Breeding herd management to maximise efficiency & output

Professor Paul Hughes
SARDI, AUSTRALIA
Topics to be covered

• What are best-practice targets

• How to achieve them commercially
Topics to be covered

• What are best-practice targets

• How to achieve them commercially
# Targets vs. commercial realities in Australia & the USA.

<table>
<thead>
<tr>
<th></th>
<th>Targets*</th>
<th>Australia</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Litter size – total born</td>
<td>13.0</td>
<td>11.8</td>
<td>14.0</td>
</tr>
<tr>
<td>Litter size – born alive</td>
<td>12.2</td>
<td>11.0</td>
<td>13.1</td>
</tr>
<tr>
<td>Litter size – weaned</td>
<td>10.9</td>
<td>9.6</td>
<td>11.6</td>
</tr>
<tr>
<td>Stillbirths %</td>
<td>5.5</td>
<td>6.9</td>
<td>6.4</td>
</tr>
<tr>
<td>Pre-weaning mortality %</td>
<td>10.0</td>
<td>11.4</td>
<td>11.2</td>
</tr>
<tr>
<td>Farrowing rate %</td>
<td>90</td>
<td>84</td>
<td>93</td>
</tr>
<tr>
<td>% bred in &lt;8 days</td>
<td>90</td>
<td>-</td>
<td>90</td>
</tr>
<tr>
<td>Repeat breeds %</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Annual replacement rate %</td>
<td>45</td>
<td>53</td>
<td>39</td>
</tr>
<tr>
<td>Litters/sow/year</td>
<td>2.40</td>
<td>2.32</td>
<td>2.40</td>
</tr>
<tr>
<td>Pigs weaned/sow/year</td>
<td>26.2</td>
<td>22.3</td>
<td>27.8</td>
</tr>
</tbody>
</table>
Notes on these targets & actuals

1. Most Australian herds are using genotypes selected on growth & carcass performance, with little or no selection on reproductive traits. Hence, we generally run 1.5-2.5 pigs/litter behind many of our European & N. American equivalents.

2. The litters/sow/year figures are wrong as they only include gilts at first mating

3. Annual replacement rates of <40% are unrealistic.
Litters/sow/year

My target  = 2.40 (= 26.2 PW/S/Y / 10.9 LS-W)
USA target = 2.40 (= 27.8 PW/S/Y / 11.6 LS-W)

NOTE:
Litters/sow/year = \[
\frac{365 \text{ days}}{114 \text{d gestation} + 28 \text{d lactation} + \text{NPDs}}
\]

EXAMPLE: 2.4 L/S/Y = 365/ (114 + 28 + 10)
BUT !!!

How did you calculate NPDs ?????
### Calculating NPDs – 100 sow herd

<table>
<thead>
<tr>
<th>Factor</th>
<th>Calculation</th>
<th>NPDs produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gilt entry-service</td>
<td>63d x 50 gilts</td>
<td>3,150</td>
</tr>
<tr>
<td>Anoestrus gilts</td>
<td>77d x 5 gilts</td>
<td>385</td>
</tr>
<tr>
<td>WSI</td>
<td>5.0d x (240-50)* sows</td>
<td>950</td>
</tr>
<tr>
<td>Anoestrus sows</td>
<td>12d x 7 sows</td>
<td>84</td>
</tr>
<tr>
<td>Gestation deaths</td>
<td>60d x 3 sows</td>
<td>180</td>
</tr>
<tr>
<td>Regular returns</td>
<td>21d x 14 sows</td>
<td>294</td>
</tr>
<tr>
<td>Irregular returns</td>
<td>30d x 6 sows</td>
<td>180</td>
</tr>
<tr>
<td>Double returns</td>
<td>42d x 3 sows</td>
<td>126</td>
</tr>
<tr>
<td>Lames &amp; other culls</td>
<td>50d x 7 sows</td>
<td>350</td>
</tr>
<tr>
<td>Abortions</td>
<td>70d x 2 sows</td>
<td>140</td>
</tr>
<tr>
<td>NIPS</td>
<td>70d x 2 sows</td>
<td>140</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>5,979</strong></td>
</tr>
</tbody>
</table>

*100 sows x 2.4 L/S/Y = 240 litters BUT 50 are from gilts – i.e. no WSI
Combining this information on NPDs

There are 5,979 NPDs/year for the herd
This equates to \( \frac{5,979}{240} = 25 \) NPDs/litter produced

Hence:
Litters/sow/year = \( \frac{365}{167} \) days* = 2.19

* This is made up of Gestation of 114d, Lactation of 28d & NPDs of 25d

HOWEVER:
If you only count gilts from first breeding the NPDs/year = 2,444
OR 10 NPDs/litter produced.

