JoTT Review 3(6): 1826–1836

Captive elephants – an overview

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Date of publication (online): 26 June 2011
Date of publication (print): 26 June 2011
ISSN 0974-7907 (online) | 0974-7893 (print)

Editor: April Yoder

Manuscript details:
Ms # o2620
Received 01 November 2010
Finally accepted 20 May 2011

Citation: Riddle, H.S. & C. Stremme (2011). Captive elephants – an overview. *Journal of Threatened Taxa* 3(6): 1826–1836.

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Abstract: Currently a significant portion of the world's elephant population is in captivity, mainly in Asia. Elephants have a long history of captivity in both Africa and Asia, and have adapted to many environments. Today, due to evolving needs and philosophies, some changes have occurred in the use of captive elephants, and debate about their welfare and management is increasing. To address this, several countries are developing higher standards of care via policies and guidelines; unfortunately most elephant range countries do not have a national strategy concerning their captive elephant population. Challenges in elephant medicine are always present, yet there is a lack of standardized requirements for veterinary care in elephant range countries, and the ability of veterinarians to treat elephant diseases is often limited. In recent years, much has been learned about elephant physiology, biology, and communication from captive elephants, and this knowledge supports management decisions affecting both captive and wild populations. Captive elephants present important educational and fundraising opportunities in support of conservation, but these are often not fully leveraged. Future considerations include implementing changes to improve staff support and training, establishing comprehensive registration of all captive populations, and ensuring that captive management does not negatively impact wild elephant populations.

Keywords: Captive elephants, conservation, education, management, policies, staff training, standards, welfare.

INTRODUCTION

This paper presents a general overview of captive elephants - history, current management status and strategies, contributions via science and education, and considerations for the future.

Captive elephants are those in direct human care and control. The words "domestic" and "domesticated" have been used to describe captive elephants; however, that characterization is not necessarily correct. While historical records indicate that elephants have been closely linked with humans for thousands of years (Sukumar 2003), they have not been selectively bred by humans for certain traits, as is the case with other animals defined as "domestic" such as dogs, cats, or cattle. Furthermore, the majority of captive elephants in the world today were originally born in wild herds and subsequently captured.

Currently there are between 30,000 to 50,000 Asian Elephants *Elephas maximus*, and about 500,000 African Elephants *Loxodonta africana* worldwide (Riddle et al. 2010). Regional studbooks and government estimates (AsERSM 2006) suggest that approximately 12,000–15,000 of the world's elephants are living in captivity, and most of these animals are in Asia. Approximately 25% of the entire Asian Elephant population is currently in captivity (Desai 2008), and that number is likely higher. The largest single population of captive elephants is in India and numbers about 3,400 individuals (AsERSM 2006). According to regional studbooks, there are fewer than 1000 captive African Elephants worldwide, and most

of these are housed in non-range countries.

Elephants have adapted to a wide variety of captive environments: in ancient times they were implements of war; more recently they work in forest camps, are venerated in temples, and displayed in zoological facilities (Lair 1997). Today, due to evolving needs and philosophies, changes are occurring in the uses of captive elephants around the world, and the debate about their welfare and management is increasing. In a growing number of countries, higher standards of elephant care and management are being addressed by identifying welfare parameters (Varma 2008), and developing policies and guidelines suggesting more opportunities for socialization, larger spaces with natural substrates, and better handling techniques (Olson 2004). Overall there is a need to recognize concerns about captive elephant care and welfare, and to implement improved standards of husbandry, handling, and management allowing captive elephants to achieve a maximum of their natural behaviors and social interactions. As elephants are long-lived animals, it is probable there will be elephants in captivity for many years in the future, even without adding large numbers of new animals to the existing captive populations. Therefore it is essential that long-term strategies addressing the need for and care of captive elephants be developed and implemented without further delay.

THE MANAGEMENT OF CAPTIVE ELEPHANTS

Historical perspective

Elephants have had a close connection with mankind for thousands of years. The first known use of captive elephants in both Africa and Asia was for war. Their successful military use spread as far as Europe by 331 B.C. (Scullard 1974). In times of war, elephants carried heavy loads and were used to charge enemy lines in combat. With the advent of gunpowder warfare in the 15th century A.D., the use of captive elephants as war animals began to diminish.

