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# Are wild animals suited to a travelling circus life?

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## Abstract

*A comprehensive synopsis of the welfare of captive, wild (ie non-domesticated) animals in travelling circuses is missing. We examined circus animal welfare and, specifically, behaviour, health, living and travelling conditions. We compared the conditions of non-domesticated animals in circuses with their counterparts kept in zoos. Data on circus animals were very scarce; where data were absent, we inferred likely welfare implications based on zoo data. Circus animals spent the majority of the day confined, about 1–9% of the day performing/training and the remaining time in exercise pens. Exercise pens were significantly smaller than minimum zoo standards for outdoor enclosures. Behavioural budgets were restricted, with circus animals spending a great amount of time performing stereotypies, especially when shackled or confined in beast wagons. A higher degree of stereotyping in circuses may be indicative of poorer welfare. Inadequate diet and housing conditions, and the effects of repeated performances, can lead to significant health problems. Circus animals travel frequently and the associated forced movement, human handling, noise, trailer movement and confinement are important stressors. Although there is no conclusive evidence as to whether animals habituate to travel, confinement in beast wagons for long timeperiods is a definite welfare concern. Circuses have a limited ability to make improvements, such as increased space, environmental enrichment and appropriate social housing. Consequently, we argue that non-domesticated animals, suitable for circus life, should exhibit low space requirements, simple social structures, low cognitive function, non-specialist ecological requirements and an ability to be transported without adverse welfare effects. None of the commonest species exhibited by circuses, such as elephants and large felids, currently meet these criteria. We conclude that the species of non-domesticated animals commonly kept in circuses appear the least suited to a circus life.*

**Keywords**: *animal welfare, circus, health, husbandry, performance, stress, travel*

## Introduction

Captivity constrains an animal's behaviours and restricts appropriate, or allows inappropriate, social interactions, both intra- and inter-specifically (Price 1999). Wild (ie non-domesticated) animals that have been bred for tens of generations in captivity still show extremely high motivation to perform certain activities seen in their wild counterparts (eg Mason *et al* 2001; Jegstrup *et al* 2005). The restrictions that captivity imposes on an animal's behaviours are increasingly being recognised as deleterious for an animal's cognitive development, normal social development and, later in life, reproduction and health (Carlstead & Shepherdson 2000; Knight 2001; Würbel 2001). As a consequence, the welfare of non-domesticated animals kept in captivity is being scrutinised at length in zoos, in laboratories, fur farms and, to some extent, in private ownership (Carlstead & Shepherdson 2000; Schuppli & Fraser 2000; Mason *et al* 2001; Würbel 2001). In a limited way, zoos try to justify any negative effects of captivity through the benefits they claim to bring, such as conservation and education, and have taken steps to review whether such benefits actually accrue (Zimmermann *et al* 2007).

Non-domesticated animals in circuses and establishments of the film and stills industry are kept in captivity for entertainment. Hediger (1955) stated that circuses were good environments for animals because they were financially better off than zoos and they provided a stimulating environment in comparison to barren zoo cages. However, a modern comprehensive overview of all aspects of animal welfare in circuses is absent (Radford 2007), and the limited peer-reviewed literature has generally focused on single issues (eg housing: Friend & Parker 1999; stereotypic behaviour: Gruber *et al* 2000; transport: Nevill & Friend 2003) without considering the overall welfare of the animals.

According to the World Association of Zoos and Aquariums (WAZA 2006), whenever wild animals are used in presentations or shows in member establishments, there must be a conservation or educational value without trivialising the animals. Thus, WAZA is against the inappropriate keeping of animals, such as in circuses. Similarly, the British and Irish Association of Zoos and Aquariums (BIAZA) does not allow member establishments to pass its animals to circuses (BIAZA 2005). Elephant researchers state that "…elephants

should not be used in circuses" (Amboseli Elephant Research Project 2007). Moreover, in addition to animal welfare considerations, several species widely kept in circuses pose serious concerns in terms of risk to the public. The number of keepers and visitors injured or killed worldwide (1–11 per year during 1982–2004) by African (*Loxodonta africana*) and Asian (*Elephas maximus*) elephants in zoos (Gore *et al* 2006) and captive tiger (*Panthera tigris*) attacks on people in USA circuses and theme parks (1.75 fatal, 9 non-fatal attacks per year [Nyhus *et al* 2003]) seem to represent a disproportionate threat in proportion to their number (360–720 times greater risk of a fatal attack than a domestic dog [Nyhus *et al* 2003]). Elephants and tigers are the main causes of occupational fatalities for circus workers and zoo keepers in the USA (Langley & Hunter 2001).

In this context, we examine the welfare of non-domesticated animals in circuses and the extent to which their lives differ from other captive animals' lives. We focus on European, and especially UK circuses as worldwide data are sparse and mainly available from non peer-reviewed literature. We attempt to review all animals commonly kept in circuses worldwide but, inevitably, research has focused on a few species which are best represented in our examples. Where data were lacking for some measures, we have reviewed the evidence available from studies of animals in other captive situations, such as zoos and, secondarily, laboratories and farms. Out of necessity, some of this literature includes domestic animals. We believe this comparison to be valid for two reasons. Firstly, zoos keep all of the species commonly used in circuses and, in both cases, the history of the animals (captive-bred or wild-caught, owned by one or several institutions) is comparable. Secondly, despite being domesticated and adapted to living with humans, domestic species are still liable to experience negative welfare whenever the ability to perform highly-motivated behaviours, inherited from their wild ancestors, is thwarted (eg Goodwin 1999; Schrøder-Petersen & Simonsen 2001; Cooper & Albentosa 2005). For these reasons, we think it reasonable to assume that any shortfalls in the level of welfare of zoo, laboratory or farm animals is equally, or more likely, to apply to other captive wild animals in similar situations. In this paper, we first review the number and origin of animals involved in the circus industry. Following a framework initially developed to assess the suitability of exotic species as pets (Schuppli & Fraser 2000), we then examine whether non-domesticated animals are suited to living in circuses. In particular, we review: (i) the welfare of non-domesticated animals in circuses (living and travelling conditions, behaviour, health and performance) and, (ii) following this, drawing on the evidence collated, we assess whether non-domesticated animals are suited to a circus life.

