March 2007.
Collaborators:	NGOs.
Measurable Outcomes:	At least 3 articles to be published in magazines and newspapers and the information made available on a website.

Solution 3
Area specific methods should be used to estimate prevalence, i.e. sightings at lodges, camera traps, spoor etc.

Action Step 1:
Determine appropriate techniques (see suggestions from the “Population Biology and Dynamics Working Group”).

Action Step 2:
Use of appropriate techniques in a specific location or area (in line with suggestions from the “Population Biology and Dynamics Working Group”).

PROBLEM STATEMENT 2
WE HAVE VERY LITTLE INFORMATION ABOUT THE ILLEGAL OFF-TAKE AND THE IMPACT THAT IT HAS ON THE POPULATION.

Solution 1
To provide for some form of incentive for the declaration of destroyed problem animals (effective marketing strategies – use the fact that the hunter removed an animal causing problems and helping the farmer as something he can boast about).

Action Step 1:
Gather data on illegal off-takes through interviews with farmers.

Resources Needed:	Fieldworkers, money and time.
Responsibility:	NGOs, proposed National Leopard Forum and PHASA.
Timeline:	Start October 2005.
Obstacles:	Available personnel, willingness of farmers to co-operate and funding.
Collaborators:	Researchers and agricultural unions.
Measurable Outcomes:	Better understanding of the extent of the illegal off-take and the impact it has on the population.

Solution 2
Allocate a proportion of the perceived “problem causing animals” for export under the revised CITES quota of 150 (20% of the quota should be allocated to problem animals and should be pre-allocated to provinces as per the current system of dividing the quota amongst provinces).

Action Step 1:
Provincial and national nature conservation agencies should investigate the allocation of a proportion of “problem causing animals” to the CITES hunting quota.

Resources Needed:	Political will within national and provincial conservation agencies.
Responsibility:	National and provincial conservation agencies, proposed National Leopard Forum.

Timeline:	In the first year that the Leopard quota is increased to 150 and all quotas are allocated.
Obstacles:	Buy-in from the landowners and professional hunters.
Measurable Outcomes:	The numbers of Leopards that are perceived to be “problem animals” that are hunted legally and illegally have declined by 30% within five years. (NOTE: of these, 20% will be held back for transfer to problem animals).

PROBLEM STATEMENT 3A
THE QUANTITY, QUALITY (AGE, SEX, AREA) AND DISTRIBUTION OF LEOPARD QUOTAS IS NOT SCIENTIFICALLY BASED.

Solution 1
Policy guidelines from national government on methods being used in determining the quota number and distribution, i.e. age, sex and area where animals may be hunted, and what percentage of the quota goes to which of the provinces.

Action Step 1:
Development of policy guidelines.

Resources Needed:	Personnel from national and provincial government in collaboration with landowners.
Responsibility:	National government.
Timeline:	Completion of first draft by the end of April 2006; comment and finalisation by end of April 2007.
Obstacles:	Disagreement between various stakeholders; lack of resources in national government; not being able to work with landowners.
Collaborators:	Landowners.
Measurable Outcomes:	Policy guideline document produced timeously.

Action Step 2:
Dissemination of guidelines to all stakeholders.

Resources Needed:	Personnel from national and provincial government
Responsibility:	National government
Timeline:	End May 2007
Obstacles:	Policy guidelines being completed timeously
Measurable Outcomes:	Policy guideline document disseminated

PROBLEM STATEMENT 3B
THERE IS A PERCEPTION BY GAME FARMERS THAT PREDATION BY LEOPARDS ON THEIR GAME IS DETRIMENTAL TO THE ECONOMIC ACTIVITIES OF THE FARM.

Solution 1
Education of landowners, regarding prey selection by Leopards, i.e. A Leopard is not always responsible for the kills for which they are often accused (workshops, etc. in at least the two main areas of concern which include the Northern Limpopo area and

Waterberg and Mpumalanga area, but preferably country wide – please refer to the Population Modelling and Dynamics Working Group Report for details of these areas).

<u>Action Step 1:</u>
Dissemination of known knowledge to landowners by means of extension (farmers days), brochures, magazine articles (*Landbou Weekblad* / *Farmers Weekly*).

Resources Needed:	Extension officers, facilitators, time and effort, funding and specialist knowledge.
Responsibility:	Proposed National Leopard Forum
Timeline:	October 2005 to ongoing. Start in the Northern Limpopo area (e.g. Waterberg, Soutpansberg) and Mpumalanga area and expand nationally.
Obstacles:	Resistance from farmers (entrenched belief), lack of personnel.
Collaborators:	NGOs, conservation authorities and game farmers associations
Measurable Outcomes:	More tolerant attitude to Leopards in core area at the end of 5 years.

Solution 2
To provide the landowner with a mechanism by which he can derive benefit from having the Leopard on his property, i.e. similar system to the old legislation which allowed for more immediate hunting of problem animals, branding on gate / product – "Leopard friendly farmer" and preferred seller.

<u>Action Step 1:</u>
To allocate 20% of the additional CITES allocation to be used in the case of proven problem animal incidents.

Resources Needed:	Time and effort (commitment).
Responsibility:	Provincial authorities and proposed National Leopard Forum.
Timeline:	In the allocation of the present CITES allocation, if approved (2005 / 2006 hunting season).
Obstacles:	Resistance from government; lack of acceptance by farmers and possibly hunters.
Collaborators:	PHASA, governmental agencies and NGOs.
Measurable Outcomes:	30 CITES tags are allocated to problem animals in major problem animal areas.

Solution 3
Encourage research on the problem of Leopard preying on game / livestock.

Minimum goal: Need 2 to 3 research projects as a minimum but preferably 5.

<u>Action Step 1:</u>
Research to be undertaken on the perceived impact of Leopards on the viability of game farming

Resources Needed:	Find student, submit research proposal, funding – R300 000 (e.g. PHASA), vehicle, accommodation, etc.

Responsibility:	Academic institutions and proposed National Leopard Forum.
Timeline:	2007 academic year, two year study
Obstacles:	Lack of suitable student, lack of funding, study area not properly identified.
Collaborators:	Academic institutions, provincial authorities, game farmers association and NGOs.
Measurable Outcomes:	Substantive and reliable data on whether Leopards are a problem or not, is obtained.

Action Step 2:
Disseminate outcomes of research project(s) to stakeholders in magazines (*Farmers Weekly*, *Landbou Weekblad*, *Magnum*, *SA Wild and Jag*), newspapers, scientific journals etc.

Resources Needed:	Time and effort, as per methodology of study
Responsibility:	Academic institutions (student) and proposed National Leopard Forum.
Timeline:	Project progress reports every six months and a final report disseminated within three months of completion of study.
Collaborators:	Academic institutions, provincial authorities, game farmers association and NGOs.
Measurable Outcomes:	Results disseminated regionally and then nationally and internationally.

PROBLEM STATEMENT 3C
THERE IS DISPARITY AND DISAGREEMENT BETWEEN DIFFERENT STAKEHOLDERS REGARDING CURRENT LEGISLATION AND POLICY.

Solution 1
Conservation bodies should act responsibly and in line with current legislation during decision making processes and when disseminating information. This includes making provision for representative public comment, workshopping issues, being transparent, timely dissemination of information and developing policy which fits specific problems.

Action Step 1:
Establish a process for collaborative participation in the development of satisfactory policy and legislation, with respect to all forms of utilisation of Leopards.

Resources Needed:	Funding (up to R50 000) and personnel.
Responsibility:	Conservation bodies, NGOs, government, hunting institutions and all other stakeholders.
Timeline:	June 2006 to December 2008.
Obstacles:	Funding, someone / institution to run the process and true stakeholder participations.
Collaborators:	Independent academics, NGOs and hunting institution
Measurable Outcomes:	A process is established whereby, through representative participation in (two) workshops, there will be mutual feedback and progress regarding developing legislation and policy.

PROBLEM STATEMENT 4A
THERE IS A LACK OF ENFORCEMENT OF EXISTING LEGISLATION.

Solution 1

Provincial government should increase capacity and will to enforce the law.

Action Step 1:
Train enforcement staff in appropriate methodologies and compliance techniques.

Resources Needed:	Training programmes.
Responsibility:	TRAFFIC, government, border police and customs.
Timeline:	Immediate and ongoing.
Obstacles:	Willingness to co-operate.
Collaborators:	Other training bodies, i.e. ARC
Measurable Outcomes:	Increase in capacity and will to enforce the law (difficult to measure).

Solution 2
Provincial government should be held accountable if they do not meet these responsibilities. (Refer to National Environmental Management: Biodiversity Act).

Action Step 1:
Provincial Governments should publish a report annually providing information on governments progress on law compliance.

Resources Needed:	Provincial legislative support.
Responsibility:	Proposed National Leopard Forum and government.
Timeline:	Annually.
Obstacles:	Government cooperation, success of the proposed National Leopard Forum.
Collaborators:	Stakeholders.
Measurable Outcomes:	Government meets annual reporting deadlines.

Solution 3
Extension programmes should be held to encourage compliance with legislation.

Minimum goal:	2 to 3 programmes in the prime core areas.
Maximum goal:	Entire country.

Action Step 1:
Hold workshops with various stakeholders

Resources Needed:	Funding and suitable venue.
Responsibility:	Government hunting industry and NGO (CCG).
Timeline:	Ongoing.
Obstacles:	Capacity (time of organisers).
Collaborators:	NGOs, farmers.
Measurable Outcomes:	Three workshops held annually.

Action Step 2:
Use various media to disseminate the information, i.e. website, magazines.

Resources Needed: Provincial budgeting.
Responsibility: Government, proposed National Leopard Forum.
Timeline: Ongoing.
Measurable Outcomes: Website with comprehensive information and five magazine articles per annum published.

PROBLEM STATEMENT 4B
THERE IS A PERCEPTION THAT LEOPARD HUNTING IS FOR ECONOMIC VALUE ONLY AND THAT THERE IS NO CONSERVATION BENEFIT.

Solution 1
Industry and government should embark on education programmes for the general public to highlight the economic benefit of sustainable utilisation of Leopard for conservation.

Minimum goal: 2 to 3 programmes in the prime core areas
Maximum goal: The entire country

Action Step 1:
Host education programmes highlighting the (economic) benefits of sustainable utilisation.

Resources Needed: Personnel from government, funding from government and other sources.
Responsibility: Provincial government and NGOs as delegated by national government.
Timeline: Education programmes should start beginning April 2006 and be ongoing.
Obstacles: Resources from government, time constraints.
Collaborators: Proposed National Leopard Forum.
Measurable Outcomes: At least one education programme addressing the relevant issue in each province annually.

PROBLEM STATEMENT 5A
THERE IS PERCEIVED TO BE INSUFFICIENT ECOLOGICAL INFORMATION TO SUPPORT THE UTILISATION OF LEOPARD.

Solution 1
Education, knowledge and dissemination of information with regard establishing sustainable off-takes.

Minimum gaol: 2 to 3 programmes in high impact areas

Maximum goal: 5 programmes nationally.

<u>Action Step 1:</u>
A report must be completed which clearly outlines the process whereby the Leopard quota is set and distributed for South Africa.

Resources Needed:	Funds for one person to review the process and data and write this up – includes salary, communication and transport.
Responsibility:	Proposed National Leopard Forum or EWT's Carnivore Conservation Group (CCG) / CBSG.
Timeline:	From June 2005 for three months
Obstacles:	Government being willing and capable of providing the necessary input to the review process.
Collaborators:	Academic institutions and PHASA.
Measurable Outcomes:	Compilation of a report and distribution to all relevant stakeholders.

Solution 2
Research to fill the gaps in knowledge regarding utilisation of Leopard by i) empirical route; and ii) alternative strategies

<u>Action Step 1:</u>
Initiate a PhD or Masters study that evaluates the two strategies that have been proposed, to result in sustainable utilisation of Leopards, namely population estimation, sex / age based selection.

Resources Needed:	Fund to come from the hunting community, both national and international (bursary, tuition fees, and field trips / data gathering) – R200 000.
Responsibility:	Universities.
Timeline:	2006 to 2008 academic year.
Obstacles:	Funding, student, academic supervision.
Collaborators:	Hunting associations and state.
Measurable Outcomes:	Thesis with a workshop process and other routes of dissemination.

PROBLEM STATEMENT 5B
LACK OF LEGISLATION AND POLICY GUIDELINES ON THE NATIONAL AND PROVINCIAL LEVEL REGARDING UTILISATION.

Solution 1
Lobby government regarding policy and legislation development using the knowledge available and the successful implementation thereof. Furthermore, this knowledge includes information from existing hotspot areas (index of abundance), research results, hunt returns, complaints received, expert forums etc.).

Minimum goal: In areas where utilisation is highest
Maximum goal: Nation wide

Action Step 1:
Conservation groups should assist government in policy / development through a workshop process.

Resources Needed:	Resources within provincial and national government
Responsibility:	National and provincial government.
Timeline:	Start October 2005 and ongoing
Obstacles:	Lack of resources within provincial and national government.
Collaborators:	NGOs and proposed National Leopard Forum.
Measurable Outcomes:	Government must have set a timeframe to handle permit applications and comply with that commitment.

