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PROGRESS

Sow Resilience

the Herd's Foundation

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Global Application Manager Swine

Sow Resilience Leads Herd Productivity

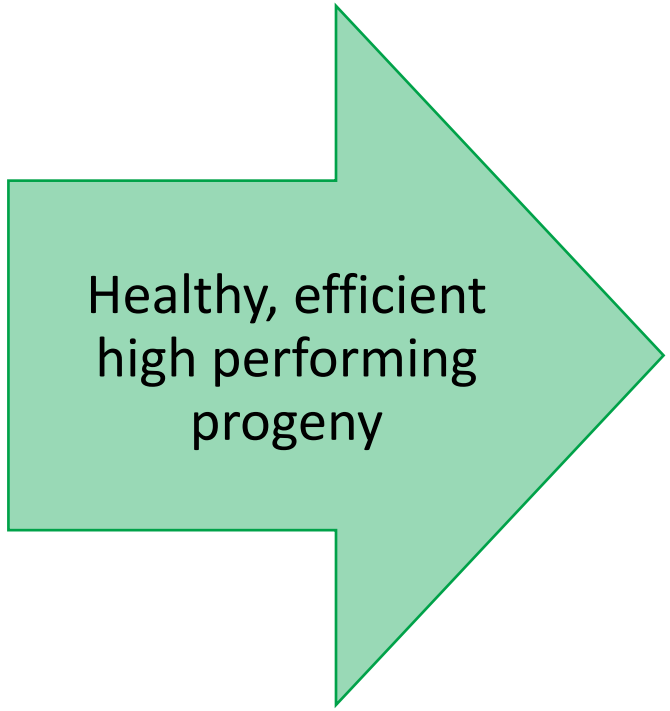
ew | nutrition

Resilience – the ability to successfully adapt to stressors, maintaining well-being and performance in the face of challenges

A resilient sow herd is crucial for achieving sow longevity, and total herd productivity in the long term.

A resilient sow is the end product of –

- Genetics
- Health
- Nutrition
- Husbandry
- Management
- Environment



➔ **HERD PROFITABILITY**

➔ **REDUCED ANTIBIOTICS**

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Sow Resilience and Herd Productivity

1. Understanding Herd Performance
   - Utilization of herd data
2. Sow Longevity
   - Mortality and removals
   - Gilt selection and management
3. Sow Herd Resilience
   - *Health & nutrition*
   - Husbandry, management, environment

Understanding herd performance

Understanding Herd Performance | Utilization of Herd Data

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Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Whole-herd risk factors associated with wean-to-finish mortality under the conditions of a Midwestern USA swine production system

Edison S. Magalhães [a], Jeffrey J. Zimmerman [a], Pete Thomas [c], Cesar A.A. Moura [c], Giovani Trevisan [a], Derald J. Holtkamp [a], Chong Wang [a,b], Christopher Rademacher [a], Gustavo S. Silva [a], Daniel C.L. Linhares [a,*]

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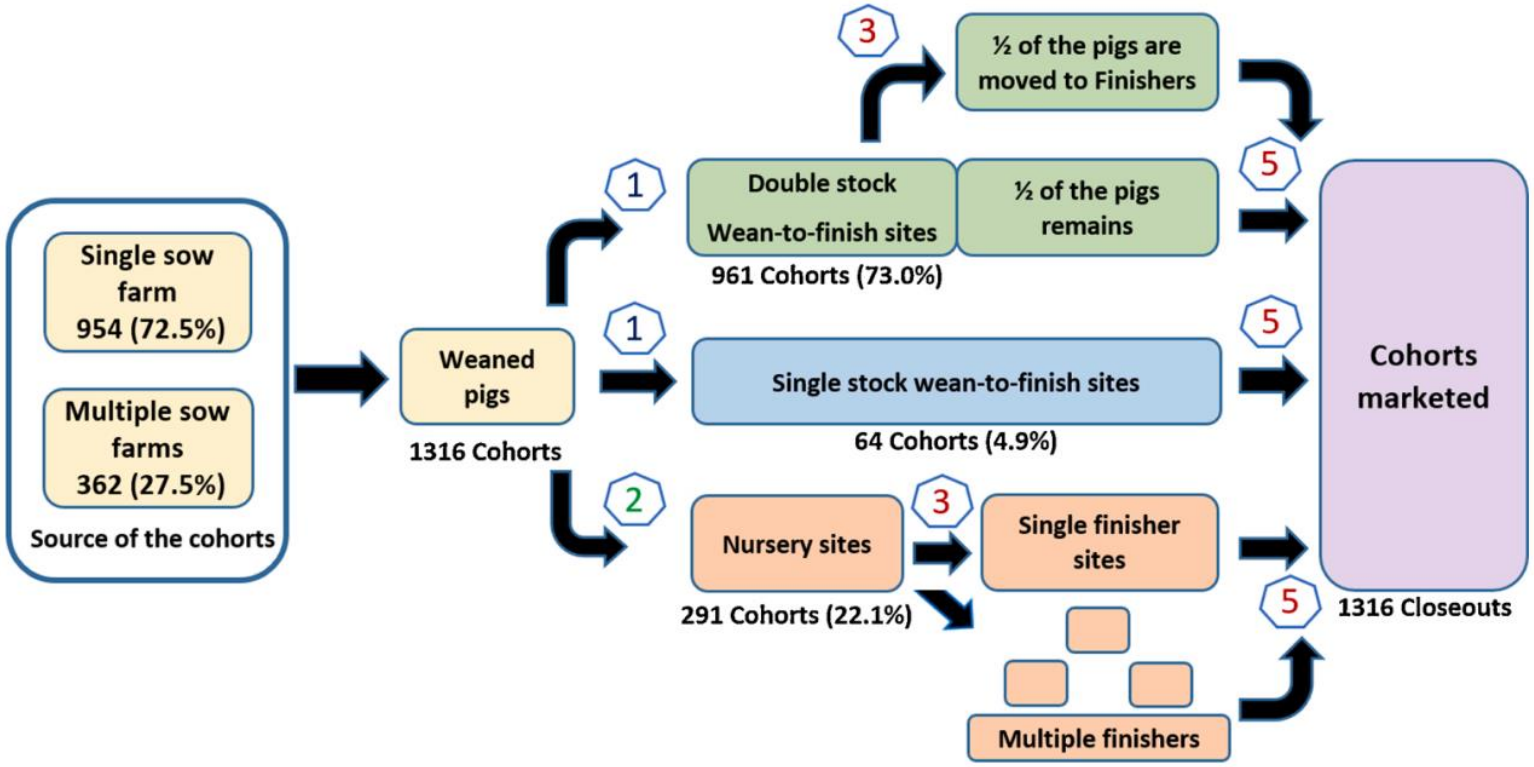
Understanding Herd Performance | Utilization of Herd Data



Flow diagram of 1,316 cohorts marketed from July 2018 to June 2019 by production phase.

