



# Social Behavior and Time Budget of Breeding Bulls

*Socialt beteende och tidsbudget hos aveltjurar*

**Lottie Schwan**

**Etologi och djurskyddsprogrammet**



---

Sveriges lantbruksuniversitet  
Institutionen för husdjurens miljö och hälsa  
Etologi och djurskyddsprogrammet

Skara 2011

Studentarbete 367

*Swedish University of Agricultural Sciences  
Department of Animal Environment and Health  
Ethology and Animal Welfare programme*

*Student report 367*

ISSN 1652-280X



## **Social Behaviour and Time Budget of Breeding Bulls**

*Socialt beteende och tidsbuget hos avelstjurar*

**Lottie Schwan**

Studentarbete 367, Skara 2011

**Grund C, 15 hp, Etologi och djurskyddsprogrammet, självständigt arbete i biologi,  
kurskod EX0520**

**Handledare:** Lena Lidfors, SLU, Box 234, 532 23, Skara

**Biträdande handledare:** Magareta Håård, VikingGenetics, Box 64, 532 31, Skara

**Examinator:** Jan Hultgren, SLU, Box 234, 532 23, Skara

**Nyckelord:** Bulls, welfare, breeds, housing, behavior, social

### **Sveriges lantbruksuniversitet**

Fakulteten för veterinärmedicin och husdjursvetenskap

Institutionen för husdjurens miljö och hälsa

Avdelningen för etologi och djurskydd

Box 234, 532 23 SKARA

**E-post:** [hmh@slu.se](mailto:hmh@slu.se), **Hemsida:** [www.hmh.slu.se](http://www.hmh.slu.se)

---

I denna serie publiceras olika typer av studentarbeten, bl.a. examensarbeten, vanligtvis omfattande 7,5-30 hp. Studentarbeten ingår som en obligatorisk del i olika program och syftar till att under handledning ge den studerande träning i att självständigt och på ett vetenskapligt sätt lösa en uppgift. Arbetenas innehåll, resultat och slutsatser bör således bedömas mot denna bakgrund.

## Contents

Summary.....	4
Sammanfattning.....	5
Background.....	6
Introduction.....	6
Aim.....	9
Materials and Methods.....	9
<i>Materials</i> .....	9
<i>Methods</i> .....	11
<i>Data Analysis</i> .....	12
Results.....	13
<i>Social behaviour in individual and group housing</i> .....	13
<i>Social behaviour between Swedish Red and Holstein</i> ...	14
<i>Time budget in individual and group housing</i> .....	16
Discussion.....	17
<i>Social behaviour in individual and group housing</i> .....	17
<i>Social behaviour between Swedish Red and Holstein</i> ....	18
<i>Time budget in individual and group housing</i> .....	19
<i>Sources of error</i> .....	20
Conclusion.....	21
Acknowledgments.....	22
References.....	23

## Summary

The aim of this study was to investigate the social behaviour and time budget of breeding bulls kept at VikingGenetics, Falkenberg in Sweden when the staff was off duty. It was of interest to see if there was any difference between bulls housed in group pens and bulls housed in individual pens. It was also of interest to investigate if there was any difference in the behaviour between the dairy breeds Swedish Red (SR) and Swedish Holstein (SH).

Sixteen bulls were used in this study. Eight bulls kept in individual pens and eight bulls kept in group pens were used. The individually housed bulls had a social gate with wider bars where the bulls could but their head and neck through to have social contact with the bulls in its neighbouring pens. In each group there were four SH and four SR. Cameras were mounted to record the behaviour of the bulls. The film material was saved onto hard discs and decoded manually.

The behaviour and time budget of the bulls was analysed from the video between 16:00 and 22:00. The bulls' behaviour was analysed during seven days, except for two bulls that were only recorded for three days. Instantaneous sampling was used to investigate the time budget with five minute intervals and continuous sampling was used to investigate social behaviour. Mann-Whitney test was used for all the statistical analysis.

The group housed bulls showed significantly ( $p < 0,05$ ) more pushing (median: 0.49 obs./h compared to 0.05 obs./h) and mounting (median: 0.05 obs./h compared to 0 obs./h) whilst the individually housed bulls showed significantly more of the behaviours licking muzzle (median: 0.02 obs./h compared to 0 obs./h) and head through gate (median: 0.70 obs./h compared to 0.11 obs./h). No significant difference was found in the behaviours licking another's body, licking another's urine/penis, sniffing, butting, rubbing, chin pressing, head to head pushing and being groomed/licked.

There were no significant differences in any of the social behaviours between the breeds. The SR however showed a slighter higher frequency of the behaviours licking another's body (median: 0.25 obs./h for SR, 0.19 obs./h for SH) and licking urine/penis (median: 0.15 obs./h for SR, 0.07 obs./h for SH). SR also had a higher frequency of being groomed/licked (median: 0.36 obs./h for SR, 0.31 obs./h for SH).

There were no significant differences observed in the time budget between the individually housed bulls and the group housed bulls. The largest difference was seen in locomotion ( $p = 0.19$ ), where the group housed bulls moved more often than the individually housed bulls. The three most common behaviours were lying ruminating followed by exploration and being social. The median percentages of these behaviours were 52.2%, 18.2% and 6.8% respectively for individually housed bulls and 54.3%, 19.7%, 7.4% for group housed bulls.

It is concluded that there was no greater difference in social behaviour and time budget between individually housed bulls and group housed bulls as well as between the two breeds Swedish Holstein and Swedish Red. Due to this both housing systems seem to have similar influences on these breeds of bulls.

## Sammanfattning

Syftet med studien var att undersöka sociala beteenden samt tidsbudget hos avelstjurar som hölls på VikingGenetics, Falkenberg när personalen har gått hem för dagen. Det var av intresse att undersöka om det fanns några skillnader i beteenden mellan tjurarna som hölls i grupp och tjurarna som hölls ensamma och även skillnad mellan raserna Svensk röd och vit boskap (SRB) och Svensk Holstein (SH).

Sexton tjurar användes för denna studie. Åtta tjurar i ensambox och åtta i gruppbox studerades. Tjurarna som hölls i ensamboxar hade möjligt till social kontakt mellan grindarna till sina grannar. Varje grupp bestod av fyra SH och fyra SRB. Videokameror användes för att spela in tjurarnas beteende. Filmmaterialet sparades ner på hårddiskar.

Tjurarnas beteende och tidsbudget avkodades manuellt mellan 16.00 och 22.00. Tjurarnas beteende avkodades under sju dagar (förutom två individer som avkodades tre dagar). Momentan registrering användes för att undersöka tjurarnas tidsbudget med fem minuters intervall och kontinuerlig registrering användes för att undersöka deras sociala beteenden. Mann-Whitney test användes för statistisk analys av data.

Tjurarna som hölls i grupp visade signifikant ( $p < 0,05$ ) mer puttande (median: 0,49 obs./tim. jämfört med 0,05 obs./tim.) och bestigningar (median: 0,05 obs./tim. jämfört med 0 obs./t) medan tjurarna som hölls i ensambox visade signifikant mer av beteendena: slicka mulen (median: 0,02 obs./tim. jämfört med 0 obs./tim.) och huvud genom grind (median: 0,70 obs./tim. jämfört med 0,11 obs./tim.). Inga skillnader sågs i beteendena; slicka kropp och urin/penis, sniffande, stångning, hak press, huvud till huvud buffning samt bli slickad.

