gestation day, parity, and space measurement method. There were no observed differences in the space required to perform the lying-down or standing-up sequence between lame and non-laminate sows (P > 0.05). There was no difference in the space required between the two measuring methods used (P > 0.05). On average, sows used 1.16 ± 0.4 m² to lie down and stand up. Space required to lie down and stand up increased as gestation progressed (P < 0.05). Parity 3+ required 0.20 m² more space to lie down compared with parities 1 and 2 and required 0.26 m² more space to stand up compared with parity 1 sows (P < 0.05). Under the conditions of this study, lameness did not affect the dynamic space needed to lie down and stand up, but parity and stage of gestation did. Results from this study could be important in the decision making process for new regulations regarding space needs for gestation sow housing in the USA.

**Key Words:** dynamic space, lie-down stand-up sequence, sow lameness

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**015 Do pigs form social structures: an application of social network analysis?**

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As social animals, pigs in a group may form certain social structures which could be important to their welfare. The objective of this study was to use social network analysis to assess social structure and social position of pigs when grouped with littermates or non-littermates. Pigs (n = 96; initial wt = 6.93 ± 1.56 kg) weaned at 4 wk of age were housed in 12 pens (8 pigs/pen) for 5 wk, which consisted of 6 pens of littermates and 6 pens of non-littermates. Pigs were weighed at birth, 4 wk, and 9 wk of age. The behavior of pigs was video recorded for 6 h between 0900 and 1500 h at 7 wk and 8 wk of age. Videos were scanned at 20-min intervals to register individual pigs that were lying together (1) or not (0) in binary matrices. Pigs that were lying together were considered to be socially connected. Social network analysis was performed using the UNICET software. Degree centrality (DC) and closeness centrality (CC) measure direct and indirect connections, respectively, that a pig has with its pen mates. Network density describes how frequently pigs in a pen were lying together. Larger values for DC, CC, and network density indicate a greater degree of social connection. No differences in average DC (0.79 ± 0.23 for littermates vs. 0.83 ± 0.25 for non-littermates), CC (0.63 ± 0.34 vs. 0.73 ± 0.30), or network density (4.12 ± 0.96 vs. 4.34 ± 0.54) were found between litter origin treatments, indicating that CC in pigs of littermates connected with each other in a similar way to pigs in pens of non-littermates. Standard deviation of CC tended to be higher (P = 0.06) for littermates than non-littermates. This suggests that some littermates may form more indirect connections than other littermates, while non-littermates form similar indirect connections among themselves. Furthermore, CC was correlated with bodyweight at 4 wk (r = 0.242; P < 0.05) and 9 wk (r = 0.233; P < 0.05) of age. Network density was correlated with bodyweight at 9 wk (r = 0.629; P < 0.05) and 4 wk (r = 0.559; P < 0.10) of age, and ADG (r = 0.568; P < 0.10). These data suggest that heavy pigs had more indirect connections and connected with their pen mates more frequently than lightweight pigs. These preliminary results suggest that social network analysis may be a useful tool to measure social structure among pigs.

**Key Words:** behavior, pigs, social network analysis


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**016 Changes in scratches and skin elasticity in cull sows after transport to the abattoir**

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Each year, over 400,000 Danish sows are transported by road to abattoirs. Only very limited knowledge about these animals is available. In this study, the clinical condition of 522 sows was examined before and after transport to an abattoir. The effects of journey duration (max 8 h), temperature in the vehicles, as well as the effect of sows’ pre-transport condition on their clinical condition at arrival were investigated. The study included sows from 12 private farms sampled randomly and stratified according to distance to a larger slaughterhouse. Selection of animals to slaughter was done by the farmers taking into account the EU Council Regulation (EC 1/2005) that excludes animals unable to move independently without pain; present open wounds or prolapse; pregnant females in late gestation or having given birth within a week. Transport duration ranged from 46 to 469 min (mean = 236 ± 114 min) and average temperatures from 3.4 to 26.1°C (mean = 14.3 ± 5.3°C). Clinical registrations were made on-farm before transport and immediately on arrival at the abattoir, and we here present data on the number of scratches and skin elasticity (a measure of the degree of dehydration). Overall differences in these two variables were analyzed with the signed-rank test (PROC NPAR1WAY), and the effects of journey and sow characteristics were analyzed with PROC GLIMMIX, both analyses in SAS. Table 016 shows the median and IQR (25% and 75%) of number of scratches and skin elasticity before and after transport. The risk of having more scratches was affected by an interaction between transport duration and average temperature (F₃, 405 = 8.44; P < 0.05) and 9 wk (r = 0.59; P < 0.10) of age, and ADG (r = 0.68; P < 0.10). These data suggest that heavy pigs had more indirect connections and connected with their pen mates more frequently than lightweight pigs. These preliminary results suggest that social network analysis may be a useful tool to measure social structure among pigs.

**Key Words:** behavior, pigs, social network analysis


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**Table 016.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before transport</th>
<th>After transport</th>
<th>Signed Rank Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of scratches</td>
<td>0 [0; 1]</td>
<td>6 [2; 12]</td>
<td>N = 509; S = 38134.5; P &lt; 0.001</td>
</tr>
<tr>
<td>Skin elasticity</td>
<td>3 [2; 3]</td>
<td>3 [3; 4]</td>
<td>N = 492; S = 5001.5; P &lt; 0.001</td>
</tr>
</tbody>
</table>
with transport time with more moderate temperatures. At temperatures below 6.5°C, the risk was highest on short transports. Among other findings, the risk of more scratches was higher in dry sows compared to lactating sows (F1, 405 = 7.96; P < 0.01). Odds of getting more dehydrated were 2 to 6 times higher at temperatures above 18°C compared to lower temperatures (F3,423 = 8.12; P < 0.001). These results show that the clinical condition of culled sows are worsened by the transport. Among the most important risk factors were transport duration and temperature. Future studies should examine whether and to what extent culled sows can be transported without the welfare impact of the worsened clinical parameters.

