Increased light intensity and mat temperature attract piglets to creep areas in farrowing pens

1A-116

Report prepared for the

Co-operative Research Centre for High Integrity Australian Pork

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June 2017

Established and supported under the Australian Government's Cooperative Research Centres

An Australian Government Initiative

Executive Summary

Pen farrowing systems have been considered as alternatives to crates to enhance sow welfare. A major concern with pen systems is the higher piglet pre-wean mortality due to crushing by the sow. It was hypothesized that an optimized management of light and mat surface temperature can promote greater piglet use of the creep, which has been associated with reduced piglet crushing.

A total of 113 sows and their piglets were studied in Sow Welfare and Piglet Protection (SWAP) pens on a commercial pig farm, across two replicates. Sows were randomly assigned to pens arranged within a two (Bright, 300 Lx, vs. Dark, 4 Lx, creep) by two (30 ºC vs. 35 ºC mat surface) factorial treatment combination. Six sows and their litters of each treatment combination had their behaviour continuously recorded for 72-h post-partum (pp), and four focal piglets were weighted on the first and third days of life. Live behavioural observations were performed daily (from 8:00-h to 17:00-h) on all sows and their litters every 15 min over 72-h pp to record piglet time spent in the creep, latency to enter the creep for the first time, latency for the litter to remain in the creep for at least 10 min, and piglets and sows use of pen areas immediately in front (A2) and farthest from the creep (A3).

Piglets with access to Bright creeps spent in average 7.2 % more time ($P < 0.01$) in the creeps than piglets in pens with Dark creeps. Additionally, for each degree increase in mat temperature, piglets spent in average 2.1 % more time ($P < 0.01$) in the creep. Piglets in pens with Bright creeps spent less time in A2 ($P = 0.04$) and the least time in A3 ($P = 0.01$), but light or mat temperature did not affect sow use of pen areas or piglet weight gain. Piglets of Bright creeps tended ($P = 0.08$) to take longer to enter the creep for the first time after birth, but the latency for 75.0 % and 30.0 % of the litter to remain clustered for 10 min was shorter in Bright compared to Dark creeps of Replicates 1 ($P = 0.06$, trend) and 2 ($P = 0.04$), respectively. Overall, piglet use of the creep increased with warm mat temperatures and brightness, which should be further investigated as potential strategies to promote piglet safety and reduced crushing in pen farrowing systems.

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1. Introduction

The search for alternative farrowing systems without a crate becomes particularly important as the world pork industry strives for improvement in sow welfare. Piglet pre-weaning mortality is critical in farrowing systems without a crate, where sows are placed either in pens, natural, or semi-natural setups, mainly due to crushing of the piglets by the sows. Reports of pre-wean mortality were as high as 32 % and 27 % in pen systems (Blackshaw et al., 1994; McGlone and Morrow-tesch, 1990), 25 % and 23 % in pen systems with communal areas (Li et al., 2009; Marchant et al., 2001), and generally lower in farrowing crate systems (Gu et al., 2011: 10.8 % crushing pre-wean; Kilbride et al., 2012: 11.7 % total pre-wean; Lou and Hurnik, 1994: 15.0 % total pre-wean).

Attracting piglets to a protected warm creep area, in between nursing bouts, may be a solution for reducing piglet mortality, as increased time spent spread around the sow increases chances of piglets being crushed (Marchant et al., 2001). Piglet use of heated areas was reported to increase with the increase in temperature gradient between heated and pen areas (Burri et al., 2009; Schormann and Hoy, 2006; Xin and Zhang, 1999), as well as to vary with age and type of heating (Xin and Zhang, 1999).

Very little has been done to explore additional environmental aspects, such as creep illumination, which may function as attractants to piglets. Furthermore, the design of creep areas varies substantially on commercial farms, from enclosed to fully opened, which affects light. The reported effects of light intensity on piglet behaviour are somewhat controversial, as some authors have reported piglet preference for darkness (Larsen and Pedersen, 2015; Parfet and Gonyou, 1991), while others reported fear of darkness (Tanida et al., 1996). However, most of the light studies have been conducted with distinct light sources, within distinct contexts and light levels. Still, light affects the reproduction, welfare and behaviour of older pigs (McGlone et al., 1988; Prunier et al., 1994; Stevenson et al.,1983). Thus, light could be used to alter piglet behaviour, in an effort to enhance piglet survivability.