Solution 2
Develop mechanisms and procedures to enhance the efficient and responsible administration of permits and quota systems.

Action Step 1:
Conduct a review of the permit and quota system making recommendations to achieve responsible administration.

Resources Needed:	Personnel from NGOs and funding.
Responsibility:	National government.
Timeline:	Beginning April 2006 to December 2006.
Collaborators:	Applicable NGO.
Measurable Outcomes:	Report provided by an NGO recommending mechanisms to achieve the efficient and responsible administration of permits and quota systems.

Action Step 2:
Government to implement recommended steps

Resources Needed:	Personnel from NGOs and funding.
Responsibility:	National and provincial government.
Timeline:	January 2007.
Obstacles:	Government not able to implement system adequately.
Collaborators:	National government.
Measurable Outcomes:	Improved administration of quota and permitting system.

PROBLEM STATEMENT 5C
UTILISATION DATA IS INSUFFICIENTLY ADMINISTERED AND DISSEMINATED.

Solution 1
Interpret existing data from utilisation returns when setting and allocating quotas and identifying problem areas. Make these data available to stakeholders.

Minimum goal:	To establish this in the most critical areas
Maximum goal:	To have this nationally

Action Step 1:

Collect and analyse existing data relating to:

i) success rate / permit issued;
ii) age of animal utilised;
iii) sex of animal utilised;
iv) area (farm name) where utilised;
v) whether problem animal / local hunt / foreign hunt; and,
vi) if problem animal techniques are used.

Resources Needed:	Access to all permits issued as far back as possible (at least five years) and commitment.
Responsibility:	Provincial authorities, proposed National Leopard Forum and academic institutions.
Timeline:	Start October 2005 and completed by April 2007
Obstacles:	Resistance from provincial authorities and apathy
Collaborators:	Provincial and national authorities, NGOs, academic institutions and PHASA.
Measurable Outcomes:	Data accurately analysed and presented in orderly fashion (matrix).

Action Step 2:

Disseminate information from analysis of existing off-take (permits) to all stakeholders by means of a report

Resources Needed:	Commitment.
Responsibility:	National authorities and proposed National Leopard Forum.
Timeline:	After 1 year starting April 2006.
Obstacles:	Apathy.
Collaborators:	PHASA.
Measurable Outcomes:	Report to provincial appropriate stakeholders (provincial conservation authorities, PHASA, proposed National Leopard Forum, academics) and press release to general public.

PROBLEM STATEMENT 5D
THE CONTRIBUTION OF LEOPARD UTILISATION TO THE ECONOMY IS NOT APPRECIATED.

Solution 1

Dissemination of information about the economic benefits of consumptive and non-consumptive Leopard utilisation

Action Step 1:

Initiate a programme to inform the general public about the economic value vested in Leopards.

Resources Needed:	Available information.
Responsibility:	PHASA.

Timeline:	Starting January 2006 and ongoing.
Obstacles:	Anti-hunting groups.
Collaborators:	National government.
Measurable Outcomes:	At least two articles published per quarter in different magazines.

Action Step 2:
Publish articles in various magazines and newspapers, newsletters etc.

PROBLEM STATEMENT 6
THERE ARE INSUFFICIENT DATA / INFORMATION / SAMPLES EMANATING FROM CURRENT UTILISATION.

Solution 1
To make the submission of data and biological samples compulsory for all permit holders. This information must be used to gain knowledge on the applicable population.

Action Step 1:
Make the collection of data and samples a condition of the permit.

Responsibility:	Provincial authorities.
Timeline:	Implemented by January 2006.
Measurable Outcomes:	Receipt of all samples by selected institution.

Solution 2
Identification of a central laboratory to process and analyse biological samples relating to off-takes.

Action Step 1:
Identification of suitable institutions to analyse tooth data.

Responsibility:	Provincial authorities, proposed National Leopard Forum and Brian Reilly / Paul Funston.
Timeline:	By December 2005.
Obstacles:	None.
Collaborators:	PHASA.
Measurable Outcomes:	Suitable institution found and agreed to by relevant stakeholders.

Action Step 2:
Lobbying provincial government for funding from permit fees.

Resources Needed:	Manpower
Responsibility:	Proposed National Leopard Forum and PHASA
Timeline:	Treasury approval for funding by May 2006
Obstacles:	Provincial treasuries
Collaborators:	PHASA

Measurable Outcomes:	The provincial treasury agrees to pay for identification services.

PROBLEM STATEMENT 7A
THERE IS A LACK OF SUITABLE CRITERIA BY WHICH TO JUDGE LEOPARD WHEN HUNTING SO AS TO MAINTAIN TROPHY QUALITY.

Solution 1
To educate professional hunters on techniques regarding the reliable sex and age determination of Leopards which are hunted.

Action Step 1:
Identify criteria by which to judge a Leopards sex and age correctly.

Resources Needed:	Paul Funston
Responsibility:	Paul Funston, professional hunting schools, PHASA and SAPHCOM.
Timeline:	Commence by December 2005 and ongoing
Collaborators:	SCI and proposed National Leopard Forum
Measurable Outcomes:	i) These criteria should form part of the hunting school curriculum by December 2005; and, ii) The criteria should be workshopped and accepted by PHASA by December 2005.

PROBLEM STATEMENT 7B
LEOPARD HUNTING IS PERCEIVED NEGATIVELY BY VARIOUS GROUPS BECAUSE THE VALUE OF LEOPARD TROPHY HUNTING TO CONSERVATION IS NOT UNDERSTOOD.

Solution 1
Convey the message of the sound use of natural resources, particularly with regard to Leopard.

Action Step 1:
Convey benefits of sustainable use of Leopards through workshops and magazine articles.

Resources Needed:	Sponsorship by PHASA and SCI.
Responsibility:	Proposed National Leopard Forum and hunting / game ranching industry.
Timeline:	Start by December 2005, complete initial action within 1 year and ongoing.
Collaborators:	PHASA, SCI, IUCN and SUSG
Measurable Outcomes:	Two stakeholder workshops are held and five magazine articles are published initially.

PROBLEM STATEMENT 8
THE BAITING OF AND HUNTING OF LEOPARDS WITH DOGS IS PERCEIVED AS UNETHICAL BY SOME GROUPS (EMPHASIS ON ETHICS NOT LAND-USE CONFLICT).

Solution 1
The use of dogs should be limited to following up a wounded animal or during controlled traditional hunts.

Action Step 1:
Provincial and national conservation bodies must pass legislation outlawing the use of dogs for hunting Leopards, except when following up wounded animals or participating in traditional hunts.

Resources Needed:	Does not require much financial resources.
Responsibility:	Provincial and national bodies.
Timeline:	End of 2006.
Obstacles:	Apathy and resistance from certain stakeholders.
Collaborators:	Proposed National Leopard Forum.
Measurable Outcomes:	Legislation in place.

Solution 2
Educating the general public with regard to the advantages of baiting, i.e. the hunter is better able to determine the sex and age of the animal before shooting it; and the hunter is often able to obtain a better shot to enable a clean kill.

Action Step 1:
Initiate an education programme to highlight the advantages / disadvantages of baiting Leopards for hunting.

Resources Needed:	Partly self funded.
Responsibility:	Hunting associations.
Timeline:	By the end of 2006.
Obstacles:	Willingness of hunting associations to take on the responsibility.
Collaborators:	Proposed National Leopard Forum and research institution.
Measurable Outcomes:	Opinion survey to determine whether there was any measurable changes in people's perceptions.

Comments from Plenary for Problem Statements

- Group discussed the sale of skins for the fashion industry and it was felt that this did not contribute substantially to the trade.

Comments from Plenary for Solutions

- There was some discussion on whether or not a farmer will be prepared to carry potential stock losses which could be offset against the rewards of getting a foreign hunter to hunt a problem animal.
- Observers on hunts / someone who can verify that the animal claimed to be shot was in fact shot – hunting outfitters should ensure that a photo is taken of each animal shot with the date on the photo. This photo should be submitted

with the two teeth for ageing. Telephone numbers can also be provided on the permit which the hunter can use to contact an independent observer who will go out and verify the samples and hunted animal.

Population Modelling and Dynamics Working Group

WORKING GROUP PARTICIPANTS:

1. Kathy Traylor-Holzer: Conservation Breeding Specialist Group (SSC / IUCN)
2. Brenda Daly: Conservation Breeding Specialist Group Southern Africa
3. Kerryn Morrison: Endangered Wildlife Trust

INTRODUCTION

Many of the parameters included in this model are best guesses due to the lack of current data. Biologists at the PHVA workshop felt that the input data could not be regarded as accurate but agreed that the process should not be abandoned, as the modelling process could be used to highlight critical problems and provide an overview of the species situation and persistence. Many saw the value in a framework for later integration of accurate data from field research results. Therefore the model is intended to be a guide for further research and conservation work.

Once consensus was reached among all workshop participants, and all agreed that the baseline data best projected the *status quo* in South Africa, a number of key areas were identified in a plenary session for further investigation. The baseline data were then used to predict the outcome of different scenarios using the key areas identified. The objective of this exercise was to improve decision-making with respect to management needed to maintain a viable Leopard population over time.

VORTEX SIMULATION MODEL

Computer modelling is a valuable and versatile tool for assessing risk of decline and extinction of wildlife populations. Complex and interacting factors that influence population persistence and health can be explored, including natural and anthropogenic causes. Models can also be used to evaluate the effects of alternative management strategies to identify the most effective conservation actions for a population or species and to identify research needs. Such an evaluation of population persistence under current and varying conditions is commonly referred to as a population viability analysis (PVA).

The simulation software programme Vortex (v9.56) was used to examine the viability of Leopard populations in South Africa. Vortex is a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wild populations. Vortex models population dynamics as discrete sequential events that occur according to defined probabilities. The programme begins by creating individuals to form the starting population and stepping through life cycle events (e.g., births, deaths, dispersal, catastrophic events), typically on an annual basis. Events such as breeding success, litter size, sex at birth, and survival are determined based upon designated probabilities. Consequently, each run (iteration) of the model gives a different result. By running the model hundreds of times, it is possible to examine the probable outcome and range of possibilities. For a more detailed explanation of Vortex and its use in population viability analysis, see Lacy (1993, 2000) and Miller and Lacy (2003).

Vortex Baseline Model Parameters

This population model was designed to investigate the viability of the Leopard population (*Panthera pardus*) in South Africa. In northern and eastern South Africa this population may be connected with Leopard populations in the adjacent countries of Namibia, Botswana, Zimbabwe, Swaziland, and Mozambique. The final values used in the baseline model are described below. The Vortex project file with these input values is available at www.vortex9.org/ projects/SAleopard.zip.

<u>Number of iterations:</u> *500*
500 independent iterations were run for each scenario.

<u>Number of years:</u> *100*
Life expectancy of Leopards is approximately 10 - 12 years (Hunter and Balme 2005) and possibly 10 – 15 years (Turnbull-Kemp 1967, Martin and de Meulenaer 1988, as cited by Nowell and Jackson 1996). The population was modelled for 100 years (approximately 14 generations) so that long-term population trends could be observed.

<u>Extinction definition:</u> *Only one sex remains*
Extinction is defined in the model as no animals of one or both sexes.

<u>Number of Populations:</u> *10 populations*
The distribution of Leopards in South Africa is widespread across a variety of geographic locations, habitats and management units. Ten core areas were identified based on a presentation by Gus Mills and subsequent group discussion; these were modelled as separate populations with different levels of connectivity or isolation (see Figure 2). These are:

Population 1: Greater Kruger Area
Population 2: Northern Limpopo Area
Population 3: Waterberg / Mpumalanga Area
Population 4: Northern KwaZulu-Natal
Population 5: Kalahari Area
Population 6: Orange River Area
Population 7: Western Cape Area
Population 8: Eastern Cape Mountain Area
Population 9: Eastern Cape Valley Area
Population 10: Wild Coast Area

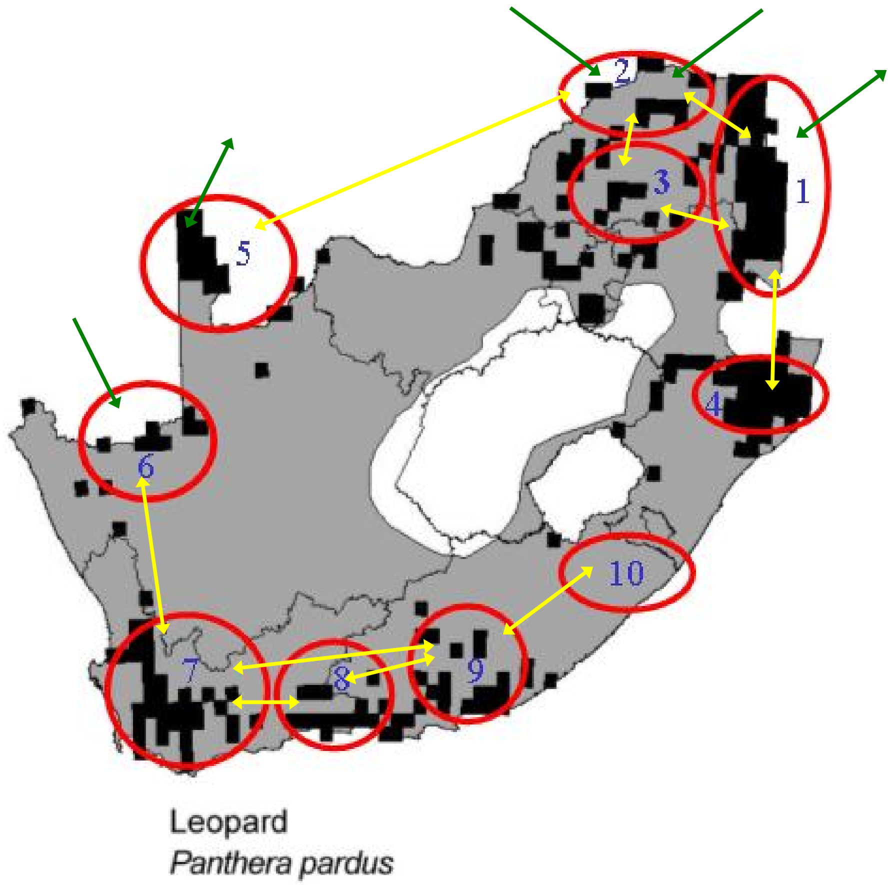

Figure 2: Ten Leopard populations in South Africa were used in the *Vortex* model. Arrows indicate dispersal pathways in baseline model (yellow = dispersal within South Africa; green = movement across international boundaries).

