



**Behaviour of Young Dairy Bulls under
Group Housing Conditions and Mature
Dairy Bulls during Semen Collection**

Iftikhar Ali

Master of Science Programme in Veterinary Medicine
for International Students
Faculty of Veterinary Medicine and Animal Science
Swedish University of Agricultural Sciences

Skara 2005

Report - Master of Science Programme in Veterinary Medicine for
International Students
Faculty of Veterinary Medicine and Animal Science
Swedish University of Agricultural Sciences
Report no. 52
ISSN 1403-2201

**Behaviour of Young Dairy Bulls under Group
Housing Conditions and Mature Dairy Bulls
during Semen Collection**

Iftikhar Ali

Department of Animal Environment and Health
Faculty of Veterinary Medicine and Animal Science

**Swedish University of Agricultural Sciences
Skara 2005**

The present thesis is a partial fulfilment of the requirements for a Master of Science Degree in Veterinary Medicine for International Students at the Swedish University of Agricultural Sciences (SLU), in the field of Ethology

Iftikhar Ali,
Department of Animal Environment and Health
Faculty of Veterinary Medicine and Animal Science
Swedish University of Agricultural Sciences (SLU)
P.O. Box 234, SE- 532 23 Skara, Sweden
Print: SLU Service/Repro, Uppsala 2005

Dedication

**To my father who spent his whole life and energy to make me
grown up and educated
To my mother who bore all kinds of hardships to bring up
seven children
To my sisters who always pray for me
To my brothers who helped and encouraged me in all aspects of
my life
To my country 'Pakistan' which gave me my own identity in the
world**

Contents

Abstract	7
Introduction	9
Aims of the investigation	11
Review of literature	13
Dairy breeds in Sweden	13
Swedish Red (SR) cattle history	13
Swedish Holstein (SH) cattle history	13
SR sexual development	14
Housing systems	14
Behaviour of bulls in natural feral cattle	15
Behaviour of bulls in groups under farm conditions	15
Effect of remixing and re-grouping on welfare of bulls	16
Sexual stimulation	17
Reaction time (RT)	18
Collection Interval	18
Acknowledgements	21
References	23
Paper I	
“Behaviour of Young Dairy Bulls under Group Housing Conditions”	1
Abstract	1
Introduction	2
Material and methods	4
Materials	4
Animals	4
Housing	5
Pens	5
Feed and management	6
Methods	6
Animals observed and individual marking	6
Behavioural observations	7
Statistics	8
Results	9
General behaviour of bulls	9
Effect of age	9
Effect of observer	11
Effect of breed	11
Social behaviour of bulls	11
Individual social behaviour	13
Discussion	15
Conclusion	18
Acknowledgements	18

References	19
Paper II	
“Behaviour of Mature Dairy Bulls during Semen Collection”	1
Abstract	1
Introduction	2
Material and methods	4
Housing and management	4
Housing	4
Feed and management	5
Semen collection hall	5
Handling staff	6
Semen collection management	6
Methods	6
Behavioural recordings	7
Volume and concentration of semen	8
Statistical methods and calculations	8
Results	9
Reaction time and factors affecting	9
Part I (Sexual stimulation period)	9
Part II (First ejaculation period)	10
Part III (Second ejaculation period)	12
Behaviour of bulls during semen collection	13
Semen volume and concentration	15
Volume	15
Concentration	15
Total sperms collected (TSC) per ejaculate	17
Discussion	18
Conclusion	21
Acknowledgements	21
References	22

Abstract

Ali, I. 2005. 'Behaviour of young dairy bulls under group housing conditions and mature dairy bulls during semen collection'

Master Science's thesis No. 52 ISSN 1403-2201

This thesis consists of two studies carried out at a semen collection centre (Svensk Avel) in the South-West part of Sweden.

The first aim was to observe the behaviour of young dairy bulls under group housing conditions and difference in the aggressive and other social interactions between the bulls. Behaviour of 163 bulls of Swedish Holstein (SH) and Swedish Red and White Breed (SRB), from 1.5 to 4 years, was observed. The bulls were housed in groups of 7-12/pen in 16 different pens in two half open buildings. The bulls were divided into three age groups (2, 3 and 4 year). Statistical analysis was done to test the difference of age, breed and observer on the general behaviours, and the effect of age, breed and breed*age on the social interactions. A significantly higher percentage of lying in the 2 year age groups, ruminating standing in the 3 year age groups and rubbing walls in the 4 year age groups was found. Aggressive behaviour was the major social interaction among the bulls of all age groups. Mounting was significantly higher for the 2 year age groups and lower in 4 year age groups. It was concluded that the bulls living under group housing conditions spent most of their time standing, eating and lying ruminating (during our observation period). The bulls showed a quite high level of aggressive behaviours, but that did not seem to cause harm to their health. There were no differences in the aggressive behaviours between breeds and age groups.

The second purpose was to observe the behaviour and the reaction time (RT) of mature dairy bulls during semen collection and the effect of handling staff (3 persons at a time) and other factors during semen collection. Effect of delayed RT on semen quantity, semen quality and total sperm collected (TSC) per ejaculate was also investigated. Behaviour of 18 bulls (13 SRB and 5 SH) was recorded. The bulls were divided into four age groups (5, 6, 7 and 8 year). Statistical analysis was done to investigate the effect of day (once or twice a week), order (of the bulls 1-9, during semen collection), age group, handler A, B and collector (seven people handling bulls on different days) on RT, behaviours, semen quantity, semen quality and TSC. The RT to first mount, first semen collection and second semen collection was 253.84 s, 91.08 s and 110.02 s respectively. A significant effect of handler B and day on RT to first ejaculation was found. Walking, sniff teaser and vocalize tended to be affected by handler A. A significant negative correlation between RT and semen quality, RT and TSC in the first semen ejaculates was found. A higher number of sperms per ejaculate were collected from the bulls being collected once a week. It was concluded that RT and some behaviours of the bulls was affected by the presence of different handling persons in the semen collection hall. Moreover long RT caused a decreased TSC with low quality.