The present research, therefore, hypothesized that changes in the light intensity and mat temperature inside piglet creep areas alter piglet creep use and consequently their chances of survival. The current project evaluated the effects of two light intensities (300 Lx vs. 4 Lx) in creep areas with two mat temperature set points (30 °C vs. 35 °C), without any source of radiant heat, on piglet behaviour and survivability in farrowing pens.

2. Methodology

2.1. *Facilities*

The present research was conducted in two farrowing rooms on a commercial farm located in Central Queensland during the months of September (Replicate 1) and November (Replicate 2), 2016. Environment in the farrowing rooms was automatically controlled with the use of ventilation fans, attic inlets, and evaporative cooling for warmer seasons. Artificial lighting, within a schedule of 12-h light: 12-h darkness (0 Lx), provided 80 ± 30 Lx (ranging from 29 to 186 Lx) during the light phase, averaged across all pens in both farrowing rooms at the sow's head level when in a standing posture, and not statistically different between rooms and replicates. Farrowing rooms were equipped with four rows of nine 2.0 m × 2.8 m Sow Welfare and Piglet Protection (SWAP) farrowing pens, each with a trapezoidal creep area of 1.1 m (length) × 1.0 m (wider width) × 0.5 m (narrower width) with a trapezoidal metal heated mat (no heat lamp), and a slatted area for the sow, which piglets could access. Creep areas had three sides fully closed, with the side facing the pen open. Creeps were covered with a black wood lid, which could be lifted to check on the piglets (Figure 1). Sows were free to move and were never crated prior to or after farrowing.

A total of 113 multiparous (Large White × Landrace) sows (67 sows in Replicate 1, and 46 in Replicate 2) were randomly allocated into the 72 farrowing pens available across the two studied farrowing rooms, approximately 3 days before their farrowing due date. Farm practices were performed following their standard operation procedures, with minimal external interference from the research team, hence the unbalanced distribution of sows across the two replicates. As part of the farm's routine, one or two employees were available covering 24-h per day to constantly assist with births when necessary, and care for the welfare of sows and their litters.

2.2. *Experimental Design*

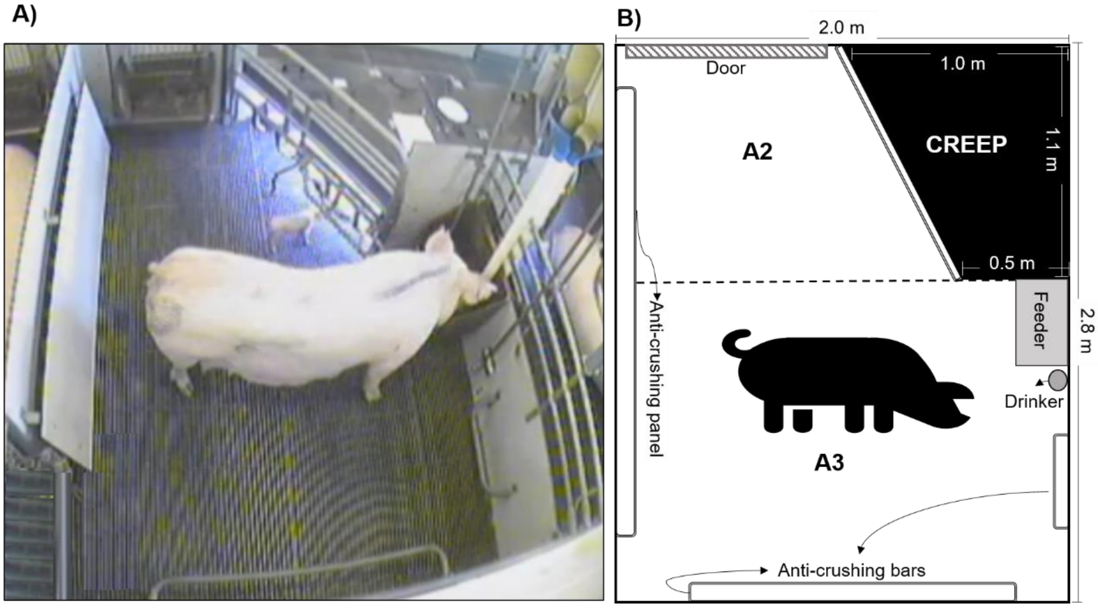
The experiment was performed in a Generalized Randomized Block design, with two blocks or replicates (September, and November) and a two (Bright, 300 Lx, vs. Dark, 4 Lx, creep) by two (30 ^{o}C vs. 35 ^{o}C mat surface) factorial arrangement of treatments. Mat temperature was controlled at room level, hence the use of two farrowing rooms for the present research, which had their mat treatment swapped between replicates. Within each study room, two staggered rows of 15 pens had lit creeps by cool white LED light strips (Bright creep treatment) and the remaining two rows of pens had unlit creeps without any provision of artificial lighting (Dark creep treatment). Creep light levels were measured at floor level, before piglets were born. Pregnant sows, due to farrow, were randomly assigned to pens of distinct treatment combinations after balancing for their parities (first versus multiparous sows) across treatments, as they were brought from gestation rooms into the farrowing rooms, following the farm's schedule. Sows and piglets' behaviour was studied for 72-h pp, which is the period with the greatest risk for piglet crushing by the sow (Marchant et al., 2001). Piglets were weaned at 29.1 ± 2.9 days in Replicate 1 and 25.8 ± 3.7 days in Replicate 2.

