Kiel University
Christian-Albrechts-Universität zu Kiel

SUSTAINABLE AND INNOVATIVE HOUSING CONCEPTS FOR SOWS AND REARING PIGLETS

Positive effect of nesting material on crushing losses in free farrowing pens with short-term fixation

J. Wahmhoff [1], M. Wutke [1], N. Kemper [2], A. L. van Asten [3] and I. Traulsen [1]

[1] Institute of Animal Breeding and Husbandry, Christian-Albrechts-University Kiel, Hermann-Rodewald-Straße 6, 24118 Kiel, Germany

[2] Institute for Animal Hygiene, Animal Welfare and Farm Animal Behaviour, University of Veterinary Medicine Hannover, Foundation, Bischofsholer Damm 15, 30173 Hannover, Germany

[3] Chamber of Agriculture of North Rhine-Westphalia, Centre for Agriculture Haus Düsse, Ostinghausen, 59505 Bad Sassendorf, Germany

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Introduction

Revision of **German animal husbandry regulations** in February 2021

- 6.5 m² pen area
- Max. 5 days of fixation
- Supply of organic nesting material

➡ Studies on free farrowing systems observed increasing crushing losses (E.g. Grimberg-Henrici et al. 2019, Nicolaisen et al. 2019)

➡ Positive effects on piglet losses due to improved maternal behavior and lower stress levels in sows (Yun et al. 2013, Herskin et al. 1998)

Aim of this study

- Evaluation of the potential for reduction of crushing losses by providing organic nesting material
- Gain more insights into the relation between crushing losses and sow behavior

➡ Optimize the management in free farrowing pens with short-term fixation

Overview of the experiment

Key data:

- N = 216
- 11 batches
- 1st to 6th parity

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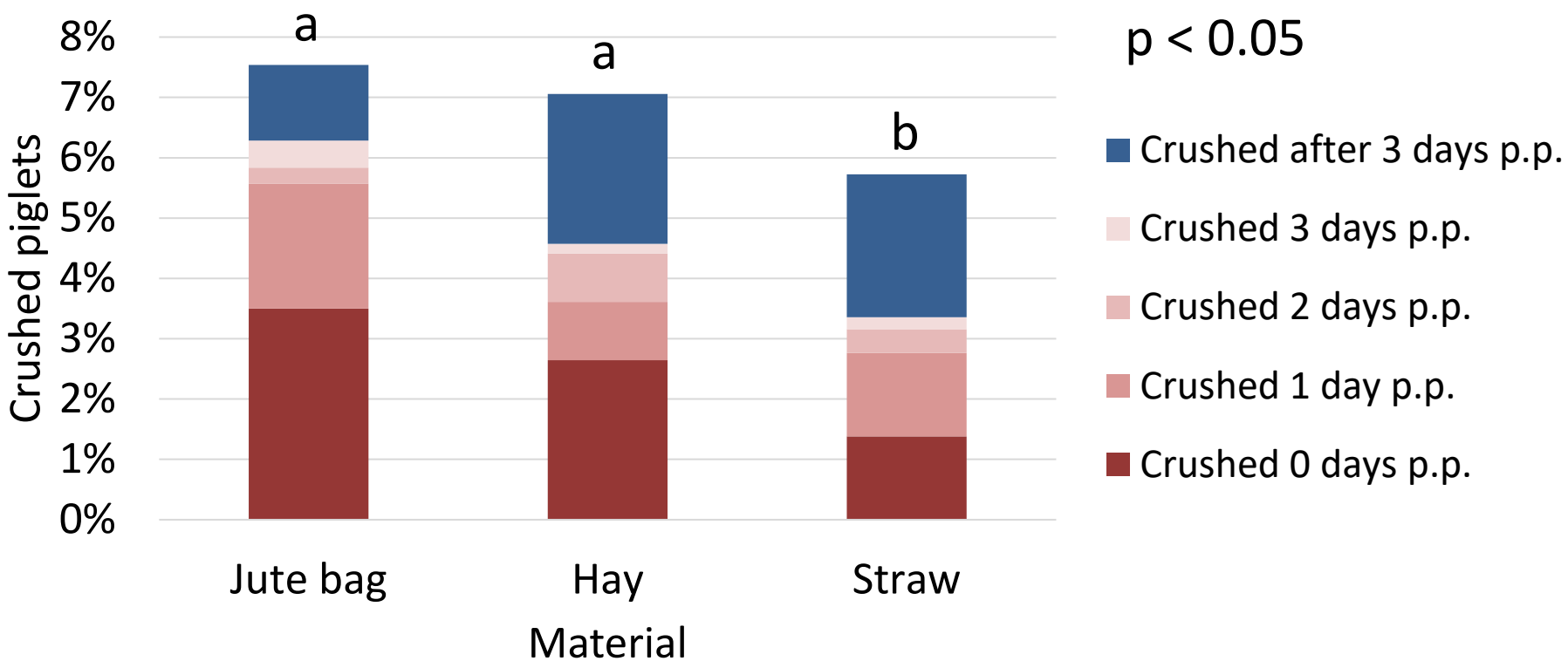
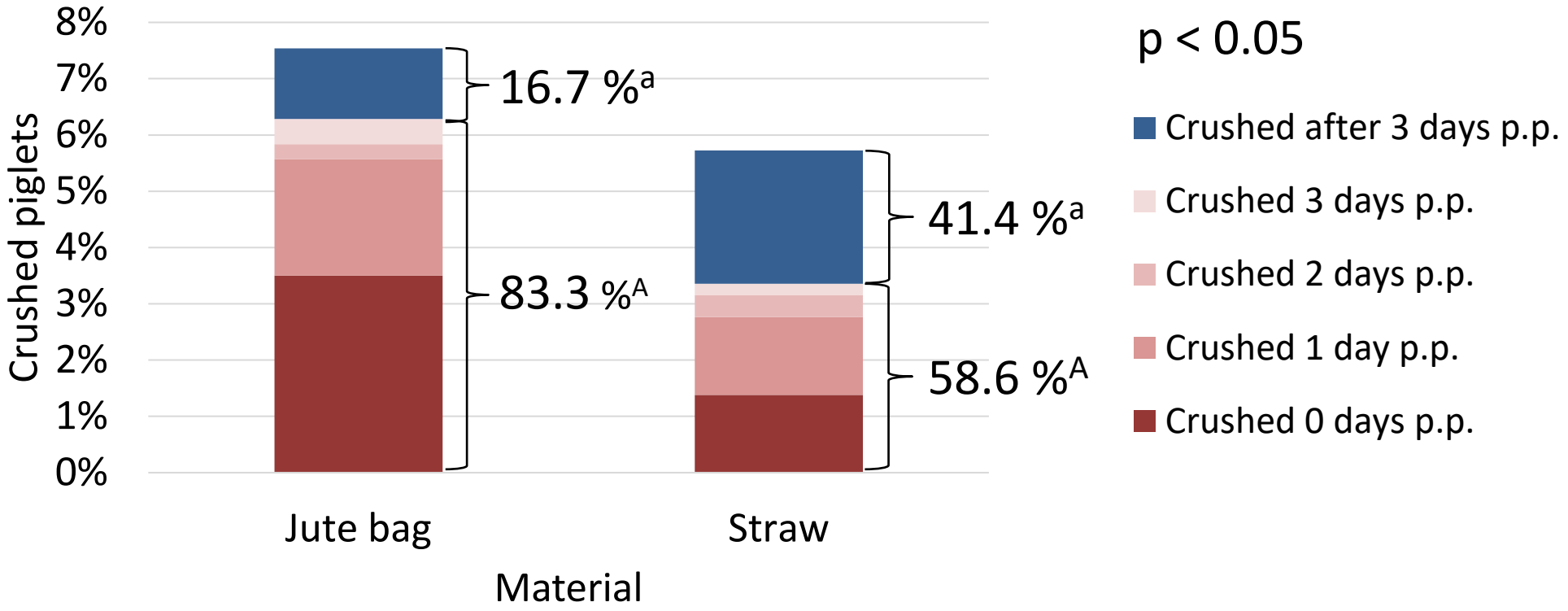
Nesting material:
- Hay (n = 78), straw (n =67) or jute bags (n = 71)
- 120 g in the morning and 120 g in the evening if needed
- From gestation day 112 until birth
- Permanently accessible