Det var inga signifikanta skillnader för de sociala beteenden mellan SH och SRB. SRB visade en liten högre frekvens av beteendena slicka annans kropp (0,25 median obs./tim. för SRB jämfört med 0,19) och urin/penis (0,15 median obs./tim. för SRB jämfört 0,07 obs./tim. för SH) samt bli slickad (0,36 median obs./tim. för SRB jämfört med 0,31 obs./tim. för SH).

Det fanns inte heller några signifikanta skillnader i tidsbudgeten mellan tjurarna som hölls i ensambox och de i gruppbox. Största skillnaden var i beteendet, rörelse, där de grupphållna tjurarna rörde på sig mer ( $p = 0,19$ ). De tre mest utförda beteendena var att ligga och idissla följt av att undersöka boxen och att vara social. Medianprocenten för dessa beteenden var 52.2%, 18.2% och 6.8% för ensamhållna tjurar respektive 54.3%, 19.7%, 7.4% för grupphållna tjurar.

Slutsatsen dras att det inte fanns några större skillnader i sociala beteenden och tidsbudget mellan de ensamhållna tjurarna och de grupphållna tjurarna eller mellan raserna Svensk Holstein och Svensk röd och vit boskap. Båda inhysningssystemen verkar ha liknade påverkan på tjurarna.

## **Background**

The housing of cattle has been of interest for many researchers, and group housing instead of individual housing is a large step towards improving their welfare (Bouissou et al., 2001). The importance of group housing can also be found in legislation. From the year 2017 bulls in Sweden above the age of six months need to be kept in loose housing (Statens jordbruksverks föreskrifter och allmänna råd (SJVFS 2010:15) om djurhållning inom lantbruket m.m.; saknr L100, 2 kap., 2§).

The problems faced when trying to find an optimal housing system for bulls is trying to fulfil the animal's needs. As with all systems there are advantages and disadvantages. The advantage with keeping bulls in individual pens is that the risk for injuries decreases, though at the same time keeping bulls individually reduces their possibility for social interactions. The advantages of group pens are that social interactions can be displayed; however group pens increases risk of fights and thereby injuries. In this study it was of interest to see how the bulls behaved when the staff was off duty because it may take longer time to find a bull which is injured or stressed by the other bulls if it happens at night when there is no personal available. It is also not immediately observable for the staff that may be unaware of a bull that has problems coping with other bulls.

A previous study has been performed investigating the advantages and disadvantages of group versus individual pens for bulls (Dahlgren, 2010). The results showed lower activity levels in the individually housed bulls; however as the reason for this lower activity was unclear no conclusion could be drawn on whether this was positive or negative with regards to animal welfare. When comparing occurrences of social and general behaviours, only one significant difference was recorded between individually and group housed bulls (Dahlgren, 2010). The difference that could be seen was that there was more pushing in the group housed bulls (Dahlgren, 2010). From these behavioural observations no clear conclusion could be drawn.

This study is a follow up study of the previous one to investigate the behaviour and time budget of breeding bulls when staff is off duty as well as investigating if there is any difference in behaviour between Swedish Red and Swedish Holstein bulls.

## **Introduction**

Most research on the behaviour of cattle has been performed on feral herds (Jensen, 2002). Cattle were domesticated about 9000 years ago (Jensen, 2002). They are social animals whom form ranks as well as individual relationships (Watts & Stookey, 2000). Bulls have a stricter hierarchy than cows (Hall, 1989), which makes them more difficult to keep and handle.

Cattle are able to recognize each other by visual and vocal cues and even by olfactory (Soffie & Zayan, 1977). It is thought that cattle can recognize 50-70 herd mates (Fraser & Broom, 1990). There have been some studies on the social behaviour of bulls. In the studies by Hall et al. (1988) and Hall (1989) bulls were found to be in small groups of two to three individuals that had specific home ranges. Bouissou et al. (2001) similarly states that bulls around three to four years old have been found to live either solitary or in small groups of two to ten bulls outside the mating period. Phillips (2002) states that mature bulls have been observed to find territorial isolation from other bulls; however they stay in sight of other bulls.

Studies have shown that if cattle are kept isolated they show signs of stress through increase heart rate, increased vocalisation as well as an increase in urination and defecation (Rushen et al., 1999). This suggests that it is important for cattle to be able to have social interactions.

Bulls can distinguish each other by using vocalisation. Vocalisations give information about sex, age, rank as well as reproductive status of the vocaliser (Hall et al., 1988). Calves that have been reared in groups vocalise more than calves reared individually (Warnick et al., 1977). Calves that have been reared individually have restricted social development, are less skilled in social contact situations, less dominant and also show more disorientated mounting behaviour compared to calves reared in groups (Silver & Price, 1986).

The main method used by cattle to communicate is by the use of visual signals; cattle have been observed to respond more to visual signals than auditory signals (Phillips, 2002). An example of a visual signal in bulls is pawing the ground which indicates an intention to charge. Another example is lowering of the head, drawing the chin towards body and inclining the horns towards an opponent indicating a threat. Other visual signals that indicate stress are shaking of the head and neck and rubbing of the head on the ground. Submissive individuals usually meet these threats by lowering the head and turning away or by lowering the whole body to display retreat (Phillips, 2002).

The tail has also been suggested to be used for visual communication. It has been observed that cattle hold their head and tail elevated during exploratory behaviours. The tail is also held high during greetings, threats and fighting. An individual that holds its head and tail low indicates that it is frightened or cold (Phillips, 2002).

Social interactions are important for the establishment and maintenance of social hierarchy (Jensen, 2002). Some common social behaviours include mock fighting, mounting and allogrooming. Allogrooming often occurs in groups of cattle, it consists mainly of licking of the head, neck and shoulder areas. It is important for communication as well as being a social interaction (Bouissou, 1985). Allogrooming is a behaviour which mostly is performed by subordinates and received by the animals that are dominant. In bulls licking of the penis, rump and genital areas are seen as a sexual behaviour. An individual often shows that he wants to be licked by gaining a special posture; he lowers the head and neck and has a slight hump under the chest or neck. It has also been observed that the frequency of social licking is greater among individuals that are related or have been kept in the same group for longer (Bouissou, 1985). Allogrooming is thought to be a comfort mechanism, a behaviour which reduces stress, which helps cattle to cope with today's intense husbandry systems (Phillips, 1993). The licking behaviour is also important for removing ticks in cattle at pasture (Jensen, 2002).

Mock fighting is a behaviour that has been observed in all ages and by both sexes (Reinhardt & Reinhardt, 1982). It is often seen as a friendly playful behaviour where the participants do not try to overpower each other. It is classified as a playful behaviour as it is started just as often by both dominant and subordinate individuals. Mock fighting is mostly seen between cattle that are of a similar age and social rank and between the same sexes (Reinhardt & Reinhardt, 1982).

