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Elephants in UK Zoos

Zoos Forum review of issues in elephant husbandry in UK zoos in the light of the Report by Harris *et al* (2008)[1]

Zoos Forum

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Executive Summary and Recommendations

1. In 2008, 'The welfare, housing and husbandry of elephants in UK zoos', the report of research commissioned by Defra with funding also from the British and Irish Association of Zoos and Aquariums, the RSPCA and the International Fund for Animal Welfare, was completed and submitted to Defra by Dr Moira Harris, Dr Chris Sherwin and Professor Stephen Harris of Bristol University.

2. The Zoos Forum has reviewed this report and the results of other studies relevant to zoo elephant welfare to help consider and make recommendations about the way forward.

3. At the time of this review there were about 70 elephants in UK zoos, comprising roughly equal numbers of Asian and African.

4. Elephants have been kept for hundreds of years but are not domesticated animals. The reasons for keeping elephants in zoos in the UK have probably changed over time. Until relatively recently there was no strong motive to breed them in zoos, partly because of the difficulties of managing adult bulls.

5. Among the conclusions of the report by Harris, Sherwin and Harris were concerns about foot health, gait and being overweight, and that almost 50% of the Asian and 25% of the African elephants performed stereotypic behaviours.

6. Recent studies indicate that the UK populations, and the European populations of which they form a part, are not self-sustaining. This is because of both lower rates of breeding and higher rates of mortality than have been observed in wild populations and in working populations in one range state.

7. Although as Harris et al (2008) state '*Zoos are acutely aware of the issues surrounding the welfare of their elephants, and attempts to enrich and improve their lives are ongoing*', the high prevalence of gait abnormalities, of excess weight and of stereotypic behaviours reported are matters of serious welfare concern. Keeping elephants to good welfare standards is challenging.

8. In view of these difficulties, why keep elephants? Most zoos now try to breed from their animals and believe that keeping elephants in zoos can bring various benefits (these reasons given for keeping elephants are outlined in Section 4).

9. We have suggested that, although vigorous concerted action is needed to address the problems seen in elephants, these problems are not categorically different from those that have been recorded in other species and to which the response has been to find solutions rather than to conclude that the species or breed should be managed to extinction in the UK.

10. However, if solutions to welfare problems and threats cannot be found, if no or negligible evidence of improved health and welfare can be observed, and if there is no compelling reason to breed elephants in the UK, then, in our opinion zoos should take steps to stop keeping elephants.

11.   We have recommended, by a majority, establishing an independent Elephant Advisory Group to advise upon, encourage, and monitor progress with husbandry and welfare improvements (See Section 6).

12.   We have recommended that this Elephant Advisory Group should review husbandry guidelines and further develop these where necessary and we have made recommendations about specific aspects that should be included (See Section 6).

13.   We have recommended that a section should be added to the Secretary of State's Standards of Modern Zoo Practice to make species-specific husbandry requirements regarding the keeping of elephants (See Section 6).

14.   We have recommended that there be a review of progress in ten years time, with an interim review in five years time (See Section 6).

Preamble

The Terms of Reference of the Zoos Forum are to encourage the role of zoos in conservation, education and scientific research, to keep under review the operation and implementation of the zoo licensing system in the UK, and to advise or to make recommendations to Ministers of any legislative or other changes that may be necessary.

In the light of concerns arising from studies into the welfare and reproductive success of captive elephants in UK zoos, the Zoos Forum recommended to Defra that independent research be carried out into the welfare of elephants. The results of that research were published in November 2008 (Harris *et al*, 2008).

The Forum welcomed this report and undertook to consider it and, in due course, to offer advice to Ministers on the welfare of elephants in zoos.

In conducting this work the Forum's aims were to:

- review the evidence and conclusions in the report;
- seek further information and expert opinion as appropriate;
- assess the degree to which the welfare of elephants can be met in the zoo environment; and
- make recommendations regarding the future of elephant husbandry in the UK.

This Report is the outcome of this process. Section 1 provides a brief introduction including background relating to recent studies of elephant welfare, and the Forum's aims and methods in conducting this review.   It also includes brief introductory material on elephants in zoos, elephants in the wild and their ecology and behaviour.

Section 2 reviews recent findings regarding health, welfare, and reproduction and Section 3 comprises a consideration of the reasons that have been proposed for keeping elephants in UK zoos.

In Section 4, options for the way forward are considered and these are further discussed in Section 5. Section 6 concludes with recommendations.

1.   Introduction and background

1.1   Recent reviews of elephant welfare in the UK

With the development of animal welfare science over the last 25 years or so, the husbandry of many kept animals – farmed, laboratory, companion and zoo – and also the ways in which we interact with many of those in the wild has been, and is being, scrutinised and re-evaluated.

The Royal Society for the Prevention of Cruelty to Animals (RSPCA) commissioned Ros Clubb and Georgia Mason, of the Animal Behaviour Research Group of Oxford University Zoology Department "to identify welfare problems associated with keeping elephants in captivity; to scientifically identify relationships between such problems and elements of elephant husbandry; and to make sound, ethically based recommendations for improving welfare of captive elephants". Their report "A Review of the Welfare of Zoo Elephants in Europe" was published in 2002 by the RSPCA (Clubb and Mason, 2002). This was based on an analysis of data collected particularly from the European Endangered Species Programme (EEP) Elephant Studbooks on Asian elephants dating from 1896 to 1999 and on African elephants from 1960 to 2001, and a review of relevant literature.

The study and report highlighted current welfare concerns in keeping elephants, suggested particular areas for future research, and made recommendations concerning the guidelines for elephant husbandry.

It was recognised that the data used to calculate survival of these long-lived animals were inevitably historical, and during this time husbandry practices and veterinary medicine have changed, (however, subsequent analysis showed that, although there has been improved adult longevity in African females in recent years (P<0.01), longevity in zoo animals remains almost three times lower than that of those in the wild: Clubb et al, 2008). Conditions also vary widely across Europe. It was considered that the current UK elephant situation should be examined in detail - attempting to obtain objective independent data on the welfare of individual animals in the UK and to explore some of the research suggestions made by Clubb and Mason (2002). The aim was to establish what current practices and facilities were most associated with better or poorer welfare in the current UK zoo elephant population.

Defra, with joint funding from the RSPCA, the British and Irish Association of Zoos and Aquariums (BIAZA), and the International Fund for Animal Welfare (IFAW) commissioned research '*to provide objective, independent data on the welfare of elephants in the UK and to assist the stakeholders in this debate*' (Harris *et al*, 2008). This work was carried out by Dr Moira Harris, Dr Chris Sherwin and Professor Stephen Harris, of the University of Bristol, and their report on 'The welfare, housing and husbandry of elephants in UK zoos' was published in November 2008.

1.2   Zoos Forum review of the Harris *et al* (2008) report and other recent studies

On receipt of the Harris report (Harris *et al*, 2008), the Zoos Forum set up a Working Group to assist it in considering the issues (See Appendix 9.3).

Although the Forum has, in this review, focused particularly on the Harris report (Harris *et al*, 2008), it took the view that it was important to take note also of other recent publications relating to elephant welfare and the viability of captive populations and of other relevant scientific literature.

The Working Group invited a selection of experts and individuals (listed in Appendix 9.4) with particular interests to meet with it or to submit views. Some members of the Working Group made a visit to observe elephant husbandry at Whipsnade Zoo in May 2009.

The Working Group undertook a large part of the detailed review of evidence in producing drafts for discussion by the full Forum. This is the Forum's Report.

1.3   Elephants in zoos in the UK

Currently (2009) there are approximately 70 elephants held in 13 zoos (here and throughout 'zoo' includes wildlife and safari parks) in the UK. Roughly half are African elephants (*Loxodonta africana*) and half are Asian (*Elephas maximus*). Further details of species, sexes and numbers at zoos are listed in Appendix 9.1. Visitor records indicate that zoo elephants in the UK and Ireland are seen by about 7 million visitors per year (BIAZA, pers. comm.).

With one exception (where it is considered that, for welfare reasons, an Asian and an African that have been kept together for many years, should remain together), UK zoos keep either one species or the other, not both. The elephants are currently in groups of 2 to 12. Two-thirds (48) of the animals are in locations where breeding is practicable and is currently pursued. Just over half of the elephants in UK zoos were born in captivity, either in the UK or overseas. The reasons for keeping elephants in zoos in the UK (see Section 3) have probably changed over time. Until recently relatively few were bred in zoos because bulls were rarely kept (BIAZA, 2006).

The zoos generally provide heated indoor accommodation (Harris *et al*, 2008, p. 24) and access to larger outdoor enclosures. The elephants are fed primarily on hay, plus concentrate pellets, a range of fruit and vegetables, and browse material (twigs and branches). Adults each consume about 30-50kg dry matter per day (about 1.5-2% of their bodyweight), with growing elephants consuming around 2% of body weight (Sukumar, 2003, p. 196; Hatt and Clauss, 2006).

Female elephants are mostly kept together as a group, and are no longer routinely chained at night (as used to be common practice in the past), but some cows are stalled individually overnight (Harris *et al*, 2008, p23). Adult bull elephants usually have to be separated from the rest of the group for varying proportions of time, particularly at night.

Almost all elephants in UK zoos are closely managed by their keepers, using either 'free contact' (in which the keepers spend time in the same enclosure space as the elephants) or 'protected contact' (in which the keepers remain outside the animals' area). In both handling systems the elephants are trained to obey commands of their keepers as part of routine husbandry. An alternative method of husbandry is 'zero contact' in which there is no contact between elephants and staff.

All of the UK zoos that keep elephants are members of the collaborative European Endangered Species Programme (EEP) for management and breeding of elephants, run by the European Association of Zoos and Aquaria (EAZA). All follow insofar as they are able the 'Management Guidelines for the Welfare of Zoo Animals: Elephants' written and published by the British and Irish Association of Zoos and Aquariums (BIAZA, 2006). BIAZA oversees a system of audit against these guidelines. We understand that not all zoos are yet compliant with all elements of the BIAZA standards. However, as highlighted in the following paragraph, elephant husbandry practices are not static.