NOW: Litters/sow/year = \( \frac{365}{152} \) days = 2.40
Sow turnover rate (%)

My target = 45%

Any target <40% is unrealistic. At 40% it means the average sow remaining in the herd for 2.5 years – at 2.4 L/S/Y = 6.0 litters!

To achieve this you must either cull no gilts or young sows OR keep functional sows to 8+ litters.
Topics to be covered

• What are best-practice targets

• How to achieve them commercially
Gilt management

- Inadequate/no use of boar stimulation
- Assumed cyclicity – many pubertal matings
- Overcrowding
- Low gilt cull rates

What failures here result in:

1. Poor puberty management leads to high % 1\textsuperscript{st} heat mating & low 1\textsuperscript{st} LS.
2. Low gilt culling rates place sub-fertile females in the herd thus reducing all herd reproduction figures.
What are we trying to do when managing gilts?

1. Ensure she has adequate body reserves to have a long, productive breeding life

2. Then breed her as early as possible as long as this breeding time ensures a good first litter size
What are “adequate body reserves” for a gilt

- How much fat does she need?
- How heavy should she be?
What about targets for gilt fat levels?

• While it would be nice to target 18mm P2 backfat at 1st farrowing this is unachievable in many modern genotypes.

• Anyway, except for extremes of leanness, there appears to be little or no relationship between gilt backfat level & lifetime performance.

• This may reflect the fact that the vast majority of tissue mobilisation in young lactating females is protein not fat.

Adapted from Foxcroft & Patterson (2010)
<table>
<thead>
<tr>
<th>&lt;135kg</th>
<th>&gt;155kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low wt at 1&lt;sup&gt;st&lt;/sup&gt; farrowing</td>
<td>High wt at 1&lt;sup&gt;st&lt;/sup&gt; farrowing</td>
</tr>
<tr>
<td>Low body reserves at 1&lt;sup&gt;st&lt;/sup&gt; farrowing</td>
<td>High gilt cost to 1&lt;sup&gt;st&lt;/sup&gt; farrowing</td>
</tr>
<tr>
<td>High anoestrus rate after 1&lt;sup&gt;st&lt;/sup&gt; weaning</td>
<td>High nutrient requirements</td>
</tr>
<tr>
<td>High risk of early culling</td>
<td>High risk of early culling</td>
</tr>
<tr>
<td>Low production over 1&lt;sup&gt;st&lt;/sup&gt; 3 parities</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Foxcroft & Patterson (2010)
Conventional gilt management

1. Stimulate puberty
2. Mate at a suitable time after puberty (2nd oestrus?)
Ways to Stimulate Early Puberty

• Boar contact - usually referred to as The Boar Effect

• Stress
  – transport
  – management stressors (mixing & relocation)

• Exogenous hormones
  – PG600
  – Folligon & chorulon
  – GnRH
Using boars to get gilts cycling

- Start when gilts are 25-28 weeks old
- Ensure gilts have at least 1.5m\(^2\) (preferably 2m\(^2\)) space
- Use boar 10 months old +
- Use regularly mating boar
- Give full physical contact (same pen)
- Give boar contact for 15-20 min daily – if it’s not working well:
  - Try a different boar
  - Split the boar contact into 10 minutes each in morning & afternoon
- Expose gilts in groups of 12 or less
Consider using a vasectomised boar
Advantages of using vasectomised boars

• Boars get regular matings

• No need to supervise boar exposure periods

• Get a further benefit in FR & LS
## Value of using a vasectomised boar

<table>
<thead>
<tr>
<th></th>
<th>Control gilts - not mated at 1\textsuperscript{st} heat</th>
<th>Mated with vasectomised boar at 1\textsuperscript{st} heat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farrowing rate*</td>
<td>84%</td>
<td>90%</td>
</tr>
<tr>
<td>1\textsuperscript{st} Litter Size*</td>
<td>9.5</td>
<td>10.7</td>
</tr>
<tr>
<td>1\textsuperscript{st} Litter Size*</td>
<td>9.0</td>
<td>10.1</td>
</tr>
</tbody>
</table>

* All data for 2\textsuperscript{nd} heat matings with stock boar

Sources: Bischof & Hughes, unpublished data, Riley & Foote (1999)
What is the value of those gilts that are slow to reach puberty when given boar contact?

