Setting the record straight – when science counts count!

By Rudi van Aarde

Elephant management decisions are complex and in an ideal world should be steered by the best available science. The Botswana Department of Wildlife and National Parks recognises this. Their recently commissioned report by ecologist Dr Mike Chase, to evaluate the distribution and trends in wildlife numbers across northern Botswana represents just that – best available science. Counting elephants is no easy task, nor is the interpretation of the meaning of these counts. Developing accurate and reliable techniques to count elephants, and interpreting these counts, requires an in depth scientific understanding of ecology, population biology and a familiarity of site characteristics.

Chase, a Botswana national who grew up in northern Botswana and based his PhD research on the movements of elephants across this region, is therefore particularly well qualified for the task. Chase's conclusions that elephant numbers across northern Botswana have stabilised and that the numbers of 11 other large mammal species have declined are robust and defendable and, most importantly, provide crucial information to better understand what drives the wildlife populations of this remarkable region.

Knowledge however, even when provided by robust science, can sadly be the Achilles heel of those who prefer to remain uninformed. Not surprisingly, because Chase's conclusions were unfavourable to some who hold extreme personal opinions about elephant management, they were met with outcries of misinterpretation. Statements such as '*there are simply too many elephants in Botswana*', that '*the population doubles every ten years*', that '*numbers increase at 8 per cent per year*', and that by the Chobe River, elephants have "*nibbled away at every piece of edible grass they found and browsed off every edible woody plant species* ……" are provocative, ill-founded and unfortunate. However, to the detriment of a well informed society, these unsubstantiated statements enter the general media as if based on fact.

The misrepresentation of Chase's report and slandering of Chase himself in a recent copy of '*The Outfitter*' is a case in point. In the article, the author Ron Thomson rejects Chase's findings, in favour of his own interpretation that elephant numbers are higher than those reported by Chase, and that elephants alone are responsible for the noted declines in numbers of other large mammal species. However while Thomson tries to position his interpretations as superior to those of Chase and others, his article sadly reveals more about his own limited understanding of the ecological processes that drive animal numbers, than it does the calibre of Chase or his report. To understand why, let us first explore how Chase estimated animal numbers and then how he calculated changes in these estimates over time. Then we can build on Chase's findings by exploring how natural processes limit elephant numbers and in doing so illustrate why Thomson's views and management paradigms for elephants are misguided. Indeed although Thomson's column is largely irrelevant in the context of elephant management, I believe that as a scientist I have a responsibility to society to correct his misrepresentations and foster a well-informed public. To do this I share my insights and interpretations gained from Chase's report together with those from my own research team's programs and those of others currently being conducted in the region.

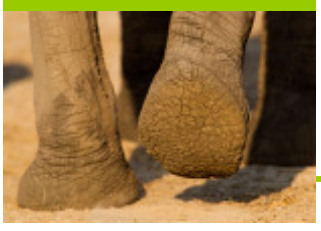
To be reliable means to be accurate and precise

Estimates have two components that reflect reliability - accuracy and precision. Accuracy describes how close an estimate is to a real value. Because we have no idea of real numbers for free ranging populations we use the variability in estimates obtained through repeated counts to express accuracy. This can seldom be afforded. Accuracy also has both a bias and precision component. We can reduce bias by using rigid and repeatable survey routines to provide counts for which precision can be calculated. Precision improves with survey intensity and it therefore is advisable to cover as much as possible of an area when conducting surveys to estimate population numbers.

The reliability of any estimate is dependent on an acceptable level of precision and as a first approximation precision should not exceed 20 percent of the value of the estimate. Chase's report details these measures for all estimates of numbers for each species surveyed. Worthy of note, his 2010 survey provides the most precise estimate to date for elephants in northern Botswana of about 128 000 elephants. By contrast, Thomson's effort to convince the reader that there are at least 155 000 elephants in northern Botswana is unfounded. Being generous, it is possible that Thomson gleaned this figure from unsubstantiated values of 151 000 for 2003 and 153 000 for 2004 given in previous reports by Botswana's Wildlife Department. The differences between these estimates and the estimates from which they were extrapolated are enormous as the real estimates in the report are 70 000 and 80 000, albeit for two incomplete surveys done during 2003 and 2004. In reality however, regardless of where Thomson got his estimate, his unwillingness to identify his "reliable source" or any measures of accuracy or precision that accompany it, renders it irrelevant.

Deriving trends from estimates

Northern Botswana is huge, and the area over which elephants occur here may be as large as 85 000 km^2. Because Chase's survey covered 86% of this area his estimates are more reliable than those made during previous years when surveys were at lower intensities. Consequently the extent of extrapolation over the vast area varies considerably between years making year to year comparisons of wildlife for the total area complicated. This is especially because elephants and other wildlife are free to move from one area to another, often in response to changing living conditions.



