

## A preliminary study of the impact of stocking density on the behaviour of group housed Göttingen Minipigs

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### Introduction

In welfare discussions the space available for each animal has been in focus for many years. It is, however, difficult to carry out experiments, which end up setting precise data for minimum space. Experimental setups have to some extent investigated the space demands for rodents, guinea pigs and rabbits (Eveleigh, 1988; Stauffacher, 1992; White et al., 1989), while only little work has been done on minipigs. Some studies have been carried out on farm pigs to show the minimum welfare-acceptable space for a pig at fifteen kg, but data differ. Beattie et al. (1996) found the optimal floor area to be 0.5 m<sup>2</sup> per pig, whereas Pearce & Paterson (1993) only found it to be 0.18 m<sup>2</sup> per pig. As minipigs in general are more active than farm pigs (Bollen et al., 1998), they may need more space than farm pigs at the same size.

The aim of the present study was to find a method to evaluate the minimum welfare-acceptable floor space required for each group housed pig. Behavioural studies are used to discuss whether pigs's welfare and ability to perform a natural behavioural repertoire are reduced under certain housing conditions.

### Materials and Methods

Fifty-four male Göttingen Minipigs (Ellegaard Göttingen Minipigs ApS, Dalmose, Denmark), weighing 14.6 ± 2.3 kg, and aged 8 months ± 14 days, were used.

The pigs were distributed randomly in nine groups with six pigs in each at three different stocking densities (Table 1): 0.27 m<sup>2</sup> (0.84 x 1.95 m) per pig, 0.44 m<sup>2</sup> (1.08 x 2.45 m) per pig and 0.52 m<sup>2</sup> (1.55 x 2.00 m) per pig (Figure 1).

Table 1: Experimental design. Number of animals per group and per density.

	0.27 m <sup>2</sup> per pig	0.44 m <sup>2</sup> per pig	0.52 m <sup>2</sup> per pig
Group 1	6	6	6
Group 2	6	6	6
Group 3	6	6	6

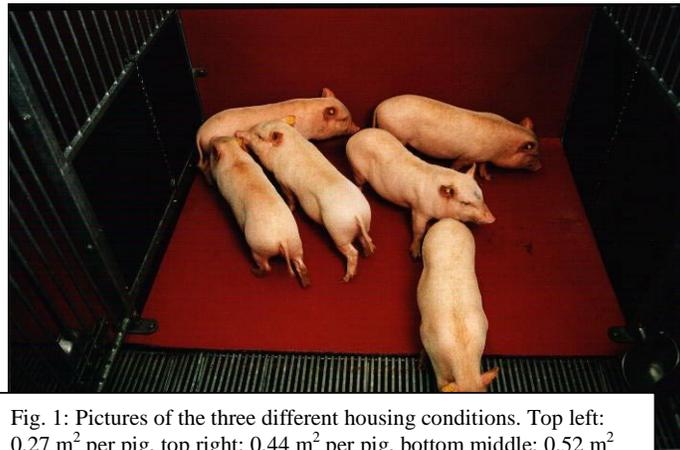
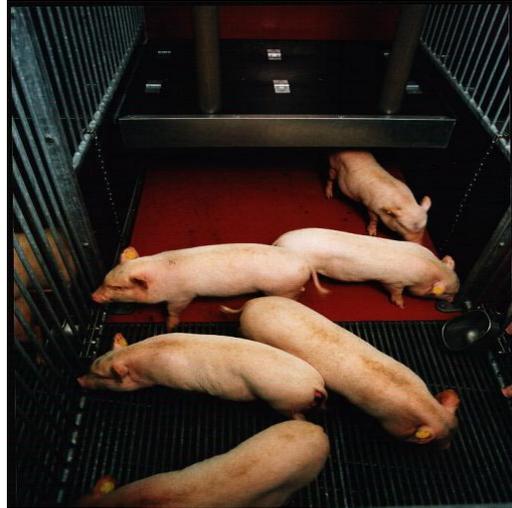


Fig. 1: Pictures of the three different housing conditions. Top left: 0.27 m<sup>2</sup> per pig, top right: 0.44 m<sup>2</sup> per pig, bottom middle: 0.52 m<sup>2</sup> per pig.