In Asia, ancient Sanskrit texts from India document the region's long-standing association between humans and elephants, where elephants were first captured and trained for warfare and as beasts of burden. One of these early texts, the "Arthasastra", provides some detail about elephant capture, training and care, as well as use in war (Sukumar 2003). Large numbers of captive elephants were kept by Asian rulers: during the Mughal period in India in the early to mid 17th century A.D., there were tens of thousands of captive elephants in the empire, illustrating that many elephants still lived in those regions. After the Mughal period, the use of elephants in battle waned, but their functional use transporting military troops and supplies in Asia continued into the 20th century (Sukumar 2003).

During ancient times in Africa, elephants were captured and trained by the Egyptians and Carthaginians as implements of war (Scullard 1974). After about 500 A.D., there are no further records of elephants being captured for use in battle in Africa. In early 1900, the former Belgian Congo (now Democratic Republic of the Congo) established a program to capture and train African Forest Elephants *Loxodonta africana cyclotis* for plowing fields and pulling wagons to move soil and rocks for road construction (Laplume 1911). This practical use of elephants was thought to have little future as the capture and training process required long delays, was costly, and risky (Laplae 1918). Nevertheless, the capture and training program continued until the country's independence in the 1960s, and anecdotal information indicates that there were still trained elephants in the region through the 1970s.

Captive elephants have also been displayed in menageries, zoos, and circuses since antiquity. Some of the earliest recorded zoo elephants were acknowledged as being kept by a Syrian king in the 9th century B.C., having been captured in Syria, which was then part of their natural range (Sillar & Meyler 1968). Elephants were brought to Rome around 250 B.C. to be used in combat spectacles involving gladiators and wild animals, and to participate in circus, the first such documented use (Sillar & Meyler 1968). Across their African and Asian range and into Europe, captive elephants were part of menagerie type exhibits for centuries. In contrast, the first captive elephant to arrive on the American continent was a single animal brought to New York in the late 1700s from India (Goodwin 1951).

Modern day management

Presently, the majority of captive elephants come from capture programs. While the large scale capture

of elephants for captivity has declined in very recent years, both legal and illegal captures continue in some countries. Some elephant range countries have used capture as a tool to address increasing conflicts due to the re-settlement of local people in or near elephant habitat (Basrul et al. 2001). This strategy can cause welfare issues for the captured elephants when husbandry conditions are under-funded, and policies guiding the utilization of these elephants are inadequate (Stremme et al. 2007). In other countries, capture was one component of management policy to control overpopulation through culling of wild elephants in areas with limited space, such as within fenced parks (Balfour et al. 2007). These various types of sanctioned large-scale captures have diminished significantly; currently most legal captures are of individual problem elephants that repeatedly come into conflict with humans, causing damage, injury, or death.

Today in Africa, captive elephants are primarily used for tourism activities such as elephant back safaris, and for exhibition in zoos and circus. The majority of these animals are Savanna Elephants *Loxodonta africana africana,* with very few Forest Elephants still in captivity. Less than half of the 37 African Elephant range countries manage a captive elephant population, and these are mostly southern African nations. A very small number of elephants are in zoos in northern African non-range countries. Many of the captive elephants in Africa today came from culling operations (Cadman 2007). In recent years, culling as a conservation management tool has been practiced much less frequently in Africa, and where there is an interest to supplement captive populations in this region, captive breeding programs are being established.

Currently all 13 Asian Elephant range countries have a captive population. However, the numbers, uses, and need for captive elephants differ from country to country (AsERSM 2006). While some uses of captive Asian Elephants have become obsolete (i.e. as war animals), other uses are increasing, such as elephant-back patrols to monitor protected areas or to mitigate human-elephant conflict (HEC) (Azmi et al. 2006). Within Asian range countries captive elephants are managed in a variety of environments; their ownership and management is by government agencies, commercial organizations (i.e. tourist resorts, circus), religious institutions, and private individuals. They are used for a variety of purposes: for practical work, i.e. logging, transport, patrolling, HEC mitigation, and for cultural activities, i.e. tourism, ceremonial, display, performance, and education.

