

TOWARDS INTEGRATED DECISION MAKING FOR ELEPHANT MANAGEMENT

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In answer to the question ‘Is containment of a population eruption desirable?’ Graeme Caughley replied ‘This is not a scientific question. I can boast of no qualifications that would make my opinion any more valuable than those of my two immediate neighbours, a garage mechanic on the one hand and an Air Vice-Marshal on the other.’ (*Caughley, 1981*)

INTENTION AND APPROACH

THIS CHAPTER draws on material from previous chapters and builds linkages among them. We supply some theoretical background that may help explain the consequences of various approaches to the ‘elephant problem’ as currently framed, a ‘problem’ which has arisen in conjunction with the growth of human settlements and activities across the landscape. We construct and discuss an integrative framework, and then summarise and synthesise the main points from the contents of Chapters 1–11 into this framework.

Using the above analysis, we then suggest how decision makers might most usefully approach and formulate elephant issues. We present a range of options for particular circumstances, at the level of societal influences, strategy and practical implementation, and the integration of these three. Finally we list what we see after the assessment as important gaps, and conclude.

MAKING COMPLEX ISSUES TRACTABLE

One underlying reason why the ‘elephant problem’ appears so intractable is that it is complex (Chapter 1). This affects decision making. Kinnaman & Bleich (2004) describe a range of responses, from toleration through to full collaborative behaviour, where there are different combinations of agreement and certainty

(figure 1). The elephant issue clearly falls into the zone of complexity. Therefore it should not come as a surprise that reductionist ‘command-and-control’ policies (Chapter 1) have not succeeded. Even if they had been correct in assessing the biodiversity outcomes as simple and predictable (and there is serious doubt that this is the case (Chapter 3)), there is no doubt that the associated social responses (Chapter 4; Chapter 9), and hence the problem as a whole, are complex. Some even feel it is a ‘wicked problem’ (Conklin, 2006), insoluble because of ever-shifting goalposts.

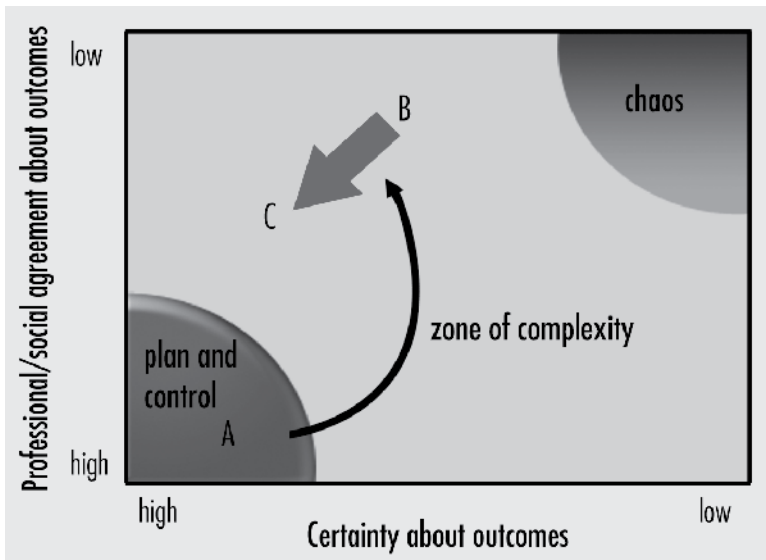


Figure 1: Feasible response zones for different levels of agreement (y-axis) and certainty around outcomes (x-axis). Elephant management in South Africa began (mistakenly) at A, but failed because it overstated the certainty on both axes. It is possible that this assessment initiative can help move the situation from the current position B to a hypothetical position C (modified after Kinnaman & Bleich, 2004)

Forming collaborative partnerships is central to the resolution of such issues. Figure 1 suggests that the predominantly unilateral management of elephant in the past operated in the command-and-control domain, and was therefore unlikely to lead to lasting solutions of any kind (Chapter 1). Furthermore, the different parties involved in the search for a solution must have sufficiently overlapping understanding of a problem (Abel *et al.*, 1998) or enough of a shared rationale, to succeed. Holling (2001) asserts that ‘there is a requisite level of simplicity behind the complexity that, if identified, can lead to an

understanding that is rigorously developed but can be communicated lucidly'. This chapter, indeed this assessment, attempts to crystallise out such requisite simplicity, that might then permit agreement from most stakeholders, and assist understanding, communication and action.

One of the challenges to effective management is co-ordinating not only the linkages within a level (such as say, the province) but also the vertical or inter-level linkages in a way that serves the overall purpose, and that works for almost everyone at the different levels (figure 2).



Figure 2: Social networking across and between levels, required for successful natural resource management. Conceptually illustrated for a large and a small park, with selected concrete examples of links in italics (modified after Olsson *et al.*, 2003)

This chapter emphasises management of elephants in single protected areas, where most day-to-day decisions are made, but it must be remembered that this is nested in a wider decision making and management context, as shown in this figure. People at the various levels, and those operating among levels, are all searching for clearer guidance for decision making concerning elephants. Keeping these kinds of linkages in mind usually helps decision makers arrive at more useful, robust and inclusive decisions.

AN INTEGRATIVE FRAMEWORK

Figure 3 presents a way of linking together the wide range of issues dealt with in this Assessment. According to this schema, there are three primary clusters of interest that are believed to meaningfully represent bundles of issues in the ‘real world’ of elephant management:



Figure 3: How societal drivers shape strategy, which guides implementation, with several feedback loops. Numbering and lettering corresponds with description in text

1. The *societal drivers* of attitudes to elephant issues can be analysed in terms of a ‘V-STEEP’ (Values, Social, Technological, Economic, Environmental and Politico-legal) framework of Rogers (2005), an extension of the SEEP framework of Campbell & Olson, 1991. Although individual issues allocated to the various subdivisions could arguably belong in more than one of the six (e.g. ‘animal rights’ might feature

under 'values' or under 'social'), this is not seen as a problem, as long as the approach helps us comprehensively elicit the full range of important drivers. We have generally not written such overlapping issues under more than one of the headings. We shall refer to these as broader societal drivers, or where the context makes it clear, simply drivers.

2. The *strategic or explicit philosophical approach* towards elephant management. A strategic paradigm usually underlies the actual strategy, though sometimes strategy development is absent as an explicit step in peoples' thinking. In such cases, one can sometimes infer a plausible strategy and underlying paradigm from the tacit assumptions made. The strategy, whether explicit or implicit, is shaped by all the drivers in (1), as well as many concepts from the 'set of concepts' depicted in figure 3. The terms 'goals' and 'objectives' are used synonymously in this chapter, and in such a way as to incorporate their full range of meaning.
3. The *ultimate implementation or deployment* 'on the ground'. This is guided by strategy and also informed by certain concepts (operational plan; indicators/triggers for action). The 'toolbox of available interventions' (culling, contraception, translocation, etc.) is in turn renewed particularly by technological innovations, but also by other changes in the drivers.

Drivers help shape the particular strategy, if not explicitly then subconsciously in peoples' minds, or *de facto*. Similarly, strategy should form the guiding basis for implementation. Furthermore, there exist three important feedbacks:

- a. *Implementation to strategy*: implementational realities often affect the way the strategy can be derived. For instance, if contraception is possible and being considered, any ecological threshold levels in the strategy need to take into account the longer lag period till population reduction can be achieved, as opposed to, say, the immediate population reduction effect after culling.
- b. *Implementation to drivers*: experiences of consequences, including successes and failures, can feed directly back to technological innovations as improved or new technological ideas, or modified societal values, as with experiences with Scoline during culling operations, which was forced by societal pressure out of the allowable toolbox (Chapter 8).

- c. *Strategy to drivers*: Similarly, learning accumulated from experiences in the use of strategy feeds back to modify drivers. For instance, infeasibility of certain key ideas that were deemed necessary in a strategy may lead to a reappraisal of ecological theory.

There are ‘internal feedbacks’ in each step. For instance, the main drivers co-evolve and influence each other along the way. Readers may like to add other feedbacks that are important in their particular situations. For example, we have added a direct line of influence from the technology driver to the toolbox of interventions.

Each feedback is an important step in adaptive learning which decision makers should be encouraged to use. This will allow the spirit of the Norms and Standards (Department of Environmental Affairs and Tourism, 2008) to be upheld.

FACTORS INFLUENCING MANAGEMENT DECISION MAKING FOR ELEPHANTS

The discussion below has elements of summary, analysis and synthesis, often using a chronological development sequence.

Societal drivers

Values

Values are deeply-held beliefs, sometimes explicitly espoused, but often unstated. They hold the underlying key to understanding where our elephant management approaches come from, and in which direction they are likely to be heading. Values interact and co-evolve with all five of the other drivers but perhaps represent the most fundamental level of human aspiration that ultimately determines, or at the least significantly influences, elephant management (Chapter 9). In eras showing unequal power among different stakeholder groups, the dominant values driving the system tend obviously to be those of the powerful, while widely differing values may be held by others, and these may or may not be documented or even well understood.

By the end of the nineteenth century we observe (Chapter 1) exploitation values (that had been supporting the by then nearly exhausted ivory trade) and recreational values (underlying sport hunting) as dominant, with conservation values just emerging (driving preservation of elephant, seen by society as

threatened). During the second half of the twentieth century, as elephant numbers increased in conservation areas in southern Africa (supported by growing conservation values), managers drew mainly on a belief that consequences of abundant elephants were unacceptable in the ecosystem as a whole (Chapter 1). They therefore strove to reduce elephant densities (and at the same time expand elephant range for conservation through translocation) using the many tools that technology was developing. These tools included culling (Chapter 8) as a major option. The belief around the unacceptability of elephant impacts was justified through the criterion of 'exceeding the carrying capacity' (Chapter 1). This justification appeared, after explanation, to be widely accepted by society, though with little input from them in the process other than insisting that, when culling was used, it was done humanely. A minority voice of animal rightists condemned killing in principle. As a largely separate development to the rights-based ones, eventually the simple use of the notion of 'carrying capacity' was also challenged by an increasing number of scientists, this being driven by a growing recognition of complexity (Chapter 1). By the 1990s, the influence of democratisation had opened the playing field for a much wider range of societal values to be drawn into the debate. One outcome (but not one emanating from the previously unfranchised majority of South Africans, several of whose representatives were talking about possible benefits from use of elephants and their products) was that elephant culling was placed under moratorium in South Africa (Chapter 1), pending further discussion of which this assessment forms part.

Given wide agreement on the elephant conservation value, the simple dichotomous moral dilemma posed by contrasting 'culling to protect the ecosystem and other species' with 'not killing elephant' (Chapter 9) may be in the process of growing into a multi-way moral dilemma. The outcomes are now seen as more complex than simply 'elephants vs. other organisms'. For the first time, the rural poor in southern Africa (victims especially of elephant crop raids) have a voice that is being heard, against elephant conservation (Chapter 4), though many recent examples exist where benefits of elephant utilisation (for tourism and especially trophy hunting) lead these communities on balance to want to promote or maintain elephant numbers (Chapter 10). Aesthetic values (the simple preference for landscapes with tall trees, elephants being blamed for their loss) may now be taken more seriously (Chapter 9) because such emotions are no longer considered necessarily weaker than so-called 'concrete' objectives like preventing biodiversity loss. Wilderness values (non-disturbance of pristine landscapes by humans) have been present for almost a century, but their proponents have not effectively

influenced interventions on elephants (Chapter 9) apart from suggesting that mechanised transport (as used in culling) or 'non-natural' interference (as in contraception) should not be allowed in wilderness areas. With such a five- or six-way 'tug-of-war', the suggestion of moral pluralism (allowing all points of view some practical outlet) as a 'solution' appears attractive. But who will then allow what and where? Perhaps management strategies could be agreed on locally, bearing in mind that international pressures also have a bearing. One thing the decision maker needs to know is that this moral dilemma is likely to persist, unless one value becomes dominant over others (Chapter 9).