2.3. *Data Collection*

2.3.1. **Behaviour**

Six focal sows and their litters (three in Replicate 1 and three in Replicate 2) from each of the four possible treatment combinations (total of 24 focal sows and litters) had their behaviour continuously recorded, with the use of night view cameras (model QC-3694, Signet Technologies Inc., USA). The remaining 89 study sows and their litters (55 in Replicate 1 and 34 in replicate 2) were scanned sampled through live observation once every 15 min (from 8:00-h to 17:00-h) for their location. Piglets use of the creep, as well as piglets and sows use of pen areas immediately in front of the creep (Area 2, A2) and farthest from the creep (Area 3, A3) were recorded (Figure 1). Sows were considered to be in a certain area if at least 70 % of their body was at this area, otherwise sows were marked as being in the middle of the pen. Latency for piglet to enter the creep for the first time, latency for 30 % and 75 % of the litter to remain in the creep area for at least 10 min were obtained from the recorded videos.

Figure 1 - A) Top view of a Sow Welfare and Piglet Protection (SWAP) pen with Bright creep. B) Schematic plan view (not to scale) of a SWAP pen, depicting the trapezoidal covered creep area, pen Area 2 (A2), distinguished from pen Area 3 (A3) by the virtual pattern line.



2.3.2. **Piglet Weight**

Four piglets (one light- and one heavy-born female and male) from each of the 24 focal litters were marked soon after birth and weighed both in the first and third days of life (72-h pp), to evaluate treatment effects on piglet weight gain. Average weaning weights for the focal litters were retrieved from the farm's records.

2.3.3. **Temperature and Light Measurement**

Light and temperature levels were automatically registered hourly inside creep areas of the 24 focal pens, with the use of light and temperature loggers (Hobo, U12, Onset Computer Corporation, USA). Ambient temperature and light levels were measured once daily at 12:00-h in the centre of each study pen, at the sow´s head level when in a standing position, using a heat stress meter (Sper Scientific Ltd., USA). Room temperature was also read from the rooms' control systems once at 8:00-h, 12:00-h, and at 17:00-h every day. Mat surface temperature was automatically registered using a temperature coin logger (Thermocron, OnSolution Pty. Ltd., AU), attached directly to the mat. The coin loggers were covered with 0.5 cm thick extruded polystyrene foam and insulation tape, except for the face in contact with the mat, to avoid measuring air instead of mat surface temperature. This method of measuring mat surface temperature was tested and validated prior to the study. Radiant temperature was measured inside the creep areas once before each replicate, to ensure that light treatment did not add extra heat to the creep's thermal environment.

2.4. *Statistical analyses*

The Procedure GLMSELECT was performed on SAS (SAS Institute, Cary NC through a stepwise method to find the best model explaining the pig behavioural parameters, after data was checked for normality and homoscesdasticity. The parameters considered as possible independent variables were: Treatment combinations (Bright and Dark creep; Low and High mat temperature), sow parity, farrowing room, replicate, ambient temperature, ambient light, number of piglets in the litter, and all possible interactions among these variables. After the best model was selected, an analysis of variance was performed through Procedure GLM on SAS (SAS Institute, Cary NC) and least square means were compared.

