Question to EURCAW-Pigs: Drivers for tail biting
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Question
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EURCAW-Pigs received the following question from a veterinary inspector at a government of one of the Member States:

What is the current scientific knowledge on the risk factors or drivers for tail biting, in particular:

- Stocking density
- Feeding (competition)
- Pen design: solid flooring
- Pen design: general
- Air quality
- Rooting and foraging behaviour
- Manipulable material
- Aggression

Answers
Several EURCAW experts contributed to the response below. The EURCAW secretariat did the final editing, and may be contacted for queries: info.pigs@eurcaw.eu.

- ***Stocking Density**: What is the current scientific knowledge on the relationship between space and tail biting, for all categories of pig from piglets to breeding stock (if possible)?*

To our knowledge there is no new knowledge that would significantly affect our understanding of the relationship between space and tail biting. In a 20 year old review by Schrøder-Petersen and Simonsen (2001) on tail-biting in pigs, a number of papers was identified in which high stocking density was said to be a crucial factor leading to tail-biting. More recent work confirms this (Bracke et al., 2013; Valros and Barber, 2019). Whilst extensive commercial experience supports this view, and it is widely believed to be true, experimental studies that prove it are rare.
A reason for this apparent contradiction may be confounding by other factors, such as feeding space or group size. Larsen et al. (2018) found that although space allowance per se did not reduce the risk of tail biting, the combination of increased density and straw provision reduced the risk as effectively as tail docking. Nevertheless, irrespective of possible confounding factors, several epidemiological studies indicate a clear link between space allowance and tail biting risk (Moinard et al., 2003; Munsterhjelm et al., 2015; Scollo et al., 2016; Grümpel et al., 2018). In the study by Munsterhjelm et al., (2015) there was a relatively linear inverse relationship between amount of space and on-farm tail biting prevalence, when increasing from 0.7 to 1.5 m^2 per finishing pig.
EFSA (2014) analysed a few large international datasets addressing tail biting risk factors. The error in these analyses was high, but space allowance and manipulable material type were found to be very influential. Secondary, but also relevant are method of water provision, feed formulation, flooring type, temperature, cleanliness of the pen and tail-docking to be of lesser

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importance. Regarding space allowance, a crude analyses of the datasets obtained indicate that finishing pig pens with space allowance of more than 2.6 m^2 do not present tail lesions.

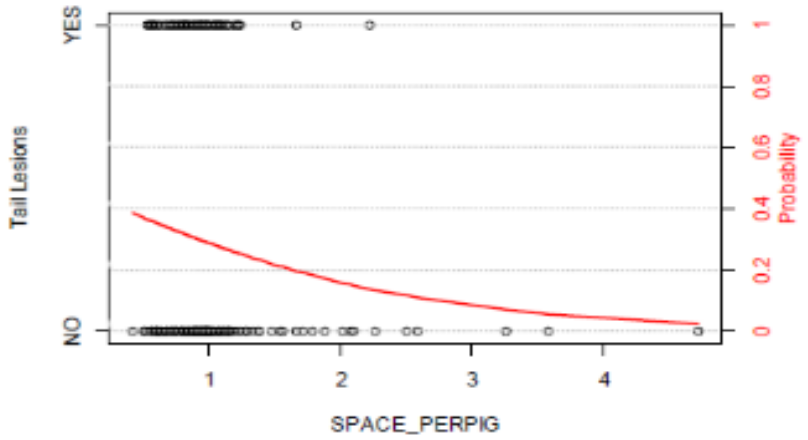

Figure 1. Probability of tail lesions at different space allowances (m2 / pig), estimated by EFSA (2014) on the basis of a limited number of datasets.

- ***Feeding (competition):*** *Is there an ideal feeding space per pig, in each category, to minimise competition, and what effect does the feeding system have on this?*

Competition for resources, namely feed, is an important risk factor for the occurrence of tail biting (EFSA, 2007). The importance of that risk is reflected by the fact that competition for food is included in the risk assessment suggested by the EU Commission in order to reduce the need for tail docking (Commission Recommendation 2016/336).

