Results of the GEF Biodiversity Portfolio Monitoring and Learning Review Mission, Zambia

Enhancing Outcomes and Impact through Improved Understanding of Protected Area Management Effectiveness

Mark Zimsky, GEF Secretariat Biodiversity Coordinator and Mission Lead,
Paul Ferraro, STAP-Biodiversity;
Flavian Mupemo, Acting Technical Project Coordinator, Reclassification and Effective Management of the National Protected Area System project;
Johan Robinson, Former Project Technical Coordinator, Reclassification and Effective Management of the National Protected Area System project;
Nik Sekhran, UNDP, Principal Technical Advisor, Biodiversity and Ecosystems.

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I) Mission Context and Rationale

1) The GEF Results Based Management (RBM) framework and approach includes an emphasis on portfolio monitoring and learning by placing particular attention on using monitoring information for accountability, internal management, learning and knowledge management.

2) In support of the GEF RBM and based on a review of evaluations and OPS 4 findings and biodiversity focal area task force discussions, a select number of learning questions were identified for the biodiversity focal area and these were included in the GEF-5 biodiversity strategy to be implemented and lead by the GEF Secretariat in collaboration with the GEF Agencies. As part of the replenishment process, the GEF Council approved the biodiversity learning objectives to be implemented during GEF-5 as part of the GEF-5 biodiversity strategy. The GEF network of agencies, partner government and non-government executing agencies and country-based staff will be the main users of the findings derived from the portfolio monitoring and learning review process.

3) Given the extensive investment that the GEF has made in protected areas over the course of its existence ($1.89 billion of GEF resources which supported 2,302 protected areas spanning 634 million hectares and 700 globally threatened species), priority has been placed on first implementing learning objective one, "Enhancing Impacts and Outcomes through Improved Understanding of Protected Area Management Effectiveness", through five country case studies as a priority for the first two years of GEF-5. The first learning mission was undertaken in Zambia from November 23-December 3, 2010 and this report summarizes the results and findings from that mission.

4) Midway through the third phase of GEF (GEF3, FY 02-06), the GEF began tracking the impact of its investment in protected areas systematically through the application of the Management Effectiveness Tracking Tool (METT) which assesses progress in improvement in protected area management effectiveness. The METT is comprised of 30 questions that assess the key elements of protected area management based on a management framework developed by the IUCN World Commission on Protected Areas. At both the project and portfolio level, the GEF is using protected area management effectiveness as assessed through the METT as a proxy for biodiversity status and condition and as a measure of one key contributing factor towards ensuring the sustainability of a protected area system, i.e., effectively managed individual protected areas must be considered a cornerstone of a sustainable system, notwithstanding key aspects of sustainability such as financing, institutional sustainability and capacity, and ecosystem and species representation that may not be directly assessed at the system level.

5) While the METT has positive attributes as a monitoring tool in terms of its ease of application, and the calculation and aggregation of scores, the tool is largely made up of inputs that are *hypothesized* to matter for conservation outcomes but for which there has been little empirical analysis of the hypothesized links. In addition, the scores are aggregated in a way that may not actually correlate with effectiveness (i.e., we hope that the score is an indicator for a continuous latent underlying variable of effectiveness that we cannot observe). The METT can only be considered an effective performance metric, and thus a tool to assist learning and the delivery of project results, if a correlation between the METT scores and conservation outcomes exists.

6) The mission to Zambia began to assess whether and how that correlation may exist and sought to establish initial findings that may lead to the establishment of an evidence base on the correlation between the METT score of a protected area and conservation outcomes. The analysis conducted during the mission will also help inform and guide a broader quantitative analysis that will attempt to carefully establish and elucidate the causal relationships between the METT scores, the key elements of protected area management, and conservation outcomes at protected areas. Finally, the mission team analyzed the METT in terms of its application in the GEF context with the aim of improving the tool as a performance metric.

II) Mission Objective and Key Learning Questions

7) The objective of the mission was to improve understanding of the causal relationship between protected area management effectiveness as measured by the Management Effectiveness Tracking Tool (METT) and biodiversity outcomes and impacts. Current understanding of this relationship is quite low, undeveloped, and largely anecdotal.

8) The key portfolio monitoring and learning questions for this mission were:

   a) *Does protected area management effectiveness accurately reflect biodiversity status and project impact in protected areas?*

   b) *Are increases in protected area management effectiveness scores attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool (METT)?*

   c) *Is achievement of project outcomes and impact attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool?*

   d) *What are the strengths and weaknesses of the METT based on the Zambian experience?*

   e) *How might the METT be improved for use by the GEF?*

III) Mission Approach

9) The projects identified in Zambia as part of this analysis were selected because they met the following criteria to allow for an analysis of management effectiveness and conservation outcomes. Thus, the projects were able to provide the necessary information required to answer the key portfolio monitoring and learning questions. The criteria included the following:

   a) Project intervention is focused on improving the management effectiveness of individual protected areas and/or the sustainability of the protected area system.

   b) The management effectiveness tracking tool (METT) has been systematically applied more than one time to protected area sites thereby providing at least two data points.

   c) The protected area sites and the protected area system administration are able to provide biodiversity status and pressure or threat reduction data for the period prior to the project and for the duration of project implementation. These data allows for an initial analysis and

comparison between the METT score (a performance metric) and conservation outcomes (what the GEF projects aims to influence in a positive direction.)

10) In Zambia, GEF has invested in individual protected areas as well as the entire protected area system and the METT has been systematically applied throughout the system more than one time at the two sites the mission team visited as well as all many other sites in the entire PA system.

11) Project sites supported under the following two GEF projects were visited. The two project sites were part of either the WB project "Securing the Environment for Economic Development (SEED)" (Kafue National Park) or the UNDP project: "Reclassification and Effective Management of the National Protected Area System" (South Luangwa National Park-SLNP). In the case of the latter project, SLNP benefited from a variety of national and system-wide activities implemented through the UNDP system-wide project including: 1) reclassification map identifying critical corridors and vegetation communities to be given protection; 2) ecotourism potential analysis for Zambia using SLNP as a case study; 3) development of new PA management categories and Public-Private Partnership models applicable to the GMAs in the South Luangwa valley; 4) introduction of the METT and its evolution into the METTPAZ; 5) financial viability assessment for SLNP; 6) management development training for protected area regional managers, area wardens, and park managers; and 7) GIS database.

12) In addition and equally important, sites directly funded and/or benefiting from the UNDP project were analyzed using existing METT data and biodiversity data supplied by the Zambian Wildlife Authority (ZAWA). All sites analyzed were able to provide other objective data linked to conservation outcomes such as: a) wildlife counts (for buffalo, elephant, lechwe, puku, etc), and b) catch per unit effort (violations per unit of control effort).

13) Given travel, time, and budget constraints, and difficult access at the start of the rainy season, visits to two UNDP demonstration project sites Bengweulu Game Management Areas (GMA) and Chiawa GMA/ Lower Zambezi National Park (NP) were not possible, but data analysis was undertaken and interviews conducted of experts to assess PA management progress in these sites. In total, the mission team was able to obtain data for 12 protected areas (seven protected areas and five game management areas).

14) Site visits and interviews with a wide variety of Zambian experts were also conducted to better understand relationships between protected area management effectiveness and outcomes in the Zambian context (See Annex 1 for a list of experts that were interviewed.) In addition, these expert interviews were used as part of a process of "triangulation", which relies on securing expert inputs from a variety of stakeholders that served to ground-truth the data from the METT as well as the biodiversity status and threat reduction and pressure data.

IV) Summary of Mission Results and Discussion

15) We were able to obtain comparable 2004 and 2007 METT scores for eleven protected areas (seven national parks; four game management areas). The 2004 scores come from an exercise conducted by a UNDP consultant. The 2007 scores come from the UNDP project which

supported a system-wide scoring effort using a modified METT called the METTPAZ (see below for methodology used to make scores comparable across years).

16) The mean increase in the METT performance measure was 3.1 percentage points over three years, but there is a lot of variability. See Table 1 below. Fifty-five percent of the protected areas experienced an increase in the METT performance measure. For those protected areas that experienced an increase, the mean increase was 14.8 percentage points (Note: Mosi-oa-Tunya National Park was also scored by the World Bank in 2004. If one uses this baseline, this national park also experienced an increase in score.)

Table 1: Changes in METT Scores as Percentage of Total Possible Points and Biodiversity Condition

Protected Area	2004	2007	Change (2004-2007)	Qualitative Trend of Biodiversity Condition	Source for Biodiversity Condition
South Luangwa NP	73.6%	73.9%	0.3	stable	data/expert opinion
Kafue NP (World Bank)	47.1%	67.8%	20.7	increase	data/expert opinion
Mosi oa Tunya NP	67.8%	55.4%	-12.4	decrease	expert opinion
Bangweulu GMA	36.8%	36.7%	-0.1	increase	data/expert opinion
Chiawa GMA	47.1%	55.4%	8.2	increase	data/expert opinion
Lower Zambezi NP	56.3%	50.5%	-5.9	decrease	data/expert opinion
Kafinda GMA	27.6%	46.9%	19.4	stable	expert opinion
Kasanka NP	75.9%	56.1%	-19.7	stable	expert opinion
Lavushi Manda NP	21.8%	19.1%	-2.7	stable	expert opinion
Liuwa Plains NP	56.3%	68.9%	12.6	increase	data/expert opinion
West Zambezi GMA*	20.7%	34.0%	13.3	increase	data
MEAN SCORES	48.3%	51.3%	3.1		

* West Zambezi GMA was split into Lower West Zambezi and Upper West Zambezi for METTPAZ. Given the areas of the two sections are roughly the same; we averaged the two scores to yield a single score that would be comparable to the 2004 score.

Table Description: METT values for 2004 and 2007 indicate the percentage of total points available that the protected area scores on the tracking tool (87 for METT and 111 for METTPAZ). Unless otherwise noted, scores are from UNDP. Given that the METTPAZ is simply unpacking the METT into its component questions, we believe that contrasting this percentage over time is valid. The METT sums to 87 (instead of 90) because the indigenous community question was listed as "not applicable" in the METT in Zambia and was removed in the METTPAZ. To make the METT and METTPAZ comparable, we eliminated the question from the METT.

NOTE: Recognize that the METTPAZ, by virtue of unpacking questions, can lead to changed scores without any changes in the underlying elements. For example, a PA might have an annual work plan, but it is not being implemented. Under the METT Q8, the score would be 1. Under the METTPAZ Q5 (Planning), the score could be 1 if the plan exists but is not approved or 1.5 if it has been approved. A score could also go down. For example, a PA might have a management plan, but it is not being implemented. Under the METT Q7, the score would be 1. Under the METTPAZ Q4 (Planning), the score could be 0.50 (if the plan exists but is outdated), 1 if the plan exists and is in process of being updated), or 1.5 (if revised plan exists). In general, it appears that increases in scores are more likely given the category breakdowns and an assumption that if a category description is not fully achieved, the METT respondents would select the category one point below.

17) We categorized the METT questions in the global METT (2004) and the METTPAZ (2007) as inputs, outputs and outcomes. The mission team concluded that these categories, which reflect the logframe project design approach used in most GEF interventions (See Annex 2 for a re-categorized METT), are more accurate and useful than the categories used to organize the METT or METTPAZ questions. We observed that:
    a. About 70% of the METT questions and 57% of the METTPAZ questions are related to inputs and only one question in both relates to outcomes.
    b. The average increase in METT performance scores arises, on average, from an increase in scores in the output questions.
    c. The mean outcome score for the eleven protected areas increased by about a half-point. About half of the protected areas experienced an increase in outcome score.
    d. There is a strong positive correlation between the score from the outcome question and the cumulative scores from the input and output questions.
    e. There is a negative correlation between the change in the METT performance values and the starting METT score in 2004 (i.e., the higher the starting score, the less growth observed).

18) Using quantitative data and expert opinions, we categorize for each protected area the change in biodiversity condition from the early 2000s to more recent years as follows: “decrease” (-1), “increase” (+1) or “stable” (0). An increase in the METT performance measure is positively correlated with changes in biodiversity condition. This positive correlation is summarized by both a positive Spearman correlation of 0.64 ($p=0.03$) and the marginal effects from an ordinal probit model that ranks a decrease as the least desirable category, stable as next most desirable and an increase as the most desirable. In the latter model, the strongest relationship is between an increase in the METT measure and an increase in the probability that a protected area experiences an increase in biodiversity condition.

19) Our results suggest correlations, but cannot be interpreted as causal relationships. However, many of those interviewed who have been directly or indirectly involved in Kafue National Park and South Luangwa National Park felt there was a clear causal relationship between improvements in wildlife numbers and increasing effort at anti-poaching patrols and communication to surrounding villages. This belief is supported by our analysis of violation and arrest trends in the patrol data (see Annex 2), which would be affected by the inputs that have changed over time, and the trends in fires in the parks, which would not have been.

V. Summary of Mission Findings and Discussion (presented under each of the portfolio monitoring and learning questions for the mission)

a. Does protected area management effectiveness accurately reflect biodiversity status and project impact in protected areas?

b. Are increases in protected area management effectiveness scores attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool (METT)?

c. Is achievement of project outcomes and impact attributable to a particular set of elements of management effectiveness as recorded by the Management Effectiveness Tracking Tool?

A. Finding One: An increase in the METT performance measure is positively correlated with changes in biodiversity condition.

20) As noted above, the 11 PAs (8 National Parks and 3 GMAs) for which we were able to collect and analyze biodiversity status and threat data showed that the data are consistent with the hypothesis that there is a correlation between increased METT scores and either stable or increasing wildlife populations (the key biodiversity value of Zambia's PA system).

21) The judgment on the wildlife populations was an expert opinion based on qualitative analysis and the available quantitative data. The elements of the METT which were responsible for this increase are owed to outputs as defined by the mission team in the re-categorized METT. (Note: the mission team categorized all of the questions in the METT into inputs, outputs, and outcomes to be better aligned with the project logframe used in GEF projects.)

22) Within both Kafue and South Luangwa National Park, the mission found that increased resources for staffing including patrolling and law enforcement (tracked under increased scores for inputs in the re-categorized METT) resulted in a decline in violations per unit patrol effort (threats declined) and arrests went up while wildlife numbers increased. This conclusion was supported both by expert opinion (PA managers, tour operators, tour guides), wildlife survey data, and catch per unit effort data. However, it was apparent that the wildlife data was not entirely reliable due to differences in sampling techniques between some survey dates, as well as natural variability and clumping issues, all of which are magnified by the short-time frame of a GEF project or other donor investment.

23) Thus, once a functioning enabling environment was established (recorded in the METT under the categories identified above) it lead to functional and improved management operations. Experience from Kafue National Park and South Luangwa National Park indicates that this will translate into positive conservation outcomes (increased or stable wildlife populations, reductions in pressure and threats) over time.

24) Depending on the associated threats to the PA and the biodiversity that is being conserved (i.e., wildlife may see quicker response to reduced poaching than conserving vegetation cover for example), investments in the enabling conditions of PA management, as measured in the METT,

can be said to be positively correlated with project outcomes associated with biodiversity condition and/or reduction of threats in Zambia.

B. <u>Finding Two:</u> **Initial donor investments, by virtue of focusing on inputs, will almost always push METT scores up.** Initial improvement in METT scores at the two sites visited Kafue National Park, and South Luangwa National Park, and most likely other under-funded PA systems—is attributed to a flush of investment which allows minimally funded protected areas (PA) to elevate management above what is often a very weak baseline.