3. Outcomes

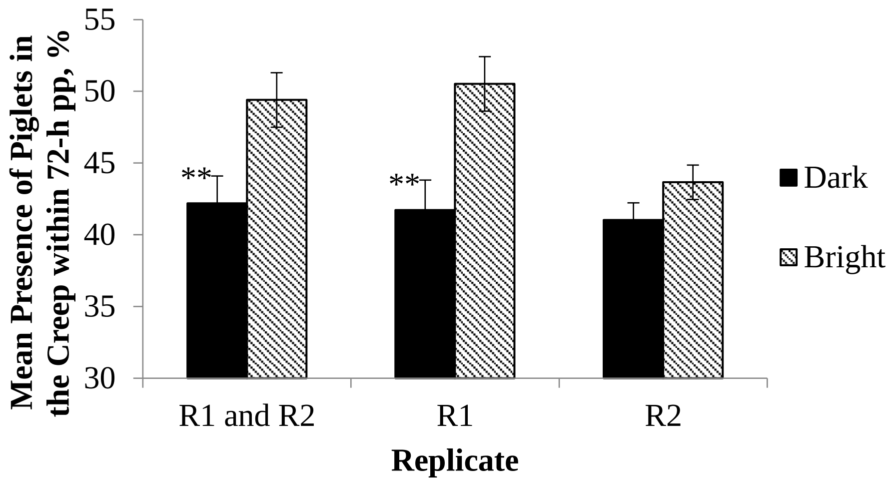
The interaction between light intensity and mat temperature treatments was not significant, and therefore results are presented separately for light intensity and mat temperature.

3.1. *Effects of the Light Treatment*

Light significantly affected piglet use of the creep area ($P < 0.01$). When considering data from both replicates together in the statistical model, piglets with access to the Bright creep spent 7.2 % more ($P < 0.01$) of the 72-h pp time in the creep than piglets with access to Dark creeps (Figure 2).

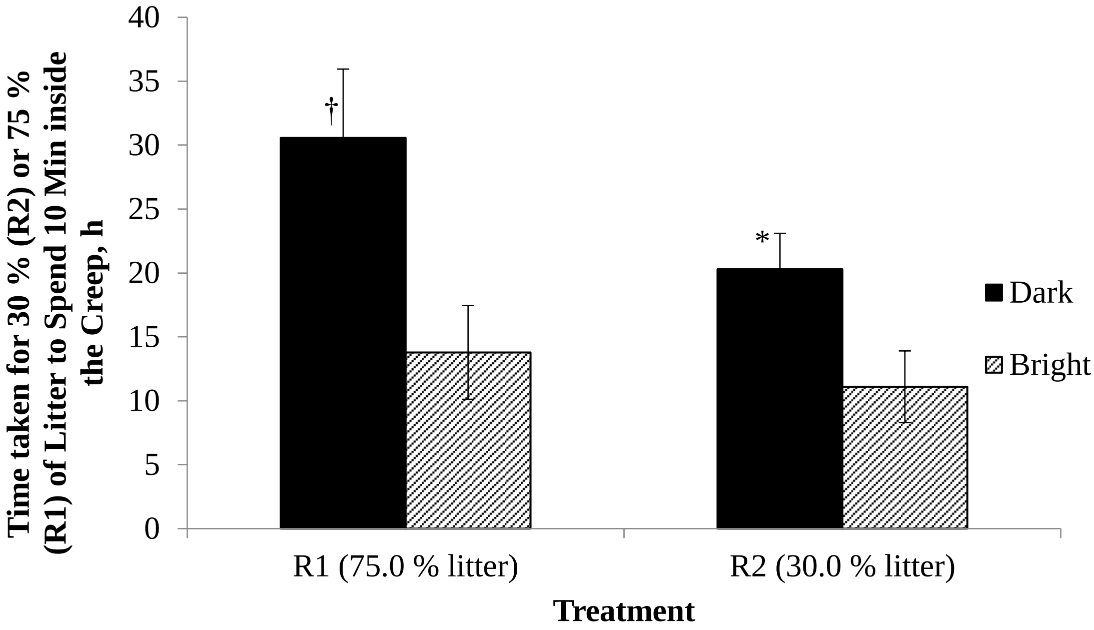
Although no significant interaction was found between replicate and light treatment ($P = 0.70$), most of the difference in creep use between the light treatments was found for Replicate 1, R1, (Figure 2), with R1 piglets with Bright creeps spending approximately half of their of the 72-h pp period inside the creep, while R1 piglets with Dark creeps spent about 8.8 % less time ($P < 0.01$) inside the creep, as illustrated on Figure 2. Piglets of Replicate 2 (R2) only spent 2.6 % more of their 72-h pp period inside Bright creeps compared to piglets with Dark creeps (Figure 2), and this difference was not significant ($P = 0.42$).

Figure 2. Mean time spent by the piglets inside Bright and Dark creep areas, corrected for total number of scan sample observations performed and number of piglets per pen, for both replicates combined and each replicate. (Dark creep with ** is different from Bright creep at 99.0 % confidence level. R1 = Replicate 1; R2 = Replicate 2; pp = post-partum.)



