

A Case History of Colonization in the Asian Elephant: Koundinya Wildlife Sanctuary (Andhra Pradesh, India)

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Introduction

Andhra Pradesh did not have elephants for the past 200 years (Syam Prasad & Reddy 2002). However, during the early 1980s, a small herd of elephants moved into the Kuppam and Palamaner forest divisions of Chittoor district in Andhra Pradesh from the Hosur-Dharmapuri forests of Tamil Nadu, ca. 60 km to its northwest (Fig. 1). An assessment undertaken during 1985-86 (Sivaganesan & Bhushan 1986) found the habitat to be sub-optimal and postulated that the elephants had moved into the area due to drought in their normal distributional range and that they would possibly move back to their original home during the next (favourable) monsoon. However, this did not happen, and later, more elephants migrated into the area during 1986 from the Bannerghatta National Park, Karnataka, which adjoins the

Hosur-Dharmapuri forests. The Kuppam and Palamaner forests were subsequently declared as a sanctuary, viz., Koundinya Wildlife Sanctuary (KWS) for the elephants. Some of the elephants that moved into KWS further dispersed ca. 100 km north into the Sri Venkateswara Wildlife Sanctuary-National Park (Andhra Pradesh) and ca. 40 km southwards to the Javadi Hills (Tamil Nadu).

The dispersal of elephants into Koundinya in the 1980s was among the first recognized (and highlighted) of elephant dispersals in India. With reports of dispersals emerging from other parts of India (e.g. Singh 2002; Sarma & Easa 2006), there was a need to assess the status of colonizing elephants. This would help policy makers and wildlife managers to understand and better manage such situations. Considering these, we

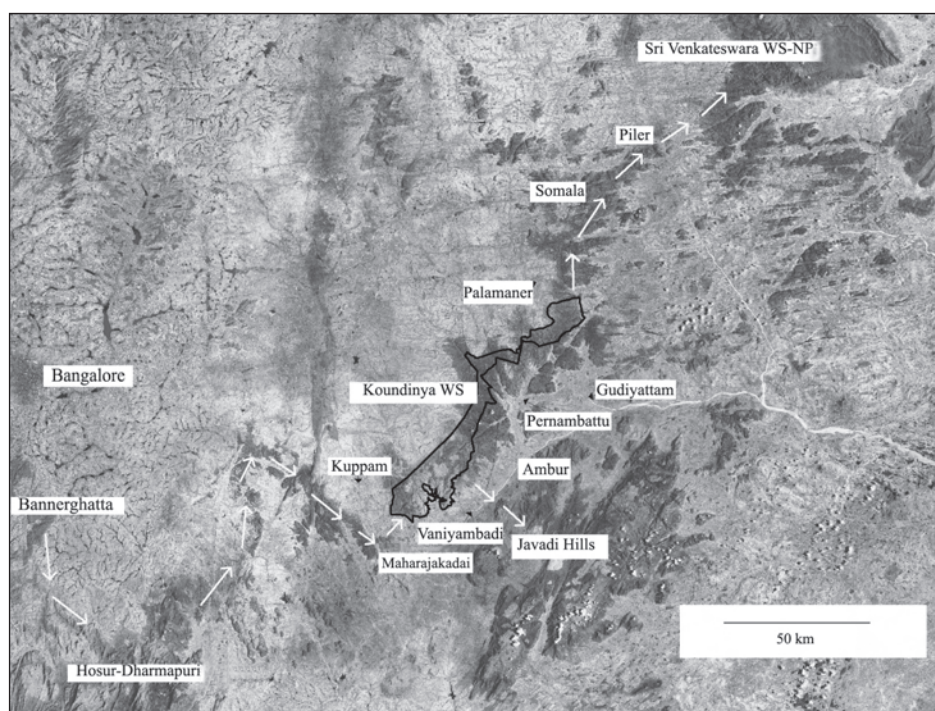


Figure 1. Dispersal route of elephants from Bannerghatta-Hosur-Dharmapuri to Koundinya and other sites.

undertook an in-depth study in KWS from Jan. 2005 to Dec. 2005 (Daniel *et al.* 2006), which would serve as a case study of colonization. In this paper, we trace the history of the colonization, analyse the past and present population and distribution of elephants in the area, and examine the conservation issues and long-term survival prospects of the elephants. The issue of human-elephant conflict is not discussed here, as it forms the basis of another paper (Manakadan *et al.* 2009).