Over the last four decades the number of zoos in the UK that keep elephants has declined, but group and enclosure sizes have tended to increase. Historically, captive breeding was not considered a priority, whereas now efforts are made to give animals the opportunity to breed naturally or to use artificial insemination (see Rees, 2003). Elephants can have long life spans and, during the lifetime of some of the elephants currently living in UK zoos, changes in housing and husbandry practices have taken place in pursuit of animal welfare improvements as knowledge of needs and of good practice in husbandry has developed. Harris *et al* (2008) noted in their 'General Discussion and Conclusions':

'*Early in this study, it became apparent that almost every zoo was making changes and improvements to the environment and husbandry of the elephants. Many of these were ongoing. Thus, the environment of a UK zoo elephant is not static. Zoos were remodelling and in some cases rebuilding indoor and outdoor facilities, making improvements, increasing space, adding enrichment and altering flooring. The main impetus for these changes is undoubtedly the desire of zoos' management and staff to maintain or improve the welfare of their elephants. Zoos are acutely aware of the issues surrounding the welfare of their elephants, and attempts to enrich and improve their lives are ongoing.*'

1.4   Elephants worldwide

Elephants are wild animals and, although for centuries they have been captured and trained, they have not undergone domestication.

Asian elephants

The Asian elephant is distributed in forest habitat from India through South-East Asia (Appendix 9.2). Over half of the world's free-living Asian elephants are in India, with significant populations remaining also in Sri Lanka, Myanmar, and Sumatra, and small numbers elsewhere. The total number is estimated to be between 35,000 and 50,000. It has been estimated by the International Union for Conservation of Nature and Natural Resources (IUCN, 2008a) that there has been a 50% reduction in population size over the last three generations – approximately 75 years.

The Asian elephant is listed by the IUCN in Endangered Category A2c, showing significant declines in numbers and range size (IUCN, 2008a). Throughout its range it is listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The main threats are considered to be the loss, degradation and fragmentation of habitat associated with increasing human population size, and Asian elephants are killed through poaching for ivory and through conflict with agriculture (IUCN, 2008a).

African elephants

The African elephant is much more numerous than the Asian, being still distributed over much of sub-Saharan Africa, particularly in southern and south-eastern Africa (Appendix 9.2). The total population is estimated at 300,000 – 500,000 animals, probably less than a tenth of the numbers in the 1940s (IUCN, 2008b). The Forest elephant, the subspecies *L.a.cyclotis*, which is a smaller animal, probably constitutes about a third of wild African elephants. It occurs mostly in the forests of central Africa. There are no animals of this subspecies in UK zoos.

African elephants occupy a much wider range of habitat types than do Asians, occurring in environments ranging from arid to savannah to bush to swamp to forest.

The African elephant is listed by the IUCN as Near Threatened. Although its total population size is declining (IUCN, 2008b), populations have increased in some areas. It is listed on CITES Appendix I over most of its range, but is on Appendix II in four countries in southern Africa where culling is often deemed necessary.

The main threats to African elephants are from pressures on their habitats for agriculture by the rapidly increasing human populations, coupled with poaching for meat and ivory, and killing associated with civil unrest and crop protection (IUCN, 2008b).

Elephants in captivity

There are estimated to be as many as 15,000 Asian elephants in captivity in Asia, being used as temple animals (where they are venerated), or for timber extraction work or for tourism (Sukumar, 2003, p.396). Some of those in logging camps are reproductive, usually through mating with wild bulls, but temple or tourism elephants rarely are.

The European populations of elephant species (African and Asian), of which the UK populations are component parts, are managed as European Endangered Species Breeding Programmes (EEPs). The sizes of the European zoo populations are (approximately) 262 Asian elephants at 65 zoos, and 174 African elephants at 44 zoos (ISIS, 2009).

Worldwide, there are about 1,200 elephants in zoos (58% Asian). There are also about 550 elephants in circuses (Clubb and Mason, 2002).

1.5 Some Aspects of Ecology and Behaviour

Some aspects of elephant ecology and behaviour are outlined below.

The main foods of wild elephants are long grasses of a variety of species. The animals also take leaves, roots, fruits and flowers of herbs and trees when these are available, and they also consume twigs, small branches and the bark of trees, particularly when other food is in short supply. Their large size adapts them to a rapid throughput of large quantities of coarse low-quality vegetation, which is digested inefficiently compared with most other herbivores. In consequence they need to spend a large proportion of their waking time feeding (estimated at 60-80%), and take in 128-225kg freshweight of food per day dependent upon season (Sukumar, 2003, p.197).

How far wild elephants travel depends largely on the distribution of food and water (Ntumi *et al*, 2005). Opinions differ, but it appears that family groups of Asian elephants generally move only a few kilometres per day, whereas Africans generally travel about a dozen kilometres (Clubb and Mason, 2002, p. 16). In places, where necessary, African elephants undertake very long migrations and congregate in large numbers, but generally both species remain within defined ranges of very variable size.

Elephants live in stable family groups of about 5-15 related females (and their calves), who spend their lives in the group in which they grew up, along with adolescent males (Moss and Poole, 1983). A group may permanently split (groups often split and reform temporarily) when it becomes unduly large. Groups are led by matriarchs, who are the oldest and therefore generally the largest. Males leave their natal group when 10-15 years old, wander more extensively, and associate with other males. When mature and sexually active (in musth), bull elephants behave aggressively and travel long distances in search of receptive females.

Elephants are intelligent animals with complex social lives, who communicate with one another by a variety of means, including touch (using the sensitive trunk), smell, and sound including infrasound.

In the wild, females reach sexual maturity around 11-14 years of age (Croze *et al,* 1981; Sukumar, 2003). Females come into oestrus for only a few days. The gestation period averages 22 months. The single calf is dependent on its mother's milk for 6-24 months, but may continue suckling for a few years. The next calf is usually born 3-4 years later. Females may continue to breed into their fifties or sixties (Clubb and Mason, 2002; Clubb *et al*, 2009).

2.   Health, welfare and reproduction

The subjects discussed in this section relate to welfare, health and also to the sustainability of the zoo breeding populations (based on age related survival and breeding performance). The concept of animal welfare has been and continues to be subject to considerable debate (Fraser, 2008). In the words of Chapter 4 ('Animal Welfare and its Assessment in Zoos') of the Zoos Forum Handbook (Zoos Forum, 2005):

'The central concern of animal welfare is that animals should feel well and the best approach to this, and good welfare, is to provide an environment that as fully as possible meets their immediate needs and those for their future welfare.'

As Harris *et al* (2008) noted in discussing indicators of welfare in the introduction of their report, *'There is generally considerable debate about which indicators should be measured, even amongst*

experts when studying well-researched species'. They focused particularly on behaviour, indices of health (including foot health), faecal cortisol metabolites (FCM), locomotion score and body condition score, and in their 'General Discussion and Conclusions' (Harris *et al*, 2008, p. 61) they '*give an overview of factors widely accepted by scientists as welfare indicators and relate these to UK zoo elephants, their housing and husbandry*'. They discussed these factors under the headings: social composition, environment, behaviour, handling, health check, locomotion scores, faecal cortisol metabolites, and overall welfare score.

Although we have striven, in the Sections below, to comment on all of these points, we also discuss some issues that were not addressed by Harris *et al* (2008). Others (e.g. Clubb and Mason, 2009) have argued that since stress can affect reproductive performance, reproductive performance can also be an index of welfare and we include some information on this. We also discuss some further aspects of health (the risks presented by tuberculosis and Elephant Endotheliotropic Herpes Virus disease) not covered by Harris *et al* (2008). We also discuss the need to plan for the management of bulls.

2.1   Social composition

In their General Discussion and Conclusions, Harris *et al* (2008, p. 61) wrote: '*The social composition of most groups of elephants in UK zoos was atypical of the normal composition of wild elephant herds. Most zoo groups were skewed towards a higher number of younger animals, and in particular, did not have mature bulls. This is markedly different from normal herd structure in which both male and female elephants gain social stability from older elephants, and is a cause for some concern*'.

Maintaining groups whose composition reflects that typical in the wild presents considerable challenges. It is not clear what composition (in detail) is necessary or optimal for welfare and this may vary according to circumstances. Certainly, there is a wide spectrum of views about this (e.g. BIAZA, 2006; Forthman *et al,* 2009, p. 301).

BIAZA has recommended that elephants should be kept with others of the same species and that the minimum group should be of four compatible females plus any offspring (BIAZA, 2006). The BIAZA Audit (Field and Plumb, 2007) stated that most collections are working towards or exceeding the agreed minimum of keeping four compatible females plus any offspring. The Forum recognises the benefits of this.

Achieving and maintaining appropriate social groups can require movements between zoos. This is also necessary, in the longer term, to prevent inbreeding. However, moving individuals between collections can have adverse effects. It has been implicated as a factor in poor survivorship when females are moved (Clubb *et al*, 2009). Responses to translocation between zoos have been reported in two studies. One reported short-term effects on a small group of female Asian elephants (Schmid, *et al*, 2001), which concluded: '*Taken together, the results suggest that transfer and introduction caused some stress responses in the elephants, but that stress was neither prolonged nor severe*'; the other study reported increased faecal cortisol metabolite concentration (see Section 2.10 below) alongside behavioural indicators of poor welfare in a male Asian elephant transferred between collections (Laws *et al*, 2007).

2.2   Environment

Harris *et al* (2008) investigated various aspects of the environments provided for elephants, and in their General Discussion and Conclusions (p. 61-62) stated:

'Indoor environment
Most elephants spent considerable amounts of time confined in indoors enclosures, some of which were small and barren. The minimum indoor space available was 14.5m$_2$/elephant. Given that wild elephants would naturally range over hundreds or thousands of square kilometres, and are active and move during both the day and at night, the typical indoor environment represents a minute fraction of the amount of space they might normally use. Smaller amounts of indoor space were associated with increased stereotypical activity by the elephants, indicating that zoos should provide as large an amount of indoor space as possible.

Individual housing
None of the measures used here indicated that the welfare of individually housed elephants was worse than that of group-housed elephants housed. This was possibly due to many of the individually housed elephants being able to maintain visual, auditory, olfactory and sometimes physical contact with others. However, given the high sociality of these species, we do not believe elephants should be kept in individual housing except where necessary for reasons of human and/or elephant health and safety.

Outdoor environment
The minimum outdoor space available was 140m^2 per elephant. In some zoos, the outdoor area available was over a hundred times greater, although, this still represents a small fraction of the amount of space elephants would normally use in the wild. Greater amounts of outdoor space were associated with reduced stereotypical activity and improved gait scores, again indicating zoos should provide as much outdoor space as possible. More outdoor space is clearly linked to improved welfare in UK zoo elephants.'

The findings that larger enclosures were associated with lower stereotypic activity and that lower gait score (*i.e.* better gait) was associated with larger outdoor accommodation indicate the importance of provision of large enclosures. It would not be possible to provide space equivalent to home ranges in the wild. Deciding how much space kept animals require for their welfare is frequently difficult and this has been the subject of a great deal of debate, for example, as regards space requirements for laying hens, laboratory mice and many other animals. Provided that it, at least, exceeds minimum requirements (also a very difficult concept which we do not attempt to define here), other aspects of the quality of the environment may be more important than space *per se*. With greater space allowance, however, there is an increased opportunity for enrichment and exercise (see Section 2.5).