C. <u>Finding Three:</u> **Low overall METT scores with high responses on the outcome question can imply at least one of two things: (1) efficient management by the protected area (i.e., despite few resources, the protected area is well managed for biodiversity objectives); or (2) the protected area is a "residual reserve," which means that the area is not highly threatened and thus in the absence of much management, the biodiversity objectives are still achieved*. Case missions in the future should examine this issue more closely*.** GEF would not want to encourage growth in METT scores for the sake of growth in METT scores**.**

D. <u>Finding Four:</u> **Monitoring biodiversity status in terms of species populations and trends may not be a cost-effective way to measure the outcomes and impact of a GEF project over its lifetime given population variability between sampling dates and other sampling problems noticed during the mission (clumping, inconsistency in data collection, etc).** Proxy indicators of biodiversity status that record reduction of threat may be more reliable, as was found in Zambia with catch per unit effort in protected areas where the threats to wildlife are driven primarily by poaching.

E. <u>Finding Five:</u> **Feedback from interviews suggest that strategic incentives to alter the METT scores to meet goals other than to provide an objective view of management effectiveness may be present but have not dramatically influenced scores**. ***However, future missions should more carefully consider how to best use a performance metric like the METT so it still tells you what you want, while avoiding "displacement" (efforts aimed directly at increasing the METT score, rather than increasing management effectiveness) or simple fabrication of responses.***

F. <u>Finding Six:</u> **From our interviews and our analyses, we observed that increasing METT scores is easier when baseline scores are low.** Protected areas with lower METT scores increase more quickly given that improving management effectiveness from a low baseline is much easier than increasing it from a high baseline. Thus, a lower percentage increase or even a small decrease in a protected area that starts from a high baseline will not necessarily correlate with a decrease in biodiversity condition. ***Thus an important question for future missions is "Is a given point increase equally valuable at every point in the distribution?" In other words, if a protected area with a baseline score of 32 increases by 10 points, it is equally as valuable as a protected area with a baseline score of 52 that increases by 10 points?***

G. <u>Finding Seven:</u> Less strictly protected areas (Game Management Areas) had lower METT scores, on average, than more strictly protected areas (National Parks). These lower scores reflected both the greater difficulty of managing protected areas that permit multiple uses and human occupation and the lower priority on investing in these areas as opposed to the "core" conservation areas with strict protection. ***Future missions should consider what, if anything is the relevance of protected area category to interpreting changes in METT scores at the level of the portfolio.***

d) What are the strengths and weaknesses of the METT based on the Zambian experience?

25) The following strengths and weaknesses were identified by stakeholders interviewed during the mission (The strengths and weaknesses of METT have been studied and analyzed by many individuals. Here we only focus on what stakeholders in Zambia told the mission team and our observations of its application in the Zambian context.)

<u>Strengths</u>

- The tool is simple to apply, easy to understand, and allows for easy aggregation and analysis.
- All experts interviewed concluded that the key elements of protected area management effectiveness at site level were indeed being tracked in the METT and that the tool was a valid performance metric.
- In Zambia, the METT was completed with peer review and full stakeholder participation (PA managers, private sector in the form of tour and lodge operations, and local communities living in the Game Management Areas). When completed in such a rigorous process, the METT serves not only as a performance metric but also as a means to foster communication and participation in the management of the protected area or GMA. In addition, the scores derived from such a process appear to have more buy-in and be more accurate as more debate and discussion is undertaken before a score is decided upon.

<u>Weaknesses</u>

- Important aspects of management effectiveness are not captured by the METT: (1) system sustainability (sustainable financing and administrative and institutional capacity in particular, but also issues like robustness to changes in future demand for wildlife products); and (2) management effectiveness in the broader landscape that ultimately will affect success inside the protected area (e.g., if wildlife need wet and dry season habitats, but only the wet season habitat is protected, the METT may not reflect this problem).
- Within the original METT framework, when re-categorized based on inputs, outputs, and outcomes, 70% of the available score are inputs, one question is outcome and the rest is outputs (See Annex 2 for a newly categorized METT.) Furthermore, the current METT question on outcome is quite broad and thus perhaps not as informative as it could be. In addition, the outcome question fails to require those who fill out the form to justify outcome scores with concrete data of biodiversity status, threat reduction, etc.
- The outcome questions masks the residual reserve effect and does not take into account distance from threats, population pressures, etc.

- The METT ignores the scaling issue. For example, larger protected areas may benefit from applying the METT to sub-areas of the protected area, rather than the entire protected area. Sub-application can address the spatially varying management demands and threats of ecosystems within the large protected area.
- The METT scoring only allows four gradations of assessment (0,1,2,3) which may be too limiting when movement is made between each gradation. Allowing for half points (0.5 points) between the four grades may be useful.
- Large parks or countries with large parks may find it hard to move scores up the trend line towards improvement. Small parks or countries with small parks may find it easier to improve management scores given that achieving management objectives over the entire protected area is easier in smaller areas.
- All elements (inputs, process, outputs, planning, outcomes) of the METT are not worth the same score. The unequal weighting biases some elements over others.
- The mission conducted a number of METT scoring exercises for South Luangwa National Park and found the revised METT dated July 2007 inadequate. The data sheet for threats is equally confusing and problematic. The classification that is used to categorize the questions (inputs, process, etc.) are not useful in the GEF project context and do not contribute or add value to the process of completing a METT.
- Threats may change in the course of a project which will substantially alter the context in which the METT questions are posed. Thus, scores related to staff numbers, protection and resource access may be impacted strongly and in a negative fashion. When interpreting changes in scores, some attention should be given to changes in context.
- The METT does not adequately measure landscape management outside of the PA and its influence on PA site management. This was particularly salient in the Zambian context given the critical importance of GMAs to the sustainability of protected areas.
- METT scores developed for the same point in time at the same park by different experts can result in widely varying scores. Therefore, in order to allow for trend analysis of METT scores, METT scoring needs to be done by a larger group of stakeholders than one person and, as much as possible, should be done by the same group of stakeholders over the time of the scoring period. The Zambian approach to implementing the METT through a two-step process that included an expert peer review should be considered a best practice for emulation in other countries.

e) How might the METT be improved for use by the GEF?

26) GEF should develop a guidance document for completing the GEF METT, to ensure more consistency in completing the METT. Such instructions will reduce variance in responses to the METT questions across sites and across years at the same site.

27) GEF should encourage collaborative (or even "adversarial collaboration") among different stakeholders when filling out the METT. One useful system-wide approach is to first allow protected area site stakeholders to complete the METT and then have a higher-level group, whose performance evaluation is not tied to the METT score, judge the entire set of protected area METT performances and adjust scores based on their "system perspective." This approach helps address two issues: (a) it can help reduce variance in responses to the METT questions across sites and across years at the same site; and (b) it can reduce the incentives to adjust

METT scores strategically by protected area stakeholders (e.g., to assign a low baseline score and a high follow-up score, which will ensure that the protected area looks like it has performed very well over the project period).

28) To address the low weight of outcomes in the METT, GEF could (1) keep the tool as is but continue to emphasize that the tool does not reflect outcomes; (2) categorize METT questions as inputs , outcomes and outcomes and create an overall score that weights the categories equally (this is similar to what METTPAZ does, albeit with categories that may not make as much sense from a management perspective); or (3) pull the outcome question out and treat as separate performance metric, which does not go into the overall calculation of the METT score (in other words, the METT overall score would be just a function of inputs and outputs).

29) GEF could unpack the questions in METT in a way similar to the way METTPAZ unpacked the questions. Unpacking the questions, whether at the level of the GEF METT or the level of a country METT, can ensure (1) that inputs, outputs and outcomes are clearly differentiated; (2) that the answers to the questions are more meaningful to protected area managers using the METT as an input into planning; and (3) that analyses of METT scores at the GEF Secretariat can provide greater insights than are possible with the current tracking tool. A prime candidate for unpacking the question is the outcome question.

30) The METTPAZ provides additional added-value to protected area management effectiveness measurement that should be considered by the GEF as the METT is revised. The following additions should be considered by the GEF:
    a. Revise question 30 on the METT to be more precise with regards to biodiversity values.
    b. Require that questions related to biodiversity status be justified by either biodiversity data being collected by the project or threat/pressure data.
    c. For all questions, require that supporting data for arriving at a score be provided in the comments section.

31) GEF could encourage agencies and collaborators to break down large parks. Such an approach presents a more nuanced view of management effectiveness by (1) avoiding averaging over large areas and (2) mitigating the problem that increasing METT scores can be more difficult in large protected areas than in small ones and thus performance increases are more likely in countries that have small protected areas, which is not necessarily optimal from a conservation perspective (e.g., a large protected area may have great management in one area and really poor management in another, which can make scoring with the METT difficult and make it difficult to move up in score given the greater difficulty in achieving “sufficient” or “adequate” in resource categories).

32) For METT score analyses at the level of the Agency or GEF-Secretariat portfolio, one might consider the following analyses: (1) break down score changes by input, output and outcome; (2) break down score changes by starting values (i.e., are the score changes predominantly happening among protected areas with low baseline or high baselines?); and (3) break down score changes by protected area type (e.g., IUCN classification or something coarser that reflects the strictness of the protection).

VI. Other lessons and observations

33) Future mission should be aware of confounder in interpreting catch-per-unit-effort (CPUE) from patrol data. CPUE can change because (a) violation frequency is changing (threat), (b) because the efficiency of effort is changing, (c) because species numbers have decreased to such a low level that the incentives to violate and have been reduced, or (d) because of misreporting (e.g., CPUE can go up because violations are going up or because patrol efficiency is going up; for example through improved intelligence gathering). Qualitative data that targeted species still exist in an area can help eliminate the third rival hypothesis. Data on arrests and evasions, and patrol lengths, can be used to eliminate the second and fourth hypotheses. Using data that differentiates minor versus major violations can also be used to better interpret any changes in CPUE.

34) One should always remember that an absence of an improvement in biodiversity conditions does not imply ineffective management. If, for example, threats increased over the same period, a decline in biodiversity status could still reflect an improvement in management effectiveness (i.e., status would have been a lot worse had management effectiveness not improved). Future learning missions should not lose sight of this issue about drawing inferences about effectiveness from status data.

35) Patrol data can also be used, in some circumstances and under certain assumptions, to generate insights into the dynamics of targeted species populations (best for rare species). Experts we interviewed indicated that there exists a literature about collecting and using patrol data in a more rigorous, scientific way.

36) Comparison across sites is useful when score differences are quite large. However, when scores are quite close (10-20 points), there is too much noise from the subjective nature of completing the METT to make useful comparisons.

VII. Preliminary Overall Recommendations

37) The mission identified wide variability in the recording of population numbers of wildlife within national parks. This is due in part to the fact that the process can be subject to observer bias, clumping phenomena, etc as noted in this report. Thus, over the course of the short-time periods of GEF projects, this data can be a very unreliable indicator of project success. Therefore, GEF should develop a menu of standard indicators for application in GEF projects that measure biodiversity threat reduction drawing on the existing literature as appropriate. This menu can complement species data currently being recorded in GEF projects. Possible improvements in performance indicators could include a focus on threats using indicators like "violations per unit of patrol effort (broken down by type of violations)," "arrests per unit of patrol effort," and "evasions per unit of patrol effort," "land cover change," and "fires." Although it is easy to imagine how threats could decline in the absence of a change in biodiversity status, it's harder to imagine how biodiversity outcomes could improve without a decline in threats.

38) Monitoring species populations and trends, if deemed a priority in a GEF project, should be approached in such a way that the monitoring exercise will be sustained over a longer-term

period once the project closes. This will help project recipients collect data over a long-term period and will address the problem in variability over time. Recipient agencies should make every effort to institutionalize data collection to continue post GEF investment. Biodiversity status indicators can only be valuable if they are monitored over the long-term.

39) As part of GEF's annual monitoring processes (Project Implementation Review and Annual Monitoring Review), analyses should be conducted on what elements (inputs, outputs, as well as specific questions) of the METT are driving METT score increases. In order to implement this recommendation, Agencies would have to submit the METT in an excel spreadsheet with the questions in rows and the protected area names in columns.

40) GEF protected area projects should adopt the METTPAZ implementation process in the application of the METT at the site and national level to ensure rigorous peer review and to eliminate bias.

41) For use by the GEF, the current categorization of the 30 questions in the METT is not particularly useful. The team undertook an exercise to re-categorize the questions based on inputs, outputs, and outcomes to be more in line with GEF project design and project results frameworks. The mission team concluded that the GEF should re-do the METT as an output of the case studies conducted during GEF-5 with the aim of producing a "GEF METT" for GEF-6 that incorporates the most germane recommendations arising out of the missions being implemented to support Learning Objective One.

42) The outcome question in the METT should be separated out from the scorecard and treated as a separate reporting issue. Projects should report on outcomes using a scoring approach, but also have to justify it with supporting data. In the revised GEF METT this will be developed.

43) Movement of scores and the importance of moving a PA from one "band" (low (0-30), medium (30-60), high (60-90)) to the next may be a more relevant objective of GEF investments as opposed to minor movements within a band.

44) Numerous experts interviewed noted that the METT does not take up system level issues that impact individual protected area management. GEF should develop a PA system wide monitoring tool to measure progress in changing PA system-level effectiveness for those projects that focus on PA system effectiveness.

