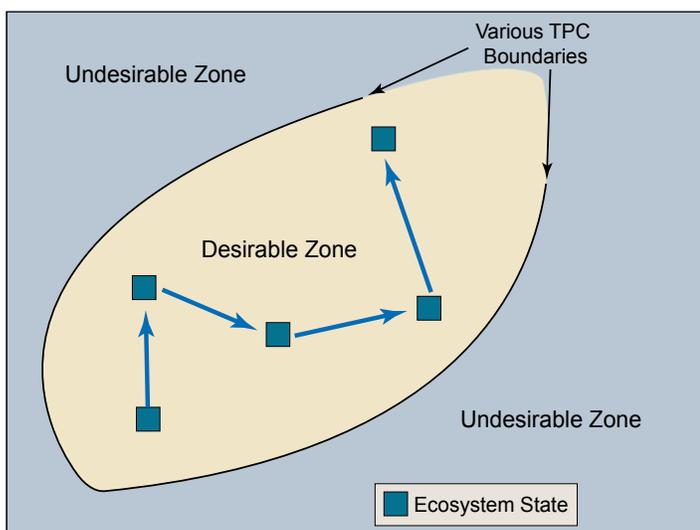


## Thresholds of Potential Concern

*Summarized from Materials Developed at Kruger N.P., South Africa\**

### What are Thresholds of Potential Concern (TPCs)?

Thresholds of potential concern (TPC's) are a set of operational goals that together define the spatial and temporal variation in ecological conditions for which the Kruger ecosystem is managed. TPC's thus represent the upper and lower limits along a continuum of change in selected environmental indicators. Taken together, TPC's define the envelope of desired conditions within which ecosystem changes are managed. When the upper or lower thresholds are reached, or when it is predicted that they will soon be reached, an assessment of the cause is implemented. This assessment provides the basis for determining whether management action is warranted and/or whether the TPC should be recalibrated in the light of new knowledge and/or understanding. TPC's can be considered as hypotheses about the limits of acceptable change in ecosystem structure, function and composition, which leads to adaptive management approach. Thus, they are always subject to challenge, and are expected to be adaptively modified as our understanding and experience of the system increases.



*Thresholds of potential concern define the envelope of conditions within which ecosystem states may bounce around, without moving into an undesirable zone. Adapted from South Africa National Parks Official Website.*

## OVERVIEW



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### How are Thresholds of Potential Concern Developed and Applied?

TCPs in Kruger National Park are applied in such a way that they dictate whether, when, and how management actions are implemented. This is accomplished through an adaptive process that begins with developing TCPs that reflect a hierarchy of objectives for the park.

#### *Hierarchy of Objectives*

The TPCs in Kruger National Park are developed in such a way so as to reflect the management objectives of the park. These objectives are expressed as a hierarchy ranging from a broad value-laden vision of the park's mission to explicitly stated objectives needed to realize this broader vision (Keeney 1992; Biggs and Rogers 2003) (see also example paper in this series on the Kruger Objectives Hierarchy). The broad vision began with identifying key elements that reflected the social needs and values for Kruger (Biggs and Rogers 2003). These elements include such things as biodiversity, human benefits, wilderness, naturalness, and custodianship. In contrast, the finest level of the hierarchy were intended to represent explicit operational targets, which were ultimately manifested as "Thresholds of Potential Concern" (Biggs and Rogers 2003).

#### *Development of TPCs*

TPCs are defined as "the upper and lower levels along a continuum in selected environmental indicators" (Biggs and Rogers 2003). From a management standpoint, they

## Overview - Thresholds of Potential Concern

represent a set of operational goals that define the spatial and temporal heterogeneity for which the ecosystem is managed. As such, for a given indicator, they are an explicit expression of the desired and undesired conditions for that indicator. Taken as a whole (i.e., the full suite of TPCs) they represent the multi-dimensional envelope within which ecosystem variation is deemed acceptable (Biggs and Rogers 2003).