<table>
<thead>
<tr>
<th></th>
<th>Fast responders* (&lt;40d)</th>
<th>Slow responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bred %</td>
<td>95</td>
<td>73</td>
</tr>
<tr>
<td>Lifetime piglets born alive</td>
<td>23.6</td>
<td>21.4</td>
</tr>
<tr>
<td>Retention at 3rd parity</td>
<td>58</td>
<td>47</td>
</tr>
</tbody>
</table>

* Represents ~85-90% of selected gilts in most herds

Adapted from Foxcroft & Patterson (2010)
When to mate a gilt?
### PG600-induced puberty

<table>
<thead>
<tr>
<th>Boar contact</th>
<th>Showing 2(^{nd}) oestrus (%)</th>
<th>Having a 2(^{nd}) ovulation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>85</td>
<td>82</td>
</tr>
<tr>
<td>NO</td>
<td>46</td>
<td>59</td>
</tr>
</tbody>
</table>

Source: Paterson and Lindsay (1980)
## Boar contact and continued cyclicity in gilts

### Boar-induced puberty

<table>
<thead>
<tr>
<th>Boar contact</th>
<th>Cycles/100 days</th>
<th>Short (&lt;18d) cycles (%)</th>
<th>Long (&gt;25d) cycles (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>4.9</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>NO</td>
<td>3.0</td>
<td>4</td>
<td>31</td>
</tr>
</tbody>
</table>

Source: Siswadi and Hughes (unpublished)
At which heat should a gilt be bred?

<table>
<thead>
<tr>
<th></th>
<th>1st.</th>
<th>2nd.</th>
<th>3rd.</th>
<th>4th.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farrowing rate (%)</td>
<td>72</td>
<td>87</td>
<td>88</td>
<td>91</td>
</tr>
<tr>
<td>Litter size (total)</td>
<td>10.1</td>
<td>11.3</td>
<td>11.4</td>
<td>11.4</td>
</tr>
</tbody>
</table>

Adapted from Kummer (2005)
Feeding the gilt

For the 2-3 weeks before mating she needs to be on full feeding.

Prior to that she can be restrictively fed if her weight is getting too high. The alternative of feeding a high fibre diet ad libitum really doesn’t work very well.
# Gilt Nutrition & Egg Quality

## Feeding x Week of oestrous cycle

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Embryo survival rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>High</td>
<td>High</td>
<td>84%</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>82%</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>68%</td>
</tr>
</tbody>
</table>

If using Regumate to have gilts ready for breeding at the best time to fit into mating batches etc. what are the rules?
Rules for heat synchronisation using Regumate

• Not effective unless the gilt is cycling

• Train gilts using oral dosing of canola oil for 4 days before using Regumate
Effective Use of Regumate

• **Randomly cycling gilts**
  – Feed for ≥ 14 days to ensure all gilts have completed their luteal phase. Gilts return ~5-6 days after the last dose

• **Known dates of oestrus**
  – Feed from 12-14 days after the start of the previous oestrus until 6 days before planned breeding
Oestrus timing after Regumate

Percent of gilts

Day after last Regumate feeding

3 4 5 6 7 8
Suggested Gilt Management Framework

1. **Select gilts at 22-23 weeks & 100kg+**
2. **Start daily boar contact at 25-28 weeks**
3. **Mate gilts at 30-34 weeks**
4. **Cull unmated gilts at 34 weeks**
Weaned sow management

- Early weaned (<19-21 days)
- Weaned in poor condition
- Underfed after weaning
- Poor use of boars to stimulate oestrus
- Housed in fenceline contact with boars

What failures here result in:

1. For most herds weaning early increases NPDs & reduces SLS
2. Nutritionally compromised sows at weaning may not return to heat quickly, but are more likely to have reduced FR & SLS
3. Underfeeding post-weaning reduces oocyte quality & hence SLS
4. To induce & detect heat in sows need them to get daily, non-habituated boar stimulation.
Heat detection

- Inadequate facilities poor boar contact
- Poor technique – no BPT or BPT/no boar
- Use of low stimulus value boars?