Keywords: dairy bulls; group housing; behaviour; aggression; social interactions; reaction time; semen quantity; semen quality; total sperm collected

Introduction

Swedish Red (SR) and Swedish Holstein (SH) are the most common dairy breeds in Sweden. Bulls used for semen collection have traditionally been kept on individual tie stalls while waiting for the evaluation of their progeny testing. Since cattle are highly social domestic animals (Bouissou *et al.*, 2001) a new way of keeping bulls in groups was introduced by Svensk Avel, Sweden in 1987. Group housing of cattle is a much discussed topic in Europe and group housing is compulsory in the European Union for calves over eight weeks of age (Council Directive 97/2/EC, 1997). There is no such regulation for keeping older bulls in group housing system. The group size of bulls, at Svensk Avel, is near to the natural feral group sizes. Bulls from one and a half to four years of age are kept in groups of 7-12 bulls per pen which is similar to the numbers previously reported in feral groups (Bouissou *et al.*, 2001). Outside the mating period, three to four year old males have been reported to live either solitary or in male groups of two to ten individuals (Bouissou *et al.*, 2001).

Aggressive behaviour is commonly observed among bulls at pasture (Kilgour & Campin, 1973), in feedlots (Gonyou & Stricklin, 1984), in paddock (Hunter & Edwards, 1964) and in natural feral cattle (Schloeth, 1958, 1961; Hall, 1989). Agonistic behaviour as a major behavioural response in bulls was also recorded by Jago *et al.* (1997). At Svensk Avel most of the fighting problems have been observed among bulls which are either 1.5 or 4 years old. Bulls often start fighting just after being placed into new groups at Svensk Avel at the age of 1.5 year. These bulls, before coming to Svensk Avel, had been kept in groups at Falkenberg bull station. Then bulls remain almost in the same groups up to the four year of age. The fights stop after a period of time, but bulls start fighting again just before four years of age. This is probably age of bulls when they become dominant, because in feral cattle middle-aged males (3-5 years) tend to become dominant (Bouissou *et al.*, 2001). May be, there are only one or two bulls in each group who disturb the equilibrium of the whole group at Svensk Avel. Either these bulls have become bullied (always fight with other bulls) or they are high ranked (dominant) bulls in that group. When bulls at Svensk Avel reach the age of four years it is not possible to keep them in groups any more because of the hard fighting among the bulls. So, bulls have to move to individual pens. According to the knowledge of the author there is no behavioural study that has been done in the past on young bulls kept in this kind of group housing system. Behaviour is a sensitive measure of animal welfare, probably more sensitive than animal health or production because it is elastic and easily modified in stressful conditions (Raussi, 2005). Welfare is defined as the quality of life experienced by an animal (Bracke, Metz & Spruijt, 2001). Behaviour of feral cattle can give us some clue about the natural behaviour of bulls (Bouissou *et al.* 2001). In this study we have observed the behaviour of bulls kept under farm condition and tried to compare with behaviour of bulls in feed lots, paddocks, pasture and the natural feral cattle.

At Svensk Avel variations in reaction times have been observed in the mature bulls when the semen was collected. Some times a normal healthy bull takes a longer time for semen collection than normal and some times even it refuses to

give semen. The entire procedure of semen collection mentioned by Collins, Bratton & Henderson (1951) was followed at Svensk Avel. Usually semen is collected from a bull within one ejaculatory thrust and that might take a few seconds. The period of time during which the bull approaches the mount prior to copulation has been termed the reaction time (RT) (Mercier, Bratton & Salisbury, 1949; Kerruish, 1955). The factors affecting RT of bulls like; attendants and nearby structures (Kerruish, 1955) as well as psychological and other factors (Fraser, 1960) has been discussed in detail. Better quality semen have been obtained from bulls restrained for a while just before semen collection (Collins, Bratton & Henderson, 1951) and some other studies have also reported the same results (Amann & Almquist, 1976; Hale & Almquist, 1960; Hafs, Knisely & Desjardins, 1962; Foster, Almquist & Martig, 1970; Hafs, 1972; Almquist, 1973). Restraining a bull for a while near the mount animal before semen collection was termed as *sexual preparation* (Amann & Almquist, 1976). Moreover they have discussed the methods to decrease RT. According to the knowledge of the author the factors affecting RT in the semen collection room and the effect of delayed RT on semen collection has not been studied in detail before.

It should be noted that most of the literature on the sexual behaviour of the cattle is between 20 and 50 years old, and much is descriptive in nature. There appears to be a need for the conduct of some rigorous hypothesis testing in this subject area (Petherick, 2005). The first purpose of this study was to observe general and social behaviour of young dairy bulls under group housing conditions and to investigate the difference in the aggressive and other social interactions. Moreover, if there was any homosexual, bullee or dominant bull in the groups. The assumption was that there was a big difference in the aggressive behaviour of the bulls in different age groups and that the youngest and the oldest bulls would fight the most. The second purpose of this study was to observe behaviour, RT, factors affecting RT and effect of long RT on semen volume, semen concentration and total sperms collected (TSC) per ejaculate in mature dairy bulls during semen collection. It was supposed that there was no effect of RT on semen volume, semen concentration and total sperm produced per ejaculate. To start with a detailed literature review is provided in this thesis.

Aims of the investigation

The general aim of this study was to observe the normal behaviour of the two most prevalent breeds of Swedish dairy bulls when they were kept under group housing conditions (from 1.5 to 4 years of age) and during semen collection. The research has been split up into two studies.

