Timing of transfer after mating influence dam cortisol and maternal care in farm mink

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Transfer to maternity unit

- Why?
  - Clean delivery environment
  - Introduce distance between delivering mink
  - Cage/nest box prepared for kits

- When?

  § 23 ”Breedings females should be housed from mid April and until weaning of kits/young in every second cage”
  (Danish Ministry of Justice, 2006)

  Mink farmers: variable times of transfer into delivery unit
Stress prior to delivery: negative impact

Birth process

Maternal care

Kit survival

Study aim: Influence of timing of transfer on

- Maternal stress
- Maternal care
- Early kit vitality
Treatment groups

Time of transfer \textit{relative to expected day of birth}

- EARLY \hspace{1cm} Day -36 \hspace{1cm} N=60
- INTERMEDIATE \hspace{1cm} Day -18 \hspace{1cm} N=60
- LATE \hspace{1cm} Day -3 \hspace{1cm} N=60

In total 180 double-mated yearlings from one line of brown colour type, housed and feed identically
Time of transfer

- **EARLY**
  - March -36
  - mating

- **INTERMEDIATE**
  - April -18

- **LATE**
  - May -3
  - delivery

- 7.8% barren
- N=166
Results

- Faecal Cortisol Metabolites (FCM) - sampled weekly before delivery + day 3 post partum

Non-invasive method for circulating cortisol validated in female mink

Malmkvist et al., Stress 2011
<table>
<thead>
<tr>
<th></th>
<th>EARLY</th>
<th>INTERMEDIATE</th>
<th>LATE</th>
<th>P-value</th>
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</thead>
<tbody>
<tr>
<td>Pre-delivery (2-3 w</td>
<td>40.5 a ± 5.6</td>
<td>59.9 b ± 5.3</td>
<td>43.0 a ± 5.6</td>
<td>0.002</td>
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<tr>
<td>before)</td>
<td></td>
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<tr>
<td>Day 3 pp</td>
<td>76.4 ± 14.2</td>
<td>47.5 ± 13.8</td>
<td>75.3 ± 14.2</td>
<td>0.054</td>
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<tr>
<td>Kits born</td>
<td>8.4 ± 0.3</td>
<td>7.9 ± 0.3</td>
<td>8.3 ± 0.3</td>
<td>0.39</td>
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<td>Range 1-14</td>
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Nest score

- weekly from mating to day 2 postpartum
In-nest climate

- Temperature

![Graph showing in-nest climate temperature over time relative to birth. The graph indicates that early temperatures are generally higher than late temperatures, with a statistically significant difference at \( P = 0.016 \).]
Nest building

Pregnant females

• Nest-build 1 month prior to delivery when given the opportunity
• Can relative quickly (< 1 day) build a full nest

In EARLY transferred females (vs. LATE)

• Warmer nests postpartum
  offspring better protected against hypothermia
during the early period critical for survival
Young survival

Among litters affected by kit mortality (N=92)

Live-born kits dying day 0-7 postpartum
EARLY: 28.9 %
INTERMEDIATE: 28.5 %
LATE: 42.7 %  \(P = 0.085\)
Maternal care

Highly motivated behaviour
Kit-retrieval test day 5
-an indicator of maternal care

Malmkvist & Houbak, *Scientifur* 2000

**Role of kit vocalisation**
Brandt et al., *J. Exp. Biol.* 2013

**Kit vocalisation**

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<tr>
<td><strong>P = 0.015</strong></td>
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<tr>
<td>EARLY:</td>
<td>16.7 % a</td>
<td></td>
</tr>
<tr>
<td>INTERMEDIATE:</td>
<td>41.2 % b</td>
<td></td>
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<tr>
<td>LATE:</td>
<td>40.0 % b</td>
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Timing of transfer

- **EARLY** Day -36
  - Warmer nests than group LATE
  - Fewer kits vocalising = fewer kits in need

- **INTERMEDIATE** Day -18
  - Different cortisol profile over time
  - Increased dam cortisol during weeks prior to delivery

- **LATE** Day -3
  - Colder nests than group EARLY
  - Increased kit mortality (tendency)
Conclusion

Transfer to the maternity unit immediately after mating (around day -36), rather than later during the pregnancy period (day -18/day -3), reduce pre-delivery stress and increase maternal care in farmed mink dams.

This study received funding from
• Danish Fur Animal levy foundation
• Kopenhagen Fur
Time of transfer to maternity unit relative to birth, days:

-40 -35 -30 -25 -20 -15 -10 -5 0

Number of delivering females:
0, 2, 4, 6, 8, 10, 12, 14

Treatment groups:
Early
Intermediate
Late

Graph showing the number of delivering females over time of transfer to maternity unit relative to birth, with early, intermediate, and late treatment groups represented by different colors.
In-nest climate
-Relative humidity, %

Time relative to birth, day

Relative Humidity, %

- Early
- Late