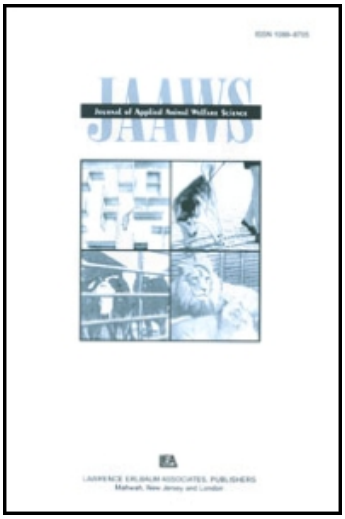

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Social Life of Captive Asian Elephants (*Elephas maximus*) in Southern India: Implications for Elephant Welfare

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Social Life of Captive Asian Elephants (*Elephas maximus*) in Southern India: Implications for Elephant Welfare

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Asian elephants in the wild live in complex social societies; in captivity, however, management often occurs in solitary conditions, especially at the temples and private places of India. To investigate the effect of social isolation, this study assessed the social group sizes and the presence of stereotypies among 140 captive Asian elephants managed in 3 captive systems (private, temple, and forest department) in Tamil Nadu, India, between 2003 and 2005. The majority of the facilities in the private (82%) and temple (95%) systems held a single elephant without opportunity for social interaction. The forest department managed the elephants in significantly larger groups than the private and temple systems. Among the 3 systems, the proportion of elephants with stereotypies was the highest in temple (49%) followed by private system (26%) and the forest department facility (6%); this correlates with the social isolation trend observed in the 3 systems and suggests a possible link between social isolation and abnormal elephant behavior separate from other environmental factors. The results of this study indicate it would be of greater benefit to elephant well being to keep the patchily distributed solitary temple and private elephants who are socially compatible and free from contagious diseases in small social groups at "common elephant houses" for socialization.

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The Asian elephant (*Elephas maximus* Linn.) is an integral part of the culture and mythology of India and elsewhere in Asia and was probably captured first about 4,000 years ago by the people of the Indus Valley civilization (Carrington, 1959). The Asian elephants in captivity used as work elephants constitute about 22–30% of the remaining Asian elephants (Lair, 1997; Sukumar, 2003). However, most of the captive populations across the world are not reproductively sustainable (Brown, Freeman, & Duce, 2006; Leimgruber et al., 2008; Vanitha, 2007) and need imports from the wild to sustain populations over the long term. In India, captive elephants are managed in almost all states (including numerous nonrange states) because they are an integral part of the country's cultural and religious landscape. According to Anonymous (2004), approximately 3,400–3,600 captive elephants are distributed across 23 states and union territories, including the Andaman and Nicobar Islands. A majority of these are found in the northeastern (55%) and southern (25%) states.

In Tamil Nadu, a southern state of India, elephants are managed in captivity by the state forest department, religious institutions such as Hindu temples, *mutts* (Hindu Religious Concerns), trusts, charities, mosques, and individual caregivers (owners) for various purposes. The Government of Tamil Nadu categorizes these elephants into three captive systems: (a) forest department captive elephants (managed at timber camps and zoos), (b) temple elephants (managed at Hindu temples), and (c) private elephants (managed by *mutts*, trusts, charities, mosques, and individual owners).

Elephants live in social groups in natural conditions. The social bond is very strong among females, who live in groups of related females and their offspring of both sexes (Moss, 1988; Vidya & Sukumar, 2005) and are led by the matriarch, the oldest female. The groups typically consist of six to eight individuals (Sukumar, 2003). Males leave the maternal herd around the age of 15. Male elephants lead mostly solitary lives. At times, however, the males join female herds for breeding; alternatively, or when not sexually active, they may join other males to form bachelor herds with weak social bonds (Desai & Johnsingh, 1995; Douglas-Hamilton, 1972; Sukumar, 1989).

Captive elephants, especially in the temple and private places, are maintained in conditions that do not closely resemble the social environment of their counterparts in the wild. For instance, a given temple or private owner generally maintains only one elephant (either a male or a female) in isolation; thus, the elephant has no opportunity to interact socially with conspecifics.