The highest density is almost identical to the European guidelines for farm pigs at 15 kg (Council of Europe, 1986), while the lowest density is close to the U.S. National Council's guidelines (National Research Council, 1996). One third of the floor of the pens was slatted, while the rest was epoxy-treated concrete. No bedding was used. In each pen two chains were presented as enrichment objects.

The room temperature was 20-21° C and the relative humidity was 50-70 %. The light was on from 0600 am to 0600 pm and light intensity was approximately 100 lux measured 30 cm above the floor.

The pigs were fed twice a day (at 0730 am and at 0300 pm) directly on the epoxy-treated concrete part of the floor with 1.140 kg pelleted minipig diet per pen (SDS, Witham, SMP MOD), i.e. on average, 190 g per pig. Water was offered ad libitum from drinking cup.

Behaviour was observed and registered in a predefined ethogram (Table 2). During the data analysis some behaviour patterns were pooled in over all categories (Table 3). Each group in each density was observed twice in the morning and twice in the afternoon for 25 minutes each time, totally four times of 25 minutes for each group for each density. Behaviour was registered by instantaneous sampling.

Table 2: The ethogram used for studying the pigs.

Lying:	The pig lies down, either on its belly or on one side
Lying alone:	The pig lies on the floor without any physical contact to other pigs.
Lying together:	The pig lies on the floor and is in physical contact with at least one other pig.
Sitting:	The pig sits on its tail with its forelegs stretched under the body.

Standing:	The pig stands on all four legs.
Standing passive:	The pig stands without any activity.
Standing active:	The pig stands while moving its head to investigate the surroundings or performing sham-chewing.
Movement:	The pig walks or runs around the pen.
Drinking:	The pig drinks water from the water-cup.
Elimination:	The pig defecates or urinates.
Comfort behaviour:	The pig rubs its body against the inventory, stretches or yawns.
Exploration:	The pig makes horizontal movements of the head over the floor or bars, sniffs the floor or bars.
Inventory manipulation:	The pig licks, manipulates, sniffs or bites the inventory of the pen, e.g. bars and chains.
Play:	The pig jumps in the air or runs back and forth in the pen doing buck-jumps.
Social interaction:	The pig sniffs, bites or massages another pig in the pen or performs homosexual mounting.
Aggression:	The pig pushes, bites or fights with

Other behaviour: another pig from the pen. The pig performs in a way not mentioned above.

There was significantly higher standing passive behaviour at the 0.27 m<sup>2</sup> density compared with 0.44 m<sup>2</sup> per pig density. The sitting behaviour was significantly lower at 0.44 m<sup>2</sup> density compared with 0.56 m<sup>2</sup> density. The lying alone behaviour was significantly higher at 0.44 m<sup>2</sup> density compared with the two other densities.

Table 3: The pooled behavioural categories.

Inactivity:	Lying alone + lying together + sitting + standing passive
Active behaviour:	Standing active + movement + comfort behaviour + play + drinking + elimination
Social behaviour:	Social interaction + aggression
Exploration:	Exploration + inventory manipulation

#### Discussion

As no differences between the three densities were observed for the over all behavioural categories, if there is any impact of available space for each pig, it seems to be minor within the range studied, which is similar to findings in farm pigs (Bryant & Ewbank, 1972). However, previous studies also showed, that high stocking densities affected the communication in the group (Ewbank & Bryant, 1972) and caused more serious fights among the pigs (Bryant & Ewbank, 1974). In the present study aggression was observed so rarely that no conclusion could be made, and, therefore, aggression was pooled in the category for social interaction. The amount of social behaviour was registered between 8 and 14 % of the total observation time. This was also the range found in previous studies, both for pigs housed in barren environment, in enriched environment (Beattie et al., 1995) and under semi-natural conditions (Stolba & Wood-Gush, 1989). For the pigs lying in direct physical contact with each other, no differences were found between the groups, the percentage of observation time being between 39 and 43 %. This indicates that the pigs do not feel aversion against being close together when resting, which corresponds with the results for social interaction.

In general, the sitting behaviour is regarded as a cut-off behaviour as the pig tries to cope with the housing conditions (Pearce & Paterson, 1993). In the present study there were differences in the amount of sitting behaviour among the three

All data were tested for normal distribution by linear regression model and subsequently analysed by a modified ANOVA model (GLM-procedure) using SAS version 6.08 (SAS Institute Inc., 1989). A significance level of 0.05 and a power of 0.90 were set.

