Swedish University of Agricultural Sciences
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Pig behaviour during crowding - a study in organic and conventional herds

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Pig behaviour during crowding
- a study in organic and conventional herds

Grisars beteende vid trängsel
- en studie i ekologiska och konventionella besättningar

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PREFACE

This project was completed as a Master's Thesis in Animal Science at the Department of Animal Breeding and Genetics, Swedish University of Agricultural Sciences (SLU). The subject was chosen because of my own interest in pigs, behaviour, slaughter transports and different production systems. Development of the methods used was done at SLU:s research centre, Funbo-Lövsta outside of Uppsala, and the field-study was carried out in six commercial pig producing herds; three organic (KRAV-certified) and three managing their pigs according to conventional methods.

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ABSTRACT

Rearing in organic pig production differs from conventional rearing; pigs have outdoor access and larger space allowances. Regardless of production system all pigs are transported before slaughter and during transport pigs are crowded together in a new environment and in a space smaller than they are used to. As pigs in organic herds are reared at even larger space allowances than conventional pigs, such crowding could possibly have a stronger impact on pig behaviour and well-being. Six pig producing herds, three conventional and three organic, were visited and pigs from each herd were enclosed during 12 minutes in a test area corresponding to the crowding on a transport vehicle. During the crowding, pigs' behaviour was observed, before and after enclosure in the test area skin lesion scores were recorded, and also measures of heart girth (for weight estimation) was done. The results show that there are differences in how organic and conventional pigs' response to a crowded situation. Pigs in organic herds were more active, i.e. standing up ($p=0.004$), only pigs in conventional herds lied down during the test period. Moreover, organic pigs were more engaged in social tactile interactions ($0.001>p<0.006$), had higher vocalisation scores ($p=0.002$) and climbed the walls of the test area more ($p<0.001$) than conventional pigs. Conventional pigs had higher skin lesion scores than organic pigs before the study ($p=0.013$), but no difference in change during the enclosure was detected. The interviewed transporters had experienced behavioural differences between organic and conventional pigs; they regarded organic pigs as more active and agitated. However, whether this was regarded as positive or negative for their work was not consistent. In conclusion, pigs reared in organic herds vocalised more, were more active and performed a higher frequency of social interactions during crowding compared to pigs in conventional herds. This could indicate that pigs from organic herds have more difficulties, compared to pigs from conventional herds, to cope in crowded situations.

SAMMANFATTNING

Uppfödningsperioden i ekologisk grisproduktion skiljer sig mycket från uppfödning i konventionell produktion; grisar i ekologiska besättningar har betydligt större områden att röra sig på samt tillgång till utevistelse. Oavsett om grisar föds upp i ekologiska eller konventionella system så transporteras alla innan slakt. Transporten innebär trängsel i en ny miljö på en mycket mindre yta jämfört med uppfödningsperioden. Eftersom grisar i ekologiska besättningar är vana vid ännu större områden än konventionella grisar, skulle en sådan trängsel kunna ha en starkare inverkan på deras beteende och välmående. I den här studien besöktes sex slaktsvins-besättningar, tre ekologiska och tre konventionella. I alla besättningar stängdes grisar in, under sammanlagt 12 minuter, på ett litet testområde för att motsvara trängseln på en slakttransport. Under studien observerades grisarnas beteende, före och efter studien bedömdes hudskador och efter studien mättes även bröstomfånget (för viktuppskattning). Resultaten visar att det finns skillnader i ekologiska och konventionella grisars beteende vid trängsel på en liten yta. Ekologiska grisar var mer aktiva, dvs. stod upp ($p=0,004$), endast grisar i de konventionella besättningarna lade sig ner under 12-minutersperioden. Dessutom var grisarna i de ekologiska besättningarna mer involverade i sociala interaktioner ($0,001>p<0,006$), vokaliserade mer ($p=0,002$) och klättrade betydligt mer på väggarna till testområdet ($p<0,001$) jämfört med de konventionella grisarna. Grisarna i de konventionella besättningarna hade mer hudskador än de ekologiska innan studien ($p=0,013$), men ingen skillnad i förändring efter studien kunde urskiljas. De intervjuade transportörerna upplevde skillnader i beteende mellan ekologiska och konventionella grisar, de ansåg att ekologiska grisar var mer rörliga och stirriga. Huruvida detta ansågs vara positivt eller negativt för deras arbete upplevdes olika. Sammanfattningsvis, grisar i ekologiska besättningar vokaliserade mer, var mer aktiva och utförde mer sociala interaktioner vid trängsel på en liten yta jämfört med grisar i konventionella besättningar. Detta skulle kunna tyda på att grisar från ekologiska besättningar kan ha svårare, än grisar från konventionella besättningar, att hantera trängsel på en liten yta.

INTRODUCTION

Alternative ways of animal production is growing in popularity; the interest concerns production that regards ethical values such as environment and animal welfare, and is considered sustainable in the future. One increasingly popular alternative choice is the organic production. The basis of organic farming rests upon four basic principles: health, ecology, fairness and care (IFOAM, 2009). The ambition is to produce high quality products from a long-term sustainable point of view, considering the basic functions of nature. All parts of organic production should be created so that a good animal health is promoted, the animals should have the possibility to perform natural behaviours and have both a worthy existence and a dignified end of life (KRAV bye-laws: §4, 2008). In Sweden, conventional pig production has higher standards on animal welfare compared to large parts of Europe, according to the ´Swedish concept´. For example, space allowances are more generous and housing systems with fully slatted floors are banned (SJVFS 2010:15). However, there are large differences between Swedish conventional pig production and Swedish organic pig production.

Regardless of which production system pigs are reared in, they must be transported to an abattoir before slaughter. There is limited amount of literature available on how pigs reared in different production systems (i.e. conventional and organic) reacts to crowding and transport, and since transportation is known to be stressful and challenging for pigs it is important to increase the knowledge in this area. It is becoming more and more common to centralise slaughter houses into fewer and larger plants which means that transports are increasing in time and length. It is not only during the actual transport that there is a risk of pigs being negatively affected, this starts already at the farm, pigs ready for slaughter are selected and put in lairage, which often means crowding on a limited area together with unknown individuals. Thereafter pigs are loaded on a vehicle and then follow the actual transport, at arrival at the slaughter house pigs are unloaded in a new environment and often put in lairage again before slaughter. Collectively the chain impose many challenges for pigs; they are moved out from their comfort zone e.g. their home pen, introduced to novel environments, encounter physically difficult situations such as loading ramps, and are crowded together with other individuals.

The Swedish legislation has set standards for the transport of pigs; a maximum stocking density on the transport of 235kg/m^2, or a floor-space of at least 0.43 m^2 per pig of approximately 100 kg (SJVFS 2010:2) and these regulations apply to all pigs, regardless of rearing system. These space allowances are much smaller compared to the rearing period, especially for organic pigs. Organically reared pigs have had larger areas to move around on and consequently the possibility to maintain a larger distance to other individuals. This suggests that such crowding could be perceived as a worse challenge for organically reared pigs as compared to conventionally reared pigs, and can thus reduce their welfare the last period in life which is not consistent with the standards of organic production. The intention of this thesis is to acquire knowledge on how pigs reared in different production systems react under crowded circumstances. The thesis consists of three parts, one literature study, one on-farm study and one interview study.

LITERATURE

This literature review aims to describe the behaviour of pigs and explain how behaviour is connected to welfare and stress. By relating challenging and stressful situations to different behavioural responses, this connection will be clarified. Since behaviour will be practically measured during the field study, particular focus will be put on behavioural responses and not physiology. Thereafter, the differences between Swedish conventional and organic rearing will be illustrated and how rearing system could influence the behaviour of pigs.

Social behaviour of pigs

Dominance hierarchy

Domesticated pigs descend from the wild boar (*Sus Scrofa*) and its behaviour still resembles that of its wild ancestors (Graves, 1984). Pigs form stable social groups with linear relationships (Gonyou, 2001) where dominance is used to maintain the system and settling disputes over limited resources (Graves, 1984). In the wild it seldom occurs that new individuals are allowed to enter an already stable social group, except for the sow and her newborn piglets that are introduced to the group a few weeks after farrowing (Gonyou, 2001).

The establishment of a pig's individual social rank is complex and dependent on factors such as sex, environment, physical size, other group members and previous experience (Meese & Ewbank, 1973). Dominance relationships are based on animals of high rank having superiority over low rank individuals in competitive situations, such as over food and other limited resources. The rank order is established by fights and threats, head-to-head knocks together with pushes or bites and turning of the head in aggressive manners. Aggressions and fights are most intense during the first hours after mixing of unfamiliar individuals and after 24-48 hours the group has rather stable social relationships (Meese & Ewbank, 1973). Threats are used to maintain the dominance within the group, actual attacks are rare and the social organization is maintained through avoidance behaviour (Gonyou, 2001).

To maintain the hierarchy in stable social groups, individual recognition is important. Individual recognition is based on visual and auditory signals together with smell (Graves, 1984). Pigs communicate to a large extent via sounds. Grunts, snarls, snorts and squeals are used together with clacking of teeth and champing of jaws. At the first interaction the sense of smell is used to discard known individuals from unknown (Gonyou, 2001). Meese & Ewbank (1973) found that it takes longer time to form the hierarchy in groups of pigs held outdoor on larger areas. It can take up to four days before any relationships can be distinguished, the bonds are not as clearly visible as for indoor pigs and the level of aggression is lower. This is consistent with other findings with average lower levels of aggression in outdoor and enriched pigs (Beattie et al., 1995; Cox & Cooper, 2001; Terlouw et al., 2009). Amount and design of the available space influence how animals can escape and avoid each other, in large areas animals can walk around without having to enter the personal space of a dominant individual (Gonyou, 2001; Rodenburg & Koene 2007). This could be the reason behind the lower level of aggression in outdoor and enriched pigs, the hierarchy can be maintained only via threats and low ranked individuals can move away from high ranked ones.

Social spacing

In pigs, flocking and following behaviour is commonly seen, and pigs willingly follow each other (Van Putten & Elshof, 1978; Hemsworth, 2007). In flocking behaviour the social spacing and orientation of animals are maintained. Social spacing or personal space is the distance an individual wants to keep to others, or the area around an individual, which if invaded by another can result in an aggressive reaction (Price, 2008). Pigs in a group need to keep this distance to each other in order to maintain the ability to communicate with their body in a way that is normal for their species. In dominance hierarchy the personal space plays a crucial role, low ranked individuals avoid the personal space of high ranked ones and the dominant individuals can invade the area surrounding a

subordinate in order to get access to a resource. Generally a low ranked individual begin to avoid a dominant one at a greater distance than the dominant's threat-zone (Price, 2008). Orientation is the direction that an individual tries to maintain to others in order not to impose any threat or display of hostile posture. If pigs are crowded in such a way that this communication is hindered this can result in aggressive interactions (Hemsworth, 2007).

Crowding means that a group of individuals is restricted in its movements by presence of other individuals in close proximity, and a high density means that the possibility that an animal will invade the personal space of another is increased. Such invasion often leads to aggression and avoidance and in crowded situations the avoidance results in yet another invasion of personal space (Broom & Fraser, 2007).

Welfare and stress

Animal welfare could include both the physical and mental condition of an animal (FAWC, 2009), which suggest that good welfare should mean an excellent fitness together with feelings of well-being. Implying that welfare as a concept includes much more than measurements of production or absence of injuries. The Farm Animal Welfare Council (FAWC) is responsible for setting down the famous ´Five Freedoms´ as a concept for animal welfare (FAWC, 1979):

1. **Freedom** from hunger and thirst
2. **Freedom** from discomfort
3. **Freedom** from pain, injury or disease
4. **Freedom** to express normal behaviour
5. **Freedom** from fear and distress

(FAWC, 2009)

These five statements could represent basic states and definitions of acceptable animal welfare. Broom (1986) defined welfare as: *"the welfare of an individual is its state as regards its attempts to cope with its environment"*. This definition can be put on a scale ranging from ´coping very well´ to ´not coping at all´, with the outcome ´very good welfare´ to ´very poor welfare´, and the outcome depends on the effort used by the animal in order to cope with the situation. This definition could be regarded as the outcome when trying to meet the ´Five Freedoms´ and implies that such a definition could be useful when trying to measure the welfare of an individual under practical conditions. If an animal has difficulties coping or is failing to cope, i.e. has poor welfare, it is said to be stressed (Broom, 1986). Stress is considered to include poor welfare (Broom & Johnson, 1993; Broom, 2007) but it should also be emphasised that the welfare of an individual can be poor without it being stressed (Broom & Johnson, 1993). Stress is a term that often is generalised and interpreted in many different ways. It could be regarded as the adjustment in a body as a response towards a change in the environment perceived as a threat (Von Borell, 2000). The event, sound, object or change in the environment which elicits the so called stress-response is called the stressor. The response can cause changes in the body's homeostasis or behaviour and the reactions seen are attempts to cope or restore the homeostasis to normal.

Psychological stress includes handling, novel situations and restraint while physical stress more deals with physiological parameters as dehydration, starvation, injury, exhaustion or exposure to different thermal situations (Grandin, 1997). If the responses fail to restore the homeostasis, the animal is said to be stressed and its welfare reduced (Blokhuis et al., 1998). Pain is a physiological stressor, especially if there is no way of getting away from the pain eliciting stimuli. The greater the pain, the greater stress is experienced. Pain is without questioning a very uncomfortable state, but also very subjective. Individuals react differently to the same pain eliciting stimuli and one could therefore argue that the pain-threshold varies. But despise this difference in subjective feeling, pain is the state of an individual and affects its welfare. The susceptibility to stress could be dependent on how well the animals have been customised to changes in environment, temperature or physiological challenges

such as hunger and thirst. Lack of experience in such situations can lead to increased stress susceptibility (Van Putten & Elshof, 1978).

Lack of control

Lack of control arises for example when the freedom of movement is lost, as when animals are confined and have difficulties to perform basic postures as moving around, lying down or getting up. When animals know how to control and interact with their environment but are in some way prevented from doing the actual action, feelings of stress and frustration will arise (Broom, 1991). Dry sows that are fixated in crates experience both frustration and stress and perform higher frequencies of stereotypes, like bar-biting, compared to loose-housed sows (Jensen, 1981). Animals with no previous experience of tight confinement can find it so aversive and stressful that its welfare is greatly reduced and it could ultimately die (Broom & Fraser, 2007).

Fear and stress

Fear is an important psychological stressor for farm animals and can be seen as the response towards a detectable danger, or as a preparation for a perceived danger. Novel situations and objects are frightening and often perceived as a very strong stressor to pigs and other animals (Hemsworth, 2007). A novel situation is considered as a potential threat which is connected to life in the wild, where fear keep animals alert in order to detect predators in time (Grandin, 2007). One could therefore argue that fear is actually a fitness-trait, important for the survival and longevity of the individual animal. It has also been suggested that extensively reared animals display more fear stress or psychological stress during handling and transport procedures compared to more intensively reared individuals (Grandin, 1997). Reluctance to move towards a fear eliciting stimuli and turning back has been recommended as legitimate behavioural measures to assess fear in pigs (Dalmau et al., 2009). If the novel situation or object perceives no actual threat the fear will decline after some time (Hemsworth, 2007). However, novelty could also be eye-catching for some animals. Pigs often approach and manipulate a novel object like a piece of paper, but if forced to move towards it they will refuse and try to turn back (Grandin, 1997).

There have been some indications that animals release pheromones in response to a fearful situation. Pheromones influence the behaviour of other animals as they sense these and react thereafter. If, for example, pigs have passed through a funnel, and become very agitated and stressed inside it, other pigs entering the funnel can react fearfully and refuse to walk the same way since these react to the pheromones by sensing that there is something wrong (Hemsworth, 2007). Therefore it is important to minimise stress as much as possible when handling pigs, otherwise it may have more long-term effects.