1. ***Great Kruger Area:*** Kruger Park and surrounding private reserves, Lowveld of the Limpopo and Mpumalanga provinces.

2. ***Northern Limpopo Area:*** Includes the north-western regions of the Limpopo valley in the Limpopo province.

3. ***Waterberg and Mpumalanga Area:*** Includes widespread central areas of the Limpopo province, eastern regions of the North West Province (such as Pilanesberg and Magaliesberg) and the Mpumalanga Escarpment up to the Lydenburg area. Another important area is the Soutpanberg which is in the northern extremity of this defined area.

4. ***Northern KwaZulu-Natal:*** Includes Hluhluwe-Imfolozi Park, Greater St Lucia, Mkuzi, Phinda, Ndumu, and Itala as well as other numerous private reserves. Many participants felt that the Greater Kruger Area and Northern KwaZulu-Natal area should be combined assuming there is a continuous population through Swaziland and Mozambique.

5. ***Kalahari Area:*** Kgalagadi Transfrontier Park, Molopo, and the North West Province (this population may be a sink for the neighbouring Botswana population).

6. ***Orange River**:* Includes the northern area of the Northern Cape, within the riverine vegetation of that river system e.g. Orange River.

7. ***Western Cape:*** The population widely distributed within the Cape Fold Mountains in the Western Cape.

8. ***Eastern Cape Mountain:*** Includes the cluster in the mountains and forest areas in the Eastern Cape.

9. ***Eastern Cape Valley:*** The valley Bushveld areas of the Eastern Cape appear to contain another population.

10. ***Wild Coast:*** Northern part of the Eastern Cape including the Transkei area.

<u>Initial Population Size (N)</u>: 4250
Maximum, minimum and best guess estimates for current Leopard population numbers were developed by the workshop participants (see Table 3 for individual population numbers). These best guess estimates were used as the baseline values for the Vortex model using a stable age distribution; maximum and minimum values were explored through sensitivity testing.

<u>Carrying capacity (K)</u>: 4965
The saturation level of Leopards in each core area was estimated to calculate an approximate carrying capacity for each population (see Table 3 for estimated *Ks* for the baseline model). No environmental variation was added to the carrying capacity, as variations in population size are accounted for by environmental variation in reproduction and survival.

Table 3: Population and carrying capacity estimates for each of the 10 identified core Leopard habitats in South Africa.

	Est. Population Size			**Saturation Level**	**Est. K_{Best}**
Population Area	**Min.**	**Best**	**Max.**		
Great Kruger	750	1200	1500	100%	1200
Northern Limpopo	500	1250	2000	80%	1563
Waterberg & Mpumalanga	400	850	1600	80%	1063
Northern KwaZulu-Natal	200	400	600	90%	444
Kalahari	30	50	70	90%	56
Orange River	20	30	60	50%	60
Western Cape	200	350	600	80%	438
Eastern Cape Mountain	35	40	80	65%	62
Eastern Cape Valley	30	50	150	70%	71
Wild Coast	20	30	120	100%	30
Total	*2185*	*4250*	*6780*	*86%*	*4987*

<u>Dispersal Among Populations:</u> Limited
Many of the 10 identified core Leopard populations are likely connected and allow for occasional movement of Leopards between them (Figure 2). Dispersal among populations was included in the model as a small annual probability of Leopards (ages 2 – 4 years, both sexes) moving between populations as shown in Table 4. Additional mortality is expected during dispersal due to the risk of being hit by vehicles, starvation, intra-specific aggression, poisonings, illegal hunting and other factors; survival during dispersal was modelled as 80%.

Table 4: Annual probabilities (as percents) of dispersal from source populations (rows) to recipient populations (columns)

	Krugr	N Limp	Wat/ Mp	KZN	Kala	Orng R	W Cape	E Cp Mtn	E Cp Vlly	Wild Cst
Kruger	98.0	1.0	0.5	0.5	-	-	-	-	-	-
N Limpopo	0.5	98.3	1.0	-	0.2	-	-	-	-	-
Water/Mp	0.2	1.0	98.8	-	-	-	-	-	-	-
KZN	0.2	-	-	99.8	-	-	-	-	-	-
Kalahari	-	0.2	-	-	99.8	-	-	-	-	-
Orange R	-	-	-	-	-	99.8	0.2	-	-	-
W Cape	-	-	-	-	-	0.2	97.3	2.0	0.5	-
E Cape Mtn	-	-	-	-	-	-	2.0	96.0	2.0	-
E Cape Vlly	-	-	-	-	-	-	0.5	2.0	97.3	0.2
Wild Coast	-	-	-	-	-	-	-	-	0.2	99.8

Inbreeding depression: Yes
Inbreeding is thought to have major effects on reproduction and survival, especially in small populations, and so it was included in the model. The impact of inbreeding was modelled as 3.14 lethal equivalents, the median value estimated form analysis of studbook data for 40 captive mammal populations (Ralls *et al.* 1988), with 100% of the effect of inbreeding due to recessive lethal alleles.

Concordance between environmental variation in reproduction and survival: Yes
Environmental variation (EV) is the annual variation in reproduction and survival due to random variation in environmental conditions. Environmental variation not only affects Leopards directly but also prey populations, which in turn affect Leopard survival and reproduction. EV for survival and reproduction were linked in the model (i.e., good years for reproduction are also good years for survival).

EV Correlation Among Populations: 0.5
Leopard populations cover a wide variety of geographical locations and environments in South Africa. The model includes a moderate correlation (0.5) between variation in reproduction and survival rates among these 10 populations.

Mating system: Short-term polygyny
Leopards do not form pair bonds but exhibit a promiscuous breeding system in which individuals may breed with several mates. The model incorporated a short-term polygynous mating system, in which animals can select new mates every year.

Age of first offspring for females: 3 years (females); 4 years (males)
Vortex defines reproduction onset as the time at which offspring are born rather than sexual maturity. Female Leopards reach sexual maturity between 2½ and 3 years of age (Bailey 1993, Nowell and Jackson 1996, Hunter and Balme 2004), and males slightly later (Bothma and Walker 1999). Leopards are non-seasonal breeders and likely breed soon after reaching sexual maturity.

Maximum age of reproduction: 12 years
Vortex assumes that animals can reproduce throughout their adult life and does not model reproductive senescence. Individuals are removed from the model after they pass the maximum age of reproduction. After much group discussion the maximum age of reproduction was set at 12 years for the baseline model to produce the most realistic results; however, other values for this parameter were explored through sensitivity testing.

Maximum number of progeny per year: *4 cubs*
Leopards give birth to 1 to 4 cubs per litter. Mean litter size was calculated as 1.92 (SD = 0.38), taken as an average across estimates by Hemmer (1976) as cited by Nowell and Jackson (1996), Martin and de Meulenaer (1988), Skinner (1989), and Mills and Hes (1997). Sex ratio at birth was assumed to be 50:50.

Density-dependent reproduction: *No*
Reproduction was assumed to be density-independent in the model.

Percent adult females breeding: *50%*
Inter-birth intervals (IBI) for Leopards have been reported as short as 15 -17 months to over two years (Martin and de Meulenaer 1988, Bailey 1993, Bothma and Walker 1999). The percent of females breeding each year was modelled at 50% (approximate IBI = 2 years), with a SD due to environmental variation of 10%.

Percentage of adult males in the breeding pool: *100%*
All adult males were considered to be potential breeders in this polygynous mating system.

Mortality Rates: *See below*
First-year mortality was estimated to be 41% by Martin and de Meulenaer (1988) and to be at least 50% by Bailey (1993). Bothma and Walker (1999) estimate that in Kruger National Park only 50% of all cubs survive to become adults. Bailey (1993) observed high annual sub-adult mortality (32%) in Kruger and a mean annual adult mortality of 19%. Mortality rates were observed to be higher in males than in females and higher in older individuals vs. prime age adults. These data were based on relatively small sample sizes and appear to be high as compared with other large cats; when combined with reproductive values used in the model, these mortality rates resulted in a negative deterministic growth rate. After much consultation and discussion among workshop participants, the mortality rates in Table 5 were selected for the Leopard Vortex model.

Table 5: Mean annual mortality rates for male and female Leopards by age class.

	Females			**Males**		
Life stage	**Age class**	**Mean annual mortality**	**EV**	**Age class**	**Mean annual mortality**	**EV**
Juvenile	0 – 1	40%	8%	0 – 1	40%	8%
Sub-adult	1 – 3	10%	2%	1 – 4	14%	3%
Adult	3 – 10	5%	1%	4 – 10	7%	1.5%
Geriatric	10+	15%	1%	10+	20%	1.5%

Number of catastrophes: *None*
No catastrophes were included in the baseline model (distemper was modelled as a catastrophe in an alternative scenario).

Harvest: *Yes*
Leopards are removed from the population each year through a variety of legal and illegal methods. The number of individuals removed each year through trophy hunting, legal and illegal local hunting, and the removal of problem animals was estimated by the workshop participants (see Table 6). Removals were assumed to be

adults of equal sex ratio, except for trophy hunting (60% male, 40% female). In addition to these estimates, Leopards are thought to be lost from the Greater Kruger and Kalahari populations in South Africa due to trans-border emigration to Mozambique and Botswana respectively; and these emigrants are also included in the annual harvest numbers.

Table 6: Annual harvest modelled in each population due to legal and illegal removal methods and to emigration out of South Africa.

Population Area	**Trophy hunting**	**Local Hunting**		**Problem animals**	**Emigrants**	**Total**
		Legal	**Illegal**			
Greater Kruger	6	0	2	2	20	30
N Limpopo	25	10	40	15	0	90
Waterbg / Mp	25	10	40	15	0	90
KwaZulu-Natal	5	2	20	10	0	37
Kalahari	0	0	2	0	5	7
Orange River	0	0	2	2	0	4
Western Cape	0	0	3	4	0	7
E Cape Mtn	0	0	6	2	0	8
E Cape Valley	0	0	4	2	0	6
Wild Coast	0	0	2	0	0	2
Total	*61*	*22*	*121*	*52*	*25*	*281*

<u>Supplementation</u>: Yes

Leopards are also estimated to enter several of the South African Leopard populations through trans-border immigration. These additions were modelled as annual supplementation events in the Vortex model (see Table 7). Immigrants were modelled by Vortex as unrelated to the recipient population and therefore represented new genetic founders to the South African Leopard population.

Table 7: Annual supplementation modelled in each population due to immigration into South Africa.

Population Area	**Immigrants**	**Source Population**
Greater Kruger	5	Mozambique
N Limpopo	12	Botswana, Zimbabwe
Kalahari	10	Botswana
Orange River	1	Namibia

BASELINE MODEL RESULTS

Deterministic Output

The demographic rates (reproduction and mortality) included in the baseline model can be used to calculate deterministic characteristics of the model population. These values reflect the biology of the population in the absence of stochastic fluctuations (both demographic and environmental variation), inbreeding depression, limitation of mates, and immigration / emigration. It is valuable to examine these values to assess whether they appear realistic for the species and population being modelled.

The values chosen for the *Vortex* Leopard model result in a deterministic growth rate (r_{det}) of 0.093 (λ = 1.098). This represents an annual potential growth rate of about

10%. Generation time (the average age of reproduction) is 7.2 years for males and 6.7 for females. Adult sex ratio is 1.6 females per adult male; Bailey 1993 reports a sex ratio of 1 male: 1.8 females based on trapping data. Few individuals live to the maximum age of 12 (12-year-olds represent 2.2% of the population). Overall, these population characteristics were accepted as realistic for free-ranging Leopards and lend validity to this model as a reasonable representation of wild Leopard populations.

Stochastic Baseline Results

The baseline model represents the best estimates of the PHVA workshop participants on the current biology and status of the Leopard populations in South Africa and therefore the best projection of the future of these populations given our current state of knowledge. Caution should be used in interpreting the results, which are dependent upon the accuracy of the model input values. Model revision is encouraged as more current and accurate data become available or different modelling strategies are explored.