To overcome this problem, Chase divided the survey area into distinct districts and assessed district specific population trends in elephant and other wildlife numbers from previous estimates derived from surveys that covered the same area. Using matching estimates derived from seven to nine surveys conducted between 1993 and 2010, Chase calculated growth for each species. 1993 was a cut-off date because that was when the Botswana Wildlife Department standardized survey design. To overcome differences in survey coverage from year to year he also converted estimates to densities to ensure that units over time remain comparable.

What did he find?
Across most districts elephant numbers increased during the period 1993 to about 2001 and thereafter stabilized, with the 2010 estimate for the total population being just below 130 000. Numbers for other wildlife either increased or decreased, depending on the district. Notably, in protected areas such as Chobe, all species (buffalo, eland, giraffe, hippo, impala, kudu, lechwe, sable, tsessebe, warthog and zebra) except wildebeest and roan increased in numbers. By contrast, in non-protected areas across Ngamiland numbers declined while those of cattle increased. Most species of wildlife in the Moremi Game Reserve declined, but not at statistically significant rates. The period of declines extended over some 10 to 15 years and coincided with notable human-induced land degradation and an extended drought. However, for northern Botswana, little information is available on the interaction between wildlife, domestic stock, land use practices and droughts and Chase therefore suggests that research is needed to determine whether these factors may be responsible for the decline in wildlife numbers.

What do these changes mean?
Natural systems are dynamic and wildlife numbers are expected to decrease, increase or stabilise over time. This is because their survival and breeding rates align with environmental conditions, especially food availability, which is driven by rainfall. In northern Botswana, rainfall varies considerably through time, with decadal spells of above average rainfall followed by similar periods of drought. Rainfall also varies across space. In the more arid portions of savannas in northern Botswana, rainfall tends to be patchier than in mesic areas. Food availability in northern Botswana is also dictated by flooding regimes across the Okavango Delta and along major drainage lines such as the Savuti Channel and the Selinda Spillway. The amount of flooding depends on rainfall in the highlands of Angola, while tectonic movements in the earth's crust determine the extent and location of flooding in northern Botswana. In simple terms, the location and extent of food availability and quality changes over time. Such changes induce asynchronous fluctuations in numbers as animals move in search of food and die in response to food shortages in one place, while flourishing in response to abundance in others. Collectively these challenges ensure that populations persist.

Correcting misinterpretations

Elephants and other wildlife
Given the above, simplistically blaming elephants for declines in wildlife numbers reflects a poor understanding of ecology and of the dynamics that drive numbers. Should elephants have been responsible for the declines, then wildlife numbers in northern Botswana's protected areas should have also declined. Clearly, this was not the case, because in protected areas large mammal populations mostly increased while elephant numbers stabilized. Elephant numbers also stabilised in non-protected areas, while other large mammals tended to fair more poorly than they did in protected areas.

Elephants can alter living conditions for other species, but this only occurs in small protected areas, or in areas where they concentrate throughout the year due to fences which cramp them in, and/or due to the placement of artificial water supplies that lures them onto previously inaccessible land during the dry season. The latter seems to be the case in Zimbabwe's Hwange National Park where some 60 water holes maintained through boreholes modified elephant movements. However, after lack of maintenance rendered many of these waterholes dysfunctional, elephants once again roamed further afield to regain their natural patterns of spatial use. In a nutshell, these movement patterns provide an ebb and flow of numbers and consequently negate impact. As a matter of interest, a detailed scientific analysis of long-term counts of all species together with a detailed vegetation analysis clearly showed no cause-effect relationship between elephant and wildlife numbers, or any deterioration of habitat away from the piospheres around artificial water points in Hwange.

Elephants and vegetation
The concern that increasing elephant numbers are responsible for the deterioration of vegetation along the Chobe River needs to be placed in context. Elephants certainly do change vegetation with some species along riverfronts responding more than others. This is the case for acacias and marulas along the Chobe riverfront, and along sections of the Zambezi and Luangwa rivers in Zambia and the Crocodile River in South Africa's Kruger National Park. However, the interaction between elephants and vegetation is not straightforward. In the case of the Chobe riverfront, over-hunting and an outbreak of rinderpest resulted in abnormally low numbers of elephants and other wildlife from the early 1900's to the 1950s. Because this situation persisted for nearly half a century, atypical dense woodlands established along the river and vegetation flourished. Understandably, this also gave rise to a false perception that densely wooded riverbanks here were normal. However, in the wake of conservation, wildlife numbers increased and the dense woodlands along the riverfront declined to a state more natural than the anomaly that developed in the absence of wildlife and elephants.

In general though, in semi-arid savannas such as northern Botswana, vegetation changes are driven by a combination of droughts, floods and fire and their effects on wildlife. Pulses of wet periods following extended droughts and the local temporary disappearance or depression of wildlife, provide windows of opportunity for certain tree species to establish, notably acacias on floodplains. As seen on the Chobe river front and elsewhere in northern Botswana, the near even-aged stands of these trees then die off in near synchrony, would it be in response to flooding, or droughts, or increased depredation, or a combination of extreme conditions, or simply age. As an aside, the suggestion that habitat destruction has lead to the disappearance of scarce species such as the Chobe bushbuck beyond the sanctuary of lodges is simply wrong – Indeed, I have yet to pay a visit to the riverfront without seeing a Chobe bushbuck!