Transport and stress

It has been suggested that pigs is the species having most difficulties coping with challenging conditions during transport (Warriss, 1998). Many studies of responses seen under transport circumstances have been conducted; these often have very varied results which are difficult to interpret (Grandin, 1997; von Borell, 2000). Transportation to slaughter is not just the actual journey in a vehicle; it includes many steps that are challenging and potentially stressful. Also, previous negative experiences like rough handling by humans is remembered and can cause handling to be more difficult in the future since the animal become agitated by the human presence (Grandin, 1997). Being handled by humans and loaded on a transport via a steep loading ramp means both psychological and physical challenges for pigs. Very steep loading ramps are difficult for pigs both to ascend or descend and cause increased heart rate (Van Putten & Elshof, 1978; Warriss et al., 1991; Brown et al., 2005). If pigs slip or fall it can also result in injuries, longer loading and unloading times and increased work load for the stock personnel. Geverink et al. (1998) reported effects on cortisol level, heart rate and ambulation activity during loading, transport and unloading. Loading and unloading gave the highest differences in cortical levels and the journey resulted in elevated heart

rate. After transportation pigs commonly display large differences in several measurements of physiological stress. Such as reduced body weight, reduction in total white blood cell count and elevated blood levels of cortisol (Sutherland et al., 2010).

Meat quality and stress

There have been connections drawn between stress and exhaustion before slaughter with a lowered quality of the end-product, the meat. After slaughter the aerobic muscle metabolism will die away but ATP production continues for some time. Post slaughter, under anaerobic conditions, glycogen is degraded to produce ATP and this process produces lactic acid. The acidity of the meat, which can be indicated by lactate levels and decided by the pH-value, is the result of this process. Stress just prior to slaughter is assumed to lead to a decline of the body´s energy stores, which consequently results in a high glycogen breakdown and a fast acidification of the carcass. This is turn may cause an earlier onset of *rigor mortis* together with a high carcass temperature (Lambooij, 2007). A low end-pH when the carcass is still warm cause protein denaturation and the meat can be classified as pale, soft and exudative (PSE) (Bowker, et al, 2000), such meat is characterized as moist. Other important parameters considering the quality are the colour, water-binding capacity and temperature of the meat.

Genotype is also known to have an effect on pig meat quality, like for example the recessive gene RN^-, also called the halothane gene. The gene is common in some breeds, for example Pietrain and Belgian Landrace. Pigs homozygous for this gene have a malfunction in their muscle metabolism which makes the pigs extremely susceptible to halothane gas and stressful situations such as transports (Atkinsson, 2000). This increased stress susceptibility can lead to sudden deaths and also an increased incidence of PSE-meat or dark, firm and dry meat (DFD) post slaughter. The occurrence of this gene has been reduced by major work through breeding assisted by DNA-tests during the last decades (Barbut et al., 2008), but it is still more common in countries like Belgium and Germany which use breeds with a higher incidence of the RN^--gene.

Intensive handling of pigs before slaughter increase the incidence of both PSE and DFD meat post slaughter (Warriss et al., 1994). Similar findings of inferior meat quality have been detected by Correa et al. (2010) who reported that pigs prodded with electric goad prior to slaughter displayed lower ultimate pH-values post slaughter, greater lactate levels in the blood at slaughter and more incidences of blood splashed ham. This is also consistent with the findings of Hemsworth et al., (2002) who found positive correlations between highly aversive handling before slaughter, levels of lactate at slaughter and the light colour score of the ham after slaughter. There is however no consistent findings on how pig production systems (i.e. conventional and organic) could have an impact on the meat quality of pigs. Findings report of variation in increased and decreased carcass fat and occurrence of PSE and DFD meat (Bonneau & Lebret, 2010).

Measurements of welfare and stress

Pigs exposed to novel and challenging situations or other stressors reacts to these by changing both physiology and behaviour in order to cope. Such changes can be measured and quantified in attempts to estimate the level of stress that the animal is subjected to and hence its welfare. Measurements can include behavioural differences together with changes in physiological measurements. It is considered that a robust overview of pig's welfare can be accomplished by combining measures of both behaviour and physiology (Sutherland et al., 2010).

Physiology

A challenging situation, anxiety, stress or fear results in a response of the autonomic nervous system together with the adrenal glands medulla and the Hypothalamic-pituitary-adrenal cortex axis (so called HPA-axis). In the cascade of reactions the adrenal medulla releases the catecholamines adrenaline and nor-adrenaline, the latter is also transmitted from autonomic nerve endings (Axelrod & Reisine, 1984; Broom & Johnson, 1993). Together these cause acceleration of the heart rate, increased

blood flow and other metabolic reactions in order to deal with the challenge. Also the adrenal cortex is involved in the hormonal answer to a shift in the homeostasis and release glucocorticoids, which affect the energy and protein metabolism. As a response to the HPA-axis reaction, corticotrophin releasing factor (CRF) is produced and released from the hypothalamus which in turn stimulates the anterior pituitary to secret ACTH in the blood stream (Broom & Johnsson, 1993). Secretion of ACTH stimulates formation of glucocorticoids in the adrenal cortex, which then act as a positive feedback in the blood to hold back additional discharge of ACTH (Axelrod & Reisine, 1984; Broom & Johnsson, 1993). All these physiological reactions can be measured and used to indicate the level of stress the individual is experiencing.

Behaviour

Posture

How an animal hold its body posture is important for social behaviour and can signalize many different things to con-species. When studying behaviour of animals it is important to include the posture and consider what this means. Crowding, i.e. small space allowances, is often perceived as stressful and pigs in such situations have been observed spending a larger proportion of their time sitting or standing without moving (Pearce & Paterson, 1993). This can then indicate increased levels of arousal and agitation. Different housing systems also affect the main posture and behaviour. Pigs reared in large group, deep litter housing systems, i.e. larger space allowances, in general spends more time active; standing or moving around and exploring their environment compared to pigs from a more barren environment (Morrison et al., 2003; 2007).

Vocalisation

It is commonly known that pigs subjected to stressors scream and squeals therefore vocalization is commonly used as a stress and welfare indicator (Schön et al., 2004; Broom, 2007; Düpjan et al., 2008). Standardised stressful situations have been used to identify the structure of stress vocalisations in pigs. The situations tested were immobilisation of piglets by holding them upright at the thorax and keeping them above the floor, immobilisation of growing pigs by forcing them on their backs and immobilisation of sows by using a nose snare. Vocalisations identified as stress-calls were characterised by high numbers of LPC vectors (Schön et al., 2004), meaning that the frequency of the calls were very intense. Weary and Fraser (1995) identified intense vocalisations as indicators of high stress-levels. If the stressor is not anticipated the stress-calls will have an even higher frequency (Düpjan et al., 2008), suggesting that a surprising and not expected aversive situation will result in more intense vocalisations.

Prodding with an electric goad when moving pigs is regarded to be very pain- and stressful. Use of electric goad when driving pigs result in more and longer vocalisations compared to moving with a board and a paddle (Correa, 2010). Piglets that are castrated have a elevated rate of high calls compared to piglets only sham-castrated, castration is painful and therefore high vocalisations is a direct measure of physiological stress (Weary et al., 1998). Pigs are a social species, which can collaborate in defence against a predator. In general social species vocalize more when under distress compared to species lacking active defence (Broom, 2007), probably as warning calls and means to attract the help of other con-species. Also pigs isolated and subjected to an “open field” test, show high levels of arousal, tries to escape and vocalise frequently (Fraser, 1974).

Social tactile interactions and aggression

Rooting and foraging are considered natural behaviours for pigs, and pigs are in general highly motivated to perform such behaviour patterns. In enriched housing or housing outdoors pigs spend a large proportion of their time active; foraging substrates or rooting (Lyons et al., 1995; Beattie et al., 2000; Scott et al., 2006; Morrison et al., 2007). Housing in conventional pens means a small area is provided and the environment is often barren with limited amounts of rooting or foraging substrates available. Under such circumstances pigs often direct their attention towards other pigs in order to find something to manipulate and interact with. Hook-Presto et al. (2008) found that pigs reared

indoors display more manipulative behaviours directed to other pigs, such as sniffing pushing and tail manipulation compared to pigs reared outdoors. Also, other aggressive behaviours and ear manipulating was found to a lower extent in pigs reared outdoors. Pigs in barren environments are more involved in nosing and biting pigs together with other aggressive encounters compared to pigs housed in enriched surroundings (Lyons et al., 1995; Beattie et al., 2000).

For pigs, some level of aggression is normal to develop and maintain social relationships. An agonistic social interaction is often a response to some kind of conflict, like over a resource such as food or simply concerning a certain space in the pen. When feeding sites are situated close together this increases the aggressive encounters and almost all aggressive recordings are in close proximity to the feeding site (Thomsen et al., 2010). Aggressive behaviours are a common response from animals if they are subjected to aversive situations or experiencing some kind of physical or mental fear. Aggressive behaviours are also more frequent in small groups compared to larger groups, and pigs from large social groups often display less aggressive social behaviours (Gonyou, 2001; Samarkone & Gonyou, 2009), this probably because the tolerance is higher for non-familiar individuals.

Excessive attention towards other pigs and more aggressive social behaviours can lead to outbreaks of tail-biting, which is more commonly seen in barren environments compared to enriched (Van de Weerd et al., 2005; Scott et al., 2006). Outbreaks of tail-biting can easily escalate and ultimately lead to cannibalism (Beattie et al., 1995).

Defecation

If a pig is agitated, the body's activated defence-mechanisms leads among other things to increased bowel-movements. Increased bowel-movements cause the feed to pass more rapid and this result in increased defecations. Increased frequency of defecation can be regarded as a sign of arousal (Jones & Nicol, 1998). This is consistent with the findings of Smulders (2006) who found that pigs subjected to a stressor defecated more and had high levels of epinephrine in the blood. Also pigs subjected to an open field test showed positive correlations between squeal vocalisations and frequency of defecation (Fraser, 1974).

Abnormal and unwanted behaviours

Abnormal behaviours, or more commonly called stereotypic behaviours, can be used when assessing the welfare of pigs. Natural behaviours can be regarded as abnormal if performed repeatedly over and over again or not at all. It has been argued that abnormal behaviours are better indicators compared to productivity or general health status measurements, since these can be identified as the primary response to a stressful or challenging environment (Courboulay et al., 2009). Stereotypic behaviour patterns can be identified as a monotone, often repeated behaviour that often lack any purpose at all (Broom, 1991). An animal that is in a situation where it has lost or lacks control over the direct environment, as for example when tethered or in some other way restricted of movement, can display stereotypic behaviour. It is especially displayed in situations perceived as threatening, frustrating or just very low in stimulation. There have been suggestions that stereotypic behaviours actually help animals to cope with a challenging environment via action of analgesic opioids (Cronin et al., 1985, in: Broom, 1991).

Skin lesions

It is common to record damages on the skin or on the carcass as a way to measure welfare in pigs (Broom, 1991). Skin lesions can be assessed and counted both *ante-* and *post mortem* and its frequency can be compared between housing systems or other situations. At the slaughter house, skin lesions are routinely measured on carcasses and damages can lead to deductions on the payment, which makes this an important feature to minimise. Mixing unfamiliar pigs at loading on a transport and a subsequent transportation leads to higher skin lesion frequencies than before (Gade, 2008; Sutherland et al., 2010). Housing on concrete or fully slatted floors, e.g. barren environments, or at high stocking densities cause more body damages from aggressions compared to housing with straw bedding and more space allowance (Lyons et al., 1995; Guy et al., 2002). Also, when comparing

outdoor and indoor pigs, Terlouw et al. (2009) found that indoor pigs fought more and had higher skin damage levels. Group size and space allowances are two other factors that can influence aggression levels and increase skin damage. When increasing the group size, skin lesions increase together with group size (Spoolder et al, 1999), and a low space allowance cause more skin lesions (Turner et al., 2000).

Swedish production systems

In Sweden, the conventional production system is most predominantly used. In total around 2.8 million pigs are slaughtered every year (SJV: JO 48 SM 1102), of these around 20000 are organically reared (EU or KRAV) which is less than 1%. Generally, Swedish conventional pig production is run according to the minimum standards in the legislation. However, this "Swedish concept" has, compared to European standards, much higher demands on animal health, welfare and food safety due to the applied animal welfare legislation. But still, compared to organic rearing, space allowances are lower and there is no demand for outdoor access. Lately, trends together with more widespread consumer awareness have lead to an increased interest in locally produced and organic products. This could result in a higher number of pigs reared in alternative production systems in the future. This will require more knowledge on how rearing system affects slaughter pigs during different stages of the production chain.

Conventional rearing

From birth to slaughter

In Sweden, sows in conventional production are not allowed to routinely be kept fixated or in crates, neither during the dry period nor around farrowing (SJVFS 2010:15). In general dry sows are kept in groups on deep-litter and thereafter moved to a conventional farrowing pen, earliest one week before farrowing. The farrowing pen must have a minimal total floor area of $6m^2$ and straw must be available (SJVFS 2010:15). Piglets are born in this pen and depending on which system the farmer is using they can either stay there from birth until slaughter, stay after weaning (not before 28 days) and then be moved to a finishing pen, or be moved after weaning to a weaning pen and thereafter to a finishing pen. Finishing pens in Sweden often have partially slatted floor, but not fully slatted floors and straw should be available to meet pigs' need for occupation and comfort (SJVFS 2010:15).

Summary of Swedish legislation for keeping of pigs:

- Housing shall be designed to promote natural behaviours.
- Material for rooting shall be available in such amount and structure that pigs' need for occupation and comfort is met.
- Measures:
    - Growers <30 kg (>0.41m^2/animal)
    - Finishers <85 kg (>0.82m^2/animal)
    - Finishers <110 kg (>1.02m^2/animal)
- No roughage or grazing requirement.
- No outdoor requirement.

(From: SFS 1988:534; SFS 1988:539; SJVFS 2010:15)

Organic rearing

EU-organic

Products labelled "EU-organic" is produced and controlled in agreement with "Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91" (EC 834/2007), without being KRAV-certified. The producer must besides the Swedish animal welfare legislation also meet the standards in this regulation. There is no demand on pasture under EU-organic labelling, however the animals must during their whole life have access to an outdoor paddock on concrete (EC 834/2007).

KRAV

KRAV was formed in 1985 in order to develop a credible Swedish labelling of organic foodstuff. KRAV is run as a non-profit, economic co-operative and registered trademark (®). It constitutes of 27 organisations and companies both from producer and consumer origin (KRAV, 2010). In order to acquire the certification producers must besides following the Swedish animal welfare legislation also follow the rules set down by KRAV. The KRAV-rules cover the whole production chain, including soil management, feed-stuff production, animal welfare, housing, management, transport and slaughter. Important features are requirement for outdoor access at all times, pasture during the grazing season and that keeping of animals must be characterised by very high standards of animal welfare (KRAV, 2011).

From birth to slaughter (KRAV)

Sows are kept group-wise in pens with outdoor access, during the grazing season they are held outdoors on pasture. At the time around farrowing the sow can either be kept in a farrowing pen with access to nesting material and a minimum floor space of 7,5m^2, or during pasture season in a farrowing-hut with plenty of nesting material to promote nest building behaviour (KRAV, 2011). After two weeks the sow and piglets must have outdoor access and in connection with this it is common to group a couple of sows and their litters together in larger pens, given that it is not during the grazing season in which the sow and litter are kept on pasture with huts (KRAV, 2011). After weaning (not before 40 days) the piglets are moved to large pens often with deep straw-bedding and kept there until slaughter.