Without going into detail, it is important to note that the unfolding of elephant-related values in East Africa has differed considerably from the southern African narrative, and has led to a very different trajectory taken in elephant management there (Chapter 1). While this has involved a differing balance of unfolding values, several other formative drivers have also been very different in East Africa.

Social

Social drivers reflect revealed values manifesting as individual or group expressions, or 'social movements' or reactions.

Human-elephant conflict, especially in Africa north of South Africa, has proved to be a perennial issue, those worst affected being the rural poor (Chapter 4). Generally, and especially in South Africa, levels of human-elephant conflict are low (Chapter 4), but they can be locally severe, and clearly devastating in the case of occasional resultant human deaths (Chapter 4). There are many helpful remedies (such as fencing and other barriers, conditioning, and killing of habitual offenders) but the conflict continues as elephants learn to avoid or overcome these deterrents (Chapter 4). Increased interaction between humans and elephants, as happens when people encroach on elephant habitat, or elephant habitat expands (the main mechanism in South Africa) may mean higher levels of conflict (Chapter 4). Decision makers need to acknowledge the reality of the resultant negative sentiment towards elephants and conservation in general (Chapter 4). Economic opportunities based on elephants may counterbalance these negative effects and sentiments in many communities, but this requires careful institutional arrangements to ensure that the benefits do indeed reach the affected parties (Chapter 10).

Grassroots conservation responses in favour of elephants have arisen repeatedly, and this civic society 'movement' can be expected to continue, especially from middle classes relatively safe from elephant deprecations

and damage (Chapter 4). Another frequent, almost universal response is the reported awe (Chapter 9) with which humans view elephants, even from societies very exposed to threats by elephants, and much symbolism in these societies reflects elephants (Chapter 1).

Technological

Technological developments have had spectacular impacts, especially in the last few decades, on possibilities for elephant management. Between the 1950s and 1990s, managers tended to readily embrace whichever technical option they could use, and to an extent these tools appeared to 'lead' elephant management (Chapter 1).

From the early 1900s onwards, roads began making an enormous difference to elephant management, for instance in terms of access for control of poaching. Coupled with the later development of elephant-proof fences (Chapter 7), a defined area could be protected in a way that allowed realisation of a command-and-control management style (Chapter 1).

Effective culling methods (Chapter 8), chemical immobilisation for translocation (Chapter 5), and eventually contraception and sterilisation (Chapter 6), all led to major management uses or possibilities, often aided by airborne support (helicopters in particular), along with electronic tools such as GIS/GPS, that also facilitated effective counting of elephant. When elephant densities were the primary criterion for decision making, such technology was paramount. A relatively unexplored area, except for experiments in so-called 'disturbance culling' (Chapter 8), is that of behavioural modification. This new stream of scientific work (Chapter 7) promises possibilities of promoting avoidance of certain areas by wild herbivores.

Fencing (including all forms of barriers, repellent plants, and even protection of individual trees) is dealt with in Chapter 7, which also touches on the effects of artificial water provision on elephant distribution and numbers – the latter clearly influential under arid conditions. Fences in our landscape are invariably an integrated expression of various influences. They often have more to do with veterinary legislation, direct demarcation or protection of property than with ecologically influencing elephant populations (Chapter 7). Electric fencing has made a major difference to controlling movement of elephants, and indeed in many circumstances, to maintaining wildlife reserves amidst other land uses (Chapter 7). Some believe that fence maintenance is straightforward, and should be diligently practised by authorities to limit occurrence and effects of breakages, while others point out how difficult maintenance can be

in certain topographies, and under certain social circumstances (Chapter 7). However, fencing can have an obvious major disruptive effect on ecological processes, affecting dispersal of many species including elephants. Fences are also useful research tools (for instance, for excluding elephants to study effects) (Chapter 7). When fences are removed for whatever reason, a lag period can be expected before elephants colonise adjacent areas (Chapter 7).

Economic

In broad terms, elephants and humans compete for similar habitats. The result is that in the modern era, humans have generally marginalised elephants, reducing their range (Chapter 1). Re-establishing connected corridors between current regions of elephant distribution has been suggested (Chapter 2), but will be practically difficult in the densely populated and developed regions of South Africa where these are needed, though more possible in less-developed countries. Translocating elephants into small areas from which it is impossible to allow range expansion should be viewed with great circumspection, as this creates a whole host of ecological and management challenges.

TEV (including use and non-use values) has not been calculated (Chapter 10) in South Africa, but some such exercises have been carried out in neighbouring countries. Results are strongly influenced by the social values predominant at the time, and the general context. In other words, drivers, other than economic ones, modulate economic outcomes as exemplified by CITES bans (Chapter 10).

Elephants can have a negative economic value (e.g. landscape degradation or crop-raiding by elephants). Positive economic values are not necessarily additive (e.g. spatial separation between tourism and trophy hunting) (Chapter 10). Findings of the studies in Namibia, Botswana and Zimbabwe show that economic benefits from elephant often outweigh negative effects, though acceptable and effective rules and arrangements are crucial to the realisation of these benefits, and have not always been possible to make (Chapter 10).

Demand for ivory from the Far East peaked in the 1970s (Chapter 10). The subsequent CITES bans on elephant trade effectively caused a shift in profitability and operations for legal and illegal markets (Chapter 10). Since these bans, estimates of willingness-to-pay for elephant survival have been measured in some northern hemisphere countries, and can cover negative effects of elephant damage and still show a surplus (Chapter 10). This opens possibilities for, for instance, payment of compensation for lost revenue (elephant damage; foregone cost of ivory that can no longer be sold) and

effective conservation (Chapter 10). Ultimately such market solutions may supersede regulatory incentives such as bans (Chapter 10) though both 'stick' and 'carrot' approaches are usually needed.

Environmental

The concern that elephants could be degrading landscapes mostly arose post-1960 following growth of elephant populations in South Africa, and their confinement to certain areas (Chapter 1). It is clear that losses of other species can occur due to habitat modification by elephants, but the occurrence and extent (and particularly societal perception of the acceptability thereof) of this varies under different circumstances (Chapter 3).

Ecological views also shifted markedly in the late twentieth century. Notions of simple causality, stability, and 'balance of nature' gave way to complexity and to views allowing ecosystems to vary over space and time, thus yielding other interpretations of the undesirability of such changes brought about by elephants (Chapter 1). Although ecosystems may be subjected to multiple drivers, it is usually only two or three that are the major determinants of system behaviour (Holling, 2001). In semi-arid savanna systems, where most southern African elephants occur, rainfall, fire and herbivory (including by elephants) are key factors. How they play out is mostly determined by underlying geology, soils and landscape structure. Current philosophy of ecosystem management emphasises the dangers of modifying, or attempting to control, single drivers because ecological systems generally require the action of a full suite of varying drivers to maintain heterogeneity and system resilience (Levin, 1999). This has led to the idea of managing to allow for high, medium and low elephant (and other driver) impacts at different places and times as the strategy most likely to guarantee a wide range of biodiversity (Chapter 1); some feel this is most likely to be achieved by varying water provision across the landscape. The appreciation of complexity and change placed a premium on a rapid rate of ongoing learning (Chapter 1), thought to be best achieved by adaptive management with clear initial goals and an anticipation of surprise. Pushing and probing the system to gain knowledge, and abstractly modelling system behaviour to promote understanding and generate predictions or scenarios, form the basis of such an approach (Chapter 1).

The global biodiversity crisis (Cracraft & Grifo, 1999) is relevant in that the results of inappropriate elephant management could be seen as further worsening the worldwide decline of biodiversity through habitat homogenisation or degradation (Chapter 3). Conversely, without elephants effecting seed

distribution (certain plants are distributed by elephants) or creating necessary disturbance (producing heterogeneity), species could also be lost (Chapter 3) in terms of Levin's (1999) hypothesis of heterogeneity as the basis for biodiversity. A common theory proposed (also with respect to likely elephant effects) is the intermediate disturbance hypothesis. It posits that intermediate disturbance produces higher biodiversity than low or high disturbance, although Mackey & Currie (2001) show that evidence for this is by no means universal. However, different species are found at different disturbance levels, so that over a bigger area a patchwork of low, medium and high disturbance should give the greatest overall diversity (Chapter 3). Disturbance is itself a complex phenomenon, characterised by severity, frequency and extent (Chapter 3).

Global environmental change not only includes land use change (already discussed under economic drivers) but also rising levels of CO₂ and resultant climate change which could in combination lead to possible increase in tree cover in grassland areas.

Politico-legal

The major statutory protected areas in South Africa were proclaimed in the twentieth century, reflecting a growth of the conservation belief in society among the white population who had a near-monopoly of power during this period; one of the goals was to save the elephant species in South Africa.

After the Union of South Africa was created in 1910, land occupation and ownership was increasingly segregated by race. At that time there were very few elephants in South Africa. The few in the Addo and Knysna areas were nearly exterminated by government efforts to protect the white agricultural community, commercial agriculture and elephants being largely incompatible. Over time, the growing density of rural black communities also meant that further parts of South Africa became unsuitable for elephants. A broadly similar narrative applies to South Africa's neighbours Namibia and Zimbabwe. Land restitution in South Africa (Chapter 11) includes many claims inside statutory and private protected areas. It is anticipated that as this process unfolds, it will have consequences for elephant management, some hard to anticipate. For example, there could plausibly be greater demand for the lucrative and easy-to-start trophy-hunting option; or equally plausibly, pressure to cull elephants to limit their damage to crops; or to protect elephants in support of ecotourism.

After the culling era, governments and agencies have tended to skirt the elephant management issue (Chapter 4), creating the impression of inaction through lack of political will. Recent developments in South Africa, which

include this assessment, represent a move towards a more explicit and accountable policy formulation. In the adaptive approach, making mistakes as a result of actions taken is seen as an important source of learning. Mistakes should thus be embraced rather than avoided or feared, as the no-action option can lead to even greater problems (Maguire & Albright, 2005).

Several global conventions are related to elephant management (Chapter 11). The Convention on Biodiversity obliges signatories (including South Africa) to achieve biodiversity conservation targets and to move towards benefit-sharing with local communities in areas of resource utilisation, while the Convention on Trade In Endangered Species restrains international trade in elephant products.

