



# Phenotypic and genetic relationship between litter birthweight characteristics, indicators of intrauterine growth restriction and piglet survival

S.M. Matheson<sup>1</sup>, G.A. Walling<sup>2</sup>, S.A. Edwards<sup>1</sup>

<sup>1</sup> Newcastle University, <sup>2</sup> JSR Genetics Ltd.

# Risk factor for piglets



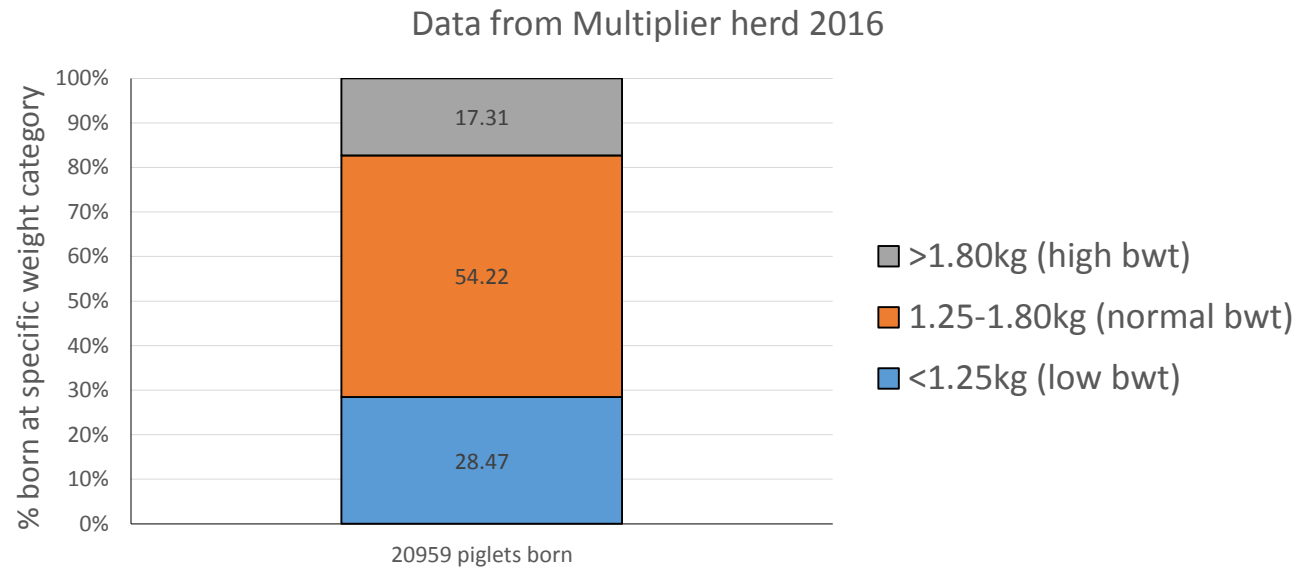
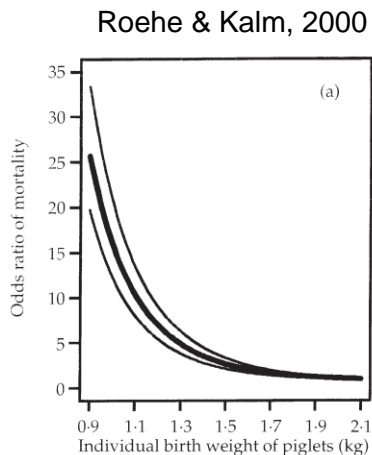
- Low birth weight piglets
  - Industry-wide push for selection of increased litter size in breeding herds
- More piglets being born with reduced birth weight (Rutherford *et al*, 2013; Root *et al*, 2012)
- More intra-litter birth weight variation (Rutherford *et al*, 2013; Baxter *et al*, 2013)



# What is a low birth weight piglet?



- Meta-analysis study of risk focusing on piglet outcomes
  - Piglets with a birth weight  $\leq 1.25\text{kg}$  are at a significant risk of impaired lifetime growth (Douglas *et al*, 2013)



## More than just low birth weight?



- Low birth weight piglets may be:
  - Small for gestational age (SGA)
  - Intrauterine growth restricted/retarded (IUGR)
- Intrauterine growth restricted (IUGR) piglets typically identified by birthweight
- However, birthweight does not indicate whether a piglet has been exposed to IUGR during development

