

1     ***Incorporating stakeholder perspectives into the assessment and provision of***  
2                                     ***captive elephant welfare***

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4                                     ***CL Chadwick<sup>†</sup>, E Williams<sup>‡§</sup>, L Asher<sup>\*‡#</sup> and L Yon<sup>\*‡</sup>***

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6     <sup>†</sup> Ecosystems and Environment Research Centre, School of Environment and Life Sciences,  
7     University of Salford, The Crescent, Greater Manchester M5 4WT, UK

8     <sup>‡</sup> Faculty of Medicine and Health Sciences, School of Veterinary Medicine and Science,  
9     University of Nottingham, Sutton Bonington Campus, Loughborough LE12 5RD, UK

10    <sup>§</sup> School of Animal Rural and Environmental Sciences, Nottingham Trent University,  
11    Brackenhurst Campus, Southwell, Nottinghamshire NG25 0QF, UK

12    <sup>#</sup> Centre for Behaviour and Evolution, Institute of Neuroscience, Newcastle University,  
13    Framlington Place, Newcastle NE2 4HH, UK

14    \*Contacts for correspondence and requests for reprints:

15    [lucy.asher@ncl.ac.uk/lisa.yon@nottingham.ac.uk](mailto:lucy.asher@ncl.ac.uk/lisa.yon@nottingham.ac.uk)

16

17    **Running title:** Stakeholders' perspectives of elephant welfare

18

19    **Abstract**

20    *Recent concerns over the welfare of elephants in UK zoos have implications for their future*  
21    *in captivity, and it is clear that improvements in welfare should be made. Evidence suggests*

22 *that the knowledge of experienced stakeholders is vital to captive animal welfare assessment.*  
23 *However, there have been few attempts to consult with zoo personnel and other stakeholders*  
24 *on the assessment of elephant welfare, and much of their valuable knowledge of routine*  
25 *husbandry has not been captured in the published literature. As part of a research project*  
26 *commissioned by the Department for Environment Food and Rural Affairs, open response*  
27 *focus groups and workshop discussions were conducted with representatives from 15 UK*  
28 *elephant-holding facilities, and other experts in the welfare and behaviour of captive or free-*  
29 *-ranging elephants. Participants described three broad categories of welfare indicators:*  
30 *behavioural, physical and physiological. Resources perceived to be of importance to*  
31 *elephants included aspects of the physical environment, such as feeding opportunities and*  
32 *appropriate substrate, and aspects of the social environment, including group size and*  
33 *relatedness. The data obtained during this study can be used to develop an elephant welfare*  
34 *assessment strategy, informed by the knowledge and expertise of experienced stakeholders,*  
35 *and for consideration of potential changes to guidelines for managing elephants in captivity.*  
36 *Our approach to capturing the views of those who work closely with captive species could be*  
37 *applied elsewhere, in order to draw upon the extensive knowledge of expert stakeholders and*  
38 *consider ways to improve the welfare of captive animals.*

39

40 **Keywords:** animal behaviour, animal welfare, elephant, stakeholder opinion, welfare  
41 assessment, zoo

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43

#### 44 **Introduction**

45 Concerns over the welfare of elephants in UK zoos have implications for their future in  
46 captivity (Zoos Forum 2010), and improvements in elephant welfare must be made (Clubb &

47 Mason 2002; Clubb *et al* 2008; Harris *et al* 2008). For the purposes of this study, animal  
48 welfare is considered to be a concept which encompasses mental and physical health,  
49 engagement with the physical or social environment, and the opportunity to exhibit control or  
50 choice (Asher *et al* 2015). The assessment of wild animal welfare in captive contexts can be  
51 difficult. There are typically few animals of each species in captivity, and little  
52 standardisation in husbandry and housing (Hill & Broom 2009; Mason 2010).  
53 Behavioural observations are central to the assessment of welfare (Dawkins 2004; Veasey  
54 2006; Hill & Broom 2009; Mason & Veasey 2010), and some previous studies began laying  
55 the groundwork to assess elephant welfare in the UK. Clubb and Mason (2002) carried out an  
56 epidemiological assessment which gave an overview of elephant welfare across zoos. They  
57 cited behavioural problems, reproductive problems and high mortality rates as indicators of  
58 poor welfare, although they did not collect new data or explore the behaviour of individual  
59 elephants. Their report subsequently drew criticism and it was suggested that their findings  
60 were, in places, based on anecdotal evidence (Rees 2003). Harris and colleagues (2008)  
61 analysed behaviour and welfare across 14 British and Irish zoos. Using behaviour (including  
62 aggression and stereotypies), health, faecal glucocorticoid metabolites and aspects of the  
63 environment (including housing and space allowance) as welfare indicators, overall welfare  
64 scores were assigned to individuals. The results revealed welfare concerns, such as a  
65 significant correlation between increasing age and poor welfare, but due to restrictions of  
66 time and funding, welfare was assessed in a ‘snapshot’ fashion, based on very brief and  
67 limited behavioural observations.

68 In a recent review of welfare indicators in captive elephants, Williams and colleagues  
69 (submitted) identified 37 unique welfare indicators from 30 studies. These included resting  
70 behaviour (Laws *et al* 2007; Koyama *et al* 2012), social behaviour (Schmid 1995; Stoinski  
71 *et al* 2000); abnormal behaviour (Rees 2009; Hapleslagh *et al* 2013), cortisol levels (Grand

72 *et al* 2012) and body condition (Wemmer *et al* 2006). Behavioural indicators were used most  
73 frequently to assess welfare; however, some of the studies reviewed were limited by small  
74 sample sizes and short duration. In addition, conclusions were often based on only one or two  
75 welfare indicators. The authors advocated the systematic validation of welfare indicators, and  
76 concluded that a more comprehensive approach to welfare assessment should be developed in  
77 consultation with relevant stakeholders.

78 While previous studies have focused on measuring the current welfare state of elephants, no  
79 studies, to date, have collected evidence to make targeted suggestions for the improvement of  
80 individual elephant welfare on a routine basis (Williams *et al* submitted). Furthermore,  
81 although evidence indicates that the knowledge and experience of keepers is vital to animal  
82 welfare assessment (Meagher 2009; Whitham & Wielebnowski 2009; Tetley & O'Hara  
83 2012), there have been few attempts to consult with zoo personnel and other stakeholders on  
84 assessing elephant welfare in a systematic manner. This is surprising, given the extensive  
85 knowledge of zoo personnel (Harris *et al* 2008; Gurusamy *et al* 2014) and the absence of a  
86 substantial body of scientific evidence on captive elephant welfare (Gurusamy *et al* 2014;  
87 Asher *et al* 2015).