In the wild, Asian elephants roam extensively on a day-to-day-basis, averaging 6–8 km a day, and engage in different activities that change according to season (Baskaran, 1998). In captive conditions, especially in temple and private systems, elephants often lack opportunities for exercise. Lacking a complex physical environment, they are confined to small enclosures, where monotonous daily routines usually do not vary year-round (Krishnamurthy, 1998; Vanitha,

2007). Such confinement, with the absence of conspecifics, has been documented to affect the physiology and behavior of captive elephants and often leads to the development of abnormal stereotypic behavior (Clubb & Mason, 2002; Kurt & Garai, 2002). Stereotypy is defined as any movement that is performed repeatedly, is relatively invariant in form, and has no function or goal (Odberg, 1978). The common stereotypic behaviors performed by elephants in captive environments include weaving, head bobbing, trunk tossing, and pacing (Gruber et al., 2000; Rees 2004). This article compares the group sizes and proportion of elephants with stereotypic behaviors who were managed in three captive systems in Tamil Nadu during 2003–2005. Further, the article makes suitable recommendations for improving social interaction among conspecifics.

METHODS

Study Area, Animals, and Husbandry

The study was carried out in Tamil Nadu, a southern state of India. The state is rich in Hindu temples constructed by ancient kings of the Pallava, Chola, and Pandiya dynasties from 900 to 1750 CE.

Elephants are worshipped and held in high esteem in various Hindu religious practices, and many temples traditionally use one or two captive elephants to perform daily rituals. The daily rituals of elephants include 15–30 min of performing regular rituals to the deity, blessing devotees for a few hours in the morning and evening, and participating in occasional temple-festival processions. Otherwise, the elephants mostly remain confined in chains in small, barren, indoor enclosures eating green fodder (Vanitha, 2007). These elephants are not allowed to breed for religious reasons and were usually purchased from the Tamil Nadu Forest Department. Any elephant who turns out to be unmanageable in the temple system is transferred back to the forest department.

The private elephants, especially those owned by institutions such as *mutts*, charities, trusts, missions, and mosques, are also employed in activities similar to those of the temple elephants. The private elephants owned by individuals, especially elephant keepers (*mahouts*), who represent about 66% of those who own private elephants, are rented out to different places for a variety of uses:

1. Ceremonies such as marriages and temple festivals and
2. Commercial activities such as film shoots, VIP programs, and circus companies (on contract basis).

This work is highly seasonal. When there is no demand for their services, the elephants are often used for begging at shops/houses in the nearby bazaars/streets.

Shopkeepers and households offer food items such as fruits, vegetables, and rice instead of, or along with, money. As they cannot be used for begging in the same town every day, occasionally these elephants are taken to places as far as 30–40 km; this forces them to walk long distances, sometimes even in hot weather, which is contrary to the behavior of elephants in the wild (Baskaran, 1998). The private elephants owned by individuals are therefore highly mobile, unlike those owned by institutions or temples, and their ownership also changes frequently (Vanitha, 2007). Because owners consider elephants expensive or manage them in isolation, almost no breeding among private elephants occurs in Tamil Nadu.

The Tamil Nadu Forest Department has managed captive elephants since 1857, mainly in the timber camps of Mudumalai and Anaimalai wildlife sanctuaries (presently Tiger Reserves) for timber-hauling purposes (Krishnamurthy & Wemmer, 1995). However, since 1994 (after the ban on timber logging), the elephants have been mostly left in the nearby forest for free grazing, except for a few hours in the morning (06:00–08:00) and evening (16:00–18:00), when they provide rides for ecotourists. There are two permanent camps at both Mudumalai and Anaimalai, located inside the forested area. The elephants are brought to the camps every day (both morning and evening) for bathing, supplementary feed, and veterinarian inspection; they are then left to return to the forest for grazing. These elephants are well known for their breeding (Krishnamurthy, 1995; Sukumar, Krishnamurthy, Wemmer, & Rodden, 1997). In addition, the department manages a few elephants at Arignar Anna Zoological Park (AAZP), Chennai, for public education and entertainment. The zoo receives orphan calves quite often, and the forest department transfers the zoo elephants to timber camps and vice versa on a rotating basis.