Summary of KRAV-rules for keeping of pigs:

- Respect should be taken concerning animals' different behavioural needs (social, locomotion, flocking etc), feed and housing environment.
- During the grazing season (4 connecting months during the summer period) all animals should be kept on pasture.
- During the indoor season pigs should have access to an outdoor exercise yard.
- Pigs shall have access to substrates and areas (deep-litter) that promotes natural behaviours such as rooting and searching for food.
- Measures:
    - Growers, <30kg (>0.6m^2/animal indoor and >0.4m^2/animal outdoor)
    - Finishers, <85 kg (>1.2 m^2/animal indoor and >0.8m^2/animal outdoor)
    - Finishers, <110 kg (>1.5m^2/animal indoor and >1.0m^2/animal outdoor)
- Free access to roughage.

(From: KRAV, 2011)

The main differences in legislation and rules between organic and conventional production is given in table 1.

Table 1. Summary of main differences between organic and conventional rearing

Issue	Organic (KRAV)	Conventional
Outdoor access	Always outdoor access	No outdoor requirement
Roughage	*Ad libitum* roughage available	No roughage requirement
Pasture	Requirement during grazing season, no space allowances available	No pasture requirement
Housing indoors; space allowances		
Nursing period, per sow and litter	1st two wks: ≥7,5 m2 (indoor pen or a hut on pasture), thereafter group housed ≥7,5 m2 indoor and 2,5 m2 outdoor (not pasture)	Single and loose housed, ≥6,0 m2 indoor
Growers, per pig <30 kg	Loose housed, ≥0,6 m2 indoor and ≥0,4 m2 outdoor	Loose housed, 0,41 m2 indoor
Finishers, per pig <85 kg	Loose housed, ≥1,2 m2 indoor and ≥0,8 m2 outdoor	Loose housed, 0,82 m2
Finishers, per pig <110 kg	Loose housed, ≥1,5 m2 indoor and ≥1,0 m2 outdoor	Loose housed, ≥1,02 m2 indoor

Behavioural differences between housing systems

There are several differences between production systems that can influence how pigs behave. Conventional production systems are more barren compared to organic, although there is some provision of straw. Pigs are very curious and when moved to a new area, pigs immediately start to explore it to see what resources it might hold. In barren environments the new area is soon explored and the pigs might instead direct their attention towards other pigs. Compared to pigs housed in large groups on deep litter, conventionally reared pigs spend a larger amount of time engaged in physical pig interactions, such as anal nosing, nose-to-body, nose-to-nose and pushing (Morrison et al., 2007), and a poor environment results in more manipulative social behaviours directed towards pen-mates (De Jong et al., 1998).

Physical pig-to-pig interactions can result in more aggressive behaviours between pigs and in general, aggression levels are higher in intensively reared pigs compared to pigs raised in enriched surroundings (Cox & Cooper, 2001). Higher levels of aggression can result in more injuries and skin lesions. Outdoor reared pigs engage less in unwanted aggressive behaviours and display more general activity behaviours such as rooting and chewing (Cox & Cooper, 2001). The provision of straw keep pigs more occupied and they spend a large proportion of their time manipulating it (Lyons et al., 1995; Scott et al., 2006; Morrison et al., 2007; Scott et al., 2009b). On the contrary, pigs housed in the absence of straw engage more often in behaviours directed towards other pigs (Lyons et al., 1995; Day et al., 2002; Scott et al., 2006). Pigs housed with much straw also display more playful behaviours such as shoving, running and scampering, compared to pigs housed with no straw (Lyons et al., 1995). Playful behaviours could be an indication of good welfare for pigs, since play is often not displayed unless all other needs are fulfilled.

Differences in space allowances and group sizes can also influence pigs' behaviour. The average level of aggression is lower in large groups of pigs compared to small groups, but the aggression in large groups is often going on for a longer time (Andersen et al., 2004), the larger group and area might results in rivals loosing track of each other. At small space allowances the average numbers of aggressive interactions between pigs in a pen is higher than at larger space allowances and the competition over limited resources such as resting place or feeder space increases (Ewbank & Bryant, 1972; Anil et al., 2007).

Aim of the thesis

The aim with this study was to investigate behaviours related to well-being and stress in finishing pigs during crowding and to investigate if any differences in behaviour can be distinguished between pigs reared in conventional and organic production systems, when crowded in a small area. Moreover, to gain knowledge about differences under practical circumstances, professional transporter's experiences of moving, loading and unloading pigs from different production systems is assessed.

The specific hypothesis set up for this study are:

- When comparing organically reared pigs and conventionally reared pigs during crowding, pigs from organic herds will express behaviours indicating that they have difficulty coping with the crowded situation, such as:
    - vocalisation
    - climbing
    - increased activity behaviours
    - physical pig interactions

- Professional transporters experience organically reared pigs as difficult to handle and agitated during their work.

MATERIAL & METHODS

This thesis includes one field-study and one interview study. The field-study was performed in six commercial slaughter-pig-producing herds, three of the herds were organic (KRAV-certified) and three were managing the pigs according to conventional methods. The field-study includes direct behavioural observations, video-recorded behavioural observations, recordings of skin lesions and measures of pig heart girth. Moreover, the thesis includes a telephone interview with professional pig transporters about the experiences of handling and transporting organically reared and conventionally reared slaughter-pigs.

Organically reared pigs will hereafter be referred to as ´organic pigs´ and conventionally reared pigs referred to as ´conventional pigs´. The expression ´test area´ referrers to the area in the home pen or connecting alley chosen to enclose the pigs during the behavioural observations, the time the pigs were enclosed in the test area and observed is referred to as the ´observation period´. ´Finishing pigs´ or ´finishing-period´ referrers to the last rearing period before slaughter and/or pigs with an average live weight (LW) between 90 – 115 kg.

The study was approved by the Committee for Ethic use of Experimental Animals in Uppsala. Development of the practical method was done during one week at the research farm of SLU at Funbo-Lövsta outside Uppsala, prior to the collection of data in the commercial herds.

Herd contact

With the help from contacts (teachers and researchers) at SLU, six pig-producing herds (three conventional and three organic; KRAV-certified) were identified as herd's suitable to be included in the study. The herds were chosen on the basis of distance to Uppsala (maximum 1.5 hours travelling time, one-way) and on previous contact with SLU (study-visits, participation in earlier research or personal experiences), since the latter was considered positive for the acceptance of participation in the current study. The herd-owners were contacted between January and February 2011 by a letter (appendix 1) explaining about the study and what it would mean to them as herd-owners. Thereafter all the herds were contacted via telephone (approximately one week after the letter had been received) and formally asked if they wished to participate. Five of the six identified herds accepted to participate at the first telephone conversation and the sixth one was excluded since this was a piglet producing herd and consequently had no slaughter pigs (~90 – 115 kg LW). However, from this herd-owner, contact information was received for another herd and this herd owner accepted to participate.

Before the study, all herd-owners were asked to sign a written agreement stating that the participation was voluntary and that they could choose to exit the study at any time (appendix 2). The dates for herd visits were planned for March and early April 2011 and were decided together with the herd-owners. Regards were taken to state of finishing unit, making sure that pigs at slaughter size (>90 kg LW and about six months old) would be available for the study. Also, time between the different herd-visits was taken into account; a minimum of 48 hours was required for bio security reasons.

Herds and animals

The field-study was performed in the six commercial pig-producing herds during the period 14th of March to 4th of April 2011. Each herd was visited once and during that visit as many observations as possible were carried out. In total 161 finishing pigs entered the study, of which 77 were organic and 84 were conventional. Each pig was studied and included only once in the study.

The conventional herds were all larger than the organic herds; producing between 4000 and 7000 pigs for slaughter per year, while the organic herds produced between 800 and 1700 pigs per year. The pigs in the different herds were of two different breed combinations: (Landrace x Yorkshire) x Hampshire ((L x Y) x H) or (Landrace x Yorkshire) x Duroc ((L x Y) x D), and the combinations

were found in both conventional herds as well as in organic herds. Information about the different herds is presented in table 2. More detailed information about the herds and figures of the different test areas is presented in appendix 3 – 8.

Table 2. General information of the participating herds

	Herd					
	A	B	C	D	E	F
Type	conventional (farrow-to-finish)	conventional (farrow-to-finish)	organic (farrow-to finish)	organic (finishing)	conventional (farrow-to-finish)	organic (finishing)
Date of visit	14 March 2011	17 March 2011	21 March 2011	24 March 2011	31 March 2011	4 April 2011
Pigs prod./year	~4000	6500-7000	~1100	~800	~4000	~1700
Breeds	(L x Y) x H	(L x Y) x H	(L x Y) x H (some with D)	(L x Y) x D (some with H)	(L x Y) x D	(L x Y) x D (some with H)
Feed						
Concentrate	automatic wet 4 times daily	automatic dry 3 times daily	*ad libitum** dry outside	*ad libitum** dry inside	automatic wet 5 times daily	automatic wet inside
Roughage	no	no	yes outside *ad libitum*	yes outside *ad libitum*	no	yes outside *ad libitum*
Bedding material	straw (for rooting)	sawdust (for rooting)	straw deep litter	straw deep litter/ natural land	straw (for rooting)	straw deep litter
Test area						
Location	slatted area	slatted area	inside pen deep litter	inside pen concrete floor/ in alley	slatted area	in connecting alley
Size (m²)	2.595	3.138	2.700	2.850/2.568	2.714	2.730
№ observations	6	6	4	4	6	8
Pigs/observation	4 or 5	5	4 or 5	4 or 5	4 or 5	5

** = except the last period before slaughter when concentrate was restricted to ~3 kg/pig/day*

Study design

According to the Swedish Board of Agriculture´s transportation regulation (SJVFS 2010:2, L5), pigs weighing approximately 100 kg should have a minimum floor space of 0.43 m^2, and the maximum weight per m^2 cannot exceed 235 kg/m^2. To investigate behaviour differences in finishing pigs´ immediate response to crowding in a small area, four or five pigs were confined in a small area, corresponding to the space allowances allowed on Swedish slaughter transports. The numbers mentioned above (SJVFS 2010:2, L5), were used as absolute minimum space allowances.

Herd owners were asked at what LW they send their finishers to slaughter and at what stage the pigs in the unit available for the study were. Pen design and area available for setting up the test area varied between herds. The potential test areas was judged and measured, the floor area was calculated and thereafter a decision was taken on how many pigs (four or five) to enclose for each observation period. Before the pigs were enclosed in the test area they were individually marked and skin lesion scores were recorded. The test area was either located in their home pen or in an area in connection to their home pen. Each observation period lasted for 12 minutes, and the pigs were before that given five minutes to acclimatise to the new area. The reason for the relatively short acclimatisation period was that we wanted to monitor their immediate response to crowding in a small area. During the observation period, the group of pigs were continuously monitored for behavioural states and events (defined in table 6) and every second minute they were also scanned for posture and general activity

(table 4 & 5). After each observation period the pigs´ heart girth was measured with a measuring tape and skin lesion scores were recorded a second time. All registrations (behavioural, skin lesions and heart girth) was recorded by the same person and for practical reasons one person accompanied to be of assistance, though it was not the same assistant for all herd visits.

Materials

One or several metallic panels (Figure 1 & 2) in combination with pen walls were used in all the herds to enclose the pigs in the test area.

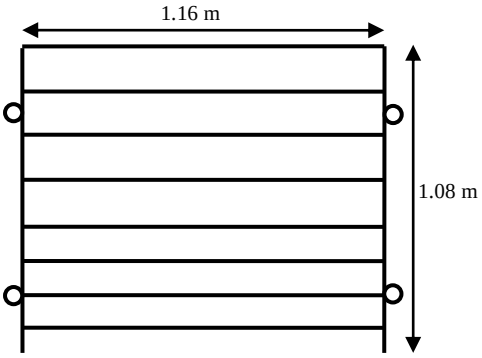

Figure 1. Metallic panel used to enclose pigs in the test area.

Figure 2. Metallic panel with an attached plastic board.

To prevent pigs from lifting the panel upwards, one side was covered with a plastic board measuring 1.20 x 1.00 m (Kolon, IKEA, Sweden), 20 holes were drilled in the board and thereafter plastic stripes were used to attach the board to the panel. This created a somewhat solid side of the panel directed towards the test area and the pigs (Figure 2.). The panels were connected with plastic stripes and/or attached to the fittings of the pen.

To stop transmission of any potential pathogens and limit the contamination between herds, all equipment used like metallic panels, plastic boards, measuring tape, pens, cutters etc. were thoroughly cleaned in water and detergent and thereafter disinfected using 1 %-solution of Virkon®-S (Pharmaxim, Sweden). Disposable materials such as plastic stripes, rubber gloves and bags was used during only one herd-visit and thereafter thrown away. Rubber boots were thoroughly washed with water and detergent and thereafter left in Virkon®-S (1 %-solution) until next herd-visit (>48 hours). Protective clothes were washed in a washing machine (>90° program) between visits. All papers and folders were unique to that particular herd-visit.

Data collection

Individual marking

Before being put in the test area, pigs were individually marked with commercial spray colour (Porcimark mærkespray, Kruuse, Denmark) and also their sex was recorded. The scheme for individual marking is visualised in figure 3 and table 3.

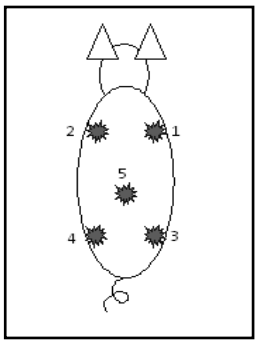

Figure 3. Scheme used for individual marking.

Table 3. Animal number and position for individual marking

Animal number	Sex	Marking
1	F / M	Right shoulder
2	F / M	Left shoulder
3	F / M	Right hind quarter
4	F / M	Left hind quarter
5	F / M	Back

F = Female
M = Male

Behavioural observations

Registration of pigs´ posture and general activity was recorded through instantaneous scan sampling. Every second minute (observation time indicated by a digital stopwatch with sound alert) the pigs were scanned and their posture and activity was recorded according to the etograms in table 4 and 5, respectively. Registration was done on group-level and the number of pigs performing all behaviours was recorded for each scan. The recording sheets used are presented in appendix 11.

Table 4. Etogram for pig posture used during scan sampling

Posture	Definition
Stand	Standing up with three or four hoofs in contact with the floor, pig can be stationary or moving
Sternal	Lying with the belly in full contact with the floor, with front legs directed forward or all legs under the body
Lateral	Lying with the side in full contact with the floor and a minimum of three legs extended from the body
Sit	Sitting in an upright posture, resting on the hind quarters with stretched front legs

Table 5. Etogram for pig general activity used during scan sampling

Activity	Definition
Root	Rooting movements directed towards the floor surface (with or without substrate)
Snout-floor	Snout approaches (<5 cm) or in contact with the floor surface (without rooting)
Snout-furnishing	Snout approaches (<5 cm) or in contact with the furnishing of the test area
Snout-air (nothing)	Snout is "in the air" (no contact with the floor, furnishing or another pig)
Snout-pig	Snout approaches (<5 cm) or in contact with any body part of another pig
Other	None of the above

Registration of behavioural states and events such as social tactile interactions, agonistic interactions and vocalisations was recorded through continuous sampling throughout the observation period. Every display of any of the behaviours visualised in table 6 was recorded as one registration. The recording sheets are found in appendix 12.