## Materials and methods

We searched for relevant, peer-reviewed and non-peer-reviewed literature on circus animals through electronic databases (ISI Web of Science, BIOSIS Previews, Copac), the Worldwide Web (www.google.co.uk, www.scholar.google.com), and the bibliography of significant reports (Cox 1998; Clubb & Mason 2002) following the methodology proposed by Pullin and Stewart (2006). We used the search terms ('circus AND animal', '*Panthera tigris* AND circus', 'tiger AND circus', 'primate AND circus', '*Elephas* AND circus', '*Loxodonta* AND circus', 'elephant AND circus'). In addition, we searched the Worldwide Web to investigate travel habits of European and North American circuses using 'circus AND touring schedule', and 'circus AND transport' as search terms.

## The numbers and origin of non-domesticated animals in circuses

There are two types of circuses: static and travelling. In this review, 'circus' refers to a travelling group of entertainers and animals. The animals are confined in 'beast wagons' when travelling and for a certain period of time after arriving at a location. Beast wagons are transport containers that are typically small enough to be carried on a long trailer. Alternatively, animals are held in exercise pens on site (larger cages, connected to the beast wagon) when they are not performing. When not on tour they are held at one location, such as winter quarters, but very little information on these facilities is readily available, so we did not include them in this review.

The total number of animals kept in captivity in circuses worldwide is unknown; estimates (including domestic animals) range from a minimum of 2,400 to a maximum of 5,900 individuals in Europe (Galhardo 2005). In British circuses, there were approximately 513 wild and domestic animals in 1990 (Kiley-Worthington 1990); since then, the number of non-domesticated animals has declined from 92 individuals recorded in 1997 to 33 in 2005 (Born Free Foundation & RSPCA 2006) and to 47 in 2007 (Radford 2007), perhaps partially due to the outbreak of foot-and-mouth disease in 2000–2001. In the period 1975–2005, the total number of animals officially exported globally for circus and travelling exhibition purposes was about 25,500 (Table 1). Of these, carnivores (31%), birds (27%) and reptiles (22%) represent about 80% of the trade, whilst the most traded species are tigers with 3,003 individuals, brown bears (*Ursus arctos*) with 1,866, pythons (*Python* spp) with 1,808, macaques (*Macaca* spp) with 1,547, lions (*Panthera leo*) with 1,473, lovebirds (*Agapornis* spp) with 1,283 and Asian elephants with 1,168. For some species, a considerable number of non-domesticated individuals are housed in circuses. For instance, worldwide, about 31% of all captive African and Asian elephants are kept in circuses (although this figure is based on a total that underestimates the number of working elephants in Asia, see Clubb & Mason [2002]). Some 800 captive tigers are involved in global conservation strategies, whilst estimates of privately-owned individuals (including exotic pets and those in non-accredited zoos, circuses, and safari parks) vary between 5,000 and 12,000 (Nyhus *et al* 2003). This number is greater than the number of breeding individuals in the wild (Cat Specialist Group 2002) and is outside management for breeding and reintroduction purposes.

Similarly, data on the origin of animals in circuses are very scarce. Kiley-Worthington (1990) reported that 40% of carnivores and 14% of ungulates in 15 British circuses were unwanted zoo animals, whereas approximately 94% of elephants were wild-caught. However, it must be noted that, although the remaining animals were classified as bred in circuses, the category 'circus' actually included 'private owners, market, etc' (Kiley-Worthington 1989a). This implies that an unknown percentage of animals classified as captive-bred in circuses were actually bred in other private facilities. *The International Tiger Studbook* (Müller 2004) has no record of the numbers of tigers bred in zoos and subsequently released to circuses, safari parks and private owners before the age of three. Consequently, an unknown proportion of captive-born tigers pass into private hands (Müller 2004). The origin and lineage of the majority of these animals is unknown but, as some zoo associations do not allow member establishments to pass its animals to circuses (eg BIAZA 2005), this source may be reduced in some countries. Thus, the contribution of circuses to captive breeding conservation programmes is, at best, negligible.

**Table 1 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) trade statistics on net export of all animal species officially traded worldwide for circus and travelling exhibition purposes in the period 1975–2005.**

| Taxon | Number of animals | Sub-total |
|---|---|---|
| *Carnivores* | | 7,888 |
| Felidae | 5,412 | |
| Ursidae | 2,348 | |
| Canidae | 128 | |
| *Reptiles and amphibians* | | 5,687 |
| Snakes | 2,827 | |
| Lizards and geckos | 1,117 | |
| Chameleons | 516 | |
| Crocodiles | 817 | |
| Tortoises | 281 | |
| Frogs | 129 | |
| *Cetaceans and seals* | | 508 |
| *Primates* | | 2,889 |
| *Birds* | | 6,769 |
| Parrots | 1,341 | |
| Birds of prey | 309 | |
| Other | 5,119 | |
| *Herbivores* | | 1,838 |
| Elephants | 1,640 | |
| Others | 198 | |
| **Total** | | 25,579 |

Data derived from the CITES Trade Database, UNEP World Conservation Monitoring Centre, Cambridge, UK.