Data Collection

Through an extensive survey, data on the number or group sizes of captive elephants managed at each facility were collected from the following:

1. The Tamil Nadu Forest Department: the timber camps in Mudumalai and Anaimalai wildlife sanctuaries and AAZP, Chennai;
2. Hindu temples; and
3. Private owners.

In total, the study surveyed 80 facilities from private ($n = 34$), temple ($n = 41$), and forest department ($n = 5$) systems. During the survey, the study recorded details of age and sex of each elephant by checking with the keepers (*mahouts*) and by verifying the studbook or register of records. Where proper age records were not available, the age was estimated by employing the shoulder-height method of Sukumar, Joshi, and Krishnamurthy (1988) for elephants caught or

rescued from the wild by the forest department or those bought by private and temple authorities. In addition, presence or absence of stereotypic behavior was assessed by the authors through direct observation using a focal sampling method (Altmann, 1974) on 135 elephants from all three systems and also by confirming the same with the concerned *mahouts*. The direct observations were carried out during the extensive survey for a period of 5–8 hr in different hours of the day (between 6 and 9 hr, 12 and 15 hr, and 16 and 18 hr) while performing various daily routines for a period of 1–2 days. In general, more observations were made, especially while the elephants were chained without fodder, as captive elephants are known to perform stereotypies under such conditions (Gruber et al., 2000; Rees, 2008). Although such biased observation may result in overestimation of stereotypic duration, it shows whether or not a given elephant performs stereotypies for the assessment carried out. Apart from the direct observation of the private and temple elephants at their facilities, additional observations were made at the captive elephant-rejuvenation camps, conducted especially for the temple and private elephants at Mudumalai wildlife sanctuary during the winter seasons (December) of 2003–2005 for further confirmation of stereotype prevalence. Criteria used to designate an elephant with stereotypic behavior(s) included multiple performances of any one stereotypic behavior and a combination of stereotypic behaviors (Gruber et al., 2000; Ress, 2004) during the observation time. Criteria also include confirming the following with the elephant keepers: (a) occurrence (presence/absence), (b) time of day, (c) duration (start/finish), and (d) type of stereotypic behaviors. The animals in the study exhibited three different stereotypic behaviors: (a) weaving, (b) head bobbing, and (c) pacing. These behaviors are defined as follows:

1. Weaving: The classical form of weaving behavior consists of swaying the body from one side to the other and swinging the trunk.
2. Head bobbing: This consists of repeated up-and-down or forward-and-back rocking of the head while standing still.
3. Pacing: This consists of moving a front leg from one side to the other or hind leg forward and back and swinging the trunk while standing still.

Data Analysis

Mean group size was arrived at for each system separately based on group sizes observed in all facilities of a given system. The mean group size estimated among the three systems was tested using one-way ANOVA and between systems using a post hoc multiple comparison test (DMRT). Similarly, group composition was computed for various group sizes in each system. The number of elephants showing stereotypic behavior in each system was tested using proportion test.

Locations where "common elephant housings" could be established were identified using spatial distribution data on elephant locations (collected using Global Positioning System) and by establishing buffers in a radius of 3–4 km around an elephant location, where elephants are closely distributed. The analysis was carried out using computer software Geographical Information System (Arc View 3.2).

RESULTS

Group Size Distribution

Among the three systems, group sizes of elephants ranged from 1 to 15 individuals, with solitary condition being more frequent than large group sizes (Figure 1). Mean group sizes estimated for the private ($M = 1.3$, $SD = 0.72$, $n = 34$), temple ($M = 1$, $SD = 0.22$, $n = 41$), and forest department ($M = 10.4$, $SD = 4.45$, $n = 5$) varied significantly ($F = 157.4$, $df = 2$, $p < .001$). A DMRT showed that the forest department managed the elephants in significantly larger