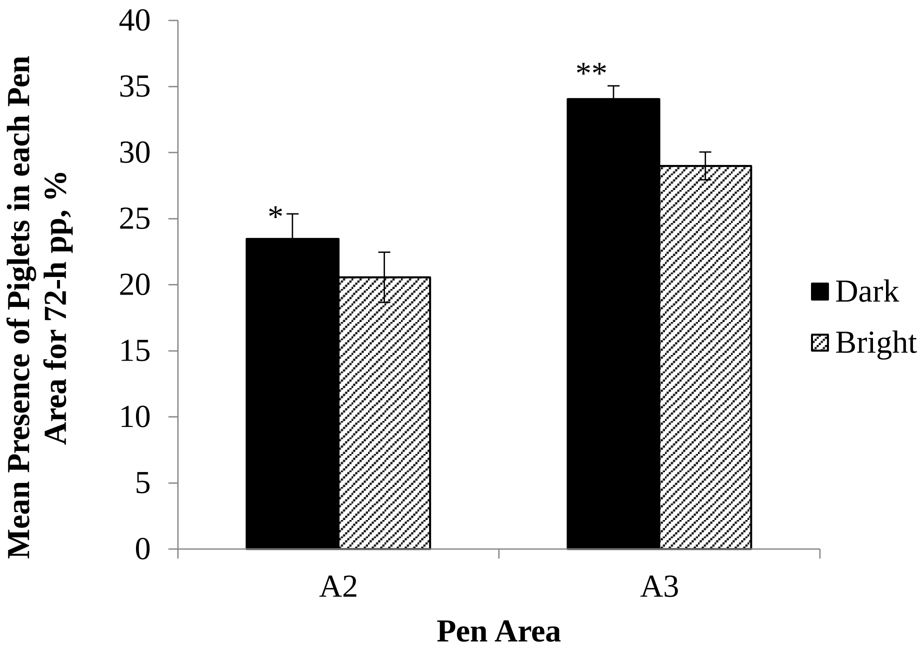
Piglets with Bright creeps tended (P = 0.08) to take longer (104 ± 28 min) to enter the creep for the first time, compared to piglets with Dark creeps (24 ± 33 min). On the other hand, piglets with Bright creeps took (P = 0.04) or tended (P = 0.06) to take less time to remain in the creep area for at least 10 min compared with piglets with Dark creeps in R2 (based on 30.0 % of the litter) and R1 (based on 75.0 % of the litter), respectively (Figure 3). No statistical differences were found between Bright and Dark for 30 % of the litter in R1 and 75 % of the litter in R2 to remain at least 10 min in the creeps (P > 0.10).

Figure 3. Time taken for 30.0 % (Replicate 2, R2) and 75.0 % (Replicate 1, R1) of the litter to spend at least 10 min inside the creep after birth in Replicate 1. (Dark creep with * or † is different from Bright creep at 95.0 % or 90.0 % confidence level, i.e. trend, respectively.



Overall piglets in Bright creeps spent 5.0 % less time of the total 72-h pp period in A3 compared to piglets in Dark creeps (P = 0.01), and 2.9 % less time in A2 (P = 0.04, Figure 4).

Figure 4. Mean time spent by the piglets in pen Areas 2 (A2) and 3 (A3), during the 72-h post-partum (pp) period, corrected for total number of scan sample observations performed and number of piglets per pen. Dark creep with * and ** is different from Bright creep at 95.0 % and 99.0 % confidence levels, respectively.



3.2. *Effects of Mat Temperature*

It was not possible to maintain mat temperature within the pre-determined treatment levels of 30 °C and 35 °C, due to variation inherent to the automatic system control. Thus, mat temperature was used as a covariate in the model of analysis of variance. Mat temperature averaged 33.0 ± 6.2 °C (ranging from 20.3 °C to 42.2 °C) and 34.2 ± 5.3 °C (ranging from 34.2 °C to 41.7 °C) for Bright and Dark creeps, respectively, and did not statistically differ between light treatments (P = 0.40).

Mat temperature affected piglet use of the creep, as well as A2 and A3. For each increase of 1 °C in mat temperature, there was an approximate 2.1 % increase (P < 0.01) in piglet use of the creep, and conversely a 0.7 % decrease in piglet time spent in A2 (P = 0.02) and a 1.6 % decrease in A3 (P < 0.01).