# More than just low birth weight?



# How to recognise IUGR?

- Chevaux *et al* 2010 developed scoring system for identifying IUGR piglets based on head morphology
- ‘Brain sparing’ effects – prioritised brain development
- Foetal adaptive reaction to placental deficiency

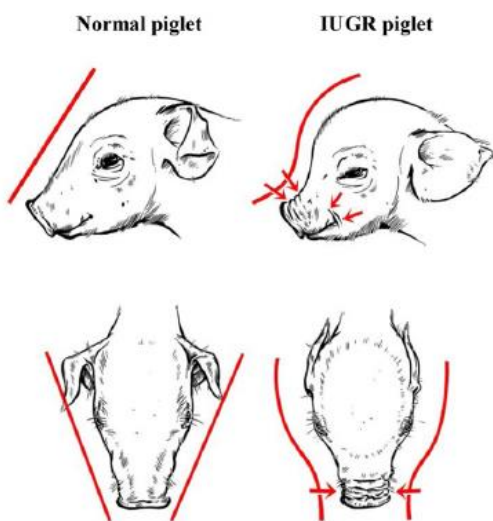
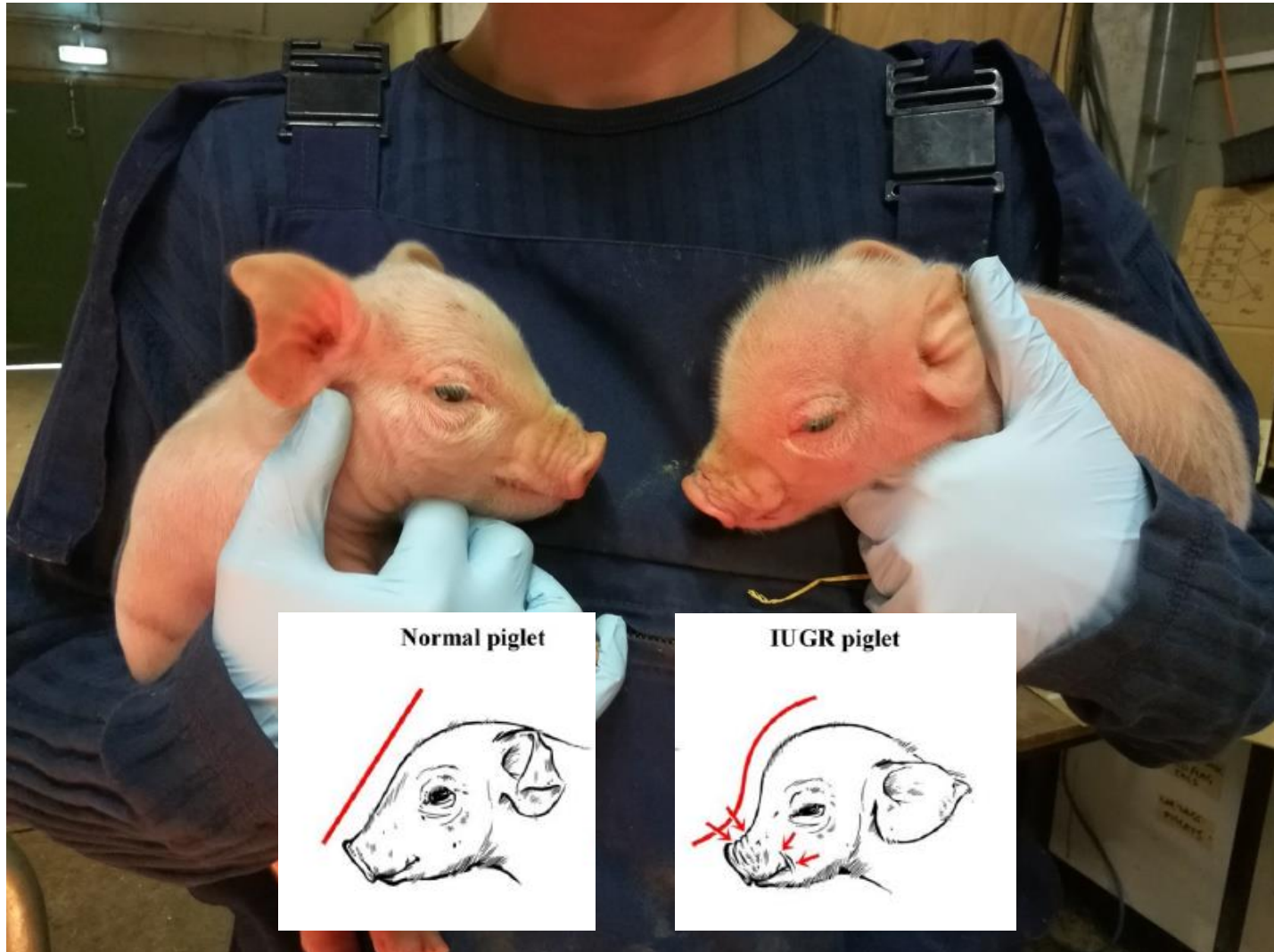