What failures here result in:

1. Missed heats.
2. Poorly timed matings/AIs & reduced FR & SLS.
Timing of mating/AI

• First mating/AI too early

• Repeating mating/AI every 12 hours

• Many late (post ovulatory) matings/AIs

What failures here result in:

1. Poorly timed matings/AIs result in reduced FR & SLS.
2. Post-ovulatory matings/AIs can cause infections & vulval discharge problems - & they don’t contribute to the pregnancy.
Boar management

- Under-use & occasional overuse
- Underfeeding
- Use of old boars
- Little checking on fertility/fecundity

What failures here result in:

1. Under-use can result in poor boar fertility while over-use is more likely to give reluctant boars.
2. Boars in low condition & old boars also tend to be more reluctant maters.
3. Poor record keeping &/or non-use of nominated matings can allow sub-fertile or even infertile boars to remain in the herd.
AI management

- Poor semen storage conditions – temp. & turning
- Use of old semen
- Poor boar control during AI
- Catheter removal & sow movement too early
- No record of quality or inseminator
- Inseminator fatigue (larger herds only)

What failures here result in:

1. Poor quality semen reduces FR & SLS
2. Lack of boar contact during AI reduces sow stimulation & semen uptake – leads to longer & lower quality AIs & reduced FR/SLS.
3. Early catheter removal &/or sow movement, acceptance of poor quality AIs & inseminator fatigue all give reduced FR/SLS.
Gestation management

- Mixing & others stresses (season ?) in early gestation
- Overfeeding & underfeeding
- Poor return checking – timing & boar presence
- Poor PDs – timing, equipment & technique

What failures here result in:

1. Stress in the 1st 3 weeks is likely to reduce LS (& sometimes FR).
2. We’re unsure what is optimum feeding in early pregnancy – or late pregnancy.
3. Poor or no heat checking around 3 weeks post-AI significantly increases NPDs.
4. Poor PDs add to NPDs.
What Causes Regular & Irregular Returns?

- Mating
- Day 11
- Day 17-19
- Farrowing
What Causes Regular & Irregular Returns?

Am I pregnant?

- Mating
- Day 11
- Day 17-19
- Farrowing
What Causes Regular & Irregular Returns?

Am I still pregnant?

- Mating
- Day 11
- Day 17-19
- Farrowing
Some “Rules” on Regular & Irregular Returns

• Ratio of 3:6 week returns must be more than 4:1

• Ratio of regular:irregular returns must be more than 3:1
Better heat detection in dry sows

<table>
<thead>
<tr>
<th>Typical returns profile (days after breeding)</th>
<th>&lt;25</th>
<th>25-38</th>
<th>39-45</th>
<th>&gt;45</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. profile I’ve seen</td>
<td>4%</td>
<td>12%</td>
<td>29%</td>
<td>55%</td>
</tr>
<tr>
<td>Optimal profile</td>
<td>60%</td>
<td>20%</td>
<td>15%</td>
<td>5%</td>
</tr>
</tbody>
</table>

- Not using boars for heat detection
- Relying on ultrasound pregnancy checks at ~4 weeks
Farrowing management

- No farrowing induction or night shifts
- Slow intervention with farrowing problems (25-45+ min.)
- Inappropriate use of oxytocin

What failures here result in:

1. Unattended farrowings result in higher SBs & PWM.
2. Failure to assist slow farrowings results in higher SBs & PWM.
3. Use of oxytocin without an ‘internal’ can exacerbate problem farrowings.
USA data – note that average herd loses approximately 18-19% of potential weaned pigs.

Ketchem (2013)
Farrowing Induction: Reasons

• Reduce days group farrows
  – foster, uniform piglets etc.