From a science or research standpoint, the development of TPCs represent the expression of environmental hypotheses (with relevance to the objectives hierarchy) in various stages of confirmation. In some cases the TPCs are little more than an educated guess; whereas, in other cases, TPCs are the cumulative result of substantial research effort. In either case, they are subject to revision as data are accumulated through the adaptive process.

### *Monitoring*

The research and other staff responsible for monitoring at Kruger National Park jointly develop a monitoring program for which TPCs are the central focus (Biggs and Rogers 2003). Because prior agreement has already been established regarding TPC values, the staff carefully evaluate and implement the monitoring program, recognizing that it will form the basis of future management decisions. The only monitoring themes within KNP that are at least partially exempt from TPCs include weather and some aspects of hydrology, for which unexpected events can occur.

### *What Happens if TPCs are Exceeded?*

When a TPC is formally reported (tabled) to have been exceeded, or even if it is likely to be exceeded, the management section has the responsibility to initiate action. Assuming that the action is not a recalibration of the TPC (which is always open for consideration), the team generates options, predicts and evaluates consequences, and decides on an appropriate course of action (Biggs and Rogers 2003). At this point, returning to within the TPC is closely monitored, and an additional explicit check to ensure that returning to within the TPC serves to meet the intended objectives outlined in the objectives hierarchy.

All phases of the process are clearly outlined, the responsibilities identified, and the results visible. Consequently, the process is completely transparent, and serves to unify research, monitoring, and management toward a common vision.

## **Some Specific Applications of Thresholds of Potential Concern at Kruger National Park**

### *Application of TPCs for Managing Invasive Plants*

The underlying philosophy regarding the management of invasive plants in Kruger National Park has been undergoing a shift in recent years from a command and control approach (Holling and Meffe 1996) based on the “balance of nature” paradigm of to a more proactive adaptive management philosophy emphasizing biodiversity as a primary goal for KNP (Foxcroft and Richardson 2003; Foxcroft 2004). Under the old philosophy, managers did not accept invasive species as part of the ecosystem and therefore management was governed by control actions (Foxcroft 2004). However, the failure of such control programs has led to an alternative view of invasive species being accepted as part of system where control efforts maintain invasive species at minimal levels where their minimized effects form part of the system function (Foxcroft 2004).



*Trees of the Jacaranda family pose a threat to some regions of KNP.*

Like other disciplines in KNP, the current approach is based on an objectives hierarchy for which TPCs are identified that reflect the hierarchy. Foxcroft and Richardson (2003) identified a coarse approach for TPCs, although it was recognized from the outset that refinement and calibration would be needed. The TPC themes they initially identified are as follows:

### *Initial TPCs for Invasive Plant Species Reported by Foxcroft and Richardson (2003)*

#### *TPCs Related to Distribution*

- *Any new occurrence of an alien species in the KNP*

## Intermountain Region

- *Imminent external threat by an alien species to the KNP*
- *Extension of range (first ever report from a new block, or from blocks not contiguous with neighbouring blocks)*
- *Expansion of blocks, which represents more than a 5% increase in distribution*
- *over the number of blocks infected the previous year*

**TPCs related to increase in density:** (all areas infested – blocks are measured in modified canopy cover estimates to assess plant density. These densities are arranged into a number of classes)

- *An increase of density two classes upwards in any block.*
- *Overall increase in density*

**TPCs relating to rate of spread vs. rate of clearing:**

- *Number of new blocks infested greater than number blocks cleared.*

It was soon recognized that these initial TPCs failed to adequately deal with repeat invasion events and a multi-tiered set of TPCs was developed (Foxcroft 2004):

**Revised Multi-tiered TPCs Reported By Foxcroft (2004):**

**TPC level 1—TPCs that deal with new invasions of a species in the KNP.**

- *Imminent external threat (a species on the boundary is likely to invade within 12 mo) and*
- *A species being reported as having invaded the KNP for the first time;*