Aggression usually occurs when unfamiliar individuals are put into a group as they then establish a hierarchy. In established groups with hierarchy aggression is rare. Aggression is shown by threats which include lowering the head and even physical contact consisting of head to head pushing or butting (Bouissou, 1974). Other signs of aggression are vocalizations, rubbing of the head on the ground and pawing of the ground. Bulls normally stand so that they appear bigger. Mounting is a behaviour which is considered to have sexual as well as aggressive functions (Klemm et al., 1983). Most of the fights that occur are normally very short, 80% last less than one minute though fights can range from a few seconds up to an hour (Bouissou, 1974).

Social behaviours have been observed to change with age. For dairy bulls agonistic behaviours have been observed to increase when the bulls reach 3.5-4.5 years, it is at this age the feral bulls have been seen to show signs of dominance (Bouissou et al., 2001). In a study by Hall (1989) it was observed that Chillingham cattle displayed more social behaviours during the daytime compared to night time. This is also supported by Vitale et al. (1986) where play was seen to occur most frequently in mid-morning and mid-afternoon and was rarely observed during the night. The frequency of play behaviour has been found to be correlated with light intensity (Dannenmann et al., 1985).

There have been few studies on the time budget of breeding bulls. One study was performed by Houpt & Wollney (1989) on the time budget of dairy bulls (Holstein) kept for semen production, however this study focused on masturbation. The study showed that they spent 11% of the day eating, 30% standing, 0.8% walking, 52% lying and 28.3% ruminating. In a study that compared the time budget between Hereford and Holstein it was found that Holstein spent less time eating and more time lying and resting than Hereford, however this study used heifers and not bulls (Kropp et al., 1973). In another study it was found that Holstein had calmer temperament than beef cattle (Lainer et al., 2001). This shows that time budgets and also behaviour can vary between breeds. It was therefore of interest to see if there was any difference in behaviour between the breeds Swedish Holstein and Swedish Red.

There is no definite way of measuring the welfare of animals. The five freedoms is one method that can be used (Jensen, 2002). While the five freedoms which was set up by the British Farm Animal Welfare Council is a good method to use it only covers basic needs of animals such as access to food and water and does not take into consideration how the animals perceive and cope in their environment (Jensen, 2002).

There are two other definitions of welfare that are frequently used. Broom (1996) defines animal welfare as 'the welfare of an individual is its state as regards its attempts to cope with its environment.' With this definition welfare can be measured using a few parameters; injury, disease, behaviour, stress, growth and reproduction. The disadvantage with this method is being able to use these measurements for determining the level of welfare and deciding if any measurements are more important than others (Jensen, 2002).

The second definition of animal welfare has been written by Duncan (1996). His definition is that 'welfare is all to do with what the animal feels.' This definition includes animals feeling physical pain, hunger, thirst, stress and pleasure. The disadvantage with this method is that it is hard to measure, people have different views on what animals feel, making it



hard to observe objectively. Feelings can only be indirectly measured through behavioural observations which can lead to high levels of errors (Jensen, 2002).

Grandin (2001) has suggested that vocalisation can be used as a welfare measurement for cattle. Another measurement of welfare for cattle has been developed by Norwegian researchers, Sandeman et al. (2002). Their study showed that the eye white of cattle that were frustrated were over twice the size of a normal eye, therefore the size of the eye white can be used as a welfare measure.

### **Aim**

The aim of this study was to investigate the social behaviour and time budget of breeding bulls housed individually or in groups when the staff was off duty and to investigate if there was any difference in behaviour between Swedish Red and Swedish Holstein. Three questions were formulated;

1. Are there any differences in social behaviours between bulls housed in group pens and bulls housed in individual pens when the staff is off duty (16.00-22.00)?
2. Are there any differences in social behaviour between Swedish Red and Swedish Holstein?
3. Are there any differences in time budget between individually housed bulls and bulls kept in groups?

### **Materials and Methods**

#### Material

The study was conducted at VikingGenetics facility in Falkenberg, Sweden from the 29<sup>th</sup> of March to the 29<sup>th</sup> of April 2011. Before the study was conducted it was approved by the Swedish Ethical Committee in Gothenburg (Dnr: 54-2011).

The facility in Falkenberg has 20 group pens (10 x 11 m) and 38 individual pens (2.5 x 10 m) situated in one building. The pens used for observations are highlighted in Figure 1.

The pens for individual housing have larger distance between bars, 40 cm, in the middle of the pen where bulls can put their head and neck through and have social contact with the bulls in their neighbouring pens (Figure 2). The group housed bulls were able to put their head through the bar until the ears. This enables them to have contact with the bulls in the neighbouring boxes. The pens had one area with straw bedding and one area with concrete. Two neighbouring bulls shared one manger situated outside the pens in the aisle. Two bulls shared one drinking bowl. The bedding was changed approximately twice a week.

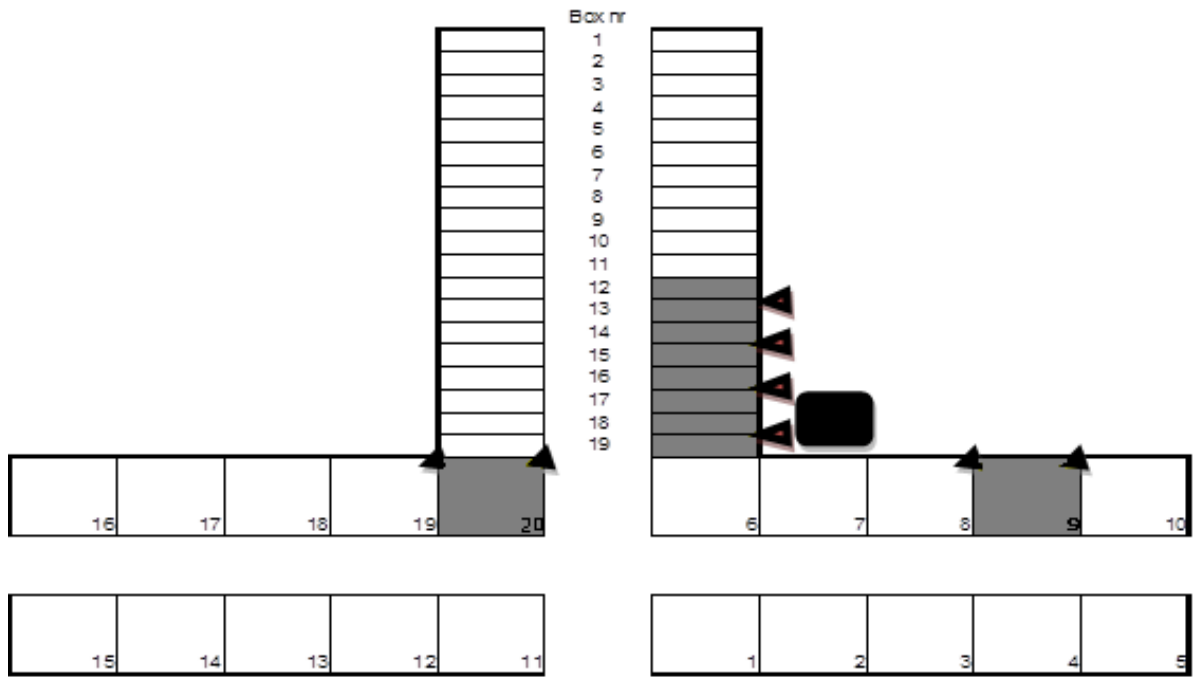


Figure 1. Drawing of the stables for bulls with 20 group pens (lower horizontal part) and 38 individual pens (upper vertical part) Highlighted pens are those used in the study. The arrows indicate the position of the cameras used to record the bulls' behavior. The rectangle above box 7 is a shed in which the computers were kept (Not to scale).