Study area

KWS (12°39'–13°10' N and 78°29'–78°52' E), Chittoor District, Andhra Pradesh falls in the hill ranges of the Eastern Ghats, a broken and discontinuous line of mountains in peninsular India. KWS (357 km²) is linear in shape, running ca. 70 km north to south; the breadth varies from 1 to 15 km (Fig. 2). It has a periphery of about 224 km with 53 fringe and 8 enclosure villages, and is bordered by reserve forests of Andhra Pradesh or Tamil Nadu. The Sanctuary comes under two ranges: Palamaner in the north and Kuppam in the south. Palamaner Range has four blocks: Tekumanda, Musalimadugu, Mordana and Nellipatla. The Kuppam Range has six blocks: Naikaneri, Peddanaikdurg, Charagallu, Peddur Extension, Peddur and Kangundi.

The water sources in the Sanctuary consists of the River Palar, its tributaries the Malattar (or Kaigal) and Koundinya, from which the Sanctuary gets its name. The other water sources in the Sanctuary comprise of natural or manmade ponds or lakes, most of which are situated at the outskirts of villages. Rainfall is from the SW monsoon (June-August: 380 mm) and NE monsoon (October-December: 410 mm). The cold weather is from November to February with temperatures sometimes dropping to 10°C. Summer (March-May) is mild with maximum temperature of about 33°C (Anon 2004).

The vegetation comprises predominantly of Southern Tropical Dry Mixed Deciduous (Champion & Seth 1968) with trees of *Hardwickia binata*, *Chloroxylon swietenia*, *Albizia amara*, *Boswellia serrata*, *Anogeissus latifolia*, *Pterocarpus santalinus*, *Shorea* spp., *Diospyros* spp. and *Ficus* spp. The water courses are dominated by *Terminalia arjuna*, *Pongamia pinnata*, *Tamarindus indica*, *Mangifera indica* and *Syzigium cumini*. The vegetation varies widely in different areas as a result of terrain, soil, impacts of grazing, fires, woodcutting, and history of exploitation. Due to the past exploitation for timber and fuel, most of the trees in the Sanctuary are results of coppice growths or got established in the last 2-3 decades, hence their