**TPC level 2—TPCs that deal with an increase in distribution of a species.**

- *Any new grid cell not contiguous with the previous distribution,*
- *Expansion of contiguous grid cells that represent more than a 5% increase over the number of grid cells recorded as invaded the previous calendar year, and*
- *Total number of grid cells cleared vs. total number of new grid cells invaded;*

**TPC level 3—TPCs that deal with an increase in density of a species.**

- *Any increase by two density classes upward in any*

*grid cell and*

- *Any increase of one density class upward of medium in any grid cell.*
- 

Because of the adaptive nature of the KNP program, it would not be surprising for the TPCs to be further refined and changed, but it is recognized that the approach has facilitated a shift from traditional wildlife management to a focus on biodiversity concerns identified by the objectives hierarchy. It is also suggested that the KNP approach is approaching a more sustainable approach that better reflects the issues of concern in KNP (Foxcroft 2004).

### **Application of TPCs for Managing Elephants at Kruger National Park**

First and foremost it should be emphasized that elephant management in Kruger National Park has a long, complicated, and sometimes controversial history, particularly related to the practice of culling. This brief synopsis is by no means intended to be a comprehensive summary of elephant management in KNP; rather, it is intended only to summarize the logic and application of “Thresholds of Potential Concern” within the current management policy.

It should also be recognized that (South Africa National Parks (SANParks) management policies are reviewed approximately every five years, and the policy upon which this summary is based is currently under review (at the time of this writing) and may be subject to change in the near future.



*Kruger's current elephant management policy focuses on measured impacts on biodiversity indicators, rather than absolute numbers of elephants.*

## Overview - Thresholds of Potential Concern

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*It is an accepted principle in Kruger National Park that elephants are an important agent of disturbance on the landscape.*

The current policy for managing elephants in Kruger National reflects the KNP emphasis on biodiversity expressed in their objectives hierarchy and is based on the following three fundamental principles for which substantial evidence has been accumulated (SANSParks Official Website; Whyte et al. 1999):

- 1. Fluctuation in ecosystems is natural and desirable in that it contributes to biodiversity.*
- 2. Elephants are an important agent of disturbance, which at least at intermediate levels, contribute to biodiversity through creation of heterogeneity. However, it is also recognized that at high densities, excessive disturbance may have a negative impact on biodiversity.*
- 3. It is accepted that elephant populations which are confined but not managed will increase in numbers to a level that negative impacts on biodiversity will result.*

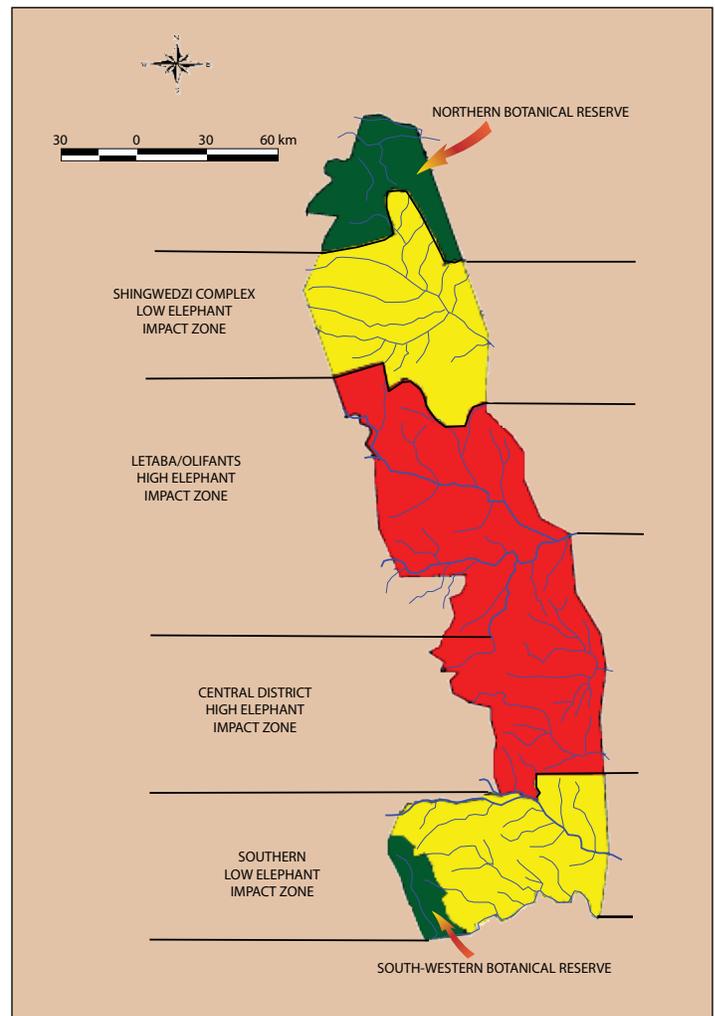
One of the important corollaries of these principles is that it is recognized that effective management will likely require some form of culling. While beyond the scope of this summary, consideration of effective and humane means of culling are important considerations for KNP elephant management.