Data collection:
- Crushing losses
- Video recordings of focal animals

Percentage of crushed piglets for each material



Percentage of crushed piglets for each material



Closer examination of the crushing events

- *"Piglet mortality peaks during first 24 h after parturition and **almost all piglet crushings occur during the first 3 days after farrowing**."* (WACKERMANNOVÁ ET AL. 2017)

- *"Most piglets are crushed when the sow moves from **standing to lying** or when she **rolls over while already lying**."* (DAMM ET AL. 2005)

→Evaluation of position changes within 72 h after birth of the last piglet

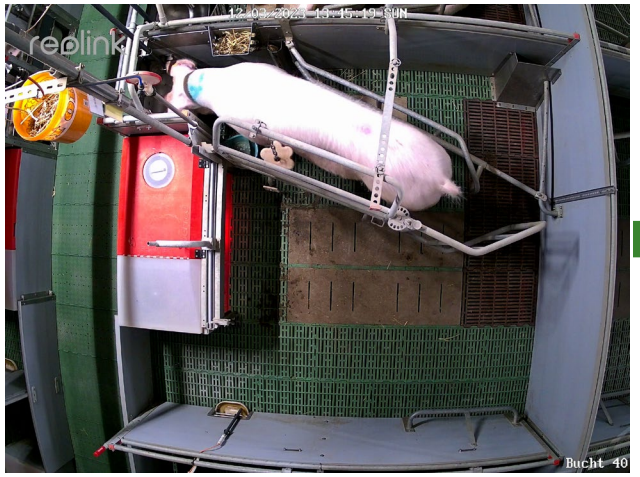
Experimental groups for behavioral analysis