Historically, logging was one of the most locally important economic uses of captive elephants in Asia; this reached a peak in the mid 19th century (Sukumar 2003). Today, due to a ban on logging in several Asian countries, the use of elephants for this type of work has considerably diminished. In countries where large numbers of captive elephants were used for this purpose, some former logging elephants now provide tourism activities such as rides and shows (Godfrey & Kongmuang 2009); however, the lack of this specific work has forced other elephants to be used for questionable purposes such as begging in cities, thereby increasing welfare concerns (Angkawanish et al. 2009). Presently a few Asian countries still rely on logging elephants, and consideration should be given to the potential of illegal trans-border movement of captive elephants from countries who do not use these animals for logging to countries who do.

In non-range countries, captive elephants are primarily used for exhibition, performance, and education in zoological institutions, commercial organizations (circus), and private facilities. As elephants in these countries are largely for display, over the past decade the focus has been on developing management systems. These systems originate from two basic concepts: free contact management where staff and elephants share the same space, and protected contact management where staff and elephants are separated by some form of barrier (Olson 2004). Currently most non-range facilities manage their elephants using a combination of these two basic systems, however most adult male captive elephants are managed in a protected contact system, in contrast to the free contact system used with adult males in range countries. Variables such as gender, age, and disposition of the exhibited elephants, staff expertise, and enclosure design and size all contribute to the management style used by a facility. Every management system has inherent rewards and difficulties for the exhibited elephants and staff, and this needs to be carefully considered when developing elephant programs.

There is a need to better leverage opportunities in

these small non-range country elephant populations for study, public awareness, fundraising, and advocacy in support of the conservation of wild elephants and their habitats. Non-range elephant exhibitors at times overestimate the effect their outreach programs and fundraising have on conservation and on the general public's awareness of issues and challenges facing elephants today. The impact of such programs should be constantly evaluated and improved to ensure successful public education and awareness, as well as effective support of conservation actions.

Management strategies

The management of captive elephants is a controversial issue; there is a great deal of debate as issues of ideology and ethics are easy topics upon which to disagree. However, the continued discussion has led to increased efforts to address captive elephant concerns by identifying welfare parameters important for management (Varma 2008), as well as improving care, husbandry, handling, and training techniques through the development of professional guidelines and standards for captive elephant management (Olson 2004).

Successful captive elephant management relies on a clear strategy, as well as outlining proper policies, protocols, and standards. Policies need to assess the purpose for captive populations, long-term goals, and the implications for humane management of these populations (Desai 2008). Practical standards need to be developed to address the physical and social environment of these animals, as well as their purpose. Monitoring and enforcement mechanisms need to be considered so that standards can be successfully implemented (Desai 2008). Written policies and protocols are important for success as these tools aid the consistency of elephant management programs; periodic review of the policies ensures that standards are met and even improved where needed.

Specific captive elephant management protocols designed with individual, regional, and national differences in mind are more likely to succeed. Effective captive elephant management protocols should examine all aspects of management programs and address individual situations such as the local need and use of the elephants, number of animals, type of environment (physical, work, social), personnel support and training, and animal welfare (Olson 2004; Desai 2008). Non-existent, poorly written, or poorly executed protocols can contribute to the neglect of captive elephants' needs.

Recently, some elephant range countries have included captive elephant management policy in their national strategy for elephant conservation. Examples include the "National Norms and Standards for the Management of Elephants" issued by the government of South Africa in 2008, and the "Strategy and Conservation Action Plan for Sumatra and Kalimantan Elephants 2007-2017" (*Strategi Dan Rencana Aksi Konservasi Gajah Sumatra Dan Gajah Kalimantan 2007-2017)* adopted by the Indonesian government in 2007. The South Africa document outlines provisions for captive elephants such as management plans and registration. In the Indonesian plan, the government highlights the importance of synergetic elephant conservation addressing both wild and captive populations via two main points: utilizing captive elephants for various conservation strategies and programs such as HEC mitigation, and maintaining a stable, self-sustaining captive population through careful management and breeding. Decisions and policies about captive elephant management are more successful when based on a formal strategy and it is unfortunate that most elephant range countries do not have a national strategy or goal to address the management of their captive elephant populations.