## Welfare of circus animals

To identify an acceptable level of welfare for captive animals, a comparison can be made with free-ranging animals (Barnard & Hurst 1996). The range of activities and behaviours performed by free animals, the time spent in each activity/behaviour, reproductive lifespan and life expectancy can be used to assess the welfare of captive animals. However, such a comparison is not always straightforward — a difference in activity budgets between wild and captive animals does not necessarily imply poor welfare — but, used alongside other measures of welfare, it can provide useful information. In addition, it is useful to compare the welfare of circus animals with the welfare of other captive animals, eg the criteria developed by the Farm Animal Welfare Council (1992), which are based on 'five freedoms': from hunger and thirst; from discomfort; from pain, injury and disease; to express normal behaviour; and from fear and distress (Farm Animal Welfare Council 1992). In the following sections, we review the implications of a circus life for animal welfare from general aspects, such as husbandry, to aspects specific to circuses, such as performance and frequent transport. We then assess the effects that captivity and, specifically, circuses, have on behaviour, health and reproduction.

### Limitations in space availability

In captivity, space is limited when compared to free-living animals; however, even compared to zoo enclosures, minimum guidelines for circus cages and pens provide a lower amount of space, on average only 26.3 (± 8.2)% of the recommended size for zoo outdoor enclosures (Table 2). Beast wagons provide, on average, 27.5 (± 4.2)% of the recommended size for zoo indoor enclosures (Table 2). However, guidelines vary country-by-country. For instance, in Australia (Department of Agriculture, Fisheries and Forestry 2007), governmental guidelines for circus cages/exercise pens are generally larger than those recommended for Great Britain (large felids: AU = 60 $m^2$, GB = 76 $m^2$; ungulates/camelids: AU = 100 $m^2$, GB = 7.5–12.0 $m^2$; elephants: AU = 800 $m^2$, GB = 100$m^2$), with those from New Zealand falling somewhere in between (Ministry of Agriculture and Forestry 2005). There are no clear guidelines for species in many other countries, but descriptions of enclosure sizes for many species are similar to those in Table 2, eg for the USA, tiger beast wagon = 9.0 $m^2$ (Krawczel *et al* 2005); pen for 1–5 elephants = 80–150 $m^2$ (Gruber *et al* 2000).

Captivity-related stress caused by reduced space is believed to be more acute the more wide-ranging the species (Forthman-Quick 1984; Clubb & Mason 2003). Clubb and Mason (2003) suggest that zoos could stop housing wide-ranging species and instead house species that do not show adverse effects of captivity. We argue that this should also apply to circuses.

**Table 2 Recommended minimum cage size ($m^2$) in European circuses compared to minimum ($m^2$) or mean (± SEM) enclosure size ($m^2$) in European zoos, for some species commonly held in circuses.**

| | Large felids | Bears | Zebra | Camel | Pygmy hippo | Giraffes | Elephants | Primates |
|---|---|---|---|---|---|---|---|---|
| Number of animals in the same circus/zoo/pen | 1–5 | 1–5 | 1 | 1 | 1 | 1–3 | 1–3 | 1–2 |
| Circus cage/pen | 76.0 | 76.0 | 7.5 | 12.0 | 12.0 | 250.0 | 100.0 | 10.0 |
| Zoo enclosure outdoors | 118.5 (± 25.5) | 233.7 (± 79.6) | 350.0 (± 89.0) | 212.5 (± 37.5) | 100.0 (± 70.7) | 436.0 | 500 (± 108.0) | 60.0 |
| Circus cage as percentage of zoo enclosure outdoors | 64.1% | 32.5% | 2.1% | 5.6% | 12.0% | 57.4% | 20.0% | 16.7% |
| Circus beast wagon | 12.0 | 12.0 | – | – | – | 12.0 | – | 6.0 |
| Zoo enclosure indoors | 36.0 (± 9.0) | 40.5 (± 6.8) | 10 (± 1.2) | 10 (± 1.2) | 12.5 | 32.4 | 79.4 (± 19.4) | 60.0 |
| Circus cage as percentage of zoo enclosure indoors | 33.3% | 29.6% | – | – | – | 37.1% | – | 10.0% |

Average enclosure size was calculated across the values provided by different references and/or for different species in the same reference (eg for large felids). The species chosen as representatives of each category are those highlighted by the Association of Circus Proprietors of Great Britain (2001) as acceptable circus species. All circus data were taken from the British Association of Circus Proprietors (2001), zoo data from Born Free Foundation & RSPCA (2006), with the exception of the pygmy hippo (B Steck, personal communication 2006), giraffes (Lee 1991), and primates (capuchins, Gsandtner *et al* 1997). Figures were recalculated to account for the maximum number of animals kept in a circus/zoo enclosure, only using data from European zoos (Association of British Wild Animal Keepers, Belgium, BIAZA, Germany, Switzerland, City of Vienna).