Ntumi *et al* (2005) reported that the ranging behaviour of African elephants in range states is dependent upon ecological constraints such as water and food supply. However, even where there are year-round water supplies, elephants still have large ranges (e.g. Ntumi *et al* (2005) reported a mean range size of 523km^2). Some populations remain relatively static in areas of plentiful supply, whilst others range extensively. However, range size in the wild is not the same as space

requirements to meet welfare needs. There is no general agreement about the space requirement for captive elephants at present, and this is not something that is easy to determine. Where space is limited in captive accommodation, it is likely to be helpful to manage animals such as to encourage them to make full use of the space available, e.g. by dividing the day's diet into portions fed at alternate ends of enclosures through the day. However, whilst this seems a sensible general recommendation, in each case husbandry procedures must take account of the particular circumstances of the individual animals. Whilst it may be appropriate to encourage animals to spend a considerable time in locomotion this may not always be appropriate for all animals (e.g. for health reasons).

In the UK, elephants are housed at night for security reasons and to provide a suitable thermal environment, but Harris *et al* (2008) reported that some zoos allow animals free access to outdoor enclosures at night. Elephants sleep at night for 4-6.5 hours (Harris *et al,* 2008). Allowing animals to come in and go out, and to use indoor accommodation as they choose throughout the year may have implications for both security and heating costs during the winter. Unless all zoos can address these issues, as some already have, the size of the indoor accommodation will constrain the amount of space available to the animals for the period when they are housed, which is likely to be at least 14 or 15 hours a day in the middle of winter. Indeed, Harris *et al* (2008) reported that average time indoors was 12 hrs (range 0-17hrs) in the summer and 18 hrs (range 15-24hrs) in the winter. We note that the BIAZA guidelines (BIAZA 2006, p. 40-41) include:

*'Thus zoos **MUST** strive to keep animals in unrestricted social groupings at night and provided with sufficient enrichment and access to food ... It has been demonstrated that elephants benefit from having 24 hour access to the outside area ... and zoos **MUST** strive to provide conditions that allow elephants this choice consistent with welfare and safety considerations.'*

The Forum supports this with the proviso, regarding the last line, that elephants should be allowed this choice consistent with considerations of *their* welfare and safety (every effort should be made to overcome any other, e.g. human health and safety, considerations in ways that do not compromise the animals having this choice). (See Recommendations, Section 6).

2.3   Body condition, Diet and Exercise

Body condition score (BCS) is often used as an index of the nutritional status and energetic state of animals (Hosey *et al*, 2009, p. 382). Body condition scores can provide an index of the state of fat (energy) reserves at one end of the scale and of muscle depletion at the other. The state of an animal's energy reserves reflects the history of the balance of food intake and its energy expenditure (Millar and Hickling, 1990). An animal that has excessive reserves is overweight or obese.

Various methods have been used to assess body condition in elephants (e.g. Chatkupt *et al,* 1999; Wemmer *et al*, 2006; Freeman *et al*, 2009). Harris *et al* (2008) examined photographs, generally of the rear of elephants, to conduct a visual body scoring akin to that used in livestock handling (although with livestock, palpation of the lumbar region is often also used).

In their discussion of body condition scores Harris *et al* (2008, p. 45) reported that: '*The distribution of the body condition scores of the UK zoo elephants was relatively narrow.... Only one elephant was*

scored as being greatly overweight, whereas 16 were scored as 1.5, the next leanest score. The vast majority were scored as 2.0, subjectively described as 'slightly to moderately' overweight. What this means in terms of welfare is somewhat open to interpretation. In the present study, we found that for elephants being scored as 'non-normal', fatter elephants had higher FCM concentrations. It has been argued that overweight captive elephants are more susceptible to serious diseases and defects of joints and ligaments, and that heavier females are more likely to experience stillbirths (Taylor and Poole, 1998). However, elephants are unlikely to be aware of the consequences of being overweight. Therefore, they are probably not suffering from being overweight per se. It is only when this impinges on other welfare-related biological functions, e.g. circulatory or musculo-skeletal problems, such that the elephant then has difficulty breathing or walking, that the animal is likely to experience suffering. The vast majority of the elephants were judged by their keepers to have little difficulty in getting from a standing to a lying position and the reverse, suggesting that the animals' bodyweight did not hinder movement to any great extent.'

And, they continued: *'Overall, it appears that although the UK elephants could be described generally as 'overweight', this is not a critical issue per se, unless this leads to secondary health problems. Certainly, the keepers and zoo staff were aware during this study of the elephants being overweight and were attempting to reduce this'* (Harris *et al*, 2008, p. 45).

Because of its potential to lead to adverse consequences for health and welfare, it is important that body condition is controlled. It has been suggested by other authors that being overweight may affect foot health (Sadler, 2001), fecundity (Hatt and Clauss, 2006; Clubb and Mason, 2009) and observations from other species would suggest that it may predispose to arthritis.

Managing body condition depends on both food intake and levels of exercise. If there is not a system already available so that bodyweight in relation to some appropriate linear measure (e.g. height at shoulder as used by Freeman *et al*, 2009 and recommended by Clubb *et al*, 2009), can be checked regularly against body weight, then such a body mass index system should be developed and used to ensure that the weight to height ratio stays within limits judged, for each species and in relation to age and sex, to reflect good health. (See Recommendations, Section 6).

Hatt and Clauss (2006) reported that manipulation of browse/fibre content of diet along with systematic exercise and weighing of elephants can provide a successful method of reducing or managing elephant body weight. Recently, Clauss and Dierenfeld (2008) reviewed the nutritional needs of browsing species and the challenges in meeting those needs. These principles are explicitly incorporated within the BIAZA Management Guidelines for elephants, with the addition that regular laboratory analysis of hay should be carried out (BIAZA, 2006, p. 55). We recommend that scientifically based nutritional guidelines be developed and that diets be analysed sufficiently to ensure that energy and nutrient intakes keep within the guidelines. (See Recommendations, Section 6).

As emphasised above, being overweight is an important health issue in animals and it has the potential to lead to adverse welfare consequences. It is an issue of increasing concern, and surveys have been conducted in some other species of kept animals also in recent years. For example, in a study of the prevalence of obesity in riding horses in Scotland, Wyse *et al* (2008) reported that 45% of the animals they assessed were fat or very fat, and, in a study of mature horses in Virginia, USA,

Thatcher *et al* (2008) found that 32% were overcondition and 19% were obese. In a review of obesity in dogs and cats, German (2006) reported that *'Studies from various parts of the world have estimated the incidence of obesity in the dog population to be between 22 and 40%. …. The incidence of feline obesity is similar'*.

2.4   Gait and lameness

In their Executive Summary, Harris *et al* (2008, p. 6) reported that: *'Only 11 of the elephants were scored as having a normal gait; 22% had an imperfect gait, 35% were mildly lame and almost a quarter of the national herd (23%) had an obvious limp or were severely lame. Older elephants had poorer gaits. Elephants with larger amounts of outdoor space during summer had better gaits.'*

This high prevalence of lameness is a major problem in elephants. It is not, however, a problem only of zoo elephants. Of the 20 extensively managed Asian elephants at Kaziranga National Park in Assam, North East India, examined as part of the study, by the same researcher that examined the zoo elephants, 17 (85%) were scored as having some degree of abnormality and, overall, there was no significant difference between the locomotory scores of the extensively managed elephants and those from UK zoos (Harris *et al*, 2008, p. 60). However, the extensively managed elephants were all older than 15 years and, when the comparison was undertaken omitting zoo elephants aged less than 15, the mean score for zoo elephants was significantly higher (i.e. they had poorer gaits). Overall, mean foot health score was higher (where, the higher the score the worse the foot health) in the extensively managed elephants examined than in the zoo elephants. However, if African elephants were excluded, so that the comparison was just between Asian elephants in zoos and at Kaziranga, there was no significant difference.

Lameness/abnormalities of gait in animals is caused by pain or functional abnormalities during locomotion and these, in turn, can be due to a wide range of diseases of or injuries to the feet, limbs or elsewhere. Some conditions causing lameness in animals have a multifactorial base, being influenced by the way the limb develops, the nature of the substrate with which it interacts and by other factors. Harris *et al* (2008, p. 35) found no significant correlations between foot health score and indoor, outdoor or total space, time spent in stereotypic behaviour, faecal cortisol concentration, or body condition score. As they said (p. 44,): *'Given the prevalence of foot health problems, it would clearly be advantageous to identify any possible risk factors. However we were unable to find (many) significant relationships between foot health score and the environment or husbandry'*. They suggested that this may be possible through a more long term study. (They did find a significant effect of handling method on mean foot score – those kept in 'no contact' systems had lowest foot scores – however, they suggest caution in the interpretation of this result because it may have been due to difference in method of assessment). Harris *et al* (2008, p. 35) did find a significant negative correlation between locomotion score and total amount of space available in summer and winter, i.e. *'elephants with larger amounts of outdoor space during summer and/or winter had better gaits'*.

Although they mentioned various specific foot health conditions (categorising foot problems into none; minor – uncomplicated nail cracks, minor overgrowth of nail cuticle or pad, minor injuries; and major – abscesses, infection, rot, significant overgrowth of nail, cuticle or pad, significant injuries), no clear picture has emerged from the study of the relative prevalence of the conditions that

underlie foot health problems in captive elephants or of the factors that may predispose to them. It is therefore not possible to specify, for certain, husbandry measures that will lead to improvements, although the finding that elephants with larger outdoor space had better gaits suggests that exercise is a factor.

It is hoped that the use of better substrates, developments in foot care, and provision of greater space and exercise, that have been developing in recent years will help to reduce the prevalence of lameness and foot health problems; and that measures to control bodyweight will contribute to this also. However, it is important to note that prevention and treatment of lameness, even when the causes are quite well understood, can be difficult as the high prevalence of lameness in a wide range of commonly kept animals indicates (as outlined below). Whilst emphasising the urgent need for progress with this issue we should perhaps be cautious about the prospects for very rapid and dramatic success.