#### Results

All analysed data were normally distributed and therefore analysed by the GLM procedure. Inactivity, active behaviour, exploration and social interaction of pigs in the three different densities are shown in Figure 2. No significant differences between the three housing densities could be observed within any of the behavioural categories. Neither were there any behavioural differences between morning and afternoon observations. Figure 3 shows the composition of the behavioural category inactivity. It is made up of four behavioural elements: lying alone, lying together, sitting and standing passive. For lying together the percentage was 39 %, 39 % and 43 % for 0.52 m<sup>2</sup>, 0.44 m<sup>2</sup>, and 0.27 m<sup>2</sup> respectively. For lying alone it was 6 %, 28 % and 3 %, for sitting 18 %, 3 %, 9 %, and for standing passive 37 %, 30 % and 45 %.

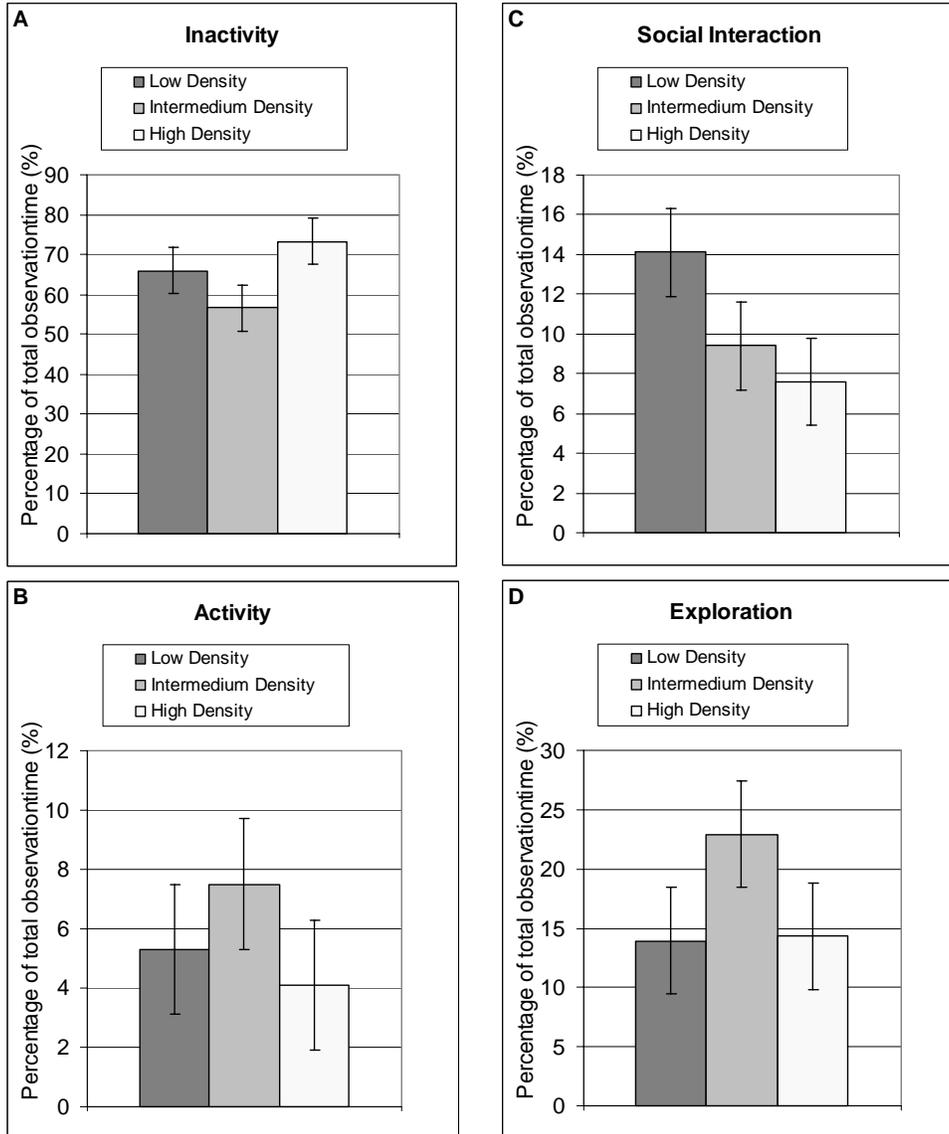


Fig. 2: Inactivity (A), active behaviour (B), social interaction (C) and exploration (D) as percentages of total observation time for the three densities (0,52 , 0,44 and 0,27 m<sup>2</sup> per pig). Values are means for each density +SEM.

