PREVENTION OF ANTLER GROWTH IN DEER

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Abstract

The behavioural measures of 31 red and 39 fallow deer yearlings prior to, during and following application of rubber ring to prevent antler growth were determined. Animals were mechanically or manually restrained and treated according to their random allocation to one of the following groups: control (C), local anaesthesia only (LC), local anaesthesia and rubber ring application (LR) , rubber ring application only (R).

In a further field trial 45 yearling red deer stags and 84 yearling fallow bucks were randomly allocated to control or rubber ring application.

In both studies the development of the pedicle/antler post treatment was examined at intervals to investigate the percentage of loss of pedicle/antler due to the treatment and to detect possible side effects of the treatment.

In red deer during the first three hours post treatment a significant increase in walking, standing and feeding and a decrease in lying were seen in the R group. Twenty minutes after treatment the R group showed a significantly higher frequency of scratching. In fallow deer a significant increase in frequency of ear flicks was observed in the R group until six hours post treatment. Other activities (walking, standing, lying) varied significantly at some time periods but no consistent patterns were observed.

In both species a substantial reduction of the pedicle/antler could be observed two to four weeks after application of rubber rings. However, the loss of distal parts of the pedicle/antler varied in percentage and time until the loss. A rate of 38-100 % regrowth occurred in the first study in fallow and red deer, respectively.

In red deer the application of rubber rings stopped further antler growth in 36 of 37 stags thirty days after treatment. The loss of pedicle/antler occurred in 60-66.7 %.

In fallow deer 93% pedicle/antler loss occurred in bucks. A rate of 10 % regrowth occurred.

No infections or other untoward side effects of the treatment were seen.

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List of abbreviations

ACTH	adrenocorticotrophic hormone
ANOVA	analysis of variance
as	after slaughter
bpm	beats per minute
C	control
can	cannulation
CIDR	controlled internal drug relaese device
cm	centimeter
ck	creatine kinase
DSP	deer slaughter premises
ECO	enchondral ossification
et. al.	et altera
f	female
FSH	follicle stimulating hormone
g	gram
GnRH	gonadotropin releasing hormone
ha	hectare
hrs	hours
HPA	hypothalamic-pituitary-adrenocortical axis
IGF	insulinlike growth factor
IMO	intramembraneous ossification
IU	international Units
km	kilometer
l	liter
LC	local control
LH	luteinizing hormone
LR	local rubber (anaethetic and rubber ring application)
m	male
µg	microgram
m^2	square meter
ml	milliliter
ng	nanogram
no	number
nmol	nanomol
OPC	ossification pattern change
QA	quality assurance
R	rubber (ring without prior anaethesia)
re	remote
sec	second
U	units
vp	venepuncture
yrs	years

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CHAPTER 1 LITERATURE REVIEW

1.1 ANIMAL WELFARE WITH SPECIAL ATTENTION TO THE FARMING ENVIRONMENT

Studies on animal welfare in a farming environment have increased considerably over the last decade (Rhodes et al., 1994; Broom 1994). This reflects expanded public awareness and the development of social and political debate on these issues. Interest in this topic has been further fuelled by a progressive realisation of agricultural producers and their organisations, that public concern in consumer countries may eventually take the form of non tariff trade barriers (Matthews, 1992). Since animal welfare is a concern to many interested parties, animal welfare science could and should provide the necessary information to enable a scientific, political and social consensus for all parties (Stafford and Mellor, 1993).

Farming of livestock is a compromise between cost, operating convenience, animal performance, health, animal welfare and profitability. It is sometimes claimed that animal performance, defined by productivity, and welfare, go together (Fox, 1985). In reality the economics of farming can jeopardise individual animal welfare in order to produce more per unit of space (Fox, 1985; Broom, 1994). The seemingly perfect picture of healthy looking animals on green pasture may be misleading, as stocking rates, a reduced nutritional diversity, disruption of social patterns by segregation according to age and sex and modern farm practices may compromise animal well-being (Hemsworth et al., 1995; Wilson 1991).

As farming procedures in general come under intense scrutiny (Stafford and Mellor, 1993) the majority of studies on farm animal welfare investigate possible negative effects of existing farming practices. This might be interpreted by urban populations as justification of certain painful procedures which by consensus of the farming communities are unavoidable. However, animal scientists, farmers and veterinarians may have different perceptions of animals ultimately destined for slaughter, than the consumer (Beilharz, 1988).

Attitudes toward animals and animal welfare are influenced by religious, social and political backgrounds and personal philosophy (Dawkins, 1985; Beilharz 1988). While animal welfare research alone cannot resolve the animal welfare issue it is most certainly necessary and justified to provide a framework and a basis for the ongoing informed debate on animal welfare.

This chapter will review the principal areas of farm animal welfare. A general outline of animal welfare definitions, its contents, and limitations are given. The potential risk factors for deer welfare will be presented and description of research methods and their limitations are outlined. This will be followed by speculation about future issues for deer welfare research.

1.1.1 Definitions of animal welfare

There have been a number of attempts to define the term welfare. The Brambell Committee which reported on farm animal welfare in the United Kingdom 1965 (Brambell, 1965) described welfare as: *"..a broad concept that embraces both the physical and mental well-being of the animal."* Another definition often referred to regards the welfare of an individual as *"its state as regards its attempts to cope with its environment"* (Broom, 1988). Coping is the biological response to noxious stimuli. This response is either adequate to maintain stability or inadequate and leads to reduced fitness if the animal fails to cope. Broom (1991) stated that *" welfare is poor when the individual has difficulty in coping with its environment"*. This difficulty may be measured in a scientific way by using physiological responses such as heart rate, ventilation rate, and adrenal function. The need for combining behavioural and physiological indicators of welfare was emphasised by Dantzer and Mormede (1983), and Barnett and Hemsworth (1990). Whatever definitions or scientific methods are chosen, there still remains the question whether that what is measured *"in a scientific way"* (Broom, 1988) really reflects the state of welfare the animal is in. Furthermore it is still debatable who is able to decide either scientifically or politically if coping is successful (Wechsler, 1995).

Another issue is that humans readily interpret the behaviour of other species in terms of their own thoughts and intentions but other species, due to their sensory abilities, may perceive their world to be radically different from our own (Dawkins, 1985). However, since it is people who specify the standards of animal welfare, it is a matter of human perceptions as to what constitutes animal welfare (McInerney, 1994)

The majority of authors seem to take for granted a general understanding of what welfare means and do not bother to try to define it precisely. However, it is pertinent that this review addresses the question of definition.

1.1.2 The five freedoms concept - Contents and limits

The most widely used 'definition' of welfare is the list of 'five freedoms' formulated by the Farm Animal Welfare Council in the United Kingdom (Brambell, 1965). These five freedoms are quoted with slight differences in wording and sequence by most authors who attempt to identify the term welfare.

The five freedoms are:
- Freedom from thirst, hunger (or malnutrition)
- Freedom from (physical) discomfort and exposure
- Freedom from injury, disease and pain
- Freedom from fear (and distress)
- Freedom of movement and the opportunity to express most normal behaviour patterns

(Mellor, 1992; Matthews, 1992; Mayr, 1993) (the words in brackets show the different use by various authors).

The five-freedom-concept clearly describes an optimal state of well-being. The problem with an ideal state is, that any deviation from that state can only be in the negative direction; i.e. any event that compromises the well-being of the animal means that the welfare is at risk. The welfare of animals in the wild as well as animals under the care of humans as companions, or as resources in modern animal husbandry, is constantly influenced by natural phenomena or by an increasing amount of human intervention. We can assume therefore that in farming environments the ideal of the five-freedom-concept is not met (Fox, 1985; McInerney, 1993).

Although the meaning of animal welfare varies, there is a general agreement that for the animals well-being, pain, stress, anxiety and fear should be kept low as possible while the animals are under human stewardship (Beilharz, 1988). While these terms are essential to the welfare issue they are also commonly and sometimes inappropriately used. In order to avoid misunderstandings a short definition of each is appropriate.

1.1.2.1 Stress

The concept of stress is widely used and often misused. In this paper it is defined as an abnormal or extreme adjustment in the physiology and behaviour of an animal in response to adverse stimuli which overtaxes the control systems (Fraser and Broom, 1990). Acute (short term) stress involves activation of behavioural and endocrine responses, "fight or flight reaction" and general adaptation syndrome (Sleyle, 1946). Long term (chronic) responses involve substantial changes reducing the fitness of the animal as defined by reproductive success, disease susceptibility and life span (Andrews, 1992). It is important to differentiate between stress and "adaptive response" (Fraser and Broom, 1990). The latter is a behavioural and physiological response mediated by the same pathways of the hypothalamic-adrenocortical system of the organism to environmental stimuli, which does not overtax but may even enhance the animals coping ability.

The interpretation of acute stress responses in terms of animal welfare is difficult as they involve "normal adaptive responses" (Barnett and Hemsworth, 1990). The stresses deer are subjected to in the farming environment are partly recognised (Griffin et al., 1988, Griffin et al., 1992) and range from acute to chronic during a variety of farming procedures such as handling, inadequate nutrition, and weaning, just to mention a few.

1.1.2.2 Pain

The term pain is described by the International Association for the Study of Pain as "unpleasant sensory or emotional experience associated with actual or potential tissue damage" (cited in Zayan, 1986). The category of pain is heterogeneous. Cutaneous pain can have quite different qualities than deep pain or visceral pain. The issue is further complicated by the wide range of pain responses to a standard stimulus between and within individuals. Pain responses involve two components: a) nociception; the physiological perception of pain and responses in humans and mammals is mediated via similar anatomical and chemical pathways: b) pain perception; the conscious emotional experience of pain. The latter, the way the animal feels about that state, cannot be measured (Loeffler, 1994). Although any evaluation of pain in animals has to take into account the different dimensions of pain perception (Sager, 1993), there are only limited indicators for the recognition of pain in animals.

1.1.2.3 Anxiety and fear

These terms describe an emotional state that may arise correlated to pain and or stress (Smith and Boyd, 1991). Symptoms that accompany anxiety such as motor tension, increased heart rate, anticipation of and attempts to avoid what lies ahead can be seen in humans as well as mammals. This is demonstrated by the fact that in clinical trials a variety of mammals are used successfully to test anti-anxiety drugs intended for humans (Rowan, 1988). Fear and anxiety are internal states that can only be inferred to be present (Rowan, 1988).

1.1.3 Measurement of animal welfare

Stress, pain, anxiety and fear are essential aspects of animal welfare (Broom, 1991). Their subjective, internal nature necessitates application of a wide range of research activities for their evaluation, which encompass physiology, ethology, veterinary and animal science. Any findings have to be carefully interpreted as only possible indicators are measured; the degree and quality of pain, fear and anxiety experienced can not be quantified directly (Rowan, 1988; Morton and Griffiths, 1985). In the following section the emphasis is placed upon measurement of deer welfare.

1.1.3.1 Physiological measures

A range of physiological parameters has been identified as indices for animal welfare (Morton and Griffiths, 1985; Fraser and Broom, 1990; Broom, 1991; Broom, 1993; Mellor, 1992). Physiological changes that can be measured include heart and respiration rate, and adrenal functioning (Broom, 1988). However, as Fraser and Broom (1990) pointed out, most of the indices can only be used to indicate poor welfare.

Assessing the welfare of deer we have to face the fact that deer are only a recent addition to the farmed environment. There are only limited data available on physiological parameters. But when assessing welfare, any findings have to be seen in the framework of known physiological values.

Rowan (1988) described a range of symptoms characteristic for anxiety such as motor tension, autonomic hyperactivity such as sweating, increased heart and respiration rate. The use of heart rate as an indicator of stress in deer has been described by a number of authors (Price, Silby and Davies, 1993; Espmark and Langvatn, 1979; Broom, 1988, Pollard et al., 1992a; Pollard et al., 1993c; Baldock and Silby, 1990; Herbold et al., 1992) (see Table 1.1). Essential for the possible interpretation of results is a detailed knowledge about the method used to generate data. Possible confounding factors of measuring heart rate can be close presence of humans, restraint and unfamiliar surroundings. This can be lessened by remote heart rate recording in a familiar environment (Matthews et al., 1994).

Another well known system in the adaptation to stress is the hypothalamic-pituitary-adrenocortical (HPA) axis (Andrews, 1992). The hormonal response via the adrenocorticotrophic hormone (ACTH) leads to a release of glucocorticoids. Levels of these glucocorticiods, in particular Cortisol (C) have been used to measure stress in a number of deer species (van Mourik et al., 1985; Bubenik et al., 1983; Goddard et al., 1994) (see Table 1.2).

Although raised corticosteroid levels are used as an indicator for stress (Andrews, 1992) care must be taken to interpret these measures in regard to animal welfare because adrenal cortical activity also occurs during courtship, mating and food acquisition (Broom, 1988). Possible circadian and circannual rhythms of Cortisol have to be taken into account when trying to interpret any findings (Bubenik & Bartos 1993)(see Table 1.2). Rushen (1991) questioned any claims about animal welfare based on data regarding the pituitary-adrenocortical axis in any species because of the lack of consistency between results in different studies.

An animal with a chronically high production of ACTH, resulting from the inability to cope with stress can develop adrenal insensitivity to the ACTH challenge. The use of ACTH stimulation test as index for adrenal sensitivity was reported by various authors (Bubenik and Bartos, 1993; Mellor et al., 1991; Goddard et al., 1994). The reliability of the ACTH challenge test as a possible indicator for the assessment of animal welfare however, was questioned by Rushen (1991) and Goddard et al. (1994).

Other blood markers which may indicate reduced welfare such as creatinine kinase (see Table 1.3) and aspertat aminotranferase (see Table 1.4) were reported by a number of authors (Brelurut, 1991; Chapple et al., 1991; English and Lepherd, 1981; Matthews et al., 1994; McAllum, 1985; Wilson and Pauli, 1993; Knox et al., 1988; Reid and Towers, 1985).