## Limitations in available social interactions

In circuses and, generally, in captivity, it is often unavoidable that social animals are housed singly, in groups smaller than the average in the wild or in unnatural groupings, thereby preventing the establishment of normal social dynamics. This can have significant negative consequences for behaviour, welfare and reproduction (see review in Price & Stoinski 2007). Circuses often exchange animals with other institutions or obtain adults rather than breeding them in-house (Kiley-Worthington 1990; Fleming 1994; Galhardo 2005); this is especially true with animals difficult to breed in captivity, such as African and Asian elephants (Kurt & Khyne U Mar 1996; Taylor & Poole 1998; Brown *et al* 2004). This disrupts any existing group social bonds that highly social animals, such as elephants, may have developed in their former, captive environment and has potentially serious consequences for animal welfare and future reproduction (Kurt & Khyne U Mar 1996; Taylor & Poole 1998; Brown *et al* 2004).

## Training and performance

It has been suggested that training and performance in circuses is compensation for a less natural habitat and lifestyle (Hediger 1955), such as are found in the wild and in good zoos. However, this assertion is yet to be fully tested (eg Nevill & Friend 2006). Performance and training contribute a small part to the daily behavioural budget, 1–9% of the day in circus animals (Schmid 1995; Nevill & Friend 2006). Training, based on reward (positive reinforcement), may enhance health and reproductive potential of captive animals, and is recognised by zoo managers as a useful tool to improve captive species management (Desmond & Laule 1994). Training by means of negative reinforcement and/or punishment may be the cause of poor welfare for the captive animal and can also establish a poor relationship between trainer and animal (Siemoneit-Barum 1995; Hemsworth & Barnett 2000). Kiley-Worthington (1990), during 200 h observation in British circuses, witnessed no signs of prolonged or acute distress. Some of the animals initially showed fear and anxiety before becoming accustomed to trainers; others showed frustration and avoidance behaviours and refusal to perform certain acts (Kiley-Worthington 1990). The training observed included reducing levels of fear, positive reinforcement, infrequent negative reinforcement (the use of body posture and sticks or whips for controlling the animal's movement) but no evidence of cruelty. However, not enough training was practised, it lacked innovation and it was not always appropriate for the species; overall, there were not enough good trainers (Kiley-Worthington 1989b, 1990).

Performance acts in the presence of spectators may cause severe stress to non-domesticated animals. Loud noise is a well-known stressor in captive animals; acoustical stress within and outside the human hearing range can cause critical alteration in physiological parameters (Stoskopf 1983; Bowles & Thompson 1996). Tigers may develop gastroenteritis as a consequence of persistent, loud noise (Cociu *et al* 1974). It has

**Table 3 Travel data for European and North American (USA and Canada) circuses extracted from tour schedules between February and December 2007, available online (search performed on 30 May 2007).**

| Variable | Europe | North America | Total |
|---|---|---|---|
| Number of circuses | 10 | 7 | 17 |
| Number of trips | 89 | 64 | 153 |
| Mean (± SEM) resting days | 1.9 (± 0.6) | 2.6 (± 1.2) | 2.2 (± 0.6) |
| Mean (± SEM) days spent at one location | 8.5 (± 1.5) | 4.7 (± 1.7) | 6.9 (± 1.2) |
| Mean (± SEM) distance travelled between locations (km) | 167.4 (± 57.1)* | 473.7 (± 182.1)* | 293.5 (± 81.2) |

* Significant difference ($t_{15}$ = –2.17, $P$ = 0.05).

been suggested high noise and brilliant light, during circus performances, may have predisposed an Indian python (*Python molurus*) to the infection and septicaemia which led to its subsequent death (Martínez *et al* 2006). Loud noise and the presence of human crowds can cause huddling, aversive behaviour, vigilance and escape in captive primates, bears and wild ungulates (Thompson 1989; Birke 2002; Owen *et al* 2004). In circus tigers, pacing may peak at up to 80% in the hour leading up to performance and when the animals are on public display (Krawczel *et al* 2005); similarly, stereotyping increases prior to performance in circus elephants (Friend 1999). Although Friend (1999) and Krawczel *et al* (2005) concluded that the stereotypic behaviour was anticipatory, it could equally have been concluded that stereotyping indicated anxiety or frustration. The majority of the evidence available suggests that human audiences have stressful effects on non-domesticated animals (Hosey 2000).

## The effects of travel

Forced movement, human handling, noise, cage motion and confinement constitute sources of stress to captive animals; loading and unloading, presence of water and food, the opportunity for rest and climate are key welfare factors to consider during transportation (Hartung 2003; Anonymous 2004). Out of necessity, non-domesticated animals kept by circuses and the entertainment industry are required to travel frequently. We analysed 153 European and North American circus trips; the mean length of stay at one location was 6.9 (± 1.2) days (Table 3). There was a tendency for European circuses to stay longer at one location than their North American counterparts (*t*-test, $t_{15}$ = 1.84, $P$ = 0.09) but there was no difference in the number of resting days between sites ($t_{15}$ = –0.25, $P$ = 0.80; Table 3). As one would expect, North American circuses travelled on average longer distances than European circuses ($t_{15}$ = –2.17, $P$ = 0.05; Table 3). Of those analysed, 19 and 45% of European and North American trips, respectively, involved no resting days between trips.