88 Harris and colleagues (2008) consulted 50 elephant experts on welfare issues. Participants  
89 were asked to list, in their opinion, the ten most important indicators of good and poor  
90 welfare in elephants. Eighty-six percent of 50 respondents listed some aspect of behaviour as  
91 one of the ten most important welfare indicators, while 84% mentioned some aspect of  
92 physical health. Similarly, Gurusamy and colleagues (2014) conducted an online survey of  
93 stakeholders' opinions of the key welfare issues for captive elephants. Elephant keepers,  
94 representatives of animal welfare organisations, scientists, zoo directors and veterinarians  
95 completed the survey, in which respondents were asked to consider the relative importance of  
96 a pre-determined list of husbandry practices and their desirability for elephant welfare. The

97 results revealed 15 key welfare concerns, with enclosure substrate, group size and healthcare  
98 rated as the three most important. Although differences in opinion emerged among  
99 stakeholder groups, the authors advocated the inclusion of diverse stakeholder opinion in the  
100 development of welfare standards.

101 In order to accurately assess and improve captive elephant welfare, there is a need for a  
102 holistic approach to welfare assessment, incorporating scientific evidence and expert opinion.  
103 With this in mind, the purpose of the current study was to gather stakeholders' opinions on  
104 measures of captive elephant welfare, and resources thought to be of importance to elephants.  
105 We consulted representatives from elephant-holding facilities, and academics and other  
106 experts in the behaviour and welfare of captive and free ranging elephants. Instead of a closed  
107 question survey, such as that used by Gurusamy and colleagues (2014), open response focus  
108 groups were used to capture stakeholders' experiences and insights. A focus group is 'an  
109 informal discussion among selected individuals about specific topics' (Beck *et al* 1986; p 73).  
110 It involves one or more group discussions, in which participants focus on a topic or topics  
111 selected by the researcher (Wilkinson 1998), with discussion guided by pre-determined  
112 questions. Since participants are encouraged to discuss and debate with one another  
113 (Wilkinson 1998), focus groups are particularly useful for exploring participants' knowledge  
114 and experiences, and can generate more ideas than one-to-one interviews (Morgan 1996;  
115 Wilkinson 1998; Barbour 2008).

116 Focus groups have been used effectively to gather stakeholders' opinions of animal welfare  
117 issues. Skarstad and colleagues (2007) held focus groups with consumers to investigate  
118 public perceptions of farm animal welfare. They found that consumers equated good welfare  
119 with animals 'living as close to nature as possible' (Skarstad *et al* 2007; p 78), and a 'caring  
120 and personal farmer-animal relationship' (Skarstad *et al* 2007; p 78). Similarly, Miele and  
121 colleagues (2011) consulted with stakeholders to develop a method of assessing farm animal

122 welfare. Focus group participants were asked to consider what issues they felt were important  
123 when assessing the welfare of production animals. Their responses were used alongside the  
124 views of animal scientists to develop a list of welfare measures, and a quantitative scoring  
125 system for assessing animal welfare.

126 This study was conducted as part of a research project commissioned by Defra (WC1081),  
127 which was designed to develop and validate a new behavioural welfare assessment tool for  
128 elephants, and inform an evidence-based update to current management guidelines for  
129 elephants. The larger project involved a critical review of the reliability and validity of  
130 indicators of elephant welfare reported in the peer-reviewed literature (Williams *et al*  
131 submitted), consultation with zoo personnel and other stakeholders (reported here), and the  
132 development and testing of a new behavioural welfare assessment tool, for use by keepers, to  
133 assess and monitor individual elephant welfare (Asher *et al* 2015). The aims of the current  
134 study were:

- 135 • To consult and engage with a wide and representative range of stakeholders from across UK  
136 elephant-holding facilities;
- 137 • To collate information from stakeholders to assist in the development of the new welfare  
138 assessment tool, tailored to individual elephants, that can be used to develop targeted action  
139 plans to improve elephant welfare; and
- 140 • To gather stakeholder opinion on resources of importance to elephants, for consideration of  
141 potential changes to UK guidelines for managing elephants (the Secretary of State's  
142 Standards of Modern Zoo Practice [Defra 2012] and the British and Irish Association of Zoos  
143 and Aquariums Management Guidelines for the Welfare of Elephants [BIAZA 2010]).

144

145

146

147 **Materials and methods**

148 *Study design*

149 Stakeholders were invited to participate in telephone focus groups and a workshop  
150 discussion. Focus groups were conducted using teleconferencing technology in order to  
151 minimise costs and maximise the number of stakeholders that could participate. A semi-  
152 structured interview method was utilised. Questions were informed by a systematic literature  
153 review (Asher *et al* 2015; Williams *et al* submitted) and were kept consistent across all focus  
154 groups. Specific, pre-planned prompts were used to stimulate discussion where necessary. A  
155 copy of the script used to conduct the focus groups can be found in Appendix 1 (see  
156 supplementary material to papers published in *Animal Welfare* on the UFAW website:  
157 <http://www.ufaw.org.uk/t-ufaw-journal/supplementary-material>). The subsequent workshop  
158 with stakeholders was then held to facilitate further discussion and to gather opinions on the  
159 relative importance of resources that had been identified during the focus groups.

160

161 *Participant recruitment and response*

162 All 17 elephant-holding facilities from the UK and the Republic of Ireland were invited to  
163 participate in the study; 15 kindly agreed to take part. Facilities participated in either the  
164 focus groups alone (n = 3), the workshop alone (n = 3), or both (n = 9).

165 Fourteen focus groups were held with 25 zoo representatives from 12 facilities (1–4  
166 individuals from each facility). In addition, five further focus group discussions were held  
167 with eleven experts on the welfare and behaviour of captive or free-ranging elephants from  
168 across the world. These details are summarised in Table 1. All participants signed a consent  
169 form which informed them of their rights as voluntary participants. The study and consent  
170 process was approved by the University of Nottingham's ethics committee.