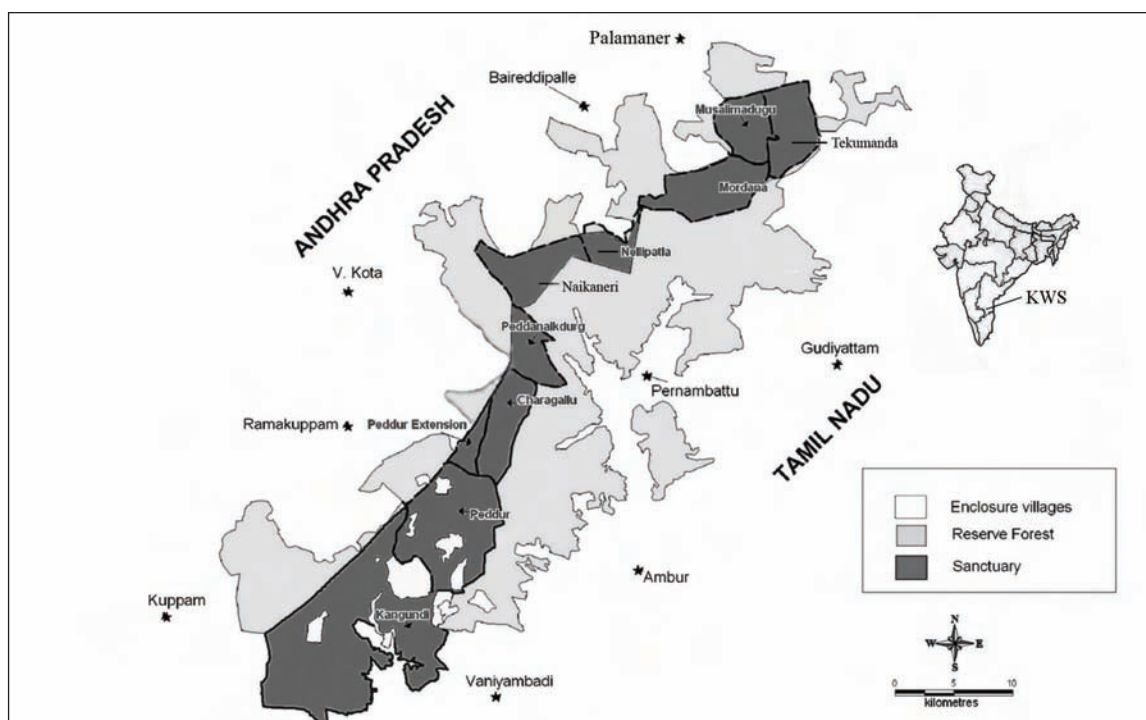


Figure 2. Map of the study area: Koundinya Wildlife Sanctuary.

overall small stature. The exotic *Lantana camara* bush has invaded most areas of the Sanctuary (Venkatayya 1972, 1974).

Methods

Data on the earlier population, distribution and movements of elephants was obtained from published literature, records available with the Forest Department, and from enquiries with local villagers, herdsmen and woodcutters. Interviews with locals were carried out along the reported dispersal routes from Hosur-Dharmapuri to KWS and KWS to Javadi Hills and SVWS-NP.

Current population, distribution and movements of elephants: Given the low population size, we did not use line transect or indirect sampling methods. With the exception of one or two males, the elephants mostly stayed together as a herd and it was easy to get an estimate of their number. We also relied on information from locals and elephant trackers of the Forest Department on the location of the elephants. All the sighting, signs or reported locations of elephants were mapped.

Results and discussion

Colonization, population and distribution

Migration of elephants into KWS: The first record of elephants in KWS was in March 1984 in the Kangundi block consisting of a herd of 2 bulls, 4 cows and a calf (Sivaganesan & Bhushan 1986; Syam Prasad & Reddy 2002). Two additional records: a dead 2-4 year old animal in the adjoining Tamil Nadu reserve forest and a 2-month old calf straying into a village were also reported (Sivaganesan & Bhushan 1986). These elephants were presumed to have originated from the Hosur-Dharmapuri Reserve Forests (ca. 2056 km²) of Tamil Nadu, situated about 60 km to the west of KWS (Fig. 1). Subsequently in 1986, another herd of 22 elephants moved into the area, reportedly from the Bannerghatta National Park of Karnataka (Sivaganesan & Bhushan 1986; Syam Prasad & Reddy 2002), which adjoins the Hosur-Dharmapuri forests to its south. Judging from the 24 deaths of elephants reported between 1987 and 2003; the numbers taken into captivity

(7) by the Andhra Pradesh, Karnataka and Tamil Nadu forest departments; those (5+) that tried to return to the Hosur forests; those that dispersed from KWS and colonized new areas; and the current total population in Andhra Pradesh, it is certain that more elephants had moved into the Koundinya area than reported. Tribal elephant trackers of the Forest Department report that elephants were earlier seen all over the over the Sanctuary unlike now, and the population was approximately 100 animals in the late 1990s but declined thereafter with deaths and dispersals.

Dispersal route of elephants into KWS: Surveys along the reported migration route of elephants into KWS from the Hosur-Dharmapuri-Bannerghatta forests revealed that the elephants after crossing the Krishnagiri-Bangalore highway near Rayakotta, moved in an eastward direction along the Eastern Ghats, passing by the villages Maharajakadai, Veppanapalli, Pungirithi, Kurivinayanapalli, Yakalnatham and Kallikovil near Kuppam. From there, the animals moved southwards crossing the Krishnagiri-Kuppam road to take a curvilinear route northwards to enter the Kangundi block of the Sanctuary near Mallanur (Fig. 1).