Many factors act simultaneously to affect the welfare of transported animals, such as genetics, exposure to novelty, experience or husbandry (Grandin 1997). Non-domesticated animals and/or animals completely naïve to travel, show signs of behavioural and physiological distress when travelling (eg Trunkfield & Broom 1990; Montes *et al* 2004), even more than would be expected from physical restraint alone (López-Olvera *et al* 2006). In contrast, domesticated animals accustomed to handling are generally less stressed by being restrained and transported (review in Grandin 1997). To date, some studies suggest that circus elephants and tigers habituate to travel but, other than body temperature (Toscano *et al* 2001), only behavioural measures are available (Nevill & Friend 2003; Williams & Friend 2003; Nevill *et al* 2004). In a study on the transport environment in six USA circuses, only two circuses used insulated walls and high capacity ventilation fans to maintain internal temperatures within a safe range (Toscano *et al* 2001). The elephants transported did not experience temperatures outside their normal range, but drivers/handlers may be unaware of any critical temperature increase in the trailers as monitoring systems were absent. For elephants, movement in trailers is constrained because they are transported chained (Toscano *et al* 2001). In zoo tigers, pacing varies individually but altered cortisol levels persist for 3–6 days after transport in animals with experience of travelling (transported on at least two previous occasions) and 9–12 days in naïve tigers, suggesting that travelling is a stressful experience (Dembiec *et al* 2004). Kiley-Worthington (1990) stated that British circus animals appeared habituated to travel but that there was concern on welfare grounds because the animals were confined in the beast wagons for long periods. Domestic horses (*Equus caballus*) are frequently transported for sport and recreational purposes; those that have positive travel experiences (ie loading, transport density, careful driving) seem to habituate readily to travel but they are also likely to develop problems associated with frequent travel, such as fatigue, weight loss, restricted movement and disrupted feeding patterns (Waran & Cuddeford 1995; Waran *et al* 2002). On the other hand, many horses are transported throughout their lives with few problems (Waran *et al* 2002). Overall, there is limited evidence on the effect of transport-related stress in circus animals (Anonymous 2004) but confinement in

barren enclosures for long periods of time is of welfare concern; physiological data on a range of circus animal species are needed to elucidate whether travel negatively affects their welfare.

## Time budgets

In the wild, elephants (both species) spend anywhere between 40 and 75% of their time feeding (Sukumar 2003). Asian elephants may consume between 33.6–44.4 kg of grass (1.5–1.9% of their bodyweight) in 12 h (Sukumar 1992). African elephants can cover 30–50 km in a single day (Leuthold 1977) and African elephants spend 57% of daylight hours moving and feeding in the Okavango Delta (Evans 2006). In contrast, physical activity is limited in zoos and grazing is unavailable in 90% (18 out of 20) of European zoos keeping Asian elephants (Taylor & Poole 1998).

Circus animals, especially elephants, may be kept chained (shackled individually or picketed in lines) continuously for 12–23 hours per day when not performing (Schmid 1995; Friend & Parker 1999). In four circuses, elephants spent 12.6–22.7 hours per day shackled in an area 7–12 $m^2$, although they could only move as far as the length of the chain, ie 1–2 m, 0.3–8.2 hours per day in a paddock measuring 22.7–72.0 $m^2$ and 0.3–2.1 hours per day training or performing (Schmid 1995). Thus, performing or training typically occupy 1–9% of the day in circus animals (Schmid 1995; Nevill & Friend 2006). Both shackling and picketing severely restrict the degree of social contact amongst individuals, basically reducing it to adjacent elephants (Schmid 1995). However, many handlers claim that chaining is needed, not only for safety reasons, but also because many trainers regard it as a means of establishing and maintaining dominance (Schmid 1995; Friend & Parker 1999). Even when not chained, circus elephants are housed in barren pens surrounded by an electric fence which is viewed as a 'revolutionary' improvement to the lives of circus elephants (Cimino 1994). In her study of 15 British circuses, Kiley-Worthington (1990) reported that half of the elephants were allowed to move freely for one hour a day and that some spent the majority of the day in the electric-fenced pens. In a study of elephant behaviour, trainers acknowledged that penned elephants were more relaxed and showed reduced stereotypic behaviour (Friend & Parker 1999). Whilst some degree of socialisation is possible in penned elephants, uninhibited social interactions are not (Gruber *et al* 2000). When animals are unsupervised, objects that might be used by zoos as environmental enrichment (eg logs) are generally not provided by circuses as they may be used to break the barriers (Cimino 1994; Gruber *et al* 2000).

Kiley-Worthington (1990) noted that being shackled or confined semi-permanently in beast wagons or stalls severely restricted the behaviour of circus animals. For instance, there were times when carnivores did not have access to exercise areas and would be kept in the beast wagons (which lacked furniture) all day except for performances, or for periods of 10–12 h between arrival at a site in the evening and the following day. Similarly, the ungulates were often not taken out of their indoor enclosures for long periods and some were kept tied or isolated. Kiley-Worthington (1990) stated that this was unnecessary and should be eliminated, and that some circuses were taking steps to improve the situation.