More directly applicable to this summary is that this policy differs from previous policies in that the population level is managed based on measured impacts on biodiversity, rather than on absolute numbers of elephants (Elephant policy /

Whyte et al. 1999). It is this impact on biodiversity which forms the basis for TPCs

To facilitate this approach, KNP is divided into six zones that are managed differently for the impacts of elephants. On the northern and southern ends of the park are two botanical reserves (Figure 1). These zones represent areas that have unique values that warrant minimizing the risk of excessive elephant impacts (Elephant policy / Whyte et al. 1999).

In the center of the park, two high-density impact zones are established adjacent to each other. In these zones, the elephant population will be allowed to increase until the TPCs are reached or exceeded. Between each of the botanical reserves and the high impact zones are two additional low-impact zones. It is hoped that these zones will



*Figure 1. The six elephant management zones establish as part of the current elephant management policy (after Whyte et al. 1999)*

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## Intermountain Region

serve as a buffer to help alleviate any problems resulting from a hard edge between the sensitive reserves and the high density areas.

monitoring information is accumulated and the adaptive process continues.

The initial TPCs (Table 1) were established at somewhat arbitrary levels based on the best available information (Whyte et al. 1999). In some cases, there was insufficient information to have a clear vision of what level of elephant-induced change is acceptable (Whyte et al. 2003). Thus, it is fully anticipated that TPCs will be revised and refined as



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Table 1: Thresholds of Potential Concern for Elephants in the Kruger National Park (after Whyte et al. 1999;)