Group	Material	Mean Crushing losses (%)
Straw NC	**Straw**	**0**
Straw C	**Straw**	**7.95**
Jute bag NC	**Jute bag**	**0**
Jute bag C	**Jute bag**	**13.18**

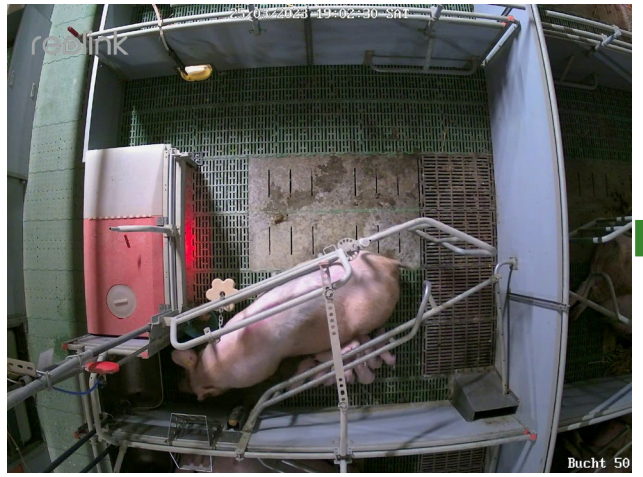
∑ 40 Sows

2880 h of video material

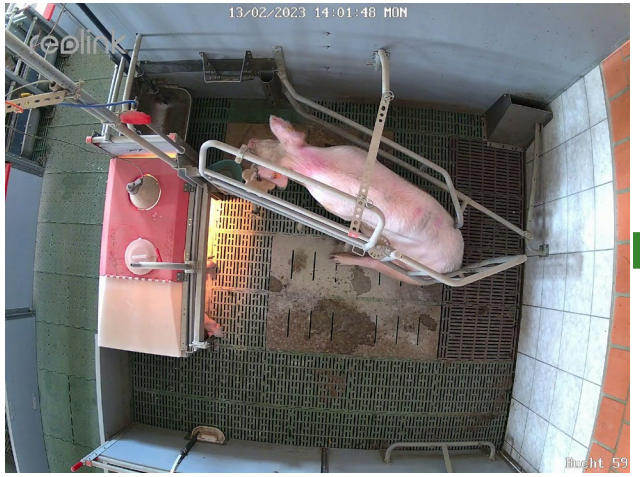
Behavioral analysis on video recordings



Standing



Lying



Sitting

Lying sideways

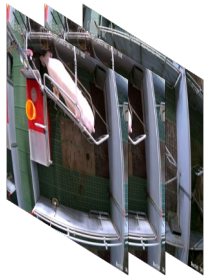
Behavioral analysis on video recordings

Standing

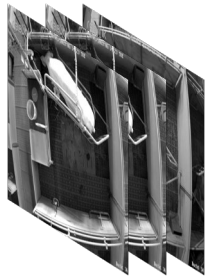