What regulates elephant populations?
As with vegetation, droughts and floods also drive elephant numbers. Therefore their numbers cannot increase indefinitely as suggested by Thomson. How droughts and floods limit elephant numbers is complicated but fascinating. From our research and that of others, we know that the green flush of vegetation that follows two to three months after the first rains induces ovarian activity in elephants. This results in a peak in births some 22 months later. Most calves are therefore born at the onset of the rainy season when food quality and availability is high, thus negating the need for their mothers to roam over long distances to find food and water. Consequently the likelihood of these calves surviving is relatively high. However, we are presently investigating how occasional flooding, along the northern Botswana's Savuti Channel which results in unseasonal and unusual short-term green flushes, may induce ovarian activity that explains birth pulses that are out of synchrony with rainfall. We suspect that calves born under these conditions are more likely to die as the flooding that provided the initial green flush eventually drowns the very flushing trees that would have provided the food source required by their mothers.

Indeed the Savuti floodplain is presently in its second year of full flood following a long dry period since 1981. Prior to flooding in 2010 water for breeding herds in this harsh and arid hinterland of Botswana was limited to a few artificial waterholes dominated by elephant bulls and a few breeding herds. Breeding herds only frequented this hinterland during the rainy season when forage was plentiful and water was provided in pans filled by rain water. Since flooding however, thousands of elephants in hundreds of family units moved from other areas onto the Savuti floodplains. This was most likely to take advantage of the greening acacias which standing in deep water are known to be highly nutritious. We suspect this explains why every breeding herd we surveyed in the proximity of the Savuti channel this year had a newborn calf at foot. By contrast, we noted few new-borns in herds we surveyed in Chobe and the Linyanti. This mis-matching of demographic profiles among elephant subpopulations suggests an operating source-sink elephant metapopulation. If so the dispersal of elephants from source sub-populations in places like Chobe, Linyanti and Moremi, maintain the Savuti subpopulation, which due to low infant survival, serves as a sink population. Collectively, these subpopulations comprise a regional metapopulation, which, over time and as documented by Chase, will have a growth rate of around zero.

Within source-sink metapopulations, we accept that elephants in some populations will starve, while others will survive. This is nature at work and collectively this maintains a species consisting of individuals selected through natural forces for those best suited to environmental conditions. Natural selection, the basis of evolutionary adaptation enhances fitness. It is a force that has been operating for millennia and one that needs to be nurtured, should our priority in conservation be maintaining biological diversity. It is the uneven distribution of individuals across the land and their responses to environmental signals, either false or real, that ensure the natural persistence of plant and animal interactions on their terms and not ours.

Knowledge as the way forward….

The information and interpretations above lead us to understand that interfering with the natural processes I have described, either through culling, water provisioning, fencing or encroachment removes the very regulatory mechanisms that maintain biodiversity, and the ebbs and flows that give rise to the dynamic ecological wonders of northern Botswana. Understanding the response of elephant populations as part of the natural volatility of nature here and allowing them to respond to this is the best we can do. No other country in southern Africa is better suited to this than Botswana. The scientific efforts of people like Chase should be commended, as it is findings such as his, together with their proper interpretation that enable a more in depth understanding of how dynamic ecosystems operate. Science, rather than opinion, provides the best guidance for management decisions and similarly informs society best.

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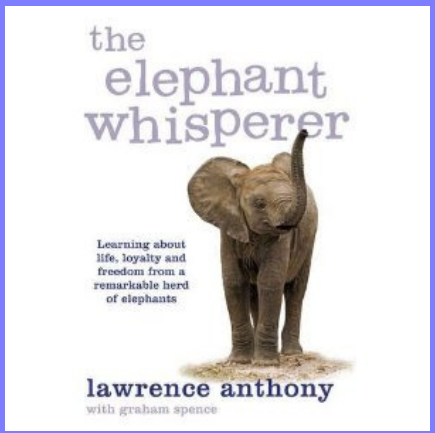

'Through skillful and engaging storytelling, conservationist Anthony takes the reader into the heart of his South African reserve, Thula Thula, detailing memorable encounters not only with his beloved elephants but also with myriad wildlife from rhinos to crocodiles and mambas to baboons.

Elephant Managers and Owners Association (EMOA), offered Anthony a herd of elephants due to the reputation of his reserve and his special ability to relate to animals. He eagerly accepted despite the creatures' problematic past. The herd's bad habits, such as breaking out of reserves, a distrust of humans and unpredictable, dangerous behavior, presented Anthony with an enormous challenge.'

Read the review of Julia Osterman at http://www.izilwane.org/the-elephant-hisperer.html. *Also read:* http://www.izilwane.org/qa-with-lawrence-anthony-author-of-the-elephant-whisperer.html