More specifically the aims of the first study were to investigate;

- 1) The difference in general behaviour between different breeds and age groups
- 2) The difference in the social behaviours, especially aggressive behaviours, between breeds and age groups.
- 3) Whether there was any kind of affiliation developing among the bulls reared in groups; as for example if there was any type of sexual relation (homosexuality), any sub-grouping within the main groups, any dominant, bullee, rider or buller bull in a group?

The second purpose of this study was to investigate;

- 1) Why some bulls show long 'RT to first mount' and long 'RT to first and second ejaculate' and which factors cause the difference in time and what the ultimate effect of that delayed RT has on semen volume, semen concentration and total sperms collected per ejaculate.
- 2) If the bulls behave differently towards the different handlers.
- 3) Whether bulls need less time for preparation, semen collection and produce a higher volume, better concentration of semen and higher TSC with some handlers.

Review of Literature

Dairy breeds in Sweden

Swedish Red (SR) and Swedish Holstein (SH) are the most common dairy breeds in Sweden.

Swedish Red (SR) cattle history

The local name for SR is *Svensk Röd och Vit Boskap* in Swedish, and synonyms for this is Swedish Red and white Breed (SRB) in English. The total population of SR animals in Sweden is 486,638 (Swedish register of bovine animals CDB, 2005) and the range of use is *milk production*. The breed originates from Red Pied Swedish and Swedish Ayrshire, which merged to form the Swedish Red and White Breed (SRB) in 1927. The Ayrshire breed was a result of earlier import from Scotland. These two breeds were approximately equal in size and yield. After turning both breeds into one, the attention was directed towards the conformation and milk production traits. The breeding objective was pure breeding of high-yielding dairy cattle (<http://neurocad.lva.lt/Breeds/SwedishBreeds.htm> 4 Nov. 2005).

The breed has had influence from other breeds only for a short time. As early as in the late 1950s a lot of Ayrshire bulls were used in Sweden, and in the 1960s many bulls of Finnish Ayrshire were imported. From the 1970s there has been an interchange of semen with Norway and Finland, which means that there has been a large influence from Norwegian and Finnish red and white dairy cattle breeds. As a result, the red and white dairy cattle in these countries in fact belong to one large Nordic population of about 700,000 cows. In Sweden, however, the term Swedish Red (SR) is used instead of Swedish Red and White Breed (SRB) (Håård, pers. comm.). Even though there has been quite some exchange of semen there are still differences between the countries due to differences in the breeding goals.

The SR animals are red with small white markings. They are spread all over the country, but are mainly found in the south and central regions of Sweden, with the exception of the southern provinces of Skåne and parts of Halland, where mostly Swedish Holstein is held. The SRB has for a long time been one of the breeds with the highest milk yield in the world. The breed is also known for high fertility, easy deliveries and a good temperament. These days there is a big demand for semen of SR bulls in USA and other big markets in the world. In short the reasons for the success are that there is no Holstein blood in SRB, they combine production and proofs for health traits (<http://neurocad.lva.lt/Breeds/SwedishBreeds.htm> 4 Nov. 2005).

Swedish Holstein (SH) cattle history

The local name for Swedish Holstein is *Svensk Låglandsboskap (SLB)*. The total population in Sweden is 596.634 (Swedish register of bovine animals CDB, 2005) and range of use is milk production. The Swedish Friesian cattle breed was established in Sweden around 120 years ago. The first SLB cow in Sweden was

imported from the Netherlands and from different German regions, most of them from the old Friesland. During hard work to increase the average milk yield of the Swedish cows in the 1870s, a large number of Holstein-Friesian animals were imported. They were established as specialised breeding herds, and thereafter the breed spread to other herds, resulting in Holstein-Friesian gradually becoming the most common breed in the southern part of the country. Further imports have been done in the 1930s and 1950s. The first imports of Holstein were cows of a pronounced dairy type. In Sweden, and particularly in the province of Skåne, the breeding efforts during the 1940s and 1950s have resulted in the individuals with shorter legs and a wider body than the original Holstein-Friesian. During the 1960s, when the number of dairy cows decreased very much, the SH breed spread into the rest of Sweden and is now common all over the country. Holstein-Friesian cattle were also exported to North America, and since the 1970s, semen from Holstein Friesian has been imported into Sweden from the USA. The typical American Holstein was then a taller and heavier cow with an excellent udder shape and a very strong skeleton. These imports have improved the Swedish SLB especially regarding milk yield and udder characteristics. The extensive import and use of North American Holstein bulls is the reason why there are now very few pure-bred Swedish Friesian cows in the country. The breed is characterised by high milk yield (<http://neurocad.lva.lt/Breeds/SwedishBreeds.htm> 4 Nov. 2005).

SR sexual development

In Sweden bulls are generally selected at an age between 11 and 12 months of age and by the age of 14 months AI organisations like to see that the majority of bulls have their semen distributed for progeny testing (Håård, pers. comm... It is known that many bulls at that age have reached a stage of development characterized by considerable growth and manifestation of secondary sexual characteristics. Bulls of the SRB, however, reach the age of puberty much earlier than this age as revealed by microscopical examination of testicular tissue (Lagerlöf, 1934; Knudsen, 1954; Abdel-Raouf, 1960, 1961).

Viable spermatozoa have also been obtained from other breeds in ages earlier than 15 months (Van Demark *et al.*, 1956; Baker, Van Demark & Salisbury, 1955; Flipse *et al.*, 1953; Davies *et al.*, 1957). Hooker (1944) stated that calves exhibited sexual behaviour as early as at 5 ½ months of age. Flipse *et al.* (1953) obtained the first ejaculate from low level fed Holstein bulls at 57 weeks of age and from high level fed ones at 41 weeks. Baker, Van Demark & Salisbury (1955) and Van Demark *et al.* (1956) obtained the first ejaculate from Holstein bulls at the age of 38 weeks. Using electro-ejaculation, Davies *et al.* (1957) obtained sperm from high level fed Shorthorn bulls at the age of 9 ½ months and from low level fed brothers at 10 ½ months. According to Abdel-Raouf (1965) healthy SRB-bulls normally attain puberty at 40 weeks of age.