Consequently, it has been suggested to install feeding systems that allow all pigs to eat simultaneously. Synchronous behavior seems to correspond with pigs' natural behavior (Stolba and Wood-Gush, 1989; Rodríguez-Estévez et al., 2010). Studies suggest that aggression during feeding accounts for most of the aggression seen in pig pens (Ewbank and Meese, 1971; Ewbank and Bryant, 1972). The stress and frustration associated with feeding competition might explain why studies found that as much as 30-50% of tail biting occurred in the vicinity of the feeder (Sutherland et al. 2009; Palander et al., 2012). When addressing competition, a high animal/feeding-place-ratio (AFR) has been shown to increase the risk for tail biting (Moinard et al., 2003). However, in pig husbandry the sufficient number of feeding places also depends on the feeding strategy (amount and duration). Although less competition for feed should occur in *ad libitum* fed pigs (easier access to feed, less hunger), a high ratio of pigs to feeding places in *ad libitum* feeding systems has also been shown to increase tail biting (EFSA, 2007). European Union Council Directive 2008/120/EC states that all pigs must be able to access feed at the same time if fed restrictively on group level, but does not specify how to fulfil this requirement. In addition to the number of feeding places, the feeding space allocated in feeding systems allowing pigs to feed at the same time can affect competition for feed. When asked about the importance of different preventive measures for tail biting, Finish farmers ranked enough feeder space to be the most important (Valros et al. 2016). Different Member States have specified feeding spaces dependent on the pigs' live weight in their National Animal Welfare legislation, e.g. Austria,

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Germany and Switzerland. Considering the physical space a pig takes up when standing side by side, the shoulder width of a pig, in centimeters, is approximately 6.1 × bodyweight$^{0.33}$, with body weight expressed in kilograms (Petherick 1983). The feeder space given for different weight categories in the above mentioned legislations are more or less equivalent to shoulder width calculated by Petherick (1983). In Sweden, when pigs are fed at the same time (no *ad libitum* feeding), the minimum feeder space per pig is calculated using the formula: 0.164 + (weight (kg) / 538) (DG Sante 2016). In addition to the physical space pigs take up when feeding, research indicates that pigs need to be allowed to keep a minimum distance to neighbouring pigs to avoid/minimise aggression at the feeder (McGlone et al. 1983). In addition to increased feeder space allocation (Baxter 1986), well designed visual partitions might help to avoid/minimize aggression at the feeder (Baxter 1986). However, systematic research on which space per pig at the feeder is needed to avoid/reduce competition and subsequently aggression and tail biting, is limited.

- ***Pen design; solid flooring****: What is the impact on tail biting of providing solid flooring (full or partial) in pens compared to slatted flooring? Is there a minimum and/or optimal proportion of the pen that should have solid flooring in order to have a significant impact on the occurrence of tail biting.*

EFSA (2014) looked into risk factors for tail biting. They analysed data from 242 intensive farms in 5 countries: Finland (97), France (30), the Netherlands (63), Spain (40) and Sweden (12). The total number of farms reporting tail lesions was 71, while 171 did not report tail lesions of severity score 2. Regarding flooring as a potential risk factor for tail biting they presented the following table.

Table 1. Presence of tail lesions in relation to flooring type

	Presence of tail lesions		% tail lesions
	no	yes	
Bedding	11	2	15
Fully slatted	16	10	38
Ground[(a)]	0	0	0
Mixed	0	1	100
Partially slatted	116	51	31
Solid	12	2	14
Unknown	16	5	24

[(a)] natural flooring mud or grass

It is very likely that the reduction in tail biting related to the proportion of solid floor is related to the use of manipulable substrates (which are usually offered on solid flooring). We could not find any literature on the relationship between percentage of solid floor and incidence of tail biting.