With particular reference to foot health, Roocroft and Oosterhuis (2001) reviewed foot health and its relationship with elephant well-being in general. They suggested that exercise will strengthen feet, establish flexibility and good blood flow to the feet, and will also assist weight control: they stated that lack of exercise is '*...probably the worst thing for elephant's feet and probably the easiest to solve.*'. However, there do not seem to be clear grounds for drawing final conclusions about the relative importance of the factors that may play a role in the aetiology of foot conditions (or other forms of lameness) in elephants: substrate type, drainage, and nutritional factors may also be very important. As outlined above, close attention to body condition, nutrition, substrate quality and exercise are likely to be important in helping to prevent lameness. However, there is a range of opinion with regard to appropriate minimum amounts of exercise that an elephant should experience on a daily basis (e.g. Kane *et al*, 2009, p. 209; Kinzley, 2009).

Lameness is a common problem in some kept species and surveys have been conducted in various other species in recent years. High incidences of lameness have been reported in some cases. For example, Webster (2005) reported that *'Most surveys of lameness in dairy cattle in Europe and the USA report an annual incidence of about 50% and prevalence of over 20%'*. Watson (2008) reviewing surveys of footrot in sheep, reported: '*in an SAC study that included the examination of over 15,000 sheep, 25 per cent of Blackface and 56 per cent of Mule sheep were found to have some degree of clinical footrot*'. Kilbride *et al* (2009) found the prevalence of abnormal gait in finishing pigs, maiden gilts, pregnant gilts and pregnant sows from 88 herds was 19.7%, 11.8%, 14.4% and 16.9%, respectively. In a study of the prevalence of hip dysplasia (which can lead to lameness) in dogs, Paster *et al* (2005) found prevalence ranged from 53 to 73% in Golden Retrievers and from 41 to 69% in Rottweilers, and Rettenmaier *et al* (2005) found a prevalence of 19.7% across purebred and 17.7% across all non-purebred dogs. Dawkins *et al* (2004) reported incidence of gait abnormalities from 19 to 39% in broiler chickens reared at various stocking densities and Knowles *et al* (2008) reported over 27.6% of broilers showed poor locomotion. The reported high prevalence of lameness in elephants is a very important matter, but (although the underlying causes vary between species) it is not a problem of elephants only.

As when dealing with the problem of lameness in other species, there are both individual and population level approaches. At the individual level, the efforts of curatorial and veterinary staff focus on trying to diagnose as accurately as possible the precise cause and on treatment, control or

alleviation of the problem. At the population level, efforts are made through scientific review of survey data, as in the Harris *et al* (2008) report, to identify predisposing factors (such as substrate type) through correlation studies.

Harris *et al* (2008, p. 60) noted: 'It was evident that both zoo elephant keepers and mahouts scored the locomotion of their elephants differently to the expert using our scoring system', and concluded (p. 63) *'UK elephant keepers tended to underestimate the abnormality of their elephant's gaits. It is obviously important to be able to recognise lame elephants, and the ability to detect more subtle gait abnormalities may prevent more severe problems developing in future years'*.

We take it that the main causes of the '*abnormal or poor gaits*' were forms of lameness associated with pain, although it is possible that some abnormalities of gait may be due to abnormalities of body conformation which may not be associated with pain. As noted above, Harris *et al* (2008) concluded that some gait abnormalities may be being missed in early stages. This is hard to evaluate, but we agree that early detection of lameness is very important; and we suggest that establishing methods for best practice in this could best be done by elephant keepers, veterinarians, and scientists specialising in locomotion analysis and various relevant forms of lameness, meeting to share their knowledge and experiences. We have also recommended a review of causes of lameness to inform best practice on preventative measures (See Recommendations, Section 6).

2.5   Stereotypies

Stereotypic behaviours are repetitive, relatively unvarying, and apparently functionless. They are acknowledged as being indicative of sub-optimal current or past environment (Mason and Rushen, 2006, p. 10).

In their General Discussion and Conclusions, Harris *et al* (2008, p. 62) observed:

'The high prevalence of stereotypies amongst elephants in UK zoos and the long duration of many of these indicated that the current and/or historical environments of many of the elephants were not suited to their species-specific requirements. Almost half of the UK herd performed stereotypies for more than 5% of the 24-hour period. Some zoos had significantly greater amounts of stereotypy amongst their elephants. This indicates that some factors unique to those zoos might have exacerbated these abnormal behaviours. We found that stereotypical activity was not due solely,and in some cases at all, to historical considerations'.

Stereotypies rarely occur in wild animals in their natural habitats and they generally reflect, as indicated above, that some current or historical aspect of the environment is suboptimal for welfare (Zoos Forum Handbook, Ch. 4, p. 16). Harris *et al* (2008, p. 29) found that there was a significant negative correlation between the amount of time spent stereotyping during the day-time and the amount of outdoor space available (and, unexpectedly, a positive correlation with indoor space available per elephant). Although caution is needed in concluding that the correlation between time spent stereotyping and outdoor space is a causal one - as it could be that, where space was relatively low, there were other suboptimal aspects of the environment that directly influenced the development of stereotypies - others have found a relationship between confinement/movement restriction and stereotypy levels. For example, elephants chained for substantial periods quickly

develop a high level of stereotypies (Kurt and Garai, 2001), and chained elephants have been found to stereotype more than those that are unchained (Schmid, 1995; Friend and Parker, 1999; Gruber *et al*, 2000). Anecdotally, stereotypy decreases when overnight chaining is stopped (Wiedenmayer, 1995). Therefore, it seems prudent to advocate the provision of large, high quality space and the adoption of husbandry methods that promote full use of it through as much of the day and night as the animals wish, and that encourage time spent in locomotion*.*

It is important to try to avoid creating conditions that lead to animals developing stereotypic behaviours. In addition, anecdotal reports indicate that poorly informed husbandry practices may reinforce the performance of stereotypic behaviour once it has developed. For example, if an individual performs a stereotypic behaviour in anticipation of a specific event such as being able to access the indoor housing, then always being let in may reinforce that specific behaviour through the process of positive reinforcement learning.

The problem of stereotypic behaviour is not unique to elephants. Stereotypic behaviours occur quite commonly in many kept (domestic or non-domestic) animals. For example, in a survey of thoroughbred and part-thoroughbred horses, Waters *et al* (2002) found that abnormal behaviour (stereotypic and redirected behaviours) affected 34.7% of the population. These behaviours are a cause for concern (Zoos Forum Handbook, Chapter 4).

We have recommended that zoos must positively address means to enable elephants to maximise outdoor access and put measures in place to enrich indoor and outdoor environments (day and night). (See Recommendations, Section 6).

2.6   Health

Some aspects of health have been discussed above. In their General Discussion and Conclusions, Harris *et al* (2008, p. 62) included a brief section entitled 'Health check' as follows:

 'Other than foot health, bodyweight and locomotion scores, the elephants were in good physical health and few problems were recorded. This reflects the very high level of care and attention given to elephants in UK zoos. The majority of UK elephants were scored as overweight. This was a bigger problem in some zoos than others, indicating some zoos are tackling this issue more successfully. The UK zoo elephants spent less time feeding than wild elephants but were also overweight, indicating that diet and/or lack of exercise were probably contributory factors. Many elephants had foot health problems which ranged from minor to severe. It is unclear how these affected their welfare, as they were unrelated to gait scores or FCM. However, major foot problems such as abscesses and osteomyelitis almost certainly cause pain and discomfort, often on a longterm and/or recurring basis. We note that cracked nails are common for elephants in the wild' (Harris *et al*, 2008, p62).

As regards dealing with health problems, Harris *et al* (2008) noted in their Executive Summary: '*The keepers and staff were all highly skilled at detecting issues such as injuries and disease, and whenever necessary, took appropriate corrective action'*.

The health issues relevant to welfare identified by Harris *et al* (2008) included: lameness, foot health and overweight. We have discussed these in Sections 2.3 and 2.4 above. However, there are some other health threats that we consider important to mention here.

2.6.1   Elephant Endotheliotropic Herpes Virus (EEHV) disease

Herpes virus infections are increasingly implicated as a cause of mortality in young captive elephants. During the relatively brief course of the Zoo Forum's preparation of this Report, two young Asian elephants died of EEHV disease in the UK. Gage (2008) reported that 22 cases had been diagnosed in calves (<6 years old) in Europe and North America, 19 of which died, and that EEHV was found in two stillborn foetuses and a 1-day old calf. Richman (2008) reported that it is likely that the virus contributes to the high stillbirth rate in captivity. The disease tends to be sudden in onset, and to lead rapidly to death, due partly to heart failure (Richman, 2008). EEHV has also caused deaths in adult Asian elephants (Richman, 2008). Treatment with the human antiviral drug Famciclovir has been attempted, but fewer than half of those treated have survived (Richman, 2008).

EEHV disease has been recognised only recently, but retrospective examination of proliferative cutaneous lesions stored from a herd of captive African elephants in the USA (Jacobsen *et al*, 1986) confirmed the presence of Herpes virus sequences identical to those found in Asian elephants with disseminated EEHV disease (Richman *et al*, 1999).

The epidemiology of these virus diseases is little known. Richman (2008) stated that African elephants carry at least two herpes viruses: one that may be lethal to Asian elephants and one that is fatal to young African elephants. The presence of varieties of EEHV has been confirmed in elephant camps in Cambodia and Thailand, and in a wild elephant in India (that had had contact with captive elephants; Reid *et al*, 2006).

In the USA, a nationwide serological survey is underway using an ELISA test to provide information that may reveal patterns that will aid in herd management and decisions about movements between herds. We understand that moves are underway to survey UK zoo elephants (see below).

2.6.2   Tuberculosis

Tuberculosis has also been identified as a threat to elephants (Mikota, 2008). Cases have occurred in zoo elephants in Europe and the USA. It can affect both the African and the Asian species. It is a chronic disease that is difficult to detect until late stages and there is potential for affected animals to pass infection to others long before detection. This could present a serious challenge in a population whose viability depends on movements between collections for breeding purposes.

2.6.3   Infectious disease screeening

We gather that BIAZA is proposing to develop an UK Elephant Health Programme to promote and coordinate TB and Herpes virus screening. It would appear that screening programmes need to be pursued vigorously in the UK and Europe-wide. Careful consideration needs to be given to what actions would be taken if the disease is detected. The chances of a viable, long-term breeding programme proving viable in Europe would seem to be precarious without rigorous and effective measures to control these diseases.

We have recommended the development of a Health Programme including screening and preventative measures, clinical and pathological investigations. (See Recommendations, Section 6).

2.7   Survivorship

From their analysis of the European Elephant Studbooks from 1960 to 2005, Clubb *et al* (2008) reported median life spans of 19 years for female Asian elephants in European zoos compared with 42 years for those in Burmese logging camps. For female African elephants, the median lifespan in European zoos was 17 years, compared with 36 years in a wild population of elephants in Amboseli (or 56 years if human-induced deaths were excluded).

