

Table 2. Behavioural indicators of welfare identified in the peer reviewed literature which have been used in assessment of captive elephant welfare

Type of indicator	Indicator category	Example of indicators used	Mean (range, SD) of the number of elephants studied	Correlation with other measures	Authors which used the indicator*	Significant change	Percent change
Behavioural	Abnormal behaviour	Stereotypies, foot lifting, faeces manipulation, trunk swinging	16 (1 – 140, 32)	Feeding Walking Resting Foot health Cortisol	Koyama et al (2012) Laws et al (2007) Gruber et al (2000) Vanitha et al (2011) Elzanowski & Sergiel (2006) Friend (1999) Hnath & Yannessa (2002) Schmid (1995) Schmid et al (2001) Wells & Irwin (2008) Wilson et al (2004) Rees (2004) Friend & Parker (1999) Meller et al (2007) Stoinski <i>et al</i> (2000) Whilde & Marples (2011) Rees (2009)	9 papers	17 papers
	Sleep/rest	Standing rest, lying rest	7 (1 – 17, 6)	Walking Stereotypies	Koyama et al (2012) Laws et al (2007) Gruber et al (2000) Friend (1999) Hnath & Yannessa (2002) Schmid et al (2001) Posta et al (2013) Friend & Parker (1999) Meller et al (2007)	3 papers	3 papers

Feeding	Eating, drinking, ingestion	6 (1 – 17, 5)	Walking Stereotypies	Koyama et al (2012) Gruber et al (2000) Friend (1999) Hnath & Yannessa (2002) Schmid et al (2001) Posta et al (2013) Stoinski et al (2000) Whilde & Marples (2011) Rees (2009) Wells & Irwin (2008)	3 papers	10 papers
Environmental interaction	Enrichment use, investigative/ exploratory behaviour	4 (2 – 7, 2)		Posta et al (2013) Meller et al (2007) Stoinski et al (2000) Whilde & Marples (2011) Hnath & Yannessa (2002) Schmid et al (2001)	3 papers	6 papers
Comfort (self-maintenance)	Dust bathing, mud wallowing, general grooming	9 (1 – 29, 8)		Koyama et al (2012) Gruber et al (2000) Friend (1999) Hnath & Yannessa (2002) Schmid (1995) Schmid et al (2001) Wells & Irwin (2008)	4 papers	12 papers

				Friend & Parker (1999) Stoinski et al (2000) Whilde & Marples (2011) Rees (2009) Posta et al (2013)		
Activity	Walking/locomotion	6 (1 – 14, 4)	Rest Feeding Stereotypies	Posta et al (2013) Koyama et al (2010) Gruber et al (2000) Schmid et al (2001) Wells & Irwin (2008) Stoinski et al (2000) Meller et al (2007) Rees (2009) Whilde & Marples (2011) Leighty et al (2009)	5 papers	10 papers
Inactive		3		Stoinski et al (2000)	1 paper	1 paper
Social interactions	Positive interactions (affiliation), negative interactions (agression)	10 (2 - 29, 9)		Gruber et al (2000) Schmid (1995) Schmid et al (2001) Wells & Irwin (2008) Posta et al (2013) Stoinski et al (2000)	3 papers	5 papers
Other	Vocalisations	4 (4 – 4, 0)		Wells & Irwin (2008) Soltis (2010)	1 papers	1 papers
	Play	17 (4 – 29, 13)		Whilde & Marples (2011) Schmid (1995)	1 papers	2 papers

Physical	Assessment of body condition/health (except feet)	Body condition score, assessment of mucous membranes, skin condition, eyesight, oedemas, wounds, abscesses	114 (82 – 140, 24)		Ramanathan & Mallapur (2008) Godogama et al (1998) Wemmer et al (2006)	NA	NA
	Assessment of foot health	Toenail cracks, presence of foot fissures, abscesses	87	Stereotypies	Haspeslagh et al (2013)	NA	NA
Physiological	Glucocorticoid and glucocorticoid metabolites analysis	Salivary cortisol, serum cortisol, faecal glucometabolites, urinary glucometabolites	5 (1 – 8, 2)	Other measures of cortisol Personality Stereotypies	Dathe et al (1992) Fanson et al (2013) Grand et al (2012) Laws et al (2007) Menargues et al (2008) Millspaugh et al (2007) Schmid et al (2001) Wilson et al (2004)	8 papers	10 papers