Housing systems

In the European Commission (SNCO.C.2/AH/R22/2000) it is reported that Swedish Legislation requires a minimum surface of 4.5 m² per head of cattle in excess of 400 kg in loose deep litter housing (Jordbruksinformation 2-1998).

However, they have not mentioned the space required for bulls when they are kept in groups. Permanent tethering of fattening cattle in tie-stalls is common in small units in Scandinavia and part of Germany (SNCO.C.2/AH/R22/2000).

Behaviour of bull calves aged 3-16 months in two different housing systems has been investigated (Lidfors, 1992). Changes of the housing environment often result in abnormal behaviours, some of which is stereotyped, such as tongue-rolling, but also excessive licking and grooming which develops rapidly in intensively housed cattle with inadequate space and diet (Phillips, 2002). No effect on eating behaviour but an increase in weight gain by increasing space was observed in beef bulls (Andersen *et al.*, 1997). The bulls waiting for progeny testing are kept in paddocks in North Australia (Fordyce *et al.*, 2002), in feed lots in America (Klemm *et al.*, 1983/84) and on pasture in America (Blackshaw, Blackshaw and McGlone, 1997).

A survey on the bull housing systems in European countries has recently been presented by Ruigh (2005). She reported that most of the bulls (while waiting for their progeny testing) are housed in closed barns in individual housing systems, some are in half open group housing systems, some are in open groups housing system and very few are on pasture/grazing.

Behaviour of bulls in natural feral cattle

Behaviour of feral cattle can give us some clue to the behaviour of bulls in natural environments. Behaviour of Chillingham cattle kept in a closed park, in the northern England, for more than 700 years with minimum human interference was observed by Hall (1986, 1989). Feral cattle has also been studied on Amsterdam, an island southwest of Madagascar (Daycard, 1990), the Maremma cattle in Italy (Lucifero, Janella & Secchiari, 1977), a population of 140 animals running in the south of Spain (Lazo, 1994) and a herd in the Orkney islands (Hall & Moore, 1986). Also observations have been done of domestic cattle that are free-ranging as for example the Camargue cattle (Schloeth, 1961), a herd in Utah (Howery *et al.*, 1996) and a small mixed herd on the Isle of Rhum (Clutton-Brock, Greenwood & Powell, 1976).

Groups of two to ten bulls of 3-4 years were observed in different studies about the natural feral cattle (Bouissou *et al.*, 2001). Individual bulls or small groups of 2-4 bulls, and rarely more than four bulls remained in specific domain all the time after feeding (Hunter & Edwards, 1964). Solitary bulls were observed in Donana feral cattle (Lazo, 1994).

Behaviour of bulls in groups under farm conditions

Abdel-Raouf (1965) reported that the bulls kept with heifers or in male groups become mature earlier than the bulls kept separately. Social behaviour among bulls can roughly be divided into agonistic and non-agonistic encounters. Agonistic interactions include aggressive acts and responses to aggression, mainly avoidance or flight. Non-agonistic interactions include social licking and sexual

behaviour (Bouissou *et al.*, 2001). Anogenital and rump lickings, as well as licking of the penis in bulls, are more associated with sexual behaviour. Lickings in young bulls are often preceded by a solicitation to be licked, including the adoption of a special posture with the head and neck lowered and often with slight bunts under the neck or chest (Bouissou, 1985; Sato & Maeda, 1991).

The dominant bull will butt its opponent in the side or rump if the threatened animal is too slow to submit or fails to notice the threat. In a well-established hierarchy, the threatened animal will spontaneously retreat and take a submissive posture, with its head held low and directed away from the opponent (Bouissou *et al.*, 2001). Before dominance relationships are established, fights may occur. Fighting is displayed by head-to-head, followed by head to neck combat (Bouissou, 1985). Most of the fights are short, 80 % last less than one minute, but the duration can vary from a few seconds to one hour (Bouissou, 1974). Buller-steer syndrome in beef bulls was observed by Blackshaw, Blackshaw and McGlone (1997) and Lott (1984). In this syndrome bulls always mount on the same bulls until the mounted bull become injured and loose weight. Homosexual behaviour in the bulls was studied by Klemm *et al.* (1983/84) and Jezierski *et al.* (1989).

Management of bulls waiting for evaluation of their progeny testing have been discussed by Hunter and Edwards (1964). Bulls awaiting results from progeny testing represent the future of an artificial breeding organization. The adage “out of sight, out of mind” should never apply to such a bull (Amann & Almquist, 1976). Even if semen is not banked, two successive ejaculates should be collected every 4 weeks from each bull in the stud to observe semen quality and testicular examination (Amann & Almquist, 1976). Unimpaired effect of sexual rest for 3 ½/4 years in dairy bulls was observed (Hunter & Edwards 1964).

Effect of remixing and re-grouping on welfare of bulls

Mixing is a stressor for cattle based on animal behaviour, stress physiology and production. Mixing-induced stress might vary for animals depending on their age (Raussi, 2005). Council of Europe (1988) recommends that ‘bulls should not be added to a group already formed.’ Mixing of bulls before slaughter causes behavioural interactions that lower the glycogen content of muscles, resulting in a higher ultimate carcass pH (Warriss, *et al.*, 1984). Placing one new bull in the already established group of bulls was a problem (Hunter & Edwards, 1964). Attempts to create familiarity through the use of common odours applied to pigs prior to regrouping have not reduced the level of aggression (Friend, Knabe & Tanksley, 1983; Gonyou, 1997). Altogether negative effects of mixing on animal welfare and production are considered so great that regrouping should, when possible, be completely avoided (Hasegawa *et al.*, 1997). A method of mixing a new bull in a group was introduced by Hunter & Edwards (1964) but pre-requisite for that was a sexual rest of that bull for at least four weeks, but preferably 8 weeks before they were turned loose together.