Annex 1. Key Informant Interviews

Name	Organisation	Position
Kenneth Nkowani, Dr.	MTENR	Director, GEF Operational Focal Point
Trond Lovdal	RNE	First Secretary - Environment
Winnie Musonda	UNDP	Advisor – Environment Programme
Jack E. Chulu	ZAWA	Director General (Ag)
Edwin Matokwani	ZAWA	Director – C & M
Wilbroad Chansa	ZAWA	Director – RPIVS
Flavian, K.C. Mupemo	ZAWA/REMNPAS	Project Technical Coordinator (Ag)
Jean-Michel Pavy	World Bank	Task Manager
Dale Lewis, Dr	WCS	Country Director
Richard CV Jeffery	Avocet Air Charters	Director/Consultant
Peter Moss	PMTC	Consultant
Patrick Francis	MTENR	Mainstreaming Advisor
Rachel Mc Robb	SLCS	Chief Executive Officer
Adrian Carr	Kapani Lodge	Director
Edjan van der Heide	Mukambi Lodge	Director
Herman Miles	Lupande Safaris	Director
David Wilson	Norman Carr Safaris	Managing Director
Charles Phiri	Consultant	Ecologist
Edmund Farmer	Kafue Trust	Director
James Milanzi	ZAWA	Regional Manager – Western
Mathews Mushimbalume	ZAWA	Regional Manager – Eastern
Francis Mkanda	ZAWA	Park Manager - KNP
Charles Simwawa	ZAWA	Area Warden – SLAMU
Twakundine Simpamba	ZAWA	Ecologist – SLAMU
Edwin Siwale	ZAWA	Ranger Operations (Ag) – SLAMU
Josias Zulu	ZAWA	Extension Officer – SLAMU
Nyirongo Sinyala Ms	ZAWA	Planning Officer – SLAMU
Moses Mukumbi	ZAWA	Park Ranger- TID – SLAMU
Lucky Mwenya	ZAWA	Park Tanger – Lupande GMA
Nelson Nyirenda	ZAWA	Senior WPO – SLAMU
Beatrice Makukula Ms	ZAWA	Senior WPO – SLAMU
Milner Kafutbubiji	ZAWA	Accountant – Eastern Region
Stanley Simfukwe	ZAWA	Revenue Officer – SLAMU

Acronyms

Ag	Acting
C & M	Conservation & Management
KNP	Kafue National Park
MTENR	Ministry of Tourism, Environment and Natural Resources
RNE	Royal Norwegian Embassy
RPIVS	Research, Planning, Information and Veterinary Services
SLAMU	South Luangwa Area Management Unit
SLCS	South Luangwa Conservation Society
TID	Tourism and Infrastructure Development
WPO	Wildlife Police Officer
ZAWA	Zambia Wildlife Authority

Annex 2. WB/WWF METT Re-categorized As an Inputs-Outputs-Outcome Typology

Issue	Criteria
1. Legal status OUTPUT Does the protected area have legal status (or in the case of private reserves is covered by a covenant or similar)? *Context*	The protected area is not gazetted/covenanted
	There is agreement that the protected area should be gazetted/covenanted but the process has not yet begun
	The protected area is in the process of being gazetted/covenanted but the process is still incomplete (includes sites designated under international conventions, such as Ramsar, or local/traditional law such as community conserved areas, which do not yet have national legal status or covenant)
	The protected area has been formally gazetted/covenanted
2. Protected area regulations OUTPUT Are appropriate regulations in place to control land use and activities (e.g. hunting)? *Planning*	There are no regulations for controlling land use and activities in the protected area
	Some regulations for controlling land use and activities in the protected area exist but these are major weaknesses
	Regulations for controlling land use and activities in the protected area exist but there are some weaknesses or gaps
	Regulations for controlling inappropriate land use and activities in the protected area exist and provide an excellent basis for management
3. Law enforcement OUTPUT Can staff (i.e. those with responsibility for managing the site) enforce protected area rules well enough? *Input*	The staff have no effective capacity/resources to enforce protected area legislation and regulations
	There are major deficiencies in staff capacity/resources to enforce protected area legislation and regulations (e.g. lack of skills, no patrol budget, lack of institutional support)
	The staff have acceptable capacity/resources to enforce protected area legislation and regulations but some deficiencies remain
	The staff have excellent capacity/resources to enforce protected area legislation and regulations
Issue	**Criteria**
4. Protected area objectives INPUT Is management undertaken according to agreed objectives? *Planning*	No firm objectives have been agreed for the protected area
	The protected area has agreed objectives, but is not managed according to these objectives
	The protected area has agreed objectives, but is only partially managed according to these objectives
	The protected area has agreed objectives and is managed to meet these objectives
5. Protected area design INPUT Is the protected area the right size and shape to protect species, habitats, ecological processes and water catchments of key conservation concern? *Planning*	Inadequacies in protected area design mean achieving the major objectives of the protected area is very difficult
	Inadequacies in protected area design mean that achievement of major objectives is difficult but some mitigating actions are being taken (e.g. agreements with adjacent land owners for wildlife corridors or introduction of appropriate catchment management)
	Protected area design is not significantly constraining achievement of objectives, but could be improved (e.g. with respect to larger scale ecological processes)

Issue	Criteria
	Protected area design helps achievement of objectives; it is appropriate for species and habitat conservation; and maintains ecological processes such as surface and groundwater flows at a catchment scale, natural disturbance patterns etc
6. Protected area boundary demarcation INPUT Is the boundary known and demarcated? *Process*	The boundary of the protected area is not known by the management authority or local residents/neighbouring land users
	The boundary of the protected area is known by the management authority but is not known by local residents/neighbouring land users
	The boundary of the protected area is known by both the management authority and local residents/neighbouring land users but is not appropriately demarcated
	The boundary of the protected area is known by the management authority and local residents/neighbouring land users and is appropriately demarcated
Issue	**Criteria**
7. Management plan INPUT Is there a management plan and is it being implemented? *Planning*	There is no management plan for the protected area
	A management plan is being prepared or has been prepared but is not being implemented
	A management plan exists but it is only being partially implemented because of funding constraints or other problems
	A management plan exists and is being implemented
7a. Planning process	The planning process allows adequate opportunity for key stakeholders to influence the management plan
7b. Planning process	There is an established schedule and process for periodic review and updating of the management plan
7c. Planning process	The results of monitoring, research and evaluation are routinely incorporated into planning
8. Regular work plan INPUT Is there a regular work plan and is it being implemented *Planning/Outputs*	No regular work plan exists
	A regular work plan exists but few of the activities are implemented
	A regular work plan exists and many activities are implemented
	A regular work plan exists and all activities are implemented
9. Resource inventory INPUT Do you have enough information to manage the area? *Input*	There is little or no information available on the critical habitats, species and cultural values of the protected area
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is not sufficient to support planning and decision making
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is sufficient for most key areas of planning and decision making
	Information on the critical habitats, species, ecological processes and cultural values of the protected area is sufficient to support all areas of planning and decision making

Issue	Criteria
10. Protection systems OUTPUT Are systems in place to control access/resource use in the protected area? *Process/Outcome*	Protection systems (patrols, permits etc) do not exist or are not effective in controlling access/resource use
	Protection systems are only partially effective in controlling access/resource use
	Protection systems are moderately effective in controlling access/resource use
	Protection systems are largely or wholly effective in controlling access/ resource use
11. Research INPUT Is there a programme of management-orientated survey and research work? *Process*	There is no survey or research work taking place in the protected area
	There is a small amount of survey and research work but it is not directed towards the needs of protected area management
	There is considerable survey and research work but it is not directed towards the needs of protected area management
	There is a comprehensive, integrated programme of survey and research work, which is relevant to management needs
12. Resource management INPUT Is active resource management being undertaken? *Process*	Active resource management is not being undertaken
	Very few of the requirements for active management of critical habitats, species, ecological processes and cultural values are being implemented
	Many of the requirements for active management of critical habitats, species, ecological processes and, cultural values are being implemented but some key issues are not being addressed
	Requirements for active management of critical habitats, species, ecological processes and, cultural values are being substantially or fully implemented
13. Staff numbers INPUT Are there enough people employed to manage the protected area? *Inputs*	There are no staff
	Staff numbers are inadequate for critical management activities
	Staff numbers are below optimum level for critical management activities
	Staff numbers are adequate for the management needs of the protected area
14. Staff training INPUT Are staff adequately trained to fulfil management objectives? *Inputs/Process*	Staff lack the skills needed for protected area management
	Staff training and skills are low relative to the needs of the protected area
	Staff training and skills are adequate, but could be further improved to fully achieve the objectives of management
	Staff training and skills are aligned with the management needs of the protected area
15. Current budget INPUT Is the current budget sufficient? *Inputs*	There is no budget for management of the protected area
	The available budget is inadequate for basic management needs and presents a serious constraint to the capacity to manage
	The available budget is acceptable but could be further improved to fully achieve effective management
	The available budget is sufficient and meets the full management needs of the protected area
16. Security of budget	There is no secure budget for the protected area and management is wholly reliant on outside or highly variable funding

Issue	Criteria
INPUT Is the budget secure? *Inputs*	There is very little secure budget and the protected area could not function adequately without outside funding
	There is a reasonably secure core budget for regular operation of the protected area but many innovations and initiatives are reliant on outside funding
	There is a secure budget for the protected area and its management needs
17. Management of budget INPUT Is the budget managed to meet critical management needs? *Process*	Budget management is very poor and significantly undermines effectiveness (e.g. late release of budget in financial year)
	Budget management is poor and constrains effectiveness
	Budget management is adequate but could be improved
	Budget management is excellent and meets management needs
18. Equipment INPUT Is equipment sufficient for management needs? *Input*	There are little or no equipment and facilities for management needs
	There are some equipment and facilities but these are inadequate for most management needs
	There are equipment and facilities, but still some gaps that constrain management
	There are adequate equipment and facilities
19. Maintenance of equipment INPUT Is equipment adequately maintained? *Process*	There is little or no maintenance of equipment and facilities
	There is some *ad hoc* maintenance of equipment and facilities
	There is basic maintenance of equipment and facilities
	Equipment and facilities are well maintained
20. Education and awareness INPUT Is there a planned education programme linked to the objectives and needs? *Process*	There is no education and awareness programme
	There is a limited and *ad hoc* education and awareness programme
	There is an education and awareness programme but it only partly meets needs and could be improved
	There is an appropriate and fully implemented education and awareness programme
21. Planning for land and water use INPUT Does land and water use planning recognise the protected area and aid the achievement of objectives? *Planning*	Adjacent land and water use planning does not take into account the needs of the protected area and activities/policies are detrimental to the survival of the area
	Adjacent land and water use planning does not takes into account the long term needs of the protected area, but activities are not detrimental the area
	Adjacent land and water use planning partially takes into account the long term needs of the protected area
	Adjacent land and water use planning fully takes into account the long term needs of the protected area
21a: Land and water planning for habitat conservation	Planning and management in the catchment or landscape containing the protected area incorporates provision for adequate environmental conditions (e.g. volume, quality and timing of water flow, air pollution levels etc) to sustain relevant habitats.
21b: Land and water planning for connectivity	Management of corridors linking the protected area provides for wildlife passage to key habitats outside the protected area (e.g. to allow migratory fish to travel between freshwater spawning sites and the sea, or to allow animal migration).

Issue	Criteria
21c: Land and water planning for ecosystem services & species conservation	"Planning adresses ecosystem-specific needs and/or the needs of particular species of concern at an ecosystem scale (e.g. volume, quality and timing of freshwater flow to sustain particular species, fire management to maintain savannah habitats etc.)"
22. State and commercial neighbours OUTPUT Is there co-operation with adjacent land and water users? *Process*	There is no contact between managers and neighbouring official or corporate land and water users
	There is contact between managers and neighbouring official or corporate land and water users but little or no cooperation
	There is contact between managers and neighbouring official or corporate land and water users, but only some co-operation
	There is regular contact between managers and neighbouring official or corporate land and water users, and substantial co-operation on management
23. Indigenous people OUTPUT Do indigenous and traditional peoples resident or regularly using the protected area have input to management decisions? *Process*	Indigenous and traditional peoples have no input into decisions relating to the management of the protected area
	Indigenous and traditional peoples have some input into discussions relating to management but no direct role in management
	Indigenous and traditional peoples directly contribute to some relevant decisions relating to management but their involvement could be improved
	Indigenous and traditional peoples directly participate in all relevant decisions relating to management, e.g. co-management
24. Local communities OUTPUT Do local communities resident or near the protected area have input to management decisions? *Process*	Local communities have no input into decisions relating to the management of the protected area
	Local communities have some input into discussions relating to management but no direct role in management
	Local communities directly contribute to some relevant decisions relating to management but their involvement could be improved
	Local communities directly participate in all relevant decisions relating to management, e.g. co-management
24 a. Impact on communities	There is open communication and trust between local and/or indigenous people, stakeholders and protected area managers
24b. Impact on communities	Programmes to enhance community welfare, while conserving protected area resources, are being implemented
24c. Impact on communities	Local and/or indigenous people actively support the protected area
25. Economic benefit OUTPUT Is the protected area providing economic benefits to local communities, e.g. income, employment, payment for environmental services? *Outcomes*	The protected area does not deliver any economic benefits to local communities
	Potential economic benefits are recognised and plans to realise these are being developed
	There is some flow of economic benefits to local communities
	There is a major flow of economic benefits to local communities from activities associated with the protected area
26. Monitoring and evaluation INPUT Are management activities monitored against performance?	There is no monitoring and evaluation in the protected area
	There is some *ad hoc* monitoring and evaluation, but no overall strategy and/or no regular collection of results
	There is an agreed and implemented monitoring and evaluation system but results do not feed back into management

Issue	Criteria
Planning/Process	A good monitoring and evaluation system exists, is well implemented and used in adaptive management
27. Visitor facilities INPUT Are visitor facilities adequate? *Outputs*	There are no visitor facilities and services despite an identified need
	Visitor facilities and services are inappropriate for current levels of visitation
	Visitor facilities and services are adequate for current levels of visitation but could be improved
	Visitor facilities and services are excellent for current levels of visitation
28. Commercial tourism operators OUTPUT Do commercial tour operators contribute to protected area management? *Process*	There is little or no contact between managers and tourism operators using the protected area
	There is contact between managers and tourism operators but this is largely confined to administrative or regulatory matters
	There is limited co-operation between managers and tourism operators to enhance visitor experiences and maintain protected area values
	There is good co-operation between managers and tourism operators to enhance visitor experiences, and maintain protected area values
29. Fees INPUT If fees (i.e. entry fees or fines) are applied, do they help protected area management? *Inputs/Process*	Although fees are theoretically applied, they are not collected
	Fees are collected, but make no contribution to the protected area or its environs
	Fees are collected, and make some contribution to the protected area and its environs
	Fees are collected and make a substantial contribution to the protected area and its environs
30. Condition of values OUTCOME What is the condition of the important values of the protected area as compared to when it was first designated? *Outcomes*	Many important biodiversity, ecological or cultural values are being severely degraded
	Some biodiversity, ecological or cultural values are being severely degraded
	Some biodiversity, ecological and cultural values are being partially degraded but the most important values have not been significantly impacted
	Biodiversity, ecological and cultural values are predominantly intact
30a: Condition of values	The assessment of the condition of values is based on research and/or monitoring
30b: Condition of values	Specific management programmes are being implemented to address threats to biodiversity, ecological and cultural values
30c: Condition of values	Activities to maintain key biodiversity, ecological and cultural values are a routine part of park management

Annex 3. Analysis of Supporting Data

HISTORIC METT/METTPAZ SCORES

All values are percentage of total points available that the protected area scores on tracking tool (87 for METT and 111 for METTPAZ). Total potential score on METT is 87 because we removed indigenous community question as it was deemed irrelevant for Zambia.								
"Project" refers to whether there is a donor project on site.								
Protected Area	**2004**	**2006**	**2007**	**2008**	**2009**	**2010**	**2004-2007**	**Project**
South Luangwa NP	73.6%		73.9%			75.2%	0.3	Y
Kafue NP World Bank	47.1%	54.0%	67.8%	67.2%	67.2%		20.7	Y
Kafue NP UNDP with WB 2004	47.1%		50.3%	67.2%	67.2%		3.1	Y
Mosi oa Tunya NP World Bank with UNDP 2007	51.7%	64.4%	55.4%				3.7	Y
Mosi oa Tunya NP	67.8%		55.4%				-12.4	Y
Bangweulu GMA	36.8%		36.7%				-0.1	Y
Chiawa GMA	47.1%		55.4%				8.2	Y
Lower Zambezi NP	56.3%		50.5%				-5.9	limited
Kafinda GMA	27.6%		46.9%				19.4	limited
Kasanka NP	75.9%		56.1%		70.1%		-19.7	Y
Lavushi Manda NP	21.8%		19.1%		10.3%		-2.7	N
Liuwa Plains NP	56.3%		68.9%				12.6	Y
West Zambezi GMA*	20.7%		34.0%				13.3	Y
MEAN SCORES	48.5%		51.6%				3.1	