## Stereotypies

It has long been recognised that captivity may have deleterious effects on an animal's behavioural patterns. Normal behaviour gives way to a higher percentage of inactivity and/or increased abnormal behaviour (self-directed behaviour or self-injury) and stereotypies (Mason 1991a). Stereotypies are repetitive behaviours with no apparent aim that develop when a captive animal is prevented from executing a highly-motivated behaviour (Mason 1991a). For instance, stereotypic pacing in captive carnivores generally increases during crepuscular hours (Weller & Bennett 2001) when wild carnivores are more active or, seasonally, when mate-seeking behaviour would be performed in the wild (Carlstead & Seidensticker 1991). Although it is difficult to make generalisations about stereotypies, they are commonly associated with a sub-optimal environment and poor or compromised welfare (Mason 1991b). That is probably why primates confiscated from touring zoos and circuses exhibit undesirable behaviour more than primates reared in recognised zoos (Mallapur & Choudhury 2003). Two studies examining transport in large felids found very similar levels of stereotypic behaviour in both zoo (22%) and circus (21.4%) animals (Nevill & Friend 2003; Dembiec *et al* 2004), possibly indicating that both are sub-optimal environments. In addition, gathering evidence suggests that stereotypies may also represent a captivity-induced dysfunction of the central nervous system (Garner & Mason 2002; Mason *et al* 2007).

Stereotypic pacing varies widely amongst zoo carnivores, from an average of 0.16% of observations in red foxes (*Vulpes vulpes*) to 30% in lions (*Panthera leo*) and 60% in tigers (Bashaw *et al* 2003; Clubb & Mason 2007). A significant proportion of this variation is explained by home range and daily distance travelled: species that travel over large distances in the wild show higher levels of stereotypic pacing in captivity (Clubb & Mason 2003, 2007). Hand-rearing also negatively influences the development of stereotypies. For instance, captive-bred, hand-reared bears, primates and African grey parrots (*Psittacus erithacus*) exhibit significantly more stereotypies than captive-bred, mother-reared individuals (Forthman & Bakeman 1992; Marriner & Drickamer 1994; Schmid *et al* 2006) and the development of feather plucking and chewing in psittacine birds has been linked to hand-rearing (Chitty 2003).

Stereotypies tend to increase in frequency with increasing restraint of movement and with more barren environments. For instance, circus elephants kept shackled or picketed, weave and head-nod more than in paddocks (Schmid 1995; Friend & Parker 1999), zoo bears and leopards (*Panthera pardus*) pace more in the smaller, off-exhibit enclosures than in the larger, on-exhibit enclosures (Mallapur & Chellam 2002; Montaudouin & Le Pape 2005), and captive parrots perform more oral and locomotory stereotypies in barren

cages than in enriched cages (Meehan *et al* 2004). Nevill and Friend (2006) found that access to an exercise pen for 20–40 min had no effect on pacing in six circus tigers. However, tiger activity in the pen was inversely related to pacing in the home cage, leading Nevill and Friend (2006) to conclude that access to an exercise pen is an important enrichment and that it should be considered for longer periods than 40 min. Some elephant handlers believe that stereotypic behaviour has some beneficial effects. For instance, weaving stereotypies are said to aid circulation in the same way that walking does in wild elephants (Friend 1999). The frequency (percentage of all observations) of stereotypic behaviour, however, is significantly greater (about 30%) in chained, circus elephants when compared to elephants in zoo or circus enclosures (about 4 and 10%, respectively [Clubb & Mason 2002]). There has been little work on stereotypies in circuses, but evidence from Britain suggests that all species of circus animal stereotype (Kiley-Worthington 1990). In both zoos and circuses, there was evidence of prolonged distress and abnormal behaviour but these were not any greater in circus animals than in zoo or other animal husbandry systems (Kiley-Worthington 1990). However, Kiley-Worthington (1990) did not consider pacing, bar chewing and pawing as stereotypies, although they are widely regarded as such (eg Mason & Rushen 2006). For felids in circuses and zoos, larger crowds are related to greater frequency of pacing (Mallapur & Chellam 2002; Krawczel *et al* 2005). As stereotypies normally indicate sub-optimal environments, a higher degree of stereotyping in circuses may be considered indicative of poorer welfare.

## Diet and health

Data on the diets of circus animals are scarce. Wiesner (1986) reported that protein deficiency is common in circus primates. When zoo elephants are kept on a sand surface, they may eat sand and stones to the detriment of their health (Schulze 1986). Occasionally, circus keepers, ignorant of plant toxicity, have fed inappropriate plants to elephants (Anderson 1968; Schaller 1983). Teeth problems (ie tooth abnormalities) occur as a consequence of incorrect feeding practices in captive elephants (Kurt & Hartl 1995) and wild ungulates (Boyd 1986); Kurt (1995) has never observed teeth abnormalities in wild Asian elephants, although it is difficult to examine wild elephants' teeth. Some diseases rarely encountered in the wild are present in captivity as a result of bad feeding practices (Banks *et al* 1999). For instance, circus lions developed botulism after consuming broiler chickens (Greenwood 1985).

The physical restrictions of the captive environment have adverse effects on captive animals' health. Elephants lacking physical exercise in zoos and circuses can become obese which, in turn, leads to joint defects and damaged feet and leg ligaments (Kurt & Hartl 1995). In a survey of 62 Asian and 5 African elephants from three circuses and five zoos, veterinarians found a high incidence of rheumatoid disorders and one of the authors observed chronic arthritis and lameness in captive elephants (Clark *et al* 1980). The development of lameness and foot problems is common in circus as well as zoo elephants (Lindau 1970; West 2001), and more common in zoo than wild elephants (Schmidt 1986). Joint and hernia problems are thought to result from circus elephants repeatedly assuming unnatural positions during performance (Lindau 1970; Kuntze 1989). In circuses, the lack of mud baths, which wild elephants typically use for skin care, commonly causes severe skin problems (Reitschel 2002). Other common health problems in circus animals in Germany are tuberculosis, protein deficiency in primates and mange in camelids (Wiesner 1986). Cross-species transmission may be faster and more common in captivity than in the wild. For instance, African elephants may transmit the lethal elephant endotheliotropic herpes virus (EEHV) to Asian elephants in European zoos (Fickel *et al* 2001). The two species do not meet in the wild. This virus is found in very young or stillborn calves, and represents a further threat (in addition to offspring infanticide and abandonment) to elephant reproductive success in captivity (Fickel *et al* 2001).