Figure 2. A photo of the individual pens and the social contact that can take place. Photo from video material



Figure 3. Photo of a group pen with the water bowls in the middle of the pen. Photo from video material.

The number of bulls kept in a group pen varied from two to ten. The bulls were kept in groups of the same breed and of similar age. These pens were divided into two parts, one with bedding and one with concrete by the aisle. There were two water bowls per pen situated in the middle of the pen by a gate. The purpose of the gate was to enable the bulls to get away during fights (Figure 3).

The bulls were fed once daily in the morning around 07:30. The concrete areas in the individual and group pens were cleaned out twice a week. The cattle were given new straw at least once each week.

### Methods

To be able to observe the bulls without disturbance and at night it was decided to put up cameras. Eight bulls kept in individual pens and eight bulls kept in group pens were selected for observations. Selection was based on having bulls of the age 3-4 years and the possibility to put up cameras close enough to the computers so that cables could be drawn. Four Swedish Red and four Swedish Holsteins were chosen for each group.

As there were only eight cameras available four cameras were chosen to be mounted by the individual pens. Each camera by the individually housed bulls filmed two bulls. Two cameras were needed per group pen to be able to observe the whole pen; therefore only two group pens could be used. These cameras were mounted about 5 m above the straw bedding in each group pen (Figure 1). Four bulls were observed in each group pen. There were seven bulls in the Swedish Holstein group pen and six Swedish Red in the other group pen.

In total eight cameras of the brand Monarc TVCCD-1401R were used. The cameras were mounted and recorded the bulls between 29<sup>th</sup> March and 3<sup>rd</sup> May 2011. The recording program used was MSH Video Client version 4.5.11.123 (Video Server Company, Lithuania). Two stationary computers were used each equipped with a PCI card for four cameras. The computers were placed in a shed outside the stables (Figure 1). The cameras

were kept on for 24 hours every day. The video material was downloaded onto a hard disc approximately once a week.

The video material was decoded manually by watching the films in another program in MSH Video Client and inserting observations of behaviours into Windows Excel. Focal continuous recording was used for social behaviours to be able to pick up behaviours with short duration. Instantaneous sampling with 5 minute intervals was used to record time budget. Ethogram can be seen in Table 1. Observations were made between 16:00-22:00 and recordings were made on April 10<sup>th</sup>, 13<sup>th</sup>, 14<sup>th</sup>, 16<sup>th</sup>, 19<sup>th</sup>, 22<sup>nd</sup> and 24<sup>th</sup>. Two bulls in individual housing were only observed under the first three days due to a camera cable being damaged by a bull.

*Table 1. Ethogram of behaviours observed*

<b><u>Ethogram</u></b>	
<b>Social Behaviours</b>	<b>Definition</b>
Licking body	Licking of another bull's head, neck and shoulder area
Licking urine/ penis	A bull licks another bull's genital area or urine
Licking muzzle	Licking another bull's muzzle
Mounting	A bull jumping on another bull so that the forelegs are on the other bulls hips or head
Pushing	Pushing by using the body or head to get another bull to move
Head to head pushing	Two bulls that are pushing against each other's forehead
Butting	Directing a blow towards another bull using its head
Chin pressing	Pressing the underside of its chin on another bull's back or neck
Rubbing	Rubbing with the head on another bull's body
Head through gate	Having head through gate into neighbouring pen
Sniffing	Placing its head toward another bull and inhaling
<b>General Behaviours</b>	
<i>-Standing</i>	
Ruminating	Standing and ruminating
Eating	Standing by the manger with the head through the gate and eating or taking straw from the bedding into its mouth and swallowing
Locomotion	Moving or walking; placing one foot in front of another
Social	Having interactions with other individuals
Self grooming	Licking itself or rubbing its body against the interior
Exploration	Investigating the environment, sniffing the interior or the bedding
Drinking	Having muzzle by the water cup and drinking water
<i>-Lying</i>	
Resting	Lying still with the head resting on the ground and not performing any other behaviours
Ruminating	Lying and ruminating

### Data analysis

For the social behaviours the sum of the behaviours was calculated per bull, this sum was then divided by the number of observation hours to get frequency of behaviour per hour (6 h x 7 days = 42 obs. h/bull). The data was tested for normality using the Kolmogorov-Smirnoff test and was found to not be normally distributed. The Mann-Whitney test was used to analyse the data. First the social behaviour of the individually housed bulls' was tested against the bulls held in group and then the social behaviours for Swedish Red was tested against Holstein. The median frequency of each behaviour per hour and Q1 and Q3 of each behavior was calculated for the group housed bulls and the individually housed bulls as well as for the breeds Swedish Red and Swedish Holstein. This data was then inserted into two bar charts.

The data was processed using Minitab version 15 (Minitab Inc.). For time budget the total sum of recordings under all the observation periods was calculated per bull for each behaviour. This sum was then divided by the number of observations (6 h x 12 obs./h x 7 days = 504 obs. or 3 days = 216 obs.) to get the mean number of observations per behaviour multiplied by 100 to get percentages of obs. The percentage for each behaviour per bull was entered into Minitab and the data was tested for normality using the Kolmogorov-Smirnoff test. The data was not normally distributed therefore the data was analyzed using the Mann-Whitney test. The time budgets of the individually housed bulls were tested against the group housed bulls. The median percentage and Q1 and Q3 of each behavior was calculated for the group housed bulls and the individually housed bulls. This data was then inserted into a bar chart.