Another challenge for national strategies is the fact that in some range countries elephant populations are classified under separate legislation: the wild population is offered a protected wildlife status, while the captive elephant population is considered on the same level as working livestock (Godfrey & Kongmuang 2009). Without a clear and unified goal, legislation is less likely to protect elephants adequately. National elephant strategies need to review and implement systematic legislation to assist the management and protection of their elephant populations.

There is heightened awareness about the welfare needs (biological and social) of elephants (Varma 2008), yet in many regions these needs are not always served by practical captive elephant management decisions. Welfare issues exist in all kinds of management and ownership systems, often due to a lack of consistent standards and operational procedures for captive elephant management from government oversight bodies (Lair 1997). Recently, in an attempt to better

address captive elephant well being, a range country issued a national directive requiring that elephants residing in zoos be transferred to forest camps. While this type of directive may offer a welfare improvement for a few captive animals, it does not provide adequate direction for enhancing the management of the entire captive elephant population in that country (Bist 2010).

Medicine

Due to a lack of standardised national regulations and requirements for the health management of captive elephants (e.g. preventative and treatment schemes, disease management, medical staff training, equipment requirements), the quality of implemented veterinary care mostly depends on the willingness, knowledge, and intent of owners, managers, and handlers or mahouts (Stremme et al. 2007). Additionally, the lack of resources and of properly trained staff leads to inadequate health management of vast numbers of captive elephants, especially in range countries (Stremme et al. 2007; Angkawanish et al. 2009).

There is a need to improve the capacity of elephant veterinary care in range countries to advance the welfare of these animals; so ongoing education and training programs for veterinary students and local veterinarians are essential (Stremme et al. 2007). Furthermore, ongoing programs should be developed in close collaboration with responsible government authorities and elephant owners and handlers to ensure sufficient and sustainable captive elephant health care.

In addition to providing better resources and qualified veterinary expertise, it is necessary to develop and support range country research programs about diseases and health management of local captive elephant populations (Stremme et al. 2007). Of particular interest are the study, identification, treatment, and prevention of diseases that may be transmitted from captive elephants to wild elephants (and vice versa), as well as from other species to elephants (and vice versa). In range countries, infectious disease control and management need to be considered where captive and wild elephants share the same environment (i.e. forest camps in Asia or elephant back safari camps in Africa), where livestock potentially carrying infectious diseases that may be transmitted to elephants enter wild elephant habitat, and when captive elephants are moved between different environments.

The most common diseases and disorders affecting captive elephant populations have been described by various authors (Rüedi 1995; Fowler & Mikota 2006; Stremme et al. 2007; Alex 2009; Angkawanish et al. 2009; Chakraborty 2009; Chandrashekaran et al. 2009; Sarma 2009) and include:

* Parasitic diseases including various types of endo and ecto parasites

* Bacterial diseases such as salmonellosis (Salmonella spec.), colibacillosis (E. coli), hemorrhagic septicaemia (Pasteurella multocida), tuberculosis (Mycobacterium tuberculosis), tetanus (Clostridium tetani), anthrax (Bacillus anthracis), blackleg (Clostridium spec.)

* Viral diseases such as rabies, elephant pox, foot and mouth disease, encephalomyocarditis (EMC), elephant endotheliotropic herpes virus (EEHV)

* Non specific and non infectious disorders such as various types of foot diseases (affecting sole and nails), wounds and wound infections, eye lesions (conjunctivitis, keratoconjunctivitis, corneal lesions), constipation and colic, skin conditions, tusk and molar problems, malnutrition.

The occurrence of several of these disorders is often linked to inadequate daily husbandry procedures, poor hygiene in the elephant housing area, improper use of tools, and lack of appropriate preventative schemes (Stremme et al. 2007; Angkawanish et al. 2009). To improve the overall health of captive populations it is crucial to address such basic management issues.