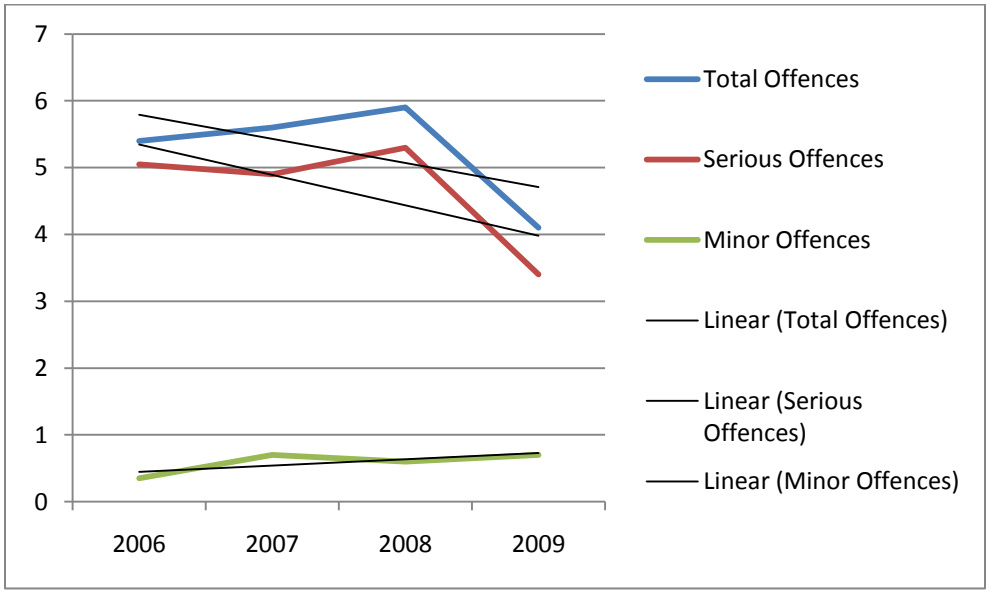
HISTORIC WILDLIFE TRENDS

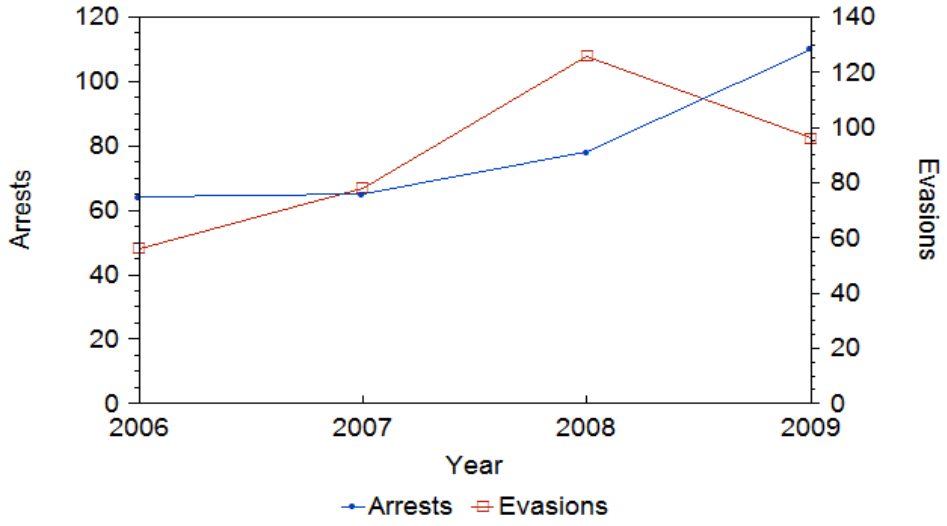
I) KAFUE NATIONAL PARK

Per Dr Francis Mkanda's report

Catch per effort:

	2006	2007	2008	2009
Total Offences	5.4	5.6	5.9	4.1
Serious Offences	5.05	4.9	5.3	3.4
Minor Offences	0.35	0.7	0.6	0.7





Observation: Catch per effort (CPUE) decreased over the period of the project, which suggests that either the number of violations (threat) has decreased over the period or the efficiency of the patrol units has decreased over the period. We can eliminate the latter explanation by examining the arrest and evasion data: arrests and evasions have increased, which implies that the efficiency of patrol units has, if anything increased over the period. Thus we infer that the threat of poaching has declined over the period.

Fairall, N & Kampamba, G. 2001. Aerial Census of Kafue National Park, CERU Technical Report 010.

Species	1997	1999	2001	Intrinsic annual rate of change (%)
Elephant	5250	1453	2141	-22.4+/-24.0
Buffalo	3426	4089	4729	+8.0+/-0.45
Sable	10515	1982	1297	-52.3+/-18.0
Wildebeest	1395	1510	1192	-3.9+/-4.6
Hartebeest	4485	1417	944	-38.9+/-10.8
Zebra	1676	998	690	
Roan	1529	924	8[1]	
Eland	2397	63	2[2]	

"As elephant numbers decreased by about 50% from 1997 to 2000 we would have expected a massive accumulation of carcasses. This is not the case and the large rate of decline thus may not be real but rather the result of limited accuracy due to low coverage of the Park during earlier surveys. On the other hand a decline in the population cannot be ruled out and the verification of trends would require further investigation.

Buffalo numbers increased at an intrinsic rate of 8% which is well within the biological capacity of the species. In buffalo such increases are usually related to favourable ecological conditions resulting from relatively high rainfall or a relaxation of intraspecific or interspecific competition induced by a reduction in the number of competitors.

The dramatic decline (nearly 10-fold) in sable antelope numbers is a matter of concern, as is the decline in all other species."

Frederick, H (2009) "Aerial Survey of Kafue Ecosystem 2008" Zambia Wildlife Authority, Lusaka, Zambia.

"The main findings below discuss the indicator species for the park; the elephant population was extrapolated for the missing P4 area but all other species' data is direct:

- *Elephant in Kafue National Park are probably increasing from 2004, showing a growing trend. Current population (extrapolated for entire park) in KNP is 3,348 +/- 933CL.*

[1] No estimates possible and these figures represents actual counts
[2] No estimates possible and these figures represents actual counts

- *No fresh elephant carcasses were seen, only older elephant bones. The very low carcass ratio (1.3%) (ratio of carcasses to live elephant) indicates that mortality is very low.*
- *Puku in KNP show significant increases from 2002. The current population is 5,700 ± 1,668 CL.*
- *Red lechwe in KNP are stable from 2002 &2006; current population is 5,417 ± 1,796 CL.*
- *Buffalo populations were assessed at 6,314 ± 4,996 CL, though the scattered and clumped distribution of buffalo leads to unreliable estimates.*

Other species:

- *Hartebeest, Kudu and Sable show increasing trends from the 2002 survey.*
- *Impala are stable from 2006 but show a possible decline from 2002; however, this is probably the result of the P4 omission and extrapolation shows no significant change.*

Recommendations:

- *Total counts of buffalo and elephant should be carried out with regular sample counts to confirm populations.*
- *Regular surveys should be carried out at least every two years and include the entire ecosystem."*

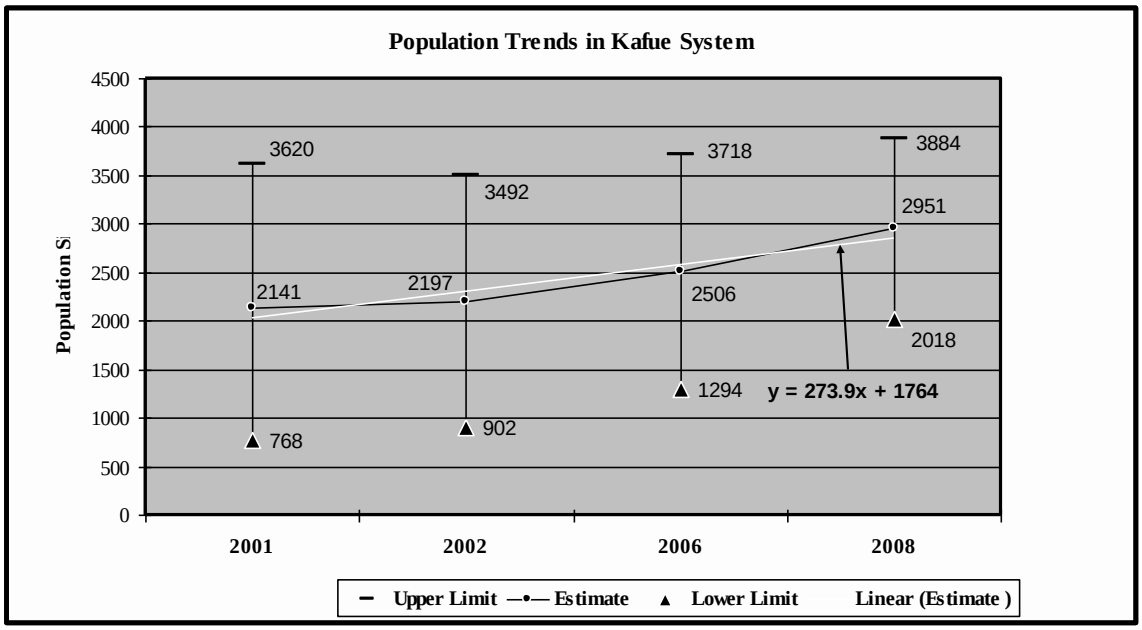
	2002		2006			2008		
Species	**Est**	**95%**	**Obs**	**Est**	**95%**	**Obs**	**Est**	**95%**
Buffalo	30840	299077	374	3714	37	1276	6314	4996
Elephant	2197	1295	251	2506	1212	528	2521	703
Elephant Carcass			2			7		
Hartebeest	3552	4340	192	2097	898	788	4048	913
Impala	14791	5618	492	5318	1483	1471	7208	2276
Kudu	555	294	18			138	695	242
Puku	7113	2834	255	3095	890	1146	5700	1668
Red Lechwe	1623	3229	414	5817	3365	1018	5494	2261
Roan	2392	2017	107	1088	1560	199	1193	563
Sable	9245	7274	345	3389	1250	1378	7753	1827

Simukonda, C. (2009). The Elephant Survey (2008) – A Country Report. Zambia Wildlife Authority, Lusaka, Zambia.

Past survey Estimates in the Kafue system:

Year	Estimate	Lower Limit	Upper Limit
2000	1453		
2001	2141	768	3620
2002	2197	902	3492
2003	1347		
2004	6306	1079	11533
2006	2506	1294	3718
2008	2951	2018	3884

Population Trends in Kafue system



"Even though the line in the graph above shows a gradual increase in the elephant population of Kafue Ecosystem, we need to interpret the trends with caution because of the overlapping confidence limits. However, from the elephant carcass ratio (No. of carcasses/Sum Carcasses and the Population Estimate) of 0.97%, and the estimates shown above, we could say that elephant populations are either stable or increasing and certainly not decreasing."

Summary:

The following table summarises the data from Frederick and Fairall:

Species	1997	1999	2001	2002	2006	2008
Elephant	5250	1453	2141	2197	2506	2521
Buffalo	3426	4089	4729	30840	3714	6314
Sable	10515	1982	1297	9245	3389	7753
Wildebeest	1395	1510	1192			
Hartebeest	4485	1417	944	3552	2097	4048
Zebra	1676	998	690			
Impala				14791	5318	7208
Kudu				555		695
Puku				7113	3095	5700
Red Lechwe				1623	5817	5494
Roan				2392	1088	1193

Observation: From the above it can be concluded that wildlife numbers have been increasing in the Kafue National Park during the GEF project period. This is based on the fact that elephant numbers in

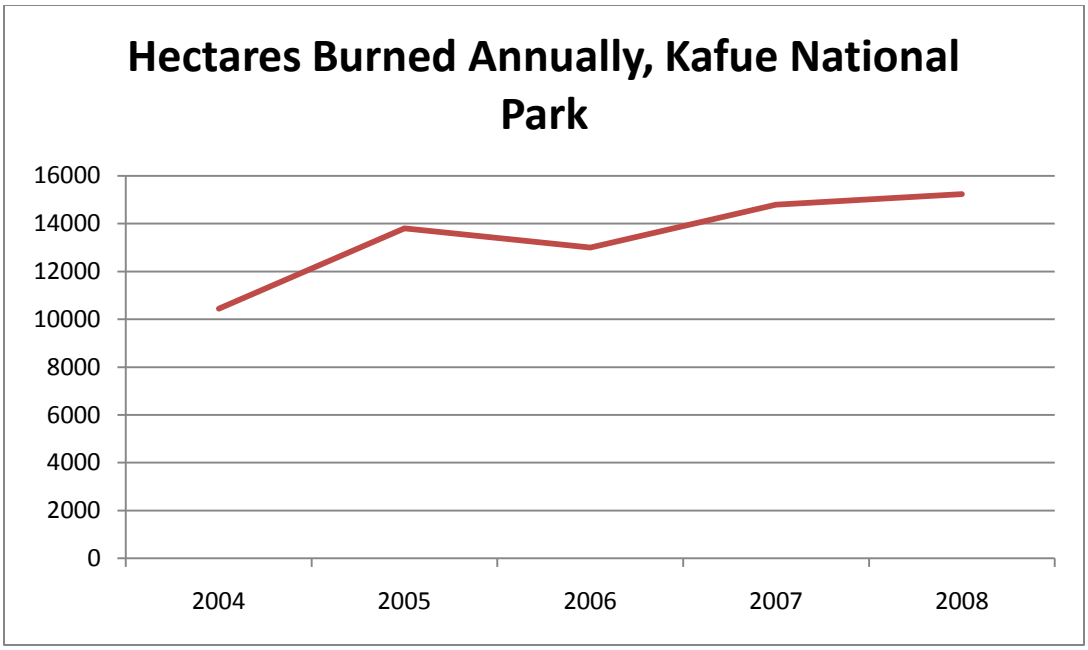
Kafue National Park are probably increasing from 2004, showing a growing trend. No fresh elephant carcasses were seen in 2008, only older elephant bones. The very low carcass ratio (1.3%) (ratio of carcasses to live elephant) indicates that mortality is very low. Puku in KNP show significant increases from 2002, with Hartebeest, Kudu and Sable show increasing trends from the 2002 survey. The threat of poaching has been reduced through the implementation of the project – this has been confirmed by expert opinion during interviews on the mission.