• Reduce hours within the day
  – schedule labour
  – assist farrowing
    • remove placental membranes
    • proper environment
    • colostrum
    • avoid crushing
    • provide obstetrical assistance
Piglet survival in induced/non-induced farrowings with & without supervision.
## Extending Farrowing Hours – Effects on Stillbirths

<table>
<thead>
<tr>
<th>Farms</th>
<th>13 weeks</th>
<th>52 weeks</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2700</td>
<td>0.57</td>
<td>0.60</td>
<td>24/7</td>
</tr>
<tr>
<td>2700</td>
<td>0.64</td>
<td>0.67</td>
<td>24/7</td>
</tr>
<tr>
<td>*3500</td>
<td>0.66</td>
<td>1.16/qt</td>
<td>18/5</td>
</tr>
<tr>
<td>2600</td>
<td>0.71</td>
<td>0.61</td>
<td>14/5</td>
</tr>
<tr>
<td>6000</td>
<td>0.27</td>
<td>0.33</td>
<td>24/7</td>
</tr>
<tr>
<td>6000</td>
<td>0.44</td>
<td>0.45</td>
<td>24/7</td>
</tr>
<tr>
<td>*6800</td>
<td>0.80</td>
<td>1.30/qt</td>
<td>24/7</td>
</tr>
<tr>
<td>*6800</td>
<td>0.60</td>
<td>1.20/qt</td>
<td>24/7</td>
</tr>
</tbody>
</table>

* Started extended hours hours last 90 days

Safranski (2014)
## Pre-weaning piglet deaths by producer-identified cause

<table>
<thead>
<tr>
<th>Producer-identified cause</th>
<th>Pre-weaning deaths (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushed</td>
<td>55</td>
</tr>
<tr>
<td>Starvation</td>
<td>14</td>
</tr>
<tr>
<td>Scours</td>
<td>9</td>
</tr>
<tr>
<td>Respiratory problem</td>
<td>5</td>
</tr>
<tr>
<td>Other identified problem</td>
<td>10</td>
</tr>
<tr>
<td>Unknown</td>
<td>8</td>
</tr>
</tbody>
</table>
Incident of pig deaths during the preweaning period

<table>
<thead>
<tr>
<th>Reported cause of death</th>
<th>No. of pigs</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supervised</td>
<td>Unsupervised</td>
</tr>
<tr>
<td>Trauma</td>
<td>34&lt;sup&gt;a&lt;/sup&gt;</td>
<td>90&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Low viability</td>
<td>49&lt;sup&gt;a&lt;/sup&gt;</td>
<td>59&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Miscellaneous (arthritis, anemia)</td>
<td>15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Deformities</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Unknown</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Total</td>
<td>106</td>
<td>165</td>
</tr>
</tbody>
</table>

<sup>a,b</sup>Numbers in a row with different superscripts differ by at least P < .05.
Saving baby pigs – what they need

- **Oxygen** (hypoxia)
- **Warmth** (hypothermia)
- **Colostrum** (starvation, immunity, thermoregulation)
Saving baby pigs – first 3 days

Predisposing conditions to early death

– Low birthweight
– Low activity level
– Prolonged delivery
– Cool environment
Saving baby pigs – what are the risk factors-1

- **High birth weight**
  - increased 2h rectal temperature
  - less time to 1st suckle

- **Lying near sow**
  - increased 2h rectal temperature

- **Long inter-birth interval**
  - more time alone

- **Low viability score**
  - Long time to 1st suckle

Kammersgaard et al., 2011
Study observed 87 gilt litters:

- Stillbirths increased in:
  - Late born piglets
  - Piglets after a long inter-birth interval
  - Small piglets

- Of 75 piglets crushed, 26 had empty stomachs
  - Small
  - Low 2h rectal temperature
Saving baby pigs – what is possible?
An example from Mexico
Saving baby pigs – in Mexico this is possible

The difference:

Plenty of cheap labour

Full supervision of farrowing.

<4% stillborn
<4% pre-weaning mortality
Piglets Need Colostrum... fast!

• Immunologically immature

• Colostral IgG
  – most efficient 12 hours postnatal
  – by 48 hours gut closure complete
  – 50% decline in colostrum within 6h of first nursing

• IgG have 14d half-life

• IgA protects gastrointestinal tract
Split Suckling for Colostrum

- First 24 hours
- When ~7 piglets have full bellies
- 1-1.5 hours in box
- Can repeat day 2
Farrowing crates & sow behaviour

• farrowing crates save lives
  – mortality reduced ~1/2
  – crushing still #1 cause - screaming doesn’t help
  – bigger, older, fatter, geriatric sows worse

• piglets seek: the udder and warmth
• calm sows are better mothers
• piglets not crushed while sow lies still
Cross Fostering