171

172 **Table 1 Summary of the origin, role and number of participants in stakeholder focus**  
 173 **groups.**

<b>Participant Origin</b>	<b>Role of participant</b>	<b>Number of participants</b>
Zoos (UK/Ireland)	Keeper	14
	Curator/Manager	8
	Veterinarian	2
	Zoo-based researcher	1
Other (worldwide)	Studies behaviour or welfare, captive or free-ranging elephants	11

174  
 175 All participants had worked with or studied either Asian (*Elephas maximus*) or African  
 176 elephants (*Loxodonta africana*), or both species. Mean (SEM) time spent by participants  
 177 working with African elephants was 4.3 (5.0) and ranged from none to 14 years ( $\bar{x} = 4.3$   
 178 years;  $\sigma = 5.01$  years) and time spent working with Asian elephants was 8.3 (8.19) ranging  
 179 from none to 31 years. Focus groups were conducted by at least one of the authors (CC, LA,  
 180 LY) and lasted approximately 60 min.

181  
 182 ***Focus group and workshop topics***

183 Focus group discussions were structured around two general themes: measures of elephant  
 184 welfare, and resources perceived to be of importance to elephants. Questions relating to  
 185 elephant welfare centred on the use of behaviour to assess the welfare of captive elephants.  
 186 Participants were encouraged to reflect upon how they would generally assess the welfare of  
 187 any elephant, rather than the individual elephants currently in their care. Participants were  
 188 also asked to name specific behavioural indicators of both good and poor welfare in captive  
 189 elephants. The second set of questions centred on features of the environment that are  
 190 important to elephants. Participants were asked to describe their ideal elephant exhibit,  
 191 including indoor and outdoor exhibits, and any environmental enrichment that is beneficial  
 192 for elephants.



193 Following the completion of the focus group discussions, a list of resources important to  
194 elephants was compiled, based on the resources identified from focus group discussions, and  
195 from a review of existing literature on resources of importance to elephants (Asher *et al*  
196 2015; Williams *et al* submitted). A workshop was held at one of the participating zoos, at  
197 which there were 27 participants (including 21 representatives from eleven elephant-holding  
198 facilities, and six experts in the welfare and behaviour of captive or free-ranging elephants).  
199 Working in six groups of four or five individuals (plus a facilitator in each group),  
200 participants were asked to rank each of the identified resources on a scale of 1 (not important)  
201 to 10 (most essential). In order to capture their immediate reactions, the groups were asked to  
202 briefly consider each resource and agree on its relative importance. Independent facilitators in  
203 each group ensured that all participants had the opportunity to contribute equally to the  
204 discussions. Where participants could not agree on a ranking, the group did not submit a  
205 score for that resource.

206

### 207 ***Data analysis***

208 Focus groups were audio-recorded (with participant consent) and transcribed; any  
209 information relating to the identity of the participants was removed from the transcripts. Data  
210 were analysed using thematic analysis (Braun & Clarke 2006; Krueger & Casey 2009), a  
211 method for ‘identifying, analysing, and reporting patterns (or themes) within data’ (Braun &  
212 Clarke 2006; p 79). This involved coding interesting features of the data in a systematic  
213 fashion, collating codes into potential themes, and defining, naming and reviewing the  
214 themes (Braun & Clarke 2006). Passages of the transcripts containing comments or  
215 discussion on similar themes by participants were highlighted and grouped together (see  
216 Devitt *et al* 2014). As our focus was on welfare outcomes, themes were identified within a  
217 framework of relevance to either measures of welfare, or resources of importance to

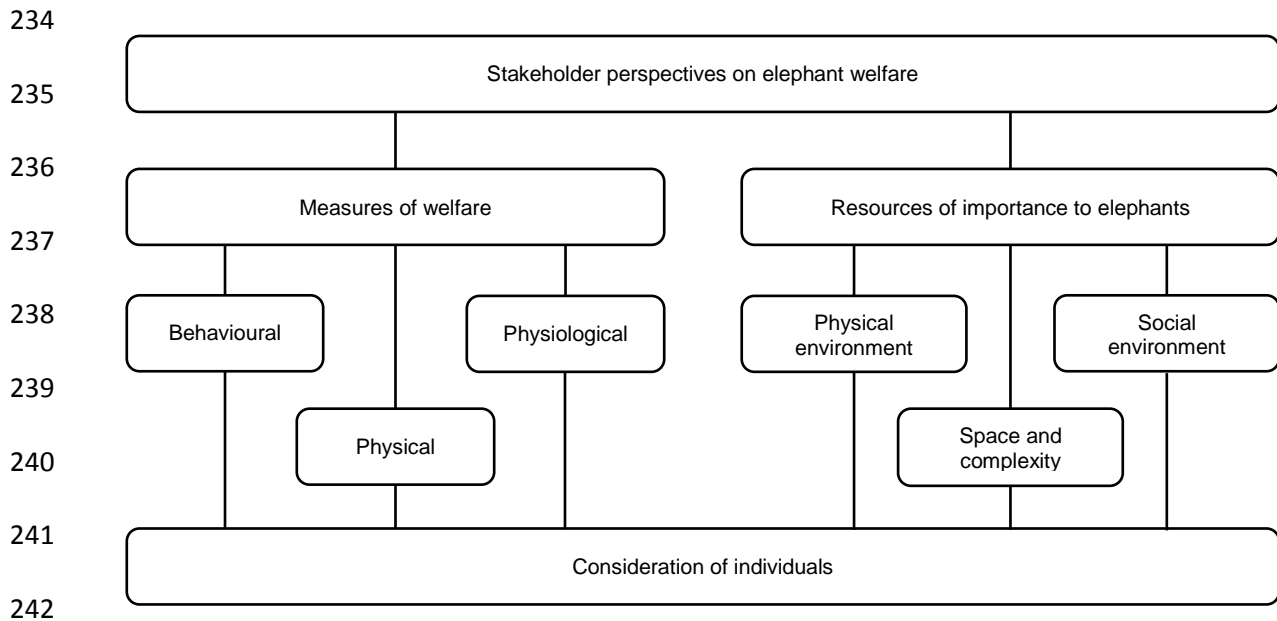
218 elephants. The software programme NVivo (QSR International, Melbourne, VIC, Australia)  
219 was used to assist the data analysis process.  
220 Each workshop group's submitted rankings were used to calculate a mean ranking and range  
221 for each resource. The resources were then placed in order of relative importance to  
222 elephants, as discussed by the workshop participants.