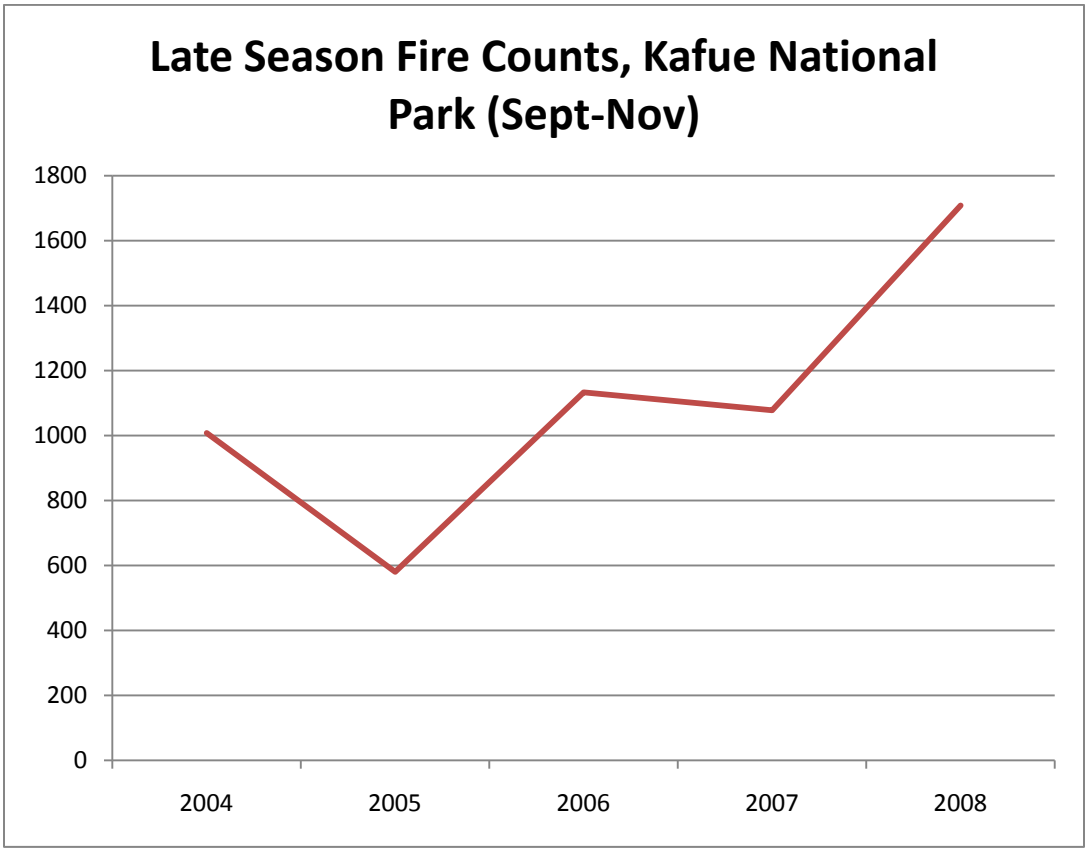
However, little has been done in controlling fires which was identified as a major threat to the Park (in the 2007 METTPAZ), with estimated areas burnt in Kafue National Park increasing with 46% from 2004 to 2008 (see table and graph below). Also of concern, is that late dry season fires are on the increase rather than early dry season fires. The late dry season fires are far hotter as a result of more combustible material, resulting in an increase in damage to trees and shrubs (see graph below).

Table 1: Number of fires in the Park and estimated areas burnt.

Year	No. of fires detected	Estimated areas burnt
2004	5,327	10,443
2005	5,736	13,800
2006	5,028	13,000
2007	5,618	14,792
2008	5,978	15,231

*Area estimated using ARC GIS 9.1, where the points (coordinates provided by Maryland University) were joined together to form a polygon whose area was calculated.


Hectares Burned Annually, Kafue National Park
16000
14000
12000
10000
8000
6000
4000
2000
0
2004
2005
2006
2007
2008


Late Season Fire Counts, Kafue National Park (Sept-Nov)
1800
1600
1400
1200
1000
800
600
400
200
0
2004
2005
2006
2007
2008

MOSI OA TUNYA NATIONAL PARK

Elephant Data

No data

Observation: Based on expert opinion, the wildlife population has been stable or decreasing. In DSI, 2004[3], a spreadsheet was used that relates wildlife biomass to rainfall and a rough analysis was made of the stocking rates of Zambia's National Parks compared to the theoretical carrying capacity based on rainfall. This showed that Mosi-oa-Tunya National Park was dangerously overstocked. A stable or decreasing wildlife population in Mosi oa Tunya National Park is therefore not necessarily bad.

[3] Development Services and Initiatives, 2004. *Conservation Planning for Protected Areas.* Report to the Ministry of Tourism, Environment and Natural Resources, Government of the Republic of Zambia.

BANGWEULU GAME MANAGEMENT AREA:

Lechwe Data

Survey Year	Estimated Number of Lechwe	Reference
Late 1960's	16,000 – 17,000	In Viljoen, 2009
1973	25,000	
1980	40,000	East, 1998
1983	41,401	Howard et. al., 1984
Late 1980's	30,000	Kamweneshe 2000
2007	87,000	Simwanza, 2007
2009	55,632	Viljoen, 2009

Viljoen, P. Bangweulu Wetlands, Zambia. Aerial Wildlife Survey. October 2009. Bangweulu Wetlands Management Bord.

"The population estimate of 55, 632 black lechwe is significantly higher than most of the previous population estimates for this species in the Bangweulu Wetlands. The black lechwe population in the Bangweulu Basin was first estimated to number 16,000-17,000 in the late 1960s and approximately 40,000 in 1980 (East 1998). A population decrease was reported for the late 1980s when the population was estimated to be 30,000 (Kamweneshe 2000). Simwanza's (2007) estimate of 87,000 black lechwe is the highest estimate to date. Kamweneshe's (2000) estimate suggested that the area could sustain up to 160,000 black lechwe and that the population numbered 250,000 up to the 1930s. There is, however, no evidence to support these early estimates.

It is, however, difficult to compare the various population estimates directly because of different survey methodologies or, as in the case of the 1980 estimates, exact survey methodologies used are not known. East 1998 suggested that black lechwe numbers are closely balanced between population stability and decline through illegal overhunting, particularly because of poaching during the dry season, especially in the main Bangweulu Wetlands area. Thirgood et al. (2008) estimated that at least 3000 black lechwe per annum are hunted illegally. Population estimates and actual numbers of ungulates counted during the 2000 survey by Simwanza (2007) were generally lower when compared to this survey. These species include tsessebe (estimate = 509) and sitatunga (estimate = 75) compared with this survey's estimate of 1,126 and 687 for tsessebe and sitatunga respectively. Only four oribi were recorded during the 2007 survey compared to 29 during this survey (Appendix V). Eight hartebeest were seen during both surveys.

Obtaining reliable estimates of animals in large herds or concentrations is particularly difficult for observers (Cogan & Diefenbach 1998; Redfern et al. 2002). The large herds of black lechwe in the Bangweulu Wetlands area offer a particular challenge. It is therefore recommended that the integration of georeferenced airborne digital video should be considered for future surveys aimed at lechwe. This will allow reliable post-processing of survey data. Video imagery also has certain advantages compared to conventional photographs. Such systems are currently available for wildlife surveys. This methodology could also be invaluable in assisting with the classification of habitat types or vegetation communities."

Observation:
Therefore, the following data on other species are used as this might be a better indication of growth/decline of actual numbers:

Species	**Simwanza, 2007**	**Viljoen, 2009**
Tsessebe	509	1,126 +/- 165 (95% CL)
Buffalo	161	216 (total count of two groups)
Sitatunga	30	649 +/- 5223 (95% CL)
Oribi	4	29

From the above, it can be concluded that wildlife numbers are increasing in the Bangweulu GMA during the project period.

CHIAWA GAME MANAGEMENT AREA:

Available data:

Species	1995 Mwima*	2003 AWF**	2005 AWF***	2007 Simwanza WWF****	2009 Simkonda*****
Elephant Family			406	284	
Elephant Bulls			34	92	
Elephant Total	167	45	440	376	586
Elephant Carcasses		0	7	13	
Buffalo		902	1177	1382	
Sable		0	6	0	
Waterbuck		0	0	52	

*Mwima, H. K. and Yoneda, K. 1995. *Preliminary Report on the Aerial Censuses of Large Mammals in the Lower Zambezi National Park.* Zambia Wildlife Authority.

**Dunham, K. M. 2004. *Aerial Survey of Elephants and Other Large herbivores in the Zambezi Heartland (Zimbabwe, Mozambique and Zambia): 2003*. Report for African Wildlife Foundation.

***Simwanza, H. I. 2005. *Zambezi Heartland Transboundary Natural Resources Management Areas: Aerial Survey of Large Herbivores in the Zambezi Heartland, Zambia: October 2005.* African Wildlife Foundation.

****Simwanza, H. I. 2007. *Aerial Survey of Large Wild Herbivores in Chiawa and Rufunsa Game Management Areas*, Zambia: October 2007.

*****Simukonda, C. (2009). *The Elephant Survey (2008) – A Country Report.* Zambia Wildlife Authority, Lusaka, Zambia.

Observation: Based on the limited data, no conclusive trend can be established. However, it is generally felt that wildlife numbers have increased in the Chiawa GMA.

LOWER ZAMBEZI NATIONAL PARK:

Available data:

Species	1995 Mwima	2003 AWF	2005 AWF	2009 Simkonda
Elephant Family			1407	
Elephant Bulls			303	
Elephant Total	112	1477	1710	289
Elephant Carcasses	85	13	7	65
Buffalo	1504	5757	3042	
Sable		215	81	
Waterbuck		250	278	
Zebra	357	166	48	

Simukonda, C. (2009). The Elephant Survey (2008) – A Country Report. Zambia Wildlife Authority, Lusaka, Zambia.

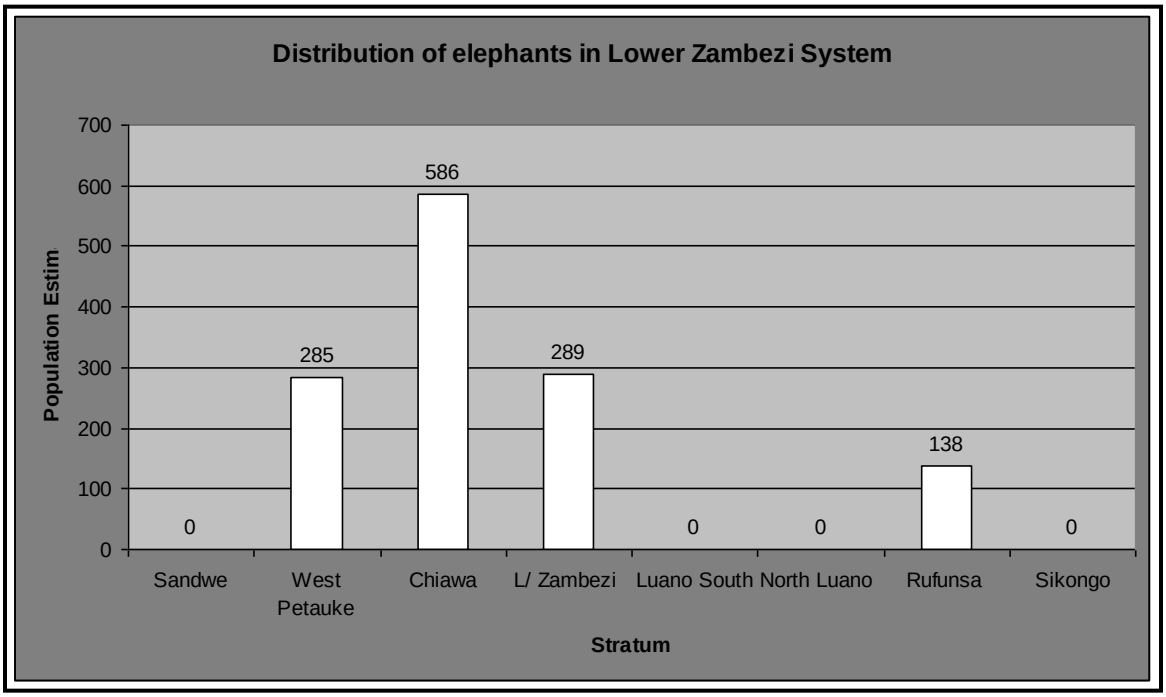
4.4.3 Distribution of Elephants

Most of the elephants in the Lower Zambezi ecosystem were outside the National Park; only 22% were found within the National Park. Out of the 78% that was found outside the park, the highest number (45%), was in Chiawa, and the least 10%, was in Rufunsa GMA.

Distribution of Elephants and Carcasses in Lower Zambezi System

Stratum	Elephant estimate	Percentage Composition	Carcass Estimate	Carcass Ratio
Sandwe	0	0		
West Petauke	285	22	23	7.47
Chiawa	586	45	69	10.53
L/ Zambezi	289	22	65	18.36
Luano South	0		0	0
North Luano	0		0	0
Rufunsa	138	11	21	13.21
Sikongo	0		40	0
Total	1298		218	14.38

Distribution of Elephants in Lower Zambezi System



4.4.4 Carcass Ratio

The elephant carcass ratio for the Lower Zambezi system is 14.37%. Carcass ratios between 1% and 8% show a stable to increasing population, while above 8% indicate a decreasing population (Douglas-Hamilton, 1981.). Therefore, although the d-test shows insignificant change, it is very likely that the elephant population in the Lower Zambezi system is decreasing. The carcass ratio is high in all the areas where elephant was observed except West Petauke which was relatively lower (7%). The carcass ratio was highest in the park – 18%.

As the table above shows, 62% of the carcasses found were in Lower Zambezi National Park and Chiawa GMA, out of which 32% were fresh carcasses. Ironically, more carcasses were found in the park which is of a high protection status than outside.

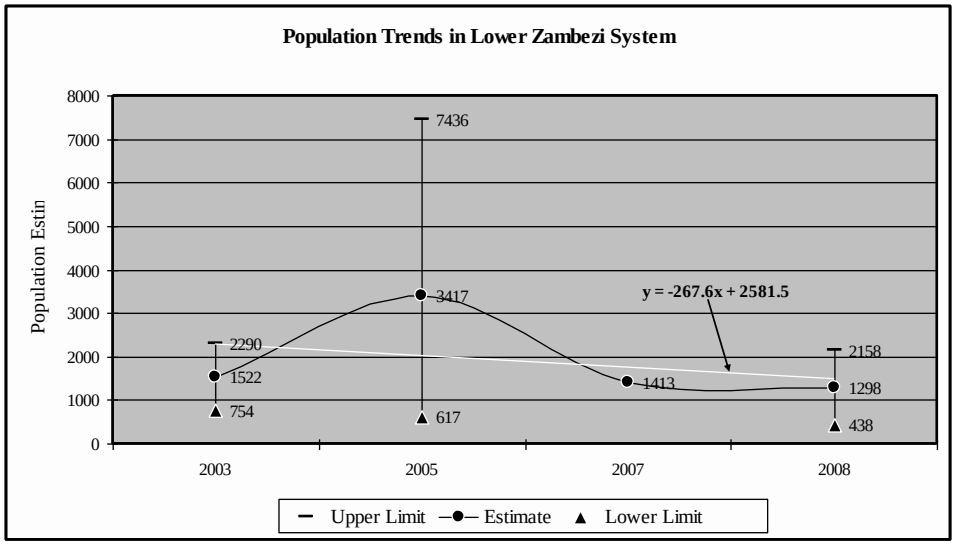
4.4.5 Trend Analysis

The elephant carcass ratio in the Lower Zambezi ecosystem is 14.37 % which is an indication of high mortality of elephants in the system. The graph below shows a decline of population from year 2003.

Past Elephant Estimates in Upper Zambezi System

Year	Estimate	Lower Limit	Upper Limit
2003	1522	754	2290
2005	3417	619	7436
2007	1413		
2008	1298	438	2158

Population Trends in Lower Zambezi Ecosystem



It is very likely that the 2005 estimate of 3,417 elephants in the Lower Zambezi Ecosystem (Simwanza, 2005) is an over estimate. A linear estimate shown in the graph above shows that a more realistic estimate could have been about 2000 elephants. The linear estimate line equation has a negative gradient which indicates a declining population."

Observation: The data is inconclusive, but in general it is felt that wildlife numbers are decreasing in the Lower Zambezi National Park.