Table 6. Etogram of behaviour states and events used during continuous sampling

Behaviour	Definition
Urination	The pig urinates
Defecation	The pig defecates
Snout-genitals	The snout approaches (<5 cm) or in contact with the genitals and/or tail of another pig, without opening of mouth or bites
Snout-body	The snout approaches (<5 cm) or in contact with the body (all parts behind the ears to the tail and genitals) of another pig
Snout-head	The snout approaches (<5 cm) or in contact with the head, snout and/or ears of another pig (without opening of the mouth and/or bite attempts)
Pressure (with body or head)	The pig pressures and pushes the body or head of another pig in attempts to move the other individual
Head-knock	The pig knocks its head towards the body or head of another pig
Lift	The pig pushes its snout and head under the body of another pig and lifts upwards
Vocalisation [0] [1] [2]	The pig vocalises (squeals) loud and intense, 0 = no audible vocalisations, 1 = separable vocalisations, 2 = non separable vocalisations during the whole observation period
Climb	The pig climbs the furnishing of the test area and/or another pig
Mount	The pig places both front legs over the head or body of another pig and performs a mounting movement
Froth	The pig chews intensively and froth is visualised around the mouth
Shivering	The pig shivers in some part of the body
Bite	The pig has its mouth open and bite towards/on another pig.
a) head	Bite towards head (excluding the ears)
b) ears	Bite towards ears.
c) neck	Bite towards neck (the part starting behind the ears to the start of the shoulder)
d) body	Bite towards body (any part behind the shoulder excluding the tail and genitals)
e) tail	Bite toward tail
f) genitals	Bite toward genitals
g) pen	Bite toward the fixtures of the pen/test area
Tail-mouth	The pig has the tail of another pig in its mouth (without biting)
Ear-mouth	The pig has the ear of another pig in its mouth (without biting)
"Buff" other pig	The pig uses its snout and performs "buffing" movements towards any part of another pigs´ body

[0] = no audible vocalisations
[1] = separable vocalisations
[2] = non separable vocalisations

Video recordings

In all herds, 20 % of the observations were randomly chosen and recorded with a digital video-recording camera. The camera was either fitted on a part of the furnishing outside the test area, or when this was not possible the camera was held by the assistant. These films were coded and thereafter analysed by a person that did not visit the farms, and not knowing which herd the film was from. When the films were analysed the same etograms defined in table 4, 5 and 6 was used. The purpose of the video recordings was to serve as quality assurance and the results of the analysis to be compared for correlations with the results of the direct observations. In this way the results from the direct observations could be validated.

Skin lesion recording

Pigs were assessed for skin lesions before and after each observation period. Skin lesions were defined as scratches, cuts, bruising or area of redness on the skin. No consideration was taken to the severity or depth of the lesion. Every visible lesion and its location on the body; head (1), front/middle (2) or hind quarters (3) (figure 4), were recorded according to appendix 9.

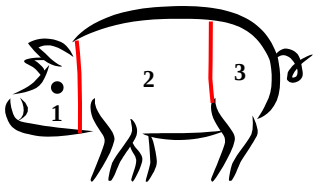

Figure 4. Localisation of regions for skin lesion recording.

Heart girth measure and weight estimation

To estimate the weight of the pigs, their heart girt was measured with a measuring tape behind the front legs. Heart girth was measured after each observation period inside the test area. Heart girth was recorded according to appendix 10. The two equations used to estimate weight from hearth girth were:

Heart girth 71 – 105 cm:

Weight (kg) = 2.47 x heart girth (cm) – 145

Heart girth 106 – 150 cm:

Weight (kg) = 2.99 x heart girth (cm) - 198

(Thingnes et al., 2009)

Statistical analyses

All statistical analyses were performed using the Statistical Analysing System; SAS 9.2 (SAS Institute Inc., Cary, NC). The statistical procedures used were proc MEANS, proc FREQ, proc GLM, proc MIXED and proc CORR. Analyses were done on pig level or group level separately. Residuals of all variables were tested for normal distribution with the procedure UNIVARIATE, considering skewness, kurtosis, Kolmogorov-Smirnov test for normality and a normal probability plot. All analysed variables were found normally distributed or approximately normally distributed.

In the statistical analyses the scan sampling variables ´Root´, ´Snout-floor´ and ´Snout-furnishing´ were pooled together to the variable ´Pen interactions´. The continuous sampling variables ´Bite-head´, ´Bite-ears´ and ´Ear-mouth´ were pooled together to the variable ´Bite-head´. The same was done for the continuous sampling variables ´Bite-neck´, ´Bite-body´, ´Bite-tail´, ´Bite-genitals´ and ´Tail-mouth´ which were pooled together to ´Bite-body´. For the scan sampling analyses the observation ´6 minutes´ is included both in time period ´0-6 minutes´ and ´6-12 minutes´.

For analysis of skin lesions one organic and one conventional herd were included. The reason was that skin lesion scores was not obtained from all organic herds. Several observations in the organic herds were terminated before the observation period was over since the pigs reacted strongly to the crowding-test and there was a high risk of pigs being seriously injured. Herds E and F was chosen for the analysis because the visits to them were close together in time, had equal length of the observation period and that skin lesion scores were obtained from pigs in all the performed observations.

Variation in posture, general activity and behaviour between herd types was analysed on *group level* and the following statistical model was used:

$$y = herd\ type^{f} + herd(herd\ type)^{f} + time\ special(herd\ type)^{f} + m^2/pig^{f.cov.} + e$$

where the fixed effects(f) of herd type had 2 classes (organic and conventional), herd had 6 classes (herd A-F) nested within herd type and time special had 2 classes (6 minutes or 4 minutes) nested within herd type. M^2/animal was included as a fixed continuous covariate(f.cov.) (ranging from 0.519 – 0.678 m^2/pig). Time special explains how many minutes of observation time that were included in that time period (´0-6´ or ´6-12´), this since the observation time varied due to termination of some observations in the organic herds.

Variation in skin lesion scores was analysed on *pig level* and the following statistical model was used:

$$y = herd\ type^{f} + group^{r} + heart\ girth^{f.cov.} + e$$

where the fixed effect(f) of herd type included 2 classes (herd E (conventional) and herd F (organic)), group was included as a random effect(r) (a group is the group of pigs enclosed in the test area for one unique test period) and heart girth as a fixed continuous covariate(f.cov.). The effect of sex was included in the initial statistical model used. Because no significant effects of the animal's sex were found for any of the analysed variables, sex was excluded from the final model. However, heart girth did have significant effect on some of the analysed variables and was therefore included in the final model.

Results for analysed variables are presented as Least Square Means (LS-means). LS-means are the mean values within the group of analysed variables that are adjusted for the different effects included in the statistical model used; they are an estimate of the marginal means for that data-set. The levels of significance presented are:

*** = $p < 0.001$
** = $p < 0.01$
* = $p < 0.05$
† = $p < 0.1$ (tendency to significance)

To investigate correlations between direct observations and video observations (20% of the observations in each herd), Pearson correlations and Spearman rank correlations were estimated using proc CORR.

Interviews

Professional pig transporters were interviewed by telephone to find out about their experiences when working with organically- and conventionally reared pigs, and if they perceive any differences between these with regards to their behaviour and ease to handle.

Interviews can either be qualitative or quantitative. If the goal is to present frequencies, questions can be answered with numbers or a measurable scale; quantitative interviews are more useful (Trost, 2005). For the interviews with professional pig transporter the quantitative technique was chosen, and questions could be answered on a scale ranging from for example ´Much more time consuming´(1) to ´Much less time consuming´(5) or ´Much more difficult´(1) to ´Much less difficult´(5). The questionnaire used for the interviews can be found in appendix 13.

To come in contact with people working as professional pig transporters, three of the major slaughter companies in Sweden were contacted. One of them had contact information to all transporters they hired available on their web-page and the other two were contacted by telephone asking if they would consider forwarding the needed contact information, which they did. After this a list consisting of 14

professional animal transporters was acquired. Contact with the transporters was done by telephone, starting from the first name and ending on the last name on the list. They were all given a short description of the study and thereafter they were asked if they wanted to participate anonymously. If the transporter did not answer they were contacted two more times and if no contact had been accomplished after that they were considered as not participating. Of the 14 transporters on the list, two declined to participate, two did not transport pigs and three did not transport organic pigs. Of the remaining eight, three were regarded as not participating (no contact) and five answered the questionnaire. Telephone contact and interviews was conducted between 19th of May and 25th of May 2011.

RESULTS

All results presented below are based on data collected during the six herd visits and from the performed interviews. Mean and standard deviation for descriptive parameters of all herds and between the two herds included in the statistical analysis of skin lesions and heart girth are presented in table 7.

Table 7. Mean and standard deviation for pen-, test area- and pig parameters of all herds and of the two herds included in the analysis of skin lesion scores

	All herds				Comparison between 2 herds			
	Organic		Conventional		Organic (herd 6)		Conv. (herd 5)	
	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD
Test group level								
Number of animals per pen	16	46.9 ± 11.43	18	7.72 ± 1.93	8	50 ± 0.00	6	7.67 ± 1.86
Test area (m²)	16	2.70 ± 0.07	18	2.82 ± 0.24	8	2.73 ± 0.00	6	2.71 ± 0.00
Animals per observation	16	4.81 ± 0.40	18	4.67 ± 0.49	8	5.00 ± 0.00	6	4.17 ± 0.41
m² per animal (test area)	16	0.56 ± 0.05	18	0.61 ± 0.07	8	0.55 ± 0.00	6	0.66 ± 0.06
Kg/m² (test area)	16	217 ± 7.35	18	203 ± 16.8	8	218 ± 5.32	6	195 ± 19.6
Pig level								
Heart girth (cm)	45	106 ± 3.36	84	107 ± 6.90	40	106 ± 3.37	25	109 ± 5.51
Estimated weight (kg)	45	119 ± 10.1	84	122 ± 19.7	40	119 ± 10.2	25	127 ± 16.0

Behavioural Observations

Results of behavioural observations (scan sampling and continuous sampling) are summarised in table 8 & 9. Scan sampling results are presented as '% of time' performing that behaviour/posture, i.e. proportion of possible observations. Results from the continuous sampling are presented as 'number per pig per minute', i.e. the registered number divided by number of pigs and minutes observed.

Vocalisation

Organic pigs vocalised more compared to conventional pigs (p=0.002, table 8). Vocalisation scores were between 1 and 2 for organic pigs (mean 1.40), meaning that many observations consisted of non separable vocalisations. Non separable vocalisations mean that the observer could not distinguish when one vocalisation began and ended. For conventional pigs the vocalisation score was between 0.5 and 1 (mean 0.67), meaning that more observations consisted of vocalisations that could be separated and counted or that no vocalisations at all were heard. The high incidence of vocalisations among the organic pigs indicates that these had harder to cope with the situation. The difference in vocalisation scores between organic and conventional pigs is illustrated in figure 5.

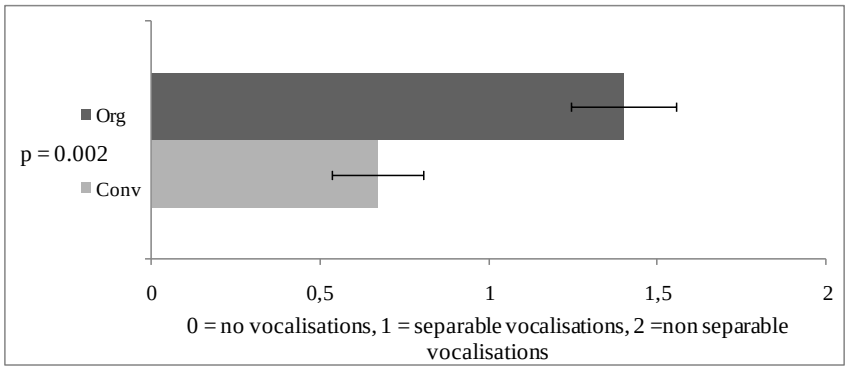

Figure 5. Vocalisation scores of organic and conventional pigs during the time period ´0-6 minutes´. A graded scale is used, ranging from 0 to 2, where 0 is no audible vocalisations and 2 are non separable vocalizations.

Climbing

Organic pigs climbed on other pigs and the walls of the test area more than conventional pigs, climbing can be regarded as an attempt to escape the current situation suggesting that organic pigs regarded the crowding as challenging. During observation period ´0-6 minutes´ organic pigs on average climbed 1.44 times (table 8) while conventional pigs only climbed 0.30 times ($p<0.001$). These findings are supported in the time period ´6-12 minutes´ when organic pigs continued to climb excessively more (0.23 climbs per pig, $p<0.001$) (table 9). Climbing for the conventional pigs did however decline in the second time period (0.05 climbs per pig), and these seemed to have accepted the situation.

Posture

During observation period ´0-6 minutes´ organic pigs were standing 100.0% of time (table 8) and conventional pigs 87.1% of time. Organic pigs remained standing significantly more than conventional pigs ($p=0.004$), suggesting that organic pigs were more active and agitated in the crowded situation. Also, conventional pigs were lying 9.2% of the time ($p=0.009$) while organic pigs did not lie down at all during any of the observation periods (0-6 or 6-12 minutes), which also can be seen as a sign of distress. In observation period ´6-12 minutes´ it was even more common that the conventional pigs lied down (19.5% of time, table 9) compared to the organic pigs (0.00% of time) ($p=0.024$), however the larger variation between organic and conventional pigs in this time period (SE 6.46 and 3.62 respectively) explains the weak significance. The relatively similar findings in time period ´6-12 minutes´ support the findings from time period ´0-6 minutes´.

In a observation in one conventional a pig reacted very strongly to the crowding. As the observer moved the pigs into the test area, the ears, head and front part of the body started to tremble and shake and this continued for about ten minutes of the observation time. During the first 8 minutes it did not move or change position, after this the pig lied down and appeared calmer. When the observer moved into the test area to measure heart girth (after the observation period), this pig again started to tremble and were very reluctant to stand up. First when all other pigs had been measured and released out to the pen it stood up.

General activity

In observation period ´0-6 minutes´ conventional pigs were engaged in some kind of pen interactions during a significantly higher proportion of time (70.1%) compared to organic pigs (55.4% of the time, table 8) ($p=0.030$). This indicates that conventional pigs focused on the changed pen surroundings while organic pigs focused on other behaviours such as vocalisation and climbing, as presented earlier. Accordingly organic pigs spent more time engaged in other behaviours, not interacting with pen fittings ($p=0.030$). General activity for organic and conventional pigs during the time period ´0-6 minutes´ is illustrated in figure 6.

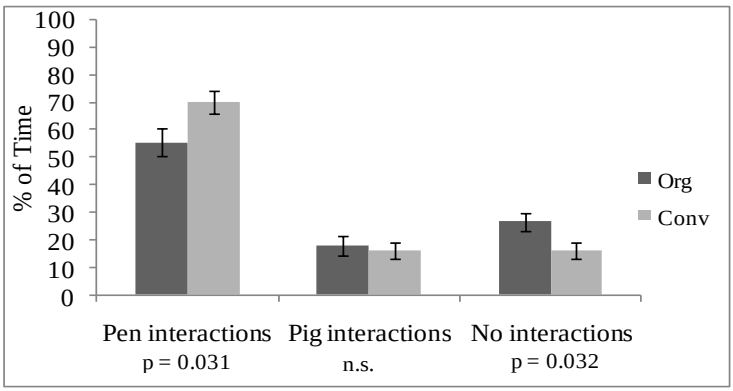

Figure 6. Differences in general activity during the time period ´0-6 minutes´ between organic and conventional pigs.

No significant differences could be distinguished in aggressive pig-pig behaviour, such as head thrusts or bites (table 8 & 9), between organic and conventional pigs in any of the time periods. Differences in behaviour parameters between organic and conventional herds are presented in table 8 (time period ´0-6 minutes´) and 9 (time period ´6-12 minutes´) respectively.