For Asian elephants in European zoos, the still birth rate was found to be high and infant mortality rates were about double those in the Burmese camps (Clubb *et al*, 2009), while juvenile survivorship was similar. Survivorship in zoos was found not to have improved over the time period. Captive born animals had much poorer survivorship than wild-born animals and one factor in this is the killing of infants, which is relatively common in zoo elephants but absent in wild elephants (Clubb and Mason, 2002). Transfers between zoos and earlier separation from their mothers were both associated with poorer survivorship when adult (Clubb *et al*, 2008).

The female African elephants in European zoos showed infant and juvenile mortality rates similar to those in the wild, and an improvement in survivorship in recent years (Clubb *et al*, 2008). In a recent review, Mason and Veasey (2010a), discussed the difficulties in interpreting the literature in which adult survivorship of captive and wild elephants are compared. Their overall conclusion was that adult survivorship of elephants in captivity is significantly lower than that of those in range states. However, they reported that there have been significant improvements in recent years in the case of African elephants. They also suggested areas of systematic health checks that might be of value in understanding the aetiology of poor adult survivorship.

We are not aware of any evidence that the situation in UK zoos has been markedly different from that of Europe as a whole.

Improvements in mean age-related mortality statistics of such long-lived animals can understandably take many years before they are measurable, particularly when the animals' numbers are relatively small. And, when the conditions in which they are kept have varied so greatly over place and time, it is difficult to ascertain the relative importance of factors relating to better survivorship.

Clubb *et al* (2008) considered that stress and/or obesity were likely to be the main causes of the poorer survivorship of zoo elephants. However, Mason and Veasey (2010) considered that while stress could explain the data so could many other factors.

A shorter life *per se* is not necessarily a *welfare* problem but is, of course, relevant to population sustainability. However the causes of mortality discussed above are likely to be associated with adverse welfare consequences.

2.8   Fecundity

Clubb *et al* (2009) used the same studbook data as described in 2.7 (above) to analyse breeding performance in European zoos since 1960 and for comparison with animals in reference populations of elephants in Myanmar and Kenya. A main finding was that *'fecundity in both species is much lower than in* in situ *reference populations, and breeding ceases at least a decade earlier in adulthood'*.

It is impossible to determine from studbook data how much effort was made historically by zoos to breed their elephants; we understand that most did not try to breed them because they did not keep bulls because of the difficulties of doing so. Breeding elephants in zoos was not generally considered necessary until fairly recently because there was a supply of young animals from Africa or Asia and captive-breeding was not given the priority it receives today. Historical data may therefore not always reflect the current situation - however, it is clear that very few female zoo elephants, of either species, are still producing young beyond the age of 30 - when females in free-living populations in Myanmar and Kenya continue to breed (Clubb *et al*, 2009).

Hildebrandt *et al* (2006) reported that, in zoos, *'many elephant cows (both cycling and non-cycling) are developing reproductive tract pathologies and subsequently exhibiting irregular or no ovarian cycles that possibly affect fecundity'.* They considered that *'continuous ovarian cyclicity of non-bred females is having a negative and cumulative effect on reproductive health in captive elephants. In the wild, most females are either pregnant or lactating and they experience comparatively few reproductive cycles in their lifetime'.*

In captivity, early onset puberty is often observed. Hermes *et al* (2008), reviewing obstetrics in captive elephants drew parallels with human populations of developed nations where a higher plane of nutrition has resulted in a shifting of the onset of puberty to a younger age. It appears that long periods of cycling not resulting in pregnancies may increase susceptibility to reproductive tract pathologies. The early onset puberty seen in captive elephants may be a factor in this also. From the data, it appears that if a zoo elephant has not bred by the age of 25-30, she is unlikely to do so. Hermes *et al* (2008) reported that over 50% of cases of dystocia (abnormal or difficult birth or labour) occured in primiparous females of over 20 years of age.

Knowledge of the reproductive physiology of the species can be helpful in the effective management of captive breeding. Considerable advances have been made in recent years (for example, it was found only in 1996 that the endocrinological cycle of female elephants is unique in having two peaks in secretion of luteinising hormone during each oestrous cycle). Such knowledge has helped open the door to the possibilities of artificial insemination (AI). The success of captive breeding in the past may have been, to some extent, limited by lack of knowledge.

Techniques for the successful artificial insemination of elephants have been developed in the past decade, and might enable more of the females that are being kept in the absence of males to be brought into the breeding population. However, it is not suggested that this may be more than an aid to maintenance of captive populations (see Social Composition, Section 2.1 above). We discuss later (Section 2.12) the need for the development of plans for housing males. This is even more important than it might otherwise be, as the sex ratio among calves born in zoos through natural conception and also as a result of AI is strongly skewed in favour of males (Saragusty *et al*, 2009).

2.9 Handling methods

There is considerable debate on the relative animal welfare merits of free contact versus protected contact management systems – those in which keepers go into enclosures with their animals and those in which they do not. There are strong advocates and opponents of both systems. One of the concerns expressed about the free contact system is that keeper safety is said to depend on the keeper having to maintain dominance over the elephants and that handling methods associated with this are not in the welfare interests of the animals (Forthman *et al*, 2009, p. 304-305)*.* On the other hand, those in favour of such close contact point to welfare advantages that they believe the system brings to the animals and maintain that negative reinforcement is not necessary in the course of free contact, although others believe that the basic principle of the use of the ankus is negative reinforcement. The Secretary of State's Standards of Modern Zoo Practice (Defra, 2004, Appendix 7, para. 7.4) state: '*Training methods should be based on positive reinforcement. Where negative reinforcement is used it must never compromise the welfare of the animal*'. Harris *et al* (2008) did not find evidence that welfare was linked to handling system and, based on these findings, there seems no clear scientific basis for deciding between the two from a welfare viewpoint. It may depend upon the particular circumstances, e.g. if a close contact system enables, without causing stress, greater locomotory exercise then the advantages of this may outweigh disadvantages. Recently, Mason and Veasey (2010b) have reviewed potential approaches that may be useful in assessing the psychological welfare of elephants. Future research may clarify these issues.

We understand that there has been a significant move towards use of protected contact or no contact systems, driven partly by human health and safety concerns. However, Harris *et al* (2008, p. 43) speculated that: '*... where elephants are not handled or handling is limited, it seems inevitable that keepers are less knowledgeable about their elephants' physical health than in zoos where elephants are regularly handled and checked.*' In both protected and free contact systems, there is considerable interaction between elephant keepers and the elephants, themselves. Whether this assertion by Harris *et al* (2008) is the case will, we suggest, depend on staff training and expertise.

In all situations where animals are successfully managed, a key feature is well-trained, dedicated staff who are respected by their managers. Harris *et al* (2008, p. 61) reported that '*all managers and elephant staff that we spoke to during the course of our study were highly knowledgeable about elephant care and welfare issues*'. However, as knowledge relevant to health and welfare increases, there will be a continuing need for training programmes for elephant keepers as well as effective means for sharing evidence-based good practice between collections.

We have recommended that there is a need for systematic elephant keeper training and sharing of good evidence-based practice across the UK, and this should take advantage of links across the rest of Europe and more globally. (See Recommendations, Section 6).

2.10 Faecal cortisol metabolites

Harris *et al* (2008) collected three sets of faeces from each individual elephant and analysed the cortisol metabolite levels in these.

The hormone cortisol is secreted in response to events that an animal may perceive as pleasant or unpleasant. Its concentration in blood or other fluids can provide an assessment of arousal (positive or negative) that can be interpreted in welfare terms by cross-reference to other indices (e.g. behavioural observations). Its usefulness has been reviewed in the Zoos Forum Handbook (Zoos Forum, 2005, Chapter 4). Whilst the measurement of faecal cortisol metabolites (FCM, the breakdown products of cortisol) may be able to contribute to welfare assessment in some circumstances, the patterns of variation reported by Harris *et al* (2008, p. 46) do not appear to provide clear conclusions about factors which may cause stress to elephants. They stated: '*These counter-intuitive relationships indicate that interpretation of FCM as a welfare indicator for zoo elephants must be made with great caution due to the highly variable nature of the husbandry, handling, history, social composition and individual responses of the elephants*' (Harris *et al*, 2008, p. 46). They found no significant relationship between FCM concentration, as a possible indicator of stress, and housing, frequency of stereotypic behaviour, handling method or locomotion score (Harris *et al*, 2008, pp. 39-40).

2.11   Overall welfare scores

Harris et al (2008) compiled a subjective overall welfare score for each elephant. Elsewhere in their report, as we have outlined, they identified several areas of concern regarding elephant welfare and it is not clear that this overall welfare score contributes further.

2.12   Bull management

Although Harris *et al* (2008) addressed social composition (see Section 2.1 above), their report contained relatively little on the management of bulls; however, in planning to maintain a captive elephant population, this is an important subject. If a captive population is to be maintained then there will need to be facilities for keeping bulls. These cannot be kept within their natal herds after maturity. Providing good quality life-time accommodation for the large numbers of bulls that would accompany a successful breeding programme (especially since the sex ratio is currently biased in favour of more males being born than females, see Section 2.8 above) will present a major challenge and one that needs to be carefully planned in advance. As far as we are aware there are no detailed plans for dealing with this situation.

As with many aspects of captive elephant management, these matters will have to be tackled at the European herd level, and this will require very close cooperation and agreement among the institutions that keep the animals. Presumably, some participants will have to plan to keep bachelor groups of males and others to keep appropriately structured breeding groups (one mature male with females of various ages). We are not aware of the existence of such a strategy for this. In addition, there will be the need to provide appropriate housing for bulls.

Several authors have identified the importance of keeping males in groups. For example, Slotow *et al* (2000) reported that the presence of older male African elephants had a calming influence on adolescents that had not previously been subject to any dominant males during their development. Evans and Harris (2008) suggested that male groups of African elephants are repositories of male knowledge and are important in the social development of adolescent males. Rees (2004) reported that mounting behaviour was socially facilitated by observing older males.

We have recommended the development of a strategy for bull management in liaison with the European Endangered Species Breeding Programme. (See Recommendations, Section 6).

2.13   Sustainability

We understand that the indications are that the zoo populations of Asian and African elephants in Europe and North America are not currently self-sustaining (Faust *et al*, 2006; Wiese and Willis, 2006; Clubb *et al,* 2009). Whether a population grows or declines depends upon the relative rates of breeding and mortality. Rates of breeding have been lower than observed in the wild (Clubb *et al*, 2009) and rates of adult and infant mortality have been higher than observed in stable wild populations (Clubb *et al*, 2008). There will clearly need to be significant improvements in reproduction and in reduction in mortality before the populations can become self-sustaining. In making progress with this, ongoing review of the European studbooks will be important.