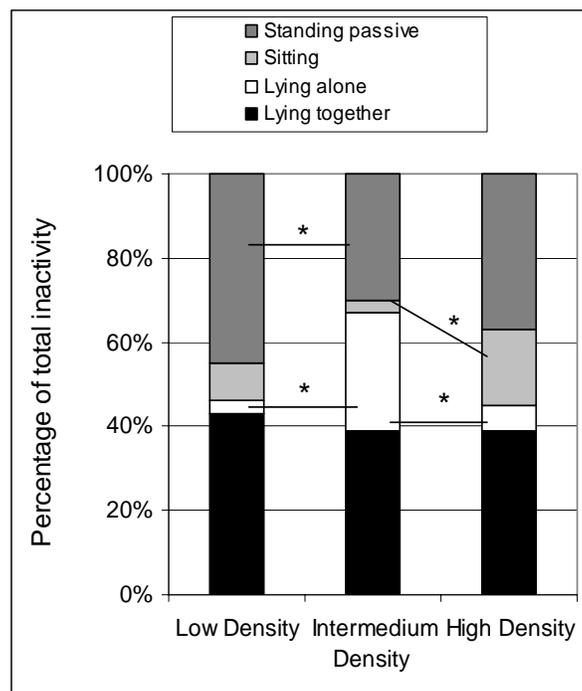


Fig. 3: The composition of the inactivity as percentages of the total inactivity time for the three densities (0.27; 0.44 and 0.52 m<sup>2</sup>). A significant difference between the three densities is marked with \*. Values are means for each density. (P<0.05).

densities, ranging from 3 to 18 % of the total observation time with the significant highest amount at the lowest density. There was no clear pattern in the observed amount of sitting behaviour and, as such, it is difficult to draw any firm conclusions. Nor have other studies been able to find a clear difference in the amount of sitting behaviour, when pigs were housed at different densities (Meunier-Salaun *et al.*, 1987).

More studies are needed before any final recommendations can be made regarding housing densities for group housed minipigs. Future studies may also include clinico-chemical parameters, such as cortisol measurement, which

has previously been shown to be an indicator of chronic stress in farm pigs (Hemsworth *et al.*, 1986). Also the effects of enrichment should be investigated as bedding and enrichment objects have been shown to alter the behaviour of farm pigs housed in groups compared to groups without enrichment (Arey & Franklin, 1995; Haskell *et al.*, 1996). As far as group sizes are small enough for the pig to cope with, environmental enrichment may show to be more important than the exact space within the ranges in this study, and it is likely to believe, that e. g. the use of bedding in this system will have a higher impact on welfare parameters.

### Summary

At present no studies have made attempts to determine the minimum floor space for group housed minipigs, although these are mobile animals with a certain need for space to carry out basic behaviour. Therefore, the aim of the present study was to find a method for evaluating the acceptable minimum space area for group-housed minipigs from a welfare point of view. Fifty-four male Göttingen Minipigs aged eight months were used for the study. The pigs were distributed in nine groups with six pigs in each at three different stocking densities: 0.27 m<sup>2</sup> per pig, 0.44 m<sup>2</sup> per pig and 0.52 m<sup>2</sup> per pig. Each group in each density was observed twice in the morning and twice in the afternoon for 25 minutes each, and behaviour was registered by instantaneous sampling of observed data. No significant differences within any of the different behavioural categories could be observed between the three housing densities ( $p < 0.05$ ), and, therefore, additional space might have little influence on the behaviour of the minipig, while the construction and equipment of the pen might have a higher impact on the behaviour of the pig. The importance of bedding and enrichment objects for minipigs should, therefore, be clarified before any firm recommendations about the design of a pen for group housing of minipigs are given.

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