A spate of post-apartheid legislation (Chapter 11) has significantly altered the politico-legal landscape. The South African Constitution established a goal of a healthy environment and the notion of participatory governance (Chapter 11). The National Environmental Management suite of Acts enforces many biodiversity obligations, including norms and standards on elephant management and on threatened species (Chapter 11). Animal disease legislation (Chapter 11; Chapter 7) is particularly influential in the realm of fencing (where elephants are often responsible for breakages and hence indirectly for disease outbreaks). However, there are serious gaps in the legal frameworks in South Africa regarding ownership and responsibility for wildlife (Chapter 11). By contrast, some recent legislation (such as for threatened and protected species) seems over-cumbersome, especially in an environment where ensuring compliance is likely to be difficult (Chapter 11). All these influence decision making regarding elephants.

Strategy

Strategy refers to the intentions and broad roles relating to elephant management. We discuss it below under the set of influencing ideas referred to in the conceptual framework.

Relevant features of elephant biology

Key aspects of elephant biology, such as growth and reproduction, endocrinology, social behaviour, musth, and communication are well documented (Chapter 2; Chapter 6). Movement behaviour (Chapter 2) and diet (Chapter 3), as well as the effect of variation in habitat (heterogeneity) on them, are well studied.

Natural mortality of elephants from droughts or predation occurs especially in very young calves and then again just after weaning (Chapter 2). Elephants are not particularly vulnerable to disease (anthrax and elephant myocarditis may cause sporadic deaths) (Chapter 7). Kruger has a good 50-year time series of elephant population size, but not of the sex and age structure, whereas Addo has an almost complete record of both (Chapter 2). Any relatively young population will show rapid growth and is likely to overshoot its key resource, causing a later correction (invariably involving deaths), and possibly associated with habitat change (Chapter 2 and Chapter 8). If specific age-classes are missing from a population, this can be disruptive to behaviour (Chapter 8). Use of immunocontraception and vasectomy will take a long time to reduce populations (Chapter 6). Large males are important gene contributors (Chapter 2).

Elephant are megaherbivores, consuming vast quantities of food per animal, and are known as 'wasteful feeders' (Chapter 3). They are regarded as a keystone species, meaning that their presence is important for other species and for the functioning of the ecosystem (Chapter 3; Chapter 4). Elephants can play both a competitive and a facilitatory role relative to other species (Chapter 3). They are important in nutrient cycling and seed dispersal, and elicit plant defence and growth responses (Chapter 3). Elephants and fire are regarded as drivers of alternate states in ecosystems (Chapter 3). It is difficult to disentangle the relative roles of elephant, fire, drought, disease, and other browsers in tree population patterns (Chapter 3). Limited palaeo-ecological results over thousands of years suggest tree densities have fluctuated in Kruger, but with no long-term trend (Gillson & Duffin, 2007), implying that pre-ivory trade impacts of elephants on vegetation were not uniformly higher. Elephants are known under certain circumstances to cause local extinctions of other species (Chapter 3) and known to also have significant effects on structure of vegetation (Chapter 3). Adult males are larger and kill or damage larger trees, also disproportionately pushing them over (Chapter 3). Elephant effects vary spatially, and piosphere effects (meaning the appearance of bare ground around waterpoints) are partly attributable to elephants (Chapter 3). When elephants are removed from a system, equally drastic changes may occur (Chapter 3).

There are important interactions between particular interventions and elephants. For instance fencing off, especially of water (Chapter 7), changes ranging behaviour. 'Overabundance' effects are often ascribed to the fact that elephants were fenced into parks (Chapter 3), but subsequent dropping of fences does not necessarily result in a quick reduction in elephant numbers (Chapter 7). The relative effects in small fenced-off parks is uncertain, with

some studies indicating that increased homogeneity results from impacts, and others increased heterogeneity over the landscape (Chapter 3). Elephant, mostly males, break fences, providing a conduit for disease transmission (Chapter 7).

Regarding manipulation of reproduction, oestrogen implant experiments were stopped due to unacceptable side-effects (Chapter 6). pZP immuno-contraception, on the other hand, has a seven-year study at one site, and has been implemented at another four, with few detectable side-effects at individual or population levels (Chapter 6), though aging effects obviously occur in the population (Chapter 6). Some work has been done on stopping male musth with GnRH vaccine. Contraception can stop population growth within two years (Chapter 6), but does not reduce population size until the older elephants reach the end of their life spans (Chapter 6).

Translocation of only young animals resulted in them forming secretive mobs, and aggression towards fences, humans and rhinos (Chapter 5). Habituated elephants, or elephants from wilderness areas, tend to retain their behavioural characteristics after translocation (Chapter 5). Females in small populations may display abnormal aggression (Chapter 8).

Ongoing culling of problem animals in peripheral 'sink areas' may erode trophy quality and have genetic implications (Chapter 8). Large-scale culling can lead to high rates of population growth once the culling is stopped (Chapter 8). In arid areas, limiting the distribution of surface water can influence elephant distribution and limit populations, the latter partly through increasing juvenile mortality; while in well-watered landscapes, elephants still concentrate more along riparian areas than elsewhere (Chapter 3; Chapter 7).

Artificially small populations easily develop genetic and behavioural problems (Chapter 3).

Level of ecological organisation

This refers to the target level of management, from individuals to populations to species to ecosystem, and ultimately, biodiversity in its broadest sense. The level being addressed influences decision making.

During the mid-1900s wildlife conservation tended to focus on the protection of individual species, as exemplified by the Addo Elephant and Mountain Zebra National Parks, and Tembe Elephant Park. These parks were initially run according to the overriding management needs of particular species (Chapter 8). It was soon realised that these focal species were part of larger animal and plant communities, and the focus was widened accordingly, for example to include threatened plant communities in both Addo and Tembe

(Chapter 3). The swing of emphasis to ecosystem management (Meffe *et al.*, 2002) that followed was endorsed by the IUCN in the late 1980s (McNeely, 1993), and many parks, such as KNP, can be seen to be effectively following those tenets today. In many respects, agencies are still grappling with the complexities of conserving biodiversity (Noss, 1990); the full definition includes diversity of structure, composition and function at the genetic, species, population and ecosystem levels. Ecosystem management may indeed cover these needs (Hunter, 1991). However, mission statements and objectives are being fine-tuned to accommodate biodiversity, and the actual target formulation and resultant monitoring programmes in particular are reflecting these demands. Generally, defining function (i.e. process) is the most difficult aspect of biodiversity, and reliance is still placed on the more feasibly measured structural (meaning pattern, across scales) and compositional aspects (meaning genes, species, communities, and ecoregions).

Ecological theories

Ecological theories have changed over the years (Chapter 1) and have been very influential in setting strategy. Early ideas suggested that the main interactions in ecosystems were relatively simple cause-and-effect relations, leading to, for instance, an orderly succession of vegetation following disturbance. Equilibrium or 'balance-of-nature' concepts meshed well with the notion of maximising productivity, an idea arising from the strong influence of agriculture. In more recent decades there has been a shift to viewing ecosystems as complex and less predictable, with non-linear responses, and (often delayed) feedbacks that make the notion of causality difficult to pin down (Chapter 1). In this view variation over space and time is considered crucial to ecosystem health and resilience. The differing ideas described above have appeared in a loose progression, the more recent ones partly replacing the older ones. The ideas co-exist to some extent, in that one aspect or facet is explained by one mode of thinking, and another component by another set of theories.

Issues of scale, extent and boundary conditions

This refers to the size of the management area, and the length, shape and permeability of its boundary, as well as the perceived relationship with a broader area beyond. It is often stated that small parks need more intensive and 'less natural' management than large parks, although this can sometimes be used as a reason for perpetuating invasive practices in small parks.

'Fortress conservation' (Brockington, 2002) refers to carrying out rigid conservation inside a tight and usually defended boundary, with little concern for what is occurring beyond. Movements that 'looked outwards' – for instance the KNP 'beyond the fence' approach used especially in river management – became more common once limitations of the 'fortress' approach became clear. Once land use outside a protected area became sufficiently similar to that inside, people automatically started referring to terms such as the 'greater Kruger National Park'. Such developments have allowed elephant range to expand, even without translocation. Under the National Environmental Management: Biodiversity Act bioregions will become formal parts of the South African geography, with some large multi-owner elephant-containing regions already existing (such as the UNESCO-designated Kruger-to-Canyons biosphere; www.kruger2canyons.com/biosphere.htm). These ideas now extend across international boundaries through the establishment of Transfrontier Conservation Parks and Transfrontier Conservation Areas, the latter including the wider area around the Parks.

A key strategic issue is the extent to which both planning and implementation approach spatial and temporal scaling, and how importantly they rate the consequences as intrinsic to their philosophy. The scale at which elephant impacts on management take place now occupies a central position in the way these are visualised (Chapter 1). Decision makers may commission planning at one scale and land up having unexpected effects or consequences at very different scales (Chapter 8). This also happens in the time dimension, where what seems to be an outcome that is acceptable in the present and the immediate future, turns out to be unacceptable over longer time scales (Chapter 8) yet the investments have been made. Because of their longevity (Chapter 2) individual elephants can carry their experiences through several successive tenures of say, protected area managers. Finally, scale issues apply to the human system as well, and problems can arise through not paying attention to them or because of mismatches in the whole interacting elephant-habitat-human system between the key biophysical scales and the scales at which management is attempted (Chapter 8).

Goals

Management goals are usually a direct consequence of the dominant ideas and legislation of the time, as influenced by societal drivers. Recognisable categories of goals may include preservation, conservation, benefit-maximisation, and more recently objectives arising from a 'desired future state' as set under the

National Environmental Management: Protected Areas Act. This ‘desired state’ (actually a set of varying conditions desired for the future), if it exists at all in goals, can be implicit, explicit but general, or explicit and articulated in detail.

Management styles

Management styles tend to follow mainly one of the following (Chapter 1):

- Indiscernible (absent, inconsistent or ineffectual)
- ‘Laissez-faire’ (‘leave it to nature’)
- Command-and-control, where man’s superiority, in terms of clear actions over a mechanistic nature, is assumed
- Management by intervention, cognisant of a more dynamic nature, but still with a ‘central balance’ or ‘optimal point’ and corresponding intervention, sometimes locally or for an isolated reason. These interventions could be widespread and far-reaching (e.g. culling in Kruger), and at other times may have constituted opportunistic local initiatives. This transitional style could be seen as an early bridge towards the later styles, but still very much rooted in command-and-control assumptions.
- Passive adaptive management. Recognition of a greater nature and ongoing change often beyond our control, and adapting accordingly to maintain particular goals.
- Active adaptive management. Further recognition that unless managers push and probe the system, we will not learn fast enough to adapt and manage successfully.

These management paradigms are ultimately only convenient (and hopefully largely appropriate) pigeonholes to help describe what in practice can be more nuanced hybrid styles. Different styles might be used at different spatial scales, or for different aspects of a system, depending on objectives, state of knowledge, and degree of effective control.

Implementation

On-the-ground management translates strategy (explicit or implicit) into action. We have chosen two focus areas (operational plan, and indicators and triggers) as key themes around which to gain insights into these outcomes. The pool

of ideas from which interventions are chosen can be considered a 'practical toolbox', which is discussed later in table 3.