Lying

Sitting

Lying sideways



3723 images



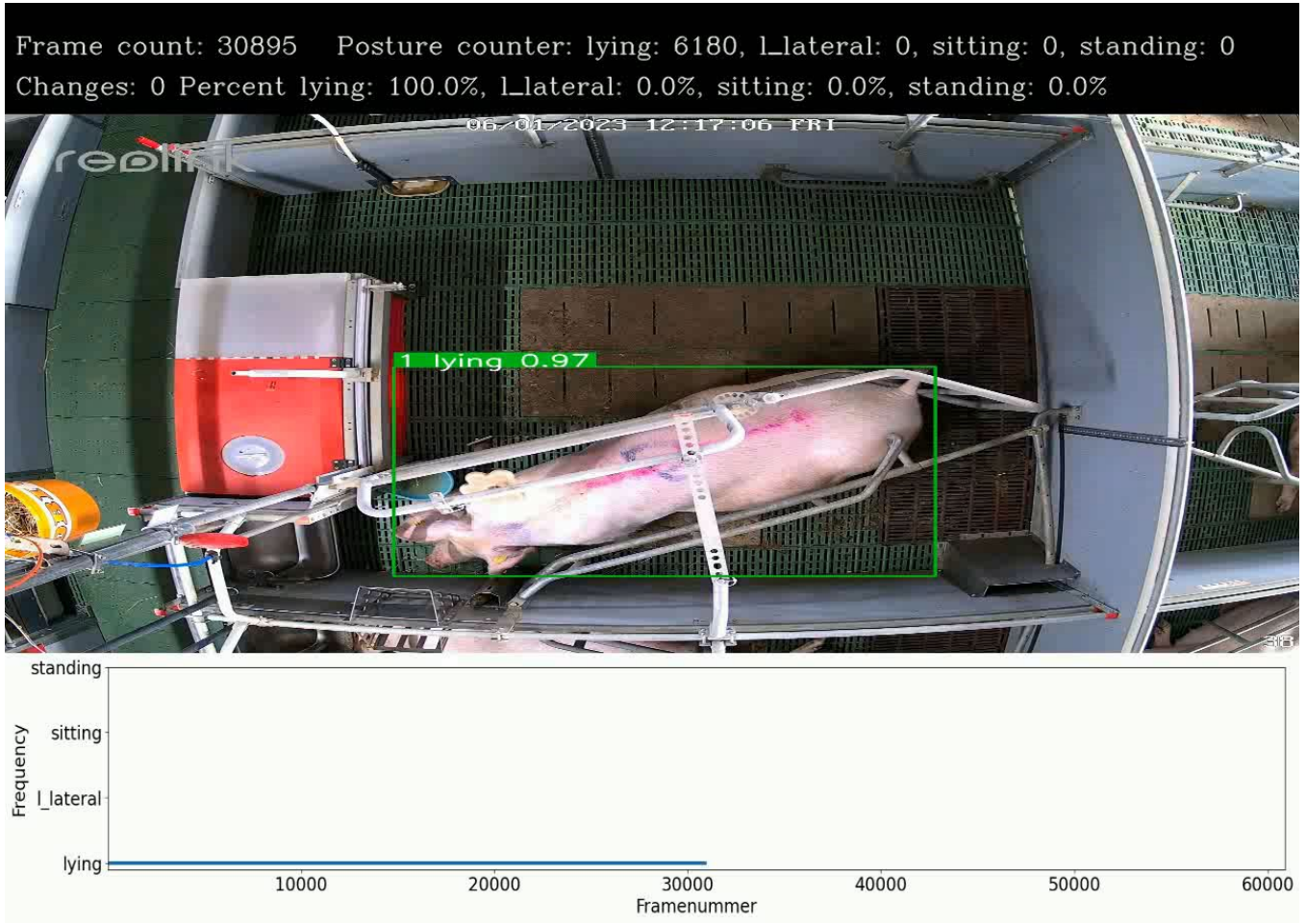
Greyscale transformation

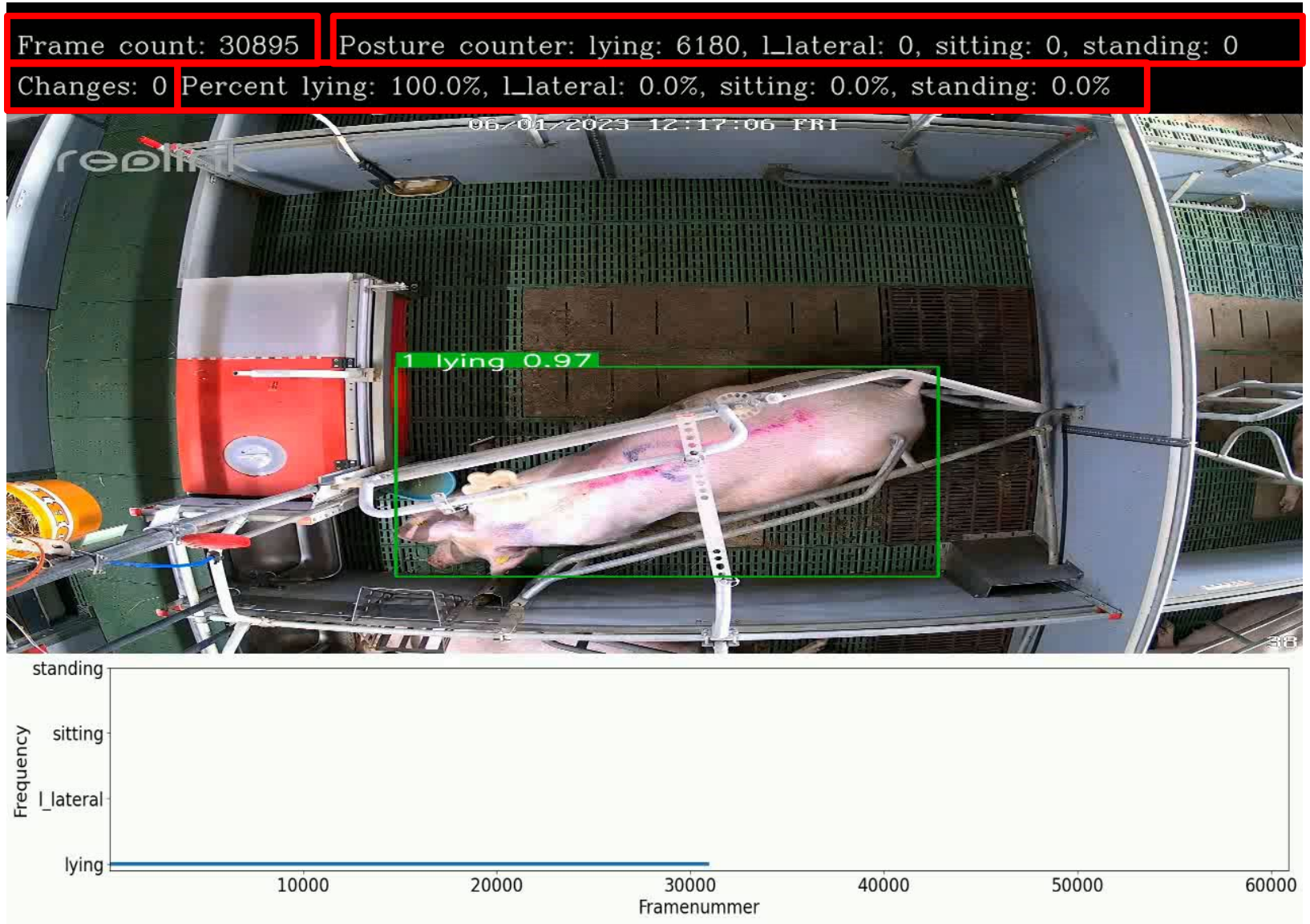
Augmentation

Training data set with 14.892 images

Automated video analysis

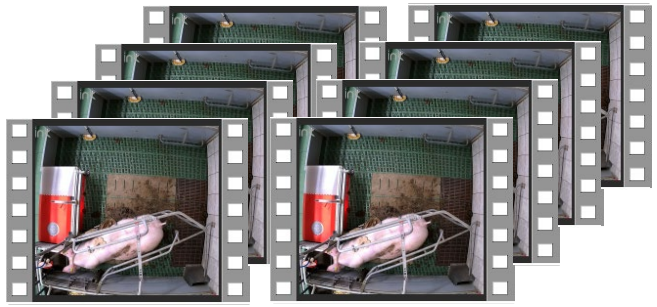
- Based on object detection framework **YOLOv9** (WANG ET AL. 2024)




Frame count: 30895
Posture counter: lying: 6180, l_lateral: 0, sitting: 0, standing: 0
Changes: 0
Percent lying: 100.0%, l_lateral: 0.0%, sitting: 0.0%, standing: 0.0%