Understanding Herd Performance | Utilization of Herd Data

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Whole herd productivity parameters included in risk management analysis

Production Phase	Framework	Data collected
Sow Farms	A. Insemination (rates at time of weaning)	Service repeat rate Abortion rate Farrowing rate Total born Birth loss (stillborn and mummies)
	B. Farrowing (data at the time of farrowing i.e. 21 days before weaning)	Born alive Parity at farrow Gestation length Capacity utilization (farrowing room) Lactation Length
	C. Weaning	Pigs weaned/sow Piglet wean age Pre-weaning mortality Sow death rate Non-productive days
	D. Sow herd performance	Pigs weaned/mated female/year Litters/female/year Herd parity (including gilts) Mated inventory Sow parity at removal from herd

Production Phase	Framework	Data collected
Growing Sites	E. Sites 1 and 2 (growing)	Stocking type Days empty before stocking Average weight in Number of pigs in
	F. Sites 3 (finishing)	Average weight out Number pigs out Wean-to-finish mortality

Plus additional parameters –

Sow farm Structure –

- Implementation of air filters (Y/N)

Season – Season of the year at weaning

Health (Pathogens) Sows and Grow outs –

- negative, endemic, epidemic

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Understanding Herd Performance | Utilization of Herd Data

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Whole herd productivity parameters included in risk management analysis

Production Phase	Framework	Data collected
Sow Farms	A. Insemination (rates at time of weaning)	**Service repeat rate** **Abortion rate** **Farrowing rate** **Total born** **Birth loss** (stillborn and mummies)
	B. Farrowing (data at the time of farrowing i.e. 21 days before weaning)	Born alive **Parity at farrow** **Gestation length** Capacity utilization (farrowing room) Lactation Length
	C. Weaning	Pigs weaned/sow **Piglet wean age** **Pre-weaning mortality** Sow death rate Non-productive days
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Production Phase	Framework	Data collected
Growing Sites	E. Sites 1 and 2 (growing)	Stocking type Days empty before stocking Average weight in Number of pigs in
	F. Sites 3 (finishing)	Average weight out Number pigs out Wean-to-finish mortality

Plus additional parameters –

Sow farm Structure –

- Implementation of air filters (Y/N)

Season – **Season of the year at weaning**

Health pathogens - **Sows** and Grow outs

The final multivariable model consisted of 13 risk factors and accounted for 68.2% of the variability of W2F mortality

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Understanding Herd Performance | Conclusions

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Conclusions

- Sow farm health and performance linked to downstream W2F mortality
  - High sow farm productivity ➔ low W2F mortality
  - High sow farm health status ➔ low W2F mortality
    - Significant differences seen in W2F mortality for –
      - Pre-weaning mortality, weaning age, farrowing rate, abortion rate, total born, birth loss, repeat service rate, parity at farrowing, gestation length
      - Season at weaning
      - PRRS and *Mycoplasma hyopneumoniae* - epidemic versus negative status

Conclusion – *Aggregating information from breeding to market identified the major risk factors associated with W2F mortality, demonstrating the value of whole herd data collection and analysis*

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Sow Longevity

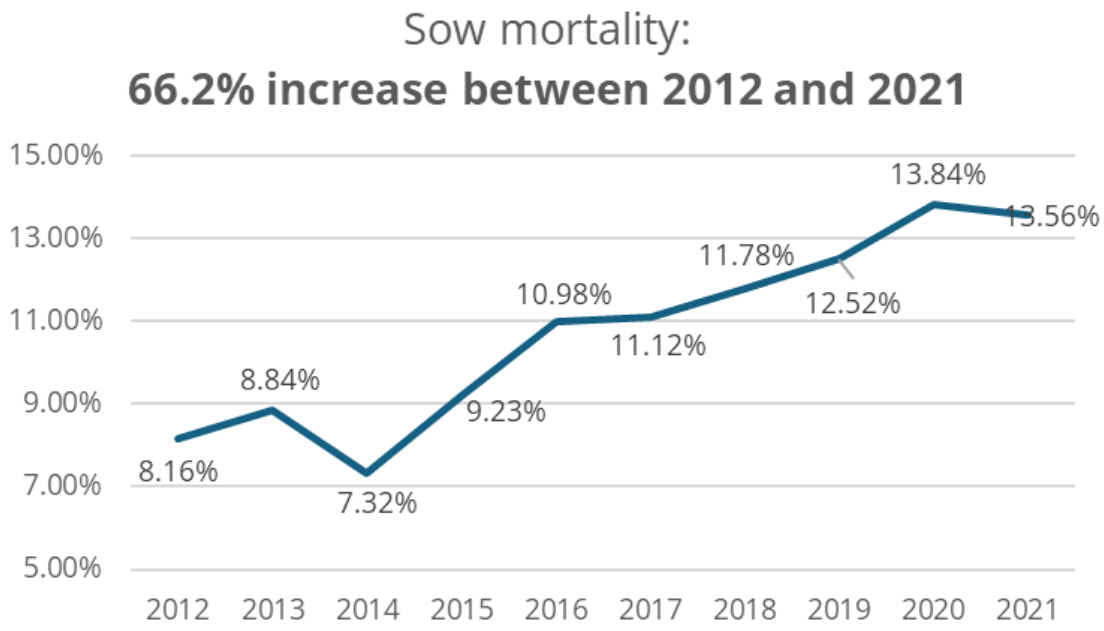
Influencers and Mitigation

Sow Longevity

Sow Loss = Mortality & Removals

- Sow loss
  - Impacts total herd performance
- Total sow loss =
  - \+ Active culling of sows
    - Reason for cull is clear
  - \+ Mortalities
    - = Unexpected death of sows
- Reducing sow mortalities
  - Not simple
  - No one solution
  - Strategy the same –
    - Investigate to determine cause
      - Evaluate detailed health and breeding history

- Sow mortality continues to increase across pig-raising regions (incls US, Canada, AU, PH)

