

## INTRODUCTION

Asian elephants (*Elephas maximus*) are a magnificent species for zoos to keep: they have high public appeal and can therefore act as ambassadors for conservation and fund raising. Since 1992, a European breeding program has been instated, resulting in an increasing number of births. However, there are several welfare issues in keeping Asian elephants in zoos, mostly revolving around foot problems and the occurrence of stereotypies. Floor type of elephant housing has been suggested to influence both foot health and repetitive behaviours, but no conclusive evidence has been presented so far for Asian elephants in European Zoos<sup>a</sup>.

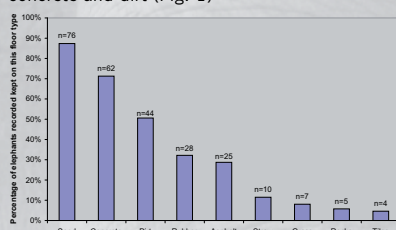
## METHODS

The purpose of this study was to investigate whether an association exists between floor type, the occurrence of repetitive behaviour and foot problems in zoo-kept Asian elephants.

Data on 1) the enclosure floor type, 2) the occurrence of repetitive behaviour (stereotypies) and 3) the occurrence of foot problems was collected for adult ( $\geq 1$  years) Asian elephants in European zoos, using a brief questionnaire. Out of 84 contacted zoos, 32 sent back a completed questionnaire (response rate=38,09%). Information was obtained for 87 adult individuals, representing 34% of 254 adult elephants incorporated in the EAZA European Studbook. Data were pooled across indoor/outdoor housing and elephant gender for statistical purposes. We used Fisher exact tests (P-value) and calculated prevalence ratios (PR) to investigate relationships between the three parameters involved (stereotypic behaviour, floor type and foot problems). For the relationships between the occurrence of stereotypic behaviour and foot problems, assignable proportions were calculated in addition to the prevalence ratios and p-values.

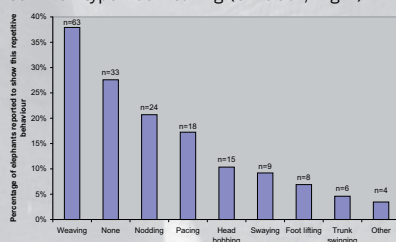
### 1) Floor type

Most of the animals had access to sand, followed by concrete and dirt (Fig. 1)



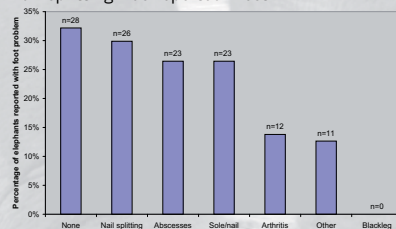
### 2) Stereotypies

A considerable proportion of the animals (72.41%) displayed repetitive behaviour (stereotypies). The most common type was weaving (37.93%, Fig 2).



### 3) Foot problems

Foot problems were reported for 59 individuals (67.82%). Nail splitting was reported most



### 4) Relationships between floor type and stereotypies, and floor type and foot problems

Elephants with access to straw flooring had less chance of displaying stereotypic behaviour than elephants that were kept on other floor types (Prevalence ratio (PR) = 0.12;  $P < 0.01$ ; Table 1). Elephants (partly) kept on dirt were less likely to have foot problems than animals standing on other substrates (PR = 0.67;  $P = 0.01$ , Table 1).

	Stereotypies	Foot problems
Concrete	0.70*	0.99
Straw	0.12*	0.87
Rubber mats	0.84	0.92
Sand	4.41*	8.40*
Dirt	0.88	0.67*
Asphalt	1.15	1.09
Tiles	1.41	1.51
Grass	0.99	1.29
Rocks	0.54	0.58

Table 1: Prevalence ratios of the relationship between different kinds of floor type and occurrence of stereotypies (left) and foot problems (right); PR <1 indicates the problem occurs less than expected, PR>1 indicates the problem occurs more than expected. \* indicate  $p < 0.05$ .

### 5) Relationship between stereotypie and foot problems

Elephants that showed stereotypic behaviour were 3.37 times more likely to have foot problems than elephants that showed no stereotypic behaviour (PR = 3.37;  $P < 0.01$ ; Table 2).

Prevalence ratio	
Proportion of foot problems assignable to elephants displaying stereotypies	70%
Proportion of foot problems assignable to stereotyping + nonstereotyping elephants	63%

Table 2: Relationship between occurrence of foot problems and occurrence of stereotypies; PR <1 indicates the problem occurs less than expected, PR>1 indicates the problem occurs more than expected. \* indicate  $p < 0.05$ .

## CONCLUSIONS

Our results suggest that stereotypic behaviour is associated with the occurrence of foot problems and that there is also a link between these and flooring type. Keeping elephants on dirt may be a protective factor for the occurrence of foot problems, whereas keeping elephants on concrete or straw may be a protective factor for the occurrence of stereotypies. Data indicated that keeping elephants on sand may be a risk factor for both the occurrence of stereotypies and foot problems. However, the results of this study should be interpreted with caution because of the limited sample size and the unbalanced design with regards to flooring type (most of the elephants had access to sand and/or concrete flooring). Furthermore, adhering to the advice of the EEP coördinator, questionnaire length was restricted and, consequently, certain factors were no longer included (e.g. distribution of

## References

- Taylor & Poole (1998) Zoo Biology 17: 311-332
- Dimeo-Ediger N (2001). In: Csuti B et al (Eds) The Elephant's Foot: Prevention and Care of Foot Conditions in Captive Asian and African Elephants, Iowa State University Press, Ames, p. 153-153

## Acknowledgements

We thank the Flemish Government for structural support to the Centre for Research and Conservation. We are grateful to all zoos who sent back their questionnaire, and especially Paignton Zoo, Chester Zoo and Rotterdam Zoo for additional information and discussions.  
Biaza Research Symposium, Chester 7-8 July 2010