06/01/2023 12:17:06 FRI
1 lying 0.97
standing
sitting
l_lateral
lying
Frequency
10000
20000
30000
40000
50000
60000
Framenummer

Validation of the model

Video data:

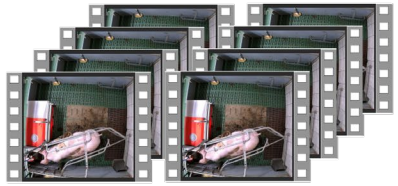


Approx. 5000 Videos

500 randomly selected Videos

Validation of the model

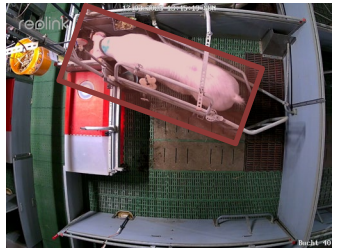
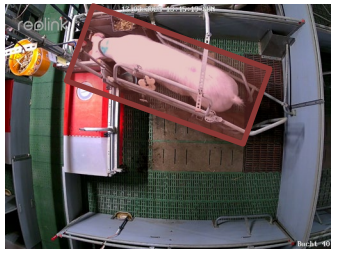
Video data:

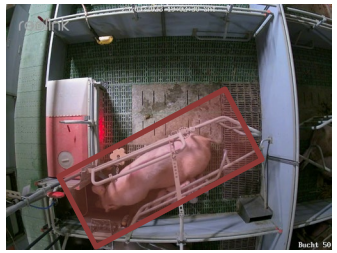
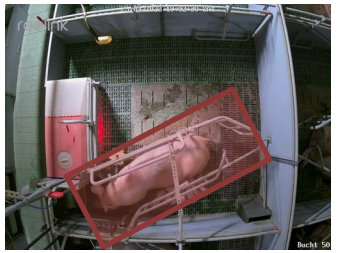