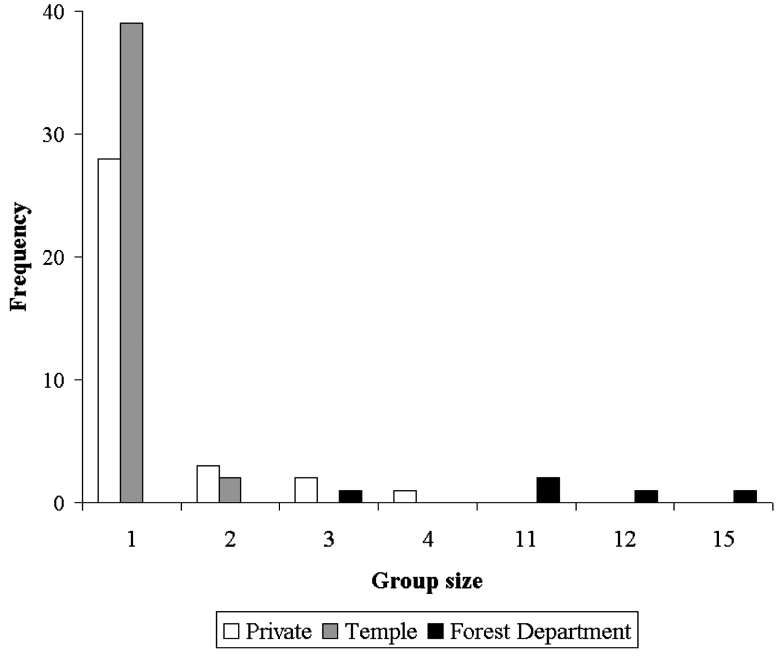

FIGURE 1 Distribution of elephant group sizes managed in three captive systems in Tamil Nadu, Southern India, during 2003–2005.

groups than the private and temple systems; the group sizes of elephants in the private and temple systems did not differ statistically ($p > .05$). However, most of the individually owned private facilities that managed the majority of group-living elephants (2–4 individuals) in this system take solitary elephants away for work for days or a week. Thus, these elephants may not have conspecifics to socialize with all the time.

Group Composition

Among the three systems, only the forest department managed elephants in larger mixed groups with access to adult males, which mimics their social nature in the wild (Table 1). The timber camps at Mudumalai and Anaimalai hosted 49 elephants at four facilities/locations with representation from all age and sex classes. These elephants were allowed to mix in various activities such as foraging, resting, and socializing. The groups consist of both related and unrelated individuals who can get along well with other individuals. Cow elephants with a young calf or in peak pregnancy were always accompanied by an allomother, an experienced adult female, to care for the young calf or assist while calving. Bulls from captivity, as well as from the wild, fathered the captive-born babies in the timber camps.

AAZP had three elephants: a captive-born individual and two orphans rescued from the wild (one subadult male, one subadult female). In addition, AAZP had an orphan calf. Because the forest department transfers the zoo elephants to timber camps and vice versa on a rotational basis, the zoo elephants also have chances to live and breed in larger social groups at the timber camps.

On the contrary, there was only a single elephant, usually an adult female (>60%), managed in isolation in more than 95% of the temples and in 82% of the private (Table 1) establishments. All the temple elephants lived alone or with a conspecific of the same sex. There were temples with two elephants (adult females or an adult female with a subadult female); however, they were not allowed to socialize and were tethered away from each other.

Stereotypic Behavior Prevalence

Of 135 elephants sampled across the three systems, the proportion of elephants with stereotypic behaviors was the highest in the temple system (49%), followed by private establishments (26%), and the lowest in the forest department captive facility (6%).

The elephants who exhibited stereotypic behavior in the forest department facility were those returned from the temple ($n = 1$), an orphan transferred from the zoo to the timber camp, and a captive-born individual transferred

TABLE 1
Group Sizes and Age/Sex Composition of 140 Elephants Managed in Three Captive Systems in Tamil Nadu During 2003–2005