Dispersal route of elephants out of KWS: The first reported attempted dispersal of elephants out of KWS took place in December 1985, when the first colonizers crossed the Bangalore-Chittoor highway near Palamaner to enter the Punganur range towards the Sri Venkateswara Wildlife Sanctuary-National Park (SVWS-NP). This area is made up of semi-contiguous hills of the Eastern Ghats with crop fields and human habitation bordering it. The herd subsequently returned to KWS through the same route. In March 1986, the herd was again seen in the Punganur range (Sivaganesan & Bhushan 1986). According to reports, the herd returned to KWS subsequently. These preliminary movements to the northwest of KWS were probably exploratory in nature and cumulated in a herd of 23 animals making a final move during 1991, moving gradually further northwest along the hills of the Eastern Ghats through Chowdepalli, Somala, Sadum and Piler mandals till 1995 (Fig. 1). In 1995, they moved into the Easwaramala forests (Anantapur district) and

finally into their new home in SVWS-NP (Syam Prasad & Reddy 2002). However, there is a report that five elephants were already present in SVWS-NP in 1993 (Rao 1995), clearly confirming that there were unrecorded movements of elephants than reported earlier. The second recorded case of dispersal was in 1997, when a group of 10-13 animals migrated from the southern part of the Sanctuary into the Javadi Hills of Tamil Nadu (Fig. 1), passing through Ambur town during daylight hours. The third case of movement out of KWS was in 2002 and involved about a dozen animals that moved out of the Kangundi block in a westward direction through the Nadumuru Range in the direction of their original home. Five of these animals (3 cows, 1 sub-adult cow and 1 juvenile) were killed in a train collision at Ullukuri village near Hosur (source: Tamil Nadu Forest Department), the rest probably returned to the Hosur forests.

The known movements of bulls were as follows: In 2003, an adult bull ventured out of KWS and roamed northwest of Kuppam towards Kolar and then northwards towards Chittoor till it was captured and sent to the Tirupati Zoo. However, some opine that this bull did not originate from KWS but had come from the Hosur-Dharmapuri-Bannerghatta tract. In the mid-1990's, two sub-adult bulls were captured near Mamandur (outside SVWS-NP) due to intense human-elephant conflict (HEC). Another sub-adult bull moved all the way to the seacoast near Naidupet (Nellore district, Andhra Pradesh). All these captured bulls were sent to the Tirupati Zoo (Forest Department; Syam Prasad & Reddy 2002).



Figure 3. Past and present elephants distribution in the Koundinya Wildlife Sanctuary area.

Former distribution and movements of elephants in KWS: Plotting of data obtained during surveys and records available with the Forest Department showed that elephants ranged over a much wider area (992 km²) in the past than present (331 km²) – Fig 3. The former larger range can be attributed to the larger population size and more wanderings, as the animals were new to the area and some in the process of dispersing. In general, the elephants, except in the case of dispersals, kept to KWS and the bordering reserve forests of Andhra Pradesh and Tamil Nadu.

Current population of elephants in KWS: Census conducted by the Forest Department in 2000 gave an estimate of 74 elephants (60 in KWS and 14 in SVWS-NP). The 2002 census gave a figure of 73 (56 in KWS and 17 in SVWS-NP). We found the population in 2005 in KWS to number only 12 animals, consisting of 2 adult bulls, 1 sub-adult bull, 1 juvenile bull, 4 adult females, 1 sub-adult female and 3 calves. It appears unlikely that there has been such a drastic decline in elephant numbers from 2002 to 2005. The high estimate of the Forest Department is based on inappropriate methods and further complicated by poor logistics and difficult terrain. It is more likely that the elephant population started declining prior to 2000, resulting in the current low population. The decline would have resulted from multiple reasons like deaths, captures and dispersals out of KWS.

Current distribution and movements of elephants in KWS: The distribution and movement pattern of the herd in 2005 indicates a smaller range of ca. 331 km² (*contra* 992 km² in the past). The range of the males was not calculated, but in the case of the largest male it was identical to the ranging of the female herd as it was always with the herd. The other adult male was largely confined to the south where it raided crops regularly. It was never seen in the northern blocks beyond Naikaneri.

Overall, the present movement pattern in KWS depicted restricted ranging with more time spent in the Kuppam Range, and within the Range, in the Charagallu and Peddanaikdurg blocks, both of which have permanent water sources. Vegetation studies (Daniel *et al.* 2006) showed

that these areas offer better habitat (shade and food resources including bamboo) for elephants than most other areas, with some relatively much less undisturbed valleys.