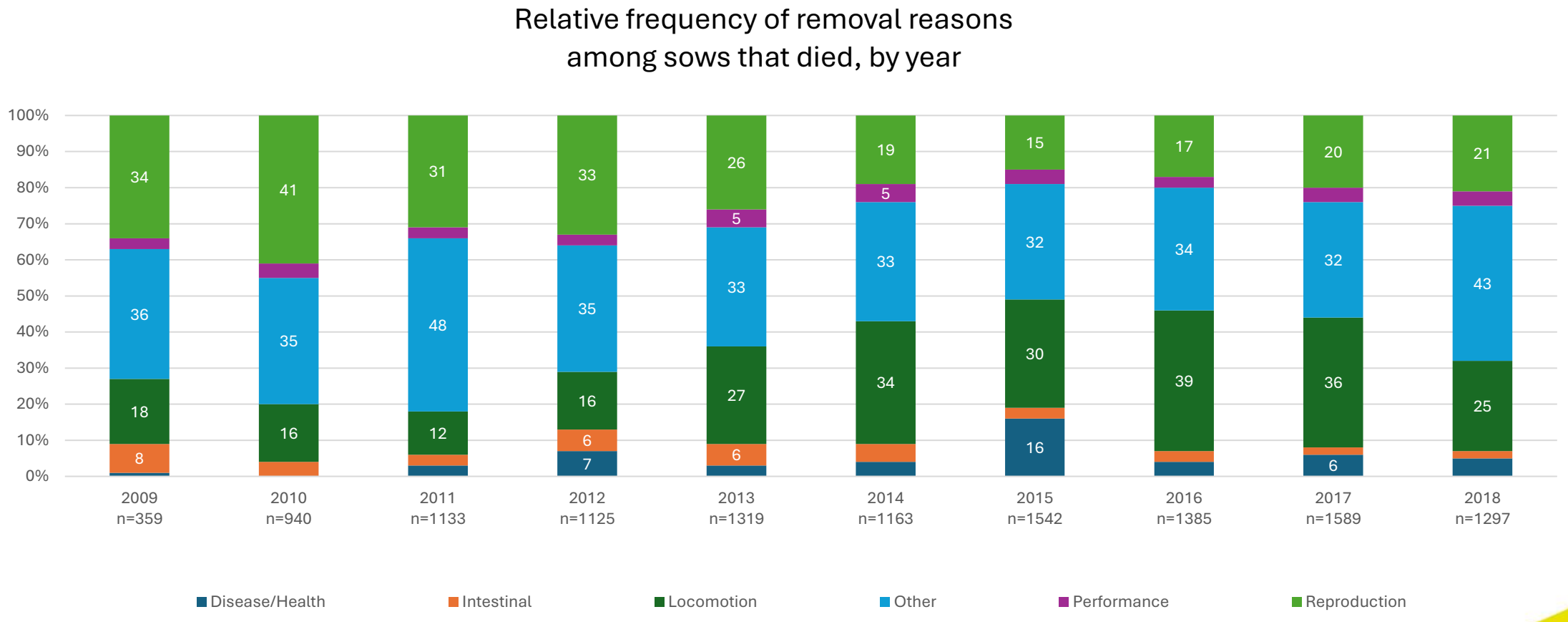


(Eckberg, 2022)

[DH1]Data, graphics.xlsx - Mortality increase

Sow Longevity

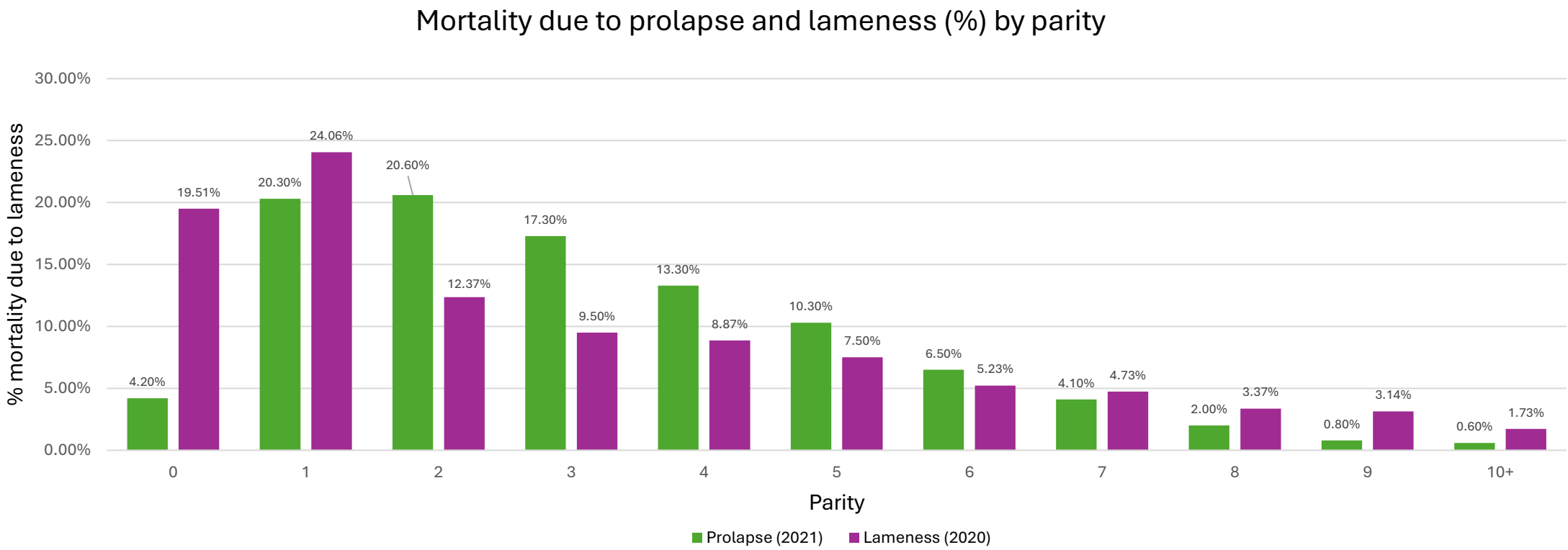
Sow Loss = Mortality & Removals



(adapted from Kikuti et al., 2022)

Sow Longevity

Sow Loss = Mortality & Removals



[DH2] (Adapted from Marco, 2024)

Sow Longevity

Gilt Selection & Management Influences Sow Longevity

- Gilt selection (basic criteria)
  - Physical structure and conformation incl. leg structure and hoof integrity
  - Weight
  - Height

- Gilt selection (additional criteria)
  - Age at first estrus
  - Age at first mating
  - Body weight at first mating
  - ADG up to time of first mating

Sow Longevity

Gilt Selection & Management Influences Sow Longevity

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1. Age at first estrus

- Link between early sexual maturity and sow lifetime productivity
  - Sows culled parity 0 or 1
    - Exhibited first estrus at 204.4±0.7 days of age
  - Sows culled at parity ≥5
    - Exhibited first estrus at 198.9±2.1 days of age (p=0.015)