Management Systems (*n* = *No. of Elephants*)	*Group Size* (*No. of Elephants*)	*No. of Facilities* (%)	*No. of Facilities With a Solitary Individual*				*No. of Facilities With More Than One Individual*				
			am	*af*	*saf*	*jm*	*af*	*af & saf*	*af, saf, & c*	*saf, sam, & c*	*In Social Herd With Access to am*
Private (*n* = 44)	1	28 (82)	2	21	4	1	—	—	—	—	—
	2	3 (9)	—	—	—	—	3	—	—	—	—
	3	2 (6)	—	—	—	—	—	1	1	—	—
	4	1 (3)	—	—	—	—	1	—	—	—	—
Temple (*n* = 43)	1	39 (95)	2	25	12	—	—	—	—	—	—
	2	2 (5)	—	—	—	—	1	1	—	—	—
	3	—	—	—	—	—	—	—	—	—	—
	4	—	—	—	—	—	—	—	—	—	—
Forest Department (*n* = 53)	1	—	—	—	—	—	—	—	—	—	—
	2	—	—	—	—	—	—	—	—	—	—
	3	1 (20)	—	—	—	—	—	—	—	1	—
	>10	4 (80)	—	—	—	—	—	—	—	—	4

Note. am = adult male; af = adult female; saf = subadult female; sam = sub adult male; jm = juvenile male; c = calf.

from the timber camp to the zoo. The number of elephants with stereotypies across the three systems varied significantly ($\chi^2 = 24.494$, $df = 2$, $p < .001$). Further, the proportion test revealed that the observed proportion of elephants with stereotypies was significantly less in the private ($\chi^2 = 8.3$, $df = 1$, $p < .01$) and forest systems ($\chi^2 = 39.92$, $df = 1$, $p < .001$).

DISCUSSION

Sociality evolves when the net benefits of close association with conspecifics outweigh the costs of (a) competition over access to resources and mating opportunities, (b) exposure to infection, and (c) increased conspicuousness to predators (Krause & Ruxton, 2002; Silk, 2007). The elephant social structure and cooperative behavior may have evolved partly to improve the survival chances of their offspring in the expensive environment (large areas with diverse biotic and abiotic factors) by protection against predators and parasites or allomothering (Gadgil & Nair, 1984; Lee, 1991; Schulte, 2000). Although such forces are eliminated in captivity, captive elephants have been observed to display a repertoire of behaviors similar to that of their counterparts in the wild (Adams & Berg, 1980; Schulte, 2000). Among the three captive management facilities, only the forest department managed the elephants in larger social groups with access to adult males, especially at its timber camps. Gadgil & Nair report the social behavior of free-ranging groups of tamed elephants from the timber camps to be similar to those of wild elephants. Most of the temple (95%) and private (82%) facilities maintained only single elephants, predominantly females, which is not suitable for their social well being. A few temple facilities manage two elephants, who, because they were donated and managed by different agencies, were not allowed to socialize. This was due in part to lack of cooperation among the *mahouts* and in part to concerned authorities' lack of awareness about the social life of elephants.

Moreover, a large proportion of the elephants in the temple and private institutional facilities in the state stay in chains for most of the day, remaining in their small, barren, indoor enclosures. No outdoor enclosures are provided, and provision for exercise is inadequate (Vanitha, 2007). The captive elephants in the forest department, especially at the timber camps, had the lowest proportion of stereotypies. Managed in seminatural conditions in larger social groups, these elephants spent relatively less time in chains than did their counterparts in temple or private individual facilities. It is important to note that all three elephants who exhibited stereotypies in the forest department system were (a) returned from the temple, (b) transferred from the timber camp to the zoo (at juvenile stage), or (c) transferred from the zoo to timber camp. Nevertheless, none of the wild-caught or captive-born individuals (at the timber camps) who were managed

only at the timber camps had, developed, or performed stereotypies indicating development of stereotypies either at the temple or the zoo, where they were not managed in the natural conditions found in the timber camps, either free from chain or in larger social groups. The effect of past husbandry practice in their earlier facilities could explain why individuals who returned to, or transferred from, temple and zoo continue to perform stereotypies at the timber camps (as reported elsewhere; Rees, 2008).