Results of the baseline model project that the Leopard metapopulation in South Africa is likely to persist over the next 100 years with relatively little loss in numbers or genetic diversity. The stochastic growth rate (r_{stoch}) is 0.049, enabling the population to grow when below carrying capacity. There is zero probability of extinction (PE) in 100 years, and the mean population size at 100 years is 4025 with 99.7% gene diversity remaining. The high retention of gene diversity is in part due to the immigration of unrelated animals into South Africa in the model.

Although the Vortex model projects that the Leopard metapopulation is secure in South Africa given current estimates, the fate of individual populations is less positive (Table 8). Populations in Kruger, Limpopo, and Western Cape fare very well, likely due to larger numbers and in some cases the influx of new genetic lines from outside of South Africa. Although the Kalahari population is small, it is likely rescued both demographically and genetically in the model by the immigration of Leopards from Limpopo, North West and Botswana.

Both the Waterberg / Mpumalanga and KwaZulu-Natal populations are also relatively large; however, they both are estimated to be experiencing fairly heavy harvesting (particularly through illegal local hunting – see Table 6), which may contribute to low growth rate, smaller population size, and higher risk of extinction for these populations (Figure 3).

Table 8: Results of the baseline model after 100 years for Leopard populations.

Population Area	PE	Stoch r	Mean N (extant)	SD (N)	% *K*	GD	Mean TE (yrs)
Kruger	0	0.064	1182	40	98	0.994	0
N Limpopo	0	0.047	1512	100	97	0.996	0
Waterbg / Mp	0.08	-0.001	619	476	58	0.958	45
KwaZulu-Natal	0.32	0.002	322	159	72	0.949	56
Kalahari	0	0.206	56	3	100	0.984	0
Orange River	0.25	0.036	50	17	83	0.926	28
W Cape	0	0.055	425	22	97	0.963	0
E Cape Mtn	0.23	0.010	29	25	46	0.896	43
E Cape Vlly	0.87	-0.046	27	29	39	0.831	33
Wild Coast	0.99	-0.035	19	8	65	0.511	32
Metapopulation	0	0.049	4025	567	81	0.997	0

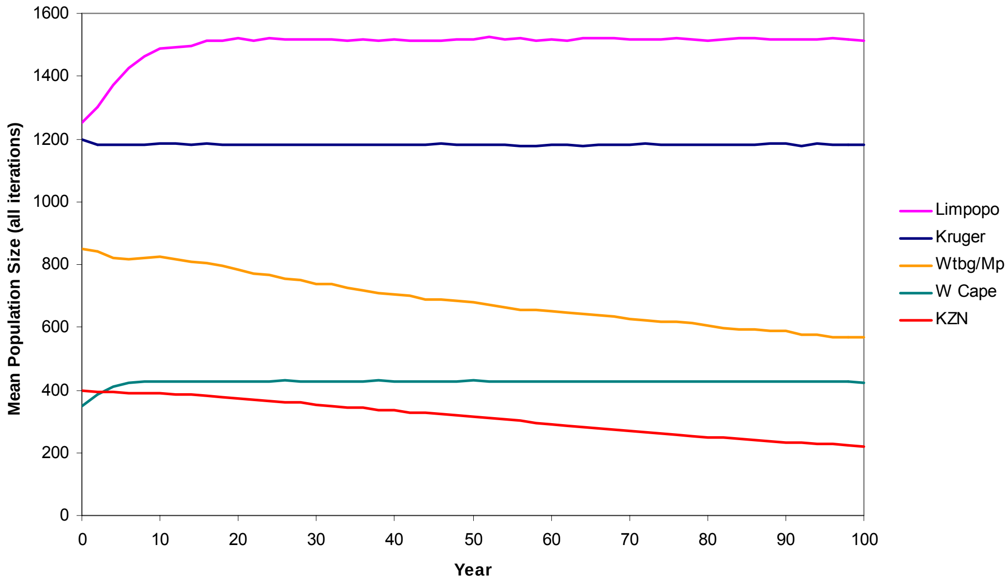

Figure 3: Mean population size (across all iterations) for five large Leopard populations over 100 years (legend order corresponds with order of N_{100}).

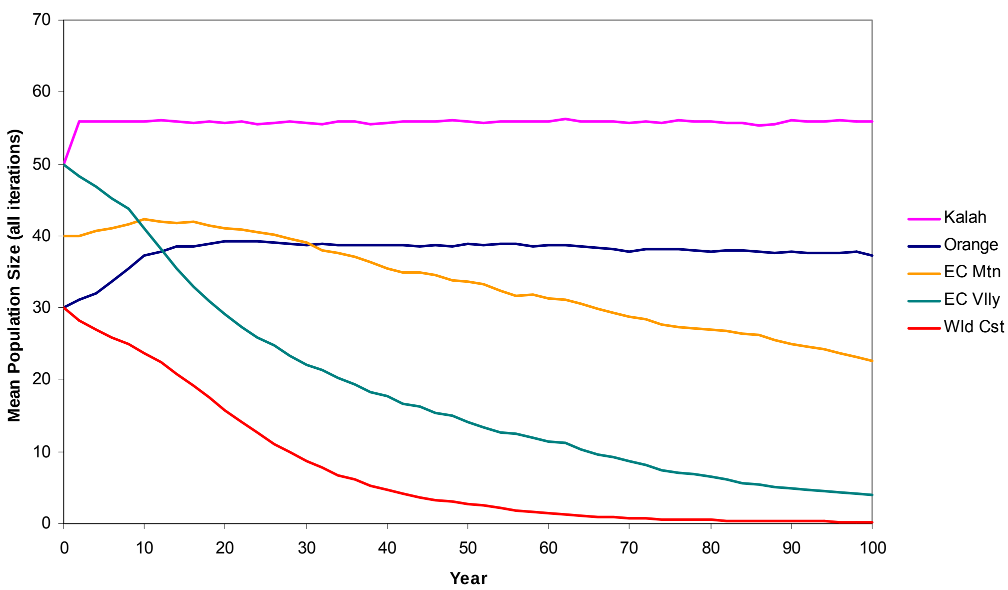

Figure 4: Mean population size (across all iterations) for five small Leopard populations over 100 years (legend order corresponds with order of N_{100}).

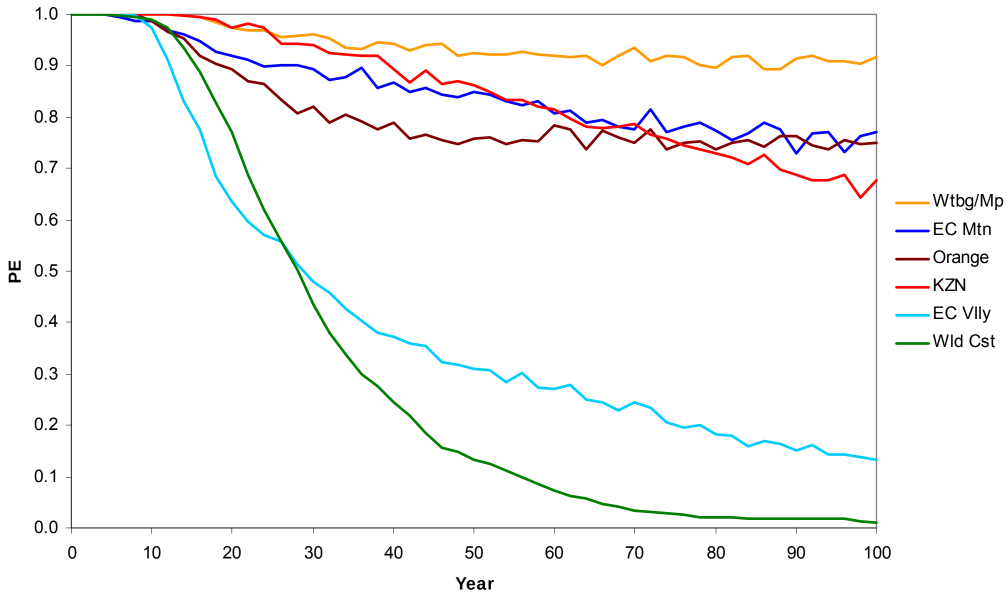

Figure 5: Probability of extinction for six Leopard populations with some risk of extinction over 100 years (legend order corresponds with order of PE_{100}).

The remaining four small populations – Orange River, Eastern Cape (Mountains and Valley) and Wild Coast – demonstrate a general reduction in population size (Figure 4) and gene diversity and a significant risk of extinction, with mean times to extinction ranging from 28 to 43 years. Populations in the Eastern Cape Valley and Wild Coast have a particularly high risk of extinction (87% and 99%, respectively); Orange River and Eastern Cape Mountain may fare better due to connectivity with more robust populations (Figure 5).

Prior to reviewing the model results, the PHVA workshop participants discussed and established the following goal for Leopard populations in South Africa (with respect to probability of extinction over the next 100 years):

- Zero risk of extinction of Leopards in South Africa (metapopulation) (PE = 0)
- PE = 0 for Kruger, KwaZulu-Natal, Kalahari, and Western Cape populations
- PE $\leq$ 5% for remaining six populations

The baseline model results suggest that some but not all of these population goals may be met given current management and harvesting conditions. Specifically, KwaZulu-Natal, Waterberg, Orange River, Eastern Cape (both) and Wild Coast populations have a higher risk of extinction than considered acceptable. Model projections suggest that the metapopulation goal of zero risk of extinction for Leopards in South Africa is met.

Sensitivity Testing of Model

There is a paucity of detailed life history data for Leopards in South Africa needed to fully and accurately parameterize the Vortex model. The baseline model was developed using the best available published data and expert opinion at the PHVA workshop. However, given the uncertainty surrounding many of these parameters, sensitivity testing was conducted on demographic rates and population estimates to determine the potential effect on model results.

Demographic Parameters

Mortality Rates

The following juvenile (first-year) and adult mortality rates were tested (baseline values are in **bold**):

Juvenile:	30%, **40%**, 50%
Adult:	3%, **5%**, 7% (females)
	5%, **7%**, 9% (males)

These variations in mortality rates had no effect on the viability of the four relatively secure populations (Kruger, Limpopo, Western Cape and Kalahari) or on the metapopulation. Effects on model results, however, were evident for many of the other populations, with higher mortalities leading to higher probabilities of extinction and smaller population sizes. Differences in juvenile mortality had a larger impact than changes in adult mortality over the values tested. Populations most affected were KwaZulu-Natal, Waterberg, Orange River and Eastern Cape Mountain; Eastern Cape Valley and Wild Coast have high probabilities of extinction under all mortality values tested (Figure 6).

Reproductive Values

The growth potential of a population is dependent upon not only survival rates but also upon fecundity. Two areas of uncertainty in reproductive rates for South African Leopards are the maximum age of reproduction and the average inter-birth interval (IBI), which determines the percent of females breeding each year. These two parameters were tested as follows:

Maximum Age:	8, 10, **12**, 14 years
% Females:	**50%**, 60%, 70%

Like mortality rates, the maximum age of reproduction (which equals the maximum age in the model) had little effect on the four secure populations and metapopulations; however significant effects were noted for risk of extinction and mean population size for Waterberg, KwaZulu-Natal, Orange River and Eastern Cape Mountain populations. All six remaining populations are subject to a high probability of extinction in 100 years with a maximum age of 8 years (Figure 6).

Genetic Factors

The baseline model includes short-term polygyny (mates are randomly assigned each year); long-term polygyny was also tested. This is unlikely to have demographic effects but can lead to more rapid loss of gene diversity due to greater variance in family size among potential breeders. Model results using long-term polygyny did not lead to significant reductions in gene diversity after 100 years.

An average level of inbreeding depression was modelled via 100% lethal recessive alleles. The use of lethal alleles vs. detrimental alleles allows Vortex to run significantly faster but allows lethal alleles to be purged, resulting in a reduction of the effects of inbreeding depression over time. Scenarios were also run with no inbreeding depression and with only 50% of inbreeding effects due to lethal alleles. Increased effects of inbreeding had only relatively small effects on the populations in Waterberg, KZN and Eastern Cape Mountain; other populations were unaffected.