Figure 2. Illustrations of a normal (left) and a growth-restricted piglet (right). Criteria for growth restriction were 1) steep, dolphin-like forehead, 2) bulging eyes, and 3) wrinkles perpendicular to the mouth. IUGR = intrauterine growth restriction. See online version for figure in color.

Figure 1: Dorso-ventral characteristics of normal (left), intermediate (middle) and IUGR (right) piglets



# Normal vs IUGR head shape



# Data collection

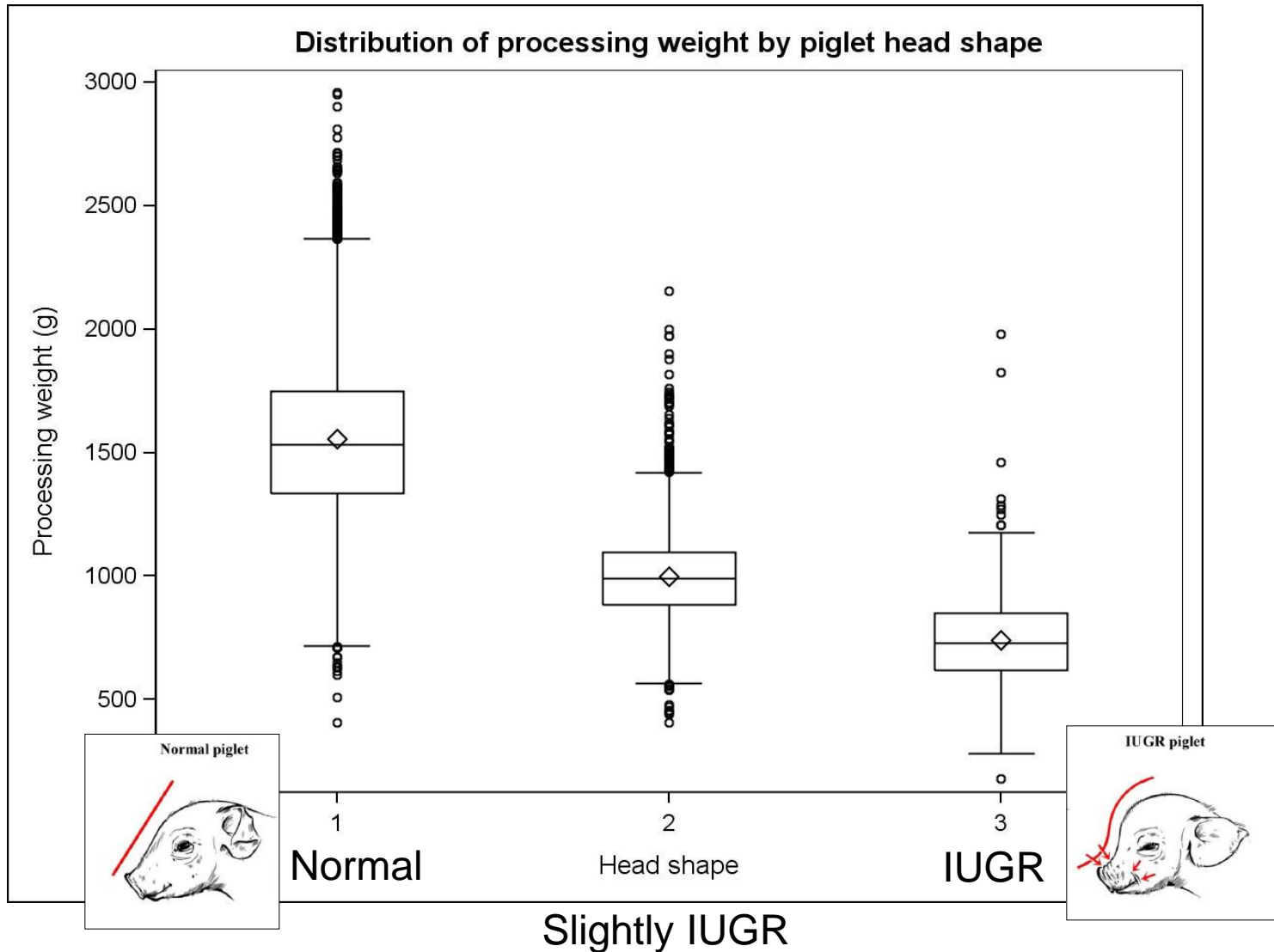
- Data collection over 52 weeks
- Number of piglets – 21,159
  - Birth weight
  - Head shape
  - Cause of death (and date)
- 1,575 farrowings
  - 862 individual sows
  - Parity 1-6+