- ***Pen design: functional areas:*** *What is the impact on tail biting of providing functional areas for dunging, resting and feeding in pens?*

No studies have identified pen design risk factors for tail bites in farms where weaning and slaughter pigs are housed in pens with access to an outdoor area. However, with reference to 6

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recognized risk factors for tail biting (https://www.eurcaw.eu/en/eurcaw-pigs/dossiers/tail-biting-and-tail-docking.htm), a pen designed with functional zones both outdoor and indoor is expected to reduce the occurrence of several risk factors related to tail biting. For example, zones for provision of floor feeding of roughage (in e.g. litter boxes) as an alternative foraging site (e.g. feeding rack) will reduce stress related to the risk factor 'Diet'. Undisturbed comfortable sleeping places will help reduce risk factors related to 'Pen structure'/'Cleanliness' and 'Climate'.

Pens designed with specific areas designated for eating/drinking, resting, exploration, and dunging are typically designed for larger groups of pigs (200-400 pigs per pen).
Indoor areas must consist of a functional zone for resting and for eating/drinking. The resting area may consist of a large straw bedded area on solid floor with easy access for trucks to accommodate cleaning, or consist of several smaller roof-covered sections with solid floor and bedding (straw or similar material). The remaining indoor area can be used as feeding areas with several drinkers and part of this floor will be slatted. The slatted floor is positioned in area with much traffic since these areas are typically used for dunging.

Existing knowledge and experience from practice points in the direction that the outdoor area can be made attractive for the pigs by providing the following separate zones outdoor:

1) Uninterrupted resting zone. Established e.g. up against solid walls, on a soft and dry flooring (e.g. straw bedding or mats), in an area where the temperature is neither too hot nor too cold. A semi-roofed area can ensure shelter and shade which attract piglets to rest there.
2) Separate foraging zones. Establishment of rooting boxes where, for example, silage or root vegetables are applied attract pigs to the outdoor area and meet the pigs' need for foraging.
3) Elimination/dunging zone. Pigs prefer to defecate and urinate away from resting and activity zones. Thus, they are more likely to defecate along open walls and in open areas where it is cold and slightly drafty, and in areas with much traffic. The elimination zone with slatted floor can therefore be established in un-roofed areas without bedding material and much traffic. In addition, the establishment of sprinkler systems in the elimination zone in the outdoor area to counteract heat stress and lip belts can be planted to shield the animals from drafts and winds.

- ***Air quality:*** *What is the current thinking around the maximum levels of harmful gases in pig houses (CO2, NH3 in particular) that might contribute to stress and therefore tail biting and what are the optimal levels of these gases?*

There is wide scientific consensus that air polluted with harmful gases and dust can initiate tail biting (Scollo et al., 2017; Vermeer and Hopster, 2018). Ammonia (NH3) is the most important pollutant. NH3 irritates mucosae and makes them more vulnerable to infectious diseases. It's produced from urine after contact with manure and related to dirty pens. Although the stimulating effect on tail biting already exists from levels as low as several ppm-s, a substantial effect starts from a level above 20 ppm. Pigs also avoid levels of 20 ppm and higher (Jones et al., 1996). A maximum level of 10-20 ppm NH3 for both pigs and humans suits to international standards. The CO2 level is more an indicator of ventilation rate, but the gas itself isn't very harmful at levels found in pig houses. This is often related with dust which originates from solid floors, bedding and

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skin. Dust threatens respiratory health, but there is no direct evidence of initiating tail biting. Both prevention of pollution at the source and increasing ventilation rate can improve air quality and living conditions for pigs and reduce tail biting risks. For assessing climate and air quality in relation to pig welfare and health, in The Netherlands a protocol and checklist was developed (EURCAW-Pigs, 2019).

- ***Rooting and foraging Behaviour**: What is the current thinking in relation to evaluation of provision for this behavioural need in pig pens?*

There is not a lot of news on this in the literature. In 1997, the Scientific Veterinary Committee (SVC) report indicated that pigs in the wild spent a lot of time searching for food by rooting. Grazing and browsing are also prominent foraging behaviours. This behaviour is intrinsically motivated. Even when fed full rations of commercial feed, domestic pigs have been noted to spend 6-8 hours foraging for food in a semi-natural enclosure. Exploration behaviour expresses the pig's motivation to get to know its environment. It develops early under natural conditions and constitutes a substantial part of the time budget of free-ranging domestic pigs. Pigs may be motivated to explore even if there are no obvious novel stimuli which may elicit the behaviour (SVC, 1997). The inability to perform foraging or exploratory behaviour may lead to behavioural abnormalities, such as stereotypies (in pregnant sows) or tail biting (in weaner and finishing pigs). The relationship between presence of manipulable materials and absence of tail biting has been well documented.