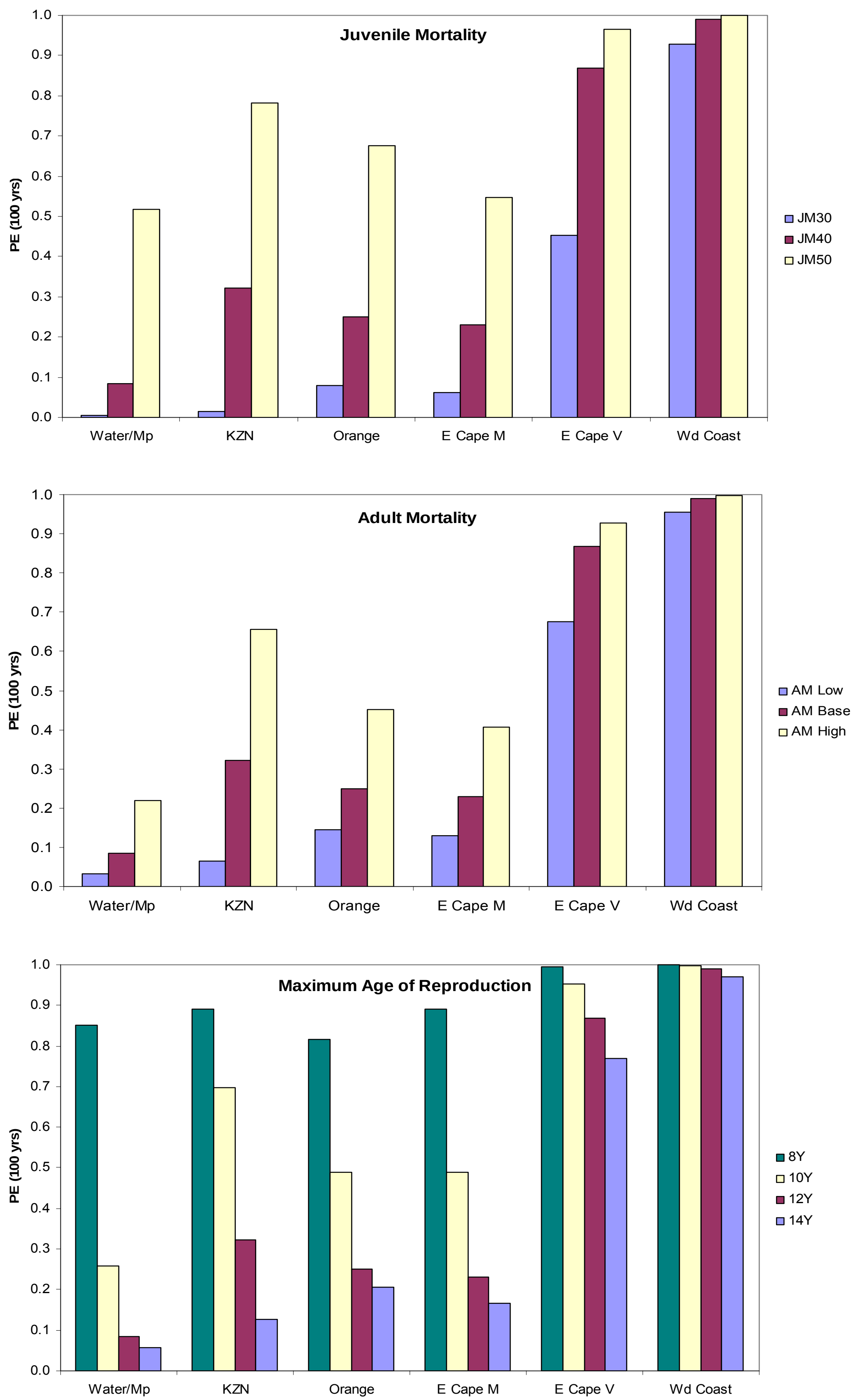

Figure 6: Effect of mortality rates and maximum age on probability of extinction.

Summary
Uncertainty in demographic rates is unlikely to significantly affect the baseline model projections for the metapopulation of Leopards in South Africa or six of the 10 Leopard core populations. Leopards are likely to persist in Kruger, Limpopo, Western Cape and Kalahari and are likely to disappear in the Eastern Cape Valley and Wild Coast. Refinement of mortality and reproductive values may, however, lead to different and more accurate future projections for Leopards in Waterberg, KwaZulu-Natal, Orange River and Eastern Cape Mountain. These parameters would be valuable to address in future research projects.

Population Parameters

Estimates of Size and Carrying Capacity
Leopards are nocturnal, solitary and secretive animals that can range across large areas, making it difficult to accurately estimate population numbers and structure. The participants at the PHVA used all available data and expertise to arrive at the best estimates possible for population numbers for use in the baseline model and management scenarios. All participants recognised the uncertainty in these estimates; therefore, maximum and minimum estimates were also derived (and corresponding carrying capacities were calculated based on estimated saturation levels – see Table 3). Scenarios were run with maximum and with minimum population and *K* estimates to ascertain the range of likely futures for the Leopard populations in South Africa.

Mean population size increased as expected with maximum current population and carrying capacity estimates. However, the level of saturation after 100 years also changed dramatically among these estimates, from 98% *K* (maximum) to 81% (best guess) to only 40% *K* (minimum estimates). This is primarily due to the differences in viability of the smaller populations; under maximum estimates, all populations have PE = 0, while six populations have a very high probably of extinction under minimum estimates (Table 9). The Kruger and Western Cape populations remain relatively large and viable even under minimum estimates; therefore, the metapopulation retains a high level of gene diversity (99%) with PE = 0 due to these populations even with the minimum population and *K* estimates suggested at the workshop.

Table 9: Population status after 100 years with maximum, best guess and minimum estimates of current population size and carrying capacity.

Population Area	PE			Mean Pop. Size (extant)		
	Max	Best	Min	Max	Best	Min
Kruger	0	0	0	1486	1182	727
N Limpopo	0	0	0	2459	1512	22
Waterbg / Mp	0	0.08	0.87	1961	619	3
KwaZulu-Natal	0	0.32	0.91	649	322	3
Kalahari	0	0	0	78	56	33
Orange River	0	0.25	0.83	117	50	9
W Cape	0	0	0	738	425	238
E Cape Mtn	0	0.23	0.78	122	29	3
E Cape Vlly	0	0.87	0.98	209	27	2
Wild Coast	0	0.99	1.00	117	19	0
Metapopulation	0	0	0	7936	4025	1025

In summary, the precision of current population and carrying capacity estimates within the estimated range of possibilities is not crucial to projecting the persistence of Leopards in South Africa. However, the difference between the maximum and minimum estimates projects a very different picture of the distribution and total number of Leopards across the country. Efforts to refine population and *K* estimates are vital to modelling the persistence of local Leopard populations. In the worst case scenario (using minimum estimates), Leopards may be reduced to three disjunct populations, two along the northern border in conjunction with populations in Botswana and Mozambique, and one in the south.

Metapopulation Structure and Dispersal

Leopard distribution is not continuous, but is fragmented over habitat patches throughout South Africa. The identification of core population areas and the level of animal movement among these areas were estimated at the PHVA workshop with some uncertainty; the true structure of this metapopulation and the degree of patch connectivity is relatively unknown. To test the importance of connectivity, the following scenarios were explored:

Complete connectivity (one randomly breeding population)
High inter-patch dispersal (twice the estimated dispersal rates)
Baseline dispersal rates
Complete isolation (no dispersal within South Africa)

The degree of dispersal among populations had no effect on the risk of extinction or retention of gene diversity in the Leopard metapopulation; reduced dispersal / isolation, however, does result in somewhat smaller mean metapopulation size due to the greater chance of extinction of small populations in the absence of supplementation from other populations.

As with other factors already examined, populations in Kruger, Limpopo, Western Cape and Kalahari persist and are unaffected by connectivity to other South African Leopard populations. Wild Coast is not viable under any of the dispersal scenarios modelled. The persistence of the remaining five populations is significantly affected by dispersal rates, with isolation leading to increased risk of extinction (Figure 7). In particular, the Eastern Cape populations face almost certain extinction if isolated from adjacent populations. Therefore, the degree of natural connectivity (or by extension, the development or enhancement of effective corridors) may determine the fate of these local Leopard populations. It is interesting to note that all populations appear to benefit from connectivity, suggesting that no populations are acting as sinks that reduce the viability of other South African populations in this model.

Because the Kalahari Leopard population is estimated to be small and could be considered an extension of the Botswana Leopard population, a scenario excluding the Kalahari population was run. The removal of Leopards in the Kalahari area has no impact on the other Leopard populations or the metapopulation as a whole.

Summary

Uncertainty surrounding the population size, distribution and connectivity of core Leopard populations in South Africa is unlikely to affect projections regarding the viability of the metapopulation (i.e., the persistence of a viable Leopard population in South Africa). However, the number and distribution of Leopards and the persistence of local populations is dependent upon these parameter values. Better information is needed to improve population projections and to evaluate and prioritize management strategies aimed at these local populations.

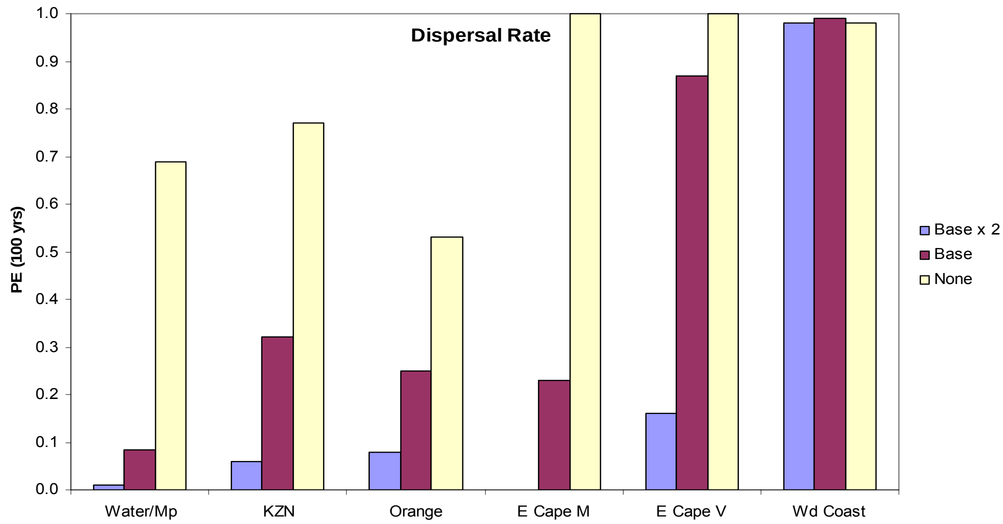

Figure 7: Effect of dispersal rates on probability of extinction of Leopard populations.

ALTERNATIVE FUTURES

Development in Waterberg / Mpumalanga

The possibility of future development in the Waterberg / Mpumalanga area was discussed at the PHVA workshop. It was estimated that there could be a net loss of about 15% of carrying capacity for Leopards in this area; in addition, illegal harvest is estimated to possibly increase by 5%. These potential future changes were modelled to assess the potential threat particularly to the local Leopard population.

Development in this area as described above results in an increase in the probability of extinction of the local Leopard population from 8% to 13% over 100 years and a decrease in the mean size of surviving populations from 619 to 460 Leopards. The remaining populations and metapopulation are relatively unaffected.

Distemper Outbreak

No catastrophes (events that affect survival and / or reproduction beyond the normal range of environmental variation) were included in the baseline model. One possible threat that was identified by workshop participants was distemper. A scenario modelling the risk of distemper was included with the following parameter values:

Annual risk:	1% (occurs an average of 1 out of 100 years)
	Occurrence linked among Kruger, Limpopo, Waterberg
	Occurrence linked among W Cape and E Cape (both)
	Occurrence independent in other 4 populations
Effect:	30% reduction in survival in year of outbreak

The inclusion of distemper in the model had little effect on the metapopulation except to reduce mean metapopulation size due to loss of smaller populations. Similarly, Kruger, Limpopo, Kalahari and Western Cape remain unaffected (PE = 0) as well as Eastern Cape Valley and Wild Coast (high PE). Distemper affected the remaining four populations by increasing the risk of extinction and reducing population size and gene diversity; however, the effects were smaller than those observed with changes in other factors such as survival, reproduction, population size and dispersal.

POTENTIAL MANAGEMENT OPTIONS

Corridor Development

Sensitivity testing indicated that the degree of connectivity among the smaller fragmented populations in western and southern South Africa can have a dramatic effect on the long-term viability of these local populations. The development of corridors among some of these populations was modelled by doubling the rate of dispersal among connected populations. The following corridors were modelled:

Corridor 6-7:	Orange River and Western Cape
Corridor 7-8-9:	Western Cape, Eastern Cape Mountain, Eastern Cape Valley triad
Corridor 9-10:	Eastern Cape Valley and Wild Coast
Corridor All:	Combination of all 5 corridors above (6-7; 7-8; 8-9; 7-9; 9-10)

As expected, the results mirror the impacts of increasing dispersal rates. There is little to no effect on the metapopulation or on local populations in Kruger, Limpopo, Waterberg / Mpumalanga, KwaZulu-Natal, Kalahari or Western Cape. Increased dispersal between Eastern Cape Valley and Wild Coast as modelled does not lower the risk of extinction for Wild Coast and may have a slight detrimental effect on the Eastern Cape populations. In contrast, the promotion of dispersal via corridors between Orange River and Western Cape and among the three populations of Western and Eastern Cape dramatically lowers the risk of extinction of the Orange River and Eastern Cape populations (Figure 8). With increased connectivity to Western Cape, Eastern Cape Mountain becomes more viable; PE drops from 23% to 0%, mean population size doubles, and GD increases from 90% to 95%. Likewise, increased movement of Leopards between the Western and Eastern Cape populations may rescue the otherwise highly vulnerable Eastern Cape Valley population.

Although these results suggest the benefit of promoting corridors among these four Leopard populations, the actual impact of such a management strategy is dependent upon the current degree of movement of animals through these areas and additional mortality factors associated with dispersal. Further investigation of these parameters is warranted before developing extensive corridor management plans.