223

## 224 **Results**

225 Thematic analysis of the focus group transcripts resulted in identification of six key themes  
226 relating to measures of welfare and resources of importance to elephants (Figure 1).  
227 Participants described behavioural, physical and physiological measures of welfare, and  
228 considered aspects of the physical and social environment, and environmental complexity as  
229 important resources. Consideration of the individual was a prominent cross-cutting theme  
230 throughout. Participants emphasised the importance of developing welfare measures that are  
231 tailored to individual elephants, and cautioned against using a simple 'one size fits all'  
232 approach to measuring welfare.

233



243 **Figure 1 Key themes relating to measures of elephant welfare and resources of**  
 244 **importance to elephants, identified via thematic analysis.**

245

246 ***Measures of elephant welfare***

247 Participants described three broad categories of welfare indicators: behavioural, physical, and  
 248 physiological (Figure 1). A complete list of welfare indicators identified by participants can  
 249 be found in Appendix 2 (<http://www.ufaw.org.uk/t-ufaw-journal/supplementary-material>).

250

251 ***Behavioural indicators of welfare***

252 Behavioural indicators of welfare included natural behaviours (behaviours that would be  
 253 observed in wild elephants), abnormal behaviours, and interactions with people. Natural  
 254 behaviours included feeding, social interaction, exploration, digging, swimming, mud  
 255 wallowing, object play and scratching or rubbing. The presence of natural behaviours, as  
 256 opposed to abnormal behaviours, was thought to indicate good welfare, and the absence of  
 257 natural behaviours indicated poor welfare. Participants specifically mentioned sleep and lying  
 258 rest as measures of welfare (Table 2). Time spent by elephants sleeping or lying down to

259 sleep were seen as positive indicators, and a lack of sleep or not lying down to sleep were  
 260 seen as negative indicators of welfare.

261

262 **Table 2 Examples of participants' comments on behavioural indicators of welfare.**

Natural behaviours	<p>“Showing natural behaviours that would also be present in wild populations, so for example natural kind of foraging behaviours, feeding behaviours with browse, exploring their habitat as they would in the wild.”</p> <p>“I think sleeping is quite important, we’ve now seen that [Elephant Name] at the moment here with us, she’s actually sleeping, so lying down comfortably, for between four and six hours a night, so I think that’s quite important visually, to see an elephant sleeping and knowing that she actually gets the rest.”</p>
Social behaviours	<p>“I think how the whole herd responds to a situation is really important, and that also gives you a good indicator of the bonds within the group and if there’s a strong bond, that to me is good welfare, because that means you’ve got an adhesive [sic] herd, which is more natural, so if you actually had a situation where the other elephants are getting distressed if another elephant is in pain or showing signs of illness, that to me is a good response from those other elephants.”</p>
Stereotypic behaviours	<p>“So if you saw an elephant with stereotypic behaviour in one facility, it’s not necessarily to say that that facility is not - has got welfare issues for that elephant. It could be that that elephant came there with that condition and it’s very difficult to get them out of it once they’ve got it.”</p> <p>“We kind of try and understand why they’re stereotyping, so we look at where, what time of the day, is there anything that we could put in place to prevent that happening, you know, to keep them busy and stimulated. I mean, if it’s because they’re anticipating or there’s an expectation, if appropriate we can make sure that expectation is fulfilled, or create something else so that they’re not waiting on us.”</p>

263

264 Positive social interactions that were mentioned included affiliative behaviour, play, and  
 265 physical proximity to another elephant or elephants. Behavioural synchrony within the group,  
 266 “*feeding together, spending time together, using enrichment together*”, was described as an  
 267 indicator of good welfare, as well as members of the group supporting one another, or  
 268 “*banding together*” in times of stress. Some participants also commented that the behaviour  
 269 of the group as a whole can provide information about the welfare of individuals (Table 2).  
 270 Negative social interactions included displacement, avoidance and aggression. If an elephant  
 271 was seen isolating itself from the herd, or being regularly displaced by other group members,  
 272 it was suggested that this might indicate poor welfare. There seemed to be agreement among

273 participants that some aggression would be likely to occur within a social group (“*you always*  
274 *get family squabbles*”), but that excessive or hyper-aggression would be cause for concern.  
275 A particularly interesting behavioural indicator suggested by participants was demeanour.  
276 This included body language and other, more qualitative measures of welfare that can be  
277 difficult to quantify (“*it’s something that’s quite difficult to describe but I and other members*  
278 *of my team do say they sort of get a feeling sometimes that they do look happy*”). Keepers  
279 particularly commented that their own knowledge of individual elephants in their care was  
280 important when assessing welfare. These comments not only highlighted the role of keepers  
281 in welfare assessment, but also the need to tailor welfare assessment to the individual  
282 elephant (“*the knowledge of experienced keepers is priceless really, because you will know*  
283 *your elephants if you’ve worked with them for a long time*”).

284 Abnormal behaviours that were discussed included stereotypies, coprophagy and self-directed  
285 behaviours. Stereotypic behaviours that were mentioned included weaving, swaying, pacing  
286 and head-bobbing. Some participants stated that they viewed stereotypic behaviour as an  
287 indicator of poor welfare (“*an obvious one is we all talk about stereotypical [sic] behaviour,*  
288 *you’re going to see that in a stressed elephant*”). However, many participants commented  
289 that stereotypic behaviours may indicate that an elephant had experienced poor welfare in the  
290 past, rather than reflecting an elephant’s current welfare state. Indeed, a common theme of  
291 the discussions was that stereotypic behaviour, and welfare in general, may be substantially  
292 affected by experiences from an elephant’s past. Regardless of the origin of stereotypic  
293 behaviour, participants also commented on methods used to alleviate or reduce the  
294 occurrence of stereotypies (Table 2).

295 Interactions with keepers were also mentioned as behavioural indicators of welfare. Negative  
296 interactions with keepers, or an elephant not responding to training or not co-operating with

297 keepers, were seen as signs of poor welfare. Conversely, an elephant responding well to  
298 training, co-operating and being engaged in training was seen as a sign of good welfare.