In order to obtain measurements useful to assess welfare, deer have to be either chemically or physically restrained in most of the cases. Data generated can be confounded by a number of variables such as temperament and tameness of the animal, previous experience with the restraint system, or familiarity with the observer. The degree of agitation, and anxiety of the animal at the time of blood sampling can result in altered haematological and biochemical values (Alexander and Buxton, 1994; Presidente, 1979) (see Tables 1.2, 1.3, 1.4). The influence of xylazine on hematological values in farmed deer was reported by Cross et al. (1992). A further important point is the sampling technique itself. Manual blood sampling requires at least minimal restraint whereas remote blood sampling, once the equipment is attached, allows free movement of the animal (Matthews et al., 1994). Although the latter has many advantages, it has to be kept in mind that the equipment itself may have impact on the animal. As the outer visual appearance and smell of the animal is changed, its conspecifics may react differently than usual in their social interaction with this individual which in turn may lead to social stress for the individual (Goddard, pers. communication).

1.1.3.2 Behavioural measurements

Changes in behaviour, especially the occurrence of abnormal behaviours have been used as indicators of animal welfare (Broom, 1991). Fraser (1988) suggested that certain behavioural manifestations in animals are evidence of suffering. That author differentiated between distress, indicated by active anomalous behaviour, and depression, indicated by a marked reduction in general activity.

Disruption of normal maintenance activities and frequent repetition of one or two behavioural characteristics have been observed in known stressful environments (Rushen, 1984). In deer behavioural changes after application of stressors were reported by Pollard et al. (1991), Pollard et al. (1992b), Pollard et al. (1993c), Diverio et al. (1993), Price et al. (1993) and Matthews et al. (1990).

The main behavioural elements observed were: lying, moving and feeding (Diverio et al., 1993) Other authors included ruminating, grooming, idling and activities of short duration such as ear flicks and head shakes (Pollard et al., 1991).

However, the general, non-specific nature of these responses, such as increased restlessness observed in deer after various treatments (Pollard et al., 1991; Pollard et al., 1992b; Matthews and Cook, 1991; Matthews et al., 1994) limit possible interpretations.

Behavioural observations are constrained by a number of factors. The variability, diversity and complexity of behaviour as well as the danger of anthropocentric thinking overshadowing the perception of the observer, can confuse or confound the findings (Stafford and Mellor, 1993). The possible bias of the observer is only one factor influencing the behavioural recording. Furthermore, the possible effect the observation itself may have upon the animal has to be taken into account (Lehner, 1979). To limit at least observer bias, the study design should be blinded.

It is well known that the design of the study itself influences possible findings. In order to facilitate individual/focal observation the number of subjects studied is generally small. Subdivision of a larger herd into smaller subgroups to facilitate behavioural observation as described by Pollard et al. (1994b) may alter the behaviour because new hierarchies may establish as suggested by Diverio et al. (1993).

To enable close monitoring, the animals may be held indoors (Pollard et al., 1994b). The reduction of personal space, close proximity of conspecifics of possibly different ranks, and limited escape space for subordinate animals may influence the behaviour observed. Because red deer tend to associate with others of similar rank, stags were most likely to be threatened or attacked by opponents that considerably outrank them (Appleby, 1983).

Provision of water and feed indoors may be a further factor confounding results. Observations of feral deer showed that generally, aggressive interactions were low except when access to food was limited (Appleby, 1983; Magnaghi et al., 1992).

In summary, a change in behavioural or physiological parameters 'per se' is not an indicator for compromised welfare. The question *"at what level of change is welfare at risk"* remains central (Barnett and Hemsworth 1990). According to Hemsworth et al (1995) *"our current state of knowledge does not allow this question to be adequately answered"*.

1.2 CURRENT DEER WELFARE ISSUES

Deer farming has become a rapidly developing industry (Yerex and Spiers, 1993; Pearse, 1994). The aim to produce the maximum amount of velvet and venison with a minimum financial and labour unit input lead to the introduction of modern farm management. It is now common in New Zealand to observe deer farms which lack natural cover, shade, wallows and carry up to 15 deer/ha (Wilson, 1991).

The realisation that deer welfare might be compromised by modern farm management practices has lead to a number of initiatives and studies. (Smith, 1993; Pollard, 1993a; Matthews and Cook, 1991). In this section the major topics of current concern in deer welfare are reviewed and potential future issues discussed.

1.2.1 Velvet removal

The bulk of the recent literature on deer welfare deals with velvet antler harvesting (Wilson, 1989; Pollard et al., 1992a; Pollard et al., 1993b; Pollard et al., 1994b; Matthews et al., 1990; Matthews and Cook, 1991; Matthews et al., 1994). The welfare aspects of this procedure, which is illegal in some countries, have even led to a number of articles in the popular press (Williams, 1992). As antlers are a social organ of the deer species their amputation (hard or velvet) is not deemed reasonable in some European countries (Bogner and Matzke, 1985). A different view is taken in New Zealand. The principal reasons for and against velvet removal were summarised by Wilson (1989). Furthermore the fact that considerable income is generated from the sales of antler velvet as medicinal and nutritional product to Asian countries has certainly driven the industry to focus research funding in this area to ensure that velvet harvest is humane.

1.2.1.1 Heart rate

Heart rate recordings while deer were held in a crush during different management procedures such as ear tagging or velveting showed a marked increase (Matthews and Cook, 1991). A varied response depending on the treatment given could be found, as shown in Table 1.1.

Table 1.1 Heart rates of red deer under a variety of conditions as reported in the literature

Author (s)	No/Sex/Age	Sampling	Values (beats/min)	Activity or treatment
Espmark & Langvatn, 1985	15/m&f/calves	r/h	170 mean	less then 2 days old; lying
			155 mean	7 days old
			50-60	approach of human
Pollard et al., 1991	9/m/yearling	r/h	110 mean	visual isolation
Price et al., 1993	?/f/adult	r/h	58	lying
			69	standing
			87	walking
			110	alert, standing neck up
			120	trotting
Matthews & Cook, 1991	7/m/yearling	r/h	83 mean	local
			105	local & velvet
			189	velvet without local
			167	ear tagging
Matthews et al., 1994	18/m/2yrs	r/h	~ 70-90	at pasture
			~ 70-135	in yard & restraint & local
			~ 80-145	in yard, restraint, local & velvet

r/h: remote on harness; local: application of local anaesthetic, velvet: removal of velvet antler, no: number, m: male, f: female, yrs: years, ~: approximately, ?: not reported

Application of local anaesthesia alone caused a slight elevation in heart rate to 83 beats per minute (BPM) (Matthews and Cook, 1991). During velvet harvesting after the administration of local anaesthesia a mean heart rate of 105 BPM was recorded (Matthews and Cook, 1991). The removal of velvet antler without anaesthesia produced a marked increase in mean heart rate to 189 BPM (Matthews and Cook, 1991). Although the experimental design contained a control group, these animals were not restrained in a crush and no heart rate recordings were made (Matthews et al., 1990). In another study comparing restraint in a crush and velvet harvesting under local anaesthesia (one antler per day) (Pollard et al., 1991), the authors noted an increase in heart rate prior to removal of the second antler suggesting an anticipatory response of the animals. No heart rate values during treatment were given in this article.

The mean heart rate of about 68.5 BPM in two-year-old red deer stags in a paddock (Matthews et al., 1994) corresponded with the values reported in hinds (Price et al., 1993). The heart rate increased to a mean of 108.1 BPM in animals subjected to yarding, restraint, and velveting (treatment one), which was slightly higher than in stags subjected to yarding and restraint only (treatment two)(Matthews et al., 1994). In the following 3.5 hours of heart rate monitoring, no gross differences between the two treatment groups were seen. However, Matthews et al. (1994) stated that HR and ECG responses were disturbed during and shortly after velveting. The incidence of ECG disturbances as a stress response has been observed in deer after velveting (Matthews and Cook, 1991). A comparison between various manipulations such as administration of local anaesthetic or tourniquet application and velvet removal in chemically restrained deer showed a marked increase in percentage of disturbance during the latter procedure. While the first procedure elicited around 6% disturbance in stags and a maximum of about 12% when a tourniquet was applied, a rate of 50% was recorded after 3 minutes in velveted stags (Matthews and Cook, 1991).

1.2.1.2 Physiological response (Cortisol)

The physiological response to treatment stress can be examined by analysing various blood constituents. The correlation between cortisol levels and changes in behaviour due to different levels of distress have been described in sheep (Mellor et al., 1991; Wood et al., 91). Transient increases in plasma cortisol concentrations, their magnitude and duration were related to treatment (Mellor et al., 1991). A number of authors have investigated plasma cortisol levels in several deer species as summarised in Table 1.2.

During velvet removal from mature stags under local anaesthesia values of 52-70 ng/ml were observed by Matthews and Cook (1991). Similar values were recorded for control stags which were not velveted but received local anaesthesia. No statistical significance values or standard deviations were given which makes an interpretation of these results difficult (Matthews and Cook, 1991).

The manual blood sampling technique in itself can lead to agitation of the animal and in consequence alter haematological and biochemical values (Alexander, 1994). In order to overcome these restrictions remote blood sampling techniques are necessary. In free-moving red deer at pasture a mean cortisol value of 11 ng/ml was reported (Matthews et al., 1994). During yarding, application of local anaesthetic and velveting the values reached a peak of about 70 ng/ml both in control stags and those with their antlers removed. The authors suggested that velveting is therefore not an additional stressor when the animals are yarded and handled and local anaesthetic administered.

Although cortisol measurements are widely used in the assessment of stress, the lack of knowledge concerning circadian and circannual rhythms of cortisol in the various deer species as well as the varied response of animals to stressors, limit interpretation of findings. A study of cortisol levels in white tailed deer showed a marked difference in levels between summer and winter (Bubenik et al., 1983). During the cold months levels of 5.2 ± 0.89 and 1.8 ± 0.33 ng/ml were reported. A rapid fluctuation during a 24 hour period was also noted (Bubenik et al., 1983). Significant differences between individuals in basal levels in red and fallow deer have been observed (Bubenik and Bartos, 1993). Thus, the variable nature of basal cortisol concentrations in red deer limits its value as an index of stress in this species (Goddard et al., 1994; Bubenik and Bartos, 1993).

The release of cortisol after ACTH administration as an index of adrenal sensitivity has been used to assess long-term stress since an animal with a chronically high production of ACTH due to chronic stress can develop adrenal insensitivity to ACTH (Andrews, 1992). A comparison between farmed adult red deer hinds and captured wild hinds showed initial plasma cortisol concentration of 238 nmol/L in wild hinds and about 70 nmol/L in farmed hinds (Goddard et al., 1994). The resulting cortisol peaks sixty minutes after ACTH administration were about 240 nmol/L for the farmed hinds. No increase was seen in the wild hinds (Goddard et al., 1994). The authors suggested that when endogenous cortisol levels were high, as in the wild hinds, the ACTH stimulation test may not be appropriate.

In sedated male red and fallow deer, initial cortisol levels of around 1-2 µg/100 ml were recorded (Bubenik and Bartos, 1993). Sixty minutes after ACTH administration, cortisol concentrations of 5-6 µg/100 ml in red deer and 7-8 µg/100 ml in fallow deer were found. Bubenik and Bartos (1993) observed a wide range of cortisol levels after ACTH administration (1-6 µg/100 ml) in both species. This variability and a possible circannual and circadian rhythm, necessitate further investigations to understand the relationship between basal cortisol levels and adrenal responses to ACTH. Table 1.2 shows the varied response in cortisol levels under a variety of conditions including velvet antler removal.

Table 1.2 Summary of means and/or ranges of Cortisol levels measured under a range of situations as reported in the literature

Author	**Species**	**No/Sex/Age**	**Sampling**	**Values**	**Treatment**
Brelurut, 1991	red deer	20/m&f/8 months	vp	53 (48-59) ng/ml	semi-wild, transport for 3 hours
				32 (9-52) ng/ml	farmed, transport for 48 hours
Bubenik & Bartos, 1993	red deer	7/m/2.5 yrs	can	< 2 µg/100 ml	sedated Xylazine/Ketamine 1-2 mg/kg, in summer
	fallow deer	8/m/ yearling	can	2 µg/100 ml	sedated Xylazine/Ketamine 1-2 mg/kg, in summer
Bubenik et al., 1983	white-tailed deer	2/m/ adult	can	0.8 -5.2 ng/ml	sedated Xylazine in summer
				3.8-13.4 ng/ml	in winter
Goddard et al., 1994	red deer	20/f/adult	vp	207-332 nmol/l	wild derived hinds restraint
		40/m&f/calves		54 nmol/l	farmed, restraint manually
				97 nmol/l	wild derived, restraint manually
Hastings et al., 1992	chin. water deer	36/?/?	as	9.1-17.3 nmol/l	culled by gunshot
Jones & Price, 1992	fallow deer	?/m&f/?	vp	~ 15-180 ng/ml	captured park animals
Jago & Matthews, 1994	red deer	18/f/mixed age	as	18.6 ng/ml mean	transport 80 km, stunned with captive bolt & slaughter
				15.6 ng/ml mean	transport 230 km, slaughter
				10.5 ng/ml mean	transport 380 km slaughter
Matthews & Cook, 1991	red deer	18/m/adult	can	35-65 ng/ml mean	restraint in crush Nov./Dec.
				26-32 ng/ml mean	sedated Xylazine 0.9 mg/kg & local & velveted
				65 ng/ml mean	local & velvet
		6/m/adult		35 ng/ml mean	hard antler removal late February
Matthews et al., 1994	red deer	18/m/2 yrs	re	11 ng/ml mean	on paddock free moving
				50-70 ng/ml mean	in yard, restraint, local or local & velvet
Smith & Dobson, 1990	red deer	20/m/15-20 months	as	29.9 ± 7.0 ng/ml mean	transport for 25 minutes & slaughter
		33/m/15-20 months		20.9 ± 5.3 ng/ml mean	transport for 2 hours & slaughter
		10/m/15-20 months		5.7 ± 3.7 ng/ml mean	culled by gunshot in field

vp: venepuncture; as: after slaughter, can: cannulation; re: remote, local: application of local anaesthetic
velvet: removal of velvet antler, no: number, m: male, f: female, yrs: years, ?: not reported
note: a conversion table is given in Appendix II

1.2.1.3 Behavioural observations

Matthews and Cook (1990) observed the behavioural elements walking, standing and lying two to three hours post treatment and following blood sampling for a further five hours. The animals were subjected to three different treatments at weekly intervals. The treatment was either yarding, handling ,restraint and blood sampling (control), or application of local anaesthetic with or without chemical restraint. During a second treatment one velvet antler was removed. In this experiment the authors did not observe any significant differences between the treatment groups. However, when compared with a completely undisturbed group of deer, which were not subjected to any of the treatments, significant differences were seen. The undisturbed animals spent less time walking, standing and grazing and more time lying. Similar findings were reported in a further experiment (Matthews and Cook, 1991). Matthews et al. (1994) also reported behavioural differences between control and treated animals but no statistical significance values were given.