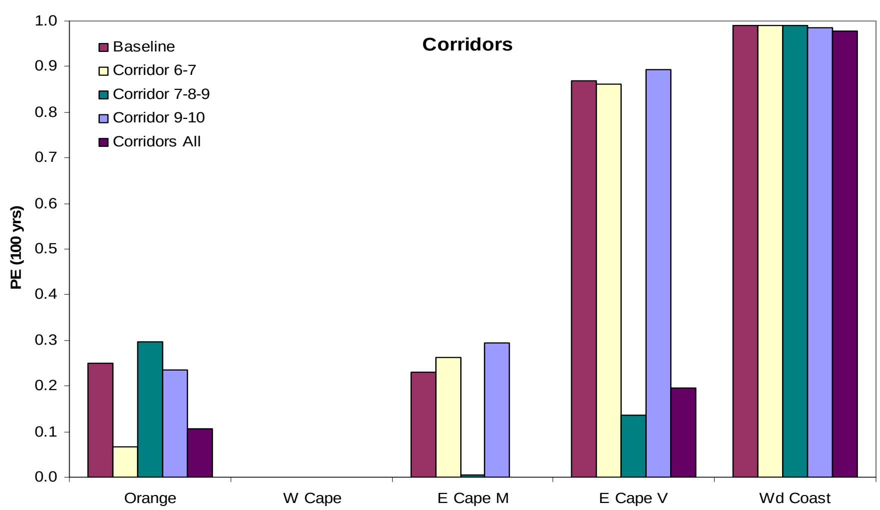

Figure 8: Effect of corridors on probability of extinction of Leopard populations.

Management of Small Populations

Five of the Leopard populations modelled are estimated to have a carrying capacity of fewer than 100 individuals (*K* = 30 to 71). Of these, the Kalahari population is the only one projected to be secure, due to the estimated continuous influx of Leopards from Botswana. The remaining four small populations (Orange River, Eastern Cape Mountain and Valley, and Wild Coast) are vulnerable to stochastic risks associated with small populations. Increasing dispersal with adjacent populations (via corridors or other methods) was found to promote population persistence. Other management strategies discussed during the PHVA workshop and subsequently explored with the Vortex model are: 1) increasing *K* by 10%, possibly through securing additional habitat; and 2) eliminating harvest of these populations, through increased protection and alternative management of problem animals. These three management strategies were compared with respect to their effectiveness in promoting the persistence of these small populations.

Table 10 illustrates the relative impact of these management strategies on probability of extinction, mean population size of surviving populations, and gene diversity retained. Increasing *K* by 10% is beneficial but does not dramatically alter the likely fate of these populations. Increased connectivity with adjacent populations has significant impacts, particularly on the probability of persistence of Leopards in Eastern Cape, as noted above. Most significant, however, is the impact of eliminating the loss of Leopards from these populations. Animals are thought to be lost from these populations due to illegal local hunting and through the removal of problem animals. Eliminating these sources of harvest allows these populations to grow to carrying capacity with little to no risk of extinction (however, Wild Coast will may still suffer effects of genetic isolation). These results suggest that efforts to conserve these populations should include concerted efforts to reduce the removal of animals from these populations via both legal and illegal avenues.

Table 10: Effect of three management strategies on small populations (at 100 years).

Scenario	Orange R	E Cape Mtn	E Cape Vlly	Wild Coast
PE				
Baseline	0.25	0.23	0.87	0.99
Incr *K* 10%	0.21	0.22	0.78	0.96
Corridors	0.11	0	0.20	0.98
No Harvest	0	0	0	0.01
Mean Population Size (extant)				
Baseline	50	29	27	19
Incr *K* 10%	56	41	45	25
Corridors	54	60	47	21
No Harvest	59	61	70	28
Gene Diversity				
Baseline	0.93	0.90	0.83	0.51
Incr *K* 10%	0.93	0.92	0.87	0.56
Corridors	0.95	0.95	0.92	0.68
No Harvest	0.95	0.95	0.94	0.68

Harvesting Strategies

The removal of Leopards can have major impacts on the persistence and viability of local populations and the number and distribution of Leopards across South Africa. Eliminating all harvest from the model results in the persistence of all 10 local populations and the maintenance of about 5000 Leopards in South Africa (vs. about 4000 projected by the baseline model with harvest). Participants at the PHVA workshop identified five sources of loss of Leopards from populations: trophy hunting; legal local hunting; illegal local hunting; removal of problem animals; and emigration out of South Africa to adjacent populations. Trophy and legal (permitted) local hunting as well as emigration are restricted to only a few of the populations, but illegal hunting and removal of problem animals is estimated to occur at some level for all populations (see Table 6). The effects of harvest depend upon the number, sex and location of the Leopards harvested. Several harvesting strategies were explored with the Vortex model to evaluate these effects.

Removing Illegal Harvest

Illegal local hunting accounts for 43% of the annual harvest in the Vortex model and affects every Leopard population. Elimination of illegal hunting from the model has a very significant impact on the persistence of local populations; all populations are projected to have zero risk of extinction in the next 100 years (except for Wild Coast, which has a 1% probability of extinction) (Table 11). Model results suggest that even the smaller Leopard populations might be able to withstand the removal of occasional problem animals if illegal hunting is eliminated. Estimates of the rates of illegal hunting are uncertain, as by definition these activities are not permitted and often go undetected. Efforts to document and reduce / eliminate illegal removal of Leopards, particularly from the smaller populations and from KwaZulu-Natal, would help to improve the viability of these local populations.

Table 11: Effect of removing illegal harvest on Leopard populations.

Population Area	PE_{100}		Mean Pop. Size	
	Baseline	No Illegal Harvest	Baseline	No Illegal Harvest
Kruger	0	0	1184	1182
N Limpopo	0	0	1512	1545
Waterbg / Mp	0.08	0	619	1042
KwaZulu-Natal	0.32	0	322	436
Kalahari	0	0	56	56
Orange River	0.25	0	50	58
W Cape	0	0	425	429
E Cape Mtn	0.23	0	29	61
E Cape Vlly	0.87	0	27	69
Wild Coast	0.99	0.01	19	28
Metapopulation	0	0	4025	4909

CITES Hunting Quota: Number of Leopards

At the 2004 CITES CoP meeting, the annual quota for Leopard hunting trophies and skins in South Africa was increased from 75 to 150 individuals. The impact of this quota increase is unknown, and the development of a Vortex model to assess this factor was a primary concern of the PHVA workshop participants. The baseline and other scenarios incorporated the effects of the past quota of 75 Leopards, specifically by removing adult Leopards (60% male, 40% female) annually from four populations – Kruger, Limpopo, Waterberg / Mpumalanga and KwaZulu-Natal. Although 75 Leopards are allotted in this quota, participants estimated that only about 61 Leopards are removed annually, as some permits have been issued in the past without a Leopard being taken. Several model scenarios were run to assess the impact of increasing the CITES quota while retaining other sources of harvest. Quota levels tested (with full removal) were 0, 75, 90, 105, 120, 135 and 150 (see Table 12 for quota distribution for these scenarios).

Table 12: Quota distribution among populations used in the Vortex model.

Population	**Base**	**0**	**75**	**90**	**105**	**120**	**135**	**150**
Kruger	6	0	6	8	10	12	14	16
N Limpopo	25	0	30	36	42	48	54	60
Waterbg / Mp	25	0	30	36	42	48	54	60
KwaZulu-Natal	5	0	5	6	7	8	9	10
E Cape Mtn	0	0	4	4	4	4	4	4
Total removed	61	0	75	90	105	120	135	150

The number of Leopards harvested through trophy hunting in the range tested (0 to 150 annually) had no effect on the persistence of Leopards in Kruger, Limpopo, Kalahari and Western Cape, despite the fact that much of the harvest occurs in Kruger and Limpopo. The risk of extinction over 100 years remains zero for these populations; mean population size was also relatively unaffected except for Limpopo, where numbers decline slightly. Orange River, Eastern Cape Valley and Wild Coast populations are also relatively unaffected, as no Leopards are removed via trophy hunting from these populations.

As might be expected, Eastern Cape Mountain shows a sharp increase in risk of extinction with all levels of trophy hunting due to the constant removal of four Leopards per year under all quota levels. The allotment of four trophy permits per year to this area increases the risk of extinction in 100 years from 28% to over 60%. Surviving populations average 3-4 animals, possibly emigrants from adjacent populations and suggesting that a resident population may not persist. This small population cannot sustain this level of removal in combination with other threats.

The remaining two populations, Waterberg / Mpumalanga and KwaZulu-Natal, are subject to trophy hunting and become smaller and more susceptible to extinction as hunting quotas increase (Figure 9). The probability of extinction for the Waterberg population increases from 16% to 25% with the increase in quota from 75 to 150 Leopards. Of more concern, however, is the significant decline in mean population size with increased hunting, from over 1000 Leopards with no trophy hunting to 464 with a quota of 75 to only 6 Leopards with the quota of 150. At the 105 level (which equals the annual removal of 42 Leopards from Waterberg), the mean population size drops below 100, suggesting that this level of removal puts this population at high risk.

Increased trophy hunting has the greatest impact on population persistence for the KwaZulu-Natal population, with the risk of extinction rising from 11% with no hunting to 62% under the 150 quota scenario (Figure 9). Mean population size drops from 393 to 217. Despite the relatively large current population size and estimated carrying capacity, the removal of 2-3 additional Leopards per year put this population at substantially greater risk.

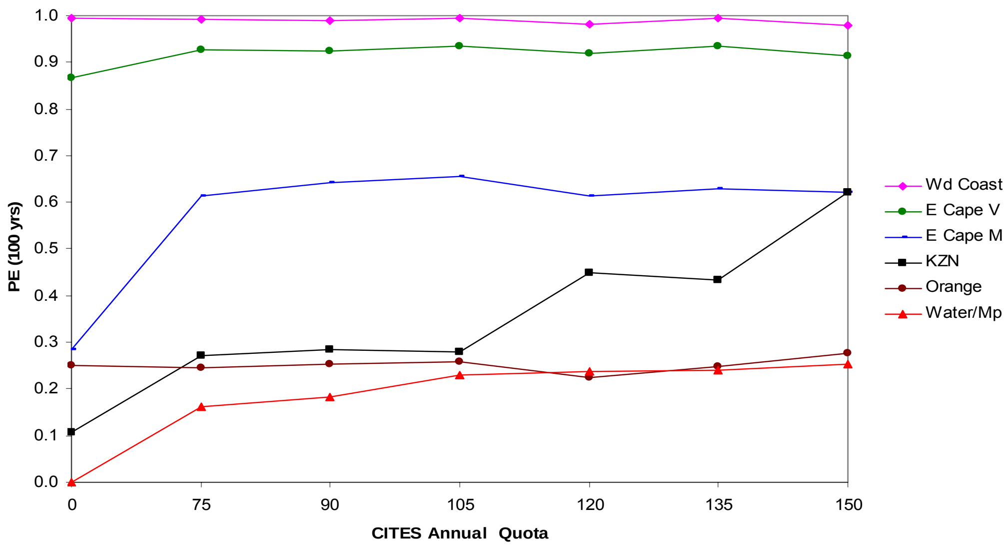

Figure 9: Effect of CITES quota on probability of extinction of Leopard populations.

Because many of the larger Leopard populations have no projected risk of extinction, the increase in the CITES quota from 75 to 150 Leopards does not increase the risk of extinction of Leopards in South Africa over the next 100 years. The total number of Leopards living in South Africa, however, decreases with increased quota levels, due to the decreasing population size and higher risk of extinction of many of the local populations. Mean metapopulation size falls from 4631 with no trophy hunting, to 3844 with a quota of 75 to 3196 with the 150 quota, representing a decline in saturation from 93% to 64% of the carrying capacity of the habitat. These results suggest that the effects of increased quotas will depend in part upon the areas from which Leopards are taken and can lead to local extinctions and reduced population size.

CITES Hunting Quota: Targeting Males

In polygynous species the removal of breeding age females generally is more detrimental to the population than the removal of adult males. Since a male can mate with more than one female, fewer males are required to maintain the same level of reproduction, while the loss of females reduces the reproductive potential of the population and decreases its ability to respond to reductions in population size. It would be difficult to restrict illegal (and perhaps legal) local hunting and the removal of problem animals to males only, and in fact some populations might not be able to withstand the loss of a large proportion of males each year given the already female-biased sex ratio. However, it may be more feasible and desirable to target adult males for trophy hunting. Vortex was used to explore the effect of hunting males only in conjunction with the CITES quota.

Table 13 gives the results for harvesting 60% males (current situation) vs. 100% males via trophy hunting; all other sources of harvest in the model include equal sex ratio. The effects of only male trophy hunting are modest. Waterberg and Eastern Cape Mountain populations have a lower risk of extinction but few Leopards persist in these areas (probably consisting of immigrants from adjacent populations). The risk of extinction for the KwaZulu-Natal population is substantially lower and mean population size is higher, suggesting that a male-biased sex ratio of trophy hunting may be beneficial in this area. Mean population size is slightly higher in Limpopo and for the entire metapopulation with male-biased trophy hunting.

