



IUCN SSC Asian Elephant Specialist Group

Guidelines on artificial waterhole management in relation to Asian elephant conservation

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Introduction

It is perhaps natural that for a large-bodied animal such as the elephant with substantial requirements of water, not only for drinking, but also for other functions such as bathing, wallowing and thermoregulation, one of the foci of management both in Asia and Africa has been to provision the species with artificial water sources. At the same time, water bodies provide an excellent opportunity for tourists to observe elephants and their behaviour, and wildlife tourism is an important source of revenue for maintaining many protected areas in the two continents. The origins of “artificial water bodies” in elephant habitat have a more complex history, though, with high elephant densities in Sri Lanka concentrated around large irrigation tanks created in ancient times (Fernando *et al.* 2011), while artificial watering points were first created at Kruger during the 1930s and greatly expanded during the 1950s to buffer the elephant (and other wildlife species) against drought (Pienaar 1983). In India, large numbers of waterholes have been created primarily in tiger reserves (with the objective of supporting or increasing the prey populations); given the overlap between elephant and tiger ranges in many regions, the former has also been a “co-beneficiary”. Since the 1990s however there has been some critical debate in southern Africa about the unintended and often negative consequences of creating artificial watering points in semi-arid habitats, resulting in the closure of substantial numbers of these points at places such as Kruger (see Hilbers *et al.* 2015). In Asia, the discussion on this subject is just beginning.

There are several, interrelated aspects of artificial waterbody management with respect to elephants that have been of interest or discussed in the literature:

- 1) changes in movement patterns and habitat use by elephants seasonally, and resulting changes in elephant densities
- 2) localized impacts of elephants on vegetation because of disproportionate browsing/grazing by elephants in areas around waterbodies
- 3) growth of elephant populations because of supplemental water.
- 4) implications for overall biodiversity.

These are, of course, not mutually exclusive, and some literature exists on these aspects of surface water in relation to elephant ecology in the African savannah, especially for two landscapes, namely, Kruger (South Africa) and Hwange (Zimbabwe). Let us examine this briefly.

1. Changes in elephant movement patterns, distribution and density

Waterbodies have long been thought to affect African savannah elephant ranging and degrade areas around waterbodies (for example, Thrash *et al.* 1993, Thrash 1998, Brits 2002; 'piosphere': Lange 1969 in the context of sheep). Apart from earlier studies, during the last decade or so, Chamailé-Jammes *et al.* (2007a) found that surface water drives the distribution and abundance of elephants in Hwange National Park. De Beer and van Aarde (2008) found that greater heterogeneity and waterbody density is correlated with decreasing elephant home range size in semi-arid areas of southern Africa. Therefore, water and habitat management can potentially be used to affect elephant numbers. Loarie *et al.* (2009), by monitoring a large number of collared elephants across a rainfall gradient in southern Africa, found longer daily movement and area covered in dry (<650 mm annual rainfall) landscapes compared to those in wetter landscapes (650-almost 2000 mm annual rainfall). Expectedly, seasonal differences in the areas covered decreased with increasing rainfall. Artificial waterholes would then contribute effectively to decreasing seasonality, resulting in reduced seasonal differences in elephant ranging (Loarie *et al.* 2009). Artificial waterholes were also found to allow elephants to range in areas that were formerly not used by elephants in the dry season (Purdon and van Aarde 2017, Loarie *et al.* 2009).

2. Impacts of elephants on vegetation

Artificial waterholes were found to impact vegetation through altered patterns of elephant ranging in southern Africa. For instance, decreased seasonality in ranging would not allow habitats sufficient respite from foraging to regenerate (Loarie *et al.* 2009). Similarly, the use of previously unavailable areas during the dry season because of artificial water would also impact the vegetation in those areas (Loarie *et al.* 2009). In a study across large parts of Africa, depending on local environmental conditions, varying elephant density was found to negatively impact woody vegetation, with lower density affecting such vegetation in arid areas and higher densities being required to affect such vegetation in areas receiving greater rainfall (Guldmond and van Aarde 2008). Therefore, impacts on vegetation may be site-specific, depending on rainfall.