The causes of low rates of reproduction are not entirely clear. In the past, the populations were not managed to maximise breeding. As mentioned above, it has been hypothesised that females which have not bred by middle age are likely to become prematurely infertile as a result of uterine pathology due to the effects of continued reproductive cycling in non-pregnant, non-lactating animals (Mason and Veasey (2010a) and see Section 2.8). Zoo elephants have tended to reach sexual maturity earlier than those in the wild; and Hildebrandt *et al* (2006) advocated delaying the onset of puberty in captive females to reduce the reproductive cycling before full physical maturity for reproduction is reached in order to address the problem of premature infertility. It has also been reported that fertility may be adversely affected by obesity (Hatt and Clauss, 2006; Freeman *et al*, 2009).

The factors underlying the higher rates of infant mortality (Section 2.7) are also not entirely clear, but it has become apparent that EEHV has contributed and may have been a significant factor (Section 2.6.1). Infanticide is relatively common in zoo elephants but is absent in the wild. It has also been suggested that a tendency to large neonate size may also be a factor predisposing to infant mortality (Clubb *et al*, 2009).

3.   The role of elephants in UK zoos

From the preceding section it is apparent that there are some difficult welfare problems to be overcome in keeping elephants in the UK. So why keep elephants? In this Section, the various reasons that have been given for keeping elephants are outlined.

From the literature and from our discussions, it is clear that several possible roles have been envisaged for captive elephants at the present time; there may have been other reasons also in the past. Reasons given for wishing to maintain elephants in UK zoos include those listed below.

For conservation: as an insurance against catastrophic loss of wild populations
Captive breeding is currently viewed in terms of maintaining *ex situ* populations (those outside their natural ranges) as an insurance against some *future* catastrophic loss of wild populations rather than to meet a current need for reintroduction since there is no such need for either species at the present time. It is also widely recognised that reintroductions from *ex situ* populations back to the wild, although they have been valuable and successful for some species, are not easily achieved and

are not without risks (e.g. to the welfare of the animals involved and associated with the possibility of accidental infectious disease introduction into wild populations).

There is no case for breeding elephants for reintroduction in the short term. Assessing whether or not there may be a need for this in the future is difficult. There is quite a large free-living African elephant population at present (although much lower than 50 years ago), numbers in some areas have been increasing and some populations are being controlled by culling.

The free-living Asian elephant population is much smaller and is regarded as Threatened by the IUCN (2008a), but is not under immediate severe threat (see Section 1.4). However, the human population continues to rise rapidly and it seems very likely that both African and Asian elephants and their habitats will come under increasing pressure. Maintenance of a captive population as a long-term insurance against catastrophe in the wild depends upon the captive population being self-sustaining, and neither African nor Asian populations in European and North American zoos (nor elsewhere outside their usual geographic ranges) are self-sustaining at present.

There are large populations of captive Asian elephants held within the normal geographic range of the species (e.g. in India and Thailand) and some feel strongly that if there is a case for sustaining a captive population as an insurance, efforts for this should be focused in those countries rather than outside the animals' normal geographic range. However, it is not clear how this might be funded. On the other hand, some believe that continued maintenance in the UK (as part of a European programme) is important for various reasons including to contribute to developments in elephant husbandry (e.g. in veterinary aspects and disease control) that, they believe, are likely to become increasingly important for both conservation and welfare as, with growing anthropogenic pressures, free-living populations are likely to be increasingly confined to smaller areas and will need to be managed.

To attract visitors and to enable fund-raising for *in situ* conservation initiatives
Elephants are impressive and attractive animals. We are aware that some zoos undertake specific fund-raising from the public at elephant exhibits. We understand that elephants do attract visitors to facilitate fund-raising. However, we are unaware of research into the scale of sums raised or how the use of elephants in fund-raising compares with the use of other species.

We have been told that gate takings did not drop markedly in the short term at four zoos when elephants were no longer kept there, but we have no clear data on these points. The circumstances at these four zoos may not have been comparable with circumstances at zoos which currently continue to keep elephants.

For education: to provide opportunities for education about conservation threats to free-living populations
Zoo elephants are used in zoos to help present information about threats to their conservation and to promote interest in and support for their conservation, and in wildlife conservation more generally. Some believe that, in this way, elephants can help promote such interest; others have expressed doubt about this. It is very difficult to measure the efficacy of such education or to know to what extent use of other species for such purposes would be more or less effective. There are very few detailed reports that assess the impact that elephants or other animals have on visitor

perceptions; and two studies addressing this gave conflicting results (Balmford *et al*, 1996; Ward *et al*, 1998). A Defra-funded project is currently underway which aims to provide information on the conservation and education activities of zoos more generally.

Providing opportunities for education in elephant husbandry and medicine

Through keeping elephants, zoos have provided opportunities for biologists and veterinarians to learn about, and contribute to knowledge and technology on, elephant husbandry and medicine, particularly as relevant to captive animals.

For research into aspects of biology relevant to present or future conservation

Observations on zoo elephants in the UK and elsewhere in Europe have contributed to knowledge of various aspects of their biology, including infrasound communication, aspects of anatomy and reproduction, and veterinary aspects including epidemiology of Herpes virus infections. Infectious diseases can present threats to population viability, especially in small populations. It is possible that knowledge gained on the epidemiology and control of infectious diseases to which elephants are susceptible could prove very important for species conservation in the future (but this argument also applies equally to all other wild animal species).

It has been argued that if captive breeding of elephants is not continued, an opportunity may be lost to learn more about some of these disease threats to elephants and how to address them. There are a number of reports (e.g. Bengis *et al*, 2002; Sukumar, 2003) of elephants contracting diseases as a consequence of close contact with livestock in range states. As conflict between elephants and livestock production increases, knowledge of diagnosis and control of diseases may be of benefit to both elephants and sympatric human populations.

As mentioned earlier (Section 2.8 above), studies on zoo elephants have led to advances in knowledge of aspects of their reproductive physiology which could have application to their conservation in the future.

Similarly, it has been suggested that studies in Britain (the Harris *et al* (2008) report is an example), with the elephants, staff, and facilities available, may be able to contribute to improvements of captive elephant welfare throughout the world (including the 15,000 in SE Asia).

It is widely predicted that the planet's human population will continue to grow rapidly for the coming decades, and that this will place huge and growing pressures on many species of wildlife. Almost certainly, free-living elephant populations will have to be managed much more actively in the future than is necessary now.

Advances in knowledge and understanding of animal diseases have led, in many cases, to methods for their prevention or control. For example, the discovery in 1967 that new world primates require dietary vitamin D_3 (Hunt *et al*, 1967) was crucial to their maintenance and welfare in captivity. Some believe that keeping elephants provides opportunities to find solutions to health and welfare problems and that, in the long run, this is the right way forward.

4.   Options for the way forward

In Section 2 above we outlined some of the difficulties and current welfare problems associated with keeping elephants in the UK and, in Section 3, we outlined various reasons given as to why elephants should be maintained in zoos in the UK. Before more detailed discussion of these costs (i.e. welfare costs) and benefits, we now consider the options that zoos face, regarding the future of UK zoo elephants. Decisions regarding their animals are the responsibility of the individual zoos (although local authorities can specify conditions on aspects of management) but, where zoos work together to manage populations collectively through European Endangered Species Programmes (EEPs), these decisions are, as we understand it, taken with regard also to their involvement in these programmes.

We first list the options (as they appear to us and that we have identified in our discussions) and then discuss each in turn. The possible options facing the elephant keeping zoos are:

1.   *Remove elephants from the UK*. Decide to stop keeping elephants in the UK and find ways to re-home them in zoos in other countries (which might or might not include their range countries);

2.   *Manage the national herd to extinction*. Take steps to tackle vigorously health and welfare problems, but avoid any further breeding or bringing any further animals into the UK from other European zoos or elsewhere so that, in time, there will be no elephants in UK zoos;

3.   *Continue to breed but cease imports*. Take steps to tackle vigorously health and welfare problems and continue to breed from the national herd but without any further imports into the UK;

4.   *Concerted improvement programme*. Take steps to tackle vigorously health and welfare problems whilst continuing, as part of Europe-wide collaboration, to import and export (between UK and other European countries) as necessary, for example for genetic reasons, in striving to maintain self-sustaining herds of one or both species into the future.

It would appear that Option 1 (*Remove elephants from the UK*) has little to recommend it, and is in any case probably impractical. (That is, as regards the UK population as a whole. These decisions are in the hands of the zoos and we do not wish to imply that, in individual cases, translocating elephants to other countries would be inadvisable in general: every case has to be judged on its own merits). The first requirement for this option would be to identify suitable accommodation for the animals elsewhere. The evidence we have seen indicates strongly that splitting family groups may lead to difficulties in terms of both welfare and reproductive performance and ideally, therefore, groups would need to be translocated together. Unless suitable high-quality accommodation should become available, the potential welfare disadvantages would be likely to outweigh any advantages unless the translocation was in order to contribute to a major, concerted, international, welfare and conservation initiative.

So, if it was judged that in the long run, elephants should not be kept in UK zoos because the costs (welfare or other) are not justified by the possible benefits, then Option 2, the management of the national herd to extinction, which would involve maintaining animals to the highest standards possible but preventing any further breeding, would appear to be the best way to achieve this. This process would be likely to take several decades.

However, arguably this would be an unsatisfactory approach because, if the animals are to be kept and efforts made, as they will have to be, to keep them to high welfare standards, then preventing breeding would seem, perhaps, unreasonable and out of step with accepted approaches to tackling welfare problems in other animals. Generally society seems to respond to welfare problems in kept animals – those on farms or kept as companions – by trying to prevent or treat the welfare problems rather than by managing the affected populations or breeds to extinction. This is a matter of judgement but we suggest that, only if there were no, or extremely little, prospect of progress in tackling health and welfare issues, would there be a completely compelling argument for this.

If on the other hand, it was judged that the potential benefits of elephant keeping in the UK outweigh the costs (welfare and other), and that it is likely to be possible to make satisfactory progress in tackling current health and welfare problems, then the choice is between Options 3 and 4.

Option 3 is to take steps to tackle vigorously health and welfare problems but cease imports. In the long run, if elephants are to be kept in the UK, they will have to be managed as part of the European population (and that as part of the world population). There would be no merit in establishing a separate, genetically isolated, population (which would inevitably be small) in the UK. Therefore, if the aim is for a breeding population (or populations) in the UK in the long term, there would be a need for animals to be translocated between the UK and other European countries.

Some have advocated that there should be no further imports until evidence is available of progress in tackling the problems outlined above, arguing that there would be little or no adverse genetic effect at least in the short term.