< 195 days

2. Age at first breeding

- Gilts > 225 days of age are likely overweight
- Gilts bred > 240 days show (vs Gilts bred 200-225 days of age)
  - Litter size decrease in second parity
  - Longer wean-to-service interval
  - Shorter production life overall

200-225 days

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Roongsitthichai et al., 2013 …

Sow Longevity

Gilt Selection & Management Influences Sow Longevity

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3. Body weight at first mating

- Supports ideal weight at farrowing and lifetime maintenance
  - ADG 600-800 g to reach target weight between 200 and 225 days
  - Gilts bred 150-160 kg (vs 136-140kg)
    - Larger total born (TB) second litter (p=0.050)
  - Gilts with ADG 601-650 g (vs 551-600 g)
    - Larger TB second litter (p=0.012)

135-160 kg

4. Number of estrus cycles prior to first mating

- Accurately track estrus and breed on the second estrus
  - Delaying breeding to second estrus
    - Positive effect on litter size
  - Delay breeding to the third estrus
    - ONLY to meet minimum weight

2nd estrus

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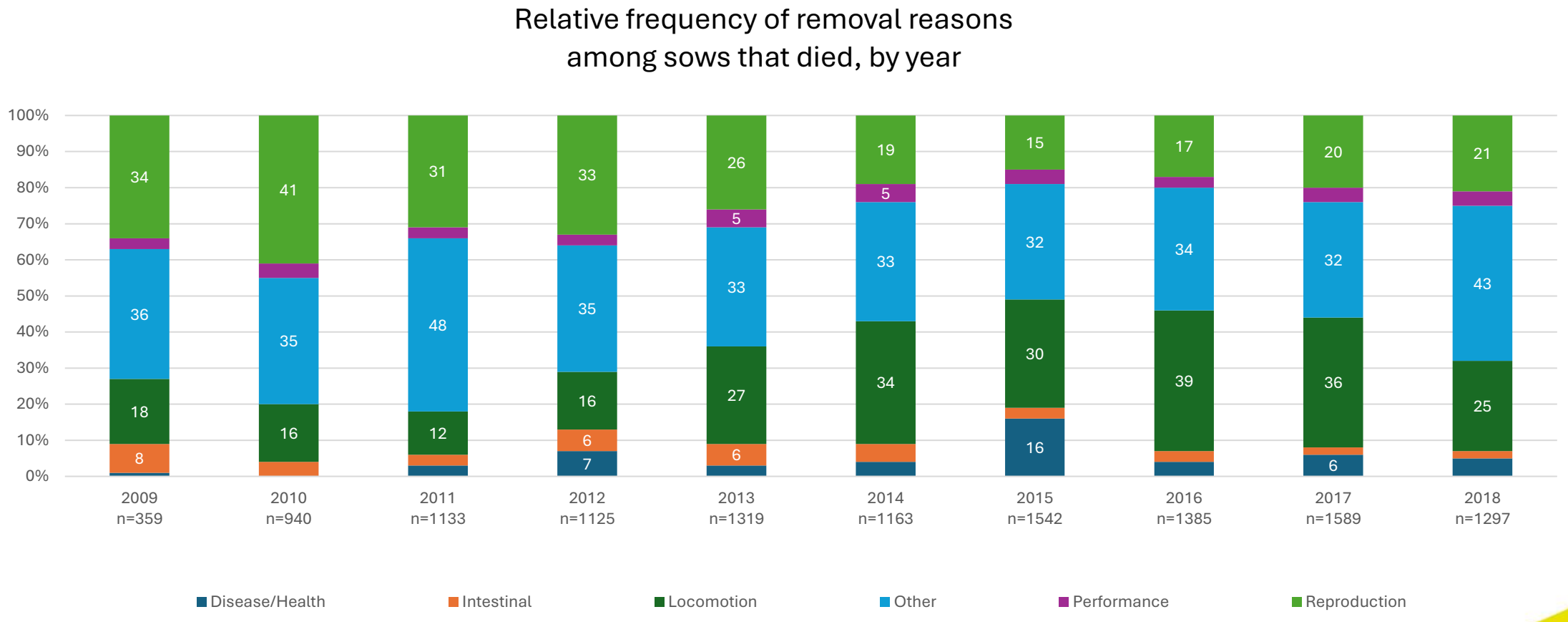
Roongsitthichai et al., 2013

Sow Longevity

Sow Loss = Mortality & Removals



(adapted from Kikuti et al., 2022)

Sow Longevity

Sow Loss = Mortality & Removals

Research in Veterinary Science 139 (2021) 127–132

Contents lists available at ScienceDirect

Research in Veterinary Science

journal homepage: www.elsevier.com/locate/rvsc

Causes of spontaneous sow deaths in the farrowing units of 10 Danish sow herds

H. Kongsted [a,*], S. Haugegaard [b], A.S. Juel [b], C.M. Salomonsen [b], T.K. Jensen [c]

Sow Longevity

Sow Loss = Mortality & Removals

- 10 Danish sow herds shared mortality data for 7-15 months
  - 126 sows died
    - 24% died within 5 days of farrowing
  - 53/126 sows were necropsied
    - Liver lobe torsion 22/53 (42%) –
      - Unknown cause (less often in first 5 days)
    - Endotoxemic shock
      - Due to retained fetuses 7/53 (13%)
      - Died within 3 days of farrowing
    - Less prevalent causes of death
      - Intestinal torsions (8%)
      - Cardiovascular collapse (8%)
      - Rupture of blood vessels (uterine & non-ut. 8%)
      - Gastric ulcers (4%)
      - Sepsis (2%)
      - Liver abscess (2%)
    - Acute introduction of *M. hyo* to 1 (naïve) herd
      - Acute increase in sow mortality (7/53 = 13%)

Sow Resilience

Influencers and Mitigation

Sow Resilience | Influencers

Husbandry, Management, Environment

- Husbandry, management, environment
  - Husbandry
    - Animal handling
  - Management
    - Gestational group housing
    - Farrowing and lactation environment
  - Physical environment
    - Heat stress

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Applied Animal Behaviour Science
Volume 17, Issues 3–4, June 1987, Pages 245-252

The influence of inconsistent handling by humans on the behaviour, growth and corticosteroids of young pigs