Approx. 5000 Videos

500 randomly selected Videos

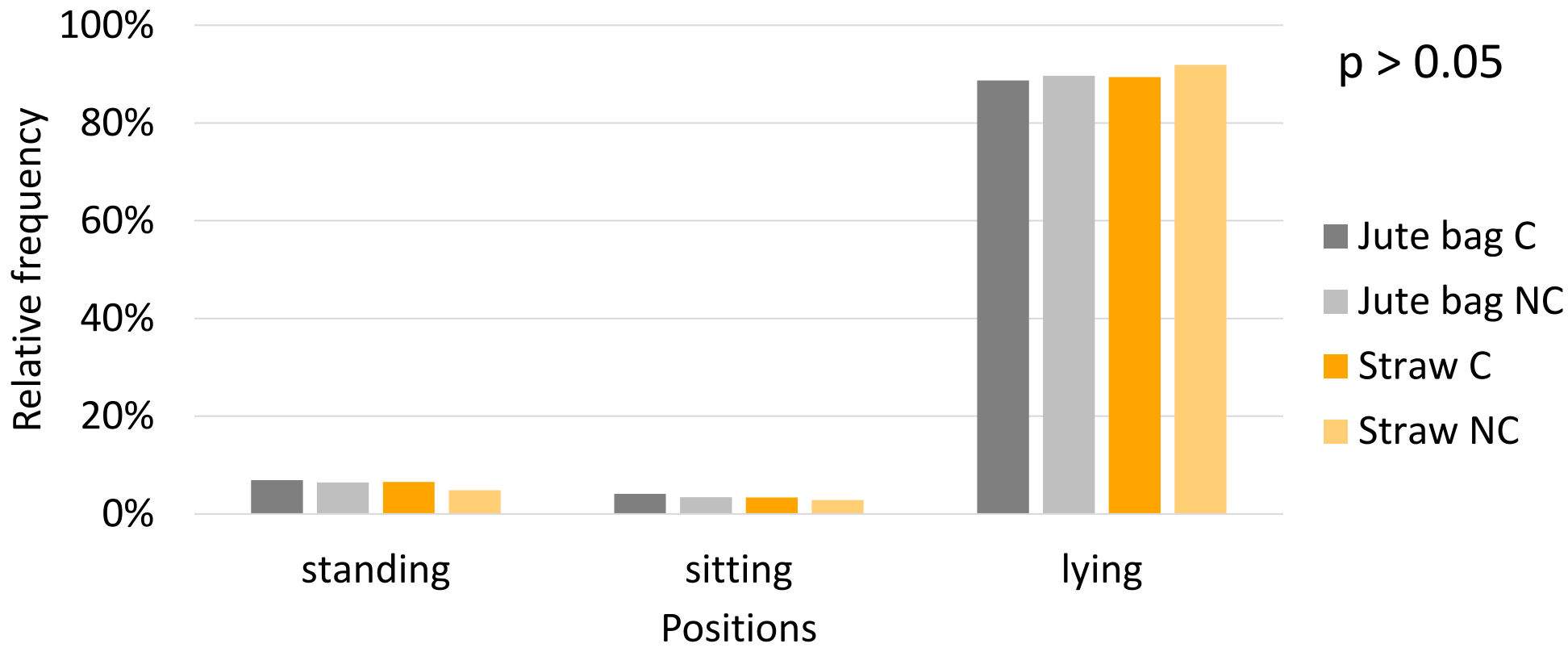
Model **Observer**

True ⟵  Standing ⇄ Standing 

False ⟵  Standing ⇄ Lying 

Accuracy: 93 % ACC

Percentage of body positions



Conclusion

- Sows offered straw as nesting material showed less and temporally shifted crushing losses than sows offered a jute bag
- Continuous evaluation of the position of sows using video recordings
- No significant differences between experimental groups in time spent in different positions

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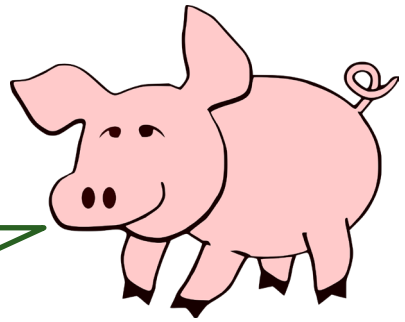


References

Damm, B. I.; Forkman, B.; Pedersen, L. J. (2005): Lying down and rolling behaviour in sows in relation to piglet crushing. In: Applied Animal Behaviour Science 90 (1), S. 3–20.

Grimberg-Henrici, C.G.E.; Büttner, K.; Lohmeier, R. Y.; Burfeind, O.; Krieter, J. (2019): The effect of group-housing with free-farrowing pens on reproductive traits and the behaviour of low-risk and high-risk crushing sows. In: Applied Animal Behaviour Science 211, S. 33–40.

Herskin, M. S.; Jensen, K. H.; Thodberg, K. (1998): Influence of environmental stimuli on maternal behaviour related to bonding, reactivity and crushing of piglets in domestic sows. In: Applied Animal Behaviour Science 58 (3-4), S. 241–254.

Nicolaisen, Thies; Lühken, Eyke; Volkmann, Nina; Rohn, Karl; Kemper, Nicole; Fels, Michaela (2019): The effect of sows' and piglets' behaviour on piglet crushing patterns in two different farrowing pen systems. In: Animals 9 (8).

Wackermannová, M.; Goumon, S.; Illmann, G. (2017): Pens with temporary crating: a viable alternative housing system to improve the welfare of lactating sows - review. In: Research in Pig Breeding 11 (2), S. 22–26.

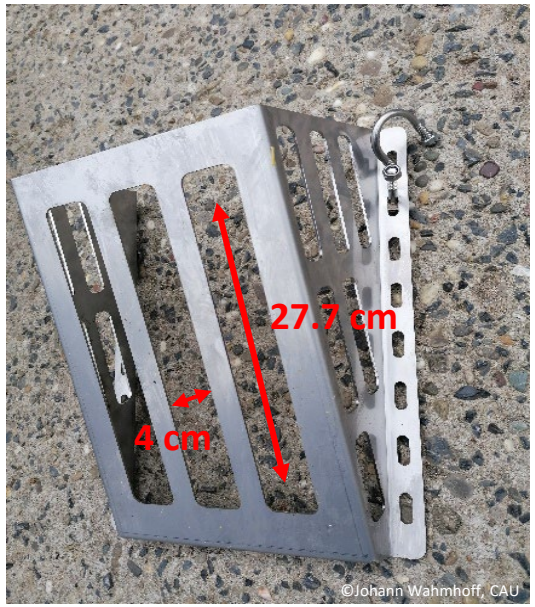
Wang, Chien-Yao; Yeh, I-Hau; Liao, Hong-Yuan Mark (2024): YOLOv9: Learning What You Want to Learn Using Programmable Gradient Information.