Operational plan

Operational plans come in a wide range of forms, and reflect the way in which the 'on-the-ground action' is conceptualised and deployed. In a closely coupled system, the structure of the operational plan takes its lead from the strategy in a clear and logical way. At other times and places, very practical plans have existed in isolation, or almost in isolation, of an explicit strategy, indicating poorly backed-up but directed action-on-the-ground. Conversely, sometimes a developed strategy exists with a poor operational plan. There are also cases where there has simply been no defined operational plan at all, either implying that no action was being taken, or that no justification or guidance was needed to take any actions that were decided on, presumably then in a very opportunistic or arbitrary way.

In the latter half of the twentieth century it became common for conservation agencies to have several plans for key species at the operational level. Most reserves with elephants had elephant management plans (required prior to introductions), often with large sections on culling. These plans often existed in relative isolation from plans for other species and sometimes even from system drivers, but served a particular role, for instance, in conservation of a threatened species, or management of a problematic species, elephants qualifying for both. Objectives tended, accordingly, to be isolated, such as introduction of elephants for genetic purposes; or the management of breakouts. Over time the wider interconnections among the growing number of ideas in ecology, and the wider range of concerns about multi-species, community and systems issues, led to clearer articulation of such operational plans in response to this wider battery of drivers.

Strategic plans should be in place and agencies ready to adequately operationalise them. Reflecting on IUCN conservation effectiveness evaluations (Hockings *et al.*, 2000), satisfactory biodiversity outcomes can result from carefully planned objectives that are in turn based on clear visioning. Many process steps (such as standard operating procedures) are needed to operationalise management in a routinised way on the ground. Even if there are such documented procedures available in certain parks, they may be functionally isolated from the strategy, adjustments being needed at both ends to harmonise the two. Scenario planning, because of uncertainty about which

outcomes may unfold as one manages, can also be very useful, even at this operationalisation level.

Implementation lags of many kinds, i.e. periods that elapse before action occurs, bedevil management (Pfeffer & Sutton, 2000). Offsetting such lags includes shortening the period between knowing and doing, effectively translating good policies into action, avoiding a culture of non-compliance, and building the human capacity to enforce and monitor. If further lags occur between action and outcome, these can make it even more difficult to understand drivers and to adapt appropriately.

Indicators and triggers

Indicators are the elements that are measured to enable decisions to be made about implementing management, and triggers are the final signals that elicit action. There is a tendency for indicators to become more complex over time and then be re-simplified, or to converge into all-encompassing general indicators of system well-being. Administrators and scientists should expect such changes. The National Environmental Management: Protected Areas Act places emphasis on adaptive management. This section thus incorporates monitoring concepts required for understanding elephant management, which are not included in previous chapters (see particularly box 1).

Under a carrying-capacity paradigm, elephant density (the number or biomass per unit area) is a pivotal indicator, particularly when introducing elephants to small reserves. The state of other species (in practice, particularly those obviously impacted on by elephants, such as plants) has proved a regular indicator, most often expressed as structure (height classes) and composition (species) of plant communities. The complexity of covering an even wider range of species and features potentially impacted on by elephants has led to the use of surrogates, or related indicators that can be more easily measured than the actual species that are of direct concern. An example might be the vegetation height and cover profile and number of downed trees as indices of how much suitable habitat there is in elephant range for other smaller animal species.

Increasing interest in the wider context outside of pure biodiversity indicators has led to social and economic indicators coming into use – for instance, the number of crop raids into neighbouring farmland, or the financial benefit accruing to a village from elephant hunting.

In structured adaptive management, indicators are only chosen after concrete objectives are identified around actual aspirations or concerns, and in some versions of adaptive management only after a mental model of

cause-and-effect suggests a conceptual threshold where a system is likely to pass into an undesirable state.

Some triggers are opportunistic. For instance, elephants may be introduced to a small population to widen a genetic base, the trigger having been a concern about the genetic bottleneck. Similarly, killing or translocation (the latter usually unsuccessful in removing the tendency in the individual) of the animal may be triggered by a damage-causing elephant.

Most agencies with monitoring programmes tend to choose too wide a set of variables, trying to 'mean everything to everybody,' and usually later find they need more focus simply to do a reasonable job under realistic constraints. Reference is sometimes later made to 'core' and 'peripheral' indicators (Palmer Development Group, 2004). Some parks with focused objectives strive to only measure those few parameters that directly reflect issues of immediate or serious long-term concern, and drop the rest so as to concentrate resources. The wider the set of objectives (such as in the case of Kruger), the wider the suite of thresholds and set of monitoring variables tend to be. Learning can generate efficiency, and in its first five-yearly revision Kruger has honed down its suite of thresholds, believing this can still meet all its needs. However, it requires more detailed monitoring on the ground in appropriate categories to properly service the thresholds retained (J. Kruger, pers. comm.). This entire process requires ongoing iterations of evaluation and adjustment. There are obvious risks in investing too little or too much in monitoring, and the judgement calls can be difficult.

A final issue relates to the link from trigger to selection of action. Upon triggering, operational procedures can be 'hard-wired' into a very clearly defined set of practical steps. Care however needs to be taken to not codify these too firmly and rob managers of the space to manage adaptively, one of the failures of an over-emphasis on decision-support systems (Hayman, 2004). There is a fine balance between keeping on a strategic course for long enough to learn, and allowing implementers to intelligently choose the practical options most appropriate to the local context, at each decision call.

FORMULATING ELEPHANT ISSUES

The intention of this section is to help guide decision making concerning elephants. This is done through a series of key questions or steps. It sets out to be practical, but does not intend to be prescriptive.

Box 1: Thresholds, targets and process-based management triggers

Triggers are the final signs or flags which elicit action; they are the 'endpoints' of particular indicators. For instance an ecological threshold is derived from the mental model of where the system is likely to 'fall over the edge of the cliff', or in ecological jargon, to change state fairly quickly into an undesirable alternative. Some time before this (but not too long before, as it is believed that systems need to be allowed to vary, to stay resilient) is a point called the threshold of potential concern. This is the 'amber light' indicating that the system is moving fast enough in an undesirable direction towards the ecological threshold, and action must now be formally considered. To operationalise such a threshold of concern (which may be, for example, that species richness is being lost at more than a specified rate) an indicator, such as a broadly representative list of reptiles, birds, and insects, could be monitored. The trigger would be the exceeding of that threshold when the rate of loss is higher than the specified rate. A closely related but more widely used concept in regional biodiversity planning is that of targets, which normally are set as an intention to secure (or maintain at least) x% of a certain vegetation type under conservation. If this is achieved, these veld types are considered adequately conserved, or said another way, safe from the risk of passing into an unacceptable state. As soon as there is evidence that the targets are already at, or clearly heading to, a point outside the 'desired state', action is triggered. If targets or thresholds are set at different scales, they can be nested under each other. For instance, elephant-related thresholds of potential concern in Kruger (each articulated at sub-park scale) take into account what regional targets (of the South African National Biodiversity Institute) are of the same vegetation type in the region as a whole. This implies that thresholds of concern might allow greater change (even perhaps with inter-generational consequences) in vegetation types which are well represented and safe outside the park, while the desired state of vegetation types which do not occur (or are poorly protected) outside the park is defined more tightly. The fact that administrative boundaries do not always coincide with ecological boundaries adds challenge to implementation.

There are many similar constructs to targets and thresholds, such as limits of acceptable change, a concept never widely used in South Africa. For Ezemvelo-KZN Wildlife, a central idea is that the relatively small or

intermediate size of their reserves means that natural ecological processes are significantly altered. Under this assumption, they have developed a philosophy of process-based management which then allows human-made interventions to make good the shortfall. For instance, they cull antelope in certain parks which cannot house large predators in a predator simulation programme; and they remove rhino from broad areas around the edges of an intermediate-sized park, to simulate source-sink dynamics (meaning the rhino breed up in the central core area and then disperse concentrically, but fences curtail this, justifying this intervention). Each of these process themes has a target or trigger to guide it, such as an expected number of a particular species that would have been taken by predators. Ignoring the underlying assumption for a moment, process-based management can be considered very advanced in that it tries to tackle ecosystem function and not mainly composition (species) and structure (such as tree height patterns) on which most other agencies concentrate. Most agencies claim that function is extremely difficult to understand, monitor and manipulate, and currently focus on composition and structure, hoping that this reflects healthy ecosystem processes as well.

Where do you fit into the decision-making process?

Decision making occurs at different levels. Most of the material presented here is pitched at the protected area level. If you are a private owner of a smaller reserve (or making recommendations to such a person), you may find that the context of the landscape and society around the reserve has an overriding effect on your decision. Alternatively, in a large park, you may indeed be able to take a very individualistic stance concerning elephant management. In both cases, following through the framework will help you determine an appropriate approach. You may decide to gloss over certain of the headings in an effort to 'get to the point' further along the framework, but resist the temptation to do so too cursorily, as your situation is materially affected by all the headings, though you may feel some of their outcomes are for all practical purposes 'givens' for your particular situation. It is good to recognise these clearly and highlight them, and sometimes even to challenge what appears to be already 'fixed'. Go to the trouble of drawing the linkages between these and your final decision, as this will make it more justifiable, better-rounded and more durable.

If you are responsible for influencing or taking decisions at a level above the protected area level (for instance, metapopulation management in a wider region; or national policy; or even international or transboundary policy), then you will need to take a very broad view and will probably be working with multiple values and paradigms, and several decision-making levels. Again, the framework should assist in comprehensively identifying and balancing the issues. To help place where your decision fits in:

1. Determine the level and scope of your own decision-making position relative to the three 'compartments' (drivers, strategic and implementation) (figure 3). Ensure that the parts of that overall process you are not dealing with are somehow adequately covered and feed into your own decision-making process. If they are not adequately covered, decide explicitly how you will deal with that shortcoming.
2. Consider how you will contribute towards the need for bridging between other stakeholders on the same level, and particularly among levels (see figure 2).

Building a goal-orientated adaptive approach

An adaptive approach is mandated by the norms and standards for elephant management (Department of Environmental Affairs and Tourism, 2008), certainly at the property or reserve level. This is in line with management philosophy (Chapter 1) as it has developed, and there is no reason to believe that other levels of decision making would not benefit equally from this approach. A structured adaptive approach can be built using the following steps:

1. Define your particular context, such as the boundaries (also abstract ones, like social impacts) of the system you are dealing with for the decision at hand. This or the next step will require the listing of relevant stakeholders. It is usually very helpful to limit your focus through explicitly listing and exploring the special and unique attributes of your particular system.
2. Generate a balanced understanding of societal drivers, in this way helping to take care of the relationship between broader society and your management decision. Relative importance and balance will differ in different situations, but ignoring any driver category or assigning even too low or high a profile in the overall portfolio, may lead to less effective results. Public facilitation to elicit this understanding may be

prescribed or desirable. Review this understanding from time to time, say every five years.

3. Ensure transparent (at least to all the relevant stakeholders in the particular context) and clear setting of objectives consistent with the values recognised. This represents the upper or conceptual part of the 'desired state'.
4. Generate targets or thresholds that represent an initial stab at whether the objectives are indeed being met. Have a mechanism for revising these in the short-term as feedbacks come in and people learn. These targets represent the operational endpoints of the 'desired state'.
5. While doing all this, be very cognisant of your capacity to actually implement the plan. In figure 3 this is indicated as a cross-cutter for consideration perhaps while dealing with broader societal drivers. The way that, for instance, a park plan is designed and deployed, may place too high an institutional burden on the agency, and may preclude effective operationalisation of the strategy and plan. At the same time, this should not be used as an excuse for ineffective planning or implementation.