P.H. Hemsworth, J.L. Barnett, C. Hansen

Methodology

- 32 young female pigs housed in individual pens 7-13 weeks of age
- 4 handling treatments -
  - 3 treatments were imposed for 3 min each, 3 times per week
    1. Pleasant - stroking the pig whenever it approached the experimenter
    2. Unpleasant - forcing the pig away whenever it approached
    3. Inconsistent - combination of unpleasant and pleasant treatments (ratio of 1:5)
    4. Minimal handling - minimal contact with humans during this 6-week period
- Data collected – behaviour observations, growth and free corticosol concentration

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Evaluating the impact of animal handling on grower pig performance

Table 2: Influence of handling on growth performance and corticosteroid concentration of female grower pigs from 7-13 weeks of age (Hemsworth et al., 1987)

	Unpleasant	Pleasant	Inconsistent	Minimal
ADG (g)	404^{a}	455^{b}	420^{ab}	4.58^{b}
FCR (F:G)	2.62^{b}	2.46^{a}	2.56^{b}	2.42^{a}
Corticosteroid conc (ng/mL)	2.5^{a}	1.6^{b}	2.6^{a}	1.7^{b}

*Kicking action staged for photo

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Sow Resilience | Management

Maternal Resilience to Social Stress and Progeny Performance

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animals

MDPI

Article

A Comparison of the Behavior, Physiology, and Offspring Resilience of Gestating Sows When Raised in a Group Housing System and Individual Stalls

Xin Liu [1,†], Pengkang Song [1,2,†], Hua Yan [1], Longchao Zhang [1], Ligang Wang [1], Fuping Zhao [1], Hongmei Gao [1], Xinhua Hou [1], Lijun Shi [1], Bugao Li [2,*] and Lixian Wang [1,*]

Methodology - Sows

- 60 large white P2 sows
- Pregnancy confirmed @ 28 days then divided into 2 groups
  - Individual stalls (IS) 2.4m x 0.65m (1.56m^2/head)
  - Group housing (GS) 10.5m x 14.4m (5.04m^2/head) with ESF
- Behaviour observations via video 9am-5pm on each of day 40, 70 and 100 of gestation
  - Number of times behaviours occurred in each 10min increment
- Temperature maintained approx. 20^{o}C
- Blood samples collected day 41, 71, 101
  - Tested ACTH, adrenaline and cortisol

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animals

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Methodology - Piglets

- 20 piglets randomly selected from 10 sows per treatment group
- 6kg healthy 21day old piglets
- Piglets from each sow group randomly assigned to LPS or saline injection groups
- Blood collected 6 hours post-injection for cortisol
- Ear temperature measured hourly after injection for 6 hours

Results - Sows

- GS sows
  - more exploratory behavior, less vacuum chewing, and less sitting behavior ($p < 0.05$)
- IS sows showed higher stress hormone levels than GS sows
  - 41 days gestation ➔ concentration of the adrenocorticotropic hormone (ACTH) and adrenaline was significantly higher ($p < 0.01$)
  - 71 days gestation ➔ adrenaline level remained significantly higher ($p < 0.01$)

Results - Piglets

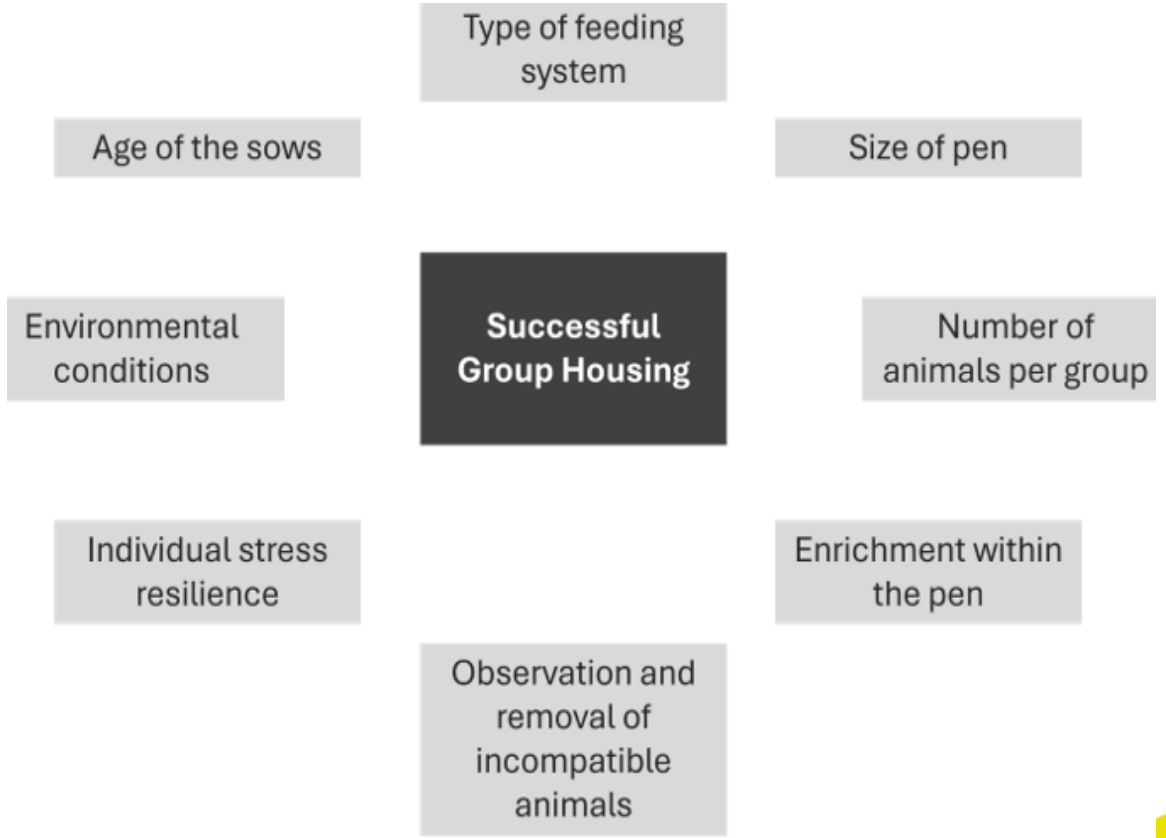
- LPS test performed in weaners from GS (PG) vs IS (PS) sows
  - PG ➔ shorter period of high temperature and faster return to normal ($p < 0.05$)
  - PG ➔ lower stress hormone levels than PS ($p < 0.01$)

GS were able to carry out more natural behaviors and showed lower levels of stress, with less stressed and more robust progeny

Sow Resilience | Management

Gestational Group Housing

- Poorly established groups elevate stress and increase aggressive behaviour
  - ➢ Increased leg injuries
  - ➢ Higher rates of abortions and returns to service
  - ➢ Lower milk yield
  - ➢ Reduced piglet growth
  - ➢ Compromised immune function
  - ➢ …… etc