KAFINDA GAME MANAGEMENT AREA:

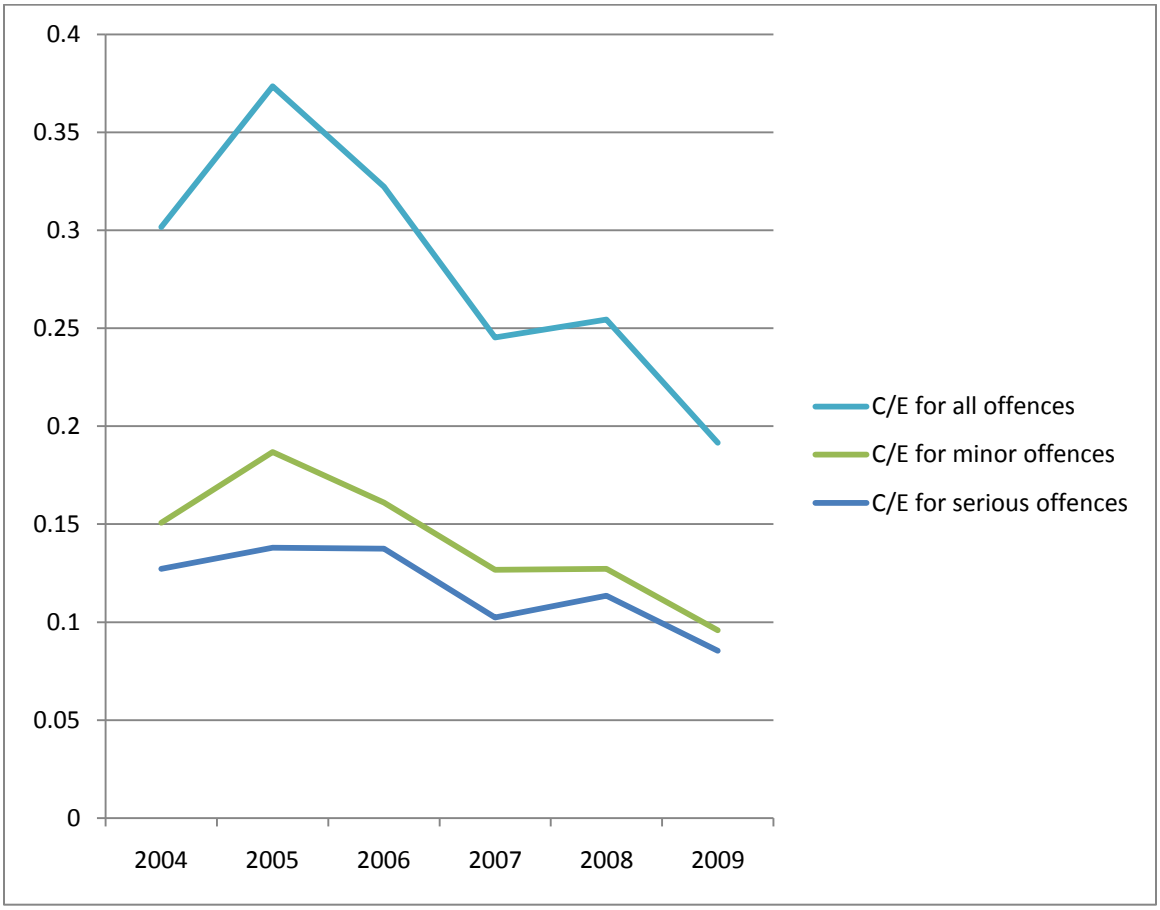
No data

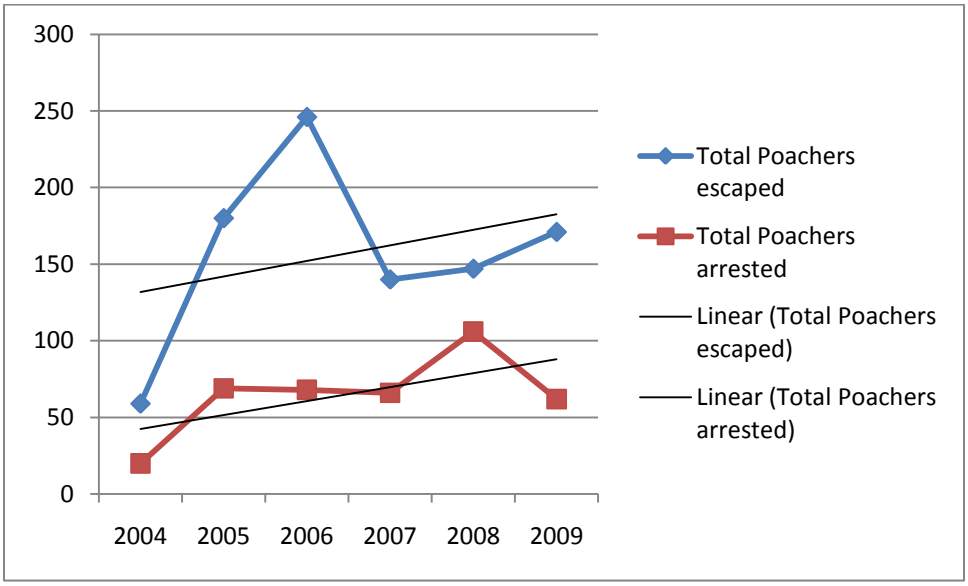
LAVUSHI MANDA NATIONAL PARK:

No information

SOUTH LUANGWA NATIONAL PARK:

Law Enforcement Data:





Observation: Catch per effort (CPUE) decreased over the period of the project, which suggests that either the number of violations (threat) has decreased over the period or the efficiency, the patrol units has decreased over the period. We can eliminate the latter explanation by examining the arrest and evasion data: arrests and evasions have increased, which implies that the efficiency of patrol units has, if anything increased over the period. Thus we infer that the threat of poaching has declined over the period.

Wildlife data:

Caughley, G. and Goddard, J. 1975. *Abundance and distribution of elephants in the Luangwa valley, Zambia.* East African Wildlife Journal, 1973, Volume 13, pp. 39 – 48.

Aerial survey estimates to the nearest thousand of elephants in the South Luangwa National Park

Date	Elephant numbers	Strip width/observer (m)	Reference
July, 1965	9,000	600	Dean, 1968
Sept, 1965	14,000	600	Dean, 1968
June, 1966	12,000	600	Dean, 1968
Nov, 1966	10,000	600	Dean, 1968
June, 1967	11,000	400	Patton, 1967
Nov, 1969	18,000	400	Martin, 1969
Aug, 1971	28,000	250	Van Lavieren, 1971
Jan, 1973	32,000	100	Caughley & Goddard, 1975

"In Table 3 [one above] the 1973 estimate of 31,600 elephants in the SLNP is compared with previous estimates. These have been modified from the original estimates to correct for differences in block boundaries… Superficially the set of estimates suggest the elephants have been increasing at a rate of 15% per year between 1965 and 1973. This rate is impossibly high, the maximum rate of which an elephant population can increase being around 4% per year (Hanks & McIntosh, 1973)… Thus, a more plausible interpretation is that the spread of estimates is an artifact of visibility bias decreasing as strip width is narrowed … The set of estimates therefore allows no judgement on whether elephants have been increasing, stable or decreasing in the SLNP between 1965 and 1973."

	Elephant Total	Elephant Carcass	Buffalo	Eland
2002*	4459	21	8,325	152
2008**	7457	44		
2009***	4419	20	10,261	185

Dunham, K. M. & Simwanza, H. I. 2002. Aerial Census of Elephants and other Large Herbivores in South Luangwa NP & Lupande GMA, Zambia, 2002.* Zambia Wildlife Authority (ZAWA) & WWF Southern Africa Regional Programme Office (WWF – SARPO)

**Simukonda, C. (2009). *The Elephant Survey (2008) – A Country Report.* Zambia Wildlife Authority, Lusaka, Zambia.

***WCS Flight Programme. 2009. *Aerial Survey Report: Luangwa Valley 2009.* Wildlife Conservation Society, New York.

South Luangwa National Park (SLNP)

Source	**Jachmann**	**Jachmann**	**Durnham/Simwanza**	**Milanzi and Msoka**	**Howard**
Species	**1996**	**1999**	**2002**	**2006**	**2009**
Elephant	7942	5808	4459	4080	4419
Buffalo	17777	18919	8325	8216	10261
Eland	489	1118	152	226	285
Giraffe	350	103	187	81	89
Hartebeest	1295	730	173	597	246
Reedbuck	214	71	225		197
Roan Antelope	1415	225	216	737	712
Waterbuck Common	815	816	519	520	374
Wildebeest Cookson	1288	201	11	193	413
Zebra	4905	5527	2956	3049	2993
Impala		34150	10267	6405	9577
Kudu		219	373	300	898
Puku		5242	4767	3153	3897
Warthog		1907	1106	1261	1161
Common duiker				394	89
Ground Hornbill			324	726	748

Elephant Population Estimates for the South Luangwa National Park and Lupande Game Management Area

Source	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Year	**1973**	**1975**	**1976**	**1979**	**1985**	**1987**	**1993**	**1994**	**1996**	**1998**	**1999**	**2002**	**2006**	**2009**
SLNP	35000	35000	39213	22800	13369	15375	5263	7197	7942	6450	5808	4459	4080	4419
Lupande						2100	666	2050	892	920	493	975	2032	1128

NB* Data for the years 1973 to 1985 not available for Lupande Game Management Area

Number	**Source**
1	Caughley
2	Kuper
3	Kaweche/Munyenyembe
4	Douglas Hamilton/et al
5	Munyenyembe
6	Mwima, Kaweche,Munyenyembe, Lungu, Bell
7	Not identified
8	Jachmann and Kalyocha
9	Jachmann
10	Jachman and Matambo
11	Jachmann and Phiri
12	Durnham and Simwanza
13	Milanzi and Msoka
14	Howard

Simukonda, C. (2009). The Elephant Survey (2008) – A Country Report. Zambia Wildlife Authority, Lusaka, Zambia.

"Trend analysis

Previous aerial surveys in Luangwa ecosystem have always been done in parts depending on the jurisdiction of the funding agency. Comparison of estimates has usually been confined to South Luangwa National Park and Lupande GMA – the area that has been under funding of NORAD. Even then, data is

still scanty and difficult to compare. It is therefore difficult to extrapolate data and compare figures for the whole ecosystem when extent and intensity of surveys have been different. The following table and graph shows population trends in south Luangwa and Lupande GMA. Results of a d-test carried out between the years 2006 / 2008, and between 2006/2002 are shown in the table below:

Table 1: Test for significance (d-test)

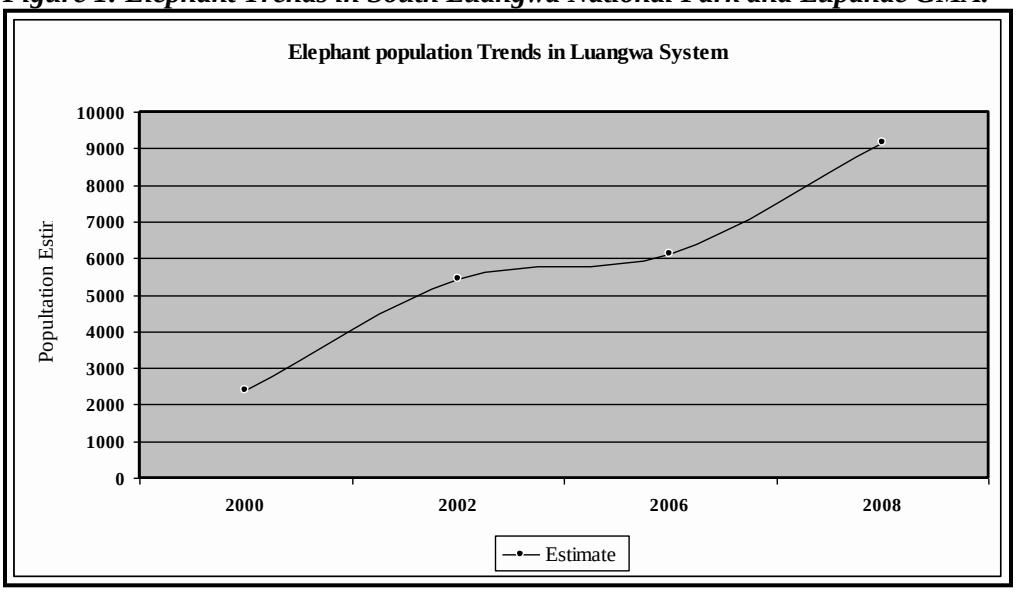
Year	Estimate	Variance	[CI%]	95%	*d-value*	Status
2008	9176	1794271	29	2638	1.974	Significant
2006	6112	613686	30.5	1864	0.594	Insignificant
2002	5434	690362	30.5	1659		

The difference between two estimates is significant when the value of d is greater than 1.9640, at α =0.05. This test reveals the fact that there is no significant difference between the elephant population estimates of 2002 and that of 2006. There is however a significant growth in population between 2006 and 2008. The graph below therefore indicates that there is no significant difference between 2002 and 2006 in population size but there is a general population increase between 2002 and 2008.

The graph in figure 2 below was drawn from the data available from past relevant aerial surveys. It is assumed that the situation in the two areas will reflect the situation in the whole system. From this graph, it can be seen that even the Luangwa system suffered elephant population declines that affected the whole wildlife estate during ZAWA's transformation period, of 1998 and 2002. The populations started to show signs of recovery only in 2002."

Year	2000	2002	2006	2008
Estimate	2414	5434	6112	9176

Figure 1: Elephant Trends in South Luangwa National Park and Lupande GMA.

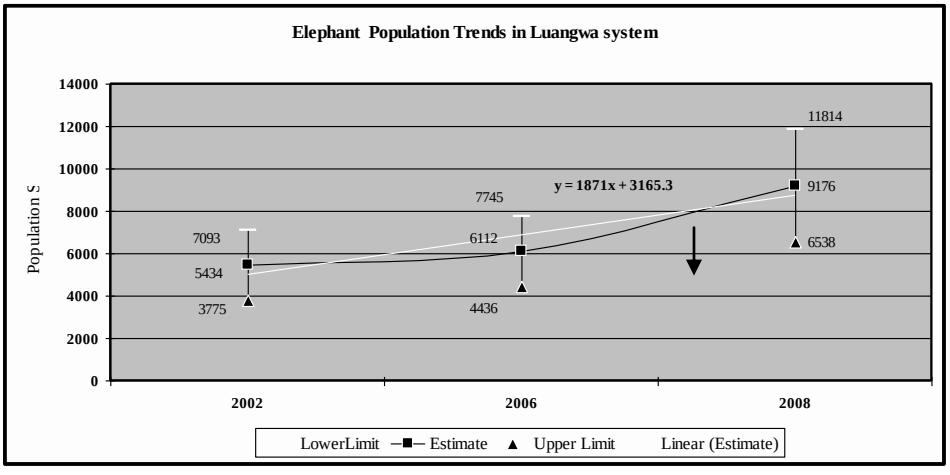


The above graph depicts the overall picture of trends of elephant populations in the Luangwa ecosystem. Same conclusions could be drawn when a linear estimate graph is drawn from the relevant data available however some areas within the system, like Musalangu, could have negative trends because of anthropogenic reasons.