Mixing can also cause problems in other animals; like in pigs, fighting and stress responses following mixing, especially during the embryo implantation period,

can affect reproduction (for review: Arey & Edwards, 1998). So, the pig Welfare Advisory Group (DEFRA, Development for Environment, food and Rural Affairs, UK) advised avoidance of mixing sows.

Sexual Stimulation

Sexual stimulation is the presentation of a stimulus situation adequate to illicit mounting and ejaculation (Amann and Almquist, 1976). Sexual stimulation should not be confused with Sexual preparation. *Sexual preparation* is prolonging stimulation of the bull beyond that needed to induce mounting and ejaculation; this result in more or enhanced contractions of the muscles involved in emission and ejaculation of semen (Amann and Almquist, 1976). Sexual preparation will increase the number of sperm ejaculated (Amann, 1990). At A.I. Organizations and to some extent on farms where a rigid routine of controlled mating is practiced, adequate sexual stimulation prior to ejaculation is not provided. Compared to natural pasture mating, the preliminary courtship and displays of masculinity and libido are absent. Sex drive is consequently reduced as well as the vigor of the ejaculatory reflex. With lowered sex drive relaxation is prolonged and longer periods of sexual continence are required between collections (Kerruish, 1955). Kerruish (1955) found a significant improvement in sexual behaviour and an 8.7% rise in conception rate when ten bulls were placed for five months on regimes of intensive sexual stimulation prior to semen collection. Five months prior to intensive sexual stimulation, the ten bulls had been on a sexual regime of inadequate sexual stimulation.

A comparison of spermatological characteristics and fertility rates from semen collected after different lengths of sexual preparation time was performed by Kommissrud and Berg (1996). Semen volume was found to be significantly higher in the 12 Norwegian bulls used when sexual preparation time was less than 15 minutes compared to longer preparation. Several studies have confirmed that the sexual performance of bulls was enhanced by allowing them to view their cohorts engaged in copulatory behaviour (Blockey, 1981). A study by Mader and Price (1984) also demonstrated that in the context of controlled mating, sexual performance is slightly improved by a bull being restrained in close proximity to a stimulus female, and by being watched by another male while engaged in sexual interactions.

Two trials were conducted by Almquist (1973) using Angus and Hereford bulls to determine the effects of sexual preparation by false mounting on sperm output, semen trials and sexual activity. The data were compared with data for Holstein bulls collected twice in succession on one day per week after three false mounts or one false mount. In this study it required nearly 10 times longer time to stimulate beef than dairy bulls, to first mount, and about three times longer to collect two successive ejaculates with three false mounts from beef than dairy bulls. However, giving 3 false mounts rather than no false mounts before semen collection had increased sperm output by about 50% in the first ejaculates for both beef and dairy bulls. Almquist (1973) found that changes of stimulus animal and semen collection location were commonly required to stimulate many of the beef bulls and to maintain their sexual interest during sexual preparation.

Reaction Time (RT)

The period of time during which the bull approaches the mount prior to copulation has been termed the reaction time (Mercier *et al.*, 1949; Kerruish, 1955; Kushwaha, Mukherjee & Bhattacharya, 1955). According to Hale & Almquist (1959) 'The interval between presentation of the bull to the stimulus animal and his initial mount is termed reaction time'. In a semen collection environment, this time should be kept to a minimum for efficiency. Various researchers have recorded many factors influencing reaction time in past years. Kushwaha, Mukherjee & Bhattacharya (1955) have observed that season may be a factor. These researchers reported significant differences between seasons in India for reaction time in bulls. Certain breeds are believed to have a long reaction time as a general rule. Couttie & Hunter (1956) claimed that fat bulls, particularly the Aberdeen Angus breed, have a lack of libido and are slow to serve. Lagerlöf (1954) has shown that breed type has an influence on the willingness of the animal to copulate. Almquist and Hale (1956) have observed that the frequency of copulation will ultimately increase the reaction time of a bull.

A number of extraneous factors such as attendants and nearby structures can affect the bull's reaction time (Kerruish, 1955). Several authors have reported that some hormones can have such an influence in bulls and other mammals (Petersen *et al.*, 1941; Beach, 1957; Lagerlöf, 1954; Asdell, 1955). Frequency of copulation will ultimately increase the reaction time of the bull. This was observed by Baker, Van Demark & Salsbury (1955). With the objective of seeking further information on reaction times, Fraser (1960) observed bulls at service over a period of 4 years. The breeds observed were Holstein, Ayrshire, Jersey, Shorthorn, Brahman, Hereford and Aberdeen Angus. The average reaction time found for all the breeds was 12.5 minutes. Fifty per cent of the bulls commenced copulation or a mounting attempt within two minutes of encountering the teaser animal. Fraser (1960) found that for bulls 4 years of age and over, the reaction time of beef breeds was significantly greater than that of dairy breeds. The interval between the presentations of the bull to the stimulus animals until ejaculation is called the *reaction time to ejaculation (RET)* (Amann & Almquist, 1976).

Collection Interval

The number of days between the semen collections can have an effect on the reaction time and sperm output. A higher number of sperm was obtained from the bulls collected after eight days as compared to bulls collected after four days (Bratton, Foote & Henderson, 1954). Shorter intervals between collection days caused ejaculate volumes to decrease slightly, sperm concentration to decrease markedly, and sperm output per unit of time to increase considerably (Hafs, Hoyt and Bratton, 1959; Hale & Almquist, 1960; Seidel and Foote, 1969). Similar trends were observed by other researchers (Amann, 1990; Bratton, Foote & Hensteron, 1954) when successive ejaculates were collected on the same day, especially when sexual preparation was intense for each ejaculate.