3. Water provisioning and elephant population growth

The suspicion that water provisioning was a major factor that resulted in the rapid population growth of elephants in Kruger National Park, with attendant impacts on vegetation, was the main reason for the closure of a number of such water bodies during the 1990s. It is not easy to correlate water provisioning with elephant mortality rates and population growth, without long-term data; therefore, much of this has of necessity to be inferential. Artificial waterholes led to increased elephant densities (which is not necessarily the same as high population growth rate) in areas (such as in Hwange National Park) where there had previously been little or no water in the dry season (Chamaillé-Jammes *et al.* 2007b). This may not be true of areas that have sufficient water (for example, Kruger; Redfern *et al.* 2005). In Hwange, it was subsequently suggested, based on a very long-term dataset, that the interaction between the dry season waterhole-determined foraging range and population size controls the population size (Chamaillé-Jammes *et al.* 2008). One African study has even suggested that the excessive provisioning of water by spacing waterbodies too close to each other may result in **higher mortality** in elephants during drought (Walker *et al.* 1987).

4. Impacts on biodiversity

Any serious impact of elephants on woodlands would serve to alter the plant diversity, perhaps negatively. The African studies also point to possible competition between elephants and other wildlife species which may be detrimental to the latter. In Hwange, Zimbabwe, shifts in the timing of waterhole use during the drier years by some herbivores, suggesting competition with elephants for use of these water sources was found (Valeix *et al.* 2007), although all herbivores also spent more time at waterholes when elephants were present than when they were absent (Valeix *et al.* 2008). Even in large areas such as Kruger National Park (~20,000 km²), artificial waterholes were initially meant to increase rare antelope populations and also helped with rhino reintroductions, but were blamed subsequently for increasing the population sizes of common grazing species, increasing damage to vegetation and even declines of the rarer antelope species (see Owen-Smith 1996, Smit *et al.* 2007, Smit and Grant 2009).

It has to be noted that most studies on African savannah elephants have been carried out in large, semi-arid areas. For example, Etosha National Park, one of the three study areas of de Beer and van Aarde (2008), is over 22,000 km², larger than the largest elephant landscape we have in Asia. Therefore, the extent to which these large-scale patterns hold in Protected Areas of a few hundred square kilometres is a guess.

The Asian situation

In the case of Asian elephants, distance to rivers influences their presence during the dry season (Sukumar 1989, Lakshminarayanan *et al.* 2016). In the only formal study of the effect of artificial waterholes on elephant distribution in India, there was no effect of such waterholes on elephant habitat use (Lakshminarayanan *et al.* 2016). Apart from this, there are no data yet to make any recommendations. From personal observations, artificial waterholes in Nagarahole-Bandipur used by elephants are often on the way from a feeding area to a river/reservoir, and elephants do not spend much time at such waterholes. Therefore, the issue of the surrounding vegetation being used or destroyed is not expected to arise at this spatial scale. In African savannahs, because of sparse vegetation, there is a tradeoff between searching for water and vegetation (Redfern *et al.* 2003), resulting in an increased amount of time spent near vegetation if additional water sources are provided nearby. However, in deciduous forests of Asia with grass undercover, vegetation is not sparse and elephant distribution is not expected to change substantially at this scale, as confirmed by Lakshminarayanan *et al.* (2016). Moreover, even in the African savannah, there is one study at least that suggests that elephants are primarily associated with rivers and not waterholes (Smit *et al.* 2007).

To what extent these small waterholes affect elephant body condition and mortality and, thereby, the population growth rate, is not clear. Sukumar (2003) argued that lowered mortality of elephants (especially calves and juveniles) during the dry season through provisioning of water would result in a positive growth rate. Further, such positive population growth was undesirable in large, regionally abundant and viable populations of elephants that could absorb adverse conditions such as droughts, with the increased mortality reflecting natural processes. On the other hand, it was essential to artificially provide resources, including water, to small nonviable populations to reduce the risk of dry season (or drought-related) mortality and promote strong population growth rate in order for the numbers to climb to safe levels.

There is also a view that artificial waterholes in southern Indian forests are built for species other than elephants. This is almost certainly true of tiny (<100 sq. ft.) waterholes and probably true of some of the small waterholes. In addition, from personal observation, some waterholes are rarely used by elephants in Nagarahole-Bandipur, southern India. Differences in frequency of waterhole use was found in Yala, Sri Lanka, with perennial and, therefore, usually large (>50 ha when full) waterholes being preferred over seasonal, small (<50 ha when full) ones (Pastorini *et al.* 2010).