One of the challenging veterinary issues is the elephant endotheliotropic herpes virus (EEHV), which was originally identified in zoo elephants in Europe (Ossent et al. 1990), and has now been found in multiple wild and captive elephant populations (Wiedner & Schmitt 2009). EEHV is characterized by high mortality and seems to mainly affect juvenile animals. Diagnosis is only achieved via blood testing of an elephant with an active case (Metzler et al. 1990; Latimer et al. 2007; Richman 2007), and very few animals have survived treatment. Intensive study continues in order to determine transmission, and improve prevention and treatment options

Another recent focus of veterinary research is tuberculosis (*Mycobacterium tuberculosis*) (TB). TB

is particularly a concern for captive elephants in range countries where the human population has a high rate of infection. Currently a trunk wash culture is the most widely accepted diagnostic tool (Olson 2004; Abraham & Davis 2008). Other methods are being investigated as elephants shed the mycobacterial organisms irregularly, but techniques used for diagnosis in other species are either not possible or dependable with elephants (Wiedner & Schmitt 2009). Treatment of tuberculosis in elephants is difficult as several of the drugs used cause severe toxicity in elephants (Wiedner & Schmitt 2007), so further study of treatment options is critical.

Most captive elephant facilities in non-range countries have preventative veterinary schemes that include regular vaccinations, blood and fecal testing, TB trunk wash, vitamin and mineral supplementation, as well as provisions for dung removal, rodent and other pest management (Olson 2004). However, many of these facilities manage overweight elephants and this also can contribute to various problems, e.g. birth problems, joint and foot problems, as well as arthritis (Sadler 2001; Fowler & Mikota 2006; Lewis et al. 2010). Interestingly, one disease, elephant pox, has been a problem in Asia and several European facilities (Baxby & Ghaboosi 1977; Pilaski et al. 1992; Chakraborty 2009; Chandrasekharan et al. 2009), but to date has not been diagnosed in captive elephants housed in other non-range regions such as North America, and the reason for this is unknown.

CONTRIBUTIONS OF CAPTIVE ELEPHANTS

Biological studies

Captive elephants offer unique opportunities to understand details about how these animals function. In recent years, much has been learned about elephant physiology, biology, and communication from captive elephants. However, biological studies of elephants should not be limited to the captive environment; every effort should be made to support such research with wild elephants.

The scientific study of captive elephants can help improve field techniques. In one example, controlled testing using captive elephants allowed comparison of DNA found in dung to DNA found in blood. Matching these samples confirmed that dung is a reliable source of DNA allowing noninvasive genotyping (Fernando et al. 2003). Dung extracted DNA from wild elephants has become a useful tool to address conservation questions such as genetic diversity in small or isolated populations.

Detailed monitoring of captive elephants has led to interesting biological discoveries. For example, the observation of liquid emanating from elephant ears was first documented and studied in captive elephants (Riddle et al. 2000). The close proximity of elephants in a zoo allowed the first recordings of infrasound produced by elephants (Payne et al. 1986). The evidence of such elephant-emitted sounds paved the way for ongoing field research in Africa and Asia to understand how wild elephants use these sounds (Payne et al 2003; Nair et al. 2009; de Silva 2010).

While the use of sophisticated electronic recording equipment allows scientists to listen in on elephant auditory communication, other modern instrumentation also contributes to a better understanding of the species: portable ultrasound units allow scientists to visualize the internal organs of elephants (Hildebrandt et al. 1998, 2000); video camera technology records distant behaviors under poor light conditions for subsequent review (Shulte et al. 2007); highly sensitive instrumentation provides detailed chemical analyses (Rasmussen 1999); and thermal imaging is an opportunity to measure from a distance the external and, to some extent, the internal temperatures of elephants (Weissenboeck 2006). Preliminary testing with captive elephants helped develop the use of these various technologies, now being used to collect data from wild elephants and inform conservation management.

In addition to sound, smell is an important sense driving elephant behavior (Rasmussen 1999). By studying captive elephants, researchers learned which chemical signals were linked to specific behaviors and used in communication from female-to-female, male-to-male, mother-to-offspring, female-to-male, and male-to-female (Rasmussen & Schulte 1998; Rasmussen & Krishnamurthy 2000; Bagley et al. 2006; Meyer et al. 2008).