Sow Resilience | Management

Maternal Resilience to Social Stress and Progeny Performance

Classifying maternal resilience for improved sow welfare, offspring performance

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Classifying maternal resilience for improved sow welfare, offspring performance - National Hog Farmer September/October 2024 (turtl.co)

Sow Resilience | Management

Maternal Resilience to Social Stress and Progeny Performance

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Objective

- To evaluate growth of piglets from social stress resilient (SR) vs vulnerable (SV) sows

Trial methodology

- 64 sows (P1 and P2) mated and confirmed pregnant at 22-24 days gestation
- Moved to free stall at 25 days gestation
  - 8 sows per pen in individual stalls until 30 days gestation
- Mixed at 30 days gestation
  - Saliva collected individually @ -1, 0, +1, +2, +3, +7 days post mixing
- Sow selection –
  - 9 stress resilient sows (baseline, acute response, recovery to baseline by 7 days post-mixing)
  - 9 stress vulnerable sows (moderate acute response but cortisol continues to elevate = chronic stress)
- Performance of progeny from SR and SV sows compared

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Classifying maternal resilience for improved sow welfare, offspring performance - National Hog Farmer September/October 2024 (turtl.co)

Sow Resilience | Management

Maternal Resilience to Social Stress and Progeny Performance

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Results

- No statistical difference in TB or BA between SR and SV sows
  - 1 SV sow removed due to layover of most piglets
- 158 piglets followed to weaning
- Birth weight @ processing
- Weaning weight @ av 26d (1 day pre-wean)

Table 1: Influence of stress resilience on performance (Luttmann and Ernst, 2024)

Trait	SR	SV	p-value
Birth weight (kg)	1.350 ± 0.039	1.246 ± 0.041	0.083
Wean weight(kg)	6.299 ± 0.185	5.639 ± 0.202	0.033*
Suckling ADG (kg/d)	0.191 ± 0.005	0.165 ± 0.005	0.004**

Least square means and standard error of stress resilient (SR) and stress vulnerable (SV) for each trait; significance threshold of $p<0.05$ with * indicating $0.01<p<0.05$, ** indicating $0.001<p<0.01$

Conclusion - Sow resilience to stress influences litter performance

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Classifying maternal resilience for improved sow welfare, offspring performance - National Hog Farmer September/October 2024 (turtl.co)

Sow Resilience | Management

Farrowing Confinement

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frontiers | Frontiers in Veterinary Science

A five domains assessment of sow welfare in a novel free farrowing system

Kate Plush*, David Lines, Lauren Staveley, Darryl D'Souza and Robert van Barneveld

SunPork Group, Brisbane, QLD, Australia

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https://doi.org/10.3389/fvets.2024.1339947; Maternity Rings – SunPork Group Website

Sow Resilience | Management

Farrowing Confinement

Objective –

- Free farrowing alternative that preserves space whilst giving sows unrestricted movement

Aim –

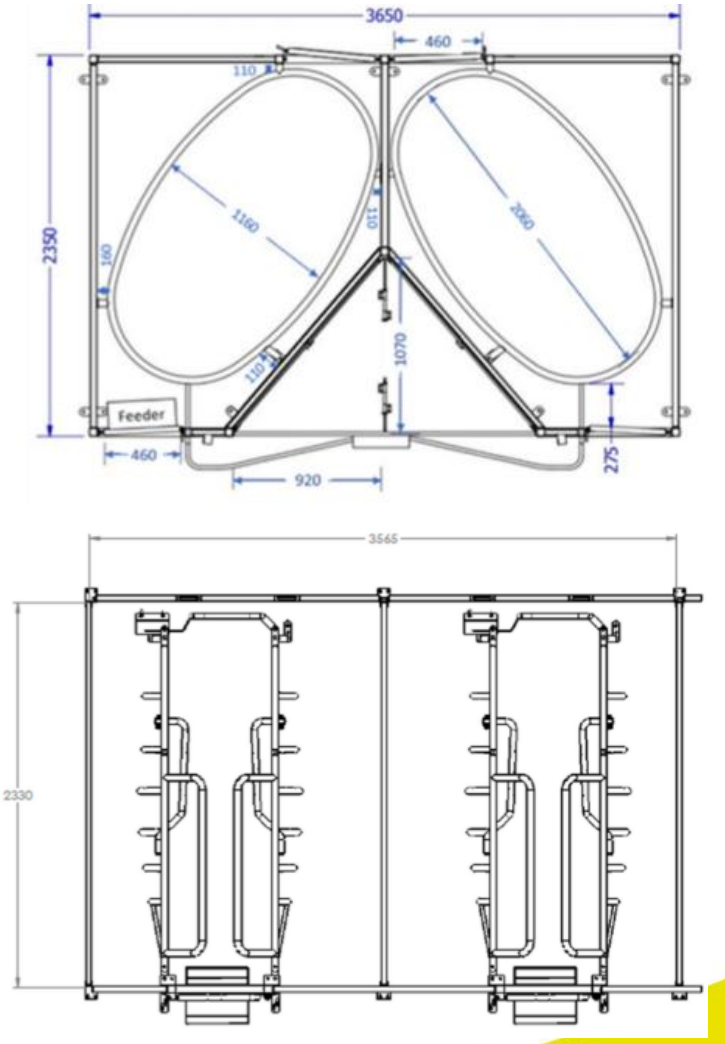
- To apply the 5 domains model to assess sow welfare, and to evaluate sow and piglet performance, in maternity ring (MR) vs individual crates (FC)
- Suitable for all parity sows
- Safe for staff

Trial Design –

- 88 sows in FC
- 83 sows in MR
- Dimensions of 2 adjacent MR or FC = 2350 x 3650

Data Collection –

- Nutrition, health, environment, behaviour and mental state



https://doi.org/10.3389/fvets.2024.1339947; Maternity Rings – SunPork Group Website

Sow Resilience | Management

Farrowing Confinement

Results –

Total **Feed Intake less in MR**

- **MR 93.8** +/- 3.06kg vs FC 111.2 +/- 3.13kg P<0.001

MR reduced P2 back fat loss during lactation

- **MR 0.0** +/- 0.11 vs FC 1.2 +/- 0.11 P<0.001

All litter performance parameters showed no sig. differences

Fewer pain-related behaviours during farrowing **in MR sows**

- **MR 0.5** +/- 0.29 vs FC 3.3 +/- 2.12 P = 0.019

Decreased proportion **MR sows** had **facial injuries post farrow**

- **MR 10%** vs FC 67% P<0.001

MR reduced udder damage at weaning

- **MR 10%** vs FC 70% P<0.001

Fewer piglet medications in MR litters

- **MR 30%** vs FC 51% P=0.008

Increased sow contact events with piglets after processing

- **MR 13.5** +/- 2.55 vs FC 6.9 +/- 1.26 P=0.016

MR sows displayed **reduced startle to aversive noise** at d18

- **MR 0.7** +/- 0.16 vs FC 2.8 +/- 0.35 P<0.001

https://doi.org/10.3389/fvets.2024.1339947; Maternity Rings – SunPork Group Website