Many non-domesticated animals are kept outside their natural geographic distribution and this may have negative consequences for their health. For instance, veterinarians treating circus polar bears (*Ursus maritimus*) performing in Spain, linked signs of depression and inappetance to extremely hot weather conditions (Banks *et al* 1999) and, in colder and wetter climates, there is a greater incidence of foot infections in livestock (Vaarst *et al* 1998).

## Captivity-related stress

Restricted physical activity and social interaction, incorrect feeding practices or a forced reduction in the time spent foraging and in other highly-motivated behaviours, can represent stressors to non-domesticated animals. Stress can have short-term behavioural and physiological effects, as well as chronic, long-term, behavioural and physiological effects (Hemsworth & Barnett 2000; Moberg 2000; Morgan & Tromborg 2007). It has been suggested that the greatest stressor of captivity is the inability of captive animals to control the captive environment, ie the inability of confined individuals to escape or otherwise avoid the stressor (Sambrook & Buchanan-Smith 1997; Morgan & Tromborg 2007). The effects of even minor stresses combine to suppress immune function, reproduction, metabolism and behaviour (Moberg 2000).

The circus environment seems likely to induce behavioural problems of the sort noted in other impoverished environments with confined spaces, barren enclosures and social isolation. Such effects vary from reduced reproductive behaviour, exploratory behaviour and behavioural complexity to increased abnormal, vigilance and hiding behaviours, behavioural inhibition, aggression, fearfulness and freezing behaviour (review in Morgan & Tromborg 2007). Captivity-related stress is linked to the development of unusual diseases which affect captive-born and wild-caught but not wild, free-ranging cheetahs (*Acinonyx jubatus*; Terio *et al* 2004). Given that social isolation, reduced space allowance and inappropriate housing conditions cause profound stress in domestic species (review in

Morgan & Tromborg 2007) and, given that there is partial evidence of their effect on non-domesticated species as well, the housing conditions of circus animals are likely to cause severe stress to non-domesticated animals, although no data are available to test this hypothesis. On the other hand, as we show in the next section, captivity-induced stress impairs reproduction in many species.

### The effects of captivity-related stress on reproduction

Reproduction is not normally included in welfare assessments (but see Crane 2007). However, we discuss breeding in captivity because it shows that captivity-related stress in circus animals is sufficient to have an impact on reproductive success.

Many species are very difficult to breed in captivity as a consequence of the detrimental effects of the captive environment on an individual's development, modulation of stress and arousal, and on the modification of social interactions (Carlstead & Shepherdson 1994). Breeding failure of captive animals is common and its origin can almost invariably be linked to certain unnatural aspects of captivity (Lindburg & Fitch-Snyder 1994). Even if viable offspring are produced, the abandonment of the offspring by the mother is common. As a consequence, hand-rearing was a widespread practice in captive environments (Young 2003). However, hand-reared individuals may fail to develop normal social and reproductive behaviours and develop abnormal behaviours (King & Mellen 1994; Chitty 2003; Young 2003), which is the reason BIAZA-accredited zoos only recommend hand-rearing for pre-determined population management purposes, eg according to Taxon Advisory Group or European Endangered Species Programme recommendations (BIAZA 2005). It has been recommended that if hand-rearing is necessary in circuses, it should be accompanied by integration with conspecifics (Kiley-Worthington 1990). Hand-rearing and a lack of social interactions are the main cause of breeding failure in captive primates (King & Mellen 1994).

Elephants are very difficult to breed in captivity for several reasons, all of which are linked to environmental effects that are more acute in circuses than in zoos. Elephants are highly social and, in the wild, live in matriarchal societies where mothering skills are learnt through social experience (Kurt 1995; Kurt & Hartl 1995). In captivity, in contrast, elephants are moved between establishments, thereby disrupting existing social bonds amongst group members (Dathe *et al* 1992; Laws *et al* 2007) and thwarting the acquisition of mothering skills. Such treatment of females is thought to lead to the death of infants (Kurt 1995), and to be the cause of higher percentages of stillbirths and infant mortality, due to infanticide, in European zoos and circuses compared to the wild (Kurt & Khyne U Mar 1996; Taylor & Poole 1998). To prevent infanticide, females giving birth may be chained separately from the group (Schmid 1998). Stillbirths seem to have a correlation with an overweight mother and/or calf, and allowing female elephants more movement or changing feeding practices would decrease female obesity (Kurt & Khyne U Mar 1996). Another reason for the low or absent reproductive performance of elephants in circuses is the lack of bulls. The keeping of bulls is normally avoided in circuses for fear of aggression (Kurt & Hartl 1995). Aggressive behaviour is most pronounced in the period of *musth*; some handlers try to control aggressive bulls by beating them in sensitive areas such as the ears, eyes and penis, which is thought to cause circus bulls to refuse to breed (Kurt 1995; Kurt & Hartl 1995). For instance, of eight bull elephants kept in western European zoos, but formerly living in circuses, two were moved to zoos before the age of 15 (prior to sexual maturity) and successfully bred whilst five of the remaining six, which lived in circuses until after 15 years of age, refused to breed (Kurt 1995). Husbandry practices seem to be responsible for the lower reproductive success of elephants in European zoos and circuses when compared to Asian extensive keeping systems (Kurt 1995; Taylor & Poole 1998; Clubb & Mason 2002).