CITES Hunting Quota: Targeting Problem Animals

When large carnivores such as Leopards live in close proximity of human-inhabited areas, conflicts arise when livestock or human lives are threatened. Workshop participants estimated that about 50 problem Leopards are removed each year from South Africa due to such conflicts. One potential harvest strategy is to target these problem animals when hunting Leopards under the CITES quota. This in effect would reduce the number of Leopards removed from the population while satisfying both needs. To investigate this strategy, the 150 Quota scenario was tested with 30 of the 150 Leopards hunted being problem animals in Limpopo (11), Waterberg / Mpumalanga (11), KwaZulu-Natal (7), and Eastern Cape Mountain (1), with 60% of them being males.

In this scenario, hunting of problem Leopards for trophies has small effect in Limpopo (larger mean population size) and no effect on the Eastern Cape Mountain population (Table 13). Although the risk of extinction remains the same for Waterberg / Mpumalanga, the mean population size of surviving populations increases from just a few animals to 63, suggesting the survival of a small resident population. The greatest impact can be observed in KwaZulu-Natal, where the risk of extinction drops from 62% to 14% and mean population size almost doubles. There is a small increase in the metapopulation under this strategy.

The net impact of targeting problem animals is to reduce the removal of Leopards from the population. The effectiveness of this strategy will depend heavily upon the population area(s) from which problem Leopards are removed.

Table 13: Effect of sex ratio and inclusion of problem animals in trophy hunting takes on Leopard populations.

	Kruger	Limpopo	Water/Mp	KZN	ECape M	Metapop
PE						
60% male	0	0	0.25	0.62	0.62	0
100% male	0	0	0.19	0.37	0.51	0
Incl. 30 prob.	0	0	0.24	0.14	0.59	0
Mean Population Size						
60% male	1176	1409	6	217	4	3196
100% male	1180	1505	7	343	5	3435
Incl. 30 prob.	1176	1481	63	376	4	3554

Sustainable Harvest for Local Populations

Each local population differs in its ability to withstand harvest. This complicates the assessment of various quota levels or the effects of targeting problem animals for trophy hunting, as the impact of the same strategy will differ depending upon the distribution of harvest across the Leopard's geographical range in South Africa. To address this issue, the baseline model was used to vary annual harvest levels in each population separately to estimate the maximum level of annual harvest that would meet the PHVA workshop population goals of zero extinction risk for Kruger, KwaZulu-Natal, Kalahari and Western Cape populations and PE $\leq$ 5% for the remaining six populations.

This analysis resulted in the following estimates for the maximum annual harvest from each population area (Table 14). Harvest here includes the loss of Leopards from all sources outside of normal mortality, including trophy hunting, legal and illegal local hunting, removal of problem animals, and emigration of Leopards out of South Africa. Harvest numbers indicate the maximum annual harvest for each population that does not exceed the risk of extinction specified in the PHVA population goals and results in a positive stochastic growth rate. In this scenario, up to 350 adult Leopards (53% males) can be removed each year without unacceptable risk to the populations. All local populations have a low risk of extinction in 100 years, and all populations except the Wild Coast maintain high levels of genetic variation. Mean population size is more variable for Kruger, Limpopo, Kalahari, Western Cape and the metapopulation as a whole as compared with the baseline model (as these are the populations that experience increased harvest under this scenario), while other local populations are more stable in size with lower harvest rates.

Table 14: Results of maximum harvest model on Leopard populations (at 100 years).

Population Area	Total Harvest	PE	Stoch r	Mean N (extant)	SD (N)	% K	GD	Mean TE
Kruger	85	0	0.006	791	482	66	0.980	0
N Limpopo	127	0	0.012	1106	603	71	0.991	0
Waterbg / Mp	74	0.05	0.033	991	127	93	0.990	50
KwaZuluNatal	23	0	0.052	431	25	97	0.977	70
Kalahari	16	0	0.032	38	17	68	0.977	0
Orange River	3	0	0.081	58	5	97	0.946	32
W Cape	12	0	0.044	419	28	96	0.964	0
E Cape Mtn	7	0.01	0.065	57	11	92	0.946	35
E Cape Vlly	3	0	0.068	68	5	96	0.936	16
Wild Coast	0	0	0.072	28	4	94	0.683	60
Metapop	350	0	0.034	3936	1054	79	0.996	0

Current estimates from the PHVA workshop include an annual loss of 77 animals through emigration and the removal of problem animals – sources of loss that may be difficult to manage (see Table 6). Participants estimated another 143 Leopards lost through legal and illegal local hunting, leaving about 130 animals to be harvested through trophy hunting under the maximum harvest strategy. Figure 10 compares the mean metapopulation size projected over the next 100 years with no trophy hunting (Quota 0), current baseline conditions (quota of 75, with actual removal of 61 Leopards annually), new increased quota of 150, and the maximum harvest strategy (approximate quota of 130 given no reduction in local hunting or removal of problem animals). With no trophy hunting, metapopulation size remains relatively stable at current levels. All CITES harvest levels are projected to result on average in population reduction due to local declines and extinctions (but not increased risk of extirpation of Leopards from South Africa). The maximum harvest level closely mirrors the baseline projection but includes the removal of an additional 69 Leopards annually, illustrating the importance of the area from which Leopards are harvested.

The number of Leopards that can be harvested from each population is specific to the input values and assumptions in this Vortex model, most of which include some level of uncertainty. Therefore, these numbers should be viewed cautiously and used only as relative guidelines. As better estimates become available regarding rates of loss through these various causes, and as better demographic and population information becomes available, it will be possible to make more confident projections regarding how many Leopards can be sustainably removed both locally and nationally.

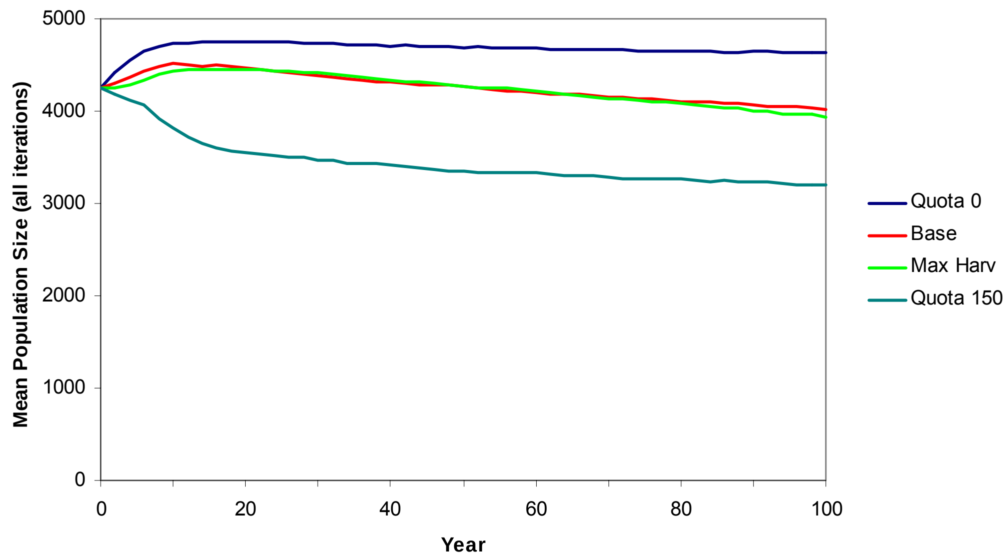

Figure 10: Mean metapopulation size with CITES quotas of 0, 75 (baseline) and 150 compared with maximum harvest strategy.

SUMMARY CONCLUSIONS

Participants at this PHVA workshop used the most current data and other expertise and resources to develop a baseline population model that appears to be a reasonable model for free-ranging Leopards in South Africa. This Vortex model is based upon their best estimates of Leopard biology and threats to South African Leopard populations and, unless otherwise indicated, assumes that these conditions will remain constant over time. Because our understanding of Leopard population biology and current status is incomplete, or because conditions are not likely to remain constant, it is difficult to produce accurate population projections over 100 years. However, this model can be useful in predicting population trends and evaluating the relative effectiveness of various management and harvest options. As more accurate information is gathered and management actions implemented, these results can be re-evaluated to promote effective conservation action for Leopards.

With current estimated rates of legal and illegal harvest of Leopards and movement of Leopards among populations and across international borders, model results indicate that there is little risk of extinction of Leopards in the areas of Greater Kruger, North Limpopo, Western Cape and Kalahari and therefore no risk of extirpation of Leopards from South Africa. Populations in other areas of the country (specifically, Waterberg / Mpumalanga, North Kwa-Zulu Natal, Orange River, Eastern Cape Mountain and Valley, and Wild Coast) are at some risk of extinction depending upon population size and carrying capacity, demographic rates, dispersal rates among populations, and harvest rates. Eastern Cape Valley and Wild Coast in particular are highly vulnerable to extinction in the next few decades. Potential strategies to promote the persistence of these six populations include augmentation of natural corridors among adjacent populations and minimizing harvest of Leopards from these populations.

Leopards are legally harvested in South Africa. The Vortex Leopard model suggests that an annual controlled harvest can be sustained without unacceptable risk to the population. It is difficult, however, to determine the exact level of harvest that is sustainable; this is highly dependent upon demographic rates, population size and distribution, available habitat, and the sex and location of harvested animals. In the absence of more accurate data, maximum harvest rates for each local population have been developed to serve as a guideline. Efforts should be made to minimize illegal hunting in all areas and to minimize the removal of any Leopards from small, fragmented populations to reduce the risk of local extinction. Continued population monitoring is recommended to assess the impact of harvest and to allow harvesting rates to be adjusted as needed. As better data on Leopard biology and populations become available, the Leopard population model can be revised to improve the ability to project the impact of harvesting on Leopard populations throughout South Africa.

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List of Acronyms

ALPRU	African Large Predator Research Unit
ARC	Agricultural Research Council
DEAT	Department of Environmental Affairs and Tourism
CCG	Carnivore Conservation Group of the Endangered Wildlife Trust
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EWT	Endangered Wildlife Trust
IBI	Inter-birth Interval
IUCN	World Conservation Union
KZN	KwaZulu-Natal
Mp	Mpumalanga Province
NCCF	National Cheetah Conservation Forum of South Africa
NEMBA	National Environmental Management: Biodiversity Act, 2004
NGO	Non-government Organisation
NLF	National Leopard Forum
PAW	Protecting African Wildlife Conservation Trust
PHASA	Professional Hunters Association South Africa
SACWG	South African Crane Working Group of the EWT
SAWMA	South African Wildlife Management Association
SANParks	South African National Parks
SAPHCOM	South African Professional Hunters Committee
SAVA	South African Veterinary Association
SCI	Safari Club International
SUSG	IUCN Sustainable Use Specialist Group
wBRC	Wildlife Biological Resource Centre
WCMC	World Conservation Monitoring Centre
WAG	Wild Dog Advisory Group South Africa

LEOPARD POPULATION AND HABITAT VIABILITY ASSESSMENT

10 - 14 April 2005

Southern African Wildlife College

WORKSHOP REPORT

SECTION 4

FINAL PLENARY: WAY FORWARD

Formulation of a National Leopard Forum

Within the different Working Groups it became obvious that a coordinating body was essential. The Population Biology and Utilisation and Policy Working Groups refer to the body as the National Leopard Forum, Habitat and Movement Working Group as the National Leopard Coordinating Body and Conflict Management Working Group referred to it as the National Steering Committee.

The Chairman of the Leopard Working Group of South Africa, Stephen Barber stated that this forum already exists and suggested that this can be used as a vehicle to develop a National Coordinating Body.

It was due to this request that the last section of the workshop was allocated to formalise a coordinating body. All participants at the workshop agreed on the name: National Leopard Forum.

The National Leopard Forum will consist of a committee and members of the committee were chosen using the criteria listed below:

Criteria needed for the committee include:

1. Minimum of one Leopard specialist
2. People from the field
3. Minimum of one person from provincial government
4. Minimum of one person from a university
5. Representative of each Leopard PHVA Working Group
6. Minimum of 2 reputable organisations
7. Minimum representative in the field of utilisation
8. Representative from SANParks
9. Landowners
10. Access to communication (email) is essential

The committee chosen at the workshop include:

Cailey Owen	K.e.r.i Research
John Power	Limpopo South Frontiers
Juan Pinto	Royal Malewane
Stephen Barber	PHASA / Leopard Working Group South Africa
Pat Fletcher	Carnivore Conservation Working Group / EWT
Gerrie Camacho	Mpumalanga Parks Board
Jaco van Deventer	CapeNature
Meluso Kharika	Department of Environmental Affairs and Tourism
Jannie Parsons	Shayamanzi Game (Pty.) Ltd
Freek Nel	De Wildt Cheetah and Wildlife Trust
Quinton Martins	The Cape Leopard Trust
Shawn Catterall	Welgevonden Game Reserve

Jannie Parsons (Shayamanzi Game (Pty.) Ltd.) was nominated due to his business background and Muleso Kharika was also nominated as a representative from the Department of Environmental Affairs and Tourism.