299

### 300 ***Physical indicators of welfare***

301 The second category of welfare measures identified from the discussions was physical  
302 indicators of welfare. These were often mentioned in response to the first focus group  
303 question: ‘How would you visually assess elephant welfare?’ Poor foot condition, lameness,  
304 an unhealthy gait and an inability to lie down and get up were seen as indicators of poor  
305 welfare.

306 Body condition scoring or weight was a commonly mentioned physical indicator of welfare,  
307 with obesity in particular being seen as an indicator of poor welfare. However, participants  
308 also commented that body condition scoring can be difficult to use and quite subjective, and  
309 not appropriate for every elephant: “*you do have some elderly elephants that don’t*  
310 *particularly fit in to everything on a body scoring chart*”. This was another instance in which  
311 a participant commented that welfare measures should be appropriate to the individual.

312

### 313 ***Physiological indicators of welfare***

314 The final category of welfare measures was physiological indicators of welfare. Physiological  
315 indicators were not as commonly discussed in the focus groups as behavioural or physical  
316 measures of welfare, most likely because the questions focused specifically on visual  
317 assessment of elephant welfare. Physiological indicators of welfare included measurement of  
318 stress hormones (“*if you did faecal glucocortisone [sic] analysis, that may show if there is*  
319 *stress going on there*”), and, in African elephants, temporal gland secretion (“*we check the*  
320 *temporal glands for secretion, especially at moments of excitement*”). Nonetheless,  
321 participants did comment on the use of physiological indicators to assess welfare, and the

322 benefits of being able to regularly take blood samples from their elephants to monitor  
323 physiological changes (“*at the moment we’re actually taking samples, faeces samples of*  
324 [*Elephant Name*], *the more aggressive elephant, to see if there’s an issue with hormonal or*  
325 *stress levels as well*”).

326

### 327 ***Resources of importance to elephants***

328 Participants discussed three broad themes of resources they considered to be important for  
329 welfare: aspects of the physical environment, aspects of the social environment, and choice  
330 and environmental complexity (Figure 1). A complete list of resources identified by  
331 participants can be found in Appendix 3 ([http://www.ufaw.org.uk/t-ufaw-](http://www.ufaw.org.uk/t-ufaw-journal/supplementary-material)  
332 [journal/supplementary-material](http://www.ufaw.org.uk/t-ufaw-journal/supplementary-material)). The list of resources and environmental features generated  
333 by the focus groups, and from the existing literature, were discussed at the workshop. The  
334 workshop discussion resulted in a ranked list of resources of importance to elephants, ordered  
335 from ‘most essential’ (those resources ranked 8, 9 or 10) to ‘not important’ (those ranked 1, 2  
336 or 3). Resources ranked as ‘most essential’ are presented in this section.

337

### 338 ***Physical environment***

339 Physical features of the environment that participants described as important for welfare  
340 included feeding opportunities, mud wallows, opportunities for scratching or rubbing, types  
341 of substrates provided, and water features.

342 Many participants emphasised not only the importance of food to elephants (“*so much is*  
343 *based around their daily life of feeding*”), but also the importance of methods of presenting  
344 food to elephants. In particular, feeding from height and providing browse were regarded as  
345 methods of feeding that encouraged captive elephants to show natural behaviours (Table 3).  
346 Indeed, ten enrichment and feeding resources were ranked as ‘most essential’ by the

347 workshop participants (Table 4). The provision of browse, methods of feeding that provide  
 348 challenge to elephants, trees or branches, and a variety of food and methods of feeding were  
 349 all given a ranking of ten.

350

351 **Table 3 Examples of participants’ comments on resources of importance to elephants.**

Physical environment	<p>“I think it’s important to add as well on varying levels, as well, because historically again, elephants have been given food on the floor and that in turn can affect the muscles in the upper part of the trunk because they’re not using those muscles to stretch or reach for food as they would do in the wild for browse on trees.”</p> <p>“In regards to the physical fitness of the animals, it’s hard to imagine anything other than increased fitness if you’re moving over hilly terrain or an undulating terrain, you’re going to be using more muscle groups if you’re clambering up or down over a little hillock than you would do if you were just on a flat pad.”</p> <p>“You know - behaviour chains, for instance, an elephant gets wet, an elephant throws sand, an elephant goes and rubs. Perfect example of a behaviour chain that you don’t need really much to do with an elephant, you just need to get the beast wet, she’ll throw sand if she has it, and she’ll rub if she has something to rub against.”</p>
Social environment	<p>“I think that specifying minimum group size could actually be counterproductive in terms of welfare where you might get a collection that’s striving to meet the absolute guidelines and then forcing four elephants that hate each other to live together and then compromising them in terms of space, social dynamics and everything like that and actually making all four of those elephants miserable.”</p> <p>“We’re trying to move forward and create the family groups with the different age ranges, but we still have a lot of older elephants still in captivity that need to, sort of, have the correct environment for their needs, and maybe some of them wouldn’t do well in a big collection of a variety of ages but they do very well in their pairs.”</p>
Space and complexity	<p>“I’ve seen a problem in some collections with choice between substrates, and that’s not been a good thing because they’ve chosen to sleep on a concrete floor that’s actually not good for them, rather than on sand, so yeah it doesn’t always work.”</p> <p>“You can never give them the space, an animal like this in the captive environment, so whether it is 500 acres or 1000 acres or only 50 acres, to the animal itself it won’t make a big difference if it’s not challenging, the habitat should be challenging so they can interact with different items, different substrates, they have to make choices.”</p> <p>“I think in an ideal world you would have multiple enclosures that were joined together and that could be accessed at different times, ideally under the control of the elephants, but you would also have other species using those enclosures so that it would be more complex. You know, olfactory smells and they could modify the environment, so the next time they went into it, it would be a bit different.”</p>

352



353 **Table 4 Enrichment and feeding resources ranked as most essential (8 or higher).**

Resource	Number of groups providing a ranking <sup>a</sup>	Mean ranking	Range
Browse provided daily	6	10.0	10
Food provided in such a manner which provides intellectual stimulation (e.g. puzzle feeders, hidden treats, etc.)	6	10.0	8-10
Trees/branches	6	10.0	10
Variety of food and methods of feeding	6	10.0	10
Food distributed throughout the day	6	9.7	9-10
Some food placed up high so that elephants must stretch to reach it	6	9.7	9-10
Scatter feed or similar that encourages exercise	6	9.5	8-10
Regular provision of novel enrichment	4	8.8	8-10
Toys (e.g. tyres)	5	8.6	5-10
Large logs	6	8.2	5-10

354 <sup>a</sup> **Only groups that reached agreement provided rankings.**

355

356 Provision of appropriate substrate was also thought to be important for welfare. Whilst it was  
 357 generally acknowledged that concrete can be beneficial in some areas of elephant enclosures  
 358 (for example in areas used for veterinary treatment), participants advocated the use of  
 359 “*forgiving substrates*” throughout the majority of the enclosure. Sand was identified by most  
 360 participants as a preferable alternative to concrete, in order to allow elephants to manipulate  
 361 the substrate for activities such as sleeping or dustbathing.