## Results

### Social behaviour in individual and group housed bulls

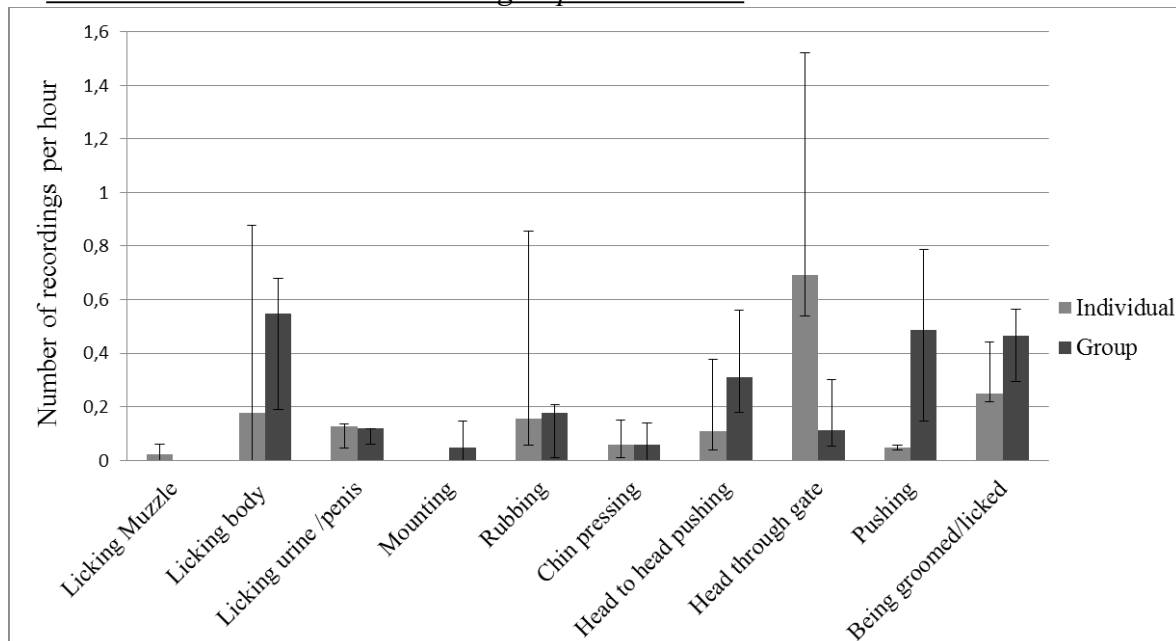


Figure 4. The median number of recordings per hour of social behaviours for individual and group housed breeding bulls. The error bars show the Q1 and Q3 values for each behaviour. (n=8 bulls per housing)

Table 2: The p-values for difference in social behaviour between individually held bulls versus group held bulls and between Swedish Red and Swedish Holstein bulls

Behaviour	Difference between housing systems	Difference between breeds
Licking muzzle	0,012	0,793
Licking body	0,074	0,752
Licking urine/penis	0,525	0,138
Mounting	0,013	0,523
Sniffing	0,561	0,561
Butting	0,761	0,247
Rubbing	0,524	0,874
Chin pressing	1,000	0,487
Head to head pushing	0,188	0,792
Head through gate	0,005	0,752
Pushing	0,015	0,635
Being groomed/licked	0,103	1,000

There was totally more social behaviour recorded for the group housed bulls compared to the individually housed bulls. The sum of the median value for the social behaviours in the group housing was 2.33 and 1.64 in the individual housing.

Significant differences were seen in the behaviours pushing, head through gate and mounting and licking muzzle (Figure 4 and Table 2). The individually housed bulls had their head through their gate 0.69 more times per hour than group housed bulls (Figure 4). Pushing occurred more in group housing where there was a difference of 0.44 observations per hour. The behaviour licking muzzle was only observed by the individually held bulls. The occurrence of this behaviour was however very low with only 0.02 observations per hour.

The behaviour mounting was only observed in the group housed bulls. Mounting was performed by three of the bulls in the Swedish Red group and by two of the bulls in the Swedish Holstein group. The max value for this behaviour was 0.36 though the median was low at 0.05 observations per hour.

Licking body appeared to be different with 0.37 more obs./h in group housed bulls compared to individually housed bulls, but it was not significant. The behaviours being groomed/licked and head to head pushing were observed 0.21 more times per hour in the group housed bulls.

The behaviours sniffing and butting had median values of 0 for both group housed and individually housed bulls. Some observations were however made of these behaviours. Sniffing was recorded for three individually housed bulls and for two group housed bulls. Butting was recorded for three individuals in each housing group.

There was no difference in the amount of observed chin pressing between the groups. There was a very small difference in the behaviours licking urine/penis, and rubbing (0.01, and 0.02 observations per hour respectively).

Social behaviour between Swedish Red and Swedish Holstein

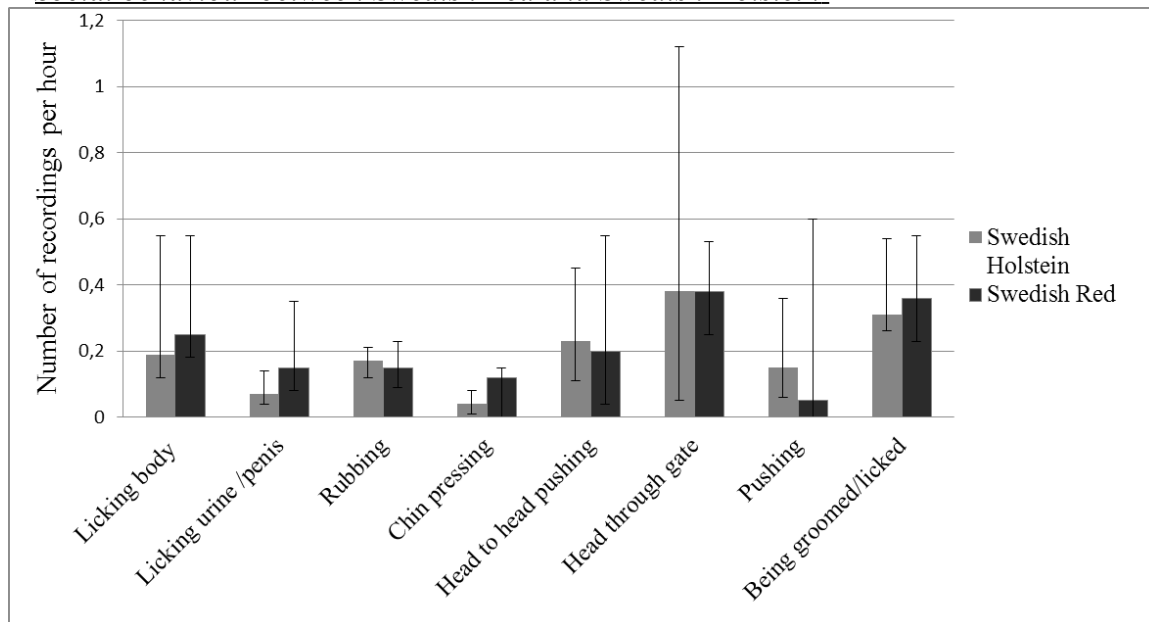


Figure 5. The median number of recordings of social behaviours for the breeds Swedish Holstein and Swedish Red between 16:00-22:00. The error bars show the Q1 and Q3 values for each behaviour (n=8 bulls per breed).

There were slightly more social behaviours recorded for Swedish Red compared to Swedish Holstein. The sum of the median values for all behaviours was 1.67 for Swedish Red and 1.54 for Swedish Holstein. There was however no significant differences in any of the social behaviours observed (Table 2).

The behaviours licking muzzle, mounting and sniffing all had a median value of 0 for both individual and group housing (Figure 5). Observations of these behaviours were however made. The range for licking muzzle was very similar for both breeds, 0.00-0.10 for Holstein and 0.00-0.12 for Swedish Red. The Swedish Red had a higher max value for mounting, 0.36 compared to 0.17 for Holstein. The recording for sniffing were very low, Holstein had a max value of 0.05 and Swedish Red 0.02.

There was no difference observed in the behaviour head through gate, this occurred 0.38 times per hour for both breeds. There was only a very small difference in the behaviour rubbing and butting, there was a difference of only 0.01 observations per hour for both these behaviours.