Pollard et al. (1993b) investigated the duration of behavioural effects of velvet antler removal in red deer stags. A range of behavioural elements were observed for the first three hours post treatment and on the following day. These authors found significant differences in frequency and duration of moving, ear flicking and grooming which were more pronounced in velveted stags than in non-velveted stags in the first two hours after treatment. 24 hours later the velveted stags exhibited significantly more playing behaviour compared to the non-velveted animals (Pollard et al., 1993b). These results were similar to former investigations (Pollard et al., 1991).

Based on behavioural measurements, Matthews et al. (1994) stated that although behavioural differences seen between treatment groups may suggest increasing levels of pain as the anaesthetic wears off, this may be attributable to possible chance events. They concluded "*that velveted animals were no more stressed than non velveted*". Conversely Pollard et al. (1993b) concluded that behavioural effects of velveting were present even if the control animals had the same amount of handling. This suggested some additional effects of the velveting procedure were responsible for the observed treatment effects. Pollard et al. (1993b) suggested that some of these additional effects were "*possibly due to pain*".

Additional analgesia supplied after velveting did not reduce the behavioural effects after velveting in one study (Pollard et al., 1994b), although an earlier study did show differences in behaviour (Pollard et al., 1992 b). Insufficient analgesia after ring block application of local anaesthetic was suggested as a possible reason for these contrasting results. This highlights the difficulties in interpreting such observations since application of local anaesthesia by different operators introduces another variable which may result in invalidation of observational results and conclusions. Standardisation and/or measurements of effectiveness of treatment is essential if meaningful comparisons are to be made between studies.

Furthermore, interpretation and comparisons of behavioural studies are difficult because the investigators introduce a number of variables by change of environment and/or social grouping. Matthews et al. (1994) observed free-ranging deer while Pollard et al. (1993b) studied deer indoors. The latter stags had been habituated to pens for several months. In others studies, the stags were kept at pasture except during handling and the following observation period where they were held in pens for approximately six hours. (Pollard et al., 1992b). In the latter case the group was split into groups of four, disrupting the social hierarchy. No comment was made about the disruption of social contacts.

In a number of behavioural observations, animals were initially derived from a larger herd and divided into subgroups 2-18 hours prior to observation (Matthews et al., 1990). It is possible that during the course of the studies new hierarchies were established, which may have influenced the behaviour observed, and the mixing of unfamiliar animals may induce social stress (Zayan, 1991).

1.2.2 Transport

The transportation of animals is potentially one of the most stressful management procedures and increases greatly the risk of injury, stress, and stress related outbreaks of diseases such as Yersiniosis (Fletcher, 1988).

1.2.2.1 Bruising and injury

The risk of injury was shown in an analysis of slaughterhouse records for animals processed at deer slaughter premises (DSP) (Selwyn and Hathaway, 1990; Jago et al., 1993). Selwyn and Hathaway (1990) suggested that poor handling on farm and during transportation, inadequate design of trucks and yards and inappropriate spacing of the deer contributed to the prevalence of wounds and bruises. An annual carcass downgrading of 6.9% due to wounds, bruising and fractures was recorded for one DSP in 1991 (Jago et al., 1993). The highest monthly incidence of 14.3% for stags and 13.6% for hinds occurred in October and a significant association between incidence of bruising and the month of slaughter was observed (Jago et al., 1993). According to the analysis there was also a strong association with transport factors such as carrier company and the proportion of animals that were bruised. However, the same carrier company always collected animals from the same farms so this may also reflect the management on those farms (Jago et al., 1993). Thus the relationship between transport and bruising needs further evaluation.

1.2.2.2 Behavioural response

The factors most likely to influence the well-being of deer during transport were mixing different categories of deer, upsetting the social structure, overexitement when loading due to poor stockmanship, overcrowding, unsuitable carrier design, abrupt cornering and braking, and excessive length of travel. The effect of stocking density and road conditions on the behaviour of de-antlered red deer stags (90 kg) during transport was examined at the densities of 0.49 m^2 and 0.74 m^2 (Jago et al., 1993). Agonistic behaviour in the form of butting or biting occurred in 23 incidents in 4 hours of observation. Analysis of the agonistic behaviour during travelling indicated that the animals grouped together in a pen should be of similar weight and size because smaller animals might be the recipients of aggressive behaviour. Loss of balance and resulting impact between deer were higher during passage of winding roads. The distance travelled was not reported in that study although a further study (Jago and Matthews, 1994) showed that the incidence of bruising on hocks and vertebrae/back increased significantly in red deer hinds with the distance transported. The authors considered a rate of 2-17 agonistic behaviours per hour per pen as relatively little. However, on two long journeys, 55 and 120 incidents of agonistic behaviour per hour per pen have been observed. The distances chosen (80, 230 or 380 km) do not reflect extremes of the commercial practice in New Zealand as some animals may be transported for up to 1000 km which may take as long as 24 hours (P. Wilson, pers. communication). The stocking density of 0.42 m^2 per animal represents the space allocated per head in the commercial carriers. For adult hinds, floor areas of 0.40- 0.60m^2 per animal are suggested (Fletcher, 1988).

1.2.2.3 Physiological response

The physiological response to transport can be examined by using various blood parameters. Any interpretation of these results must be undertaken with caution (see section 1.1.3.1). Blood cortisol levels reported by various authors (Table 1.3) range from 10.5 ng/ml (Matthews et al., 1994) to 53 ng/ml (Brelurut, 1991) for red deer. However as some of the blood samples were taken after slaughter it is not possible to attribute these levels to transport only.

The creatinine kinase (CK) levels reported (Reid and Towers, 1985) were highly variable both on individual animals on different occasions and for different animals. For farmed red deer hinds mean CK concentrations of 51 (Reid and Towers, 1985) to 99.5 International Units (IU) (Wilson and Pauli, 1983) were reported. These levels may reflect some muscle damage during yarding and restraint. Creatinine kinase is known to rise rapidly after damage of muscle tissue. The elevated levels reported after transport increased with the distance travelled suggesting that measurement of this enzyme is of benefit when assessing muscle trauma due to transport for red deer (Matthews et al., 1994). In fallow deer, seasonal patterns have to be taken into consideration as well (Reid and Towers, 1985). Table 1.3 shows a varied response in creatinine kinase levels under a variety of conditions including transport.

Table 1.3 Creatinine kinase (CK) concentrations measured under a variety of situations as reported in the literature

Author	Species	No/Sex/Age	Sampling	Values	Treatment
Knox et al. 1988	red deer	89/?/mixed	vp	186 U/l	restraint
Brelurut, 1991	red deer	20/m&f/8 months	vp	411 (369-494) U/l	semi-wild, capture
				24160 U/l	semi-wild, capture & transport for 3 hrs.
		5/m & f/8 months		425 U/l	farmed, transport for 48 hrs.
				176 U/l	farmed, handled only
Chapple et al., 1991	chital deer	10/f/adult	vp?	2.129 ?	untrained, first time of restraint
				508 ?	trained
English & Lepherd, 1981	fallow deer	30/f/?	vp	1393.60 U/l	feral, capture
		7/f/?		4941.71 U/l	feral, capture & transport for 3 hrs
Presidente, 1979	fallow deer	60/m/?	as	600 ± 64 U/l	culled by gunshot at abattoir
Matthews et al., 1994	red deer, farmed	18/f/mixed	as	162 U/l	transport 80 km & slaughter
				345 U/l	230 km & slaughter
				1096 U/l	380 km & slaughter
Reid & Towers, 1985	fallow deer	25/f/adult	vp	275 (61-2526) IU/l	March
				50 (36-389) IU/l	May
				96 (67-144) IU/l	July
				167 (69-772) IU/L	September
	red deer,	25/f/?		51 (45-133)IU/l	farmed, March-September
Wilson & Pauli, 1983	red deer	18/m/>18 months	vp	99.5 IU/l	farmed, manual restraint
		13/f/>18months		70.8 IU/l	farmed, manual restraint

vp: venepuncture, as: sample taken after slaughter; gm geometric means, no: number, m: male, f: female, yrs: years, ~: approximately, ?: not reported, IU: International units, U: units

Aspertat aminotransferase (AST/SGOT) concentrations (see Table 1.4) are known to be elevated due to hepatic or muscular damage. High values have been found in myopathic deer after capture (McAllum, 1985). A number of authors have found elevated concentrations after transport (English and Lepherd, 1981). For red deer it is suggested that values over 94 IU/l may be regarded as elevated (Wilson and Pauli, 1983). Aspertat animotransferase concentrations under a variety of conditions including transport are given in Table 1.4.

Table 1.4 Aspertat Aminotransferase (AST /GOT) IU/l concentrations reported in the literature

Author	Species	No/Sex/Age	Sam-pling	Values	Animal/treatment
McAllum, 1985	red deer, feral	?/?/?	vp	233 SFU	0.5 hrs post capture
				83 SFU	36 hrs post
				1424 SFU	0.5 hrs (myopathic)
				7352 SFU	24 hrs (myopathic)
English & Lepherd,1981	fallow deer	30/f/?	vp?	190.7 ±78.9U/L	capture
		7/f/?		265.71 ±78.9 U/L	capture & transport
Wilson & Pauli, 1983	red deer	17/m/>18 months	vp	40.5 IU/l mean	physical restraint
		13/f/>18 months		49.8 IU/l mean	physical restraint
Knox et al., 1988	red deer	90		82 (59-150)	restraint
Matthews et al., 1994	red deer	18/f/mixed	as	3.9 U/l mean	transport 80 km & slaughter
				16.6 U/l mean	230 km & slaughter
				31.4 U/l mean	380 km & slaughter
vp: venepuncture, as: sample taken after slaughter; m: mean, no: number, m: male, f: female, yrs: years, ~: approximately, ?: not reported					

The isoenzymes of Lactate dehydrogenase (LDH) can be useful blood borne indicators of stress. Lactate dehydrogenase 5, which is found in large quantities in the skeletal muscle leaks into the bloodstream when damaged. A study evaluating stress response in fallow deer (Jones and Price, 1992) showed that LDH 5 was elevated in plasma when the animal was stressed. LDH-5 levels were elevated with increasing length of transport (Matthews et al., 1994)

1.2.3 Slaughter

One of the major concerns in deer slaughter premises in New Zealand has been the condition of the animals upon arrival. The major reasons for downgrading have been wounds and bruising (Selwyn and Hathaway, 1990; Jago et al., 1993). Although in July 1992 the 'Code of Recommendations and Minimum Standards for the Welfare of Deer During the Removal of Antlers' has been published by the Animal Welfare Advisory Committee, there is still evidence of wounds or infections directly related to the use of blunt instruments and poor hygiene and aftercare during velveting found at the DSP (Killorn and Heath, 1993). Abattoir slaughter of deer is illegal in some European countries, where a field shot is considered as the most humane method of slaughter. A comparison of plasma cortisol levels immediately after slaughter (Smith and Dobson, 1990) showed that after being field shot, cortisol levels for male red deer 5.7 ± 3.7 ng/ml were lower compared to slaughterhouse levels 28.1 ± 6.2 ng/ml. The authors concluded that deer slaughtered at an abattoir were subjected to stress of handling and transport which increased the cortisol levels significantly. Similar values were recorded for chinese water deer culled by gunshot (Hastings et al., 1992). The stunning of deer prior to slaughter to render the deer insensible is achieved by means of captive bolt pistol. Problems associated with this technique arise from the different energy required to penetrate the skulls of animals of different age and sex (Blackmore et al., 1993). An alternative method, electrical head-only stunning can cause immediate insensibility (Blackmore et al. 1993). Those authors concluded that electrical stunning, was a humane method of slaughter for deer. Critical for this method was a specific head restraint as the electrical stunning might not be successful if the electrodes were not sufficiently firmly applied.

1.2.4 Calving

Observations of feral red deer showed that close to parturition the hinds move away from their matrilineal herd and seek a calving place outside their usual range (Clutton-Brock and Guinness, 1975). If possible they tended to move to higher altitude where population density was much reduced. The new-born were mainly protected by concealment. They spent the first 2-3 weeks in a sheltered and secluded spot, preferably in long vegetation, in a site which was raised above surrounding ground and sheltered from sight at least on one side. After suckling, calves less then 21 days old chose a sheltering site at least 20 meters away. Older calves prefered lying places within 0-3 m from their mothers.

In the mothers a significant change in vigilance after parturition was seen. Before calving most hinds spent 20% of their observed feeding time in alert, indicated by raised head, ears forward, moving head from side to side and staring. This percentage changed to about 70% when they were accompanied by calves which were less then three weeks old. After that period the alert stance decreased to values close to those before parturition (Clutton-Brock and Guinness, 1975).

Under farming conditions some of these behavioural patterns are not possible. Pre-parturient behaviour was observed in 54 red hinds on paddocks devoid of any form of shelter at a stocking rate of 22 hinds/ha (Kelly and Whateley, 1975). These authors concluded that there was *"no discernible attempt by the hinds to seek shelter at calving..., although there were considerable amounts of natural vegetation immediately adjacent to the deer paddocks"*.

As no shelter was available in the paddock it is assumed that the authors refer to an absence of fence pacing. This is in contrast to other authors (Cowie et al., 1985) who described fence pacing prior to parturition, firstly 7-10 days prior to calving, and then more intensely from 2 days prior to partuition. This may suggest a need for isolation.

When investigating the cardiac response of neonatal red and white tailed deer to alarm stimuli such as the approach of man, a significant bradycardia was found (Espmark and Langvatn, 1979; Jacobsen, 1979; Espmark and Langvatn, 1985). In the resting and undisturbed deer calf a heart rate mean of 170 beats/min was recorded in calves less than 20 hours old. When exposed to alarm stimuli during the first days, a slight increase in heart rate for approximately 10 seconds, followed by a reduction of 65-85% was found (Espmark and Langvatn, 1979). The observed behaviour of startled response and then freezing coincides with an inhibition of one or more heartbeats and a following decrease in heart rate. The duration of the bradycardia ranged from 2-35 seconds and the normal resting heart rate were attained again after about one minute when the alarm stimulation had ceased. The heart rate declines significantly in the first week of life to about 155 beats/min at the age of 7 days when Espmark and Langvatn

(1985) observed the change of behaviour from hiding to running. They assume that physical development, as measured by body weight triggers the onset of the fleeing response.