Therefore, the higher proportion of elephants with stereotypic behavior in temple and private facilities compared with elephants in the forest department system could be attributed to the observed more extensive social deprivation compounded by prolonged chaining in their small, barren, indoor enclosures (Gruber et al., 2000; Kurt & Garai, 2002). By denying elephants adequate space, captive facilities not only severely restrict an elephant's ability to exercise but also take away an enormous source of mental stimulation needed for the basic well being of such a highly social and intelligent individual (Poole & Granli, 2009). For social animals like elephants, even providing luxurious artificial conditions without the opportunity to be with their conspecifics will not satisfy them psychologically. Garai and Kurt (2006) state that in the past the importance of sociality for captive animals was significantly neglected. Only in the last few years have modern zoos started to understand that there is more to an elephant than eating, digesting, and walking; to maintain well being, an elephant needs other environmental factors, including socialization with appropriate conspecifics.

The Association of Zoos and Aquariums (AZA) recommends that all captive elephant facilities manage at least three females (AZA, 2003), and the British & Irish Association of Zoos & Aquariums (BIAZA) insists on the institutions keeping a minimum of four cows older than 2 years (BIAZA, 2006). A recent study that examined the social structure of the global zoo populations estimated that 5.5% of the elephants housed in zoos (as of October 2006) are kept without any companion of the same species. BIAZA suggested that zoos failing to comply with the minimum number of captive elephants should either increase the elephant group sizes or phase out the keeping of elephants (Rees, 2009). Because the elephant's basic social unit is a family unit consisting of related females and their offspring, it is important to replicate this and to maintain related individuals together as recommended by AZA and BIAZA. If this is not possible, keeping socially compatible unrelated individuals together would improve the psychological situation of the social species better than a solitary condition; studies on captive elephants show that even unrelated individuals develop some bonds (Gadgil & Nair, 1984; Garai, 1992; Schulte, 2000; Rees, 2009). Given the limited purpose of hosting captive elephants in the temple and private establishments and limitations on space (excluding the larger Hindu temples), it may not be fea-

sible for every facility to manage the elephants in large groups. Therefore, keeping some private and temple elephants, who are presently managed in isolation, together in common elephant housing, at least in areas where the captive elephants are densely distributed within a 3–4 km^2 area, would fulfill their social needs. At present, both the temple and private elephants in Tamil Nadu are distributed patchily in some cities and towns like Madurai, Palani, Tiruchirapalli, and Kumbakonam that host historically important Hindu temples. One way to create a social environment for them is to establish "common elephant housings" to manage the patchily distributed elephants together in small groups at specific central locations. Based on the distribution of temple and private elephants in Tamil Nadu, six regions around which large numbers are distributed have been identified for establishing such common housing shelters: Kumbakonam, Tiruchirapalli, Palani, Madurai, Peraiyur, and Tirunelveli (Figure 2).

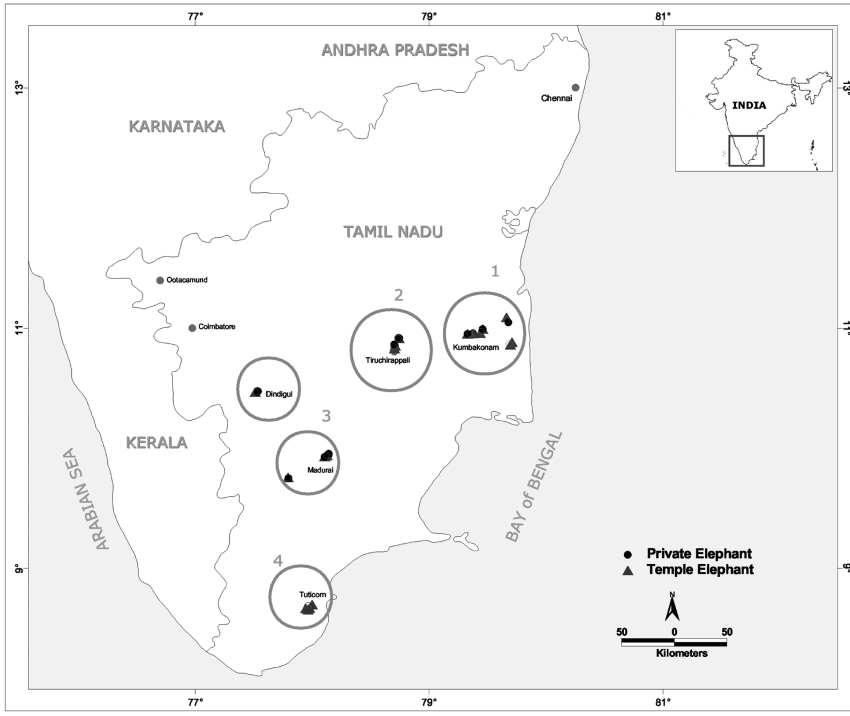

FIGURE 2 Map of Tamil Nadu, India, showing the places of clumped distribution of the temple and private elephants that could be managed as social groups in common elephant housings.