Sow Resilience | Management

Farrowing Confinement

https://doi.org/10.3389/fvets.2024.1339947; Maternity Rings – SunPork Group Website

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Sow Resilience | Management

Farrowing Confinement

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Sow Resilience | Environment

Heat Stress Performance Impact

- Sow feed intake
  - Each 1°C increase between 25-27°C and 50-60% humidity ➔ -214g/d[2]
  - Thermoneutral (18-24°C) vs hot (27-32°C) ➔ -33%[3]
- Viability of piglets at birth
  - Respiration rate >50 bpm ➔ risk to foetus' and pregnancy
- Milk supply
  - Each 1°C above sow thermoneutral zone ➔ -184g/d[2]
  - Thermoneutral (18-24°C) vs hot (27-32°C) ➔ -22.8%[3]
- Suckling piglet performance
  - Farrowing rooms at 18°C vs 29°C ➔ -1.32kg @ 24d wean
  - Thermoneutral (18-24°C) vs hot (27-32°C) ➔ -17.4% ADG[3]
- Future breeding potential impact
  - Increase culls (e.g. udder damage)
  - Reduced conception and farrowing rates
  - Extended lactations +/- nurse sows

1. Dr Nathalie Quiniou and Dr Jean Noblet in 1999; 2. B. Bjerg et. al. Journal of Thermal Biology 94 (2020) 102758; 3. Farmer and Pruniew, 2002

Sow Resilience | Environment

Heat Stress – Farrowing Room Position

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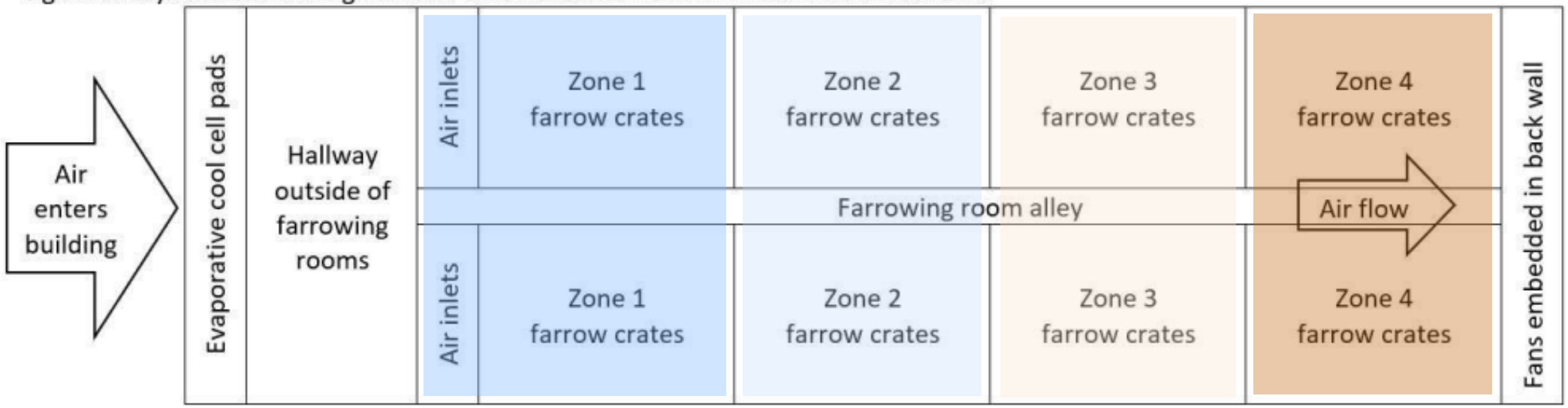
Farrowing room position impacts severity of heat stress and sow performance

North Carolina State University

Figure 1. Layout of farrowing facilities on a 3600 sow farm in eastern North Carolina.



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National Hog Farmer 2022 08 04 Mark Knauer, Suzanne Leonard, North Carolina State University

Sow Resilience | Environment

Heat Stress – Farrowing Room Position

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Farrowing room position impacts severity of heat stress and sow performance

Table 1. Impact of sow location (within the farrowing room) on reproduction, subsequent reproduction and sow body conditi

North Carolina State University

	Zone 1†	Zone 2	Zone 3	Zone 4	SE	p-value
Reproduction						
Stillborns	.53	.51	.55	.54	.055	.91
% stillborns	3.6	3.6	3.9	4.0	.45	.74
Number weaned	11.92	11.76	11.64	11.61	.09	<.01
Piglet survival, %	84.4	83.9	82.2	82.2	.82	<.01
Litter weaning weight, lb	160.1	155.1	149.7	147.3	2.0	<.01
Subsequent reproduction						
% of sows conceiving by 7 days after weaning	74.5	72.5	68.5	66.8	3.2	.01
Subsequent total number born	14.04	13.40	13.72	13.31	.25	.02
Subsequent number born alive	13.37	12.74	13.08	12.75	.245	.03
Subsequent stillborns	.60	.65	.59	.59	.076	.85
Sow body condition						
Sow caliper‡ prefarrow	14.09	14.11	13.99	13.99	.13	.67
Sow caliper @ weaning	11.95	11.86	11.55	11.57	.15	.01
Sow caliper lactation loss*	-2.10	-2.26	-2.42	-2.40	.12	.04

†Zone 1 included the sows at the front of the farrowing room near the inlets letting in cooled air. Zone 4 included sows at the back of the room where air exited the building through fans embedded within the wall. ‡Sow caliper; <12 = "thin", 12 to 15 = "ideal", >15 = fat. *Sow caliper loss - a one-unit change is equivalent to 1/3 of a body condition score change (1 to 5 scale).