Recent work has focussed on the need to provide environmental enrichment in early life to avoid tail biting later. There are studies that indicate that it is essential for suckling piglets to already get access to proper manipulable materials. Moinard et al. (2003) performed an epidemiological study and found that farms not adding straw to the creep area had a greater risk for tail biting later on than those that had added straw. In experimental studies, Munsterhjelm et al. (2009) showed a long-lasting effect of this: pigs that had been given bedding during the first weeks of life showed less negative social behaviour during the finishing stage. Furthermore, Telkänranta et al. (2014) found that if pigs had been given ropes and newspapers as extra enrichment, developed less severe tail biting damage at the age of 9 weeks.

- ***Manipulable material**: What are the latest strategies around provision of manipulable material? Are there examples for rearing pigs with intact tails without using straw for example?*

Using enrichment materials (point-source objects) to raise pigs with intact tails is a challenge and it is not clear whether it is possible (Buijs and Muns, 2019). Roughage, hessian sacks, compost, fresh wood, space dividers, rope, and providing new objects regularly can significantly reduce tail damage, but no evidence was found that commonly applied enrichment objects (processed wood, plastic or metal) reduce tail biting significantly unless exchanged regularly (Buijs and Muns, 2019). A handful of Dutch pig farmers are/were producing pigs with intact tails for export to Sweden. They used e.g. jute/hessian sacks (in combination with a high health status and special attention to good-quality feed) (Lamers, 2017; Van der Plas, C, 2020). Pig farmer J-H Hohls is rearing pigs with intact tails in a straw-less system in Germany (see his presentation at the

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Schweinefachtagung, 2021; see also results from the German demonstration project regarding tail biting and pen design, Becker et al., 2020).
In Finland, Norway, Sweden, Switzerland, less than 5% of the pigs are tail-docked (De Briyne et al., 2018). In Finland especially pig farms have slatted floors and straw bedding is rarely used (<5% of farms). Finnish farmers use, and probably need, modest amounts of substrates to raise pigs with intact tails. But they do this saying they would not revert to tail docking even if it were legally allowed (Valros et al., 2016).
As to the use of bedding or other natural, destructible materials and even if minimal so as to be compatible with slatted floors, farmers may want to pay attention to hygiene, moulds for example (see e.g. Kemper, 2020).

- ***Aggression:*** *Aggression is a normal behaviour in pigs in certain circumstances. When does normal aggression become unnecessary/excessive aggression?*

Aggression is when pigs fight about their social rank or access to resources such as feed, water, enrichment, etc. (EFSA, 2007, 2014). Fighting pigs face each other, so injuries from fights usually occur on the front of the pigs, especially head and shoulders (Olesen et al., 1996; Rushen and Pajor, 1987). If pigs have to "queue" for resources, they may also bite the tail to gain access (Taylor et al., 2010). Tail injuries from queueing may lead to repeated, continuing tail biting. In most cases though, tail biting arises from the combined effect of risk factors on a farm (Taylor et al., 2010; EFSA, 2014, 2007). There are indications for aggression being linked to tail lesions in a later stage (Ursinus et al., 2014), but there is no clear causal relationship. Aggression causes stress which in turn increases tail biting risk (Taylor et al., 2010; EFSA 2014, 2007). At the same time, many tail biting factors also influence aggression. Good enrichment, for example, will lower risk for tail biting as well as reduce aggression (EFSA, 2014). Regrouping triggers fighting for social rank and usually occurs together with a new housing environment. Both are stressful for the pigs (Puppe et al., 1997; Coutellier et al., 2007) and may increase tail biting risk (EFSA, 2014). Skin lesions from aggression may be used for detecting tail biting risk related to high competition and social instability (EFSA, 2014; EURCAW-Pigs, 2020).

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