Figure 3 shows the probable locations of common elephant housings in each of these regions where isolated elephants in a 3–4 km radius could be placed together. Criteria specified central locations relatively close to many temples and private places; thus the elephants may be easily taken on foot to their respective places in the morning and brought back in the evening on a daily basis. The elephants would maximize their exercise requirement by walking 4–6 km a day and socializing with their conspecifics. Common elephant housing could reduce the percentage of elephants living in a solitary state to 52% from the present 77% estimated during the study period. Thus, almost half the elephants (48%) in these two systems could have one or more conspecifics with whom to socialize compared with the existing one fourth of the elephants (23%) who live in groups.

Such changes in the management of private and temple elephants will accomplish the following:

1. Provide a chance for the elephants to socialize with their conspecifics;
2. Ensure and enhance sufficient exercise (walking to temple and back to common housing every day) for the temple elephants, preventing obesity, arthritis, and behavioral problems like stereotypies (Vanitha, 2007);
3. Enable maintenance of standard diet, housing, and sanitary conditions;
4. Enhance veterinary care as it is easier for veterinarians to visit a limited number of localities periodically; and
5. Bring opportunities for breeding at common locations.

It may be difficult initially to take individuals from the social groups of common elephant houses separately for their daily routines; however, it would become easier as they get acclimated to similar routines. There have been practice sessions for individuals from the timber camps' larger social groups and the smaller groups of privately owned elephants on being taken out regularly for ecotourism rides and commercial work.

The proposed common elephant housing is easier to implement for the temple elephants because most of the popular temples that own elephants are managed by the same government department: Hindu Religious and Charitable Endowments (HR&CE). However, if we consider the amount of psychological stress the complex social animals undergo in captivity without socialization with conspecifics for a long life span of more than 50 years, and that most of the Hindu temples in the cities have leased out space for commercial purposes, the establishment of common elephant housing to keep the private and temple elephants together is not an impossible task; it is only a question of drawing detailed guidelines by policymakers (Project Elephant, Government of India, state Forest Department, and HR&CE) and conservation communities (veterinary experts and elephant biologists). Necessary space and financial support for the establishment and maintenance of infrastructure for the common elephant hous-