Table 8. Least square mean, standard error and p-value for differences in behaviour parameters between pigs in organic and conventional herds (time period ´0-6 minutes´)

Test group level			0 - 6 minutes			
	Organic		Conventional			
Behaviour	N	LSM ± SE	N	LSM ± SE	p-value	Sign.
Scan sampling (% of time)*						
Stand	16	100.0 ± 3.070	18	87.1 ± 2.601	0.004	**
Lie	16	0.00 ± 2.470	18	9.20 ± 2.093	0.009	**
Sit	16	0.12 ± 1.366	18	3.69 ± 1.160	0.063	†
Pen interaction	16	55.5 ± 4.834	18	70.1 ± 4.100	0.031	*
No interaction	16	26.5 ± 3.420	18	16.1 ± 2.900	0.032	*
Pig interaction	16	17.9 ± 3.392	18	15.9 ± 2.874	0.654	n.s.
Continuous sampling (number per pig/min)						
Defecation	16	0.05 ± 0.015	18	0.04 ± 0.013	0.527	n.s.
Snout-genitals	16	0.11 ± 0.021	18	0.08 ± 0.018	0.265	n.s.
Snout-body	16	0.34 ± 0.033	18	0.13 ± 0.028	<0.001	***
Snout-head	16	0.32 ± 0.029	18	0.18 ± 0.024	0.002	**
Pressure	16	0.25 ± 0.030	18	0.13 ± 0.025	0.006	**
Head thrust	16	0.11 ± 0.030	18	0.11 ± 0.025	0.968	n.s.
Lift	16	0.02 ± 0.012	18	0.04 ± 0.010	0.387	n.s.
Vocalisation[o 1 2]	16	1.40 ± 0.158	18	0.67 ± 0.134	0.002	**
Climb	16	0.24 ± 0.035	18	0.05 ± 0.030	<0.001	***
Bite-head	16	0.08 ± 0.030	18	0.07 ± 0.025	0.790	n.s.
Bite-body	16	0.02 ± 0.013	18	0.02 ± 0.011	0.888	n.s.
Bite-pen	16	0.06 ± 0.021	18	0.11 ± 0.018	0.086	†
Buff	16	0.01 ± 0.009	18	0.01 ± 0.008	0.763	n.s.

** = for the scan sampling, observation ´6 min´ is included in both the ´0-6 minutes´ and ´6-12 minutes´ time periods*

[o] = no audible vocalisations

[1] = separable vocalisations

[2] = non separable vocalisations

Table 9. Least square mean, standard error and p-value for differences in behaviour parameters between pigs in organic and conventional herds (time period ´6-12 minutes´)

Test group level	6 - 12 minutes					
	Organic		Conventional			
Behaviour	N	LSM ± SE	N	LSM ± SE	p-value	Sign
Scan sampling (% of time)*						
Stand	11	100.0 ± 7.690	18	75.0 ± 4.315	0.012	*
Lie	11	0.00 ± 6.459	18	19.5 ± 3.624	0.024	*
Sit	11	0.00 ± 3.500	18	5.25 ± 1.964	0.194	n.s.
Pen interaction	11	58.3 ± 7.200	18	61.8 ± 4.040	0.701	n.s.
No interaction	11	22.4 ± 4.380	18	22.4 ± 2.457	0.999	n.s.
Pig interaction	11	17.1 ± 5.746	18	15.8 ± 3.224	0.859	n.s.
Continuous sampling (number per pig/min)						
Defecation	11	0.03 ± 0.017	18	0.02 ± 0.010	0.948	n.s.
Snout-genitals	11	0.04 ± 0.025	18	0.07 ± 0.014	0.423	n.s.
Snout-body	11	0.20 ± 0.040	18	0.14 ± 0.022	0.221	n.s.
Snout-head	11	0.28 ± 0.036	18	0.19 ± 0.020	0.055	†
Pressure	11	0.22 ± 0.028	18	0.01 ± 0.016	0.002	**
Head thrust	11	0.12 ± 0.037	18	0.11 ± 0.021	0.774	n.s.
Lift	11	0.01 ± 0.021	18	0.05 ± 0.012	0.146	n.s.
Vocalisation$^{0\,1\,2}$	11	1.38 ± 0.309	18	0.50 ± 0.173	0.035	*
Climb	11	0.23 ± 0.032	18	0.05 ± 0.018	<0.001	***
Bite-head	11	0.13 ± 0.049	18	0.08 ± 0.027	0.439	n.s.
Bite-body	11	0.07 ± 0.036	18	0.03 ± 0.020	0.290	n.s.
Bite-pen	11	0.12 ± 0.038	18	0.09 ± 0.021	0.458	n.s.
Buff	11	0.02 ± 0.016	18	0.04 ± 0.009	0.497	n.s.

** = for the scan sampling, observation ´6 min´ is included in both time periods*
^{0} = no audible vocalisations
^{1} = separable vocalisations
^{2} = non separable vocalisations

Social tactile interactions

Social tactile interactions can be considered as all non-aggressive tactile interactions directed towards another pig; like ´snout-to-body´ or ´snout-to-head´. During the time period ´0-6 minutes´ organic pigs were more engaged in interactions directed towards the body of another pig compared to conventional pigs, 2.04 times and 0.78 times respectively (p=0.0001). Differences were also found for interactions toward the head of another pig, 1.92 times for organic pigs and 1.08 times for conventional (p=0.002). Organic pigs also pressed with their body towards another pig more times compared to conventional pigs, 1.50 times and 0.78 times respectively (p=0.006).

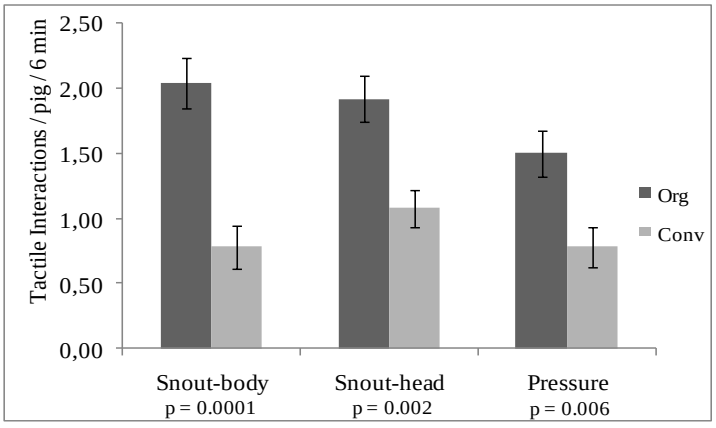

Figure 7. Social tactile interactions (per pig per 6 minutes) during the time period ´0-6 minutes´, difference between organic and conventional pigs.

Manipulating pen fittings

There was a tendency for conventional pigs to chew or bite on the pen fittings more than the organic pigs. Conventional pigs chew 0.66 times in 6 minutes while organic pigs chew 0.36 times during the same period ($p<0.1$). This is consistent with the findings that the conventional pigs also were more engaged in pen interactions (scan sampling), suggesting that the conventional pigs indeed directed more attention towards the new surroundings. During a few conventional observations it was noted that individual pigs in the test area chewed constantly on fittings throughout the observation period. Since the chewing could not be separated into single bites these were recorded as extreme cases and therefore not included in the analysis.

Validation of behavioural observations

Correlations between direct and video recordings are presented in table 10. Posture behaviours all had positive and significant correlations (table 10). For the general activity, all behaviours were positively correlated but non-significant, with the exception of ´Snout-furnishing´ that was negative. The continuous variables ´Climbing´, ´Vocalisation´, ´Lift´ and ´Bite-head´ were positively correlated and significant and these are behaviours easily distinguishable although monitored on a video. Behaviours occurring close to the floor, like ´Urine´ and ´Buff´, had negative and non-significant correlations. These behaviours are probably hidden behind pigs or furnishing and therefore easily missed. The behaviours lacking correlations (´Snout-genitals´, ´Head-thrust´, ´Bite-body´ and ´Bite pen´) had 0 recordings in both direct and video observations and therefore no analyse could be made. However this still means that the recordings was the same and corresponded to each other.

Table 10. Correlations between direct and video recorded behaviour observations

	Correlations		
Behaviour	N	r	p-value
Scan sampling			
Stand	6	0.985	0.0003
Lie	6	0.968	0.0015
Sit	6	1.000	0.0001
Snout-floor	6	0.536	0.2729
Snout-furnishing	6	-0.658	0.1555
Nothing	6	0.667	0.1480
Snout-pig	6	0.652	0.1606
Continuous sampling			
Urine	6	-0.200	0.7040
Defecation	6	0.509	0.3024
Snout-genitals	6	-	-
Snout-body	6	-0.181	0.7320
Snout-head	6	0.517	0.2931
Pressure	6	0.422	0.4049
Head thrust	6	-	-
Lift	6	0.947	0.0041
Vocalisation	6	1.000	0.0001
Climb	6	0.993	0.0001
Bite-head	6	0.949	0.0039
Bite-body	6	-	-
Bite-pen	6	-	-
Buff	6	-0.176	0.7384

Skin lesions

Skin lesion scores on *pig level* were compared between herd F (organic) and herd E (conventional). Conventional pigs hade more skin lesions on the front/middle before (p=0.006) and after the study (p=0.006). After the observation period, conventional pigs also had more skin lesions on their head (p=0.007). However, the overall change in skin lesion count before and after the study only had a tendency to be greater on the head for conventional pigs, 0.23 lesions (p=0.053). Means, standard errors and p-values for skin lesion scores in herd E and F are given in table 11.

Table 11. Least square mean, standard error and p-value for differences in number of skin lesions between herd F (organic) and herd E (conventional)

Test pig level	Comparison between 2 herds					
	Organic (herd F)		Conventional (herd E)			
Number of lesions per pig	N	LSM ± SE	N	LSM ± SE	p-value	Sign.
Before crowding						
Head	40	0.32 ± 0.105	25	0.64 ± 0.134	0.071	†
Front/middle	40	0.36 ± 0.202	25	1.31 ± 0.255	0.006	**
Hind quarters	40	0.45 ± 0.145	25	0.64 ± 0.183	0.424	n.s.
Total	40	1.12 ± 0.369	25	2.63 ± 0.443	0.013	*
After crowding						
Head	40	0.35 ± 0.112	25	0.88 ± 0.143	0.007	**
Front/middle	40	0.64 ± 0.195	25	1.58 ± 0.249	0.006	**
Hind quarters	40	1.06 ± 0.248	25	1.02 ± 0.304	0.923	n.s.
Total	40	2.05 ± 0.399	25	3.50 ± 0.486	0.027	*
Change before-after crowding						
Head	40	0.03 ± 0.063	25	0.23 ± 0.078	0.053	†
Front/middle	40	0.28 ± 0.089	25	0.28 ± 0.114	0.980	n.s.
Hind quarters	40	0.61 ± 0.186	25	0.38 ± 0.231	0.440	n.s.
Total change	40	0.92 ± 0.198	25	0.88 ± 0.246	0.909	n.s.

Conventional pigs had a higher total frequency of skin lesions before the study (p= 0.013) and after the study (p= 0.027) but no difference in total change before and after the study was detected (p= 0.909). This means that the skin lesion scores increased during the study for both conventional and organic pigs but that the change was similar for both types, neither organic or conventional pigs inflicted more skin lesions on other pigs in the test area.

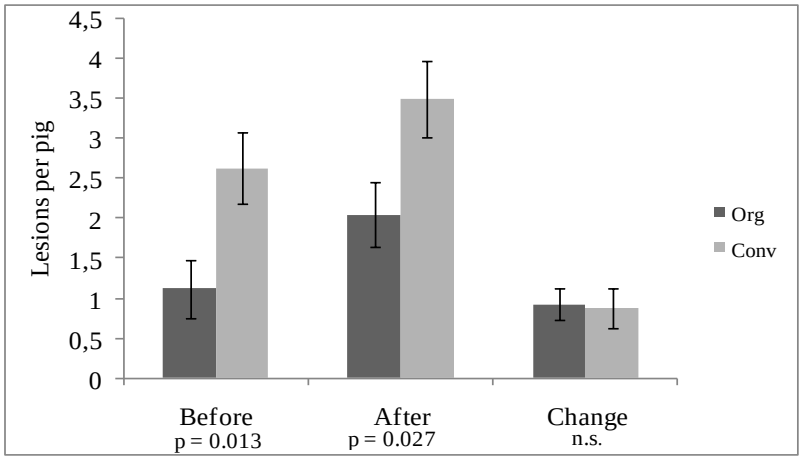

Figure 8.Total skin lesion scores between herd E & F.

In one conventional herd a pig displayed reddish skin discolouration on the head and front part of the body after the study. This pig was tail bitten already before the study and the wound appeared fresh and were bleeding afterwards, suggesting that another pig had been biting during the observation period. In the same herd, and also another conventional herd, it was noted that pigs in several other pens were tail bitten. The tail marks were recorded as skin lesions but the skin discolouration's were noted as an extreme case, and were therefore not included in the statistical analysis.

Interviews

Compiled answers and comments from interviews with professional pig transporters can be found in table 13. The transporters were all very experienced and had worked with transporting pigs for a long time. They did all transport organic pigs but to different extensions, one had only two organic farms that he picked up slaughter pigs from. Concerning the different parts of their work, the loading was considered as the most demanding and difficult, regardless if they were working with organic or conventional pigs. The reason behind this was that loading systems looks very different on different farms. If the design is poor, their work would also be more difficult. One opinion was that it generally was more difficult on organic farms, because the buildings were often not adjusted for pig production and no special systems for loading pigs were available. It was considered as better on conventional farms, especially if they were built during the last 10-20 years, since these had special lairage rooms were pigs was assembled prior to transport and well designed loading facilities. Unloading when arriving at the slaughterhouse was not considered as a problem, all pigs generally went down from the vehicle easily.

The overall opinion about organic pigs was that these were more agitated, active and lively compared to conventional pigs. Organic pigs were also perceived as more "moveable", and this was thought to depend on their rearing, that they were more used to walk and run in different environments and therefore had easier to do this. The opinions on how this increased level of activity and movement affected the ease to handle and load or unload pigs varied. For some transporters this was experienced as more difficult and made their work harder and more demanding, while for some it could also be regarded as positive. If this increased activity and agitation resulted in that pigs were moved and loaded faster, less work was required from the transporter, but on the other hand they also said that it could end up taking very long time if pigs became too stressed. Loading was the one thing that possibly could be easier because organic pigs was perceived to have better physical abilities to manage loading ramps. Two transporters had thought about how pigs reacted once loaded on the transport, and they both found them to be noisier and squeal much more than conventional pigs.

Table 12. Answers and comments from interviews with professional pig transporters about their experiences from working with organic and conventional pigs

Question	Answer	Comment
How long have you been working as a pig transporter?	10-20 years (3/5) >20 years (2/5)	
Do you manage all steps of transport (move pigs, loading/unloading, driving)?	Yes (5/5)	
Which part do you think is most difficult and challenging? Why?	Loading (4/5) Don't know (1/5)	Dependent on the difference in loading systems on farms, if they are poorly designed it is more difficult. New buildings (especially conventional) in general have better systems. It is a new and challenging situation for the pigs.
What do you think about moving organic and conventional pigs?	Organic more difficult (2/5) Organic little easier (2/5) Don't know (1/5)	Organic pigs are more agitated, upset and active. Organic pigs are lively and move around easier, like to walk. Organic pigs are more active and lively, which could be both positive and negative. Positive if they walk quickly where they should and negative the other way around. No experienced difference in time requirement between organic and conventional pigs.
What do you think about loading organic and conventional pigs?	Organic easier to load (2/5) Organic harder to load (1/5) No difference (2/5) Same time requirement (3/5) Less time requirement for organic pigs (2/5)	Move easier and therefore loads easier. More nervous and agitated than conventional pigs. Same as answered "easier to load".
What do you think about unloading organic and conventional pigs?	No difference in difficulty (5/5) No difference in time requirement (5/5)	
How do you perceive the behaviour of organic pigs compared to conventional?	Organic more lively and active (2/5) No difference in behaviour or ease to handle (1/5) Organic more afraid and agitated (1/5) Organic more afraid and agitated (1/5)	No difference to handle (1) More difficult to handle (1) Therefore more difficult to handle Therefore easier to handle
Your thoughts about moving equipment?	No difference between organic and conventional pigs (5/5)	Driving board is always used.
Do you need help by a second person during your work? When?	Rarely (3/5) Often (2/5)	Dependent on the system and design of facilities. Especially on farms, farmers must be better prepared.
Have you noticed any difference once pigs are loaded on the vehicle?	Yes (2/5) No (3/5)	Organic pigs are noisier and squeal more.