When investigating shelter seeking behaviour of the young calves (Kelly and Drew, 1976) in a farming environment it was observed that when shelter was provided, calves actively sought those sites. Those authors however, conducted daily inspection rounds of the calving paddock and the calves had been handled. The high rate (50%) of fleeing response after handling in deer less than two days old (Kelly and Drew, 1976) contrasts with the findings described above where the onset of the fleeing response was observed at the age of 6-7 days. The difference may be indicative of the level of disturbance experienced by the deer calves. The increased human presence in the study of Kelly and Drew (1976) compared with normal farming procedures may have influenced the behaviour of the dams and their offspring.

The negative influence of human interference upon the survival rate in feral deer calves has been well described (Guinness et al., 1978). In farmed deer, disturbance of the calving mob may lead to dams abandoning their calves, or appearance of abnormal maternal behaviour such as excessive licking of the ano-genital area of the calf. (English, 1992). High stocking rates may increase interference effects by other mothers which can contribute to abandonment of fawns as well. (Asher, 1992).

Calf mortality rates in red deer described in the literature varies. In feral red deer on average 18% of the calves born in Scotland died in their first summer. (Guinness et al., 1978). In paddocks without shelter 25% of the calves died within the first 4 days after birth (Kelly and Whateley, 1975). The majority of deaths were attributed to aggressive behaviour of hinds other than the dams. The aggressive behaviour was characterised by approach of a hind to the lying calf, seizing it with her teeth and flailing it with her forelegs. In a later article the authors (Kelly and Drew, 1976) suggested that change from a low stocking rate of 2-3/ha to 22/ha, as well as lack of shelter and increase in handling may be reasons for the increased aggressive behaviour observed. In the same paddocks enriched with shelter, calf mortality the following year was 19%. More research needs to be conducted to establish the relationship between calf mortality, stocking rates, shelter and other potential influences.

A more recent study investigating the risk factors for mortalities on commercial red deer farms over a period of two years has been undertaken by Audigé (1995). Loss rates were approximately 9% in adult hind mobs and approximately 17% in first calving mobs (One year old hinds) The author attributed 21% of the losses from birth to weaning to dystocia, 9% to stillbirth, 3% to calf diseases and 25% remained unconfirmed. Eighteen percent of deaths were related to disturbed dam-calf relationships, either through intervention of a foreign hind or mismothering, while 8% of losses occurred through fences. Calf mortalities of 42-50% in farmed red deer were reported from Great Britain (Leonard et al., 1994). The majority of those were due to disease, chiefly cryptosporidiosis.

In fallow deer the major causes for calf losses were non-viability (25%) due to birth weights below 3 kg, starvation (20%), dystocia (14%) and misadventure (11%) (Asher, 1992b). Similar observations have been made in Denmark where mortality rates of 7% to a maximum of 46.4% were reported (Vigh-Larsen, 1988). That author partly attributed the high losses to the number of fawns born at weights of about 2-3 kg, which were not able to stand up and suckle. Similar findings were reported in Australia where calf mortality within the first 48 hours were attributed to low birth weight (English, 1992).

1.2.5 Weaning

In feral deer, calves suckled until about 10-12 months of age and remained with their dams after weaning (Clutton-Brock et al., 1982). In modern farm practice most deer farmers wean early at the age of 3-4 months before the rut (Audigé, 1995). That author reported a positive association between early weaning and subsequent early conception. In more extensive farming management calves may be left with their dams until after the rut when food supply was short in early winter (Moore et al., 1985), but the subject of early or late weaning from management and welfare perspectives, remains an area of contention (Haigh, 1993).

The physical separation of dam and offspring, breaking of social bonds, complete deprivation of milk supply to the calf and the novel stimuli involved with yarding make weaning potentially highly stressful for the animals. A significant impaired immune response was found in deer after weaning when immunised with BCG (Griffin et al., 1988). The combined stressors such as change of nutrition, social unrest and sometimes poor weather conditions may lead to an increased disease incidence (Mackintosh, 1992). During the first days of separation fence pacing of the calves and increased vocalising of calf and dam can be observed (Pollard et al., 1992b). A comparison of the growth rates of male red deer calves weaned early versus late weaning showed that growth rates over autumn were higher in calves left with their dams 173 g/day versus 106 g/day (Moore, 1985). However this changed over winter where late weaners attained a growth rates of 36 g/day in contrast to early weaners with 70 g/day. The interpretation of these data however is difficult because no information is given about control animals, nutritional characteristics of the paddocks and preventive treatment such as drenching. In a further study, calf live weight gain over a period of 13 days and behaviour of the calves were compared between un-weaned and weaned calves with or without additional dry hinds (Pollard et al., 1992b). The presence of dry hinds lead to a 50% decrease in time spent fence pacing and the calves gained more weight, which may be attributed to an overall reduction of weaning stress.

1.2.6 Herding, yarding

The intensive farming of deer requires regular yarding and handling for husbandry treatments such as weaning, ear tagging, drenching, and harvesting velvet antlers (Yerex and Spiers, 1993). Factors such as increased contact between animals and their handlers, unfamiliar surroundings, confinement into small areas, the reduced social space and mixing of social groups may lead to a potentially stressful or possibly painful experience for the deer (Zayan, 1991).

When subjecting deer to husbandry procedures the flighty nature of these species and their social structure must be taken into account. Red and fallow deer are gregarious animals which associate according to their sex, either in matrilineal structured hind and offspring herds or in male-only bachelor herds for most of the year (Clutton-Brock et al., 1982). For these species the visual and spatial isolation of a single animal from the herd which occurs commonly during mustering and yarding may cause anxiety and stress. Yearling red deer stags exposed to such isolation exhibited increased mean heart rates (Pollard et al., 1991) (see Table 1.1). In a further publication (Pollard, Littlejohn and Suttie, 1993c) the authors observed a maximum heart rate of 141 BPM during isolation. The increased heart rate coincided with an increased frequency of activities such as stepping. Heart rate is influenced by motor activity as well as by nervous activation and it is important to differentiate between these two (Price et al.,1993). After assessing the non-motor heart rate of adult red deer hinds in their home pen an increase of 27 BPM from baseline heart rate was seen when the animal was subjected to isolation (Price et al., 1993). A similar effect was found when the deer were subjected to noise (Price et al., 1993).

1.2.7 Restraint

For a number of farming and veterinary procedures deer have to be restrained either chemically, physically or mechanically. The latter can be achieved in various degrees by a race or crush. For deer this situation is likely to be stressful and aversive as it involves close contact with humans without possible escape. This suggestion was investigated by a preference test study (Pollard et al., 1994a) in which deer, when given a choice, preferred the non restraint over the restraint walkway. When given the option to choose between an empty pen and a pen containing a person, eight out of nine stags avoided the person and preferred the empty pen.

The behavioural responses of red deer to herding, yarding and restraint have been studied by a number of authors (Pollard et al., 1992a; Matthews et al., 1990; Matthews and Cook, 1991; Diverio et al., 1993). All authors found a disruption of the normal maintenance activity budgets. Behavioural observations included duration of lying down, ruminating, grazing, alert stance, grooming, and frequencies of ear flicks, head shakes and aggressive interaction. In comparison with undisturbed control animals, stags subjected to yarding and handling exhibit an increase of up to 300% in walking during the first hours after handling (Matthews et al., 1990). A general decline from 51% to 39 % in the frequency of inactive lying is seen in red deer hinds after handling (Diverio et al., 1993).

Similar observations were reported for fallow deer in British deer parks (Humphries et al., 1989). A study investigating the effect of human disturbance on the welfare of fallow deer showed a marked increase in the percentage of deer standing vigilant when disturbed by close contact with humans. The increased time spent vigilant was at the direct expense of other activities such as feeding (Humphries et al., 1989).

Comparison between deer sedated with a mixture of long acting and short acting neuroleptics (perphenazine enanthate and zyclopenthixol acetate) and non sedated red deer hinds showed a marked difference in behavioural response (Diverio et al., 1993). When stressed, the sedated animals were lying inactively for 65% of the observed time whereas non-sedated deer were inactive for only 39% of time. An interesting finding in that study was a distinct paddock effect; the further the animals were from the handling area, the fewer stress related behavioural changes were seen. Thus deer in a paddock close by the handling area may be considered to be subjected to chronic stress (Diverio et al., 1993).

Physiological indicators for stress due to restraint have been reported. A comparison between untrained chital deer and deer that were accustomed to restraint in a cradle shows that the former had much higher creatinine kinase and aspertate transferase concentrations (Chapple et al., 1991). In red deer stags, mean cortisol concentrations of 35-65 ng/ml were reported during restraint (Matthews and Cook, 1991) compared with a mean of 11 ng/ml when undisturbed at pasture (see Table 1.2).

1.2.8 Future issues

The welfare implications of altering the farmed species by mate selection in single-sire groups and hybridisation have been seldomly addressed. The parameters used by farmers to select an animal for breeding are temperament, live weight and antler value. While this selection is driven by the need to improve production and therefore the financial return, little thought is given to what other traits might change (Fischer and Bryant, 1993).

1.2.8.1 Hybridisation

In order to increase animal production, Canadian wapiti (Cervus canadensis) have been crossed with red deer. The resulting hybrids are larger and faster growing and many articles report enhanced live weight gains in hybrids (Pearse, 1992). However, Pearse (1992) also reported a higher incidence of dystocia in red deer hinds mated with wapiti.

No research into possible behavioural changes occurring in these hybrids has been undertaken. A study investigating escape gaits in white-tailed deer, mule deer and their hybrid offspring showed that the distinctive security patterns of each species was disrupted in the hybrid offspring (Lingle, 1992). This may reduce the ability of the hybrids to evade predators.

1.2.8.2 Modern artificial breeding techniques

Artificial breeding technologies, which include out-of-season breeding, artificial insemination and embryo transfer for farmed deer have been investigated in the last decade (Asher, Fennesy and Berg, 1994; Asher et al., 1991). The welfare implications of these techniques for deer have not been addressed yet. In dairy cattle and sheep Murray and Ward (1993) noted that the welfare of dairy cattle may be compromised by the use of artificial insemination due to prolonged restraint and isolation from the herd during the application.

The artificial synchronisation of oestrus in farmed deer as described by Asher (1991) may involve four periods of restraint and manipulation of the hind. After intravaginal insertion of the controlled internal drug release device (CIDR), a CIDR device replacement on day nine may follow. At or near the withdrawal of the device, a routine application of PMSG is described followed 48 hours later by laparoscopic intrauterine insemination (Asher, 1991). Possible welfare implications of the described technique have not been addressed.

In cattle, artificial insemination and embryo transfer has lead to public debate (Murray and Ward, 1993). A growing public unease regarding routine ceasarean surgery when embryos from large breeds were placed in recipients which were unlikely to be able to give birth to them was reported by Murray and Ward (1993).The possible welfare implications of a higher incidence of dystocia in red deer hinds with large terminal sires (P. Wilson, pers. communication) have not been addressed yet.

1.2.8.3 Deer welfare and disease

A range of vaccines and products against parasite infestation have been used to prevent disease or generally improve the health and disease resistance in deer (Mackintosh, 1992). These products may enhance the well-being of an individual, protect a herd from outbreak of infection or disease and protect humans from zoonotic diseases. However, the absence of disease does not mean the well-being of the farmed deer is not at risk. With these biotechnological supports, *"primary suffering"* of farmed animals will increase as *"producers are able to adopt even more intensive methods of animal production"* (Fox, 1989). The important part stress can play in disease outbreaks in deer has been described (Griffin et al., 1988; Griffin et al., 1992). Nutritional deprivation due to lack of feed or reduced diversity of pasture, stressors such as high stocking density, transport, or exposure to harsh climatic conditions without shelter place the deer at risk (Mackintosh, 1992; Smith, 1992; Griffin et al., 1992). Therefore, the use of vaccines and other pharmaceutical products to control or prevent diseases may prevent the clinical manifestation of disease but does not change the possible underlying stress that may have contributed to expression of disease. This may mask poor husbandry practices and even promote conditions which are detrimental to the welfare of farmed deer because they allow stressful husbandry to be maintained without the occurrence of disease. Financially it may even be regarded as good management to use disease prevention technology while persisting with poor husbandry practice, because the profitability, in form of increased production per unit, is raised (Fox, 1985). Acknowledging these problems it is important that research activities in sustainable ecological deer farming systems (Wilson, 1991) that incorporate animal welfare issues will expand in the near future.

1.2.9 Conclusion

The findings described above have lead to a number of changes in deer husbandry. The initiation and implementation of the 'Code of Recommendations and minimum standards for the welfare of deer during the removal of antlers', the quality assurance programme of the New Zealand Game Industry Board and regulations concerning the transport and slaughter of deer have had an important influence in enhancing the welfare of deer in the farming environment. The scientific effort to identify indices of deer welfare has advanced considerably but still requires rigorous efforts as major constraints such as the subjective nature of distress, still limit the investigations.

Assuming that the welfare of an animal can be assessed by the above indicators the moral decision about which state of well-being or unwell-being is tolerable has still to be made. Although the questions of moral consideration are far from being solved, moral decisions are made constantly when we look upon animal welfare. Although scientific measurements may be as exact as can be it is still a moral decision if firstly the indicator we measure is important for animal welfare and secondly we have to decide when a suitable condition of welfare is reached. These decisions have to be openly discussed and should be part of scientific publications because a general (social and political) agreement has to be reached. We can assume that the public and scientific debate on these topics will increase in the future. The question of what is morally wrong or right is a highly political debate and any group or organisation which either goes actively against the contemporary morality or just tries to ignore it can be rapidly caught in a current of public outcry. This is clearly not to the advantage of the deer industry.

1.3 PEDICLE AND ANTLER DEVELOPMENT

1.3.1 Anatomical features

1.3.1.1 Pedicle and antler development

Deer antlers are deciduous appendages which grow from permanent bony protuberances, the pedicles, which are prerequisites for normal antler growth. Whereas the antlers are grown and cast annually, the development of the pedicles is a once in a lifetime event. The incipient pedicles (processus cornu cervi) grow about 2 cm left and right of the median of the frontal bone. They develop postpartum from a region of thickened periosteum during a species specific period (Bubenik, 1982; Bubenik, 1990; D. and N. Chapman, 1975; Goss, 1983). Except in reindeer/caribou (Rangifer tarandus) only male deer develop these protuberances. But the primordial tissue is present in both sexes and with an appropriate hormonal environment, can be induced to develop in females (Jaczewski, 1990).