Another medium closely studied in the captive environment is breath. Elephant breath contains brief, rapidly diffusing social signals communicating an immediate individual-to-individual message (Rasmussen & Riddle 2004). Over several years,

more than a hundred breath samples from captive male elephants (African and Asian) were analyzed (Rasmussen & Riddle 2004). The analyses and concurrent blood measurements confirmed that breath compounds differ between individuals depending on their overall health, and whether they were in musth.

Wild and captive male Asian and African Elephants go through musth, a male-specific condition. Studies of wild male elephant behavior explain how differences between musth and non-musth males affect reproduction and social dynamics (Desai & Johnsingh 1995; Poole 1996), while data collected from captive male elephants fills in many details about musth physiology (Lincoln & Ratnasooriya 1996; Rasmussen et al. 2002; Greenwood et al. 2005). Male elephants successfully reproduce while in or out of musth (Hollister-Smith 2005), but have to be in good condition to sustain musth. Observations of wild elephants indicate that bulls in poor condition do not come into normal musth (Poole 1996), and this appears to be true in captivity (Brown et al. 2007), indicating that musth is an important gauge of male health and vigor.

Knowledge about pharmacological properties and the effects of drugs used for elephant treatment and tranquilization (Gray & Nettasinghe 1970; Jainudeen 1970; Fowler 1981; Jacobson et al. 1985, 1987; Fowler & Mikota 2006) has been attained by studying the effects on captive elephants. This data benefits wild elephant management, e.g. during sedation of wild elephants for translocation, fitting GPS or radio collars, and treatment of injured wild elephants.

Reproduction

As wild elephant populations diminish, the role of breeding programs can be important to sustain captive populations – where there is a need or desire to do so. The necessity for captive breeding programs differs from context to context. In some regions there is no interest or need to increase the number of captive elephants (AsERSM 2006), and therefore captive breeding programs would not be implemented. In other regions, particularly in non-range countries, breeding programs sustain small populations (Olson 2004). When captive breeding programs are considered, it is important to carefully assess and plan for many factors, e.g. cost, resources, genetic stock, and animal welfare.

If the currently declining captive population in range countries is considered valuable for long-term conservation strategies (genetic value, use in conservation programs, i.e. HEC management, habitat patrols, and eco-tourism), there is a need to establish stable self-sustaining populations. In many regions this will require revising existing management structures, from current systems that often focus on elephant utilization, towards management systems highlighting planned captive breeding programs as one main goal of captive management. Captive breeding in range countries has often been opportunistic, relying on wild male elephants breeding captive females who are in the forest for grazing; this situation provides a healthy genetic diversity but can also lead to an undesired increase in the cost (of funds and resources) of managing additional elephants. In non-range countries, captive elephant breeding programs have to rely on small numbers of reproductively viable animals, and therefore require studbooks and scientific study to ensure the genetic diversity and health of these small populations (Olson 2004).

Captive elephant studies have supplemented the knowledge of female and male reproductive physiology (Hildebrandt et al. 2006), enabling successful assisted reproduction. Facilities with a focus on reproduction have produced second-generation (F2) offspring with both parents also born in captivity (Riddle 2002). The use of technology such as ultrasound provides a better understanding of the reproductive potential of individual elephants (Hildebrandt et al. 1998, 2000). The knowledge gained from these studies has been applied to certain conservation quandaries - for instance, the development of an immuno-contraceptive vaccine to control locally overabundant African Elephant populations in a non-lethal manner (Fayrer-Hosken et al. 2000; Delsink et al. 2006).

Education and awareness

Elephants appeal to people of all ages, especially to those who do not have to live with the threats of their presence. Around the world, facilities and private owners managing captive elephants have a responsibility to promote and support ongoing public education about elephant conservation by sharing information, creating awareness of problems and issues facing wild elephants, encouraging advocacy, and raising financial support where possible (Riddle

et al. 2003). Every single facility and owner managing captive elephants reaches members of the public - from local villagers to international tourists - therefore every elephant facility should share important educational concepts about wildlife and the environment. Education can be started very simply via signage, and/or literature handed out to visitors, and/or presentations to the public.