We do not have sufficient data on how small artificial waterholes influence elephant populations and the overall ecology in the Asian context. Here, one should add that we are talking about small artificial waterholes, and not very large ones such as the Kabini (in southern India) or Uda Walawe (in Sri Lanka) reservoirs. These large waterbodies very likely influence elephant ranging and behaviour, although more data are required on these also. In Kabini, high frequencies of

between clan dominance is observed, which is possibly a result of the reservoir (Nandini 2016), but has to be examined in the future. Aggregations of elephants from multiple clans at the backwaters (Nandini 2016) themselves are an indication of altered habitat use. In Uda Walawe, elephant body conditions were better during the dry season compared to the wet season because of fresh grass from the receding backwaters of the reservoir (Ranjeewa *et al.* 2018).



Fig: Elephants at the Kabini in Nagarhole Tiger Reserve, India @ Sandeep Kr Tiwari/AsESG

RECOMMENDATIONS

1. In the Asian context where a substantial proportion of the elephant populations is distributed in tropical moist habitat with a general abundance of surface water availability in streams and rivers, the need for civil construction work to create artificial waterholes is highly questionable. Additionally, numerous irrigation and hydroelectric dams in hilly areas impound huge volumes of water which is regularly accessed by elephants.
2. In the drier tropical habitats there may be a need for artificial water provisioning but this has to be based on site-specific considerations and broader management objectives.
3. Artificial water bodies would be certainly needed in the case of the smaller, (demographically) nonviable populations of elephants that need to be supported through lowering the chances of mortality and increasing the chances of strong positive population growth to viable levels. For a discussion on elephant population viability see Sukumar (1992, 2003) and Armbruster et al. (1999).
4. The efficacy of provisioning of water to large, locally abundant elephant populations, even in situations where water seems to “limiting” is questionable. In such situations, the opening of more and more artificial water sources should be discouraged.
5. In some situations, elephants come into conflict with agriculture primarily because they also need to obtain water from village tanks at night. Although this aspect has not been studied quantitatively, our observations show that in some places damage to agricultural crops may be “incidental” in the course of elephants traversing cultivated land on their way to water sources (rivers or village tanks). Would supply of water inside the forest itself contribute to mitigating the situation? This has to be scientifically studied at the site level before decisions are taken to create artificial waterholes.
6. Should some of the existing artificial waterbodies in Asian elephant habitats be closed? In the African savannah context, it has been suggested that waterholes should be spaced at least three times the distance animals normally travel for water daily in order to maintain heterogeneity and resilience in the system (Owen-Smith 1996). This distance between waterholes was worked out to be 12 km for elephants in Kruger (Smit *et al.* 2007). However, if waterholes are meant for other, smaller species, this would vary.
7. Owen-Smith *et al.* (2006) proposed that different water management measures be tried out and tested through adaptive management in southern Africa. Most Asian elephant range states do not have the luxury of space or elephant numbers to try out different measures. However, another recommendation of Owen-Smith *et al.* (2006) and Smit and Grant (2009) could be followed in some large landscapes: zoning areas as important for

elephants versus trees or other species and following whatever increases the population sizes accordingly.

8. Owen-Smith *et al.* (2006) also, importantly, point out that the “concept of a balance of nature is outmoded” and that, although fluxes are seen naturally in ecosystem dynamics, disturbances that may have been helpful or benign to populations in the past can be very disruptive when other conditions change and animals are constrained. In the context of Asia, this is particularly important as there continue to be other disturbances (than artificial water) within protected areas. In drought years, cattle are also allowed into several National Parks in India as a “compassionate gesture”, which increases the pressure on wildlife. Invasive plant species also decrease the amount of grass available to grazing species. Therefore, we are not dealing with a completely natural situation that, if left undisturbed, will return to a state of equilibrium. We are dealing with a disturbed situation, in which supplemental water is provided to wildlife as a buffer against the disturbance. Whether it is useful, detrimental, or of no consequence to elephants has to be studied in detail before concrete recommendations can be made.
9. If it is useful, how water should be provided is also a question to be examined. Digging borewells and depleting ground water is not the best option in the long term. Given the high density of waterholes in many parks, at least a stop on further waterholes is desirable.

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