Yun, J.; Swan, K. M.; Vienola, K.; Farmer, C.; Oliviero, C.; Peltoniemi, O.; Valros, A. (2013): Nest-building in sows: Effects of farrowing housing on hormonal modulation of maternal characteristics. In: Applied Animal Behaviour Science 148 (1-2), S. 77–84.

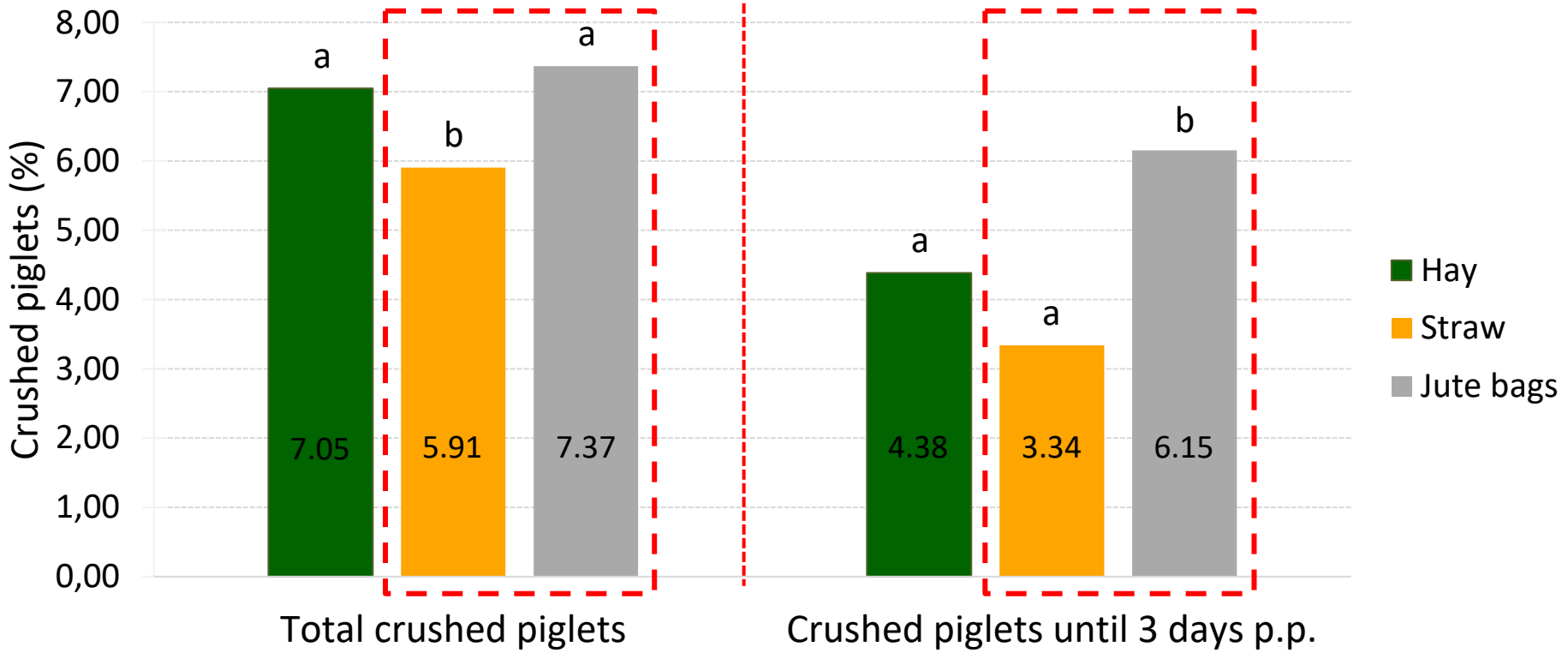
Attachments

The Farm – Husbandry system and operating metrics

- 150 Sows (Suisag) in a five-week rhythm
- 7 m² pen area (2.8 m x 2.5 m)
- Fixation 2 days a.p. until approx. day 7 p.p.