It is realistic to anticipate drivers shifting in future. Scenario planning (the use of plausible narratives about possible, as opposed to predicted, futures) is a very useful technique for testing the robustness of your plan, and can be commissioned by a conservation agency, government department, or NGO at any appropriate level, even a village level. Scenarios should be developed participatively. Particular elephant management scenarios may be built on existing and already available wider (global or regional) scenarios, such as those released by the Millennium Ecosystem Assessment. The basic reason for this is to heighten resilience through preparedness for any surprises, rather than thinking about these for the first time after they have happened. Interesting scenarios to develop around elephants would include issues such as an ascendancy of animal rights values, a domination by utilitarian values, or the effect of big swings in exchange rates or oil prices on ecotourism and hunting.

Promoting learning

Adaptive management (especially active adaptive management) encourages practical ongoing learning, and the casting of management as a series of sensible experiments from which valuable experiential and scientific learning

is possible. The following points constructively promote learning within and among disciplines and stakeholders:

1. If relevant to your level of decision, ensure a healthy science-management link, a difficult task in many agencies. Case history experience almost dictates that the science component should include reputable researchers and experts external to the agency. Long-term nurturing of this science-management link will be essential. The explicit formulation of targets, thresholds or triggers based on a shared vision and objectives constitutes first prize. Partnerships between external scientists and a particular agency must carry mutual respect, and may have to develop through phases initially requiring less trust, such as looser collaboration.
2. At the same time as ensuring tighter science-management links, it is important to retain a measure of identity and independence for both groups. When completely merged, there may arise a strong and inflexible 'groupthink' that may work against longer-term success, and raise questions about bias.
3. Biological scientists and conservation managers, particularly in the elephant debate, should be required to confront and appreciate broader societal values, and to not view their 'authoritative' results in isolation.
4. Design the management so that (at least within the limitations of your context) maximum learning is possible. This often involves a measure of responsible experimentation, and where possible, comparison of tools. This requires good documentation of the reasons actions were taken, and of the outcomes.
5. Link yourself to other sources of learning that are relevant. As essential as local learning is, you will not be able to learn fast enough without external inputs.

Dealing with change and diversity

From the history discussed in this assessment, it is clear that the pace of change concerning inputs to (not necessarily decisions about) elephant management has accelerated in recent decades. While this may level off, it is unlikely that the broad range of drivers and factors described will suddenly become streamlined into a smaller set. Whether this happens or not, we are currently faced with

ongoing change and the reality of diversity of opinions. The following general guidelines will assist us:

1. Be cognisant that today's approaches and paradigms are themselves fallible, and be open to the reality that others will emerge and the possibility that older ones may re-emerge in slightly different form.
2. Be open to the possibility of moral pluralism, in that contradictory values may have to be accommodated to some or even a great extent.
3. Expect that as values change and management systems evolve, old and new narratives may contain contradictions to each other. These may need to be managed to move forward, keeping an eye on the longer-term vision
4. Ensure that all the important feedbacks in adaptive processes are taking place. Many elephant management initiatives to date are, in practice, almost devoid of adaptive feedbacks such as shown in figure 3. For adaptive practitioners looking for a listing of generic feedbacks in adaptive cycles, see Biggs *et al.* (2003).
5. Adaptive systems should be designed to not become paralysed by differences in scientific opinion. Such differences may require contrasting recommendations arising from both points of view, in the full spirit of a well-motivated and thought-through adaptive experiment.

GUIDELINES FOR SPECIFIC DECISIONS

Decision making is a complex science and art in its own right, and this chapter can do no more than synthesise the best current knowledge coming through the assessment and apply it in the following guidelines. This will be done domain by domain, remembering that the interlinkages and feedbacks among these are as important as those within domains.

Societal drivers domain

Table 1 helps ensure that the full range of broader societal drivers is used appropriately in decision making. It contains information to help ascertain when and in what depth particular drivers should be examined, and broadly how this can proceed and be interpreted.

Strategic domain

Table 2 summarises the major guidelines for consideration when a decision maker is concentrating on strategic factors as outlined in the framework. It is intended as an overview of key concepts under each heading, and their broad relevance in decisions.

Implementation domain

The decision maker needs to decide on the character of the operational plan, for instance, whether or not it deals with elephants in relative isolation, the extent to which it allows local flexibility in decision making supporting the goal, and whether standard operating procedures are included. Importantly, and as discussed earlier in this chapter, coupling to the strategy needs to be made explicit. Finally, in any adaptive system there need to be at least some triggers/targets/thresholds and decisions on the indicators being measured that provide this information. These need to be sensibly chosen, in the light of all the discussion in this chapter, bearing in mind the absolute need to monitor adaptively, but also remembering likely limitations of capacity to do so. It may be that capacity simply has to be expanded to at least provide basic feedback, else no learning takes place, except by inference from elsewhere. Justification based on such evidence from elsewhere may not be acceptable in terms of the norms and standards (Department of Environmental Affairs and Tourism, 2008), as each park needs to justify at least the basics of its own case.

Finally, but nested inside all of the decisions taken till this point, comes the final decision whether or not to intervene, and if so, then the actual choice of intervention or interventions. Regardless of the type of trigger framework used, once a monitored indicator passes a threshold, a management action will invariably be elicited in an attempt to shift the system to meet the objectives of the plan. Table 3 compares key attributes of interventions to assist decision making at this level. When compatible, multiple interventions can be selected – that is, they are not necessarily mutually exclusive.

Feedbacks, and integrating all three domains of decision making

Decision makers who have been through the process above need to think through the linkages among the different elements. For instance, it does not help to have excellent implementational plans not grounded in good strategy, as little as it does to ignore practical feedbacks from implementers on the ground.

Societal driver category	When are these needed?	How are these elicited?	What weighting should these have?
Values	When framing the broader issue. If never framed, or no authoritative recent value determination can be cited, ensure this happens and states values explicitly, or risk failure (in any functional democracy). Do this genuinely but do not over-engage. Needs only one or two 2-hour sessions, often connected to related issues at a longer meeting. Repeat say every 5 years to check for value drift	By adequate and representative socially sensitive facilitation which produces a legitimate result. Depending on context, this may be a small set of stakeholders, but inclusivity of those is crucial. Outcome is usually sufficient consensus, but some cases may be messy. Agencies may assert own values but recognise that these should influence and be influenced by other values	Explicit identification of values (which can vary widely in different contexts) is almost an absolute prerequisite. Insufficient explicitness will result in ongoing misunderstandings and 'muddling on'. Some values preclude others, 'losers' should feel process was reasonable, and be given another chance in say 5 years' time
Social	Whenever people are significantly involved as stakeholders around an 'elephant' issue, e.g. human-elephant conflict; or right to significant concern, e.g. citizens awe-inspired by elephants	Usually at meetings to specifically discuss grievances or at joint-management fora; or public meetings around park management plans; or with specific interest groups	Depends on context. Social issues may dominate decision driver framework or may be tiny (e.g. private well fenced-off reserve with few expectations or possibilities of societal interaction)
Technological	These are realities of the decision-making landscape, the error is to not recognise or ignore their effect or potential effect in influencing decisions	Usually made known by technical salespeople or researchers with altruistic or vested interests. Options, pros and cons usually need to be summarised and possibly evaluated for decision makers	Wildcards which can overawe decision makers to the exclusion of other factors; but can also create a whole set of new positive outcomes. Best measured against values and defined objectives. May require initial experimentation
Economic	Whenever benefits and costs need to be explicitly evaluated. (May be less necessary in luxury projects with overriding values)	Ultimately, requires total economic value studies in a holistic framework by economists sensitive to complexity. These studies are expensive and rare, so decision-makers may use the best available information from studies in a similar enough context	Crucially important when changing land-use options and/or livelihoods of poor rural people are the main issues. If institutions can be put in place, may critically enhance African elephant conservation through even non-use values

Societal driver category	When are these needed?	How are these elicited?	What weighting should these have?
Environmental	If degradation or species loss is believed to be an issue (perceived to be particularly so in smaller properties)	Through scientific evidence relating to roles and effects of elephants. Elephants have 'good' and 'bad' effects, and caution is recommended in blanket use of e.g. the Precautionary Principle (Cooney, 2004)	If 'true' degradation is present or reliably predicted, place a high value on such environmental drivers. If not, be sure to evaluate elephant effects relative to values and resultant objectives – environmental issues still important but tailored to these
Politico-legal	Whenever political compliance is sought. Desire for legal compliance should be universal, though this assessment points to important gaps in some key issues of the legal framework	By being aware of current policies, trends, laws, norms and standards. These can also be influenced by you or a representative, theoretically with ongoing chances for updating over time	Generally regarded as minimum standard of legal compliance, in reality much flouting and confusion as legal landscape changes. Policy compliance can be optional depending on (e.g. private) context

Table 1 : Key guidelines regarding use of societal drivers in decision making

Key factor	Key concepts	Broad relevance
Elephant biology	Ecological role Reproductive biology Population growth Behaviour Genetics	Biodiversity and ecosystem management Manipulation of reproduction Expectations of growth or control Intervention impacts, e.g. translocation/culling/fencing Small populations/translocation
Level of ecological organisation	Continuum from species-community-ecosystem-biodiversity	Species concerns more straightforward; ecosystem management takes 'big-picture' view relying on healthy processes; biodiversity targets full spectrum of organisms and features
Ecological theories	Rough continuum of ideas from succession-production-equilibrium-resilience-scale and variability	Succession and production aims at highest yields. Equilibrium tries to maintain static balance. Resilience allows or encourages variation also at various differing scales
Extent and boundary	Rough continuum from fortress-look outward-greater ecosystem-bioregion-TFCA	Decide on most appropriate domain for your strategy and develop understanding for that context
Scale	Deals with the spatial and temporal scales of both planning efforts and consequences of these. Also social scale	Decision makers must ensure clarity of thinking about scale to avoid mismatches. Be explicit about both spatial and temporal scale of implementation as well as consequences
Goals	Focus on one or more of these: Preservation Protection Conservation People-and-parks Desired state-objectives	Preservation keeps unchanged. Protection prevents asset erosion. Conservation accepts change inside a hard barrier; People-and-parks focuses on interactions with neighbours; NEMA-mandated parks demands objective-driven planning accountable to stakeholders
Management style	Undefined Laissez-faire Command-and-control Passive AM Active AM	Unclear Watch but don't interfere Intervene: and reestablish fixed state Accept bigger dynamic and adapt Ditto but perturb to understand

Key: NEMA – National Environmental Management Act; TFCA – Transfrontier conservation area

Table 2: Guideline summary of key factors for strategic decision making for elephant management