The potential of generation and regeneration of the periosteum has been demonstrated by a number of investigators (Goss, 1983; Bubenik, 1990). A deflection of the periosteum to another site on the frontal bone led to growth on the new site while no growth occurred on the original site (Hartwig and Schrudde, 1974, Hartwig et al. 1968). The regenerative powers of this tissue have been proven after amputation without removal of the underlying periostium (Jaczewski, 1982). A number of grafting experiments (Goss, 1990) showed that wherever the graft location (outer ear, foreleg or cornea) a differentiation into bony tissue occurs (Goss, 1990). These experiments, while being debatable from the ethical point of view, prove that the periosteum in the area of the pedicle is the most important anatomical factor in antler development.

A first prenatal transitory activation of the antlerogenic periosteum was reported around day 65 (Lincoln, 1973 cited in Bubenik, 1990). The antlerogenic periosteum then remains dormant until the onset of puberty (Bubenik, 1990).

In fallow deer, pedicle development is reported to start around six to seven months of age (Chapman, 1975) in England and at the age of six to nine months (Baker, 1973; Asher, 1992) in New Zealand. Antler growth begins around eight to thirteen months of age continuing until the age of 14 months.

In red deer pedicle initiation starts around 19 weeks after birth when daylight length is decreasing and at a body weight of 41.2 ± 1.07 kg when the deer were fed to appetite (Suttie and Kay, 1982).

The exact onset of the pedicle initiation is difficult to pinpoint as the early stages of growth are hidden by the skin and hair of the frontal bone. A further hindrance is the individual difference in the height of the lateral crest. As this stage is not visible to the eye, palpation of the region in order to discover pedicle growth is still the most common technique. From the onset of initiation, the pedicle grows continuously to a height of several centimetres. It is covered by skin and hair of the scalp (Goss, 1983). Further elongation of the pedicle leads to the growth of the first set of antlers. It cannot be precisely distinguished at what point pedicle ends and antler begins (Goss, 1983). However, the skin shows a different texture from a certain height. This 'velvet' skin, characterised by a shiny surface and sparse hair follicles, can be found enveloping all growing antlers (Goss, 1983).

The first antler in fallow deer is usually an unbranched spike of 1 to 20 cm length (Chapman, 1975). These antlers become hard bone for the first time when the animal is 15 months old. (Baker, 1973; Asher, 1992c). Chapman (1975) reported that these first antlers were retained until the animal is two years old and are then cast.

The onset of antler growth in young red deer appears around 28 weeks of age (Suttie and Kay, 1982) reaching an average length of around 30 cm. However, if the onset of pedicle initiation was delayed, the antler growth will be delayed as well (Fennessy and Suttie, 1985). The first pair of antlers are usually unbranched spikes. The antler then undergoes an annual cycle of calcification, cleaning, casting, and regeneration.

1.3.1.2 Innervation and blood supply

The developing pedicle/antler is innervated mainly by the infratrochlear and zygomaticotemporal branches of the fifth (opthalmic) cranial nerve, the trigeminal (Adams, 1979). The infratrochlear nerve emerging from the dorsal rim of the orbit innervates the rostral and medial sides. The zygomaticotemporal nerve emerging from the caudal margin of the processus zygomaticus, innervates the lateral and caudal aspects of the pedicle/antler. In some deer a further third branch from the auriculopalpebral nerve, a branch from the seventh cranial nerve can supply the medial antler (Adams, 1979).

In order to determine the extent of neural influence upon the development of pedicle/antler an investigation involving sectioning of the sensory nerves at four months of age, prior to pedicle initiation, has been undertaken (Li et al., 1993). As pedicle and first antlers have grown, cleaned and cast, it has been concluded that sensory nerve supply is not necessary. However, as the resulting antlers were slightly smaller than those of the controls, the nerve supply could have had an influence on size. Unilateral denervation and amputation of the antler at the age of nine months

(Suttie and Fennesy, 1985) lead to a similar finding. The regenerated antlers were smaller on the side where the nerves have been removed.

Arterial supply to the pedicle/antler is formed by branches of the superficial temporal artery, which arises from the carotid artery (Adams, 1979; Suttie et al., 1985a). The lateral branch supplies the antler and the medial branch the pedicle. Venous drainage is provided by ventral veins.

1.3.1.3 Nutritional factors influencing pedicle and antler development

Normal development of the pedicle and the first set of antlers, as described above, can be influenced by a number of factors. The rare natural occurrence (less than 1%) of 'hummels', fertile antlerless stags, has been described in Scotland (Clutton-Brock and Albon, 1989). The authors speculated that nutritional deficits in early development as well as in later life could contribute to the antlerless state. They proposed that animal weapons have low growth priority and therefore are more affected by shortage of food. Deterioration of habitat or rising population density can produce a rapid decline in antler size.

A congenitally polled red deer stag with rudimentary pedicles has shown no antler growth for a period of five years (Lincoln and Fletcher, 1976). Amputation of the apex of one antler pedicle at 12 years of age has resulted in the growth of a complete antler on the operated side, and this antler has subsequently cleaned and cast in the normal way and a new antler cycle has been initiated (Lincoln and Fletcher, 1976). The result illustrated that the primary abnormality in the polled stag did not lie in his inability to grow antlers, but in his inability to develop fully formed antler pedicles from which normal antler tissue can differentiate.

Incomplete development of the antler pedicles is considered to be responsible for the absence of antlers in the majority of 'hummels' in Scotland. The general conclusion of Lincoln and Fletcher (1976) was that many, if not all, 'hummels' are individuals that never have produced normal pedicles, possibly as a result of malnutrition in their first year or two of life. A breeding experiment with hummels showed that all male offspring developed normal antlers (Lincoln, 1984). In the New Zealand farming environment antlerless stags are very rare (Wilson, pers. communication).

The interaction between nutrition and photoperiod on antler development in red deer calves has been investigated further by restriction of food during November to May (Suttie and Kay, 1982). In contrast to the normal development as described in section 1.3.1.1, the restricted stags began pedicle development later at 31.0 ± 1.96 weeks of age at an increasing photoperiod. When considering the body weight at the onset of pedicle initiation however, the restricted group did not differ from the unrestricted group. Throughout the growth of the first antler the unrestricted group began each stage (onset of pedicle growth, onset of antler growth and cleaning of velvet) significantly earlier than the restricted group, but each stage occurred when stags had attained the same body weights. Suttie and Kay (1982) concluded that the major stages of development of the first antler appear to be closely related to nutritional status of the deer as reflected by body weight. Kusmartono and Hoskins (pers. communication) recorded earlier antler initiation in young red deer stags on high quality and quantity diets, which accelerated growth rates.

1.3.1.4 Effect of injury on antler growth

Traumatisation of the frontal bone periosteum, the pedicle and antler tissue can have a marked effect upon antler growth. A pedicle fracture or the splitting of the budding antler can lead to abnormal growth patterns (Bubenik, 1990; Jaczewski, 1982). Suttie and Fennesy (1985) suggested that when pedicles are traumatised, subsequent antlers may be deformed, whereas if growing antlers are traumatised, no antler deformation occurs in subsequent years. In contrast to that, Bubenik (1990) described persistent, recurring malformations of antlers due to damage of growing antlers. Bubenik (1990) attributed these repeated abnormalities in several cycles to a 'trophic memory'. This 'trophic guidance' may be provided by a hypothetical antler growth center.

Fletcher and Lincoln (1976) observed that traumatising the rudimentary pedicle of a congenitally polled stag, did have the effect of stimulating growth of antler tissue, and once this has been formed the process of cleaning, casting and regrowth occurred spontaneously.

1.3.1.5 Effect of social stress on antler development

A possible effect of social stress upon antler growth cycles has been reported by Topinski (1975). When red and fallow deer stags were subjected to various forms of stress such as separation from the herd and aggregation with strange males, abnormal antler cycles, such as a growth of new antlers despite the persistence of the previous antlers, were observed.

1.3.2 Histology

The pedicle originates from the overlaying periosteum on the frontal bone (see section 1.3.1.1). Whereas the frontal bone is compact, the pedicle is composed of spongy bone (Goss, 1983). The trabeculae of this spongy bone are augmented apically under the cap of antlerogenic periosteum. They eventually push up under the scalp making the growing pedicle visible. This osteogenesis changes to chondrogenesis when the pedicle elongates (Goss, 1983). As highly vascularised cartilaginous trabeculae are formed on the top, ossification advances distally where the cartilage is replaced by bone (Goss, 1985). The process of ossification takes place in conjunction with calcification of the cartilage. Osteoblasts align themselves along the degenerating calcified cartilage trabeculae and mediate the transformation into bone. The resulting spongy bone is still highly vascularised. Vascularity is diminished once the secondary spongiosa is formed. Hardening of the antler bone involves restriction of the vascular channels eventually occluding blood supply completely. The resulting ischaemic necrosis of the 'velvet' skin leads to velvet shedding. The mature antler is now dead solid bone.

Goss (1990) highlighted the difficulties in determining where the antler begins to develop. The onset of chondrification could be a demarcation line but at this height the pedicle/antler is still covered by skin of the scalp and the typical velvet skin of the growing antler does not appear until the pedicle is approximately double its original diameter (Goss, 1990).

How pedicles and the first antlers are formed histologically in red deer has been studied intensively (Li and Suttie, 1994). In the pre-pedicle stage the frontal lateral crest is characterised by antlerogenic periosteum and the underlying cancellous bone, which has been formed by intramembraneous ossification (IMO). The antlerogenic periostium shows a dorsal fibrous and a ventral cellular layer. There is a distinct demarcation line between the cellular layer and the underlying bone. When the pedicle begins to develop (palpable stage) clusters of mature chondrocytes appear in the previous clear boundary zone between antlerogenic periostium and bone. Li and Suttie (1994) see this as an indication for an ossification pattern change (OPC). Three portions of tissue are distinguishable at this stage from distal to proximal: the hyperplastic antlerogenic periosteum (perichondrium), the osseocartilaginous tissue and the osseous tissue. This structure remains until pedicle elongation to 2.5-4 cm. A fourth layer, cartilaginous tissue, which is formed through modified mammalian enchondral ossification (ECO), develops under the antlerogenic perichondrium. This transition form OPC to ECO cannot be seen externally as the pedicle is still covered by the integument of the scalp. At the approximate height of 6 cm the internal structure is still the same. The cartilagenous portion however, expands proportionally greater in comparison to the other three layers. Although the internal structure does not change, the external tip is then covered by 'velvet' skin. As both the antler and the pedicle have the same ossification pattern a distinct line between them cannot be drawn. The histological examination of the distal segments of velvet antlers from various species (Banks and Newbury, 1982) showed the same four tissue structures. From distal to proximal, Banks and Newbury (1982) divided the zones into hyperplastic perichondrium, chondrocytic zone, primary spongiosa where osseous replacement of the calcified cartilage occurs, and secondary spongiosa.

1.3.3 Endocrine regulation

Temperate deer species exhibit a pronounced annual cycle in reproduction and secondary sex characteristics. The latter include antler cycles, changes in testicular activity and neck circumference in the male. The annual recurrence of these events are triggered by seasonal fluctuations of daylight length which influence the production of melatonin by the pineal gland (Webster et al., 1991; Lincoln, 1990; Goss, 1983; Bubenik, 1990). Melatonin seems to serve as a transducer for the synchronisation of the circannual events. The artificial application of melatonin, as described by Webster et al. (1991), advances the seasonal changes like scrotal circumference, body weight, antler state and coat type in red deer. Melatonin is at the beginning of the endocrine cascade that involves the hypothalamo-adenohypophyseal-gonadal axis. Gonadotropin releasing hormone (GnRH) which is produced in the hypothalamus, stimulates the secretion of Luteinizing hormone (LH) and Follicle stimulating hormone (FSH). LH has a specific action on Leydig cells of the interstitial tissue of the testes, stimulating the synthesis and release of testosterone. FSH supports the function of the Sertoli cells to provide nutrients and other necessary factors for the production and maturation of sperm (Lincoln, 1985).

These seasonal changes are observed in adult stags. The endocrine changes during the first year of life of a stag and the resulting manifestation in testicular development, pedicle and antler growth are not yet fully understood.

1.3.3.1 Luteinizing hormone and testosterone

The primordial tissue for pedicle growth are present in males as well as in female animals. In the female, pedicles usually remain dormant (Bubenik, 1990). The pedicle growth can be activated by testosterone (Kierdorf, 1985) or inhibited by estrogens. In most species, the antlers are produced only in males and grow under the stimulus of testosterone from the developing testes during the sensitive phase for pedicle development (Bubenik, 1990; Lincoln, 1992; Goss, 1985). Prenatal transitory development of fetal testes starts around day 65 after conception in red deer and coincides with the short term production of androgens by the fetal testes (Lincoln, 1973 cited by Bubenik, 1990). Leydig cells subsequently become quiescent and remain so until activated later by rising LH levels as puberty commences. A study investigating luteinizing hormone (LH) and testosterone changes in six red deer from the age of 3 to 15 months, sampled once a month for 24 hours (Suttie et al., 1991) showed a pulsatile secretion of LH in three phases with consecutive testosterone pulses. The first phase (March until August, Southern Hemisphere) was characterised by a slow increase of LH and testosterone pulses. The frequency of both pulses increased rapidly with time. This coincided with the onset of pedicle growth. The testes descend from the inguinal canal during this time. In the second phase (August until November/December), when the velvet antler is growing, LH and testosterone concentrations declined. This is followed in the third phase (November/December until March) by a rapid increase in LH and testosterone pulses. Testosterone concentrations were particularly high at the time of antler calcification and stripping of the integument. Suttie et al. (1991) concluded that the decrease in LH output, followed by steadily reduced testosterone output, facilitates velvet antler growth. Although no cause/effect relationships can be established, associations between hormones and antler development can be made. The above authors concluded that pedicle initiation is caused by increased plasma levels of testosterone stimulated by increasing LH pulse frequency, and that testosterone is stimulatory for pedicle growth but not necessarily so for velvet antler growth.