Percentage of crushed piglets for each material

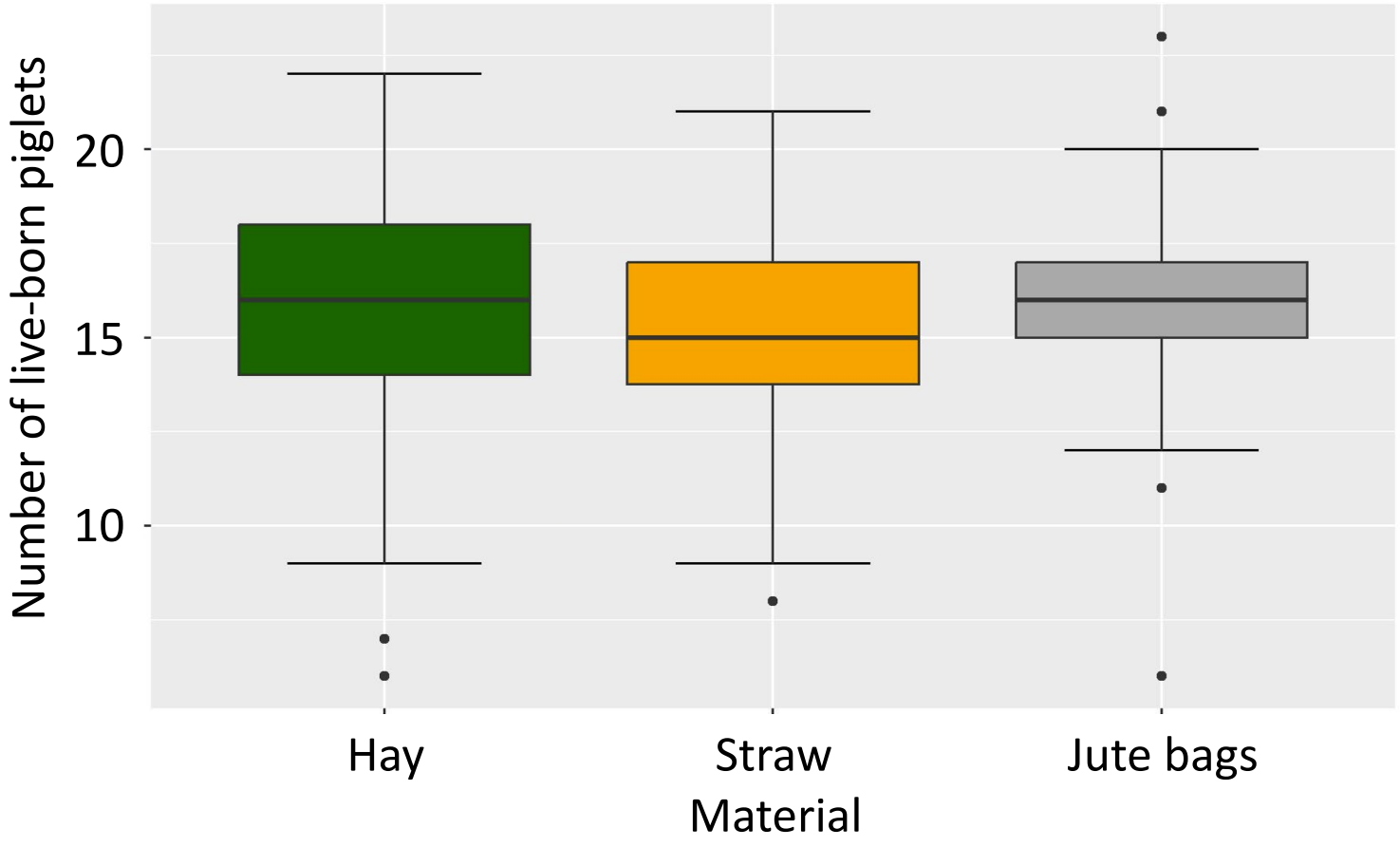


Confusion Matrix Validation

Model

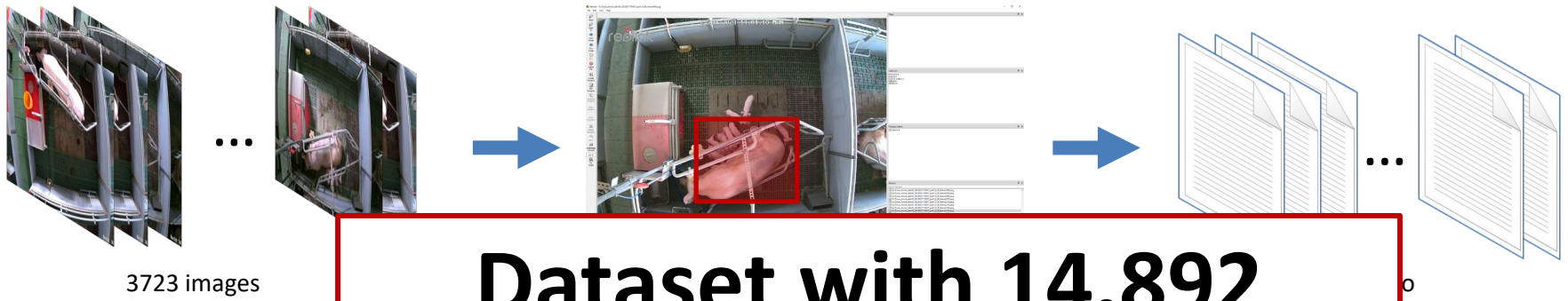
Observer	Standing	Sitting	Lying	Lying lateral	Accuracy
Standing	29904	1106	2314	1450	**84 %**
Sitting	1915	14049	3822	1202	**51 %**
Lying	1191	4886	97797	20918	**72 %**
Lying lateral	1614	2880	7940	486133	**97 %**

Number of live-born piglets for each material



P-value > 0.05

Creating a training data set



Current Challenges

Reasons:

- Complex body positions
- Occlusion
- Lighting

Thank you for the attention!

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