As a well-recognized animal, captive elephants raise public awareness about the species and about challenges confronting wild elephants, such as loss of habitat. In turn, public awareness helps motivate support for conservation and habitat protection policies (Nagendran & Riddle 2009), and provides significant opportunities for fundraising. Many of these opportunities are being missed. Education should be ongoing and programs periodically assessed to ensure that every opportunity provided by captive elephants is leveraged, thereby creating attitudinal and behavioral changes beneficial to elephant conservation.

Education should also target those people who directly work with captive elephants. In some regions there is an increasing interest to educate elephant handlers or mahouts about environmental management and conservation strategies, therefore enabling them to better understand and support conservation actions (Azmi et al. 2006). Through improved awareness, the daily management of captive elephants in the care of these handlers also progresses. Building networks is an important tool for creating better communication and improving professional awareness. Several such captive elephant manager groups now exist: in 1988, elephant keepers in North America created the Elephant Managers Association (EMA); in 2006, mahouts in Indonesia organized as the Communication Forum for Indonesian Mahouts (FOKMAS).

Future considerations

In the future, it is imperative to continue enhancing the capacity of staff directly responsible for captive elephants (i.e. elephant managers, keepers, mahouts) via ongoing educational opportunities and support of the profession itself (Stremme et al. 2007). In most Asian range countries, knowledge about elephant handling, care, and training was developed long ago and passed down from generation to generation amongst tribes and families traditionally managing captive elephants (Vanitha et al. 2009). But in many areas this tradition no longer continues. Low incomes, a diminishing standard of living, and fewer work opportunities for mahouts have reduced the attractiveness of the mahout profession, causing children of families and tribes traditionally working as mahouts to seek other job opportunities. This results in the loss of long-established knowledge and experience. Presently, elephant facilities in these countries either hire fewer mahouts or hire handlers without extensive elephant background and experience, which can result in improper care of the captive elephants (Vanitha et al. 2009).

Another necessary tool to improve management is through comprehensive registration of captive elephants - especially of captive Asian Elephants in range countries (Lair 2002). Registration assists in monitoring captive populations, and may help prevent illegal trade in captive elephants and their body parts (i.e. ivory) (AsERSM 2006). In some countries, registration is carried out in conjunction with a specific identification tool, such as the use of microchips implanted under the elephant's skin (Dutta et al. 2007). Effective registration strategies should include a documentation of numbers and specific utilization of captive elephants, in order to evaluate options available for long-term management of these animals.

Discussions and efforts to identify and address concerns surrounding captive elephant populations should continue. This will ensure that in every management system high standards of welfare and husbandry are implemented, and that wild populations are not negatively impacted via removal of individuals for captivity, the introduction of diseases, poorly planned releases, and other such factors (AsERSM 2006). As elephants are long lived animals, it is reasonable to conclude that there will be captive elephant populations well into the future, and effective management strategies need to include mechanisms to ensure compliance with higher standards of husbandry and care, as well as identifying long-term goals that can provide support to these captive populations without affecting wild populations (Desai 2008).

It would be prudent to seriously consider and make decisions now about the long-term role of captive elephants, especially those in range countries. Considerations should include whether there is a realistic need to maintain genetically valuable

populations to back up conservation strategies encompassing activities such as reintroduction into rehabilitated habitat, genetic refreshment of small pocketed populations, or wild elephant and habitat management (Stremme et al. 2007; Desai 2008). Most importantly, these decisions should benefit both wild and captive elephant populations, and not simply support one population at the expense of the other.

CONCLUSION

Wildlife around the world is continually managed more intensely by humans. As the result of habitat loss and fragmentation, local elephant populations in several range countries may already be facing extinction; captivity may be the only option for survival. Presently some range countries have a larger population of captive elephants than wild ones, so in some regions the likelihood of captive elephant populations outliving wild populations seems to be an inevitable part of the future. Communication and exchange of information between managers of captive elephants and field conservationists is vital. Captive elephants can contribute to conservation via biological information, public awareness of the threats facing wild elephants, and support of conservation actions. Each of these contributions is important; however, to be truly successful, all opportunities presented by captive populations should be maximized. Ensuring the long-term survival of African and Asian Elephants requires effective communication and collaboration in all aspects of elephant management, care, and study.

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