Intervention	Comparative values	Incompatible values	To meet what objectives	Finances (ballpark)	Short-term stress	Long-term stress	Short-term population effects	Long-term population effects	Effect of stopping	Uncertainties and risks
Do nothing	Naturalness Wilderness Tourism Welfare	Conservation? Naturalness	Natural processes	None initially	None	Contentious, none to serious stress if fenced in	'Normal growth'	Stabilisation or population crash	May predispose dramatic later intervention	What limits populations? Is there density dependence? Fail to meet objectives. Higher HEC?
Culling	Conservation Sustain. use	Wilderness Naturalness Animal rights	Biodiversity (comp.; structure) Sustain. use Learning	R6 600/ele cost; profit R7 000/ele (excl. ivory)	High disturbance	High disturbance with behavioural effects	Immediate reduction Faster growth	Eruptive growth Social disruption Avoid resource depletion	Rapid growth Social problems	Long-term stress effects. Hidden processing costs. Self-perpetuating need Public aversion Behavioural effects
Translocation	Conservation Tourism	Naturalness	Biodiversity (comp.; structure) Sustain. use	R5 000/ele	Short term disturbance	Cannot translocate twice (N&S)	Immediate population reduction but limited impact	Eruptive growth Social disruption	Rapid growth Social problems	No acceptable estimations No market
Problem animal control	Sustainable, use HEC	Animal rights	HEC	High to return animal, low to shoot	Short term disturbance	High stress	Minimal (depends on population size)	None	None	Underlying cause remains Neighbour relations
Trophy hunting	Sustainable, use HEC Tourism	Animal rights/ welfare	Biodiversity Pop structure HEC	High return	Short term disturbance	Almost none	Minimal	Possible depletion of trophy classes	None	Public aversion

Intervention	Comparative values	Incompatible values	To meet what objectives	Finances (ballpark)	Short-term stress	Long-term stress	Short-term population effects	Long-term population effects	Effect of stopping	Uncertainties and risks
Immuno-contraception	Conservation Welfare (debatable)	Sustainable, use naturalness	Biodiversity (comp.)	R900/ele	Short term disturbance	Possibly none	None for 2 years, then reduced growth rate	Reduced growth rate; eventually reduced pop. size.	Slower growth	Are there similar long-term stress and/or behavioural consequences? Neighbour relations i.t.o. foregone opportunity to cull or hunt
GnRH treatment	Conservation Welfare	Sustainable, use naturalness	Biodiversity (comp.) HEC	Unknown	Short term disturbance	Unknown (none after 7 years)	Minimal	Minimal except in very small populations	Unknown	See 'Immuno-contraception' Chapter 6
Fencing	HEC Disease control	Naturalness Wilderness Sustainable, use (outside)	HEC Habitat protection Protect resources	Capital & maintenance Aesthetic cost	Minimal local disturbance; high stress for migrants caught against fence	Unknown No direct	None	May lead to need to intervene	Attraction to elephants when fence removed, or may leave legacy. Increased HEC	Creating local hotspots of high impact. Poor maintenance. Side-effects on certain spp. May exclude human communities from parks

Intervention	Comparative values	Incompatible values	To meet what objectives	Finances (ballpark)	Short-term stress	Long-term stress	Short-term population effects	Long-term population effects	Effect of stopping	Uncertainties and risks
Water provision	Sustain. use Tourism Overcome upstream influences Humaneness in droughts	Naturalness Wilderness Conservation	Buffering Productivity Tourism	Capital & maintenance Aesthetic cost	None	None	Higher growth rate	Higher density, overshoot resource base, delays density dependence	Short term mortalities; changes in spp comp and numbers	Increased risk to biodiversity. Legal cost
Waterpoint removal	Naturalness Conservation	Tourism Welfare	Biodiversity (struc. and comp.)	Dams and gravel pits v. expensive	High	None? may return to look for water	Incr. calf mortality, esp. in arid systems	Decr. growth rate	See 'Waterpoint provision' in Chapter 7	May have limited effect in mesic systems. Possible tourism backlash
Range expansion	Naturalness Wilderness Conservation Tourism Welfare	Sustain. use Welfare	Biodiversity (comp., process, structure) Conservation are expansion	May form regional economic node and/or loss of local resources; high cost	None	Reduced	Little	Decr density. Lower prob of over-shooting resource base in original areas but eruptive in new areas	Development pressure on corridors Changes in sentiment. Only while extra range in available	Forced HEC and/or land/use change. Changes in sentiment. Only while extra range in available

Key: HEC – human–elephant conflict; N&S – Norms and Standards; pop. = population; comp. = composition; sustain. = sustainable

Table 3: Guidelines to relative assessment and selection of different management interventions. Note: except where the context dictates otherwise, effects are deemed to be those applying to animals that stay behind post-intervention

Trace influences and feedbacks by keeping figure 3 in mind, so that your overall decision will more likely be balanced and effective, in both the short and longer term. You may need to add peculiarities or particular details to figure 3, in line with your specific context. To achieve this in practice you may want to:

1. Check whether you are satisfied that all the influences feeding forward into the decision blocks of interest to you have been taken into account. For instance, has the prospect of a future eruptive population been factored into a decision to cull, or has lost revenue for joint owners (claimants) been considered in a decision to contracept? In the first example, a legacy value is being evoked, and in the second a sustainable use value.
2. Check whether the decisions you are taking, or the information in certain blocks, is in fact feeding back into the areas where people can learn, and thus hopefully produce better decisions in future. There are often natural lags in societal responses, and you may need to be persistent in helping promote or 'market' such feedbacks so that they actually do eventually improve learning. Do not be disappointed if the first, second or even later attempts appear to 'fall on deaf ears': this is normal – there is usually a premium on inertia in society, and adaptive management very often leads to change. As an example of feedback from the implantation to the strategy box, if the proposed monitoring for a particular indicator is too complex, too expensive, or found to not reflect the underlying element of concern, this should necessitate a revision of that particular threshold and associated procedures, or should result in it being removed or replaced. As another example of feedback from implementation to drivers, we might find that culling by helicopter stresses elephants in the long term, and that there may be a change to ground culling in response to an animal welfare value.

WORKED EXAMPLES

The process described in this chapter may seem fine in principle, but raises the question 'how exactly does this work in practice?' This assessment avoids quoting prescriptive figures as direct guidelines, such as numbers of plants damaged, or (less commonly used nowadays) densities of elephants, because objectives differ widely, as do the different landscapes and situations in which decisions must be taken. In addition, a particular institution will monitor their adaptive goals in a particular way, and may not be able to employ a method

used by another property or agency. In other words, one size does not fit all, a principle recognised in the Norms and Standards for elephant management (DEAT, 2008). However, we provide four worked examples from widely varying situations to show the application in practice. These contain an illustrative set of actual figures of the targets set to achieve the goals of those situations. They are not intended to be directly for use elsewhere, at least not without very careful thought and possible modification.

The four examples are selected to illustrate a range of ecosystems and management objectives. Kruger represents a large savanna national park without many sensitive endemic species, with established ecosystem-level biodiversity goals, but also goals for tourism and the maintenance of wilderness areas. Tembe Elephant Park is a small to mid-sized provincial protected area with elephants as a major tourist attraction, but that also contains patches of narrowly endemic plant communities actively used by elephants. Madikwe represents a mid-sized provincial protected area with clear job creation and financial objectives, based on maximum development of nature-based tourism. Balule Nature Reserve within the Associated Private Nature Reserves, west of central Kruger Park, represents a small to mid-sized privately owned protected area, based on tourism and recreational objectives.

In all cases there are stakeholder-based processes (varying from widely participative in the case of Kruger, to mainly internal and implicit in the case of Balule) which guide the choice of targets and indicators to be used. These target or threshold values drive elephant management by triggering response actions, hopefully in a fully adaptive process characterised by the feedbacks described in this assessment (see figure 6 in the Summary for Policymakers).

Three typical thresholds used in Kruger have been selected from their longer list, and are depicted in figure 4a. One deals with loss of the least-common plants in each landscape, one takes care of major shifts in herbivore dominance (possibly grazer-browser shifts due to changing vegetation), and the third measures the loss of large trees. Unless the given thresholds are exceeded (or are likely to be exceeded in the near future) the ecosystems are left alone. This allows flux or dynamism in the system, an approach that now de-emphasises the Precautionary Principle (Cooney, 2004) which could previously, albeit wrongly, be argued in support of opposing ends – elephants or large trees. Management of ecosystem drivers may have to be instituted many years before unacceptable thresholds are crossed, making these important long-term management decisions in the park. An important amendment to the Kruger thresholds has been the consideration of the Kruger biodiversity targets in the

context of the regional biodiversity targets established by the South African National Biodiversity Institute (SANBI). There is some residual debate as to whether, in an *a priori* sense, to actively manage towards low and high impact zones (including elephant impacts), or to allow these zones to emerge through management actions resulting only from predicted exceeding of thresholds set differentially after taking the SANBI information into account. The more likely latter route (the one depicted in the figure) is consistent with broader threshold-based management, while the former would require a procedural modification supporting highly active adaptive experimentation and possibly quicker learning. At the time of writing, only the large tree threshold has been exceeded in parts of the park. The impact of elephants on large trees is receiving much attention in terms of modelling, in order to understand the trajectories better.

The loss of Sand Forest canopy in Tembe (figure 4b) is already close to the threshold, requiring urgent management. In Madikwe (figure 4c), management concerns are driven mainly by the desire to minimise incidents involving elephants that place tourists at risk. Exceeding this threshold also precipitates immediate action.

In Balule (figure 4d), a sophisticated equilibrium approach is used to bring down herbivore biomass (currently dominated by elephants, but including a range of other mammals) whenever the threshold level is approached or exceeded. The calculations involve useful energy flows into a system minus a certain fraction that is reduced by overheads (the so-called 'environmental loading' (EL)). This is subtracted from the metabolisable energy of the total amount of measured forage, taking into account seasonal variation and proportion of forage actually available to animals. For equations and details, see Peel (2005). The approach is based on the philosophy of managing for a productive system rather than commodities within a system, by managing the context (Allen *et al.*, 2003), and may be especially appropriate to systems which have been re-scaled by humans through erection of fences and supply of extra water points.