362 Some participants also commented on the benefits of providing a variety of substrates to add  
 363 complexity to the captive environment. In addition, variation in terrain was described as an  
 364 important feature for welfare, with undulations in terrain allowing elephants the opportunity  
 365 for physical exercise and providing visual barriers (“*we’re lucky we have big, large, grass  
 366 paddocks with a lot of undulations where they can get away from each other, dominant ones  
 367 and lower ranking ones*”). Participants also indicated the importance of mud wallows, water  
 368 features and scratching or rubbing posts in elephant exhibits. These features were often  
 369 identified as tools for allowing elephants to express natural behaviours within the captive  
 370 environment, providing the opportunity for social interaction and physical exercise (Table 3).

371 Participants commented on observing social interactions, such as play, around mud wallows  
372 and pools, as well as highlighting the physical benefits of providing deep water in which  
373 elephants could swim (“*you can actually see that they’ve exerted themselves and you can see*  
374 *their muscle tone and their condition from the benefits of having pools*”). Some participants  
375 also commented on the different requirements of Asian and African elephants (“*I think Asian*  
376 *elephants tend to like water a lot, so pools tend to get used pretty regularly, you know, they*  
377 *like clean water.... but Africans aren’t quite the same, you know, Africans might go in clean*  
378 *water but they’d probably prefer to wallow in mud*”).

379

### 380 ***Choice and environmental complexity***

381 During discussions of the physical environment, participants stated that access to resources  
382 over a 24-h period was important for welfare. Ideas for achieving this included providing  
383 access to feeding opportunities throughout the day (“*I think elephants like to have access to*  
384 *food 24 hours a day so they can choose when they want to feed*”), and providing the same  
385 resources in indoor enclosures as are available in outdoor enclosures. Participants felt that  
386 elephants are often provided many more resources in their outdoor enclosures than indoors  
387 (“*we don’t put the same things inside as we put outside*”). Some participants commented that  
388 timed feeders were in use at their facility, to allow elephants to feed overnight in the absence  
389 of keepers. However, it was also acknowledged that timed feeders should be used with  
390 caution, in order to avoid interrupting natural sleeping patterns (“*...what they were finding is*  
391 *that the elephants were asleep but as soon as the winches came down with hay they were*  
392 *waking them up*”).

393 It was clear from the discussions that the complexity of an enclosure and the resources within  
394 it were thought vital (Table 5). Allowing elephants control over their environment and  
395 providing them opportunities to choose and make decisions were also thought to be important

396 for welfare. Suggestions for allowing elephants greater choice and control included leaving  
 397 doors open so that they could choose whether to use the indoor or outdoor environment.  
 398 Workshop participants generally felt that giving elephants the option to choose whether to be  
 399 indoors or out was a good idea, “*providing that it was safe for the elephants*”. Space and  
 400 complexity were also identified as features of the environment that are important for welfare  
 401 (Table 5). Participants in both the focus groups and the workshop generally felt that larger  
 402 enclosures were preferable to smaller enclosures (“*I think probably about every elephant*  
 403 *collection in the UK could do with being bigger*”). Facilities should “*aspire to have more*”  
 404 than the minimum space requirements, and participants felt that the minimum requirements  
 405 should be increased.

406

407 **Table 5 Aspects of the physical environment ranked as most essential (8 or higher).**

Resource	Number of groups providing a ranking <sup>a</sup>	Mean ranking	Range
Not chained for long periods (e.g. overnight)	6	10.0	10
Outdoor space allowance to meet current minimum requirements (500m <sup>2</sup> per elephant)	4	10.0	10
Complex environments	6	9.8	9-10
Natural light indoors	6	9.8	9-10
Places to hide from other individuals (i.e. visual barriers, different areas)	5	9.6	9-10
Furniture which enables scratching/rubbing	6	9.5	8-10
More than one entrance/exit between houses/paddocks	6	9.5	7-10
Water in the form of a deep pool with a shallow entrance	6	9.0	7-10
Variety of substrates	6	8.8	1-10
Furniture which encourages stretching/climbing	6	8.7	6-10
Good artificial lighting	6	8.7	5-10
Free access indoors/outdoors 24/7 in warmer months	5	8.6	
Free access indoors/outdoors 24/7 year round	6	8.5	4-10
Variety of terrain (e.g. mounds)	3	8.3	7-9
Indoor space allowance to meet current minimum requirements (50m <sup>2</sup> per elephant)	5	8.2	1-10
Activities not human led (no or few scheduled events)	5	8.0	4-10
Places to hide from public (e.g. visual barriers, different areas)	6	8.0	3-10

408 <sup>a</sup> Only groups that reached agreement provided rankings.

409

410 When describing their ideal elephant exhibit, some participants told us that they would like to  
411 provide live trees or woodland for captive elephants, or experiment with mixed species  
412 exhibits to provide additional complexity. Ideas for mixed species exhibits included antelopes  
413 such as blackbuck (*Antilope cervicapra*), giraffes (*Giraffa camelopardalis*), and even birds or  
414 primates.

415

416 ***Social environment***

417 Features of the social environment that were considered to influence welfare included group  
418 size, relatedness, the composition of the group and compatibility between individuals. Ten  
419 aspects of the social environment were ranked as ‘most essential’ by the workshop  
420 participants (Table 6).