Elephants avoided areas with steep hills and deep narrow valleys as in the upper Kaigal (Malattar) areas of the Naikaneri block. The hills in KWS generally have small trees and thus offer less shade, the probable reason why the western edges of the Peddur and Peddur Extension blocks were avoided by elephants. Additionally, the Forest Department took special efforts to drive elephants from these two areas, as these areas had several human settlements and were easily accessible. Elephants also avoided the heavily disturbed blocks of Kangundi, and Tekumanda and parts of Musalimadugu in the north.

Conservation issues

Small population size: The major problem for small populations in the short-term is inbreeding depression (Ralls *et al.* 1979; O'Brian *et al.* 1985). To overcome this, it has been suggested that a minimum effective breeding population of 50 individuals be maintained (Franklin 1980). In practice the Koundinya population of just 12 individuals, of which only 4 adult females and 1 adult male probably represent the founding population, does not represent a viable population even for the short term, especially as all the adult females are likely to be closely related. If elephants are to be conserved in this area, then there would be a need to infuse additional (unrelated) females and males into the population and also routinely remove related males from the population. Moreover, assuming adult sex ratios of 1: 4 (current) and 1:3, and the proportion of adults in the population as 45% and 50% (current is 42%), an effective breeding population of 50 would translate into a population of 136 to 177 elephants. The sanctuary does not have the space or the habitat to support such a population as the current population is itself dependent on crop raiding for survival.

Small sanctuary size and 'insularity': KWS is relatively small (357 km²) and is very poorly shaped having a length of ca. 70 km and a width

that varies from 1 to 15 km. It has a perimeter length of 224 km with 53 villages on its periphery and 8 enclave villages. Thus, most of the sanctuary is exposed to severe anthropogenic pressures (fuel wood and small timber removal, cattle grazing, forest produce collection and fires) resulting in most of the sanctuary being highly degraded and disturbed. KWS is also becoming increasingly 'insular' due to loss and degradation of adjoining reserve forests. A fragile or partly broken connectivity exists to the degraded areas, from which the elephants originated and also to other habitats to where elephants have dispersed from KWS in the past.

The eastern and southeastern edges of the Sanctuary that face the plains of Tamil Nadu are under severe pressure as they face a number of large towns (Gudiyattam, Ambur, Vaniyambadi and Jolarpettai), small towns and villages. Much of the reserve forests of Tamil Nadu that face the plains are almost devoid of vegetation, and these pressures are progressing into the KWS. A comparison of the past (1990) and recent (2003) vegetation cover of KWS revealed that dense forest cover has decreased from 135.01 to 95.67 km²; open forest decreased from 166.26 to 114.04 km² and scrub forest has increased from 91.34 to 112.66 km² (Daniel *et al.* 2008).

Another major problem is the exotic shrub *Lantana camara*, which is widespread throughout the Sanctuary, and is especially more abundant in degraded forests and non-crystalline soil. Besides being of no food value to elephants, it suppresses the growth of native species including grass and is a fire hazard (Ramesh Kumar 1994).

Decline in preferred browse species: Elephants are known to be destructive feeders and can damage their own habitat (Wing & Buss 1970, Sivaganesan & Kumar 1995) especially when aided by fires (Laws 1970, Wing & Buss 1970, Craig 1995). Annual mortality of 15% in *Zizyphus xylopyrus* and an almost total elimination of *Boswellia serrata* except in inaccessible hills have been reported in the Mudumalai Wildlife Sanctuary (Daniel *et al.* 1995; Sivaganesan & Sathyanarayana 1995). A decline in *Z. xylopyrus* and probably also declines in *Albizia lebbek*

and *Commiphora caudata* was evident in KWS (Daniel *et al.* 2006).

Scarcity of grass: Grass is an important component in the diet of elephants (McKay 1973; Sukumar 1989, 1990; Sivaganesan & Johnsingh 1995; Sukumar & Ramesh 1995; Santiapillai *et al.* 2003). In KWS, the available grass was either scarce or too short for elephants or comprised of largely unpalatable species due to overgrazing by livestock and thick undergrowth of *Lantana*.