DISCUSSION

The aim of this thesis was to obtain knowledge of how finishing pigs reared in organic- and conventional production systems react to crowded situations, similar to slaughter transports. Regardless of which production system slaughter pigs are reared in, the transport to slaughter is done in the same way for pigs from both production systems. The following discussion will firstly consider the main results, followed by a general discussion covering differences between production systems and herds. Thereafter the methods used in the study will be assessed and last the conclusions and suggestions for future studies will be presented.

Behavioural observations

Vocalisation

Organic pigs displayed significantly more and longer vocalisations during the crowded situation in the test area compared to conventional pigs. High frequency vocalisations are generally considered as signs of fear, distress and discomfort (Weary et al., 1998), and thus reflect high stress-levels (Weary & Fraser, 1995; Schön et al., 2004). This suggests that these organic pigs regarded the crowding as challenging and stressful. The main difference between organic and conventional pigs was that the organic pigs seldom were totally quiet, even though not all observations contained high-frequency squeals; many of the organic pigs grumbled and squeaked throughout the observation period. Conventional pigs mainly vocalised if climbed on by another pig, and this was perceived as an attempt to get the other individual to move away or stop climbing. In most cases, the vocalisation was rather short and ended as soon as the other individual moved away.

Social species, as pigs, vocalise more as means of communication than non-social species, especially under distress (Weary et al., 1996; Broom, 2007) and non-predictable stressors will result in vocalisations of higher frequency (Düpjan et al., 2008). The crowded situation during the observation period can be regarded as a novel situation for the pigs, especially for pigs in organic herds which are customised to relatively larger space allowances. Novel situations are strong stressors for most animals (Hemsworth, 2007). However two of the visited herds, both organic, were specialised finishing herds and therefore these pigs had been transported from the piglet producing herd, and thus experienced crowding before. It has been reported that extensively reared animals may behave more fearful during handling and transport procedures compared to more intensively reared animals (Grandin, 1997). It has also been suggested that pigs reared in large groups, deep-litter systems (more extensive) may be less complicated to handle and acclimatize easier to new situations and environments (Morrison et al., 2007). However, with regards to vocalisation, the results from the present study indicate that pigs from the organic herds had more difficulties coping with the crowding compared to conventional pigs.

Climbing

Pigs in the organic herds climbed on the walls and on other pigs in the test area, more than four times as frequent as conventional pigs. The crowding in the test area meant a decreased area per pig and reduced space between pigs, which increase the risk of pigs invading each other's personal space. Pigs in organic herds are reared at larger space allowances and generally in larger groups. Such rearing circumstances allow pigs to move freely around without being forced to enter the personal space of dominant individuals (Gonyou, 2001; Rodenburg & Koene, 2007). Thus, in organic herds the social hierarchy is possibly maintained with threat displays and avoidance behaviour; meaning little physical aggression. Numerous previous findings (Beattie et al., 1995; Cox & Cooper, 2001; Gonyou, 2001; Samarkone & Gonyou, 2009; Terlouw et al., 2009), reports that enriched pigs in large social groups seldom display aggressive social behaviours. The lower aggression levels can possibly depend upon a higher level of tolerance for unknown individuals (Gonyou, 2001; Samarkone & Gonyou, 2009). The intense climbing displayed by pigs in the organic herds can consequently be regarded as avoidance behaviour; trying to escape a dominant individual, an attempt to maintain a comfortable social spacing

or simply an attempt to escape the current situation. Also, several of the observations in organic herds were terminated prematurely since the pigs climbed so intensively on the walls that there were a substantial risk of pigs being seriously injured. This is yet a sign that the organic pigs had more difficulties coping with the crowding than conventional pigs.

Posture and general activity

Organic pigs remained standing and active throughout the observation periods, which can be regarded as a sign of distress. Conventional pigs often lied down and therefore appeared calmer. However, some extreme cases of strong reactions were noted among the conventional pigs, like one pig that displayed muscle trembles and became immobile during the crowding. It appears as this individual pig had extreme difficulties coping with the test situation, i.e. human handling and crowding.

Pearce & Paterson (1993) investigated how pigs responded to crowding during rearing. The findings were that crowding cause pigs to spend more time sitting and standing, with no apparent occupation. In the current study the immediate response to crowding was investigated (the first 0-12 minutes), but the behavioural response had some similarities. Pigs from organic herds were found to keep standing, had little interactions with pen fittings and more recordings of ´No interactions´ compared to conventional pigs. Pigs in conventional herds often lied down and therefore appeared to be calmer and cope better with the crowding.

Social tactile interactions

This study found that pigs in the organic herds were significantly more engaged in pig-pig interactions during the observation periods, compared to conventional pigs. Pigs housed enriched, like organic pigs, normally spend a lot of time active, rooting and foraging substrates (Lyons et al., 1995; Beattie et al., 2000; Scott et al., 2006; Morrison et al., 2007). Pigs in the organic herds might therefore have found the test area so barren that attention instead was directed towards other pigs, thus increasing the occurrence of tactile interactions. Pigs in barren environments display more attention and direct interactions toward other pigs (De Jong at al., 1998; Morrison et al., 2007; Høøk-Presto et al., 2008), compared to pigs in enriched environments. Tactile interactions are not necessarily associated with aggression. In the present study, no difference in occurrence of aggressive behaviour could be distinguished between types; therefore the higher level of tactile interactions among pigs in the organic herds cannot be explained by higher levels of aggression. Although small space allowances and barren environments can increase the number of aggressive interactions between pigs (Cox & Cooper, 2001; Anil et al., 2007), the pigs in the present study were studied temporarily and in most other studies aggressive behaviours have been studied over long time periods.

The increased incidence of pressure with the body for organic pigs can be explained partly by the increased level of activity for pigs in organic herds. These pigs remained standing to a larger extent than conventional pigs and therefore probably also moved around more during the observation periods. As the test area was small and the pigs were crowded, the incidence of pressure with the body may have increased when pigs tried to shift position in the test area.

In the posture and general activity recordings, no difference could be established for ´pig interactions´ and average level of such interactions was low for both pigs in organic and conventional herds. However, in the continuous sampling there were differences between types regarding social tactile interactions. Pig-pig interactions are in general brief and therefore easily missed during scan sampling (Martin & Bateson, 2007). This type of recording is based on snapshots at regular time intervals and thus renders an overview of the overall posture and activity over the whole observation period.

Manipulating pen fittings

Conventional pigs displayed more interactions and bites directed towards the fittings of the pen (test area), compared to organic pigs. Also, among the observations in conventional herds, extreme cases of biting pen fittings were noted; such as pigs continuously chewing on the pen throughout the observation period. Such repeated and monotone behaviours often lacking purpose and observed over longer periods have been recognised as stereotypic behaviour patterns (Broom, 1991). Pigs in conventional herds are more customised to small space allowances and barren surroundings compared to organic pigs, which could suggest that these would better adapt to crowded circumstances. However, the results imply otherwise as no extreme cases of bites or interactions directed towards the test area were noted among the organic observations. Situations where the animal lose control over its surroundings, like when movement is restricted, can result in stereotypes, and such behaviours have been identified as the primary response to a distressful or demanding situation (Courboulay et al., 2009). It has also been suggested that performing stereotypes helps the animal to cope with a challenging environment (Cronin et al., 1985, in: Broom, 1991). Perhaps conventional pigs already have developed a lower threshold for display of stereotypes and when being more crowded than usual this was expressed as a coping strategy.

Validation of behavioural observations

Video recordings were done to validate the results from the direct observations; the person performing the direct recordings knew what type of herd that was observed, which could possibly bias the results. There are many positive aspects of analysing behaviour by means of video recordings, for example the video can be analysed several times and in different ways, or played very slowly to analyse behaviours in detail (Martin & Bateson, 2007).

The association between direct and video recordings found in the correlation analysis varied depending on type of behaviour that was analysed. Postures (scan) had highly positive and significant correlations, such behaviours are easily identified and the whole pig need not be visible during recording. General activity behaviours (scan) were all positive but non-significant, except ´Snout-furnishing´ that was negatively correlated. One reason for this discrepancy could be the possibility of more exact time recording when analysing the videos. During direct observations a digital clock with sound alert was used, however time cannot be "freezed" as it can be paused when analysing video. Although the time was set to every second minute, the actual scan probably took a few seconds for postures and a few more for general activity, meaning that there was some time shift between direct and video recordings. During these seconds the pigs may have changed position and behaviour.

The correlation analysis of the continuous observations displayed large variations. For the behaviours ´Lift´, ´Vocalisation´, ´Climb´ and ´Bite-head´ the correlations were strongly significant and all had correlations close to 1. These are behaviours that are easily visualised independent of what type of observations that is used, for example you do not need to see the whole pig to be able to observe that it is climbing. The behaviours that were negatively correlated, ´Urine´, ´Snout-body´ and ´Buff´, are behaviours seen close to the floor. These can be missed during video analyses since pigs may have been hidden behind a wall or other furnishing, when performing direct observations you can shift your body to see the whole test area and all pigs.

It was difficult to standardise video recordings during the field visits. In the conventional herds the slatted area in the finishing pens were used as test area and the ability to film were depending on if any fittings were available for attachment of the camera. It was not possible to attach the camera in any of the organic herds, it had to be held by the assistant and this resulted in shaky recordings. Best possible result would probably been achieved if he camera could have been fitted in the roof above the test area, however some behaviours directed towards the floor could still have been missed. The practical difficulties to video record could be the reason for the large variation in correlations between direct and video recordings.

Skin lesions

Analysis of skin lesions was done on data from two herds as several observations in organic herds were terminated in advance, and therefore skin lesion scores were not obtained from all pigs entering the study. The two herds were chosen since they were close together in time, had equal length of observation periods and because skin lesion scores were obtained from pigs in all the performed observations.

Pig in the conventional herd had significantly more total skin lesions before the study compared to pigs in the organic herd, suggesting that aggressions is more common in conventional housing systems. Conventional pigs are housed on smaller areas and at higher stocking densities than organic pigs. At small space allowances, low ranked pigs cannot escape dominant individuals, which can result in more aggressive encounters like bites and fights, which in turn cause more skin damage on pigs. Pigs in barren environments is more involved in nosing and biting compared to pigs in enriched environments (Lyons et al., 1995 and Beattie et al., 2000) and consequently skin damage is more commonly seen in such environments, at high stocking densities or small space allowances (Lyons et al., 1995; Turner et al., 2000; Guy et al., 2002). Together this could possibly explain the initially higher skin lesion scores on conventional pigs in this study. Pigs in organic herds are housed enriched, in larger groups, at larger space allowances and have outdoor access, meaning that their environment is more varied and enriched. Several studies demonstrate that such housing has proved to reduce aggressive behaviour (Lyons et al., 1995; Beattie et al., 2000; Høøk-Presto et al., 2008; Terlouw et al., 2009) and this could explain the lower average level of skin lesions on organic pigs before the study.

The frequency of skin lesion scores was higher after the study for both organic and conventional pigs, implying that the level of aggression did increase during the crowding. This is in agreement with previous findings (Turner et al., 2000) reporting that small space allowances can cause more skin lesions. No difference in change of total skin lesion scores before and after the study was detected between types and therefore no conclusion can be drawn about the difference in aggressiveness between conventional and organic pigs in a crowded situation.

Interviews

When asking the transporters if they wanted to answer some questions about their experiences of working with pigs from organic and conventional herds, it was perceived as if they had not given it a lot of thought before, and that they did not regard it as a big problem. But once the questions got more specific some of them had experienced some differences but not to that extent that it was considered as a big problem.

Loading was regarded as the most difficult procedure for all the interviewed transporters, regardless of which production system pigs were reared in. This opinion is consistent with findings in the literature (Van Putten & Elshof, 1978; Brown et al., 2005), reporting that pigs are harder to load than to unload, and that loading can take a longer time compared to unloading. The interviewed transporters also said that the possibility to load pigs easily was largely dependent on how well planned the loading facilities were. If layout of the facilities was good, work was easier and they also thought it was easier for the pigs to handle since they then walked readily and did not get upset. It was noted that organic producers were generally considered to have worse loading facilities compared to conventional producers. These thoughts are consistent with the experiences during the field visits in this study. The organic farms had older buildings, which had often been used to something else and afterwards adjusted to fit organic pig production. Emphasis had then been put on good housing facilities and to a less extent on areas for loading of pigs. The conventional farms were more adapted, and had well planned areas where the transport vehicle can back up and lower the loading ramp in. However, the transporters had also experienced a large variation between farm's loading facilities and surprisingly this had to do with geography. One transporter had earlier worked in the middle part of Sweden and there the loading worked very well in collaboration with the producers, pigs were assembled in advance, someone from the farm was available to help and the loading facilities was

well planned. Nowadays this transporter was working in the southern parts and he regarded it as much worse there; the pigs were seldom ready in advance and he often had to go inside the buildings to collect them.

The interviewed transporters had experienced organic pigs as more agitated, active and lively, and therefore more 'moveable'. Thus, increased level of activity and locomotion could be both positive and negative with respect to transport situations. If facilities are well designed and transporters use their experience and equipment well, this could result in pigs being easier to load and thus requiring less time. Since organic pigs are more used to move around it could imply that these for example find a loading ramp less physically demanding and manage it much easier compared to conventional pigs. The result would then be that organic pigs are less exhausted once on the vehicle and may therefore have easier to handle a otherwise physically challenging transport. De Jong et al. (2000) and Barton Gade (2008) reports that conventionally reared pigs reacts stronger and are more aggressive during transport and pre-slaughter handling compared to pigs reared outdoor or enriched, implying that organically reared pigs do cope with challenging situations better. Two of the transporters had noticed that organic pigs were very noisy and squealed a lot once loaded on the transport, this is consistent with the findings in the present study and could indicate that organic pigs may find crowding on a transport more challenging than conventional pigs do.

General discussion

Herds and production systems

This study was conducted in six commercial slaughter pig producing herds in the middle part of Sweden. Three of the herds were organic (KRAV-certified) and three was rearing their pigs according to conventional methods and this is the main and largest difference between the six herds. Since they are commercial herds, the environment and surroundings does not look exactly the same in any of the herds, either for the three conventional herds or for the three organic herds. The three conventional herds were the ones that were most comparable, as for example all were farrow-to-finish farms.

One of the conventional herds can be regarded as having an extra enriched rearing compared to the others; sows were kept group-wise with their litters in large deep litter pens (as in organic herds). The piglets stayed in these large deep litter pens after weaning until approximately 30 kg of live weight when they were moved to the finishing unit. Therefore the finishing pigs in this herd might have been used to larger space allowances and a more enriched environment which may have had an impact on their response to the crowding in the test area.

In two conventional herds it was noted that pigs in several pens were tail bitten before the study. Tail biting is more often seen in barren housing environments (Van de Weerd et al., 2005; Scott et al., 2006), conventional housing can be regarded as more barren compared to organic so therefore these findings were not surprising. In the herd were tail biting was more commonly noted, the layout of the finishing pens were completely "open", meaning that no division between areas was available and consequently no possibility to hide from another individual. Also, different genetic material was also used among the conventional herds, the herd with more notes of tail bitten pigs the finishers were (L x Y) x D crosses. Suggestions have been made that Duroc pigs are more active and more engaged in harmful social behaviours (Breuer et al., 2003).