In the wild, environmental factors, such as resource availability, predation and climate, limit animal population reproduction, growth and mortality. In captivity, these environmental effects are limited. Consequently, reduced or non-existent reproductive lifespan (Mellen 1991; Kurt & Khyne U Mar 1996; Wielebnowski *et al* 2002), dysfunctional copulatory behaviour (ie failure to copulate), infanticide or abandonment of offspring due to social disruption or hand-rearing (King & Mellen 1994; Kurt & Khyne U Mar 1996), high infant mortality (Clubb & Mason 2007) and/or reduced life expectancy, all represent the deleterious effects of husbandry-related stress.

## Conclusions and animal welfare implications

This is the first study to review the welfare of non-domesticated animals in circuses and their suitability to a circus life. Information on circus animals is scarce, even to the extent that the origin of most circus animals and precise numbers kept, are unknown. In the UK, most animals appear to have been bred in captivity (Kiley-Worthington 1990) as opposed to being wild-caught, but this does not mean such animals are fundamentally different from free-living animals. We argue that there is no evidence to suggest that the natural needs of non-domesticated animals can be met through the living conditions and husbandry offered by circuses. Neither natural environment nor much natural behaviour can be recreated in circuses. Complex captive environments (naturalistic displays with plants, objects, perches, etc), such as those set up in good zoos can, in part, alleviate behavioural problems stemming from captivity and provide the animal with a diverse array of stimuli (Carlstead & Shepherdson 2000; Mason *et al* 2007). However, due to their mobile life, circuses have a limited ability to set up complex environments and a non-domesticated animal's life is consequently impoverished.

Captivity can induce poor welfare in non-domesticated animals but circuses, in particular, fail to provide some of their most basic social, spatial and feeding requirements. The ability to execute many natural behaviours is severely reduced, with partial evidence of a concomitant reduction in

welfare, health and reproduction, at least in the most well-studied species, such as African and Asian elephants. In many respects, and despite the lack of predation, food shortage and adverse environmental conditions, animals kept in captivity experience poorer welfare than animals of the same species living free (eg cheetahs, Terio *et al* 2004). Whilst it may be argued that hand-rearing, training and performance in circuses may be suitable compensation for a more natural habitat and lifestyle (Hediger 1955), such as are found in the wild and in good zoos, this hypothesis has not been tested. Given that circus animals spent only 1–9% of the day performing or in training, we do not think this would be the case. We found no data to suggest that training or performance of circus acts is enriching or harmful. In contrast, we found that human crowds are likely to cause stress to non-domesticated animals.

In Europe, the financial difficulties seen in the majority of small circuses (Fleming 1994; Galhardo 2005) enhance the risk of poor husbandry, veterinary care and feeding for the animals (Goldhorn & Kraft 1985). It must also be noted that most research on circus animals is conducted in the largest and better-financed circuses (eg Friend & Parker 1999; Gruber *et al* 2000; Nevill & Friend 2003) and, therefore, is likely to represent the best husbandry and welfare in circuses rather than representing a cross-section of conditions found in circuses with a range of finances. Thus, the data presented here are likely to be biased towards the best circuses, and are not representative of the norm.

Price (1984, 1999) argued that species differ in their degree of pre-adaptation to domestication and, for those species that have not been domesticated, the captive environment does not allow the expression of species-specific behaviours compatible with husbandry techniques. Circuses may be suitable environments for animals with low space requirements, simple social structures, low cognitive function, non-specialist ecological requirements and which are capable of being transported without adverse welfare effects, or animals habituated to human presence, such as domesticated animals. In contrast, highly social, non-domesticated animals, such as elephants and wide-ranging carnivores, which are amongst the most popular species kept in circuses (Galhardo 2005), appear to be the least suitable to captive environments such as zoos (Rees 2003; Clubb & Mason 2007) and even less so to circuses (Amboseli Elephant Research Project 2007). This has already been recognised in many countries across the world where all animals, or wild-caught animals, or some or all species of non-domesticated animals, are prohibited in circuses (eg Austria, Belgium, Costa Rica, Croatia, Czech Republic, Denmark, Estonia, Finland, India, Israel, Poland, Singapore and Sweden). In the period from 1990–2005, the number of non-domesticated animals in British circuses has been declining, possibly as an effect of the outbreak of foot and mouth disease in 2000–2001. We could not find reliable trend data on the number of circuses using performing animals but circuses with only human performers have grown in popularity in recent years. The deleterious effects that circus life has on individual animals are of primary welfare concern. Circus animals spend the majority of the day confined, a small amount of time performing/training, and the remaining time in exercise pens. Circus cages/exercise pens and beast wagons were, on average, only 26 and 27%, respectively of the recommended size of zoo outdoor and indoor enclosures. Circuses, by their very nature, have a limited ability to improve these conditions. Concerns have been raised about keeping non-domesticated animals in circuses and this review has found that, although data are scarce, such assumptions are, in part, supported. This warrants, at the very least, further physiological and behavioural studies on the effects of captivity and transportation, reproductive success and the effects of training and performance, to improve our welfare assessment of circus animals. Data collated from other studies suggest that species commonly kept in circuses appear the least suited to a circus life.

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