421

422 **Table 6 Aspects of the social environment ranked as most essential (8 or higher).**

Resource	Number of groups providing a ranking <sup>a</sup>	Mean ranking	Range
Calves stay in maternal group	5	10.0	10
Bulls with females and young	5	9.2	7-10
Auditory and visual access to the whole herd at night	6	9.0	4-10
Compatible group (affiliative behaviour shown, little aggression)	6	9.0	7-10
Cows and young animals not lone housed	6	9.0	7-10
Herd with a wide range of ages	6	9.0	7-10
Physical access to the whole herd at night	6	8.8	4-10
Auditory and visual access to some of the herd at night	5	8.8	4-10
Bull lone housed with auditory, visual or olfactory communication with other elephants	5	8.6	4-10
Mixed sex herd	5	8.4	6-10

423 <sup>a</sup> **Only groups that reached agreement provided rankings.**

424

425 Some participants believed that the size of a social group was important for welfare. Larger  
426 groups could potentially afford elephants increased opportunities for social interaction, and

427 allow for greater variety in group composition (“*the bigger your herd is, the more chance you*  
428 *have that elephants get on*”). Distinctions were made between the requirements of Asian and  
429 African elephants (“*comparing them to what might be natural, African group sizes might be*  
430 *bigger and Asian group sizes might be smaller*”). However, other participants felt that the  
431 compatibility of a social group was more important than the number of elephants (“*I would*  
432 *strongly agree that it’s not a case of numbers. Numbers don’t make elephants happy. I think*  
433 *it’s their relationships with each other that would make them contented*”). Indeed, some  
434 participants highlighted the danger of a recommended group size, which might encourage  
435 facilities to house incompatible elephants together to reach the target number, but  
436 compromise welfare as a result (Table 3).

437 Whilst there was inconsistency over the ideal size of a group, all participants emphasised the  
438 importance of relatedness among group members (Table 6). A multigenerational family  
439 group was seen as the ideal social group type for good welfare, mirroring the social groups  
440 that occur in wild populations. Welfare benefits of housing elephants in family groups  
441 included the opportunity for natural social interaction, close social bonds between  
442 individuals, and opportunities for appropriate learning and development, especially in young  
443 elephants. However, it was also acknowledged that the current captive population contains  
444 unrelated, non-breeding females for whom housing in a family group would not be possible.  
445 In these cases, participants felt that compatibility among group members was important for  
446 welfare (Table 3), emphasising further the importance of considering individual differences.

447

## 448 **Discussion**

449 The knowledge of experienced stakeholders is considered to be vital in the assessment of  
450 captive animal welfare and the development of welfare standards (Meagher 2009; Whitham  
451 & Wielebnowski 2009; Tetley & O’Hara 2012), yet few studies have investigated stakeholder

452 opinions of elephant welfare. In the present study, consultations were held with a wide and  
453 representative range of stakeholders from across UK elephant-holding facilities and beyond,  
454 and potential measures of elephant welfare and features of the environment which are thought  
455 to be of importance to elephants were identified.

456 Focus group participants identified behavioural, physical and physiological indicators that  
457 could be used to assess elephant welfare. This is in agreement with the results of the survey  
458 conducted by Harris and colleagues (2008), in which the majority of respondents listed  
459 aspects of behaviour and physical health as important welfare indicators. Participants in the  
460 focus groups also mentioned some of the welfare factors identified by Gurusamy and  
461 colleagues (2014), including enclosure substrate, group size, interactions with keepers,  
462 enclosure size and access to wallows. The list of potential welfare measures generated during  
463 the focus group discussions (Appendix 2; [http://www.ufaw.org.uk/t-ufaw-  
464 journal/supplementary-material](http://www.ufaw.org.uk/t-ufaw-journal/supplementary-material)) is also broadly in agreement with the findings of Williams  
465 and colleagues (submitted), and recent studies conducted in zoos in North America (Greco  
466 *et al* 2016; Holdgate *et al* 2016; Meehan *et al* 2016; Morfeld *et al* 2016). This may be  
467 because these common welfare indicators are well established and frequently discussed by  
468 elephant keepers and other stakeholders. However, the qualitative, open response approach  
469 and semi-structured interview method employed in the current study allowed participants to  
470 make novel suggestions which go beyond the current evidence base, and enabled the  
471 collection of more detailed stakeholder opinion on a wide range of elephant welfare issues.  
472 In keeping with the findings of Williams and colleagues (submitted), behavioural indicators  
473 of welfare were most commonly discussed by stakeholders. However, there were behavioural  
474 measures identified in the present study that were not documented in the reviewed literature.  
475 For example, keepers, in particular, discussed interactions with people, and demeanour, as  
476 two additional potential measures of welfare. Qualitative Behavioural Assessment measures

477 animal welfare using descriptors of the animals' affective state (Wemelsfelder 2007). QBA  
478 has been validated in other species (eg cattle [*Bos Taurus*]: Stockman *et al* 2011; pigs  
479 [*Sus scrofa domesticus*]: Rutherford *et al* 2012; and sheep [*Ovis aries*]: Phythian *et al* 2013).  
480 Thus, there may also be merit in applying these methods to captive elephants.  
481 Stakeholders were of the opinion that the expression of natural, species-typical behaviours  
482 that would be observed in wild populations indicated good welfare, and that the captive  
483 environment should contain resources which enable and encourage elephants to express those  
484 behaviours. Particular attention was paid to social behaviour and group composition in both  
485 the focus groups and the workshop. This is in agreement with the survey conducted by  
486 Gurusamy and colleagues (2014), in which respondents ranked group composition as one of  
487 the three most important factors affecting elephant welfare, and with a large body of evidence  
488 linking appropriate social group housing with improved welfare in other species (De Rouck  
489 *et al* 2005; Morgan & Tromborg 2007; Price & Stoinski 2007).  
490 Although few published studies have used social behaviour as an indicator of elephant  
491 welfare (Asher *et al* 2015; Williams *et al* submitted), participants in our study recognised the  
492 importance of replicating in captivity the social groups that have been observed in wild  
493 elephants (Moss & Poole 1983; Sukumar 1994). There was strong support among  
494 stakeholders for multi-generational family groups, comprising a wide range of ages, and for  
495 housing social groups together day and night. These comments are echoed in the results of  
496 Meehan and colleagues' (2016) recent study of housing and social environments of elephants  
497 in US zoos, in which individuals that had the opportunity to interact with juveniles spent, on  
498 average, 65.68% of their time with them. Furthermore, Greco and colleagues (2016) found  
499 that aspects of the social environment, including the proportion of time spent with juveniles  
500 and the proportion of time spent alone, predicted rates of stereotypic behaviour. In our study,  
501 relatedness and the maintenance of family groups were seen as important factors for

502 improving welfare. Where this is not possible, participants felt that compatibility among  
503 group members should be considered. This was also reflected in the workshop, as relatedness  
504 and compatibility were ranked ‘most essential’. In addition, participants in both the focus  
505 group and workshop discussions felt that setting minimum group sizes may be  
506 counterproductive, as welfare may be compromised if incompatible individuals are housed  
507 together in order to meet the minimum requirement. Indeed, negative effects of inappropriate  
508 or incompatible social groups on animal welfare have been documented, including chronic  
509 stress and social tension (Wielebnowski *et al* 2002; Morgan & Tromborg 2007; Davis *et al*  
510 2009).