The Swedish Red showed more of the behaviours licking body and licking urine/penis. Licking body was observed 0.06 more times and licking urine/penis was observed 0.09 more times than Holstein. The Swedish Red were also groomed more than Holstein, they were groomed 0.06 more time than Holstein.

Holstein was observed to push 0.10 more times per hour than Swedish Red. Holstein was also observed to perform more of the behaviour head to head pushing. This difference was however slight, there was a difference of 0.03. The Swedish Red on the other hand performed 0.08 more times chin pressing than Holstein.

*Time budget*

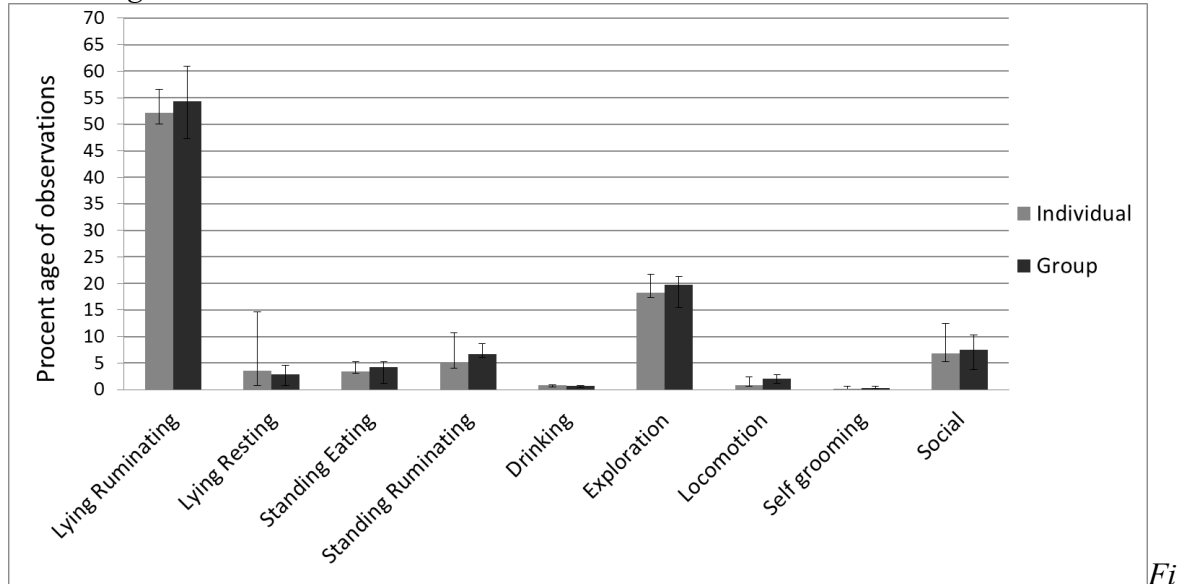


Figure 6. The time budget in percentage of recordings for individually and group housed breeding bulls between 16.00-22.00. The error bars show the Q1 and Q3 values for each behaviour (n=8 bulls per housing).

Table 3: The p-value for the difference in time budget between individually housed bulls and group housed bulls

Behaviour	P-value
Lying Ruminating	0,916
Lying Resting	0,599
Standing Eating	0,318
Standing Ruminating	0,834
Drinking	0,708
Exploration	0,495
Locomotion	0,187
Self grooming	1,000
Social	0,834

There was no significant difference between the time budget of the group kept bulls and the bulls held individually. The time budgets of the individual and group were very similar though slight differences could be seen (Figure 6).

Both the individually held bulls and the bulls kept in groups spent most of their time lying ruminating (52.2% and 54.3% respectively). The next common was exploration followed by social for both individual and group, the percentage of these behaviour was however



slightly higher for the group housed bulls. The group housed bulls spent 1.45% more time exploring and 0.65% more time being social.

The group housed bulls were observed to spend double the time self-grooming compared to the individually housed; they spent 0.30% and 0.15% self-grooming respectively.

The individual bulls and group housed bulls approximately the same amount of time drinking, 0.80% and 0.70% respectively. The group housed bulls however spent 0.75% more time eating. They also spent more time standing ruminating, they were observed to spend 1.60% more time standing ruminating compared to individually housed bulls.

More locomotion was also observed in the group housed bulls, they walked 1.30% than the individually housed bulls. The individually housed bulls were also observed to spend more time lying resting than group housed bulls; 0.65% more time was spent resting.

## Discussion

### Social behaviour in individually and group housed bulls

In this study significant differences were seen in the behaviours licking muzzle, mounting, head through gate and pushing. Licking muzzle was mostly seen in the individual housing, and it was often observed when two individuals with a box in between stretched out to lick the other and could then only reach the muzzle (Figure 7). If the bulls would have been closer and able to reach each other more licking body and urine/penis would probably have been observed and maybe other social interactions. The licking of muzzle could be a sign that the individually housed bulls wanted more social interactions than with only its neighbours.



*Figure 7: A photo of two individually housed bulls licking another's muzzle, photo from video material*

Mounting only occurred in the group housed bulls, and never in the individual housing. Mounting of a bull's head was however observed once in the individually held bulls in the previous study by Dahlgren (2010) which means that the individual bulls also had the

ability to mount another individual. Mounting can be seen as a sexual or aggressive behaviour (Klemm et al., 1983). The mounting behaviour observed in this study was generally recorded during fights and it can therefore be assumed that the mounting behaviour observed in the group housing was an aggressive behaviour. Mounting could also have been used as a way to maintain the social rank in the group. The reason that no mounting occurred in individual housing could be due to it being more difficult to perform the behaviour as well as the individuals not having to maintain a rank order. Mounting is a behaviour that can cause injury to the bulls involved and is therefore a behaviour that is often unwanted by farmers.

There was also a significant difference in the behaviour pushing. It was mostly seen in group housed bulls, and pushing most often occurred around the feeding manger and also by the straw bedding where bulls that were standing pushed bulls that were lying ruminating to get them to move. It was however also seen during fights when one individual was trying to push another individual. Pushing was also observed in individual housing, and then it was mostly observed when bulls pushed on neighbouring bulls that had their head in their pen.

The individually housed bulls had their head through the gate more often than the group housed bulls, but individually housed bulls had to put their head through their gate to have social contact which group housed bulls did not have to do. Some observations were made of the group housed bulls having their head through their gate and having social contact with the bulls in their neighbouring pen, though most social contact was with the bulls in their own pen. The group housed bulls could only have their head through the bar until their ears, which also could have decreased the likelihood of the group housed bulls displaying this behaviour.

That there were no differences in the other social behaviours could suggest that the social gates between the individual pens are sufficient for the bulls' social needs. However, it was observed that individual bulls stretched out to reach bulls in pens further away which could suggest that they wanted to have more social contact than with its neighbours.

Studies have shown that cattle are more social during the day time (Hall, 1989; Vitale et al., 1986). In future studies it could be of interest to observe the social behaviours of the bulls during different times of the day. If the cattle are more social during the day then it may be easier to find differences in behaviour between individually housed bulls and group housed bulls. It could also be of interest to observe the bulls' behaviour when they are fed to investigate if there are any differences in the social interactions then.