[www2.sch.im/groups/livestockroadshows/revisions/498d3/4/](http://www2.sch.im/groups/livestockroadshows/revisions/498d3/4/)



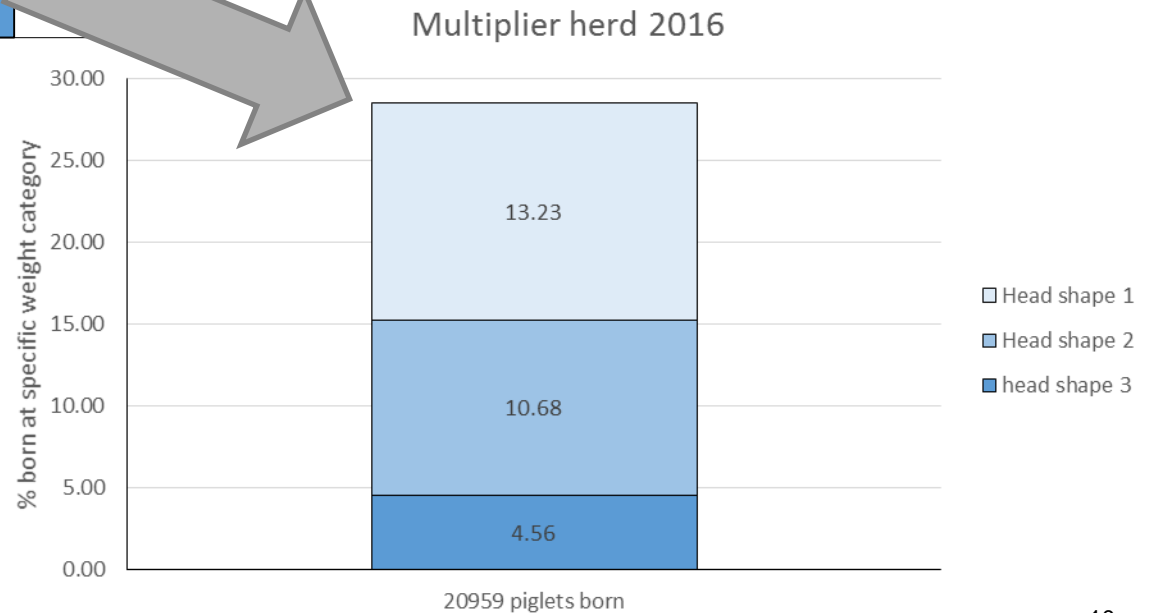
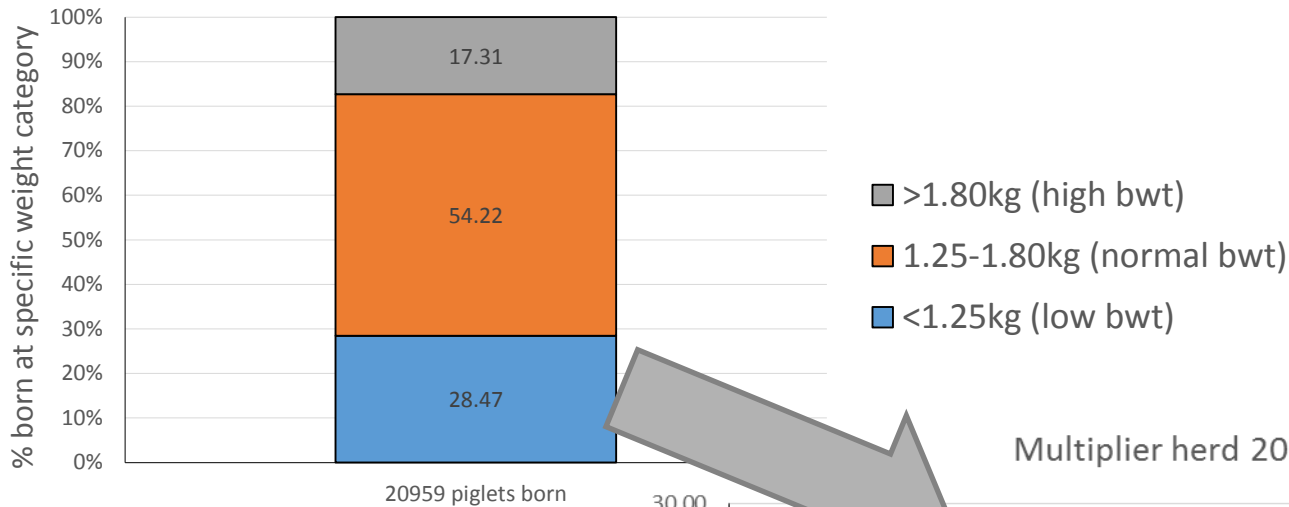
# Birth weight – head shape