Table 2: Past elephant estimates in the Luangwa system

Year	Estimate	Lower Limit	Upper Limit
2002	5434	3775	7093
2006	6112	4436	7745
2008	9176	6538	11814

Figure 2: Population Trends in Luangwa Ecosystem

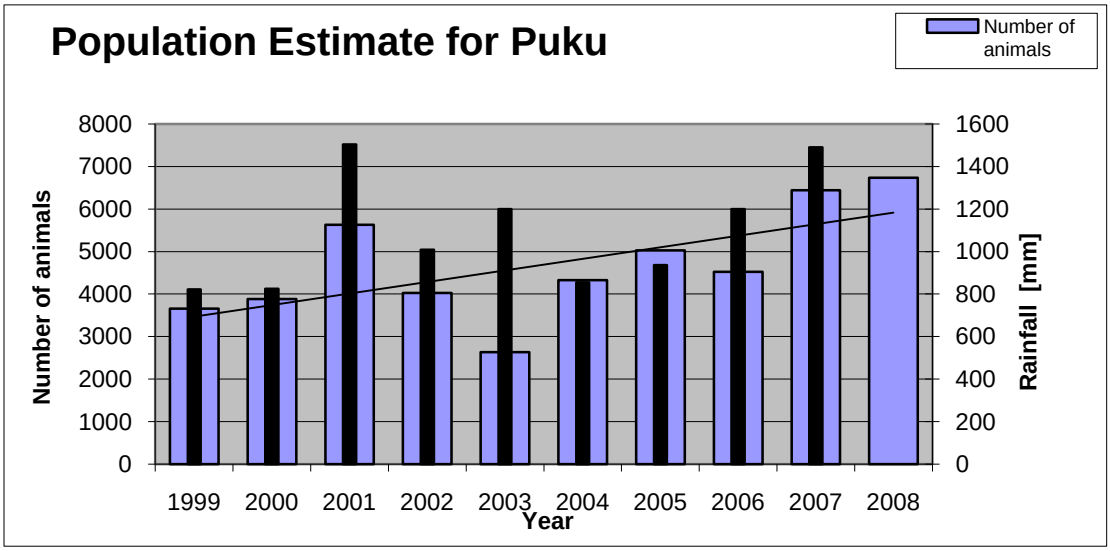


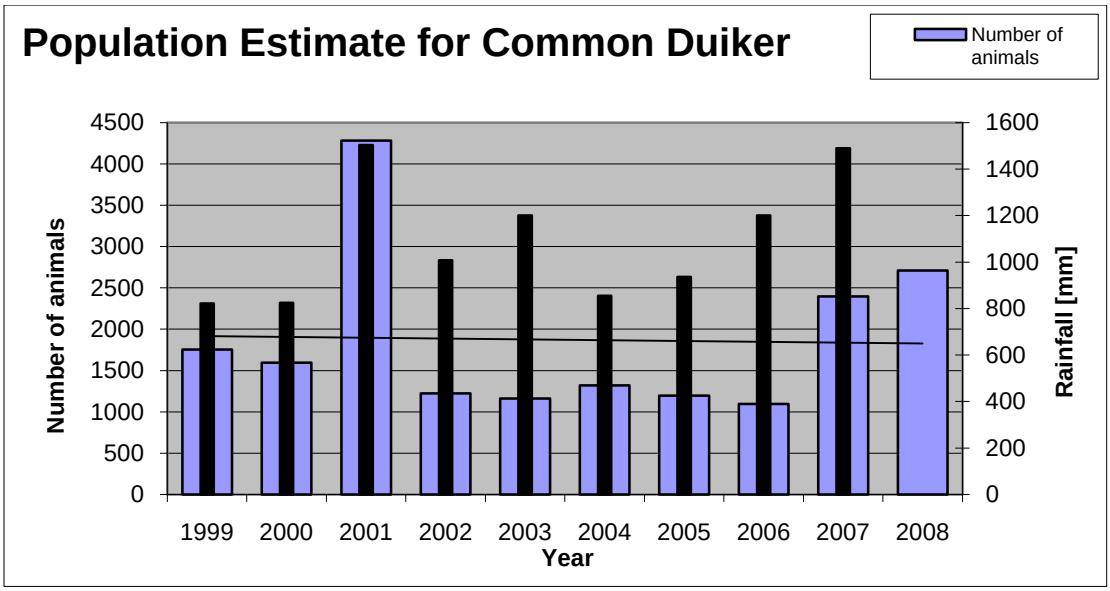
The elephant carcass ratio in the Luangwa System is 1.57% which, according to Douglass-Hamilton (1981), indicates a stable or expanding population. The linear estimate line, with a positive gradient shows a growing population."

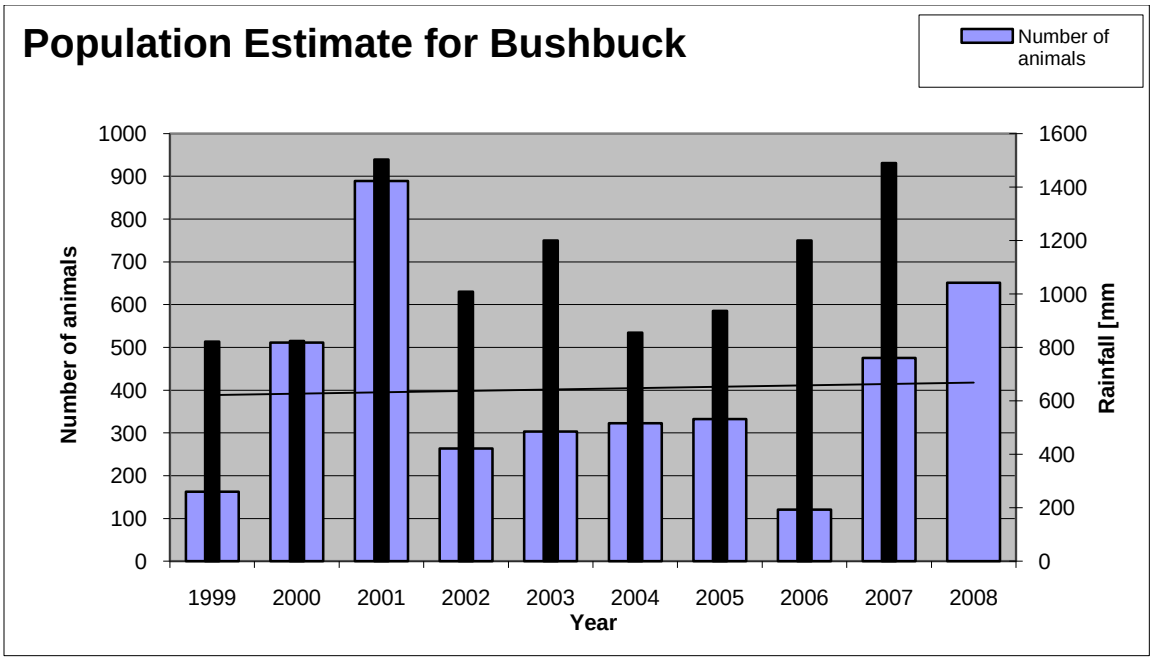
Observation: From the above it can be concluded that wildlife numbers have been increasing in the South Luangwa National Park during the 2004 – 2010 period. This is based on the fact that elephant numbers in the National Park are probably increasing since 2002, showing a growing trend. The low carcass ratio (1.57%) (ratio of carcasses to live elephant) for the Luangwa Valley indicates that mortality is very low. There has also been an increase in Buffalo, Eland, Hartebeest, Sable and Roan numbers since 2002.

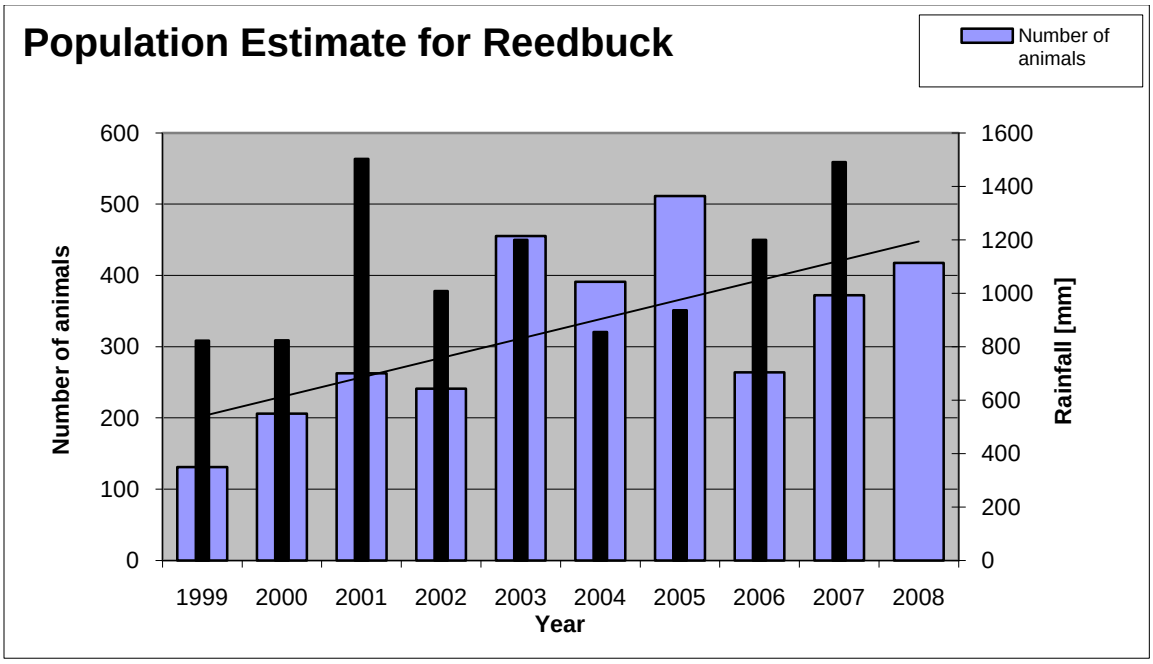
KASANKA NATIONAL PARK:

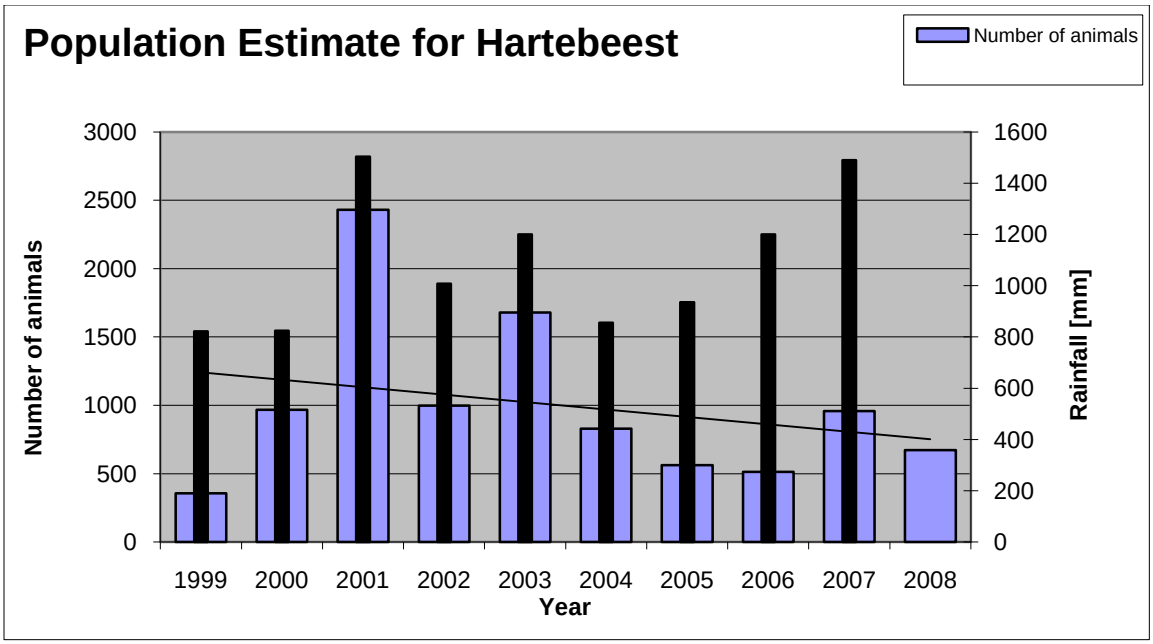
Kasanka Trust has been doing road transect counts since 1999, the population estimates and trendlines are given below for selected species.