Amann & Almquist (1976) reported that 3.5 times more motile spermatozoa could be collected from 1 to 2 year old Holstein bulls when six ejaculates per week were collected as compared with one ejaculate per week. However, 40% more time was required to obtain an ejaculate on the six ejaculates per week schedule with one ejaculate collected daily. With appropriate sexual preparation, these authors concluded that similar spermatozoa harvests could be achieved by collecting two to three ejaculates every 3 to 4 days. As short as 15 minutes was the time within which high libido dairy bulls may perform two ejaculates (Mader & Price, 1984).

Acknowledgements

I would like to say thanks to Dr. Sajjad Arshad chairman PVMA, Punjab Zone, Pakistan for selecting and providing me scholarship to study abroad. I have learned some Swedish Language and I would like say thanks to my Swedish Colleagues in Swedish.

Jag vill framföra mitt varma tack till min handledare Lena Lidfors för hennes ovärderliga stöd, ledning och tålamod. Jag vill också tacka Marie Sundberg och Karin Östensson för att de erbjöd mig att delta i SIPAR: s internationella Mastersprogram.

Ett särskilt tack går till Margareta Håård för hennes hjälp, tid och rådgivning under projektet och under min tid på Svensk Avel. Jag är också tacksam för all tid och hjälp som den övriga personalen bidragit med. Svensk Avels tjurar och faciliteter möjliggjorde detta projekt.

Jag vill tacka Stefan Lundqvist för att han bidrog med den utrustning jag behövde för att kunna genomföra mina observationer och jag uppskattar verkligen att Per Samuelsson gång på gång hjälpte mig med den flyttbara plattformen. Det var en underbar konstruktion för att kunna observera tjurarnas beteende ”från ovan”.

Jag vill tacka de personer som arbetade med tjurarna; Jörgen Andersson, Fredrik Johansson (en rolig prick), Tore Stockman, Peter Andersson, Tommy Emanuelsson (en stark man), Gunnar Stockman och Annika Linder. Utan er hade detta projekt inte varit möjligt att genomföra. Ni accepterade min närvaro utan klagomål och jag ska alltid komma ihåg de roliga samtalen med Fredrik och Annika när vi märkte tjurarna.

Jag är tacksam för att Johani Karhonen och Karin Landström höll mig sällskap de ensamma dagarna och jag ska aldrig glömma hur roligt vi hade när vi arbetade på deras gård. Jag kommer inte heller att glömma Brogården som vissa nätter var min enda vän, vilket ibland skrämde mig!

Ett varmt tack till Jan Nilsson, Jan Hultgren, Per Peetz Nielsen och Gunilla Jacobsson för att de hjälpt mig med dataarbete såsom statistik och grafer. Det var också roligt att lära sig spela innebandy av Jan Nilsson med flera.

Tack till Stefan Gunnarsson för att han introducerade mig och min forskning i samband med min presentation.

Jag måste säga tack till Åsa Regnander-Dahl för att hon läst och rättat det jag skrivit och för att hon visat mig Härjedalens Fjällvärld och sitt bästa Hjortronställe.

Min erfarenhet av Svenska människor är att de är trevliga och hjälpsamma!

References

- Abdel-Raouf, M. 1960.** The postnatal development of the reproductive organs in bulls with special reference to puberty. *Acta Endocrinol. Suppl.* 49.
- Abdel-Raouf, M. 1961.** The proliferation of germ cells in testes of bull calves and young bulls. *Acta Vet. Scand.* 2: 22-31.
- Abdel-Raouf, M., 1965.** Sexual behaviour and semen picture of bulls of the Swedish-Red-and-White Breed between the age of 9 and 15 months. *Nord. Vet. Med.*, 17: 318-322.
- Almquist, J.O., 1973.** Effects of sexual preparation on sperm output, semen characteristics, and sexual activity of beef bulls with a comparison to dairy bulls. *J. Anim. Sci.* 36: 331.
- Almquist, J.O. & E.B. Hale, 1956.** An approach to the measurement of sexual behaviour and semen production of dairy bulls. *Proc. 3rd Inter. Anim. Reprod. Plenary Papers*, p 50.
- Amann, R.P. & Almquist, J.O., 1976.** Bull management to maximize sperm output. *Proc. 6th Tech. Conf. Artif. Insemination Reprod. Natl. Assoc. Anim. Breed.*, pp. 1-15.
- Amann, R.P. 1990.** Management of bulls to maximize sperm output. *Proc. 13th Tech. Conf. on A.I. and repro., NAAB. Milwaukee, Wisconsin*, pp 84-91.
- Andersen, H.R., Jensen, L.R., Munksgaard, L. & Ingvarsten, K.L. 1997.** Influence of floor space allowance and access sites to feed trough on the production of calves and young bulls and on the carcass and meat quality of young bulls. *Acta. Agri. Scand. Sect. A, Anim. Sci.* 47: 48-56.
- Arey, D.S. & Edwards, S.A., 1998.** Factors influencing aggression between sows after mixing and the consequences for welfare and production. *Livest. Prod. Sci.* 56: 61-70.
- Asdell, S.A, 1955:** Cattle fertility and sterility. London: Churchill.
- Baker, F.N., Van Demark, N.L. & Salsbury, G.W., 1955.** Growth of Holstein bulls and its relation to sperm production. *J. Anim. Sci.* 14: 746-752.
- Beach, F.A., 1957:** *Physiol. Rev.*, 18, 240.
- Blackshaw, J.K., Blackshaw, A.W. and McGlone, J.J., 1997.** Buller steer syndrome review. *Appl. Anim. Behav. Sci.* 54: 97-108.
- Blockey, M.A.B. 1981.** Development of serving capacity test for beef bulls. *Appl. Anim. Ethol.* 7: 307-319.
- Bouissou, M.F., 1974.** Establishment des relations de dominance-soumission chez les bovines domestiques. II. Rapidité et mode d'établissement. *Annales de Biologie Animale, Biochimie et biophysique* 14: 757-768.
- 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 of Farm Animals*. CABI International, Wallingford, UK, pp. 113-145.
- Bracke, M.B.M., Metz, J.H.M. & Spruijt, B.M., 2001.** Development of a Decision Support System to assess farm animal welfare. *Acta Agric. Scand., Sect. A, anim. Sci. suppl.* 30: 17-20.
- Bratton, R. W., Foote, R. H., & Henderson, C. R., 1954.** Semen production and fertility of mature dairy bulls ejaculated either once at 4-days or 8-day intervals. *J. Dairy Sci.* 37: 1444-1448.
- Collins, W. J., Bratton, R. W. & C. R. Henderson 1951.** The relationship of semen production to sexual excitement of dairy bulls. *J. Dairy. Sci.*, 34: 224-227.
- Council Directive 97/2/EC of 20 January 1997.** Amending Directive 91/629/EEC laying down minimum standards for protection of calves.
- Council of Europe, 1988.** Animal health and welfare. Animals kept for farming purposes. Recommendations adapted by the standing committee of the European Convention for the Protection of Animals Kept for Farming Purposes. Recommendations concerning cattle. Appendix A: Social provisions for bulls kept for breeding or fattening.
- Couttie, M.A. & Hunter, W.K. 1956.** III, *Int. Congr. On Anim. Reprod.*, Cambridge, A.I. papers for Sect. III, pp. 98-100.