Responsibilities of the National Leopard Forum include the following:

1. Collation and dissemination of information on Leopards;
2. Organise an annual symposium to determine what projects exist and present results available from these projects that can be collated and organised;
3. The establishment of a committee in an advisory role;
4. Coordinate Leopard research activities and input;
5. Drive the implementation of the Leopard PHVA April 2005;
6. Identify gaps in the knowledge and understanding of Leopards;
7. Filtering and clearing house for Leopard research and data so as to determine what is happening in the rest of the country and to focus on a strategy and way forward;
8. Network and collaborate with other relevant organisations and in this way link up with those that already have programmes and projects on the ground;
9. Identify all stakeholders to become an inclusive body;
10. Perform a watchdog role that can identify problem areas and negative impacts;
11. Develop a communication forum / portal to facilitate the dissemination of information such as Large Predator Regulations and research details; and
12. Collate data (copyright on raw research data and cross pollination of results).

LEOPARD POPULATION AND HABITAT VIABILITY ASSESSMENT

10 - 14 April 2005

Southern African Wildlife College

WORKSHOP REPORT

SECTION 5

APPENDICES

Appendix 1: Leopard Workshop Participants List

CONTACT	ORGANISATION	EMAIL	ADDRESS	CELL	TEL	FAX	PHOTOGRAPH
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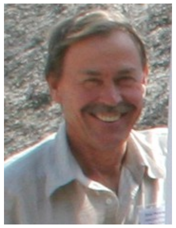
Pietersen, Errol	Associated Private Nature Reserves	errolp@netactive.co.za	Box 483, Hoedspruit, 1380	082 4578628	015 7933958	015 7933958	
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Appendix 2: Participants Goals and Hopes

Workshop participants were asked to write down the answers to the following two questions:

1. What do you want to accomplish at this workshop?
2. What do you think you can contribute to this workshop?

I wish to accomplish	I wish to contribute
A specific direction in terms of future research and conservation effort and a common consensus on utilisation options and census surveys procedures etc.	Having had experience with this species, I hope to contribute as much as I can in next 4 days, as this opportunity is not likely to arise in near future.
I would like to meet other Leopard enthusiasts and find out the status of Leopards in other regions, relevant numbers and why certain areas have greater numbers than others.	Show the research we have achieved over the last 5 years and try to add to the scant information known about Leopards in small enclosed ecosystem
An understanding of present status of Leopard distribution, condition of habitat therefore state of the population, with the view of future conservation and possible utilisation.	A broad understanding of the Lowveld ecosystem and the role played by Leopards in the system both from an ecological point of view as well as a ecotourism and hunting perspective
I would like to see a greater awareness regarding the situation around Leopard i.e.: population status and density, impact of hunting, management systems, damage causing animals etc. and that this knowledge be captured into a sound management plan.	Knowledge of monitoring systems, trade and legislation
An improved understanding of Leopard research needs; management approach and conservation status. Identification of major gaps in the conservation of Leopards in South Africa.	Provide input with regard to Leopard conservation research and management in the Eastern Cape. Provide feedback on initiatives and developments in Leopard conservation in Eastern Cape
To ensure communication and cooperation between conservation and interested parties to allow for proper understanding of Leopard population and conservation status of Leopard in South Africa.	The information I have on Leopard population in the Western Cape and an emphasis on the fact that information available to date desperately needs to be revised. Identify means to alleviate farmer Leopard conflict for future protection.
Gaining a broader understanding of Leopard conservation in South Africa. Create links with different organisations and parties involved in Leopard projects	Helping people better understanding genetics and its importance to conservation.
Get an idea of current / future work being carried out on Leopard and coordination of this work.	Introduce a proposed project and get feedback and identify possible collaborators.
Clarity of conservation status of Leopards in South Africa and identify areas where inputs are needed.	Lateral thought and commitment to put effort into needed inputs (which will hopefully be determined by the workshop), now and later.
Get guidelines for better conservation deal for the Leopard.	Knowledge, terms and energy.
That I will be more informed about all or most	Give ideas to help in current projects running.

of the issues surrounding the Leopard.	
I am here as a representative for Dieter Schleymyer, who is setting up a population research project. L.E.A.P in the Marieskop area supported by the Limpopo Department of Conservation. I will pass on info which will help the project.	My contribution will be limited to that of a complete outside observer.
A better understanding of issues surrounding the survival of and management of Leopard in South Africa, along with increased collaboration among researchers and other stakeholders involved with Leopards.	Assist in the modelling of Leopard populations to assess population viability, identity research needs and evaluate the impact of potential management options.
A coordinated way forward for Leopard conservation, with general buy-in and participation from all present at the workshop.	Something on the modelling side through Vortex.
Development of a framework for Leopard monitoring, identify issues of importance for Leopard conservation and determine the current status of Leopards	To provide input in discussion from the Governments point of view.
Getting people who work with Leopards, directly and indirectly, to share knowledge and to work together towards common goals, promoting Leopard conservation throughout Southern Africa	Personal thoughts on what will hopefully not be a too controversial workshop based on science and not emotions.
Finding a common ground between all participants regarding Leopard conservation and obtain as much info for my forthcoming study.	If I can, contribute to the above process as I am still new in Leopard conservation.
Better understanding of Leopard distribution measures for better management and long term conservation	Have ± 18 years of practical experience in Leopard management in the Cederberg and West Coast. Will share what I have learned with the rest of the group (mainly managed farmer / Leopard conflict).
More correct information and process to determine Leopard population, so as to improve current methods of Leopard utilisation (hunting)	Information on Leopard numbers, movement in the Central Lowveld bordering the Greater Kruger National Park
A rational and objective plan for the conservation of the Leopard based on sound scientific principles.	Guidance, advice and opinions which will help to achieve a rational and objective plan.
A better understanding of the Leopard population in South Africa.	Whatever I can
A better understanding of Leopard ecology, to promote informed decision-making in my work situation.	Knowledge about shortcomings in Department decision-making regarding Leopard issues.
A balanced perspective on the influences of trophy hunting and problem animal control.	A balanced perspective on the influences of trophy hunting and problem animal control.
To get as much information about Leopard in South Africa and how we in the Waterberg can contribute to this workshop	Information about the Waterberg Leopards.
More correct information on Leopards specific to the Waterberg Leopard (also important in	Create an awareness of Leopard to the business world and use the Leopard as an icon

business)	in business seminars
1. Get directions in terms of research needed to fill gaps (information on Leopard). 2. Acknowledge the complexity of Leopard's behaviour in terms of different areas / circumstances. 3. Have a good understanding of real threats to the long-term survival of this animal. 4. Coordinate Leopard research in South Africa.	1.Share my data and understanding of Leopard in my project 2. Share philosophies on Leopard behaviour.
A better understanding of the need for a Leopard quota, and what it should be in South Africa. How this quota (and thus the sustainable / unsustainable use) will contribute to the conservation of Leopards in South Africa.	I hope to contribute my limited knowledge and hopefully a national, pragmatic viewpoint based on my understanding of science, ecology and conservation.
Compile fragmented data, see where the gaps are, determine targets to close these gaps, and use the information as bases for policy formation for Leopard conservation. Formation of an executive committee that use gathered data in a centralised way on a continuous basis. Coordinate Leopard research in South Africa and a better understanding of Leopard outside protected areas.	Include data compiled in non-protected areas. Bring volunteers to assist in current and future Leopard projects throughout South Africa.
An outcome that will ensure the long-term viability of the Leopard species in the natural habitat and increased collaboration among various stakeholders with an interest in Leopard.	How the current Leopard quota is allocated by DEAT provinces. Explain the proposal to the cities COP 13 that upped the quota. A strategic way forward in the conservation of Leopard.
A strategic way forward towards the conservation of Leopard in South Africa	Experience in the PHVA process and provide and accurate report

Appendix 3: The Endangered Wildlife Trust and CBSG Southern Africa

The Endangered Wildlife Trust (EWT) is one of the largest non-governmental conservation organisations in southern Africa and was established in 1973. Widely recognised by its prominent red cheetah spoor logo, the EWT conserves biodiversity through the hands-on conservation of threatened species and their habitats, in a sustainable and responsible manner. Coordinating more than 100 field-based conservation projects and with 18 specialist Working Groups operating throughout southern Africa, Endangered Wildlife Trust programmes cover a wide variety of species and eco-systems and play a pivotal role in conserving southern African biodiversity and natural resources.

The Endangered Wildlife Trust with its access to a rich and diverse range of conservation expertise established CBSG Southern Africa in partnership with the CBSG, SSC / IUCN in 2000. Nine CBSG regional networks exist worldwide, including CBSG Indonesia, India, Japan, Mesoamerica, Mexico, Sri Lanka, Europe and South Asia. Regional CBSG networks are developed in regions requiring intensive conservation action and each network operates in a manner best suited to the region and local species. CBSG tools are adapted according to the needs and requirements of regional stakeholders and species and local expertise is utilised to best effect.

CBSG Southern Africa's mission is: *To catalyse conservation action in southern Africa by assisting in the development of integrated and scientifically sound conservation programmes for species and ecosystems, building capacity in the regional conservation community and incorporating practical and globally endorsed tools and processes into current and future conservation programmes*.

CBSG Southern Africa, operating under the banner of the Endangered Wildlife Trust is a non-profit, non-governmental organisation, serving the needs of the *in situ* and *ex situ* conservation community in southern Africa through the provision of capacity building courses, species and organisational Action Planning, Population and Habitat Viability Assessment (PHVA) and Conservation Assessment and Management Planning (CAMP) workshops, communication networks, species assessments and a host of other CBSG processes for species and ecosystem conservation. CBSG Southern Africa works with all stakeholders in the pursuit of effective biodiversity conservation throughout southern Africa.

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Appendix 4: Workshop Programme

LEOPARD POPULATION AND HABITAT VIABILITY ASSESSMENT

10 – 14 April 2005

Southern African Wildlife College, Hoedspruit

SUNDAY 10TH APRIL 2005

18h30 -	Delegates arrive, registration and icebreaker at the SA Wildlife College
19:00 – 20:00	**DINNER**

MONDAY 11TH APRIL 2005 - DAY 1

	BREAKFAST
08:30 – 09:00	Welcome and introductions
09:00 – 10:30	Presentations ▪ DEAT's position on Leopard conservation and the recent CITES approval to up the Leopard export quota for hunting trophies and skins (**Muleso Kharika, DEAT**) ▪ Current status of Leopard genetic research in South Africa (**Nicole Martins, The Cape Leopard Trust**) ▪ Non-invasive evaluation of the health status of South African Leopard (*Panthera pardus*) populations. (**William Horsnell**, Institute of Infectious Diseases and Molecular Medicine, University of Cape Town) ▪ Current status of trade in Leopards in South Africa (**Claire Patterson, TRAFFIC East / Southern Africa**) ▪ Current status and distribution of Leopards in South Africa (**Gus Mills, Kruger National Park / EWT**) (10 min each)
10:30 – 11:00	**TEA BREAK**
11:00 – 11:30	Introduction to the CBSG, CBSG Southern Africa and the workshop process
11:30 – 13:00	Plenary Session: Identify key issues
13:00 – 14:00	**LUNCH BREAK**
14:00 – 14:30	Formation of Working Groups and overview of task one
14:30 – 15:30	Working groups convene and begin on first task
15:30 – 16:00	TEA BREAK (FUTURE BREAKS SELF-REGULATED)
16:00 – 16:30	Working Group sessions
16:30 – 17:30	Plenary – First Working Group Reports
19:00 – 20:00	**DINNER**

TUESDAY 12TH	**APRIL 2005 - DAY 2**
07:30 – 08:30	**BREAKFAST**
08:30 – 09:30	Working groups convene to make changes to first reports
09:30 – 10:30	Plenary on goals / solutions and filters
10:30 – 11:00	**TEA BREAK and group photos taken**
11:00 – 13:00	Working groups convene and begin second task
13:00 – 14: 00	**LUNCH BREAK**
14:00 – 15:00	Plenary session to present and discuss goals / solutions
15:00 – 15:30	Working Groups convene to continue with second task
15:30 – 16:00	**TEA BREAK**
16:00 – 17:30	Working Groups convene and finalise second task
19:00 – 20:00	**DINNER**
WEDNESDAY 13TH	**APRIL 2005 - DAY 3**
07:30 – 08:30	**BREAKFAST**
08:30 – 09:30	Plenary session to complete task two
09:30 – 10:30	Discussion of third task: Strategies and Action plans
10:30 – 11:00	**TEA BREAK**
11:00 – 13:00	Working Groups reconvene to carry on with task three
13:00 – 14:00	**LUNCH BREAK**
14:00 – 15:00	Plenary Session to report back on task three
15:00 – 15:30	**TEA BREAK**
15:30 – 17:30	Working Groups reconvene to carry on with task three Plenary session to finalise task three
19:00 – 20:00	**DINNER**
THURSDAY 14TH	**APRIL 2005 - DAY 4**
07:00 – 08:00	**BREAKFAST**
08:00 – 10:30	Working Groups reconvene to finalise reports Group integration: Prioritise all solutions
10:30 – 11:00	**TEA BREAK**
11:00 – 12:30	Plenary session to present working group reports, discuss management recommendations and report completion

Workshop closure and survey

13:00 – 14:00	**LUNCH BREAK**

Departure by delegates