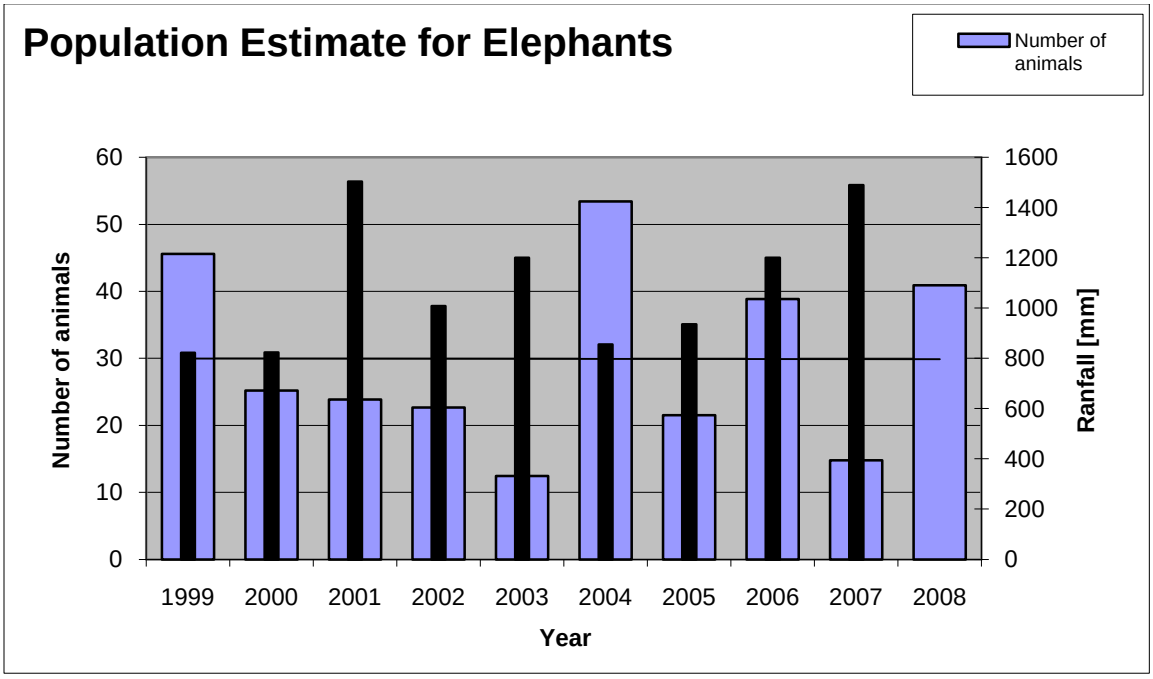


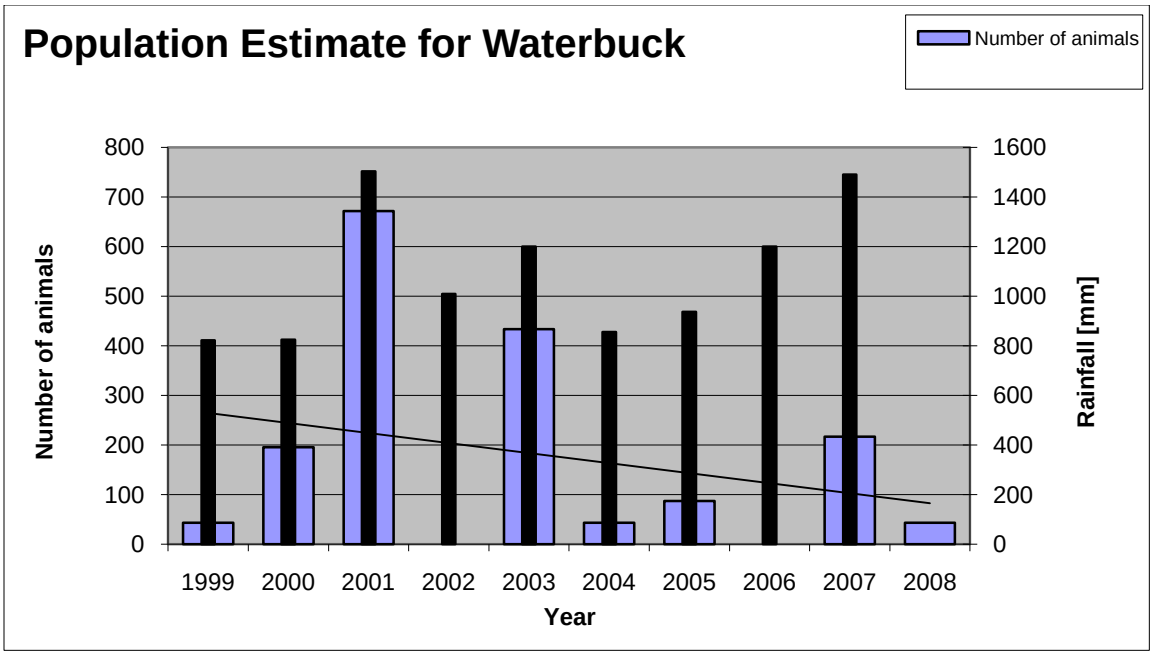


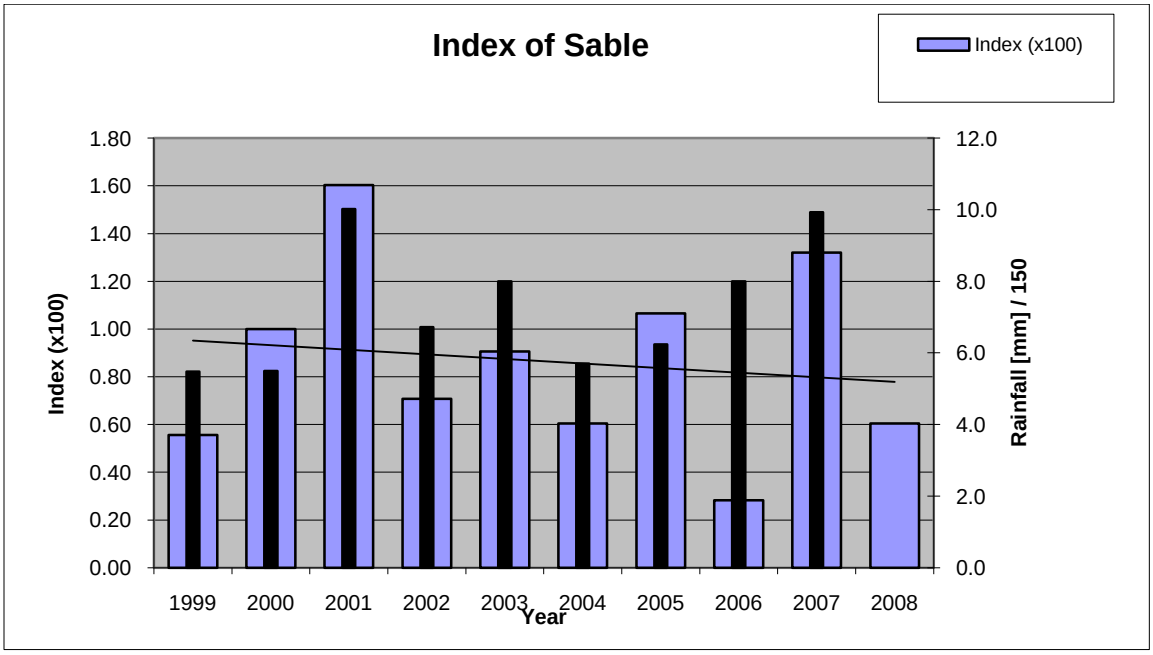

Population Estimate for Bushbuck
Number of animals
1000
900
800
700
600
500
400
300
200
100
0
1600
1400
1200
1000
800
600
400
200
0
Number of animals
Rainfall [mm
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year

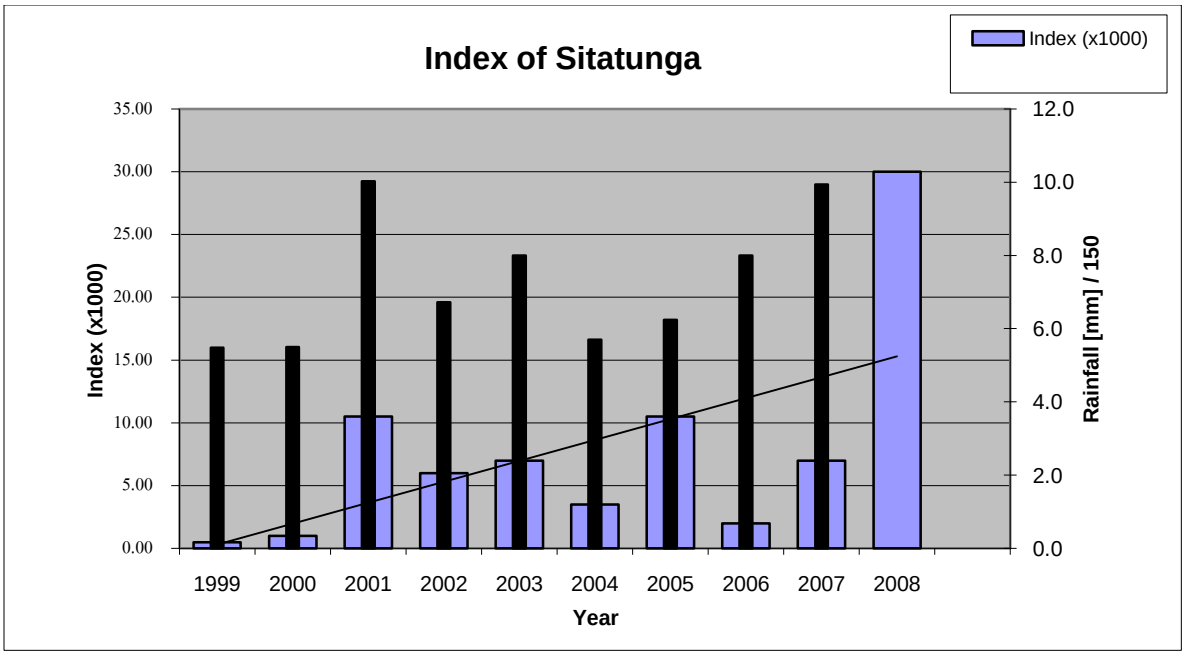

Population Estimate for Reedbuck
Number of animals
600
500
400
300
200
100
0
1600
1400
1200
1000
800
600
400
200
0
Number of animals
Rainfall [mm]
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year


Population Estimate for Hartebeest
Number of animals
3000
2500
2000
1500
1000
500
0
1600
1400
1200
1000
800
600
400
200
0
Number of animals
Rainfall [mm]
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year


Population Estimate for Elephants
Number of animals
60
50
40
30
20
10
0
1600
1400
1200
1000
800
600
400
200
0
Number of animals
Ranfall [mm]
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year


Population Estimate for Waterbuck
Number of animals
800
700
600
500
400
300
200
100
0
1600
1400
1200
1000
800
600
400
200
0
Number of animals
Rainfall [mm]
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year


Index of Sable
Index (x100)
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Index (x100)
Rainfall [mm] / 150
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
Year



Observation: From the above it can be concluded that wildlife numbers have been in general been stable in Kasanka National Park during the 1999 – 2008 period. This is based on the fact that sable, elephant, common duiker and bushbuck numbers have been stable, with sitatunga, puku and reedbuck numbers increasing, while waterbuck and hartebeest numbers are decreasing.

LIUWA PLAINS NATIONAL PARK:

Viljoen, P. 2009. Liuwa Plain National Park, Zambia, Aerial Wildlife Survey, April 2009. African Parks Foundation.

	1991*	Dec 2001**	Dec 2005***	Apr 2007****	Apr 2009*****
Zebra	771	2,500	2,706	3,977	4,992
Oribi	463	116	1,241	1,411	911
Red Lechwe	534	215	966	1,167	1,405
Tsessebe	7,674	300	430	501	1,231
Wildebeest	29,369	35,000	23,455	33,088	36,494
Wattled Crane	-	588	-	-	1,695
Grey Crowned Crane	-	> 500	-	-	952
Saddlebill Stork	-	>200	-	-	561

*Tembo & Saiwana (1991): survey included LPNP only. Sample methodology and data analysis procedures not known.

**Kameneshe et al. (2003): survey included LPNP only; 5.5 km survey strip spacing. Data analysis procedures not fully described in detail.

***Viljoen (2005): survey included LPNP and surrounding GMA (5,198 km^2); 1.6 km survey strip spacing.

****Viljoen (2007, unpublished survey results): survey included LPNP and surrounding GMA (5,198 km^2); 1.6 km survey strip spacing.

*****This report: survey included LPNP and surrounding GMA (5,198 km^2); 1.6 km survey strip spacing. The same basic methodology was used for the 2004, 2007 and 2009 surveys.

"Population estimates of large ungulates obtained during the 1991 and 2001 aerial surveys in LPNP also indicate a possible increase in numbers of most ungulates. It is, however, difficult to fully compare the survey results. The 2001 survey (Kamweneshe et al. 2003) involved significantly lower sample intensity while the emphasis was also on bird species and not on ungulates. Full details of the exact methodology and data analyses procedures for the 2001 (Kamweneshe et al. 2003) and 1991 surveys (Tembo & Saiwana 1991) are also not available.

Ungulate distributions between the December 2004, April 2007 and April 2009 surveys were mostly similar. The main exception was red lechwe. Almost all the red lechwe were grouped along the Luanginga River with just a few small groups around the pans near the Palm Tree. This significant difference in the distribution of red lechwe is clearly a seasonal cause. The December 2004 survey was done at the end of the rainy season and before any significant rain had occurred in the area.

All the wildebeest were concentrated in the south-central part of LPNP in 2004, with not one recorded outside LPNP. Zebra distribution patterns were very similar for all three surveys, although this species was marginally more dispersed during 2007. The distribution patterns for tsessebe were also relatively similar during the three surveys but, as in the case of zebra, were also somewhat

more dispersed during the 2007 survey. As expected there were no significant differences in the distribution of oribi during the three surveys."

Observation: From the above it can be concluded that wildlife numbers have been increasing in the Liuwa Plain National Park during the 2004 – 2009 period. This is based on the fact that wildebeest, zebra, oribi and red lechwe numbers **in** the National Park are increasing since 2001.

WEST ZAMBEZI GAME MANAGEMENT AREA:

Data on the Upper West Zambezi GMA is included under Liuwa Plain National Park, below some information on Lower West Zambezi GMA, but mostly concentrated on Sioma Ngwezi National Park.

Simukonda, C. (2009). The Elephant Survey (2008) – A Country Report. Zambia Wildlife Authority, Lusaka, Zambia.

"Except for Mosi-oa-Tunya National Park, the upper Zambezi System constitutes areas that have had either very little protection or no protection at all. The Sioma complex in particular was war torn for a long time resulting in poaching and severe declines in population – of not only elephant but other species as well. The area was unsafe for most animals. Elephants opted to disperse across the Zambezi River into safer neighboring countries – Botswana, Namibia and Zimbabwe. It is only in the recent years that elephant populations have started to recolonize the Sioma and Kazungula areas.

There is high variability of counts in the Sioma Complex .The variability of aerial survey counts is evidenced by the past results like: January 2004 estimates were 1212 ± 920 (Chase et al., 2004); and another in November 2005 which estimated 899±755 and another in November 2005 which estimated 385±389 (Chase & Griffin, 2005). This should not be a surprise because of the nature of movements of the elephants in the area. Most herds are transitional; they come to Zambia and cross back to other countries depending on availability of food, security and even ambient temperatures (Kinahan et al., 2007) for body thermal regulation of elephants. All these are factors that can lead landscape selection by elephants.

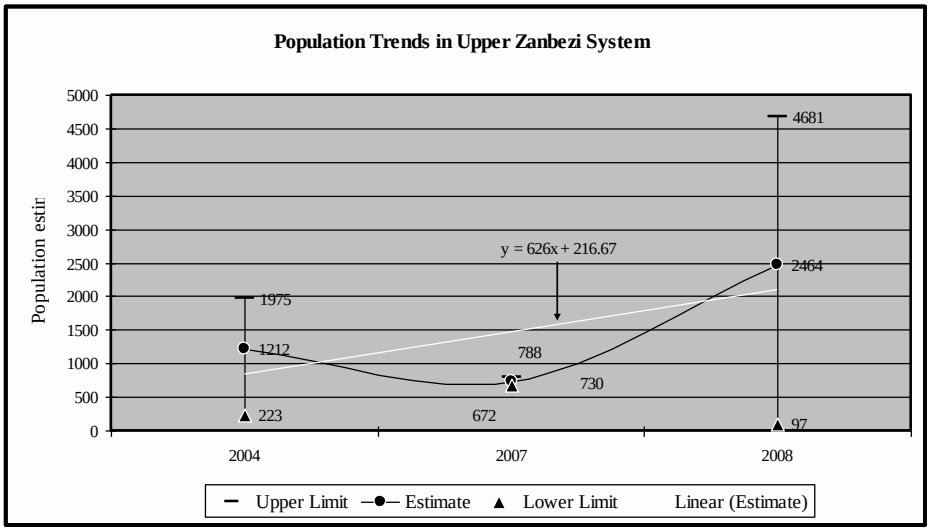
In this survey the Population estimate for Sioma is 2389 ± 2292 elephants. Conducting a d-test between aerial estimates of January 2004 and December 2008 (d=1.037166) shows that population has not increased. It is important to note that in all these surveys the confidence limits are wide, mostly because of clumped herds of elephants. This could be a sign that elephants are still recovering from various pressures – human pressure especially.

Past aerial survey data is scarce and survey designs have differed and have had diverse objectives. What is presented below in Table19 and Figure…. is from the available information from past records.

Table 3: Past and current aerial survey results.

Year	Upper Limit	Estimate	Lower Limit
2004	1975	1212	223
2007	788	730	672
2008	4681	2464	97

Figure 3: Population Trends in Upper Zambezi System



The linear estimate line shows a gradual increase with a positive gradient. This line could help approximate population if projected beyond 2008, i.e. if and only if, current conditions prevail. Past elephant carcass ratios were not reported. However this survey found 82 carcasses in Sioma Ngwezi National Park, most of which were class 1 and 2. The carcass ratio is 3.2 %. This indicates a stable or increasing population. But the fresh carcasses sound an alarm."

Observation: From the above it can be concluded that wildlife numbers are either stable or increasing at a slow pace.

ANNEX 4 (attached as a separate file) Results from statistical analysis of correlations from Table 1 in main body of report.

ANNEX 5 (attached as a separate file) Expert Opinion on PA Management Effectiveness

We asked six experts to rank six protected areas in terms of their effectiveness in protecting or enhancing the biodiversity contained within them. The mean expert rank for each protected area is highly correlated with the rank based on the 2007 METTPAZ overall score as a percentage of total points available (111 points). The Spearman correlation coefficient is 0.94 (Kendall's tau of 0.87).