The role of testosterone is further supported by the fact that removal of the testes before the onset of puberty prevents pedicle and antler growth. However, application of testosterone to such animals late in life will cause the development of pedicles and some antler growth (Jaczewski, 1982). Castration at a later stage, once the antler bud has developed, will result in a permanent velvet antler as mineralisation does not take place. It is suggested that testosterone is necessary for the organisation of antler tissue into true Haversian bone (Fennesy and Suttie, 1985). The application of antiandrogens or castration when the antler is in the hard state leads to premature antler casting (Kierdorf, 1993).

1.3.3.2 Growth hormone and insulin-like growth factor 1

Growth hormone (GH), a pituitary hormone, is known to have a growth promoting effect on cartilage. Suttie et al. (1989) have investigated the release of GH in relation to antler growth. They sampled six 4-15 month old red deer stags once a month for 26 hours. The samples were taken every 30 minutes over a 26 hour period. Because little variation was observed within months the authors assumed that the sampling periods were appropriate. A distinct seasonal profile with GH concentration peaks in August and October (Southern Hemisphere) were observed. However, when evaluating these results one has to consider some limitations of this trial, such as the small number of animals, short sampling periods, and unknown hormone profiles during days when deer were not sampled.

GH stimulates the release of insulin-like growth factor 1 (IGF 1). The IGF 1 secretion follows the seasonality of GH with a slight delay of a month. Peak levels of IGF 1 coincide with the peak of velvet antler growth (Suttie et al., 1989; Suttie et al., 1991a). Suttie et al. (1991a) concluded that IGF 1 may be responsible for velvet antler growth. In a further study the presence of IGF 1 binding sites in the growing antler has been established (Suttie et al., 1988). When two-year-old stags were surgically prevented from growing antlers by excision of the pedicle tissue, significantly elevated plasma levels of IGF 1 could be found in the non-antlered stags compared with normal antlered stags during antler growth periods (Suttie et al., 1988).

1.4 PREVENTION OF ANTLER GROWTH

1.4.1 Necessity or desirability of prevention of antler growth

In deer farm management, antlered stags can present a considerable threat to humans and conspecifics. During the phase of hard antlers the pointed spikes can cause serious injuries, especially during the rut with the increased aggressiveness of stags (Asher, 1986). This risk is elevated in modern deer farm management as herding, yarding and transport places the animals in close confinement where aggression is elevated (Jago and Matthews, 1994). The resulting higher incidence of bruising can lead to impaired carcass quality and economic losses (see sections 1.2.2 and 1.2.3).

A further problem arises during the velvet phase of the antler growth cycle. As the animals can seriously injure themselves or their antlers during this time, transport is not permitted once the pedicle/antler has reached a height of 6 cm (Game Industry Board transport QA specifications.). This coincides with the optimal time of slaughter when venison schedule prices are highest and at a time of peak market demand. In New Zealand these velvet antlers can be amputated only according to the 'Code of Recommendations and minimum standards for the welfare of deer during the removal of antlers' published by the Ministry of Agriculture and Fisheries (1992). In other countries like Germany and England this practice is illegal (Bogner and Matzke, 1985) and the farmers are not allowed to transport the deer until at least 50% of the antler is 'cleaned' (Reinken, 1987).

1.4.2 Potential methods for prevention of antler growth

1.4.2.1 Disbudding - heat cautery

Hamilton, Kyle and Robson (1993) described the use of disbudding irons to prevent antler growth in red deer calves aged five to seven months and Asher (1986 and 1992c) reported the use of this technique in fallow deer at five months of age. After sedation and application of local anaesthetic Hamilton, Kyle and Robson (1993) used a standard cattle disbudding iron which was placed centrally over the antler bud. Two sizes of iron of 2.2 cm and 1.5 cm in diameter and two different treatment times, November and January (Northern Hemisphere) were compared. Irrespective of time, the smaller disbudding iron prevented antler growth in 50-54% of the animals treated. With the larger iron a success rate of 75% in November and 83% in January were reported. No significant difference between the live weight of the treated groups and a non-disbudded control group at turnout in spring or at slaughter in November when stags were 16 months of age was found. Asher (1986) used a calf disbudding iron with 2 cm diameter after application of local anaesthetic to the general region of the primordial pedicles. Out of 29 bucks treated prepubertally, three animals developed antler growth by four years of age (Asher, 1986).

Hamilton, Kyle and Robson (1993) and Asher (1992c) stressed that although application of sedative may not be necessary when a restraining crush is used, the use of local anaesthetic is imperative.

1.4.2.2 Application of Rubber rings

Mautz (1977) described the prevention of antler growth in deer of unnamed species or age, by constriction of blood flow at the base of the antler. Rubber rings commonly used for tail docking and castration were applied with an elastrator to the antler base. During the treatment some of the animals were restrained in a 'squeeze box', but the majority were not restrained. Mautz (1977) reported a swelling of the antler immediately above the elastrator for a period of one to two weeks, after which the antler fell off. New antlers began to grow shortly after in some animals, making a further treatment necessary. The author described the reaction of the animals to the treatment as varied though minor.

The use of elastrator rings in fallow deer was presented by Deegan (1994). That author used 20 fallow spikers and seven adult bucks. One week after application of the rubber rings, four of seven adults showed velvet peeling and two lost their mainbeam on both sides. Eight weeks after treatment, four out of twenty spikers developed regrowth. The author did not state if or when the spikers lost their antlers. Of the five adult bucks two had regrowth. Treatment induced behavioural changes by the animals; 'pawing of the head' was observed.

1.4.2.3 Castration

Castration as a means to prevent antler growth has been described by various authors (Goss, 1983; Bubenik, 1990; Lincoln and Kay, 1979; Asher, 1992). The removal of the testes prior to onset of puberty prevented pedicle and antler growth. Application of testosterone to those animals at a later stage caused the development of pedicles and the beginning of antler growth (Lincoln and Fletcher, 1976; Jaczweski, 1982). Castration after puberty does not inhibit antler growth but prevents mineralisation and casting of antlers. (Lincoln et al., 1972: Bubenik, 1982; Bubenik, 1990; Goss, 1985). Mulley and English (1992) and Asher (1993) reported that fallow bucks castrated at an early age show less weight gain at 14-17 months of age than intact animals.

Mulley and English (1991, 1992) reported that although the carcass weight of castrated bucks was lower at 17 months of age, this was of little economic consequence. Much of the difference in weight resulted from increased weight of head and bones in the intact animals. Differences in muscle weight were small and of little commercial significance according to Mulley and English (1992).

1.4.2.4 Hormonal manipulation

The hormonal cascade described in section 1.3.3. can be influenced by application or withdrawal of hormones at various stages. Kierdorf, Schultz and Fischer (1993) used cyproteron acetate (CA) to suppress androgenic activity in three adult fallow bucks. Application of the antiandrogen started in September (Northern Hemisphere), shortly after velvet shedding. Stags lost their antlers prematurely at the end of November. The authors observed no signs of aggressive behaviour of the stags although they did not clarify how this was recorded and which behavioural elements they defined as aggressive.

Application of antiandrogens before onset of puberty, which may prevent the initiation of the pedicle, has not yet been examined. The same applies to the reversible suppression of testicular activity in stags by medroxyprogesterone-acetate (MPA) as described by Barrell and Muir (1985).

The use of active immunization against GnRH as temporary immunocastration in young stags was described by Freudenberger et al. (1993), Ataja et al. (1990) in red deer and Mulley (1989) in fallow deer. Ataja et al. (1990) immunised stags at the age of 13 months. They recorded significant differences in LH concentrations between control and immunised stags only in May. Although antibody titres were raised in immunised stags, a complete block of GnRH to ensure immunocastration was not achieved. This could be due to the late commencement of the vaccination programme. Freudenberger et al. (1993) applied an anti-GnRH vaccine at the age of 9-12 months. The immunisation reduced the LH and testosterone concentrations but did not eliminate them. The immunised stags showed a higher (73%) incidence of antler growth below 100 mm than the control group (42%).

Mulley (1989) immunised pre-pubertal, 6 month old fallow bucks. He reported that two immunised bucks developed antlers to the same extent as the control, five animals showed reduced growth and three bucks did not start to develop pedicles until 13 months of age. It was suggested that the varied response to the immunisation could be due to the choice of the adjuvant used.

1.4.2.5 Surgical removal

A surgical procedure of chiselling out the periostium of the frontal bone has been practised by some researchers (English, pers. communication) but there are no reports in the literature describing the process or its success. English (pers. communication) noted some regeneration of antler as long as three years after surgery in chital deer (Axis axis).

1.4.3 Aims of the study

Stafford and Mellor (1993) pointed out, that the '*present public and scientific interest in the welfare of farm livestock has caused traditional management procedures, including castration, tail docking and dehorning, to be scrutinised as causes of stress.*' Unlike traditional livestock, deer have only recently been introduced into the farming environment and as described in 1.3 only a limited number of investigations have focused on farmed deer welfare.

The need or desire for inhibition of antler growth (see section 1.4.1) has led to the development of a number of techniques but some of these methods have certain disadvantages. Castrated bucks are more easily managed and less bruising occurs but the castrated deer gain liveweight slower (Mulley, 1993). Surgical polling or disbudding described by Asher (1986) and Hamilton, Kyle and Robson (1993) is a costly major surgical process. Hormonal manipulation of the animal, as described in 1.4.2.4., even temporarily may not be acceptable by the consumer because of the linkage with hormonal manipulation..

The technique of application of rubber rings may be economically viable and has been practised by some farmers but no objective information about the effectiveness and potential welfare implications of this technique is available. The objectives of this study therefore were:

To evaluate behavioural responses to the application of rubber rings as a means of assessing the welfare implications in red and fallow deer.

To evaluate the effectiveness of the application of rubber rings as a method of prevention of antler growth in red and fallow deer.

CHAPTER 2 BEHAVIOURAL AND ANTLER ANATOMICAL RESPONSES OF YEARLING RED AND FALLOW DEER TO APPLICATION OF ELASTRATOR RINGS UPON THE PEDICLE TO PREVENT ANTLER GROWTH

2.1 INTRODUCTION

Red and fallow deer are being farmed in increasing numbers world wide (Drew, 1985; Fletcher, 1989; Fennesy et al., 1991). Deer farming has become a rapidly growing industry which is highly competitive on an international level (Bryan, 1993). The New Zealand deer industry, represented by the New Zealand Game Industry Board, has committed itself to quality assurance programmes throughout all levels of production, from on-farm quality assurance programmes to venison processing plants. Within these, deer welfare is recognised as significant for the industry and is incorporated in the quality management to ensure international market access (Bryan, 1993).

Of prime interest in deer welfare is the removal of antlers (Wilson, 1989). The New Zealand Animal Welfare Advisory Committee (AWAC) has developed a code of recommendations and minimum standards for the welfare of deer during the removal of antlers, which has been granted ministerial approval. The code requires, that prior to velvet removal, the antler has to be fully desensitised with the use of analgesia. The velvet harvesting must be supervised by a veterinarian.

However, it has been reported that these requirements are not always adhered to (Campell, 1994). In order to achieve full compliance, the industry needs to establish procedures that are humane, acceptable from the public and consumers' perspective and are at an acceptable financial cost. Therefore investigation on non-surgical methods in general is of great interest.

The AWAC code also states that the transport of animals with growing antlers at a stage where damage is likely to occur is not permitted. The antler-growing phase in rising one-year-old stags, when these deer achieve marketable carcass weight, coincides with a clear premium at pre-Christmas sales (Drew et al., 1991). It is necessary for the farmer to remove antlers, whether hard or soft, before transport to slaughter. The sale of the spiker velvet may in some years not cover the cost of removal.

In fallow deer, the situation is slightly different. Marketable slaughter weights are mostly reached by rising two-year-old animals. But as fallow bucks can be very aggressive towards each other, considerable fighting can occur that leads to more severe bruising if the antlers are not removed (Asher, 1992c; Reinken, 1987). In contrast to red deer, velvet antler from fallow bucks killed at 15-20 months is not saleable (English, 1990b). The removal of hard spikes later in the season does not require anaesthesia but the animals are still left with hard pedicles, which can still inflict bruising (Mulley and English, 1991). The surgical removal of the pedicle with the antler, using only local analgesia as described by Asher (1992c), is not permitted by the AWAC code and will not prevent antler growth in subsequent years. Early castration as a possible solution (see section 1.4.2.3) does lead to a decrease in aggression and therefore a greatly reduced chance of severe carcass bruising (English, 1990a). However the reduced growth rate of castrated bucks is a significant disadvantage (Asher, 1993).

An alternative to removal of antlers is therefore the prevention of antler growth. The AWAC code states that " *prevention of the annual growth by surgically methods must be carried out under anaesthesia by a veterinarian. Any other non surgical prevention may only be undertaken after approval by the Chief Veterinary Officer.*"

Non-surgical methods such as the application of rubber rings to the growing pedicle/antler have been used by a number of farmers but no scientific evaluation of the effectiveness and welfare implications have been undertaken yet and the practice is not approved by the Chief Veterinary Officer.

The commitment of the industry to quality management encompasses animal health and welfare at all levels of production. It is therefore timely that an investigation of the application of rubber rings for the prevention of antler growth is undertaken at this stage.

2.2 MATERIALS AND METHODS

2.2.1 Experimental design

Thirty-one red deer stags and 39 fallow deer bucks in two different mobs were assigned to the study. The animals of each mob were ranked according to weight and randomly allocated to four treatment procedures: control (C), local anaesthetic only (LC), local anaesthetic and rubber ring (LR), rubber ring only (R) as detailed in Tables 2.1 and 2.2..

As the behavioural effect of handling treatment is supposed to be of short duration (24 hours) (Pollard et al., 1993b; Matthews and Cook, 1991) in the red deer trial, the control animals (C and LC) were allocated to a second treatment period in order to increase the number of treated animals. The animals formerly designated to group C were placed into group LR and the animals of group LC into group R. The minimum period between first and second treatment was three days.

Table 2.1 Distribution of 31 weaner stags (red deer) to treatment groups

	Group C	Group LC	Group LR	Group R
Treatment period I	no. = 8	no. = 8	no. = 7	no. = 8
Treatment period II			no. = 8 (formerly C)	no. = 8 (formerly LC)
Total no./ group	8	8	15	16

In the fallow deer trial all bucks only went through the first treatment period.