• US survey in 1998:
  – Used on 98% of farms
  – Average 8% of piglets fostered

• Minimized today
  – Between 12 and 24hr
  – Preference to remain on birth dam

(Straw et al., 1998)
After Initial Survival: 2-4 days

- Fall behind pigs
- Fall backs
- Starve outs (etc.)
- thin/flat belly
- less active
- poor teat
Fall Behind Piglets

- Nurse sows
- Artificial rearing

...get them milk
Lactation management

- Sows entering farrowing house in variable condition
- Not using shift suckling (labour)
- Poor cross-fostering technique
- Inadequate feed intakes in lactation

What failures here result in:

1. Low condition sows at farrowing are generally low condition at weaning – see earlier.
2. Shift suckling increases survival of weaker/smaller piglets.
3. Good cross-fostering minimises PWM.
4. Poor sow feed intakes result in low condition at weaning – see earlier.
Group housing sows

Paul Hughes
SARDI, Australia
WHAT RESEARCH TELLS US

1. Mixing at weaning or in gestation

2. Mixing in lactation
WHAT RESEARCH TELLS US

1. Mixing at weaning or in gestation

2. Mixing in lactation
What are the important factors?

- Pen space
  - Quantity of pen space (space allowance)
  - Quality of pen space (pen barriers)
- Group size
- Sow familiarity
- Time of mixing
- Specific mixing pen?
Sows in groups obviously need to access key resources such as feed, water, lying space, etc.
Also motivated to interact with other sows and to explore (particularly if hungry).
But they need space not only to carry out these behaviours, but also avoid other sows if necessary in doing so!
So floor space and/or pen design to assist this is important.
Quantity of floor space

Day 2

Day 8

P=0.029

- Increased space reduced aggression

Hemsworth et al. (2013)
Quantity of floor space

Day 2

Day 9

P = 0.009

- Increased space reduced stress

- Adaptation?

Hemsworth et al. (2013)
Quantity of floor space

- Farrowing rate increased with increasing floor space

Hemsworth et al. (2013)
Quantity of floor space - Conclusions

- Reducing space increases aggression and stress and reduces reproductive performance.

- Optimal - 1.8 to 2.4 m$^2$/sow
Quality of floor space

From Barnett (1997)
Quality of floor space

- As with increased floor space, visual and physical barriers that provide escape areas and easier access to feed and water (i.e. allow separation from others sows), are likely to reduce aggression and stress.
Group size

Aggression at mixing (/sow/day)

- Group size 5
- Group size 10
- Group size 20
- Group size 40

Taylor et al. (1997)

NS
Space appears to have a much greater impact on the welfare or reproductive performance of sows than the number of sows in a group.
Time of mixing


- Aggression (/sow/time unit)
  - Mixing after mating: (P=0.012)
  - Mixing at Day 35: (P=0.04)

- Cortisol (nM)
  - Mixing after mating: (P=0.012)
Time of mixing

Farrowing rate (%)

<table>
<thead>
<tr>
<th></th>
<th>Stall</th>
<th>D3</th>
<th>D14</th>
<th>D35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farrowing rate (%)</td>
<td>b</td>
<td>a</td>
<td>b</td>
<td>b</td>
</tr>
</tbody>
</table>

P=0.001

Knox et al (2014)
Time of mixing

- Evidence that aggression and stress at mixing are greater early after insemination than when mixed later.

- But also evidence that mixing at weaning reduces subsequent sexual receptivity.

- Highlights the need to utilize strategies to reduce aggression and stress (e.g. dedicated mixing pen) particularly when mixing during periods in which sows may be most susceptible.
Experience

- Recent familiarity reduces aggression on mixing, but unfamiliar sows will fight when mixed.

- Arey et al. (1999) observed no fights when small groups of sows (6) were re-grouped 2, 4 or 6 weeks later.
Experience

- Mixing sows or a proportion of sows that have been housed together in the previous gestation will be useful in reducing aggression and stress when mixing at weaning or post-insemination.

- Likely to see further research examining the effects of early experience (e.g. socialization) on the long-term social behaviour and stress of sows in groups.
Mixing pen

Grouping *per se*:

- Critical step – long term impact on sow welfare and productivity.
- Purpose should be to provide a setting where sows can
  - familiarize,
  - avoid aggressive ones when they want to, with minimum risk to injury and stress,
- while also allowing the social hierarchy to rapidly form.
Mixing pen – our work

Recently-inseminated sows housed in either:

1. 2 m²/sow
2. 4 m²/sow
3. 6 m²/sow

At 4 days after mixing, all groups moved to pens providing 2 m²/sow.