3.3. *Effects of Ambient Temperature*

Ambient temperature was significantly higher (P < 0.01) in R2 (27.3 ± 0.1 °C) compared to R1 (23.8 ± 0.1 °C). Ambient temperature strongly affected the piglets use of the creep and remaining pen areas. Generally, for each 1 °C increase in ambient temperature, there was an approximate 4.8 % reduction ($P < 0.01$) in piglet use of the creep, and conversely a 1.2 % increase in piglet time spent in A2 ($P = 0.02$), and 3.4 % increase in A3 ($P < 0.01$).

3.4. *Number of Piglets in the Pen*

The number of piglets in the pen had a small, but significant effect on piglet use of pen areas, as the increase of one piglet in the litter led to a 1.2 % decrease in time piglets spent in the creep ($P = 0.03$) and conversely a 0.7 % increase in time piglets spent in A2 ($P = 0.01$), but no effects of number of piglets in the pen were found for piglet use of A3 ($P > 0.10$).

3.5. *Sow Location*

The proportion of time spent by sows in the areas A2 and A3 was not affected by light or mat treatments ($P > 0.10$). Light treatment and mat temperature did not affect sow posture ($P > 0.10$). However, most of sow standing (76.0 %) and sitting (74.5 %) events were observed in A3, excluding the situations where sows were in the middle of the pen. Lying events (both laterally and sternally) were similar in A2 (52.9 %) and A3 (47.1 %).

Sow location within the pen had a direct positive effect ($P < 0.01$) on piglet location within A2 and A3. The increase of 1.0 % of time spent by the sow in A2 and A3, there was an approximate 20.0 % increase ($P < 0.01$) of time spent by the piglets in the same area as the sow.

3.6. *Piglet Weight Gain*

Average piglet weight at weaning (7.3 ± 0.2 kg) for an average birth to wean period of 27.8 ± 0.8 days, did not differ between replicates, light treatments, and was not affected by mat temperature ($P > 0.11$). Piglet weight gain within the first 72-h pp was also not affected by light intensity ($P = 0.82$) or mat temperature ($P = 0.40$).

3.7. *Piglet Mortality*

Mortality over the 72-h pp for experimental litters were 9.0 ± 1.6 % in R1 Bright creep treatment and 12.7 ± 3.4 % in R1 Dark creep treatment, and 7.3 ± 2.1 % in R2 Bright creep treatment and 4.3 ± 1.0 % in R2 Dark creep treatment. Piglet mortality was not affected by light treatment (P = 0.21) or mat temperature (P = 0.38). However, the risk of piglet death within 72-h pp was significantly reduced with increased ambient temperature (P = 0.01), and tended to be reduced with increased piglet birth weight (P = 0.08). Overall average pre-weaning mortality for the whole room (experimental and non-experimental litters, as recorded per the farm) were 9.1 % for R1 and 7.1 % for R2.

3.8. *Discussion*

Illuminating creep areas in farrowing pens led to increased use of the creep by piglets within 72-h pp on a commercial farm. Consequentially, piglets with Bright creeps spent less time in the pen areas shared with the sow, and the reduction was greater in the area furthest from the creep (A3) where sows spent most time standing.

Piglet use of the creep area also increased with increased mat surface temperature and decreased ambient temperature (probably because of a greater temperature gradient between ambient and creep temperature), and reduction in number of piglets per pen. Piglet weight gain, mortality and sow use of pen areas were not affected by light intensity or mat temperature.

3.8.1. **Light Treatment**

The positive effect of Bright creeps on piglet creep use contrasts with the findings of Larsen and Pedersen (2015), where piglets did not change their use of lit (130 Lx) creep areas compared to piglets with access to dark creeps. Larsen and Pedersen (2015) also reported a preference of piglets to sleep in the darkness, which was not seen in the present research.

The increased use of Bright creep areas seen in this study may not necessary mean piglets preferred the lit (300 Lx) over the dark environment (4 Lx), especially because there was a trend that piglets took more time to enter Bright creeps for the first time, compared to Dark creeps. Instead, the light could have acted as an extra cue to the warmth of the creeps, helping piglets to associate the creep area with a warmer environment. This would explain why, despite the greater latency to enter Bright creeps, once piglets entered the creep, they took less time to remain in the Bright creeps as part of 30.0 % (R2) and 75.0 % (R1) of the litter for at least 10 min compared to piglets with Dark creeps. Also, in Larsen and Pedersen's study (2015), heat source was mainly through radiation, whereas in the present study heat source was mainly conductive, through heating mats. Thus, it is possible that type of heating affects how piglets associate the creep areas with a warm zone.