Table 2.2 Distribution of 39 weaner bucks (fallow deer) to treatment groups

	Group C	**Group LC**	**Group LR**	**Group R**
Treatment period I	no. = 10	no. = 10	no. = 10	no. = 9

Behavioural observations pre- and post-treatment as well as live weight and pedicle/antler development were recorded for both species.

2.2.2 Animals and management

2.2.2.1 Red deer

Thirty-one red deer stags (Cervus elaphus) aged 7-10 months with body weights of 58 to 72 kg were assigned to this study beginning July 1994. The animals were owned by Massey University and managed by Jennersmead Animal Health Service Center. The animals were grazed as one group at pasture and managed on the above mentioned station according to normal farm management practices.

Coloured ear tags were inserted and colour coded collars had been put on six weeks prior to the commencement of treatment in August 1994. At the time of treatment the body weights of the stags ranged between 60 and 82 kg (see Table 2.30). While the stags were restrained in the crush (see Treatment procedures 2.1.3) an identification number was sprayed on both sides of the rump and the ears were sprayed on the outer surface according to a colour code.

2.2.2.2 Fallow deer

Thirty-nine fallow deer bucks (Dama dama) aged 7-8 months with body weights of 24.5-31.5 kg were chosen for this study beginning in October 1994. The animals were owned and managed by a commercial deer farmer. The animals were grazed as one group at pasture.

Coloured and numbered collars were put on all bucks six weeks prior to commencement of the treatment in November. At the time of treatment the body weights of the bucks ranged between 28 and 36 kg (see Table 2.53).

2.2.3 Treatment procedures

Due to the fact that a maximum of 20 animals could be observed within one observation period, each species was treated during several treatment periods. The treatment schedule for red deer is given in Table 2.3.

Table 2.3 Number of red deer given each treatment on each day of observation

Treatment date	Group C	Group LC	Group LR	Group R
25.08	3	3	3	3
30.08	2	1	4	4
16.09	2	2	3	2
20.10	1	2	5	7

The schedule for fallow deer treatment is given in Table 2.4.

Table 2.4 Number of fallow deer given each treatment on each day of observation

Treatment date	Group C	Group LC	Group LR	Group R
30.11.94	7	5	5	5
02.12.94	3	5	5	4

Each treatment period contained pre- treatment measurement and observation, treatment and post-treatment measurement and observation.

2.2.3.1 Pre-treatment measurement and observation

2.2.3.1.1 Red deer

All stags were herded into the shed. For measurement of the pedicles as described in section 2.2.5.2. the deer were herded in groups of 4-6 animals into a holding pen. After live weight recording all animals were released onto the paddock.

The stags allocated for treatment on the next day were observed at 1 hour intervals from noon until 5 pm (see Table 2.5).

2.2.3.1.2 Fallow deer

All bucks were herded into the shed. They were restrained individually in a crush for pedicle measurement. After live weight recording the animals not allocated for this treatment period were released onto the paddock.

The bucks allocated for treatment on that day were observed at 1-hour intervals from 8.00 until 10.00 am in a paddock adjacent to the shed (see Table 2.6).

2.2.3.2 Treatment

2.2.3.2.1 Red deer

The actual treatment of red deer followed on the day after the pre-treatment observation. All stags were herded into the shed. The stags receiving treatment that day were separated and kept in the shed, the remainder of the group was released to the paddock. All stags allocated for this day were restrained in a crush for an equal length of time (approximately 1.5 minutes) and received the following treatment according to the randomisation.

Control (C) no treatment was applied
Local control (LC) application of 10 ml Lignocaine Hydrochloride as a ring block 200 mg/ml per pedicle infused with a sterile 20 gauge needle
Local rubber (LR) application of local anaesthetic as described in group LC
Rubber (R) no treatment was applied

All stags were released from the crush and herded in a group of three to four into an adjacent handling pen. After a minimum of four minutes all stags were held around the neck for fixation.
Control (C) released without treatment about one minute later
Local control (LC) released without treatment about one minute later
Local rubber (LR) two rubber rings per pedicle were applied
Rubber (R) two rubber rings per pedicle were applied

The rubber rings were expanded with pliers and placed around the base of the pedicle, close to pedicle-skull junction(see Figure 2.1 and 2.2) and behavioural reactions were scored as detailed in Table 2.7.

2.2.3.2.2 Fallow deer

The actual treatment of fallow deer followed on the same day of the pre-treatment observation. The already separated bucks (see pre-treatment observation) were herded into the shed. All bucks were restrained in a crush for an equal length of time (approximately 5 minutes) and received the following treatment according to the randomisation.
Control (C) no treatment was applied
Local control (LC) application of 10 ml Lignocaine Hydrochloride as a ring block 200 mg/ml per pedicle infused by a sterile 20 gauge needle
Local rubber (LR) application of local anaesthetic as described in group LC; two rubber rings per pedicle were applied
Rubber (R) two rubber rings per pedicle were applied

The rubber rings were expanded with pliers and placed around the base of he pedicle, close to pedicle skull junction (see Figures 2.1 and 2.2) and behavioural reactions were scored as detailed in Table 2.7. Rubber rings were applied to the left pedicle first.

Figure 2.1 Application of rubber rings (Fallow deer)

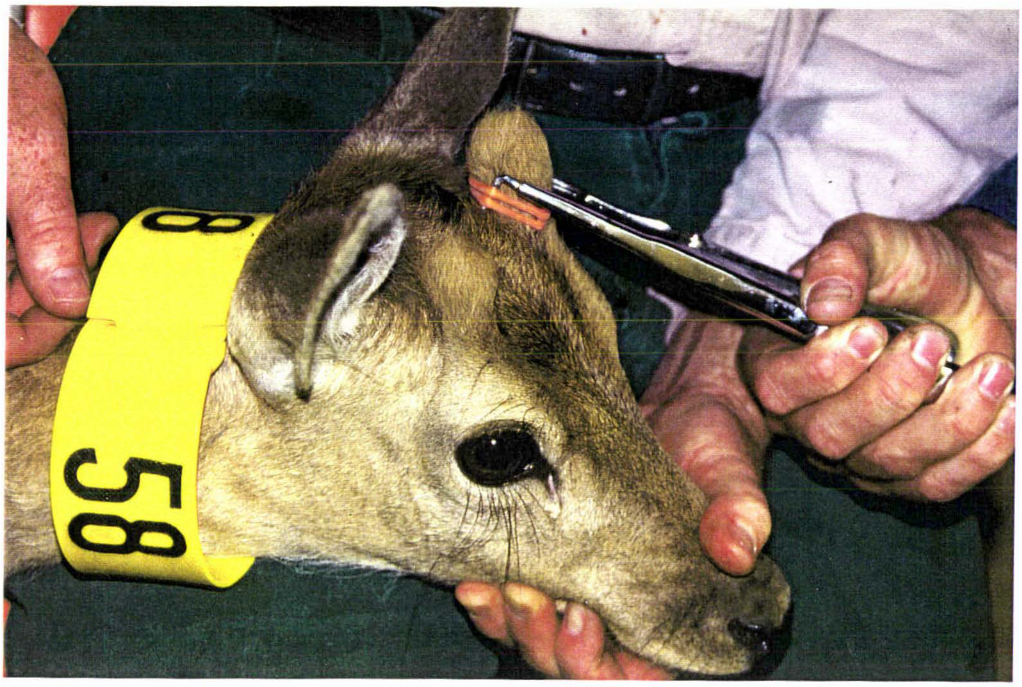

Figure 2.2 Position of rubber rings **(Red deer)**

2.2.4 Behavioural observation

2.2.4.1 Sampling techniques

For both species all behavioural observations were focal animal sampling. The duration of each observation was five minutes for the video observation (red deer only) and one minute for the observation in the paddock (both species). The animals were observed according to a randomised sequence by an observer who did not know which animal was allocated to which treatment group.

2.2.4.2 Observation periods

2.2.4.2.1 Red deer

Pre-treatment observations, one day prior to treatment, started at 12 noon and lasted until 5 pm. At hourly intervals, each individual stag was observed for 1 minute per observation period. The total duration of the pre-treatment observations was six minutes per stag (see Table 2.5).

Immediately after treatment the behaviour of the stags was scored by the person holding the animals and by the person applying the rings, according to a scoring system of 0-3 (see Table 2.7)

The post treatment observation started with a video recording of five minutes directly after treatment. Observation in the paddock started 15 minutes after treatment (approximately 10 am) and lasted until 5 pm. Each individual stag was observed for one minute per observation period.

Further post-treatment observations began at 8 am the following morning and ended at 12 noon. Per observation period each individual stag was observed for 1 minute. The duration of observations per stag is given in Table 2.5. The total duration of the post-treatment observations was 17 minutes per stag.

Table 2.5 Duration of observation per animal in minutes (Red deer)

Pre-treatment	Post treatment			
	Video	Afternoon	Morning	Total
6	5	7	5	17

2.2.4.2.2 Fallow deer

Pre-treatment observations started at 8 am and concluded at 10 am, before treatment. At hourly intervals, each individual stag was observed for 1 minute per observation period. The total duration of the pre-treatment observations was two minutes per buck (see Table 2.6).

Immediately after treatment the behaviour of the buck was scored by two persons, one being the person applying the rings, according to a scoring system of 0-3 (see Table 2.7).

Post treatment observations started 5 minutes after release from the crush approximately at 10 am. From then on the animals were observed at hourly intervals until 5 pm. Each individual stag was observed for 1 minute per observation period. The duration of observations per buck is given in Table 2.6. The total duration of the post-treatment observations was 8 minutes per buck.

Table 2.6 Duration of observation per animal in minutes (Fallow deer)

Pre-treatment	Post treatment			
	Video	Afternoon	Morning	Total
2	0	8	0	8

2.2.4.3 Equipment

2.2.4.3.1 Red deer

In the paddock the stags were observed from a caravan which served as a blind. The caravan was stationed on the perimeter of the paddock six weeks prior to commencement of the trial. A Nikon binocular with a magnification of 10 x 50 was used. The observations were recorded by audio tape on the paddock and video tape in the shed. The data were then entered into a database using the 'Observer Software programme', Version 3.0, Noldus Information Technology (Wageningen, The Netherlands).Within the programme, an event protocol is designed for coding and recording behaviour. A sample of an event protocol is given in Appendix IV.

2.2.4.3.2 Fallow deer

The bucks were observed from the shed directly adjacent to the paddock. For identification and observation the above-mentioned (see 2.2.3.4.1) binocular was used. The observations were directly entered into a Laptop computer using the above-mentioned (see 2.2.4.3.1) software programme.

2.2.4.4 Definition of behavioural elements recorded

Directly after application of the rubber rings, the behaviour of the animal was scored by the person applying the rubber rings. Table 2.7 gives the scoring system for the behavioural response of both red and fallow deer.

Table 2.7 Scoring system for response to application of rubber ring (Red and Fallow deer)

0	1	2	3
No response	**Mild response**, withdrawal of the head, head shake	**Moderate response**, withdrawal of the head, head shake, leg movement	**Strong, severe, rapid response**, forceful withdrawal of the head, kicking, pulling back, struggling with legs and body to escape

The behavioural elements for both species were recorded both from the video recording and paddock observation in the following classes:

Class: position

1.	**lie**	the animal is lying on the ground
2.	**stand**	the animal is standing on all four legs
3.	**walk**	the animal performs a minimum of three complete cycles (right front leg counted)

Class: main action

1.	**groom**	(auto-groom) the animal nibbles parts of the body it can reach with the teeth
2.	**scratch**	the animal scratches with a hind leg parts of the body or head
3.	**rub**	the animal rubs its body or part of its body against an object
4.	**feed**	the animal is standing or lying and taking up food; short phases of walking are part of the feeding element if the animal continues with feeding
5.	**ruminate**	the animal is standing or lying and chewing movements can be seen, without any intake of food prior to observation or the animal is in the process of passing a bolus up to the buccal cavity
6.	**other**	the animal is not engaged in any of the previous activities. The level of the head is be noted as above (head above shoulder level), level (head same level as shoulders) or below (head below shoulder level)

Class: flicks

1.	**ear flick**	the animal is rapidly moving one or two ears to the front and then back position.
2.	**head shake**	the animal is rapidly shaking its head from one side to the other
3.	**body shake**	the animal is shaking its whole body in a rapid movement

Class: aggression

1.	**aggressive active**	the animal engages in one of the following threat types: nose and ear threat, extended neck threat, displacements (one animals walks directly towards another individual), kicking with either one or two front legs, rearing on hind legs and waving front legs with and or without direct contact
2.	**aggressive passive**	the animal is subjected to a threat such as mentioned in aggressive active

For the behavioural elements in classes "position" and "main action" the frequency and duration were recorded. For the classes "flicks" and "aggression" only frequencies were recorded.

2.2.5 Live weight and pedicle measurements

2.2.5.1 Live weight measurements

The animals of both species were weighed before the pre-treatment observation and three days after treatment with a commercial scale to the nearest 0.5 kg.

In fallow deer an additional body weight recording was undertaken 10 days after treatment. The weight measurement ceased in December or earlier if the animal was sent to slaughter.

2.2.5.2 Pedicle/antler measurement

The pedicle and antler development of both species was measured with a flexible tape from the lateral depression caudal of the orbit to tip of the pedicle/antler to the nearest of 0.5 cm (see Figure 2.5). These measurements were taken before the pre-treatment observation.

Further measurements of the red deer only were taken three and ten days post-treatment and thereafter at three-weekly intervals until December if the animal was not sent to slaughter.

During these measurements the outer appearance, consistency of the pedicle/antler and possible wounds and wound healing due to loss of pedicle/antler were examined.

For fallow deer a further examination of the animals with special attention to the Pedicle/antler development took place 10 weeks after treatment.

Figure 2.3 Measurement of pedicle/antler

2.2.5.3 Observation of side effects

The animals were observed to detect untoward effects or any clinical illness at three and ten days and four weeks post treatment.

2.2.6 Calculation of data & statistical analysis

The behavioural data for red and fallow deer were analysed separately.

The behavioural variation between the four treatment groups during the pre-treatment observation was analysed by analysis of variance (ANOVA) (Statistical Analysis Systems Institute Inc., Version 5, SAS Institute Inc.) in order to ensure the randomised allocation of animals to treatment groups.

The post-treatment behavioural observations were analysed by treatment groups as well as by time passed after treatment in order to show
a) differences between treatment groups and
b) duration of behavioural changes over time.