Key Words: clinical condition, culled sows, transport doi: 10.2527/asasmw.2017.016

017 Bio-pesticide management of pasture flies in the great plains via a push-pull strategy. D. J. Boxler1,*, G. J. Brewer2, J. Zhu2, R. N. Funston3, University of Nebraska-Lincoln, West Central Research & Extension Center, North Platte, 2University of Nebraska-Lincoln, Lincoln, 3University of Nebraska, North Platte.

Pasture flies threaten the profitability of beef cattle production in the Great Plains. While horn flies have traditionally been the major fly pest of range cattle, in recent years stable fly populations have greatly increased. Fly control is confounded by having few conventional insecticides available for use and by documented or suspected resistance to current insecticides. These factors make fly management and protection difficult, creating a need for alternative insecticides such as plant-derived biopesticides, also known as repellents. Sprayable and encapsulated biopesticide formulations were tested on yearling crossbred (Simmental × Red Angus) cattle in a push-pull system against native stable fly populations. The push-pull strategy in this study used a repellent to ‘push’ flies from some animals and ‘pull’ them to animals treated with an insecticide, which would reduce fly numbers. Cattle were randomized into 4 treatments, and stable fly populations were recorded by visually counting flies on all four legs and belly region of each animal. The 4 treatments included push-pull (half of the animals in the group were treated with a repellent, Geraniol, and half treated with an insecticide, permethrin), push only (treated with repellent, Geraniol), pull only (treated with an insecticide, permethrin), and Control (no treatment). Testing was done in adjacent drylot pens (44 m by 7.6 m) in 2013 and 2014 and in adjoining upland range pastures in 2015 (6.8 ha). All animals were treated weekly in a holding chute and then released back into their treatment group. A repeated measures design was used. Although the stable fly population differed each year, results were similar across years and locations (drylot or pasture). Both treatments including repellent (push only and push-pull) as well as the insecticide (pull) treatment had similar numbers of flies per animal (10.01, 9.97, 9.75, ± 0.67 respectively; P > 0.05). Overall, repellent only, insecticide only, and the combination of insecticide and repellent reduced stable fly numbers per animal (P < 0.05) compared with the untreated Controls (14.98 flies per animal). The biopesticide geraniol offers promise for incorporation into stable fly management programs for pasture cattle. However, besides reducing stable fly numbers on cattle, an implementation strategy compatible with ranching systems will be required.

Key Words: beef cattle, bio-pesticide, stable fly doi: 10.2527/asasmw.2017.017

018 Salivary cortisol concentrations of group-housed gestating sows: individual vs. group samples. Y. Li1,*, S. Cui1, X. Yang2, B. A. Crooker1, S. K. Baidoo2, L. J. Johnston1, 1West Central Research and Outreach Center, University of Minnesota, Morris, 2Southern Research and Outreach Center, University of Minnesota, Waseca, 1Department of Animal Science, University of Minnesota, St. Paul.

The objectives of this study were to determine salivary cortisol concentrations and evaluate differences between individual and group samples collected from gestating sows. Mixed parity sows (n = 928, Parity 1 to 9) from 20 breeding groups were used. Sows of each breeding group were moved from stalls and housed in pens (42 to 51 sows/pen) with an electronic sow feeder after pregnancy confirmation at 5 wk postmating. Sows remained in pens until d 109 of gestation when they were moved to farrowing rooms. Within each breeding group, 8 focal sows balanced for parity were identified for saliva sampling. Saliva samples were collected from focal sows using absorbent cotton swabs in stalls before mixing, 2 d after mixing, and about 109 d of gestation in pens. Once sows were moved to pens, group samples of saliva were collected on the same day that individual samples were collected using a cotton rope hung on the front partition of the pen for 30 min until the rope was fully saturated with saliva. Saliva was removed by centrifugation and frozen for subsequent analysis of cortisol concentration by ELISA assay. Sensitivity of the assay was 0.04 ng/mL. The intra-assay CV was less than 10%. For individual focal sows, salivary cortisol concentrations were lower before mixing when sows were housed individually compared with 2 d after mixing and d 109 of gestation when sows were housed in groups (0.65 vs. 3.03 and 3.44 ng/mL, SE = 0.258; P < 0.001), suggesting that stress was induced by mixing and by physiological changes with the progress of pregnancy. Group cortisol concentrations were similar (group, 3.04 vs. individual, 3.44 ng/mL, SE = 0.536; P = 0.88) to individual concentrations on d 109 of gestation but tended to be lower (1.78 vs. 3.03 ng/mL, SE = 0.529; P < 0.10) 2 d after mixing than individual concentrations. No interactions of group and gestation period were detected (P = 0.29). Pearson correlation was moderate for d 109 (r = 0.732, P < 0.001) but not significant at d 2 after mixing between group and individual cortisol concentration. These results suggest that salivary cortisol concentrations were lower in group-housed gestating sows than in individually housed sows.