Currently, park management plans are pending approval in a new process under the Protected Areas Act. For more information on each of the four examples, consult the plan (once available), relevant management authority, or person entitled to speak on their behalf in this regard.¹

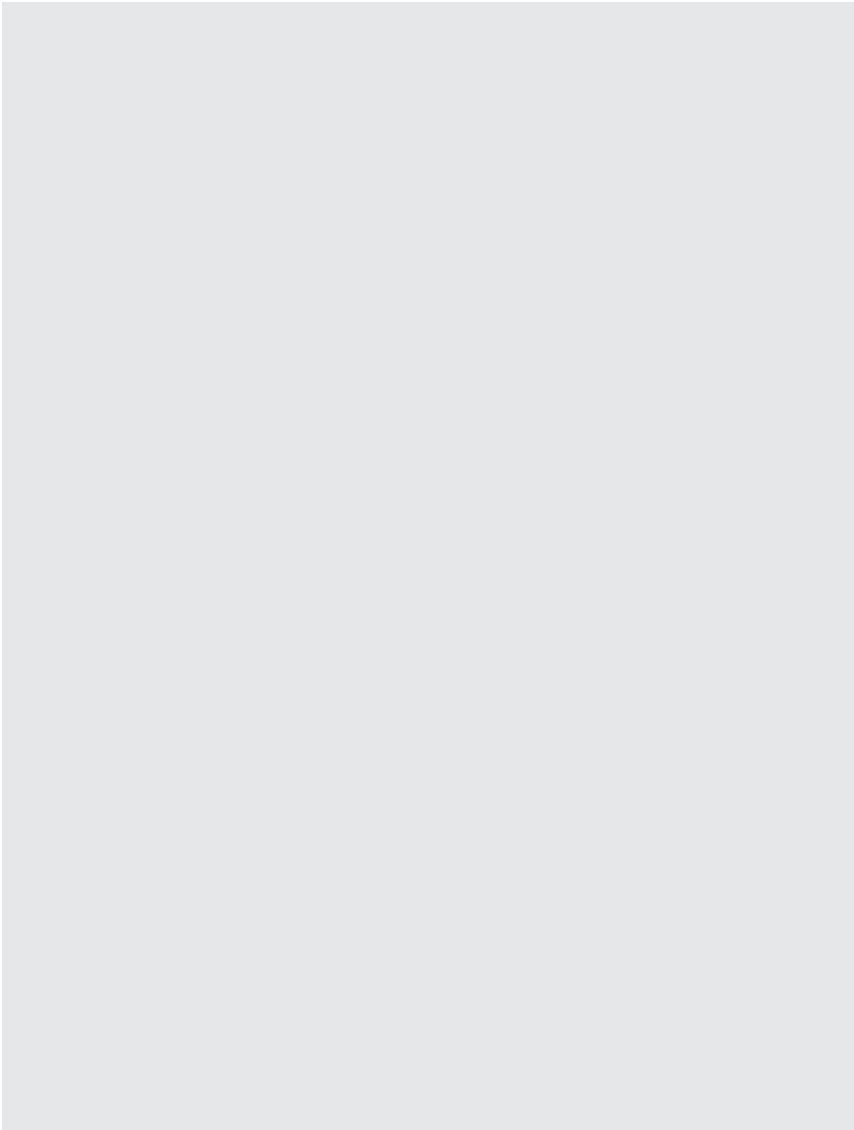
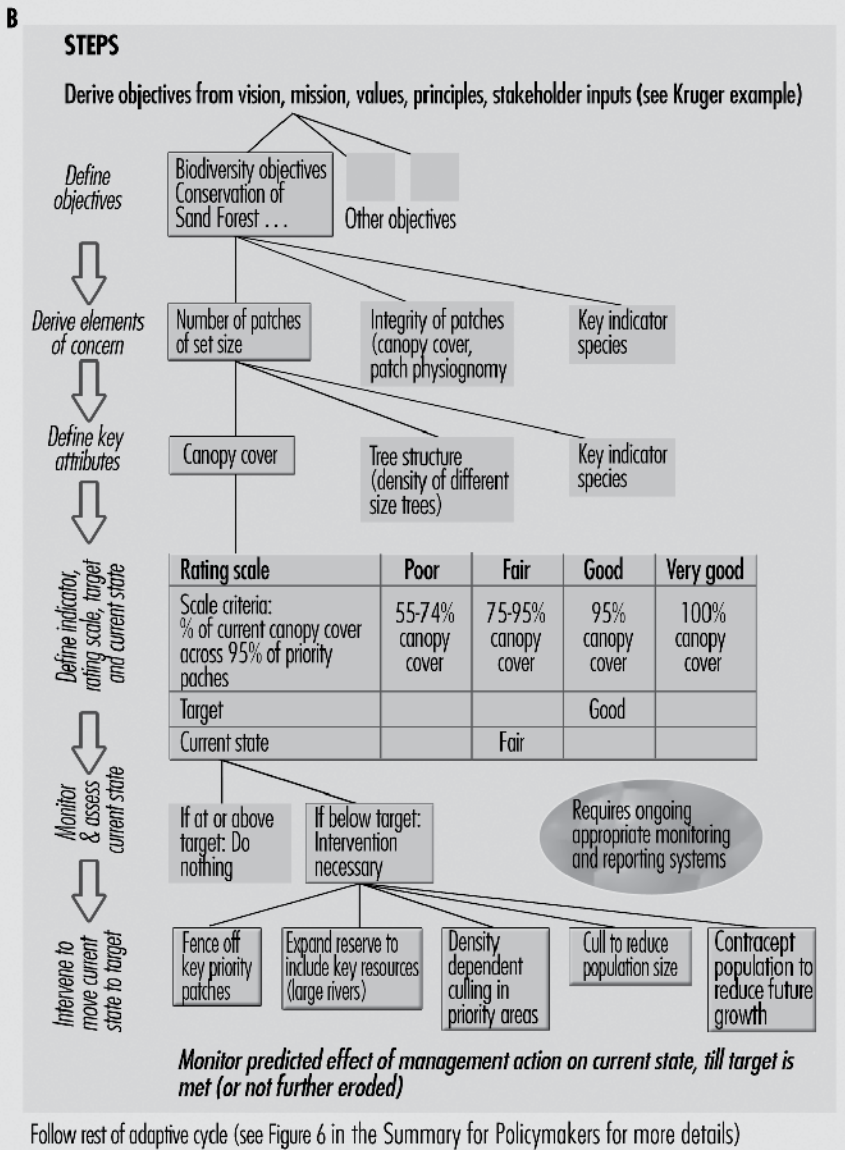
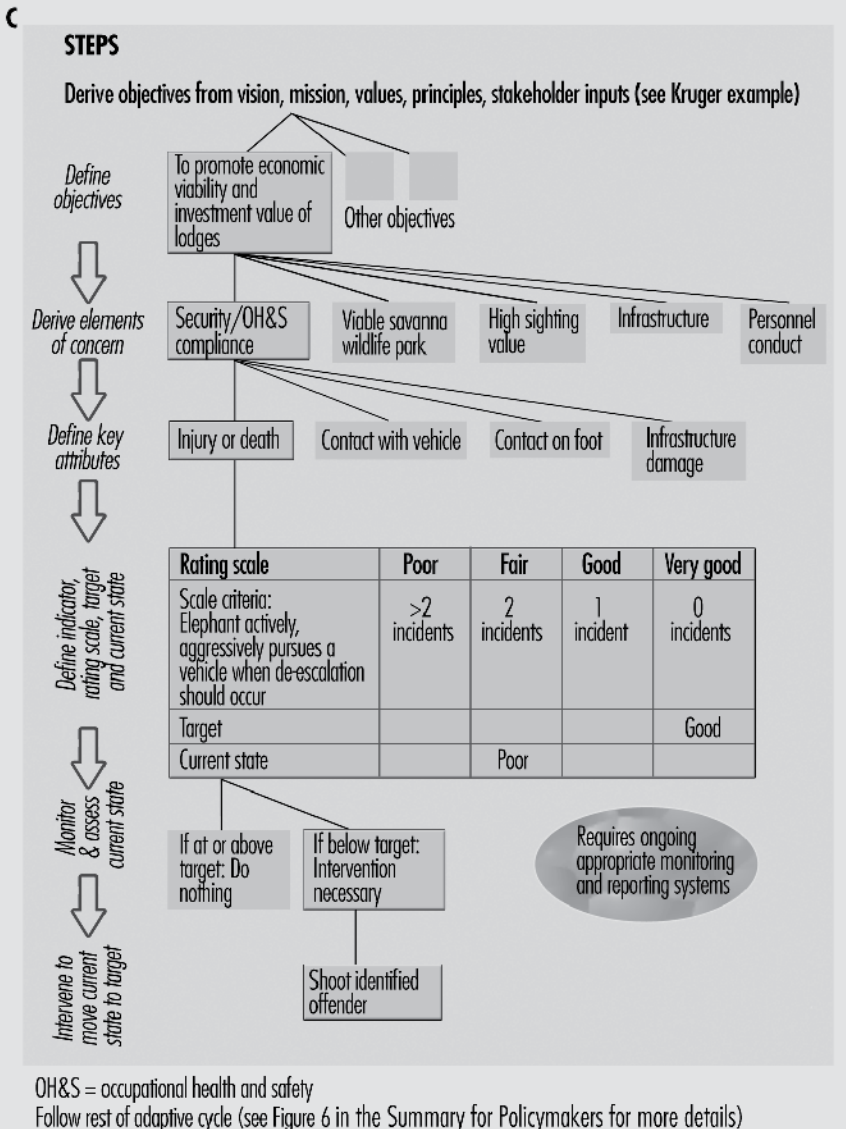
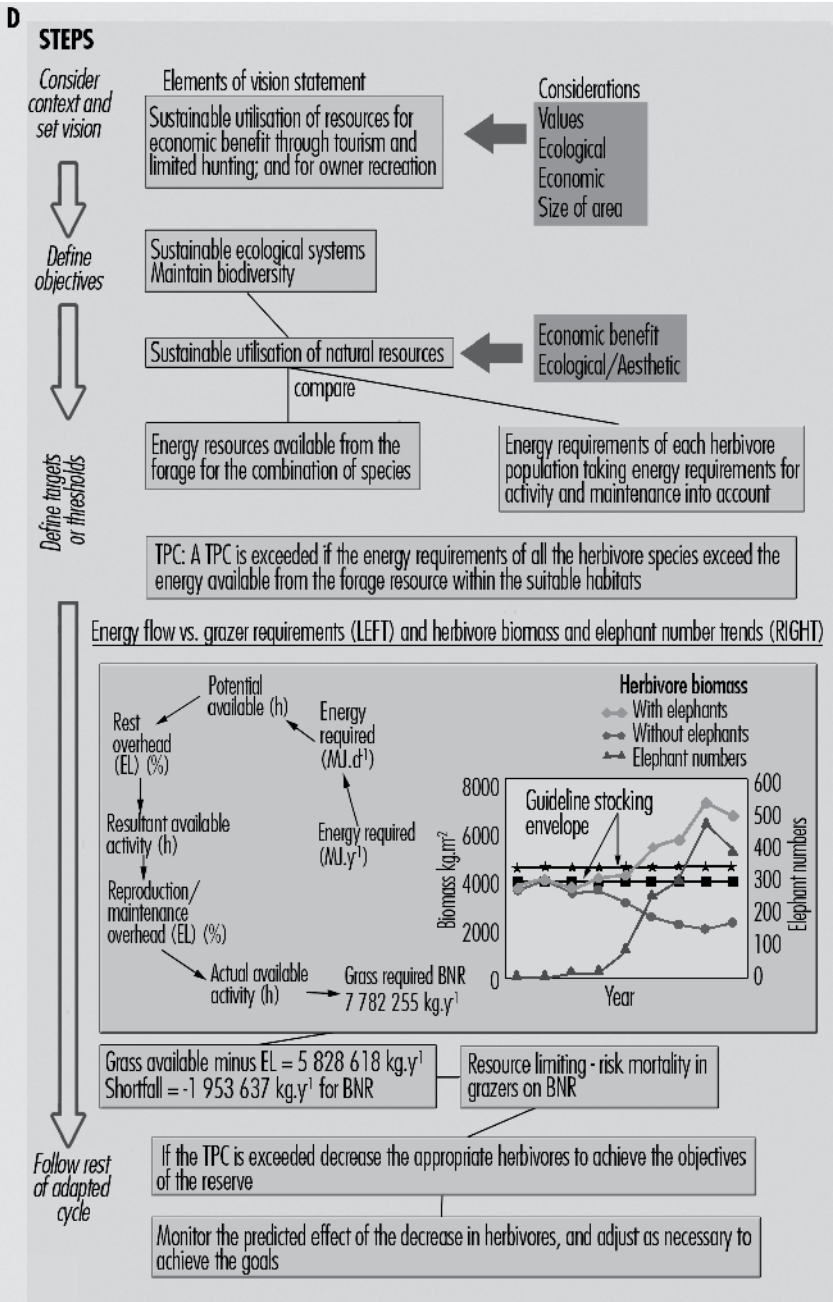


Figure 4: Graphic schemas of worked examples of elephant-related decision making in four different cases, showing derivation and type of objectives through to actual numeric examples of thresholds or targets. The localities are (A) Kruger National Park, (B) Tembe Elephant Park, (C) Madikwe Game Reserve, and (D) Balule Nature Reserve (BNR). TPC = Threshold of potential concern. In (D) EL = environmental loading, described in text







Follow rest of adaptive cycle (see Figure 6 in the Summary for Policymakers for more details)

KEY UNRESOLVED ISSUES IN ELEPHANT MANAGEMENT

Comparison of the information concerning elephant decision making made available by the assessment against the framework suggested in this chapter reveals several gaps and unresolved issues. References to Kruger are made below on the basis of the case study in Chapter 1.