Moreover, creep light levels were constantly above pen light levels (300 Lx vs. 80 Lx, respectively) in the present study, thus there was a constant light gradient in which the higher light intensity was inside the creep. Conversely, in Larsen and Pedersen's study (2015) creep light intensity was below the room light level during the day (130 Lx vs. 300 Lx), which may be an indication that light gradient plays a role in piglet behaviour, rather than intensity alone.

Based on the results of the present study, light can be potentially used as an additional cue in creeps to increase their use by new-born piglets. However, given the longer latency to enter Bright as compared to Dark creeps, the light configurations (cool white LED, 300 Lx) used in this experiment may not be the ideal ones for increasing piglet use of the creep area. Lights of different intensity and frequencies, within the pigs' visible spectrum, should be further studied as potential cues or attractants to creep areas. Furthermore, other sensory stimuli can be explored in creeps to increase piglet use of these areas, as piglets have been previously reported to be attracted to a variety of olfactory, auditory and tactile stimuli (Morrow-tesch and Mcglone, 1990; Parfet and Gonyou, 1991).

3.8.2. *Mat Temperature*

The increased use of the creep area as mat temperature increased from 20.3 ^{o}C to 41.7 ^{o}C could be a result of the increased temperature gradient between the mat and the pen environment, as mat temperature increased. Generally, the greater the difference between the pen and heated areas, the more piglets will seek the heated areas (Xin and Zhang, 1999). Although common mat set points are between 30.0 ^{o}C to 35.0 ^{o}C, mat temperatures above this range, measured at the mat's surface, did not lead to reduced use of the creep area in this study. This result is in agreement with the one reported by Zhang and Xin (2000), in which piglets tolerated up to 46.2 ^{o}C of contact temperature with the heated mat, without leaving the warm area. The variation observed among pens and over time in mat temperature, despite the central automatic control at room level, highlights the variation that is commonly observed on commercial farms, and demonstrates the importance of systematically and constantly checking mat temperature level actually being delivered.

3.8.3. *Ambient Temperature*

The increase in creep use with the reduction in ambient temperature found in this research may also have been a result of the increased temperature gradient between the heated and the pen areas as ambient temperature decreased. The increased ambient temperature in R2 may be one of the reasons why the effect of light in the creep was attenuated in this replicate, compared to R1.

3.8.4. **Number of Piglets in the Pen**

The decrease in the use of creep area with the increase in number of piglets in the pen maybe partly due to the clustering dynamics among piglets of larger litters or due to increased heat generation among greater number piglets. In support of the social dynamics hypothesis, increased incidence of crushing of at least three piglets in litters of over 13 piglets was found by Morello (2015), as compared with litters inferior to 10 piglets. Hence, it is possible that in larger litters piglets are less likely to remain close together in one single cluster, which has been demonstrated to be safer for piglets as opposed to being spread around the sow (Marchant et al., 2001). In support of the heat generation hypothesis, two day old piglets generate approximately 5 W · kg-1 of heat (Brown-Brandl et al., 2004; Zhang and Xin, 2000), which could be enough heat added up in larger litters to reduce the need of piglets to seek for warmer areas.

3.8.5. **Sow Location**

Despite all the environmental effects found on piglet creep use, sow location was the main factor associated with piglet location within the pen, when outside the creep. Early access to colostrum is vital for piglet survivability (Hoy et al., 1995) and piglets will tend to remain near the sow while nursing or seeking to nurse within the first few hours of life. It is also possible that in pen farrowing systems the sow herself tends to seek and remain near her piglets. However, the first 24-h to 72-h pp are the most critical for the risk of piglet crushing by the sow (Andersen et al., 2005; Marchant et al., 2001). A possible strategic solution to reduce crushing in pen systems may be to attract piglets as soon as possible after birth to warm areas, away from the sow between suckling episodes.

3.8.6. **Piglet Weight Gain**

Piglet weight gain within 72-h pp and between birth to weaning was not affected by light and mat treatments, thus the increased use of Bright and warmer creeps possibly did not affect piglet nursing behaviour, although further analysis would be needed to confirm this hypothesis.