- Cutton-Brock, T.H., Greenwood, P.J. & Powell, R.P. 1976.** Ranks and relationships in Highland ponies and Highland cows. *Zeitschrift für Tierpsychologie* 41: 202-216.
- Davies, D. V., Mann, T. & Rowson, L. E. A., 1957.** Effect of nutrition on the onset of male sex hormone activity and sperm formation in monozygous bull-calves. *Proc. Roy. Soc. B.* 147: 332-351.
- Daycard, L. 1990.** Structure sociale de la population de bovines sauvages de l'île d'Amsterdam, sud de l'Océan Indean. *Revue d'Ecologie (La Terre et la Vie)* 45, 35-53.
- Flipse, R. J; Snyder, J. W; Thacker, D. L. & Almquist, J. C., 1953:** Effect of total digestible nutrition intake on growth and reproductive development of dairy bulls. *Pennsylvania Agric. Exp. Sta. Progress Rep.* 104.
- Fordyce, G; Fitzpatrick, L.A; Cooper, N.J; Doogan, V.J; De Faveri, J; & Holroyd, R.G; 2002.** Bull selection and use in north Australia 5. Social behaviour and management. *Appl. Repr. Sci.* 71, 81-99.
- Foster, J., Almquist, J.O. & Martig, R.C., 1970:** Reproductive capacity of beef bulls. IV. Changes in sexual behaviour and semen characteristics among successive ejaculations, *J. Amin. Sci.* 30:245.
- Fraser, A.F., 1960:** The influence of psychological and other factors on reaction time in the bull. *Cornell Vet.* 50: 126-132.
- Friend, T.H., Knabe, D.A. & Tanksley, T.D. Jr 1983.** Behaviour and performance of pigs grouped by three different methods at weaning. *Journal of animal Science* 57, 1406-1411.
- Gonyou, H.W., 1997.** Can odours be used to reduce aggression in pigs? In: 1997 Annual Research Report. Prairie Swine Centre, Saskatoon, pp. 59-62.
- Gonyou, H.W. & Stricklin, W.R., 1984.** Diurnal behaviour patterns of feedlot bulls during winter and spring in northern latitudes. *Anim Sci.*, 58: 1075.
- Hafs, H.D., Hoyt, R.S. & Bratton, R.W., 1959.** Libido, sperm characteristics, sperm output, and fertility of mature dairy bulls ejaculated daily or weekly for 32 weeks. *J. Dairy Sci.* 42: 626-636.
- Hafs, H.D., Knisely, R.C. & Desjardins, C., 1962.** Sperm output of dairy bulls with varying degrees of sexual preparation. *J. Dairy. Sci.* 45:788.
- Hafs, H.D. 1972.** Management of bulls to maximizing sperm output. *Proc. 4th Tech. Conf. anim. Reprod. and A.I.* p. 4.
- Hale, H.D. & Almquist, J.O., 1959.** Managing bull power. *Hoard's Dairyman* 104(9): 508.
- Hale, E. B. & Almquist, J. O., 1960.** Relation of sexual behaviour to germ cell output in farm animals. *J. Dairy Sci.*, 29: 41-47.
- Hall, S.J.G., 1986.** Chillingham cattle: dominance and affinities and access to supplementary food. *Ethology* 71: 201-215.
- Hall, S.J.G., & Moore, G.F., 1986.** Feral cattle of Swona, Orkney Islands. *Mammal Review* 16: 89-96.
- Hall, S.J.G., 1989.** Chillingham cattle: social and maintenance behaviour in an ungulate that breeds all year round. *J. Anim. Behav.*, 1989, 38: 215-225.
- Hasegawa, N., Nishiwaki, A., Sugawara, K. & Ito, I., 1997.** The effects of social exchange between two groups of lactating primiparous heifers on milk production, dominance order, behaviour and adrenocortical response. *Appl. Anim. Behav. Sci.* 51: 15-27.
- Hooker, C. W., 1944.** The postnatal history and function of the interstitial cells of the testis of the bull. *Amer. J. Anat.* 74: 1-37.
- Howery, L.D., Provenza, F.D., Banner, R.E., & Scott, C.B. 1996.** Difference in home range and habitat use among individuals in a cattle herd. *Appl. Anim. Behav. Sci.* 49: 305-320.
- Hultnäs, C. A. 1959.** Studies on mating behaviour and semen picture in young bulls of the Swedish-Red-and-white Breed and on causes of this variation. *Acta. Agric. Scand. Supl.* 6: 1-81.
- Hunter, W.K. & Edwards, J. 1964.** The maintenance of an A.I. stud in an inactive state. *Proc. 5th Int. Congr. Anim. Reprod. Artif. Insem. (Trento)*, 4: 341.
- Jago, J.G.; Bass, J.J. & Matthews, L.R., 1997.** Evaluation of a vaccine to control bull behaviour. *Proc. N. Z. Soc. Anim. Prod.* 57.