#### *Difference in social behaviour between Swedish Red and Swedish Holstein*

In this study it was of interest to find out if there was any behavioural difference between the breeds Swedish Red and Swedish Holstein as previous studies have shown differences in behaviour between dairy breeds and beef breeds (Lainer et al., 2001). Differences in behaviour between dairy breeds were observed by Roy & Nagpaul (1986) when they compared Karan Swiss which is a Brown Swiss cross-breed with Karan Fries which is a Holstein cross-breed. They found that Karan Swiss had a more docile temperament.

There were no significant difference observed in any social behaviour between Swedish Red and Swedish Holstein. However, Swedish Red showed a slightly higher frequency of the behaviours licking body, licking urine/penis and being groomed licked, which could suggest that Swedish Red are more social than Holstein. Studies have however shown that licking increases the longer a group has been kept together (Bouissou, 1985). The difference observed in licking could therefore be an indication that the Swedish Red had a more established group than Swedish Holstein. However, they had been group housed and in their individual pens for about the same amount of time. Increased licking has also been observed to be a behaviour that increases the bulls comfort (Phillips, 1993), which could indicate that the Swedish Red are more stressed. This is however unlikely as they have live in the same environment. It is difficult to say why there was a difference in the amount of licking; it could be due to breed difference though it could still be due to a few other reasons such as stress and group establishment.

Swedish Holstein showed a higher tendency of pushing, butting and head to head pushing than Swedish Red which is considered to be an agonistic behaviour. These were however very small and on the other hand Swedish Red showed more of the behaviour chin pressing which is also an agnostic behaviour. These results could show a tendency for Swedish Holstein to display more agonistic behaviour though the difference is too small to draw any conclusions. Brakel & Leis (1976) investigated difference in aggression in five different dairy breeds. They found that the calmest breed was Ayrshire, followed by Holstein, Jersey, Brown Swiss and Guernsey which was the most aggressive breed. Their study is however old and this order may not be applicable to today's cattle, on the other hand shows that there has been a difference observed in aggression between different breeds of dairy cattle.

A reason for difference in behaviour could be due to different breeding goals. Some heritage has been seen for behaviour. Baehr (1983) studied the heritage of aggressive behaviour for German Holstein. He found that heritage for aggression was 0.28 h<sup>2</sup> by a feed dispenser and 0.48 h<sup>2</sup> by feeding cribs. It has also been shown that the heritage for calm temperament is positively correlated to higher milk yield (Schutz & Pajor, 2001).

The heritage of temperament has however been seen to decrease as the animals get older (Burrow, 1997). Therefore larger difference between the breeds in this study may have been found if younger bulls had been used. A significant difference may also have been found if a larger sample had been used. In future studies it could be of interest to compare social behaviour between Swedish Holstein and Swedish Red at different ages to investigate the development of their social behaviour.

#### *Difference in time budget between individually housed and group housed bulls*

The group housed bulls appeared to spend more observations exploring, locomotion and being social, but this was not significant. The time budget was in general very similar between housing systems.

Locomotion was however slightly higher for group housed bulls. A significant difference in locomotion was however seen in the study by Dahlgren (2010). The group housed bulls were most often observed to move when they were walking towards the water bowls or the feeding manger. It was not often observed that the bulls walked away due to a conflict or being pushed by another individual. The small non-significant difference in locomotion

could therefore be due to the larger area that the group housed bulls had to move on. According to Albright & Arave (1997) cattle have an instinctive motivation to move. This is also supported by Fraser (1982) that states that cattle are genetically programmed to walk large distances daily to find food. He also states that there is a kinetic drive which make them motivated to walk, and even makes them motivated to move in different gaits and also to find changes in location. These articles indicate the importance of locomotion for cattle. The only locomotion that was observed was walking; this could be an indication that the pens do not let the bulls practice all their gaits as they can also trot, gallop, jump and gambol (Phillips, 2002.).

Exploring was the second most performed behaviour for both individually and group housed bulls. Exploration appears when there is a change in an animal's environment (Fraser, 1982). Exploration was most often seen when the bulls had received new straw. There was no significant difference in the amount of time spent exploring; though the group housed bulls explored slightly more. This small difference could be due to the similar environment the bulls were kept in and similar stimuli, the reason for the group housed cattle exploring more could be due to them having a larger area to explore.

It was expected that the grouped housed bulls would spend more observations being social. The individual housed bulls still had a decent capability to be social due to the wider gates between the pens. The group housed cattle spent more time being social, this difference was however not significant. The individual bulls were however able to perform several social behaviours through the social gate. Though it can still be questioned whether this social contact through the social gates satisfies the bulls need. Confinement has been seen to reduce social activity (Fraser, 1982).

The individually housed bulls were not observed to spend more time resting than the group housed bulls, which was expected. Cattle spend approximately 7-8 hours per day in a drowsy state, which is often divided into around 20 different periods. They can also spend up to four hours in true sleep per day (Fraser, 1982). It was observed that bulls that were lying resting in the group housing were often disturbed or pushed by other group members. This could be a negative aspect of group housing, on the other hand the bulls were often observed to lie ruminating together.

#### Sources of error

There were a few environmental differences that could have affected the results. The Swedish Red kept in the group pen had two neighbouring pens and also had a large slide door open in the back part of their pen so that they could look out. The Swedish Holstein group however only had one neighbouring pen and did not have a slide door. The Swedish Holstein group pen was also situated next to the feed mixer. These factors could have slightly affected the results; ideally it would have been better if both groups had open doors and two neighbouring boxes.

Individual 1 was situated in a corner pen and therefore only had one neighbour; this could have limited the amount of social contact that this bull could have. Individual 8 had two neighbours when the study started however one bull was sold which meant that one pen beside individual 8 was empty for a few days before a new bull was placed in that pen. The moving of neighbours could have affected this individual's social interactions. To avoid

these variances it would have been better to only use bulls that had two neighbours during the whole study.

The individually kept bulls did not always get new straw on the same day as the group held bulls. This could have affected the frequency of exploratory behaviour as the frequency of observed exploring increased when the bulls had received new bedding.

In the group pens the bulls were often lying close to each other while ruminating. Even though no physical social contact occurred than just lying in a group this could be considered as a social behaviour. This kind of social interaction could not be performed in the individual housing. However, it can be questioned if it is important for the bulls to be able to lie in a group and ruminate.

The cameras had some disadvantages; it was not always easy to see what the bull was actually doing. Due to problems with a camera where a bull bit off the cable, individuals seven and eight could only be observed during three days. This could have made the results less accurate for these two bulls. The cameras were situated so that it could not be seen what the bulls were doing when they had their head through the feeding manger and it was therefore assumed that bulls were feeding when they had their head through the gate by the feeding manger. This could have led to a higher frequency of recorded eating than actually occurred. It was also difficult to read the bulls' body language on the video material; it would have been of interest to see the bulls' body language to be able to interpret threats. Another disadvantage with the cameras was that no sound could be recorded. It would have been interesting to investigate if there was any difference in the amount of vocalisation between the housing systems and breeds.