3.8.7. **Piglet Mortality**

Although mortality was not affected by creep light and mat treatments, this study was not designed to detect mortality differences among sows, as this would require studying a substantial greater number of litters. Still, previous research has demonstrated that the risk of a piglet being crushed is significantly higher if piglets are spread around within 0.5 m from the sow as she lies down (Marchant et al., 2001). Furthermore, the increased use of Bright creeps led to a reduction in the use of the remaining pen areas, mostly in A3, which was the furthest from the creep area. Area 3 was the pen area where most of the sow standing events (76.0 %) were observed, probably for the greater space available for sows to move and turn around, as well as due to the feeder and a drinker being in this area Figure 1. Thus, A3 is likely to be more dangerous for piglets than A2, as changing from standing to lying is one of the most dangerous sow posture changes for the crushing of piglets (Andersen, Berg, and Bøe, 2005; Marchant et al., 2001; Morello, 2015). Therefore, further investigations on the implications of increased use of the creep on piglet mortality is encouraged.

4. Application of Research

The interpretations from these findings are:

- Illuminating creeps with cool white Light Emitting Diodes (LED´s, 300 Lx) led to increased use of the creep area by the piglets. Creep light may have acted as an extra cue to the warmth protected area of the creeps, helping piglets to learn where to get additional heat in farrowing pens.
- Bright creeps tended increase latency for piglets to enter the creep for the first time, thus light may not necessary be a natural attractant for newborn piglets. Still, piglets took less time to remain as a group for at least 10 minutes in Bright creeps compared to piglets with access to Dark creeps,

which strengthens the hypothesis that light may have acted as an extra cue as piglets learned to seek for the warmth of the creeps.

- Increased mat temperatures led to increased piglet use of creeps, independently of light levels. This result may indicate a preference for higher surface temperatures, or an ease for piglets to find the warmth due to the increased temperature gradient between the mat and the pen environment.
- Sow use of pen areas immediately in front and farthest from the creep did not change among treatment combinations. Thus, increasing mat temperature and illuminating the creep seemed not to be attracting or driving sows away from the area closest to the creep.
- Piglets use of specific pen areas increased with the increase of sow use of same areas. It was not possible to tell from the scan sampling data if sows were following piglets or the other way around, but sow location was the main factor contributing to piglet location in the pen.
- Research on a larger sample size is needed and recommended to evaluate the direct practical and economic implications of creep light and mat treatments on piglet survivability in farrowing pens.

5. Conclusion

Australian pork producers are increasingly taking voluntary action to replace crated farrowing systems for systems where gestating and lactating sows have more freedom to move and turn around. However, pen farrowing systems are often reported to have increased pre-wean mortality compared to crated systems, mainly due to increased piglet crushing by the sow. Attracting piglets to the protected and warm areas of creeps, while piglets are not nursing, may be a good strategy to reduce crushing incidence. The present research evaluated if illuminating the creeps and varying mat temperature affected piglet use of the creep. Results revealed that increased mat temperature and provision of Bright creeps led to increased use of the creep by newborn piglets in commercial pens. Whether this increase in creep use translates to lower piglet crushing total pre-wean mortality should be evaluated on a larger sample size. Moreover, piglets with access to Bright creeps reduced their use of the area farthest from the creep, where the sow was often observed standing and sitting. Thus, illuminating the creep may potentially reduce the risk of crushing by the sow. Furthermore, other sensory stimuli can be explored as attractants to creep areas in an effort to improve piglet survivability.

6. Limitations/Risks

- These research findings were obtained in SWAP farrowing pens and in environmentally controlled rooms. Results may vary in other types of farrowing pens, farrowing crates or naturally ventilated environments.
- Although we found changes in the behaviour of the piglets, with light and mat temperature increasing use of the creep, it remains to be verified that these behavioural changes results result in lower piglet crushing and lower pre-weaning mortality.
- The experiment only tested 300 lux vs. 4 lux, and mat temperature up to 42°C. These results cannot necessarily be extrapolated to different light intensity or higher mat temperature.

7. Recommendations

As a result of the outcomes in this study the following recommendations are made:

- Evaluate lights of different frequencies and intensities attractants to piglets. In the present research, illuminating creeps with cool white Light Emitting Diodes (LED´s, 300 Lx) led to increased use of the creep area. However, the light intensity and quality used may not be the ideal ones for promoting creep use by piglets. There may exist a more effective combination of light characteristics to increase even more piglet use of the creep areas.
- Explore other sensory stimuli to attract piglets to the creep areas. Pigs were demonstrated be attracted to a variety of olfactory, auditory and tactile stimuli (Morrow-tesch and Mcglone, 1990; Parfet and Gonyou, 1991), which could act as more effective attractants to creep areas compared to light intensity.
- Research on a larger sample size to evaluate the direct practical and economic implications of creep light and mat treatments on piglet survivability in farrowing pens.

Acknowledgements

The authors thank David Murden and Seungyeol Ko for their help with collecting data for this project.

8. References

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