Methods

The main factor limiting this study was the time available. By increasing the time several things could have been improved. More herds could have been contacted and visited before being included in the study, meaning that a harder selection could have been done to minimise differences between herds with the same production system. Also the area available as test area should have been assessed beforehand, this to reduce the variation in shape and size. More time could also have meant the possibility to construct equal test areas for all the herds, with the same material, size and shape. If

several herds could have been incorporated this would mean more observations and animals included in the study, which would increase the reliability of the results. To even more improve the results, same assistant should have been helping both during the development of the method and during the field visits, then all procedures done would be performed in the same way and hence be more standardised.

The practically most difficult issue, with regards to this study, were the pen layout in the organic herds. The pens in the organic herds were large with deep-litter straw bedding, and no available furnishing to attach the test area to. Resulting in those pigs could easily root in the bedding and lift the panels upwards and since these were also poorly attached pigs easily broke out of the test area.

CONCLUSIONS

In the present study organically reared pigs' immediate response to crowding was increased vocalisation, more climbing and a higher level of activity compared to pigs reared conventionally. Collectively this indicates that pigs reared in organic herds have more difficulties coping with crowded situations than pigs reared in conventional herds. Interviewed pig transporters regarded pigs from organic herds more active and agitated during handling and transport procedures compared to pigs from conventional herds.

Practical implications

- Organic pig producers could "train" their pigs to crowding by for example put them together on a small area when performing routine procedures such as weighing. This not only customises the pigs to crowding, the producer will have easier to move one pig at a time into the scale if they all pigs are assembled on a limited area.

- The increased levels of social tactile interactions among organic pigs during crowding found in the current study could imply that these might find some consolation from their con-species in challenging situations. This stress the importance of avoiding mixing pigs from social groups on slaughter transports, not only to minimise aggressions but also to give the pigs' some social comfort.

- Poor design of loading facilities was stressed by the interviewed pig transporters as the main cause of difficulties during loading. Producers can develop and improve the on-farm loading facilities to ensure that handling and loading prior to the transport run efficiently.

Future research

- Investigate when an area can be considered as too crowded for organically reared pigs, and if there exists something as "optimal crowding"; i.e. the most crowding organically reared pigs can cope with. By comparing certain space allowances with approximately the same procedures as in the current study and the pigs' response (behaviour and physiology) to these, possibly some conclusions can be drawn about which space allowances to recommend for organically reared pigs on slaughter transports.

- Study if some kind of enrichment (straw, toys etc) can have a positive impact on organically reared pigs' abilities to cope with crowding.

- Thoroughly research how handling and pre-slaughter transports could have an impact on the well-being of pigs reared in organic herds compared to conventional herds. This should focus on responses (behaviour and physiology) during slaughter transports and pre-slaughter handling together with quality measurements on meat post-slaughter. This is important to guarantee the best possible welfare for organically reared pigs, maintain the standards of organic pig production and to ensure an end product of high quality.

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APPENDIX 1

SLU
Sveriges lantbruksuniversitet

Uppsala 2011-02-16

Hej!

Jag heter Karolina Thorell och läser mitt femte och sista år till husdjursagronom vid Sveriges Lantbruksuniversitet i Uppsala. Jag har precis påbörjat mitt examensarbete i husdjursvetenskap och det är med anledning av det som jag kontaktar dig. Jag skulle vilja be om att din gård medverkar i min studie samt att jag får använda din besättning för att samla in uppgifter som jag behöver för att genomföra mitt examensarbete.

Syftet med mitt examensarbete är att försöka utreda om det finns några skillnader i beteenden hos grisar uppfödda i olika produktionssystem när de föses samman på en liten yta, motsvarande uppsamling och transport till slakteri. Det finns indikatorer på att grisens vistelsemiljö de sista timmarna innan slakt kan påverka både dess välbefinnande och kvalitén på köttet. Det finns inga tidigare studier av hur grisarnas beteende påverkas av vilket produktionssystem de fötts upp i, vilket gör detta till en pilotstudie på området.

Försöket kommer endast innehålla beteendestudier, det vill säga att jag vill observera grisarnas beteende. Praktiskt innebär detta att 3-4 grisar från varje box skulle fösas ihop i ett hörn av sin box med hjälp av grindar och därefter studeras i 30 minuter. Djuren som medverkar behöver inte flyttas från sin box eller genomgå någon annan avvikande behandling (blodprov, hjärtfrekvensmätare etc.). Arbetet genomförs i samförstånd med min handledare Anna Wallenbeck (Institutionen för Husdjursgenetik, SLU). Utöver de praktiska momenten kommer examensarbetet även omfatta resultat från intervjuer med gristransportörer om dess erfarenheter att transportera grisar från olika produktionssystem.

Jag kontaktar Dig via telefon inom en vecka efter att du mottagit det här brevet. Då kan jag berätta mer om min studie och svara på de eventuella frågor du har. Skulle du bestämma dig för att medverka i min studie så hoppas jag att vi även kan boka in tid för mitt gårdsbesök när vi pratas vid. Har du några frågor eller undringar så tveka inte att kontakta mig.

Med Vänliga Hälsningar

Karolina Thorell
Husdjursagronom -06

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APPENDIX 2

SLU
Sveriges lantbruksuniversitet

Institutionen för Husdjursgenetik
Undervisningsplan 4A
Box 7023
750 07 Uppsala

Djurägarmedgivande

"Transport av grisar - Pilotstudie av stressbeteende hos ekologiskt och konventionellt uppfödda grisar i trånga utrymmen."

Bakgrund
Kunskapen om hur olika uppfödningssystem påverkar grisars beteende vid olika situationer av produktionskedjan är begränsad. Oavsett produktions system så transporteras merparten av alla grisar innan slakt till ett slakteri. Transport av grisar kan vara ett välfärdsproblem, eftersom grisar lätt stressas i okända och krävande situationer. Innan och under transport till slakteriet, samt i slakteriets uppstallning i väntan på slakt föses grisar ihop på en relativt liten yta. Grisar från ekologiska system skulle kunna påverkas mer av detta eftersom de har haft en större vistelse yta per individ under uppfödningen och därmed möjlighet att hålla större avstånd till andra grisar. Stressande och krävande omständigheter timmarna innan slakt kan inte bara påverka slutproduktens kvalité utan också sänka grisarnas välfärd, för att minimera denna påverkan är en ökad kunskap viktigt.

Syfte
Genom att studera ekologiskt och konventionellt uppfödda grisars beteende när de föses samman på en liten yta kan eventuella skillnader i beteenden relaterade till stress urskiljas. Om resultaten av denna pilotstudie tyder på att det finns skillnader i hur grisar från olika produktionssystem påverkas vid trånga utrymmen, skulle det eventuellt kunna leda till en större och mer omfattande studie. En sådan studie skulle kunna innehålla studier av fysiologi och beteende innan, under och efter transport samt skador på slaktkroppar och köttkvalitet efter slakt, vilket skulle ge en bättre helhetsbild av situationen.

Vad innebär studien för dig och dina grisar?
Under beteendestudierna föses 3-4 grisar åt gången från samma box ihop på en liten yta med hjälp av täckta grindar. Det området som grisarna då har till sitt förfogande ska motsvara förhållanden på en djurtransportbil. Grisar som väger runt 100 kg ska ha minst 0,43 m² per djur, dock högst 235 kg per m² (från SJV:s transportbestämmelser). För att uppskatta grisarnas storlek mäts bröstomfånget eftersom det finns ett bevisat samband mellan vikt och bröstomfång. Efter hopfösning får grisarna en acklimatiseringsperiod och därefter startar beteendestudierna för att pågå de följande 30 minuterna. Denna procedur upprepas därefter i alla boxar som finns tillgängliga, varje gris studeras dock endast en gång.

Som djurägare krävs ej att du deltar eller lägger ner någon tid och arbete under pågående beteendestudier. Om grisarna reagerar mycket negativt på sammanfösningen och orsakar djupa sår på varandra eller utför sådana beteenden som skulle kunna leda till en akut skador på ben och leder (till exempel intensiv klättring på väggar och grindar eller andra individer) så kommer försöket avbrytas. Eftersom aggressiva beteenden är en av de viktigaste parametrarna som studeras så kommer aggressivt beteende och lindrigare skador i form av t.ex. rivsår att tolereras under sammanfösningen.

Kontaktuppgifter till projektansvariga

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Tele: 0733-252338

Handledare:
Anna Wallenbeck
anna.wallenbeck@hgen.slu.se
Tele: 018-672304

Djurägarmedgivande

Jag har tagit del av ovanstående information samt fått muntlig information om studien "Transport av grisar - Pilotstudie av stressbeteende hos ekologiskt och konventionellt uppfödda grisar i trånga utrymmen".
Härmed godkänner jag att mina grisar deltar i studien. Jag är införstådd med att deltagandet är frivilligt och att jag när som helst kan ta mina grisar ur studien.

_____

_____

_____
Djurägarens namn, adress och telefon

_____
Ort, datum

_____
Namnunderskrift djurägare

_____
Namnförtydligande

APPENDIX 3

Herd A

Herd A was visited on the 14th of March 2011 and is a conventional farrowing-to-finish herd producing around 4000 pigs for slaughter per year. The finishing pigs used in this study were three breed crosses of (Landrace x Yorkshire) x Hampshire. In the finishing unit where this study was performed, wet-feed is given automatically 4 times daily and straw is provided as bedding material. The unit contained 33 finishing pens and 2 extra pens (used for injured or sick pigs). 330 pigs were moved into the unit on the 13th of January 2011 with an average weight of 34.7 kg. Slaughter of the pigs in the unit was planned for the 14th of April 2011 but some animals had grown fast and had been sent to slaughter on the day of the visit.

The test area was set up in the slatted area of the pen (Figure X.). One metallic panel covered with a plastic board was used to enclose the slatted area from the rest of the pen. The slatted surface measured 1.73 x 1.50 m, giving the test area 2.595 m^2.

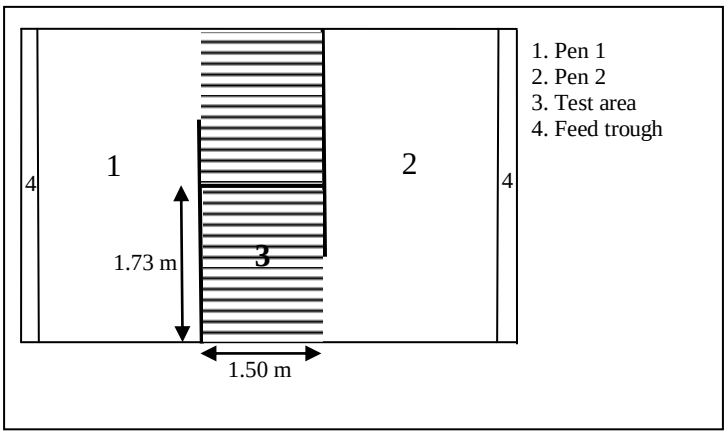


Figure X. Two pens and test area of Herd A.

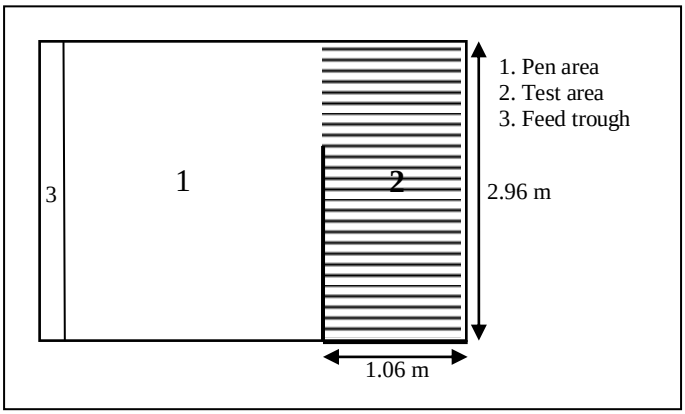
In Herd A six observations were performed, five of them consisted of five pigs and one of four. In one observation session the pigs were assessed as very big and therefore only four pigs were used in order to not exceed the space and weight limitations.

APPENDIX 4

Herd B

Herd B was visited on the 17th of March 2011 and is a conventional farrowing-to-finish herd producing between 6500 and 7000 pigs for slaughter per year. The finishing pigs used in this study were three breed crosses of (Landrace x Yorkshire) x Hampshire. In the finishing unit where this study was performed, dry feed is given automatically three times daily and sawdust is provided as bedding material. The unit contained 40 finishing pens and 8 extra pens (used for injured or sick pigs). 361 pigs were moved into the unit on the 15th of December 2010 with an average weight between 25 and 30 kg. Slaughter of the pigs in the unit had been started and some of the pens were empty and number of pigs per pen varied.

The test area was set up in the slatted area of the pen (Figure X.), one metallic panel covered with a plastic board was used to enclose the slatted area from the rest of the pen. The wall separating the slatted surface from the rest of the area was so low that pigs could jump over it; therefore two wooden driving boards available in the unit were connected with plastic stripes (Figure X.) and put up as a solid side to the test area. The slatted surface measured 2.96 x 1.06 m, giving the test area 3.138 m^2.



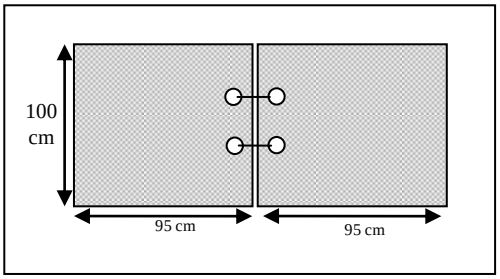


Figure X. Pen and test area of Herd B.

Figure X. Driving boards connected to create a solid side.

In Herd B six observations were performed, all consisted of five pigs.

APPENDIX 5

Herd C

Herd C was visited on the 21st of March and is an organic (KRAV-certified) farrowing-to-finish herd producing around 1100 pigs for slaughter per year. The finishing pigs used in this study were three breed crosses of (Landrace x Yorkshire) x Hampshire; however there were also some crosses with Duroc instead of Hampshire. The finishing pigs were housed in large deep-litter pens with access to an outdoor concrete platform. Concentrate feed and roughage were available on the outside platform. Except for the last period before slaughter when the concentrate was restricted to about 3 kg/pig, feed were given *ad libitum*. Pigs were housed in the same pen from a couple of weeks after farrowing until finished for slaughter. The main part of the pigs in the pens was finished and some had been sent to slaughter.

Two pens in the herd were used for this study, Pen 1 with 45 pigs and Pen 2 with 20 pigs (picture X). There were no slatted areas inside the pen available to set up as test area so one corner of the pen was used. Three metallic panels were put up, giving the test area 2.700 m^2.

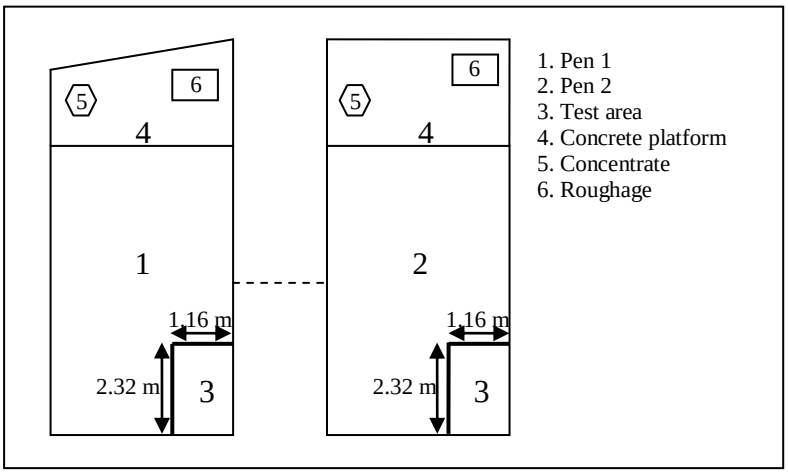


Figure X. Pens and test areas of Herd C.