Options 2 and 3 above involve, respectively, discontinuing breeding and discontinuing imports. These could happen if elephant keeping zoos decided to adopt those options. It is not clear that such measures could be easily imposed on those zoos. Suffice it to say here, that legal and other aspects would need to be investigated and considered carefully.

Option 4 is to take steps to tackle vigorously health and welfare problems whilst continuing, as part of Europe-wide collaboration, to import and export as necessary in striving to maintain self-sustaining herds of one or both species into the future. This could offer a path towards sustainable captive populations of one or both species within the European Endangered Species Programmes and, like Option 3, for it to have a reasonable prospect of success, it would require a considerable improvement upon the present situation.

5. Discussion

Recent analyses and reviews of elephant records and husbandry in UK zoos show that there are some serious difficulties. There are some important and difficult welfare problems (e.g. high prevalence of lameness and fatal cases of EEHV), populations are not self-sustaining, and in addition major challenges can be foreseen in the management of bulls if breeding becomes more successful. The fact that elephants are kept indicates that zoos believe that they make a positive contribution to the zoos in pursuit of their objectives, and we have outlined the ways in which they may contribute.

5.1 Welfare

Are the welfare problems reviewed above unique to elephant keeping? Elephants are certainly not the only kept animals that have important welfare problems (the issue of population sustainability is discussed later). As noted in the sections on lameness, body condition and stereotypic behaviour, such problems occur in some other kept animals also. Are the problems worse or more prevalent in elephants than problems in other species? Making such judgements is difficult. A logical approach in trying to rank welfare problems (e.g. so as to identify where efforts and resources to tackle problems can most advantageously be directed), is to compare them in terms of:

- number or proportion of animals affected;

- how long animals are affected for (e.g. duration of pain or discomfort); and

- severity/intensity of the problem (e.g. intensity of pain or discomfort caused).

And, in deciding priorities, it is important also to take account of the possibility and feasibility of being able to tackle the problem.

Although this provides a logical approach, different people can reach different conclusions when using it. There can be difficulties in finding good data on the parameters that can be measured (numbers of animals affected and duration for which they are affected), but a deeper problem is that the assessment of severity/intensity involves a subjective step – a judgement about, for example, how much pain or discomfort a certain condition causes – and opinions on such matters can differ.

Elephants are very long-lived animals so, if an elephant is affected by a problem that, say, affects animals for a quarter of their lives (age-related arthritis perhaps), then whilst this might be only two years for a large dog it might be 20 years for an elephant. (However, we do not know how different species experience time and so it is appropriate to be cautious about such comparisons.)

It does not seem reasonable to conclude that the welfare problems seen in elephants are categorically worse than those that occur in some other kept species, although there is no doubt that improvement is essential. As knowledge is gained of animals' needs, and of how those needs can be met, health and welfare problems can be tackled. By this mechanism, advances have gradually been made in preventing or controlling health and welfare problems in many species of animals (domesticated and non-domesticated). There is no species for which it is possible to say this process has been completed – there are always more welfare problems to be tackled. The degree of progress made in determining needs and in meeting these needs varies between species (and, in some cases, between breeds within species). In all cases there is a need for further progress. Recognising this, the England Implementation Group (EIG), the Group established to help drive forward the implementation of the Animal Health and Welfare Strategy, proposed an approach whereby all animal keeping sectors would identify a list of welfare priorities and plans for tackling these so that concerted efforts to address problems on a rolling basis could be made.

Clearly there are important improvements to be made in elephant husbandry. However, whilst some of the problems are significant and challenging to address, there seems no reason to conclude that the degree to which the welfare of elephants *could* be met in zoo environments in the UK is

fundamentally different from the degree to which the welfare of other kept animals can or could be met. However, the size, power, and longevity of these animals correspondingly affects the scale of the challenge particularly in view of the significant welfare problems. The constraints include, in some cases, lack of knowledge of how problems can be prevented (e.g. EEHV) and, since we gather that not all zoos are compliant with all elements of the BIAZA audit, we can infer that in some cases there may have been other constraints to husbandry improvements.

5.2   Population sustainability

To date, the captive populations of Asian and African elephants have not been self-sustaining. In this respect zoo elephant populations differ from those of domesticated companion and farmed animals, and many other non-domesticated species kept in zoos and as companion animals. Advances in husbandry have resulted in many species now being bred successfully in captivity and in the maintenance of self-sustaining populations (e.g. Conway, 1980; Kleiman et al, 1982; Ralls & Ballou, 2004; Wich et al, 2009). These advances have, however, been gradual. Whereas there were self-sustaining captive populations of only a few wild animal species fifty years ago, many species are bred sustainably now. It seems possible that part of the reason why progress has been slower in establishing self-sustaining populations of elephants is to do with their very long life cycles: the interval between generations is at least ten years. For this reason, assessing the consequences of changes in husbandry procedures aimed at improving rates of reproduction (or of reducing mortality in breeding age elephants) is inevitably a slow process.

The discussion above is addressed at the level of the UK zoo elephant herd. However, this comprises approximately 70 animals in total, about half of which are African and half Asian. These animals have different histories and are kept in 13 zoos. We should be cautious about assuming, in trying to draw broad conclusions, that this is a homogenous population. Whilst the animals (some of them) may be part of European breeding programmes, zoos manage, care for and make decisions about them as individuals. The treatment and care of each individual animal, and what is best for its quality of life and its future, are matters for its curatorial and veterinary staff.

Elephants are likely to continue to be kept in the UK for a considerable time (probably several decades), regardless of the options for the future listed in Section 4 (except the first). It is very important, therefore that there should be a vigorous and concerted effort to tackle the problems identified.

6.   Recommendations

There is a need for concerted and vigorous efforts to tackle the health and welfare issues discussed above and, if zoos wish to keep elephants into the future, to tackle the sustainability issues also. In view of the importance of these issues, clear progress needs to be made and this will need to be monitored.

We propose that an independent Elephant Advisory Group be established to advise upon, encourage, and monitor progress of vigorous efforts to tackle these issues and that there should be a comprehensive review of progress in ten years time, with an interim review in five years time. We suggest that this group be established by, and report to, Defra. The body proposed here is similar to

those envisaged by the England Implementation Group for other livestock sectors – to identify welfare priorities and drive coordinated efforts to tackle them. In similar fashion, the recently published report of the Associate Parliamentary Group for Animal Welfare (APGAW) on pedigree dogs, proposes an independent group that works through the Kennel Club to provide advice and recommendations (APGAW, 2009). The Elephant Advisory Group would fit within this model, reporting to Defra but working in cooperation with, and through, BIAZA.

These and other recommendations are outlined below.

Not all of the Forum Members agreed with the proposal about the establishment of an independent Elephant Advisory Group constituted as set out in 6.1 below.   Five members believe that, instead of this new body, the new BIAZA Elephant Welfare Group should, strengthened by further expertise, address the issues identified and proposed below for the independent Elephant Advisory Group.

Those who disagreed with the proposal for an independent elephant advisory group wished to include the following description of the alternative that they propose. The new BIAZA Elephant Welfare Group at present has ten members; five are employed by zoos (four by elephant-keeping zoos), one member is employed by BIAZA and four are independent members without zoo attachments. Representatives from RSPCA and UFAW were invited for additional independent expertise, but have declined. The group currently includes four published welfare scientists and three veterinary surgeons. The group's terms of reference, working within the European Endangered species Programme (EEP), are: "*1. to ensure that elephants in the UK collections are maintained to the highest standards based on current knowledge, and 2. to ensure strategic research is carried out to advance our evidence-based knowledge relating to the welfare of elephants to support objective 1*". The Group is responsible for oversight of the BIAZA Elephant Focus Group, whose membership includes a representative of each of the 13 elephant-keeping zoos in the British Isles, and which for a decade (initially as the elephant Taxon Advisory Group) has concentrated particularly on more practical aspects of elephant husbandry and welfare, and has produced and updated the current husbandry guidelines.

6.1   Remit and composition of the Elephant Advisory Group

There is a need for an independent Elephant Advisory Group (see below) to advise upon, encourage, and monitor progress in the further development of the elephant husbandry and welfare programme in the UK (that will need to be in liaison with other European elephant zoos). It is proposed that its role would include addressing the issues identified below:

- planning and driving a programme of improvements;
- development of husbandry advice where needed;
- encouraging and monitoring coordination; and
- monitoring progress

This is not to imply that good progress has not been made in these areas already. BIAZA established an Elephant Focus Group several years ago. This has already made progress in changes to the captive environment and includes representatives of the elephant keeping zoos.

Leadership in planning a programme of improvements

In the discussion above we have identified issues where there appears to be a need for driving forward planning and to monitor implementation and improvements. For example, there appears to be a need for a programme of nationwide EEHV and TB screening, and there is a need for clear planning about the management of bulls as this will very soon become a challenging problem especially if breeding success increases.

Development of husbandry advice/guidelines

Although Harris *et al* (2008) found some correlations between health or welfare parameters and husbandry practices, the results were, for the most part, not such as to provide a basis for formulation of clear and firm advice about steps necessary to tackle the problems identified. For example, although '*the vast majority were scored as 2.0, subjectively described as '*slightly to moderately*' overweight*' (Harris *et al*, 2008, p. 45), the results do not provide a basis for providing specific guidance on daily energy provision or exercise needs (e.g. kilometres travelled per day).

There is therefore a need to develop guidance where it does not exist already.

Coordination

Progress will, to some extent, depend upon close coordination and co-operation among the elephant keeping zoos. The Elephant Advisory Group will need to encourage and monitor coordination.

Monitoring progress

Crucial to making progress is determination of which husbandry systems and practices lead to improvements in elephant health, breeding and welfare. The Elephant Advisory Group will need to monitor health, breeding and welfare in the UK population (and take note of advances elsewhere) so as to provide advice about best practice.

Composition of the Elephant Advisory Group

An Elephant Focus Group exists within BIAZA, which focuses its activities on improving the husbandry and welfare of captive elephants in the UK. Indeed it has played an active role in the developments identified by Harris *et al.* (2008) that were detailed above (Section 1.3). More recently, we are aware of changes that it has recommended to the BIAZA Management Guidelines for Elephants in response to the challenges highlighted by the Harris *et al* report (we understand that the new Management Guidelines have recently been finalised). Whilst we envisage that the independent Elephant Advisory Group proposed here would include zoo specialists (e.g. curatorial and veterinary), incorporating and building upon the strengths of the BIAZA group, we strongly recommend that it should also include wider expertise (e.g. other elephant, veterinary, reproductive biology, statistics and animal welfare science specialists).