Social and politico-legal issues

Most important and urgent unresolved issues about elephant management decision making revolve around social and politico-legal concerns in adaptive management rather than environmental ones. This does not mean that new biophysical or technological information around elephant management is unhelpful, but rather that society needs to promote the related ethical and social aspects and in that way 'catch up' and enable overall decisions to be more balanced.

1. There exists an extremely serious gap in legal terms relating to ownership of wildlife, including elephants, responsibility for wildlife, and compliance with regulations, affecting not only elephants in and around parks, but species in general (Chapter 11). In spite of the comprehensive revamp of so much South African legislation, including environmental legislation, these key areas appear not to have been screened for revision in any way, and major uncertainties and perversities exist. An urgent and serious rework is necessary if our best efforts are not to be unexpectedly thwarted by this gap. By contrast, some well-intended recent legislation for threatened and protected species poses serious impediments (Chapter 11) to achieving these and other objectives.
2. There is an urgent need to more explicitly clarify stakeholder values (Cumming & Jones, 2005) in relation to assessing society's 'desired state' for elephants in ecosystems and among human communities. South Africa has made advances in this regard inasmuch as the new Protected Areas Act requires values to be elicited as part of each park plan, so that all parks with elephants (that have so far submitted plans) have at least confronted this explicitly for the first time.
3. We need a better understanding of the consequences of espoused versus revealed values. This is apparent from the case history of seemingly paradoxical behaviour in the history of Kruger

management, where for example, managers spoke of 'minimum interference' but often made significant interventions, and talked about the overriding ecological imperative but then let tourism interests override in practice. These are understandable and very human responses (and very generic elsewhere), and this critique is only possible because persons in the Kruger system had the transparency to document intentions, decisions and outcomes, and to try to understand why certain stakeholders felt this was paradoxical. With the implementation of the Protected Areas Act such transparency will become the order of the day, and we should not be surprised to find such alleged discrepancies more generally. The concept of 'mental models' (Abel *et al.*, 1998) is an important aid in assessing this, rather than resorting to additional auditing. Clarity of setting objectives, and a clear and shared understanding of contrasting issues, is paramount.

4. The elephant-ecosystem-human interaction is more complex than is allowed for by the simpler models. Management approaches often still seem to be more about perpetuating or conserving the status quo (as captured by the commonly cited ranger mandate of 'maintaining territorial integrity' that is certainly an important issue in its own right), and less about learning how to change to adapt in a bigger system which itself is changing. These contrasting layers of thought need to be internalised and somehow practised together. This requires ongoing changes in attitude (Brock & Salerno, 1998) if elephant management is not to run into the same problems as in the past and lock itself into another impasse.
5. Change management: changes in policy often proved gradual, with overlapping (contradictory) statements during transitional phases which introduced the new idea but left enough of the old to help laggards adapt, or to temper early adopters. The relative strength of early adopters versus laggards needs to be managed for successful transitions, not necessarily always in favour of the fastest change. Such inertia in Kruger appears to have 'held back' the elephant management policy by about a decade relative to other major policies, though this may also have been due in part to the very wide range of stakeholders and ethical viewpoints.
6. Differing attitudes towards external scientists and ideas are evident in agencies, and the same splits may even be seen within the staff of one agency. In Kruger there has been a major drive to engage

in partnerships with outside scientists during the last decade. This happened to a far lesser extent regarding elephant ecologists, a situation that has started changing since the Great Elephant Indaba (SANParks, undated) and Luiperdskloof meeting (Grant, 2005). Elephant decision makers can materially assist the evolution of such science-academic partnerships, a fuller subject in its own right. The challenges establishing such a relationship should not be used as an excuse for inaction.

7. The 'moral dilemma' over elephant management has evolved into a very complex circumstance, largely due to the continued addition of new perspectives as more stakeholders participate. We may therefore now have the opportunity to simplify the 'moral dilemma' to its key attributes, and need to consider whether this is achievable. Alternatively, we need to better understand that the persistent moral dilemma in particular may cast the problem as a 'wicked problem' (Conklin, 2006), one with no definitive solution in which society 'muddles along' as the problem evolves.

Monitoring for adaptive management

Thresholds or targets and the indicators and monitoring programmes that support elephant management are in an ongoing evolution to meet the demands of adaptive management, and significant financial and moral support is needed from broader society if this is to succeed. This is part of a more general issue, but one in which elephants, wherever present, are key elements. This aspect of servicing monitoring (that has both biophysical and social science components) is a key bottleneck.

1. A variety of slightly differing approaches (e.g. thresholds of concern, process-based management targets, etc.) are in use by different agencies, and these are often seen as in competition with each other. This assessment suggests that in fact these are more similar than different, and in any case provide important alternative learning paths that should co-evolve. To promote this, more sharing of knowledge and results, and some harmonisation of vocabulary or jargon, is essential. This is often more challenging across international boundaries.
2. The fact that elephants provide such a variety of effects at different scales and under different circumstances means that not only research, but in particular adaptive monitoring will be essential

if this complexity is ever to be unravelled fast enough to manage elephants effectively. In line with the general adaptive approach prescribed under the Protected Areas Act, this requires effective ongoing resourcing that appears not to be in place, especially not for monitoring. Such a successful thrust is likely, within a decade or two, to move understanding of elephant effects from the contentious state it is currently in, to one of limited consensus (based on expert opinion) and later to one of wider consensus based on factual evidence. A clear exposition of research gaps in terms of elephant effects on ecosystems is given in Chapter 3.

Effect of interventions

Apart from studies on side-effects of contraception (more of which are required), there has been little interest in understanding the effect of interventions. As far as the ethical basis of interventions and their consequences is concerned, only culling has received some attention. This assessment highlights these as significant practical gaps.

1. The legacy consequences of current and past intervention (including culling) need to be clarified and resolved, particularly regarding any residual long-term stress and population effects on current populations of elephants.
2. Ongoing studies are needed on potential side-effects of several promising novel interventions, such as immuno-contraception, and the creation of relatively large fenced exclosures that are permeable to species other than elephants.
3. Ethical consequences of the full range of interventions need as much study and discussion as culling receives.

Economic gaps

There is a dearth of economic information on elephants in South Africa.

1. Economic studies, appropriately done, have major implications for elephant decisions, especially in the crucial area of livelihoods of the rural poor, and generally in land-use and resource allocation decisions. Investment in wildlife often proves to be economically efficient, and achieves upliftment and conservation.

2. National and subcontinental issues need to be weighed up against wider, and in practice often contrasting, demands such as those emanating from central African elephant conservation requirements. Central and southern African elephant management trajectories have differed markedly (Chapter 1). The bans and donor subsidies that are instrumental in maintaining the East African system are unlikely to be sustainable in the longer run, particularly in the face of growing Asian economic influences (Chapter 10). Therefore it may be a better long-term strategy to start introducing markets into the central African system, than to expect southern Africans to continue limiting their choices in sympathy to central African needs. Such an altered mechanism will require altering existing CITES agreements (Chapter 11).

Bioregionalism

Greater bioregional emphasis is a reality for most decision makers, and the implications of this for elephant management (land-use change, fences, corridors, etc.) need to be both studied and learnt about in practice.

Technological innovations

By their very nature, these can be unpredictable and can make a big impact on possibilities for elephant management.

The possibility of intrinsic behavioural modification of free-ranging elephants has never been examined, but promising results at practical scales, based on well-understood scientific rationales, are now being reported from other wild herbivores (Chapter 7). In principle, being intelligent animals, such approaches should be applicable to elephants.

CONCLUSION

This chapter has attempted to bring together the diverse ideas around elephant management, using an integrative framework. It has suggested a set of approaches that may materially assist decision makers working in this tricky area. Contention may persist, but the Assessment offers structured defensible processes to follow in reaching decisions. This Assessment can be expected to promote a partly shared rationale, or at the very least some empathy, among parties with differing viewpoints. It carries the longer-term possibility of the

problem solutions converging to some extent, as depicted by the arrow in figure 1.

Our synthesis confirms that the adaptive approaches suggested in DEAT Norms and Standards (2008) appear to offer a sensible way forward. It must be remembered that the discipline of adaptive management itself is evolving fast, showing improvements over earlier versions. This development needs to be supported. If monitoring under this mantra of adaptive management can be funded, and carried out to confirm the ideas generated under differing and clearly set objectives for management, we should generate a stream of learning that enables us to justify an ever-improving basis for managing these intriguing animals. Ongoing change in approaches can be expected because of the evolution of broader societal drivers, especially as values shift. Greater clarity is urgently required around elucidating current and evolving values, as these turn out to be pivotal in deciding on how elephants should be managed. Indeed, society may turn out to be working towards a new and very different 'social contract' with elephants. Moral pluralism is currently advocated because of widely varying values and needs in different circumstances. Major and potentially very deleterious gaps have been discovered in legislation relating to species (including elephants) in and around parks, and this shortfall will need to receive urgent attention.

Economic studies offer particular hope for understanding and influencing land-use change as related to elephants, in particular as this relates to the welfare of poor rural communities.

Social attitudes and constructs amongst stakeholders concerned with elephant management should be influenced in ways that allow greater sharing of information and values, but also allow for the promotion of moral pluralism. Polarisation of the kind that characterised the 'culling versus anti-culling debate' led to stalled options, and to unsatisfactory progress in adaptive learning and ecosystem management.

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ENDNOTE

1. Contacts for more information on each of the four examples in figure 4:
Kruger: draft revised plan at <http://www.sanparks.org> or via Dr Stefanie Freitag-Ronaldson at stefanief@sanparks.org
Tembe: Wayne Matthews at waynem@icon.co.za
Madikwe: Pieter Nel at hpnel@mweb.co.za
Balule: Mario Cesare at olireserve@worldonline.co.za or Dr Mike Peel at mikep@arc.agric.za

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