# What is a low birth weight piglet?



Multiplier herd 2016



# Genetic selection approach:



- Two approaches:
- **Piglet level selection:**
  - Select on piglet head shape at birth

	Head shape 0/1	Birth weight
Head shape 0/1	<b>0.05</b> ± 0.016	-0.62 ± 0.008
Birth weight	-0.72 ± 0.09	<b>0.18</b> ± 0.040

# Genetic selection approach:



- Two approaches:
- **Piglet level selection:**
  - Select on piglet head shape at birth
- **Sow level selection:**
  - Select on the proportion of piglet head shapes at birth within a litter
  - Proportion of IUGR-head shape piglets – IUGR-PROP
  - Within litter average birth weight – avBWT
  - Within litter standard deviation of birth weight – sdBWT
  - Litter size at birth – Littersize
  - Proportion of litter surviving to processing – SURV-PROP

# Genetic selection approach – 2



## Sow level - selection on IUGR-PROP

	IUGR-PROP	avBWT	sdBWT	Littersize	SURV-PROP
IUGR-PROP	<b>0.19</b> ± 0.05	-0.52 ± 0.02	0.10 ± 0.02	0.23 ± 0.02	-0.18 ± 0.02
avBWT	-0.88 ± 0.07	<b>0.38</b> ± 0.07	-0.06 ± 0.03	-0.59 ± 0.02	0.26 ± 0.02
sdBWT	-0.23 ± 0.22	0.61 ± 0.17	<b>0.13</b> ± 0.05	0.19 ± 0.03	-0.08 ± 0.03
Littersize	0.63 ± 0.19	-0.62 ± 0.14	-0.53 ± 0.27	<b>0.11</b> ± 0.04	-0.11 ± 0.03
Surv-PROP	-0.64 ± 0.25	0.85 ± 0.20	0.49 ± 0.32	-0.63 ± 0.29	<b>0.06</b> ± 0.04
Repeatability	0.19 ± 0.04	0.40 ± 0.03	0.17 ± 0.04	0.25 ± 0.03	0.17 ± 0.04

Asreml model – parity !r ANIMAL ide.(ANIMAL)

# Conclusions



- Piglet survival is phenotypically impaired by large litter size and low piglet birth weight (nothing new)
- IUGR has detrimental effects on survival – these are in addition to the influence of birth weight
- IUGR using head shape as a simple phenotypic marker is amenable to genetic selection
- Selection at the **sow level** against IUGR could be highly effective in improving piglet survival
- Selection for lower proportion of IUGR in a litter has favourable genetic correlations with average birth weight and survival
- However, the genetic correlation with litter size is unfavourable

Sandra Edwards

**Newcastle University**

Sandra.Edwards@newcastle.ac.uk

[www.fp7-prohealth.eu](http://www.fp7-prohealth.eu)



This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 613574.