Scarcity of shade: The Asian Elephant needs access to shade during much of the day (McKay 1973; Sukumar 1989; Sivasubramanian & Sivaganesan 1992; Daniel *et al.* 1995; Santiapillai *et al.* 2003). Shade availability was scarce over many areas in KWS due to the short stature of the trees due to the previous history of clear-felling and continued cutting by locals.

Water scarcity: In KWS, the Palar River and its tributaries dry up along most stretches during summer months. Water scarcity in the forests areas during summer and its availability around villages contributes to human-elephant conflict in KWS (Manakadan *et al.* 2009).

Fires: Fires, accidentally or intentionally lit by people, are a frequent problem in KWS during summer. Fires are more common in hilly areas due to the presence of the relatively tall *Cymbopogon* grass, which is largely not grazed by livestock.

Fires are known to reduce regeneration of trees and also grass availability in the dry season.

Human-elephant conflict (HEC): HEC is a major problem in KWS (Fig. 4), more so in the past (Manakadan *et al.* 2009). A team of trackers of the Forest Department drives elephants away from villages but with limited success. Use of electric fences has failed because of poor design and maintenance. Elephants have been killed illegally or captured to resolve HEC. Captures have focused on males and such removal does not help in maintaining the genetic diversity of the population. HEC remains the biggest problem for conserving elephants in KWS in the short term.

Conclusions

- 1) The population of KWS has declined significantly and the current population of 12 elephants with a founding population of just 5 potentially related elephants can not be considered as a viable population for long-term conservation. The persistence of elephants in KWS is due to the species long generation time, as the ill effects of inbreeding would not be evident in such a short time. To maintain a genetically viable population for short term conservation, a population of 136 to 177 elephants would be needed (assuming an effective breeding population of 50 individuals).
- 2) The relatively small size of KWS, the degraded state of its habitat and the continued



Figure 4. Elephants passing through a village enclave in the Hosur-Dharmapuri area.

severe anthropogenic pressure exerted on it due to its poor shape, a 224 km perimeter with 53 villages on its periphery and 8 enclave villages indicate that it will be hard to restore the habitat or to maintain its current status. The existing small population is already showing signs of having an adverse impact on the vegetation. The increasing insularity of the sanctuary will not allow meaningful expansion of the sanctuary or provide connectivity to other elephant habitats. Thus, it seems unlikely that this sanctuary will be able to support a viable elephant population (ca. 136 to 177) that is required for short term conservation.

3) Conserving elephants in KWS does not appear feasible and consequently conservation investments made in this area will ultimately generate little or no conservation benefits. Ideally, elephants should be removed from such small and unviable areas taking into account the problems of habitat, population, HEC, and the long-term conservation gains-losses from investments made on such areas. Sukumar (1995) had opined that, unless effective barriers can be created to confine them to forests, elephants from places like KWS need to be removed due to HEC problems. However this solution (barriers) takes into account only the HEC component creating a habitat island with no chance of immigration or emigration. Although the Government of Andhra Pradesh wishes to keep elephants here, the *raison d'être* of the Sanctuary, there is a serious need for re-evaluation of the decision taking into account the long-term conservation needs and the potential conservation gains or losses.

4) Removal of elephants would in itself be quite problematic if they are to be translocated to their native areas, as these will first need to be restored since habitat loss and degradation besides HEC are major problems in the Hosur-Dharmapuri-Bannerghatta forest areas (Daniel *et. al.* 2008). If they are to be moved to other (better) areas, then these areas would have to be evaluated, restored where necessary, would require well thought out and implemented plans to minimize HEC (especially loss of human life), besides a strategy to contain the elephants in the new area. In the past translocation of elephants has been done

(Lahiri-Choudhury 1991, 1992; Appaya 1992; Ramesh Kumar & Desai 1992; Jayewardene 1994; Daim 1995) but lack of systematic monitoring of translocated elephants has left us with no clear understanding of the process, its consequence and requirements. This needs to be changed and the entire operation from planning to execution to monitoring needs to be done systematically. Bringing the elephants of KWS into captivity should not be the first option as it does not address the larger question of dealing with all dispersing elephants.

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