- Jeziarski, T.A., Kozirowski, M., Goszczyński, J. & Sieradzka, I., 1989.** Homosexual and Social behaviour of young Bulls of different Geno- and Phenotypes and Plasma concentrations of some Hormones. *Appl. Anim. Behav. Sci.* 24: 101-113.
- Kerruish, B.M. 1955.** The effect of sexual stimulation prior to service on the behaviour and conception rate of bulls. *Br. J. of Anim. Behav.* 3: 125-130.
- Kilgour, R. & Campin, D.N. 1973.** The behaviour of entire bulls of different ages at pasture. *Proc. N.Z. Soc. Anim. Prod.*, 33: 125-138.
- Klemm, W.R., Sherry, C.J., Schake, L.M. & Sis, R.F., 1983/84.** Homosexual Behaviour in feedlot steers: An aggression hypothesis. *Appl. Anim. Ethol.* 11: 187-195.
- Knudsen, O., 1954.** Cytomorphological investigation into the spermiocytogenesis of bulls with normal fertility and bulls with acquired disturbances in spermiogenesis. *Acta Path. Microbiol. Scand. suppl.* Cl.
- Kommisrud, E. & Berg, K.A. 1996.** The influence of duration of sexual preparation on bovine semen characteristics and fertility rates. *Reprod. Dom. Animal.* 31: 369-371.
- Kushwaha, N.S., Mukherjee, D.A. & Bhattacharya, 1955.** *Indian jour. Vet. Sci.*, 25, 317.
- Lazo, A., 1994.** Social segregation and the maintenance of social stability in a feral cattle population. *Anim. Behav.* 48: 1133-1141.
- Largerlöf, N., 1934.** Morphologische undersøchungen uber Veränderungen im Spermabud und in den Hoden bei bullen mit verminderter oder aufgehobener Fertilität. *Acta Path. Microbiol. Scand., Suppl.* 19.
- Largerlöf, N, 1954.** *Acta Endocrinol.*, 17, 239.
- Lidfors, L. 1992.** Behaviour of bull calves in two different housing systems. *Rept.* 30, ISSN 0283-0698. SLU, Sweden.
- Lott D.F., 1984.** The buller steer syndrome in American Bison bulls. *Appl. Anim. Ethol.* 11: 183-186.
- Lucifero, M., Janella, G.G & Secchiari, P., 1977.** Origini, evoluzione, miglioramento e prospettive delle razza bovina Maremmana. *Edagricole, Bologna.*
- Mader, D.R. & Price, E.O., 1984.** The effect of sexual stimulation on the sexual performance of Hereford bulls. *J. Anim. Sci.* 59: 294-300.
- Mercier, E., Bratton, R.W. & Salisbury, G.W. 1949.** Semen production and fertility of dairy bulls related to frequency of ejaculation. *Cornell Vet.*, 49:32.
- Munksgaard, L., Ingvarsten, K.L., Pedersen, L.J. & Nielsen, V.K., 1999.** Deprivation of lying down affecting behaviour and pituitary-adrenal axis responses in young bulls. *Acta Agric. Scand. A. Anim. Sci.* 49: 172-178.
- Petersen, W.E., Spielman, A., Pomeroy, B.S., & Boyd, W.L., 1941.** *Proc. Soc. Expt. Biol. And Med.*, 46, 16.
- Petherick, J.C., 2005.** A review of some factors affecting the expression of libido in beef cattle, and individual bull and herd fertility. *Appl. Anim. Behav. Sci.* 65: 13-20.
- Phillips, C., 2002.** Welfare of dairy cows; in *Cattle Behaviour & Welfare*. Sec. Ed. pp. 10-23.
- Raussi, S., 2005.** Group management of young dairy cattle in relation to animal behaviour and welfare. *Agri. Res. Report*, 71.
- Ruigh, L.D., 2005.** Questionnaire AI vets October 2005, Workshop bull housing. *European A.I. Vets 17th meeting, Cracow.*
- Sato, S. and Maeda, A. 1991.** Social licking patterns in cattle (*Bos taurus*): influence of environmental and social factors. *Appl. Anim. Behav. Sci.* 32: 3-12.
- Schloeth, R., 1958.** Le cycle annuel et le comportement social du taureau de Camarague. *Mammalia* 22: 121-139.
- Schloeth, R. 1961.** Das Sozialleben des Camarague Rindes. *Zeitschrif für Tierpsychologie* 18: 574-627.
- Seidel, G. E. JR. and Foote, R.H., 1969:** Influence of semen collection interval and tactile stimuli on semen quality and sperm output in bulls. *J. Dairy Sci.* 52: 1074-1079.
- SNCO.C.2/AH/R22/2000:** Housing systems: In *Welfare of cattle kept for beef production.*
- Swedish Register of Bovine animals (CDB), 2005.** Data of number of SRB and SH total animals in Sweden. Per. E mail, 15/11/2005. (kerstin.helmerson@sjv.se)
- Van Demark, N. L., Boyd, L. J. & Baker, F. N., 1956.** Potential services of a bull frequently ejaculated for four consecutive years. *J. Dairy Sci.* 39: 1071-1072.

Warriss, P.D., Kestin, S.C. Brown, S.N. and Wilkins, L.J., 1984: The time required for recovery from mixing stress in young bulls and the prevention of dark cutting beef. *Meat Sci.* 10: 53-68.