The walls of the pen were of solid wood and there were no furnishing available to attach the panels, due to this the construction was not stable. The pigs could root around in the straw and therefore lift the panels upwards with their snout alternatively push through the gap between the pen walls and the metallic panelss. These practical problems led to only four performed observations with four or five animals in Herd C.

APPENDIX 6

Herd D

Herd D was visited on the 24st of March and is an organic (KRAV-certified) finishing herd producing around 800 pigs for slaughter per year. The finishing pigs used in this study were three breed crosses of (Landrace x Yorkshire) x Duroc, however there were also some crosses with Hampshire instead of Duroc. The finishing pigs were bought from a piglet producing herd at 25 – 30 kg live weight and moved into the finishing pens. The pigs were housed in large, deep-litter pens with access to an outdoor area partly concreted and partly natural land. Concentrate feed was given inside via an automatic feed system and roughage was given outside on the concrete platform. Except for the last period before slaughter when concentrate was restricted, feed was given *ad libitum*.

Two pens in the herd were used for this study, Pen 1 with 6 pigs and Pen 2 with 50 pigs (Figure X.). In Pen 1, one metallic panel and one wooden board (2.31 x 1.30 m) that was available on the farm was used to set up the test area in a corner with solid concrete floor, giving the test area 2.850 m^2. In Pen 2, pigs were moved out in the connecting alley and here the test area was set up using two metallic panels, giving the test area 2.568 m^2.

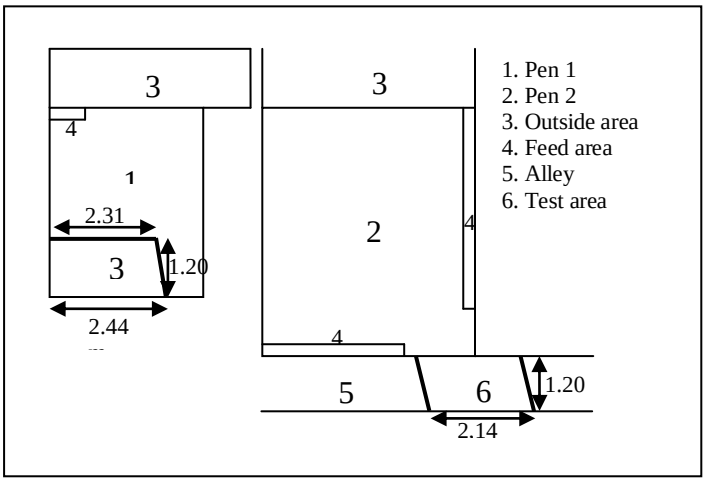


Figure X. Pens and test areas of Herd D.

In Herd D, four observations were performed, two consisting of four pigs and two of five pigs.

APPENDIX 7

Herd E

Herd E was visited on the 31st of March 2011 and is a conventional farrowing-to-finish herd producing around 4000 pigs for slaughter per year. The finishing pigs used in this study were three breed crosses of (Landrace x Yorkshire) x Duroc. In the finishing unit where this study was performed, wet feed is given automatically five times daily and straw is provided as bedding material. The unit contained 30 finishing pens and two extra pens (used for injured or sick pigs). 319 pigs were moved into the unit on the 25th of January. Slaughter of the unit had been started and the number of animals per pen varied.

The test area was set up in the slatted area of the pen (Figure X). Two metallic panels covered with a plastic board were used to enclose the slatted area from the rest of the pen. The slatted surface measured 2.12 x 1.28 m, giving the test area 2.7136 m^2.

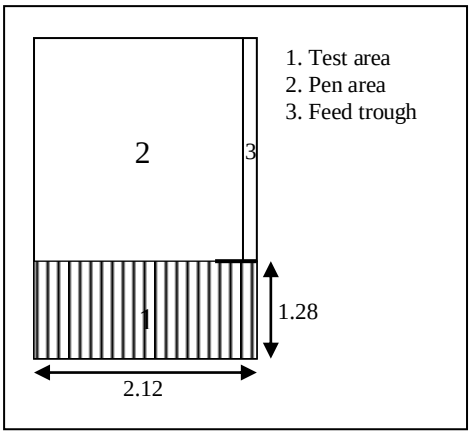


Figure X. Pen and test area of Herd E.

The opening to the pen's slatted area was as wide as the pen and when the opening was made narrower with one metallic panel pigs were reluctant to enter the area. In Herd E, six observations were performed, five consisting of four pigs and one of five pigs.

APPENDIX 8

Herd F

Herd F was visited in the 4th of April 2011 and is an organic (KRAV-certified) finishing herd producing around 1700 pigs for slaughter per year. The finishing pigs used in this study were three breed crosses of (Landrace x Yorkshire) x Duroc; however there were also some crosses with Hampshire instead of Duroc. The finishing pigs were bought from a piglet producing herd at 25 – 30 kg live weight and moved into the finishing pens. Each group of finishers were housed in two large, deep-litter pens connected via an alley from which they had access to an outdoor concrete platform (Figure X). Concentrate wet feed was given automatically inside the pens and roughage was available outside on the concrete platform. Except for the last period before slaughter when concentrate was restricted, feed was given *ad libitum*.

The test area was set up in the alley connecting two pens with one group of pigs (Figure X.). One gate already available was used to close the alley off and on the other side one metallic panel covered with a plastic board was used. The test area measured 1.30 x 2.10 m, giving the area 2.730 m^2. Firstly all pigs in the group was moved to Pen 1 and thereafter five pigs at a time was driven out in the alley and put in the test area. After each observation period the pigs were moved to Pen 2 and five new pigs were driven from Pen 1 to the test area.

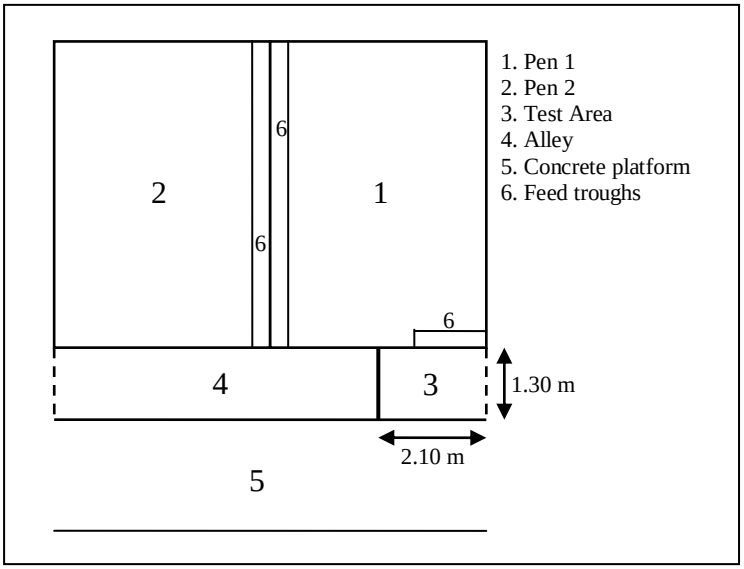


Figure X. The pens and test area of Herd F.

In Herd F, eight observations were performed, all consisted of five pigs.

APPENDIX 9

PROTOCOL – SKIN LESIONS BEFORE THE STUDY

Date:	Herd:	Pen:	Time:

Sex	Animal ID	Head	Front/middle	Hind quarters

PROTOCOL – SKIN LESION AFTER THE STUDY

Animal ID	Head	Front/middle	Hind quarters

EXPLANATION

Sex: Female (F) or Male (M)
Head: All parts of the head, including ears.
Font/middle: All parts of the body starting behind the ears to the hind quarters' start.
Hind quarters: All parts behind the hind quarters' start, including tail.

APPENDIX 10

HEART GIRTH

Date:	Herd:	Pen:	Time:

Animal ID	Heart girth (cm)	Estimated weight (kg)

APPENDIX 11

PROTOCOL – BEHAVIOURAL STUDIES (SCAN SAMPLING)

Date:	Herd:	Pen:	No of animals:	Time:

	Posture			
Time	A: Stand	B: Lie sternal	C: Lie lateral	D: Sit
0				
2				
4				
6				
8				
10				
12				

PROTOCOL – BEHAVIOURAL STUDIES (SCAN SAMPLING)

Date:	Herd:	Pen:	No of animals:	Time:

	Activity					
Time	F: Root	G: Snout-floor	H: Snout-furnishing	I: Snout-air (nothing)	J: Snout-pig	K: Other
0						
2						
4						
6						
8						
10						
12						

Remarks:

EXPLANATION

Recording of behaviours is done by quickly scanning the group in the test area every second minute. Registration is done on group level, by recording the behaviour of all pigs at every scan.

Position: The pig's body posture. Sum = no of pigs in test area.

A. Stand: Standing up with three or four hoofs in contact with the floor, pig can be stationary or moving**.**
B. Lie sternal: Lying with the belly in full contact with the floor, with front legs directed forward or all legs under the body.
C. Lie lateral: Lying with the side in full contact with the floor and a minimum of three legs extended from the body.
D. Sit: Sitting in an upright posture, resting on the hind quarters with stretched front legs.

Activity: The pig's secondary activity, extra to the body posture. Sum = no of pigs in test area.

F. Root: Rooting movements directed towards the floor surface (with or without substrate).
G. Snout-floor: Snout approaches (<5 cm) or in contact with the floor surface (without rooting).
H. Snout-furnishing: Snout approaches (<5 cm) or in contact with the furnishing of the test area.
I. Snout-air (nothing): Snout is "in the air" (no contact with the floor, furnishing or another pig) Snout is "in the air" (no contact with the floor, furnishing or another pig).
J. Snout-pig: Snout approaches (<5 cm) or in contact with any body part of another pig.
K. Other: Drink, eat etc.

APPENDIX 12

PROTOCOL – BEHAVIOURAL STUDIES (CONTINUOUS SAMPLING)

Date:	Herd:	Pen:	No of animals:	Time:

Behaviour	Frequency				
	0-6 min	6-12 min			
Urination					
Defecation					
Snout-genitals					
Snout-body					
Snout-head					
Pressure					
Head thrust					
Lift					
Vocalisation º 1 2					
Climb					
Mount					
Froth					
Shivering					
Bite					
a) head					
b) ears					
c) neck					
d) body					
e) tail					
f) genitals					
g) pen					
Tail-mouth					
Ear-mouth					
"Buff" other pig					

EXPLANATION

Continuous recording: All occurrences of a behaviour is recorded. Registration is done on group level = a behaviour displayed by a pig gives one recording. The same behaviour can be displayed by the same/another pig later, and gives than a new recording.

Urination: The pig urinates.
Defecation: The pig defecates.
Snout-genitals: The snout approaches (<5 cm) or in contact with the genitals and/or tail of another pig, without opening of mouth or bites.
Snout-body: The snout approaches (<5 cm) or in contact with the body (all parts behind the ears to the tail and genitals) of another pig.
Snout-head: The snout approaches (<5 cm) or in contact with the head, snout and/or ears of another pig (without opening of the mouth and/or bite attempts).
Pressure (with body or head): The pig pressures and pushes the body or head of another pig in attempts to move the other individual.
Head-knock: The pig knocks its head towards the body or head of another pig.
Lift: The pig pushes its snout and head under the body of another pig and lifts upwards.
Vocalisation[°] [1] [2]: The pig vocalises (squeals) loudly and intense, 0 = no audible vocalisations, 1 = separable vocalisations, 2 = non separable vocalisations during the whole observation period.
Climb: The pig climbs the furnishing of the test area and/or another pig.
Mount: The pig places both front legs over the head or body of another pig and performs a mounting movement.
Froth: The pig chews intensively and froth is visualised around the mouth.
Shivering: The pig shivers in some part of the body.
Bite: The pig has its mouth open and bite towards/on another pig.
a) Head (excluding the ears).
b) Ears.
c) Neck (the part starting behind the ears to the start of the shoulder).
d) Body (any part behind the shoulder excluding the tail and genitals).
e) Tail.
f) Genitals.
g) Pen (toward the fixtures of the pen/test area).
Tail-mouth: The pig has the tail of another pig in its mouth (without biting).
Ear-mouth: The pig has the ear of another pig in its mouth (without biting).
"Buff" other pig: The pig uses its snout and performs "buffing" movements towards any part of another pigs´ body.

APPENDIX 13

FRÅGEFORMULÄR TRANSPORTÖRER

Datum för intervju:
Åkeri/Transportfirma:
Namn:
Kön: Man Kvinna

Frågeformulär; Transportörer

1. Transporterar du både ekologiska och konventionella grisar?
    a. Ja b. Nej
2. Hur länge har du arbetat med att transportera grisar?
    a. >1 år b. 1-5 år c. 5-10 år d. 10-20 år e. >20 år
3. Sköter du alla steg i en transport, dvs. även pålastning och avlastning?
    a. Ja b. Nej
        i. Om nej, vilka steg sköter du?
4. Vilket moment i ditt arbete upplever du vara besvärligast?
    a. Pålastning b. Transport/körningen c. Avlastning d. Vet ej
        i. Vad är det som gör det momentet besvärligast?

Nu följer några frågor där jag vill att du ska jämföra dina erfarenheter av att arbeta med ekologiska och konventionella grisar. Jag kommer be dig att uppskatta ditt svar på en femgradig skala där ett till exempel kan vara mycket lättare, tre ingen skillnad och fem mycket svårare.

5. Hur upplever du drivning/förflyttning av ekologiska grisar jämfört med konventionella:
    a. 1. Mycket svårare 2. Svårare 3. Ingen skillnad
        4. Lättare 5. Mycket lättare
        i. Vet ej
    b. 1. Mycket mer tidskrävande 2. Lite mer tidskrävande 3. Ingen skillnad
        4. Lite mindre tidskrävande 5. Mycket mindre tidskrävande
        i. Vet ej
6. Hur upplever du lastning av ekologiska grisar jämfört med konventionella:
    a. 1. Mycket svårare 2. Svårare 3. Ingen skillnad
        4. Lättare 5. Mycket lättare
        i. Vet ej
    b. 1. Mycket mer tidskrävande 2. Lite mer tidskrävande 3. Ingen skillnad
        4. Lite mindre tidskrävande 5. Mycket mindre tidskrävande
        i. Vet ej
7. Hur upplever du avlastning av ekologiska grisar jämfört med konventionella:
    a. 1. Mycket svårare 2. Svårare 3. Ingen skillnad
        4. Lättare 5. Mycket lättare
        i. Vet ej

b. 1. Mycket mer tidskrävande 2. Lite mer tidskrävande 3. Ingen skillnad
4. Lite mindre tidskrävande 5. Mycket mindre tidskrävande

i. Vet ej

8. Hur upplever du ekologiska grisars beteende, jämfört med konventionella grisar?
   a. 1. Mycket mindre rädda/stirriga 2. Mindre rädda/stirriga
   3. Ingen skillnad 4. Mer rädda/stirriga 5. Mycket mer rädda/stirriga

   i. Vet ej
   b. 1. Mycket mer lätthanterliga 2. Mer lätthanterliga 3. Ingen skillnad
   4. Mer svårhanterliga 5. Mycket mer svårhanterliga

   i. Vet ej
9. I vilken utsträckning upplever du att det krävs användning av pådrivningshjälpmedel vid arbete med ekologiska grisar jämfört med konventionella?
   a. 1. Mycket mer sällan 2. Mer sällan 3. Ingen skillnad 4. Mer ofta
   5. Mycket mer ofta

   i. Vet ej
10. I vilken utsträckning upplever du att du <u>behöver</u> hjälp av en andra person vid lastning/avlastning av ekologiska och konventionella grisar?
    i. 1 2 3 4
    (1=aldrig, 2= sällan, 3= ofta, 4= alltid)
    ii. Vet ej
11. Upplever du några skillnader mellan ekologiska och konventionella grisar när de är lastade på bilen och under körning?
    a. Ja b. Nej
    i. Om ja, vilka skillnader upplever du?

12. Har du något annat att tillägga/övriga kommentarer