Criterion	Measure	Within-zone TPC	Whole-park TPC
Vegetation heterogeneity at coarse (mega) scale	Coverage (km <sup>2</sup> ) of landscape scale units (e.g. Gertenbach 1983) determined every 5 years. Result compared to any previous time, including historical.	80% change (cumulative) in the area of any landscape scale classification unit	30% change (cumulative) in the area of any landscape scale classification unit
Vegetation structure at community scale using size classes for a range of indicator woody species	Assume, e.g. 4 size classes. Then homogenisation is 90% dominance of any 2 size classes.	80% of all plots homogenous. Sensitive landscapes examined independently as well.	30% of all plots homogenous. Sensitive landscapes examined independently as well.
Woody canopy cover at community scale	% Woody (within stratified landscapes, e.g. riparian) as determined from aerial photographs, done every 3 years	80% decline in canopy cover; specified increase with asymptote (see graph)	30% decline in canopy cover; specified increase with asymptote (see graph)
Rare, sensitive or characteristic (of the Lowveld) woody species (only in relation to elephant utilisation – short list)	Population size and structure fed into pv model	None, prepared to accept local loss or definite trend towards local loss of certain species (provided same species not declining seriously in lo/hi zones at the same time. i.e. species should NOT survive only in botanical reserves.)	99% probability of population persistence for next 100 years
Birds as surrogates for structural riparian health	Presence of species using reed beds, mudflats, litter, lower stratum, middle stratum, upper stratum	Because all perennial rivers are in or border on current high elephant areas, there is need for an in-zone TPC - when species from any category are no longer represented on any particular perennial river. Recolonization thus assumed between zones.	Perennial rivers dealt with as within-zones issue per river; for seasonal rivers there will be a whole-park TPC, namely when species from any category no longer represented in park as a whole – recolonization from perennial rivers assumed.
Birds as functional class representatives in riparian corridors (what about outside riparian corridors as well, with own TPCs?)	Frugivores, gramnivores, insectivores (bark foragers, hawkers, leaf-gleaners), piscivores, raptors, nectarivores Frugivores, Gramnivores etc.	See above	See above
Invertebrate functional class representation	Ground and grass insects and spiders, tree dwelling insects and spiders, dung beetles, termites (harvester and macrotermes mounds), millipedes, pollinators.	When any class disappears from any zone (see proviso in whole-park TPC). Assumes recolonisation.	provided there are not serious concomitant decline of same classes in alternate zones.
Erosion/piosphere	RS classification – bare ground index	When affected area > unaffected area (ie index >50%) or when affected area < 5% (latter to guarantee some eroded habitat in any zone)	when aggregated whole-park bare ground index less than 2.5% or > 25%

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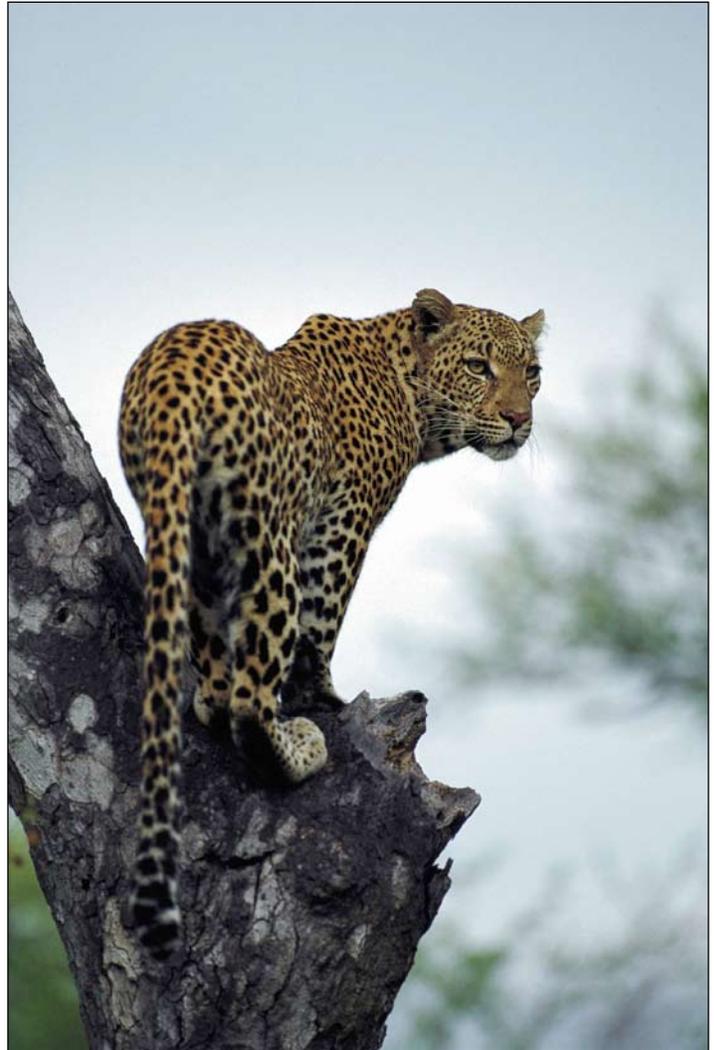
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