Hughes et al (2014)
Mixing pen

Hughes et al (2014)
While group housing provides some obvious welfare advantages for sows (e.g. more freedom of movement, exploration and socialization), some sows may suffer from excessive aggression, injuries and stress.

Unfamiliar sows will generally fight when mixed.

Optimising factors such as floor space and other design features to allow (1) access to important resources, such as feed, water and a comfortable lying area, and (2) escape opportunities are important in reducing aggression and minimizing risks to welfare and productivity both at mixing and subsequently.
WHAT RESEARCH TELLS US

1. Mixing at weaning or in gestation

2. Mixing in lactation
Why move away from farrowing crates?

Pressure from welfare organisations & large purchasing groups - i.e. we may have no choice.

In this case it’s better to be prepared by researching alternatives now.
What are the alternatives to farrowing crates?

- Farrow sows in open pens or outdoor “huts” - with or without piglet protection bars
- Modify farrowing spaces so that sows aren’t fully confined (e.g. can turn around, possibly interact with other sows etc.)
- Farrow in crates or modified farrowing spaces then move to group-housing during lactation
- Farrow in groups - not what sows do in the wild (they seek isolation until their litters are 7-10 days old) & is likely to significantly increase pre-weaning piglet mortality
Farrow sows in open pens or outdoor “huts”

- Advantage is primarily cost

- Major disadvantage is higher pre-weaning mortality - normally 15-25% v. 10-12% for farrowing crates

Beware of the upcoming welfare issue of baby piglet deaths
Modified confinement-free farrowing

- **Advantages:**
  - Perceived welfare advantages as sow can turn around & may be able to interact with other sows (at least via a ‘fence’)
  - Limited evidence suggests better maternal performance by sows farrowing ‘free’

- **Disadvantages:**
  - Usually, though not always, higher piglet pre-weaning mortality
  - Most current systems take more space than a standard farrowing crate/pen & need more labour when being cleaned
Pen design features include a solid nest area, heated creep area (under sloped wall), heated zones in floor for sow and piglet, straw nesting material, sloped walls to protect piglets, misters above dunging area). “Footprint” of approx. 7.9m².
Pen design features include a solid nest area, heated creep area, straw nesting material, individual feeder (lockable), sloped walls to protect piglets, fans/ misters above dunging area). “Footprint” of approx. 8.6m².
The PigSAFE Farrowing Pen

For performance data on these pens go to:

www.piglink.com.au
A Dutch Modified Farrowing Pen as used by Hales et al

Figure 1 Layout of free farrowing pen (FF-pen) in Herds A, B and C. Dimensions: Herd A: P1 = 270 cm, P2 = 198 cm, P3 = 120 cm, P4 = 150 cm; Herd B: P1 = 280 cm, P2 = 185 cm, P3 = 160 cm, P4 = 120 cm; Herd C: P1 = 300 cm, P2 = 210 cm, P3 = 118 cm, P4 = 182 cm. *In Herd A, the trough was placed in the corner between P1 and P2.
Early pre-weaning mortality (PWM %) in “open farrowing pen” v. farrowing crate

<table>
<thead>
<tr>
<th>Herd A</th>
<th>Herd B</th>
<th>Herd C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crate</td>
<td>Pen</td>
</tr>
<tr>
<td>No. sows</td>
<td>68</td>
<td>275</td>
</tr>
<tr>
<td>PWM – week 1</td>
<td>5.4</td>
<td>11.3</td>
</tr>
<tr>
<td>PWM – week 2</td>
<td>0.9</td>
<td>2.8</td>
</tr>
<tr>
<td>PWM – weeks 3/4</td>
<td>1.5</td>
<td>2.2</td>
</tr>
<tr>
<td>Total PWM</td>
<td>7.8</td>
<td>16.3</td>
</tr>
</tbody>
</table>

Hales et al (2014)
If we have to adopt less confined farrowing systems

- To optimally use the expensive low-confinement housing or farrowing crates, sows should spend the minimum time in them before being transferred to other, cheaper housing - group housing?
  - Opportunity to mix lactating sows - when they’re at their least aggressive & stress may have least impact on their productivity?