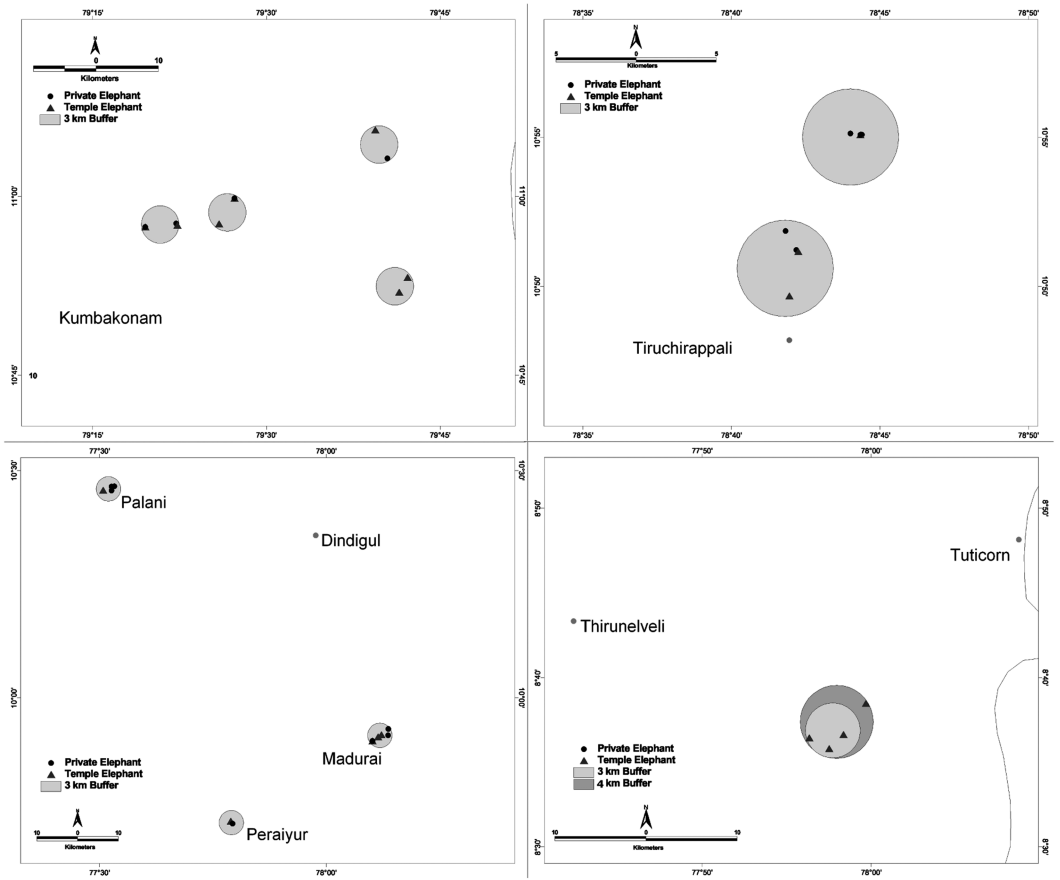

FIGURE 3 Map showing the number of temple and private elephants within 3–4 km buffer to establish common elephant housings.

ing could be met by the government agencies (HR&CE, Government of Tamil Nadu and Project Elephant, Government of India). The day-to-day maintenance cost of the elephants could be taken care of by the individual temple and private facilities that keep their elephants in a given common elephant house.

The new common facilities may not be suitable for all elephants. Elephants who are socially incompatible, do not get along with unrelated conspecifics, or are aggressive and may injure others should not be allowed to join the new common facilities; nor should elephants with contagious diseases such as tuberculosis, which can spread to others.

A detailed experimental study quantified the aggression and stress level in different methods of introduction to forming the social grouping for elephants (Burks et al., 2004); an appropriate method of introduction suggested by such a study should be adopted to reduce the level of aggression and stress among the elephants to be grouped. At present, a few captive elephants from the timber camps of Mudumalai or Anaimalai wildlife sanctuaries or orphans rescued from the wild are being displayed at the AAZP, Chennai. To some extent, elephants from the timber camps are related, as almost two thirds of the present stock is captive-born (Vanitha, 2007). Nevertheless, a special effort is needed to ensure that closely related elephants—mother and calf or elephants belonging to the same mothers—are selected for display at AAZP. The AAZP has to house a suitable experienced adult female as an allomother to take care of/interact with the orphan calves brought from the wild as such interactions are essential in shaping the behavior of young elephants (Lee, 1991; Lee & Moss, 2009).

CONCLUSIONS AND RECOMMENDATIONS

The elephant is a social animal. Except for the forest department, the majority of private (82%) and temple (>95%) facilities maintain a lone elephant in isolation. Thus, there is a strong need to keep patchily distributed temple and private elephants in small social groups in common elephant houses for socialization with their conspecifics for better animal welfare.

The Tamil Nadu Forest Department manages the elephants in a semiwild condition in captive facilities, especially at the timber camps; thus this population is globally recognized as the best bred in captivity. However, it is important to ensure that the few captive elephants housed at AAZP, Chennai, on a rotational basis from the timber camps, are closely related individuals.

Any zoo in India that manages/receives orphan calves from the wild also needs to house a suitable, experienced adult female to take care of/interact with orphan calves.

Basic awareness programs on elephant biology, behavior, and social life need to be conducted for the owners/*mahouts* of private elephants and author-

ities/*mahouts* of temples to improve the quality of managing captive elephants and maintaining their welfare.

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