There were also sources of errors with the statistical method used; as several significance tests were performed there is a risk of mass significance in the results. Due to the large amount of observations t-test could have been used instead of the Mann-Whitney test. An alternative could have been to use a variance test and only test the behaviours that were of utmost interest.

## **Conclusion**

For these results it was suggested that there was no large difference in social behaviour and time budget between the individually housed bulls and the group housed bulls as well as between the two breeds Swedish Holstein and Swedish Red. Due to the small difference observed between individual housing and group housing with regards to behaviour and time budget both housing systems seem to have similar effects on the bulls.

To select which housing system is most suitable more research is needed. There has been very little research on breeding bulls and further research is needed to fully understand their needs. It could be of interest to investigate if there is any difference in behaviour in different group sizes, it could also be interesting to compare different signs of stress between individually housed and group housed bulls. Further research is likewise needed on the behavioural differences between Swedish Red and Swedish Holstein, and it would be interesting to investigate if any significant differences are found when a larger sample is used and maybe a wider range of behaviours.

## **Acknowledgements**

I would like to thank Margareta Håård and Lisbeth Riberth at VikingGenetics for helping me with this project. I would also like to thank all the staff at VikingGenetics, Falkenberg for welcoming me and for all their help with setting up all the camera equipment and making sure everything worked while I was not there. I would like to thank my tutor Lena Lidfors for her help and guidance throughout this project.

## References

- Baehr, J. 1983. Verhalten von Milchkühen im Laufstall. *University of Kiel, Germany*. Dissertation.
- Brakel, W.J., Leis, R.A. 1976. Impact of social disorganization on behaviour, milk yield, and body weight of dairy cows. *Journal of Dairy Science* 59, 716-721.
- Bouissou, M.F., 1985. Contribution à l'étude des relations interindividuelles chez les bovines domestiques femelles (*Bos taurus*). *Thèse de Doctorat d'Etat*, Université Paris VI, France, 366 pp.
- Bouissou, M.F., Boissy, A., Le Neindre, P., Veissier, I. 2001. The social behaviour of cattle. In: Keeling, L.J., Gonyou, H.W. (Eds.), *Social Behaviour in Farm Animals*. CABI Publishing, Wallingford, UK, pp. 113-145.
- Broom, D.M. 1996. Animal welfare defined in terms of attempts to cope with the environment. *Acta Agricultura Scandinavica, Section A, Animal Science, Supplementus* 27, 22-28.
- Burrow, H.M. 1997. Measurement of temperament and their relationship with performance traits of beef cattle. *Animal Breeding Abstracts* 65, 478-495.
- Dahlgren, I. 2010. A Comparison of group housing and individual housing for dairy bulls kept for breeding. Student Report 335, Swedish University of Agricultural Sciences, Department of Animal Environment and Health, Skara.
- Dannenmann, K., Buchenauer, D. & Fliegner, H. 1985. The behaviour of calves under four levels of lighting. *Applied Animal Behaviour Science*, 13, 243-258.
- Duncan, I.J.H. 1996. Animal welfare defined in terms of feelings. *Acta Agricultura Scandinavica, Section A, Animal Science, Supplementus* 27, 28-36.
- Grandin, T. Cattle vocalisations are associated with handling and equipment problems at beef slaughter plants. *Applied Animal Behaviour Science*, 711, 191-201.
- Fraser, A.F. 1983. The behaviour of maintenance and the intensive husbandry of cattle, sheep and pigs. *Agriculture. Ecosystems Environment.*, 9, 1-23.
- French, J.M., Moore, G.F., Perry, G.C. & Long, S.E. 1989. Behavioural predictors of oestrus in domestic cattle. *Animal Behaviour*, 38, 913-919.
- Hall, S.J.G. 1989. Chillingham cattle: social and maintenance behaviour in an ungulate which breeds all year round. *Animal Behaviour* 38, 215-225.
- Hall, S.J.G., Vince, M.A., Walser, E.D. and Garson, P.J. 1988. Vocalisation of the Chillingham cattle. *Behaviour* 104, 78-104.
- Haupt, K.A. and Wollney, G., 1989. Frequency of masturbation and time budgets of dairy bulls used for semen production. *Applied. Animal Behavioural Science*, 24, 217-225.
- Klemm, W.R., Sherry, C.J., Schake, M.L., & Sis, R.F. 1983. Homosexual behaviour in steers- and aggression hypothesis. *Applied Animal Ethology*, 11, 187-195.

- Kropp, J.R., Holloway, J.W., Stephens, D.F., Knori, L., Morrison, R.D., Totusek, R. 1973. Range behaviour of Hereford, Hereford x Holstein and Holstein non-lactating heifers. *Journal of Animal Science* 36, 797-802.
- Jensen, P. 2002. The Ethology of Domestic Animals, An Introductory Text. *CABI Publishing*.
- Lanier, J.L., Grandin, T., Green, R., Avery, D., McGee, K. 2001. A note on hair whorl position and cattle temperament in the auction ring. *Animal Behaviour Science* 73, 93-101.
- Phillips, C. 2002. Cattle Behaviour & Welfare 2<sup>nd</sup> Edition. Blackwell Publishing
- Reinhardt, V and Reinhardt, A. 1982. Mock Fighting. *Behaviour* 81, 1-13
- Roy, P.K. and Nagpaul, P.K., 1986. Influence of genetic and non-genetic factors on temperament and milking parameters in dairy animals. *Indian Journal of Animal Production Management*. 2, 11–15.
- Rushen, J., Boissy, A., Terlouw, E.M.C. and de Passillé, A.M.B. 1999. Opioid peptides and behavioral and physiological responses of dairy cows to social isolation in unfamiliar surroundings. *Journal of Animal Science* 77, 2918–2924.
- Sandem, A.I., Braastad, B.O. & Bøe, K.E. 2002. Eye white may indicate emotional state on a frustration-contentedness axis in dairy cows. *Applied Animal Behaviour Science* 79, 1 – 10.
- Schutz, M.M, Pajor, E.A. 2001. Genetic control of dairy cattle behaviour. *Journal of Dairy Science* 84, p31-p38.
- Silver, G.V. & Price, E.O. 1986. Effects of individual vs. group rearing on the sexual behaviour of prepubertal beef bulls, mount orientation and sexual responsiveness. *Applied Animal Behaviour Science*, 15, 287-294.
- Statens jordbruksverks föreskrifter och allmänna råd (SJVFS 2010:15) om djurhållning inom lantbruket m.m.; saknr L100, 2 kap., 2§).
- Vitale, A.F., Tenucci, M., Papiri, M. & Lovari, S. 1986. Social behaviour of the calves of semi-wild Maremma Cattle, *Bos primigenius taurus*. *Applied Animal Behaviour Science*, 126, 217-231.
- Warnick, V. D., Arave, C. W. & Nickelsen, C. H. 1977. Effects of group, individual, and isolated rearing of calves on weight gain and behaviour. *Journal Dairy Science*. 60, p. 947-953.
- Watts, J.M., Stookey, J.M. 2000. Vocal behaviour in cattle: the animal's commentary on its biological processes and welfare. *Applied Animal Behaviour Science* 67, 15–33.