- Opportunity to breed sows during lactation:
  - Potentially more litters/sow/year
  - Less abrupt weaning giving potentially better weaner growth
When can sows + litters be moved out of farrowing crates/pens?
Litter performance in multi-suckling pens at Roseworthy

Sows & litters transferred from farrowing crates to multi-suckling pens at day 14 of lactation & weaned at day 26.

Mean piglet growth rate d14-26 = 354g/d

Mean piglet weaning weight = 7.2kg

Piglet mortality d14-26 = 3%
When can sows + litters be moved out of farrowing crates/pens? - Danish data

<table>
<thead>
<tr>
<th></th>
<th>During farrowing</th>
<th>In lactation</th>
<th>Loose</th>
<th>Loose Crated to d4</th>
<th>Loose Crated to d7</th>
<th>Crated Crated to d4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No sows</td>
<td>55</td>
<td>50</td>
<td>54</td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litter size total</td>
<td>17.0</td>
<td>17.2</td>
<td>16.8</td>
<td>16.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stillbirths/litter</td>
<td>2.5</td>
<td>2.5</td>
<td>2.2</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dying pre-XF*</td>
<td>0.7</td>
<td>0.4</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LS post-XF*</td>
<td>13.6</td>
<td>13.6</td>
<td>13.8</td>
<td>13.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PWM to d10(%)</td>
<td>11.0</td>
<td>5.9</td>
<td>4.3</td>
<td>5.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*XF = cross-fostering

Moustsen et al (2013)
When can sows + litters be moved out of farrowing crates/pens? Our data

<table>
<thead>
<tr>
<th></th>
<th>Farrow open</th>
<th>Farrow closed</th>
<th>Open on d3 post-farrow</th>
<th>Open on d7 post-farrow</th>
<th>Standard farrowing crate</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. sows</td>
<td>56</td>
<td>52</td>
<td>37</td>
<td>71</td>
<td>54</td>
</tr>
<tr>
<td>Total piglet mortality during first 24h (%)</td>
<td>13.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>7.2&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Total piglet mortality from day 3-7 post-farrow (%)</td>
<td>-</td>
<td>-</td>
<td>4.2</td>
<td>2.5</td>
<td>2.1</td>
</tr>
<tr>
<td>Overlay piglet mortality during first 24h (%)</td>
<td>10.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.9&lt;sup&gt;b&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>7.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Overlay piglet mortality from day 3-7 post-farrow (%)</td>
<td>-</td>
<td>-</td>
<td>3.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>
When can sows + litters be moved out of farrowing crates/pens?

This can be done with little or no impact on piglet survival if sows + litters remain in a farrowing crate for one week after farrowing.
Is it important for sows to be loose during farrowing?

The evidence isn’t compelling for this.

If we decide to go down that path we should consider inducing farrowing so that sows are allowed to go through their pre-farrowing behaviour repertoire (nest building etc.) but are locked away in crates when the birth begins.
Breeding sows during lactation

Theoretical litters/sow/year = \(\frac{365}{(114+25+5)} = 2.53\)
Breeding sows during lactation

Theoretical litters/sow/year = \( \frac{365}{114+22} = 2.68 \)

Weaning (28-42 days)

Mating

Parturition

114 days
## Inducing lactation oestrus

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Boar</th>
<th>Boar +SW3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sows</td>
<td>Gilts</td>
<td>Sows</td>
</tr>
<tr>
<td>No. females</td>
<td>74</td>
<td>75</td>
<td>151</td>
</tr>
<tr>
<td>Lact. oestrus %</td>
<td>24</td>
<td>8</td>
<td>76</td>
</tr>
<tr>
<td>Farr. Rate* %</td>
<td>-</td>
<td>-</td>
<td>73</td>
</tr>
<tr>
<td>Litter size-live</td>
<td>-</td>
<td></td>
<td>10.4</td>
</tr>
</tbody>
</table>

Terry et al (2014)
Is lactation oestrus a commercial option?

Currently it’s marginal because:

- Only commercially viable if sows are group housed – otherwise doing individual sow exposures to a boar
- Need to split wean
- Some doubts about subsequent reproductive performance
- System doesn’t work so well with gilts

However, further research is likely to fix some of these problems.