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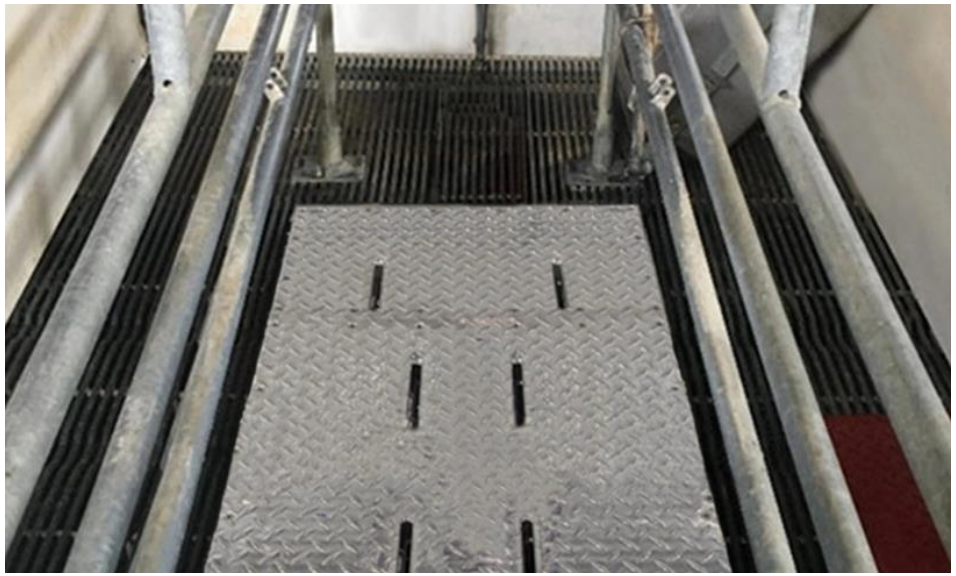
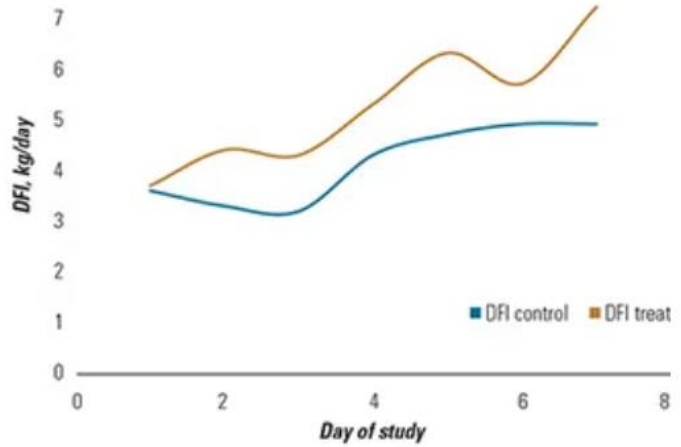
National Hog Farmer 2022 08 04 Mark Knauer, Suzanne Leonard, North Carolina State University

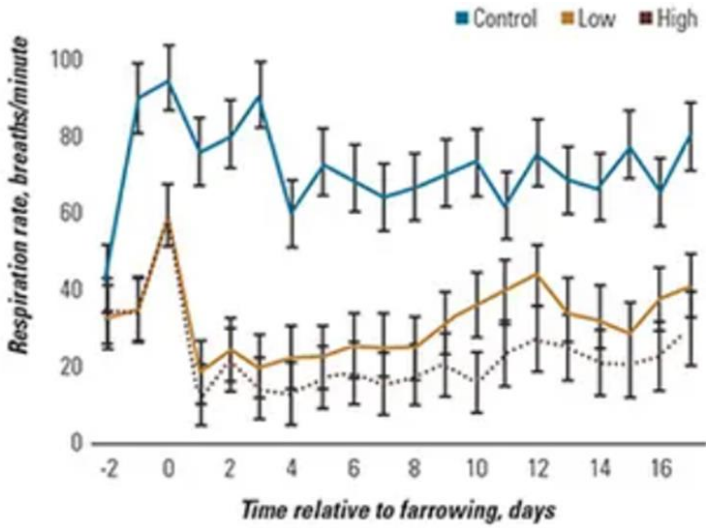
Sow Resilience | Environment

Heat Stress Mitigation – Cool Pads

- Cooling pads under sows in lactation
  - Feed intake increased[1]
  - Respiration rate decreased[1]







IHT Purdue cooling pad data 33ºC

Sow resilience

summary

Sow Resilience Leads Herd Productivity

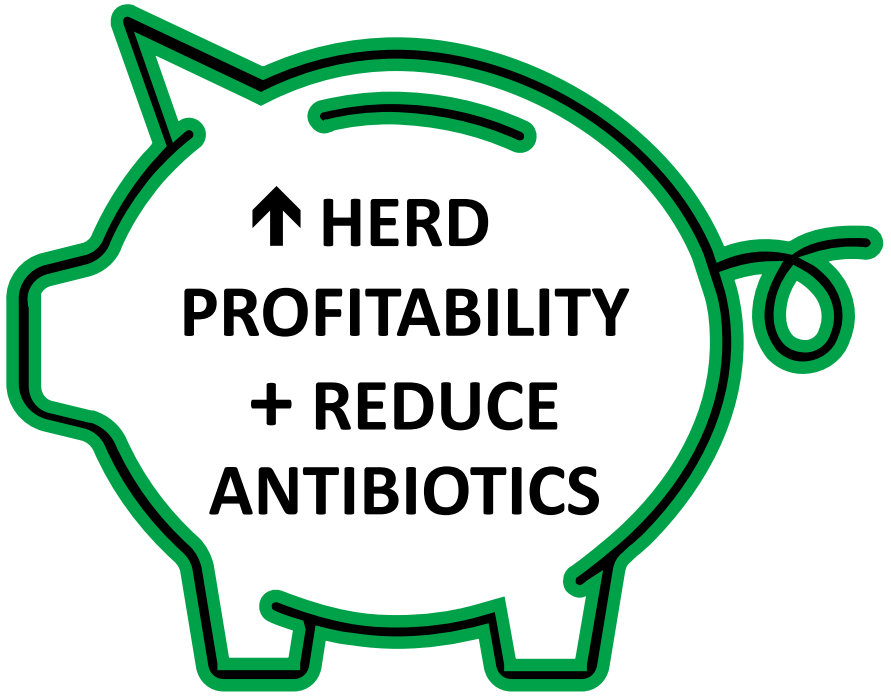
- Record and evaluate parameters of the production system
  - Quantitative data-based decisions
- Sow longevity
  - Identify sow losses and mitigate known causes
- Manage known stressors across the production system
  - Animal handling
  - Facilities
  - Environment
- Develop a resilient sow herd
  - Health & Nutrition
  - Husbandry, Management, Environment

Sow Resilience Leads Herd Productivity

ew | nutrition

Resilient Sows

↑ health, welfare, and performance of sow herd and progeny



PARTNERS IN PROGRESS

THANK
YOU!