Indicative issues identified by the Zoos Forum for the Elephant Advisory Group to consider and ensure are addressed (and see above):

- development of scientifically based nutritional guidelines
- development of a body mass index chart that takes into consideration species, age and sex to facilitate the maintenance of healthy weight to height ratios
- establishment of guidance on exercise requirements
- development of a health programme including screening and preventative measures, clinical and pathological investigations
- drafting of standards on elephant keeping for the Secretary of State's consideration for inclusion in the SSSMZP
- a review of causes of lameness to inform best practice on preventative measures
- development of a protocol for welfare assessment and monitoring
- development and promotion of knowledge and expertise in lameness detection and locomotion analysis through workshop meetings between elephant keepers, veterinarians and scientists
- development of a strategy for bull management (in liaison with the European Endangered Species Breeding Programme)
- ongoing review of demographics (to monitor progress with breeding and reduction in mortality)
- ongoing review of elephant health and welfare (to monitor progress with improvements)
- ongoing review of relevant scientific developments
- identify research needs and ways to address these
- development of criteria for assessment of progress at the five and ten year reviews
- movement of animals

6.2 Monitoring and review of progress

We recommend that there should be an independent comprehensive review of progress in ten years time (to compare, among other things, indices of health and welfare, survivability and reproduction, with those published by Harris *et al* (2008) and the other researchers referred to in this Report), with an interim review in five years time. In recommending a review in ten years, we are aware that some effects of improvements in housing and husbandry on health and reproductive performance may not be manifested until the next generation (*i.e.* over a period that is longer than ten years) and, obviously, the history of individual animals will need to be taken into account in any review. Such a review will need to be able to make comparisons with the Harris *et al* (2008) study, whose data should be kept safe and made available to the individual zoos. However, it seems very reasonable to expect evidence of improvements within this time scale and of improvements in concerted cooperation between zoos on these important issues.

6.3 Recommendations for zoos

As noted above, we envisage it to be the role of the Elephant Advisory Group to develop and set out the matters that individual zoos should address. We do not wish to pre-judge this but strongly recommend that the list should cover the following topics:

- zoos must participate constructively with the Elephant Advisory Group either individually or through BIAZA (e.g. infectious disease screening programmes, workshops on locomotion scoring);
- zoos must positively address the means to enable elephants to maximise outdoor access and put measures in place to enrich indoor and outdoor environments (day and night);
- elephants should be weighed regularly (at least quarterly, but the appropriate frequency to be established in the light of individual health needs);
- the body mass index chart (see above)should be applied to facilitate the maintenance of healthy weight to height ratio;
- opportunities to exercise must be ensured in line with Elephant Advisory Group recommendations;
- browse (twigs and branches) must be provided every day;
- forage should be analysed by appropriate laboratories on a regular basis to ensure diets keep within the nutritional guidelines;
- monitoring and recording should be undertaken of health, welfare and other parameters as specified by the Elephant Advisory Group in its efforts to monitor progress in the national herd and to identify best practice; and
- zoos must ensure adequate training for all staff. There is a need for systematic elephant keeper training and sharing of good evidence-based practice across the UK, and this should take advantage of links across the rest of Europe and more globally.

6.4   Recommendations concerning the Secretary of State's Standards of Modern Zoo Practice

The Secretary of State's Standards of Modern Zoo Practice (SSSMZP) set out general standards regarding the husbandry of zoo animals. More specific information is provided for some taxa (e.g. birds of prey, waterfowl) in Appendix 8 of the SSSMZP. Zoo Inspectors are required to take account of these standards in undertaking zoo inspections and making their recommendations to local authorities as to whether to grant a licence under the Zoo Licensing Act 1981 (as amended 2002) or not. At present, no specific standards are included in the SSSMZP regarding elephants. We recommend that a section be included in Appendix 8 with specific standards for elephants. We suggest that the Elephant Advisory Group should draft these for consideration by Defra. Here again, we would not wish to prejudge the content but suggest that points to be covered might include the following:

- elephants should be weighed regularly (at least quarterly, but the appropriate frequency to be established in the light of individual health needs);
- elephants must have the opportunity, and steps should be taken to strongly encourage elephants to engage in suitable levels of daily exercise, and records kept regarding this;
- browse must be provided every day;
- forage should be analysed by appropriate laboratories on a regular basis to keep diets within the nutritional guidelines;
- elephant keeping zoos must engage constructively with the Elephant Advisory Group, including monitoring and recording of health, welfare and other parameters as specified by the Elephant Advisory Group in its efforts to monitor progress in the national herd and to identify best practice; and

- elephant keepers should be involved in continuing professional development regarding elephant husbandry.

7.   Acknowledgements

8.   References

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9. Appendices

9.1 The elephants in UK zoos

| Collection	Asian		African		Total
	Male	Female	Male	Female	
Belfast [†]	0	3	0	0	3
Blackpool	0	4	0	0	4
Blair Drummond	0	0	0	3	3
Chester [*]	3	7	0	0	10
Colchester [*]	0	0	3	4	7
Howletts [*]	0	0	3	9	12
Knowsley [*]	0	0	1	6	7
Paignton	0	1	0	1	2
Port Lympne	0	0	1	2	4
Twycross [†]	0	4	0	0	4
West Midland Safari Park	0	0	1	2	3
Whipsnade [*]	2	6	0	0	8
Woburn	1	2	0	0	3
Total	6	31	8	25	70

Table 1: Status of UK zoo population of African and Asian elephants (adapted from Field and Plumb, 2007; ISIS, 2009). [*] Zoos that are currently breeding; [†] Zoos at which females have bred but are not currently doing so.

9.2 Elephants Worldwide

- Distribution maps (reproduced BIAZA maps from pages 17-19 of the BIAZA Management Guidelines)
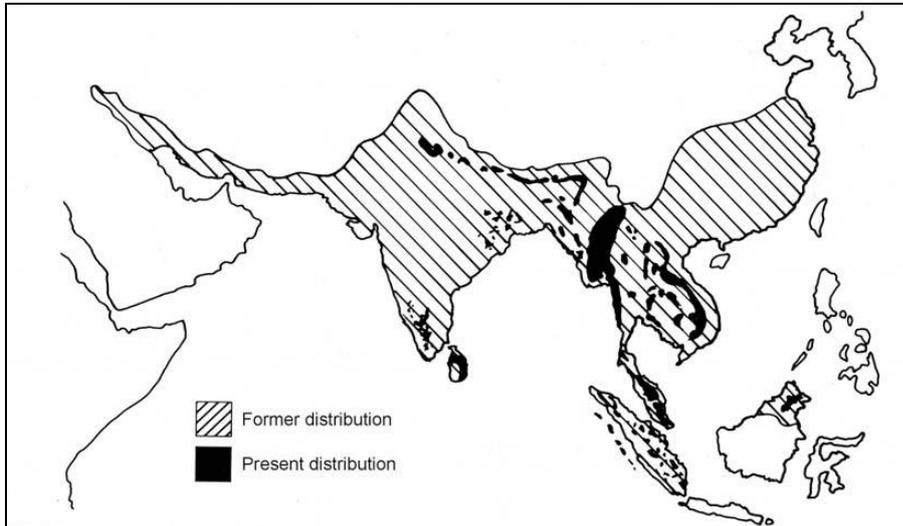
Current and former distribution of Asian Elephant (BIAZA 2006, reproduced with permission)
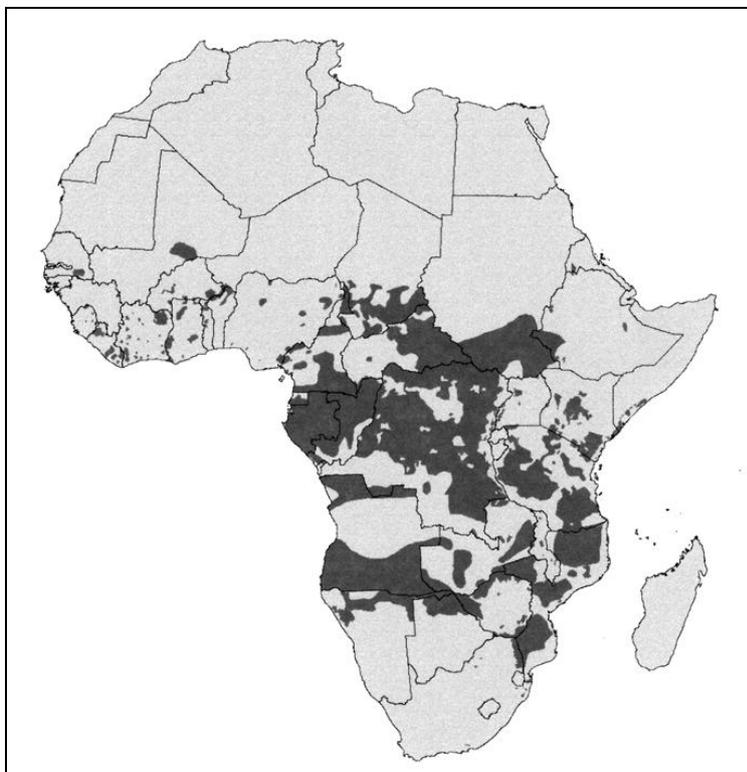
Current distribution of African Elephant (BIAZA, 2006, reproduced with permission)

9.3   Zoos Forum Elephant Working Group

Membership
Dr Brian Bertram
Dr John Eddison (Chair of Working Group)
Alastair Grant
Raymond Ings
Dr James Kirkwood

The Working Group met on four occasions in 2009 (January, April, July and August) to discuss the issues. In addition, the working group solicited advice from experts and other interested parties that represented a broad range of knowledge and perspectives on welfare, behaviour and conservation of elephants and drawn from interest groups. In May 2009, the group heard presentations from, and engaged in discussion with, six of those individuals and received written submissions from five others. The means of selection of those who were asked for comment was through discussion amongst the Forum as a whole.

9.4   Persons consulted

We are most grateful to the following for their comments during our deliberations

Dr R. Atkinson (Wildlife Department, RSPCA)
Dr J. Cracknell (Marwell Zoo)
Dr A.J. Desai (Chair, IUCN**/**SSC Asian Elephant Specialist Group)
C. Draper (Born Free Foundation)
Dr H. Dublin (Chair, IUCN/SSC African Elephant Specialist Group)
Dr J. Hutchinson (Royal Veterinary College, University of London)
Prof P. Lee (University of Stirling)
Prof G. Mason (University of Guelph)
Dr P. Rees (University of Salford)
Dr H. Schwammer (Vienna Zoo & Chair of EAZA African Elephant EEP)
Dr M. Stevenson (BIAZA)