511 Choice and complexity were also thought to be important aspects of the captive environment.  
512 Focus group participants were of the opinion that, while enclosures should be as large as  
513 possible, they should also be challenging, no matter the size. This was reflected in the  
514 workshop results, as participants ranked resources offering choice and complexity as ‘most  
515 essential’, and in agreement with respondents to the survey carried out by Gurusamy and  
516 colleagues (2014), who ranked ‘enrichment’ among the top five factors affecting elephant  
517 welfare. Participants in both the focus groups and workshop advocated complex  
518 environments with a variety of substrates and terrain, free access between indoor and outdoor  
519 enclosures, a deep pool, and places where elephants can hide or get away from conspecifics  
520 should they choose to do so. This underscores the desire to give elephants as much choice  
521 and complexity as possible, which has been identified as an important component of animal  
522 welfare (Broom 1991). Emerging evidence indicates the relevance of choice and  
523 environmental complexity to elephant welfare. Greco and colleagues (2016) found that the  
524 ability to choose between indoor and outdoor enclosures was associated with reduced risk of  
525 stereotypic behaviour, whilst Brown and colleagues (2016) reported a link between diverse  
526 environmental enrichment programmes and reduced risk of reproductive problems.



527 Our data highlight the challenges of assessing elephant welfare, as stakeholders emphasised  
528 the importance of accounting for differences among individuals, as well as the past histories  
529 of these long-lived animals. The UK captive population consists of individuals with diverse  
530 origins and backgrounds, including wild-born and captive-born elephants, and individuals  
531 originating from circuses or logging camps (Harris *et al* 2008). Reflecting this, consideration  
532 of the individual was a prominent cross-cutting theme throughout the discussions; many  
533 participants felt that a ‘one size fits all’ approach to welfare assessment would be  
534 inappropriate. For example, they felt that stereotypic behaviour may not be indicative of an  
535 elephant’s welfare state under its current environmental conditions. This is also in agreement  
536 with the published literature; whilst several studies have adopted stereotypic behaviour as an  
537 indicator of welfare in captive elephants (eg Laws *et al* 2007; Rees 2009; Koyama *et al*  
538 2012), it is recognised that stereotypies should not be used as the sole indicator of welfare  
539 (Mason & Latham 2004). Stakeholders highlighted the importance of a tailored, holistic  
540 method of welfare assessment, which makes use of a suite of indicators, as there is a great  
541 deal of individual variation among these long-lived animals. Indeed, Meehan and colleagues  
542 (2016) found no significant associations between zoo-level variables (eg herd size and exhibit  
543 size) and elephant welfare, but did find significant associations between individual-level  
544 variables (eg measures of time spent in a social group) and welfare. Methods of assessing  
545 elephant welfare should therefore take into account differences among individual animals.  
546 There is a growing body of evidence linking individual differences with animal welfare, and  
547 several authors advocate the assessment of welfare from the perspective of the individual,  
548 rather than the species or taxon (Hill & Broom 2009; Whitham & Wielebnowski 2009;  
549 Watters & Powell 2012). Research by King, Weiss and colleagues (Weiss *et al* 2002, 2006;  
550 King & Landau 2003; Gartner & Weiss 2013) has provided evidence that welfare is related to  
551 personality in felids and great apes, and studies have begun to explore this link in elephants

552 (Grand *et al* 2012; Horback *et al* 2013; Yasui *et al* 2013). Given that behavioural  
553 observations are central to the assessment of welfare (Dawkins 2004; Veasey 2006; Hill &  
554 Broom 2009; Mason & Veasey 2010), and keepers are well placed to observe individuals’  
555 behaviour, welfare assessments should also incorporate the knowledge and expertise of  
556 keepers.

557 In advocating the use of expert opinion in welfare assessments, we recognise that opinion  
558 alone should not determine welfare measures, or inform husbandry guidelines. Rather,  
559 stakeholder expertise should be considered alongside scientific evidence to develop a holistic  
560 approach to welfare assessment. Our results identified potential welfare measures of which  
561 there is currently little discussion in the published literature; these should be investigated  
562 further for reliability and validity before inclusion in any assessment of elephant welfare.

563

#### 564 *Animal welfare implications*

565 In the assessment and improvement of captive animal welfare, there is great value in  
566 considering input from experienced stakeholders. Our approach to capturing the views of  
567 expert stakeholders could be applied elsewhere, in order to draw upon the extensive  
568 knowledge of those who work closely with elephants, and other species, and consider ways to  
569 improve the welfare of captive animals. Animal welfare scientists should therefore be  
570 encouraged to identify and work with relevant stakeholders. We demonstrate how this can be  
571 successfully achieved via semi-structured focus groups or interviews. For the purposes of our  
572 study, expert stakeholders included zoo keepers, curators, veterinarians and researchers, but  
573 in other situations and for other species, this could include farmers, veterinary nurses, kennel  
574 or cattery staff and laboratory technicians, for example. This method of consulting with  
575 relevant stakeholder groups will ensure that their valuable knowledge is captured and  
576 analysed in a rigorous, systematic manner. Our results identified the need for a tailored

577 approach to assessing elephant welfare, taking into account the differences among individual  
578 animals. When used alongside evidence from the literature, expert opinion can inform  
579 husbandry guidelines, the development of welfare assessment tools tailored to individuals,  
580 and targeted action plans for improving animal welfare.

581

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593

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