Each treatment group was compared to all other treatment groups within each observation period. In each of these observation periods, mean and standard variation of every behavioural element recorded (see 2.2.4.4), were calculated and analysed by ANOVA.

Live weight data for both species were analysed using ANOVA.

2.3 RESULTS - RED DEER

In the behavioural classes 'position' and 'activity' the frequency and duration of a behavioural element were expressed as total frequency per minute (rate) and total duration in seconds. The frequencies of these behaviours are naturally low as they are a 'state', meaning an ongoing behaviour such as lying. The behavioural elements of class 'flicks' and 'aggression' were recorded as frequency only due to the transient nature of these elements, which occur so rapidly that only their occurrence can be counted.

Pre-treatment observations of all four groups had been carried out in order to ensure the randomised allocation of the animals to the treatment groups. Analysis of variance showed that the behavioural variation of the four different treatment groups did not differ significantly in any of the behavioural elements recorded.

The individual variations of behaviour are always very wide. Due to the relatively small sample we have high standard deviations. Although these phenomena pose a serious limitation significant differences between treatment groups have been found.

In the following presentation of results only behavioural differences that reached a significance level of $p<0.005$ or $p<0.05$ and trends at a significance level of $p<0.1$ are presented.

Each observation period was analysed separately because behaviour changes eminently through different phases of a day (Bubenik 1984). Therefore the observation periods cannot be summarised.

The behavioural data of each behavioural element as recorded for each individual in every observation period are given in Appendix III.

2.3.1 Double treatment

In section 2.2.1. the experimental design of the trial is shown including the double treatment of the prior control groups at a later time with rubber rings. This design is based upon the assumption that whatever effects the treatment might show, these effects may be only short lasting (Pollard et al, 1993b; Matthews and Cook, 1990). To ensure this assumption in this trial the double-treated animals were compared with the animals that were treated once only.

The statistical analysis showed that animals which had been subjected to a second treatment period exhibited significant behavioural differences after treatment compared to the animals treated once only. In deviation to the original trial protocol these animals were therefore not included in the following presentation under 2.3.1. Table 2.8 shows the revised number of red deer.

Table 2.8 Revised number of 31 weaner stags (Red deer) per treatment group

	Group C	**Group LC**	**Group LR**	**Group R**
Treatment period I	no. = 8	no. = 8	no. = 7	no. = 8
Total no./ group	8	8	7	8

A summary Table of observation periods with significant differences between double treatment and single treatment are given in Appendix V.

2.3.2 Behavioural responses to treatment

2.3.2.1 Behavioural scores directly after application of rubber rings

Five out of nine stags of the LR group showed no reaction to application of rubber rings (see Table 2.9). Two animals showed mild response and one animal exhibited a strong rapid response (score 3) to the application of the rubber ring on one pedicle while no response was elicited by the application upon the other pedicle. One animal was not scored because it was constantly fidgety about the head preventing objective assessment. Table 2.9 shows the behavioural scores of 9 stags belonging to the LR group.

Table 2.9 Behavioural score of local-rubber group (Red deer) during application of rubber ring (see Table 2.7 for scores)

Left antler	Right antler	Comments
0	0	
0	3	right score delayed
0	0	
1	1	
0	0	
0	0	
-	-	no score, but very fidgety around head
0	0	
0	1	

In the R group, one animal out of eight showed no response for both pedicles while five animals exhibited no response for one pedicle, but a mild to moderate response to the application of rubber rings to the other pedicle (see Table 2.10). One animal exhibited a strong rapid evasive response for both pedicles. As in group LR one animal was not scored. Table 2.10 shows the behavioural scores recorded in the R group.

Table 2.10 Behavioural score of rubber group (Red deer) during application of rubber ring (see Table 2.7 for scores)

Left antler	Right antler	Comments
0	2	
0	1	
3	3	
0	1	
-	-	not restrained, but pulled back
0	1	
0	1	
0	0	

2.3.2.2 Locomotion and position (lie, stand, walk)

The video recording directly after treatment showed no significant difference in position (lie, stand, walk) between the treatment groups.

In the following eight observation periods in the paddock significant differences were seen at 20, 60 and 180 minutes after treatment. Observations on the day after treatment still reveals significant differences.

2.3.2.2.1 Lie

Table 2.11 shows the duration of lying 60 minutes after treatment for all four treatment groups. Sixty minutes after treatment the Local control (LC) group was mostly lying. A significant difference ($p<0.05$) in the time spent lying could be seen between LC and Control (C) suggesting that the application of anaesthetic alone may lead to increased lying.

This increased lying may be counteracted by the application of rubber rings as the LC group spent more time lying ($p<0.01$) than the LR group. This is further underlined by the fact that the R group spent the least time lying overall.

Table 2.11 Duration of lying (seconds) in observation period 60 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	32.4	57.16	34.59	21.94
Std. Dev.	30.65	10.50	32.35	27.27
	p<0.005: LC/R p<0.05: C/LC p<0.1: LC/LR			

Table 2.12 shows the duration of lying 180 minutes after treatment for all four treatment groups. 180 minutes after treatment , the anaesthesia had apparently worn off (C similar to LC). The C group lay significantly more than R group. The above-mentioned effect that animals treated with rubber rings lie less than the control groups became more obvious.

Table 2.12 Duration of lying (seconds) in observation period 180 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	37.90	37.91	13.09	7.56
Std. Dev.	31.39	31.40	23.84	21.39
	p<0.005: -- p<0.05: C/R, LC/R p<0.1: --			

The same pattern was still found the day after (da) in observation period 2 where LC and C groups spent significantly more time lying than the LR and R group, as shown in Table 2.13.

Table 2.13 Duration of lying (seconds) in observation period 2 of the day after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	60.58	59.48	34.64	30.40
Std. Dev.	0.36	2.75	32.41	32.50
	p<0.005: -- p<0.05: C/LR, C/R, LC/LR, LC/R p<0.1: --			

The recorded durations of lying in observation period 4 on the day after are shown in Table 2.14. In this observation period this pattern is changed and although not significantly, a trend for the LR and R group to spend more time lying could be seen. This may suggest an increased need to lie for the LR and R groups to counterbalance the prior behaviour. Furthermore the behavioural effect of the rubber ring group to lie less seems to have disappeared.

Table 2.14 Duration of lying (seconds) in observation period 4 of the day after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	22.75	22.63	51.89	45.45
Std. Dev.	31.40	31.23	22.88	28.05
	p<0.005: -- p<0.05: -- p<0.1: C/LR, LC/LR			

2.3.2.2.2 Stand

During the video observation all animals remained standing all the time.

Table 2.15 shows the duration of standing for all 4 treatment groups 20 minutes after treatment. Twenty minutes after treatment significant differences in duration of standing could be observed between the treatment groups. The R group spent significantly more time standing than the C group.

The LR group spent less time standing than the R group which may indicate an effect of anaesthesia.

Table 2.15 Duration of standing (seconds) in observation period 20 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	37.81	44.15	45.72	60.13
Std. Dev.	25.22	27.30	22.29	1.34
	p<0.005: -- p<0.05: C/R p<0.1: LR/R			

Table 2.16 shows the duration of standing behaviour 180 minutes after treatment. The effect that rubber ring treated animals spent more time standing than the control groups was even more obvious 180 minute after treatment (significant differences between C and R group as well as LC and LR group) suggesting that the application of rubber rings increases standing behaviour.

Whatever effects anaesthesia might have had on the behaviour, it seems to have disappeared (C similar to LC group and LR similar to R group).

Table 2.16 Duration of standing (seconds) in observation period 180 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	20.11	17.04	47.10	48.95
Std. Dev.	28.55	27.29	23.76	22.71
	p<0.005: -- p<0.05: C/R, LC/LR, LC/R p<0.1: C/LR			

Table 2.17 shows the duration of standing behaviour recorded in observation period 2 on the day after. One day after treatment the same pattern could be detected in observation period 2 da. Significant differences could be seen between the control groups (C and LC) and the rubber ring treated groups LR and R, the latter spent more time standing.

Table 2.17 Duration of standing (seconds) in observation period 2 of the day after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0	1.01	25.90	30.19
Std. Dev.	0	2.86	32.30	32.27
	$p<0.005$: -- $p<0.05$: C/LR, C/R, LC/LR, LC/R $p<0.1$: --			

2.3.2.2.3 Walk

Table 2.18 shows the duration of walking behaviour one hour after treatment. In this period group R spent more time walking than group C ($p<0.1$) suggesting that application of rubber rings leads to increased walking behaviour.

Table 2.18 Duration of walking (seconds) in observation period 60 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	3.41	0	14.86	22.51
Std. Dev.	8.83	0	25.89	26.46
	$p<0.005$: -- $p<0.05$: LC/R $p<0.1$: C/R			

2.3.2.2.4 Summary

Summarising the position behaviour it can be said that rubber ring treated animals lay less and stood or walked more than the control groups. These effects can still partly be seen the day after treatment.

The behavioural changes due to rubber ring application seem to be reduced by anaesthesia during the first 60 minutes after treatment. Later on, no significant differences between anaesthesia treated animals and the others can be found.

2.3.2.3 Activities (feed, ruminate)

2.3.2.3.1 Feed

Table 2.19 shows the duration of feeding behaviour one hour after treatment. Sixty minutes after treatment the R group spent significantly more time feeding than the control group, LR group spent more time feeding than LC group as well ($p<0.1$). Rubber-ring treated animals fed more than the control groups.

An effect of anaesthesia could not be found (C similar to LC and LR similar to R).

Table 2.19 Duration of feeding (seconds) in observation period 60 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0	0	18.69	18.03
Std. Dev.	0	0	24.71	21.94
	p<0.005: -- p<0.05: C/R, LC/R p<0.1: C/LR, LC/LR			

Table 2.20 shows the duration of feeding behaviour two hours post treatment. Both control groups C and LC spent less time feeding than the rubber ring treated animals ($p<0.1$).

The same pattern could be seen at observation period 2 on the day after treatment (Table 2.21). In both periods the groups R and LR spent more time feeding ($p<0.1$) than the control animals.

Table 2.20 Duration of feeding (seconds) in observation period 180 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	19.14	19.58	45.23	46.98
Std. Dev.	27.09	28.06	24.36	24.88
	p<0.005: -- p<0.05: -- p<0.1: C/LR, C/R, LC/LR, LC/R			

Table 2.21 Duration of feeding (seconds) in observation period 2 of the day after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0	0	18.11	22.71
Std. Dev.	0	0	28.97	31.35
	p<0.005: -- p<0.05: -- p<0.1: C/LR, C/R, LC/LR, LC/R			

Table 2.22 shows the duration of feeding behaviour at the fourth observation period on the day after. In this period he pattern was reversed. The control animals spent more time feeding ($p<0.1$) than the rubber treated animals. This may suggest that the behavioural effect of the rubber rings to feed more seems to have disappeared. Nevertheless, a difference between control and rubber treated groups could still be seen.

Table 2.22 Duration of feeding (seconds) in observation period 4 of the day after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	33.88	24.54	8.70	7.56
Std. Dev.	29.87	28.84	23.02	21.39
	$p<0.005$: -- $p<0.05$: -- $p<0.1$: C/LR, C/R			

2.3.2.3.2 Ruminate

Table 2.23 shows the duration of ruminating six hours after treatment. A significant difference in time spent ruminating could only be seen in this observation period. The animals of group R spent more time ruminating than the control group.

Table 2.23 Duration of ruminating (seconds) in observation period 360 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	7.64	1.63	17.43	37.40
Std. Dev.	21.60	4.60	29.77	31.01
	$p<0.005$: -- $p<0.05$: C/R, LC/R $p<0.1$: --			

No significant differences were observed on the day after treatment.

2.3.2.3.3 Summary

Summarising activities, it can be said that rubber-ring treated animals spent more time feeding than the control groups for approximately 24 hours after treatment. Afterwards this pattern was reversed. This increased feeding for a period of 24 hours may be connected with the increased standing and walking behaviour shown in 2.3.2.2.2.

A similar strong effect in ruminating could not be seen. Ruminating is commonly seen as a behaviour connected with resting. As the rubber ring treated animals exhibited significantly less resting/lying behaviour than the control animals (2.3.2.2.2.) they may have been inhibited from ruminating due to this disruption of the resting pattern.

2.3.2.4 Body care (groom, scratch rub)

Table 2.24 shows the frequency of scratching behaviour 20 minutes after treatment. Scratching was the only behavioural element in this class that differed significantly between groups. All scratching observed was performed by the right or left hind leg and directed to the site of the rubber ring.

Twenty minutes post treatment the R group scratched their heads significantly more frequently than the control group and the LR group scratched more than the LC group, (not significant). This suggests that the application of rubber rings leads to scratching.

An effect of anaesthesia could be seen in the difference between R and LR ($p<0.1$).

Table 2.24 Frequency of scratching in observation period 20 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0	0	0.14	1.00
Std. Dev.	0	0	0.38	1.07
	p<0.005: -- p<0.05: C/R, LC/R p<0.1: LR/R			

2.3.2.5 Flicks (ear, head, body)

Ear, head or body flicks were rarely observed and there were no significant differences between the treatment groups.

2.3.2.6 Other behaviour

Table 2.25 shows the duration of other behaviour one hour after treatment. Sixty minutes post treatment rubber-ring treated animals showed less other behaviour than the control groups with significant differences between C and R group as well as between LC and LR group.

Table 2.25 Duration of other behaviour (seconds) in observation period 60 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	60.56	60.75	24.63	38.65
Std. Dev.	0.20	24.63	26.86	23.78
	p<0.005: -- p<0.05: C/LR, C/R, LC/LR, LC/R p<0.1: --			

Table 2.26 shows the duration of other behaviour two hours post treatment. A similar pattern could be seen 180 minutes post treatment with the LR group showing still significantly less other behaviour than the LC group.

Table 2.26 Duration of other behaviour (seconds) in observation period 180 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	40.61	40.90	6.71	13.30
Std. Dev.	28.44	28.12	14.34	24.93
	p<0.005: -- p<0.05: C/LR, LC/LR p<0.1: LC/R			

Table 2.27 shows the duration of other behaviour recorded five hours after treatment. This pattern was reversed 300 minutes after treatment when the rubber treated animals showed more other behaviour than the control groups with a significant difference between LC and LR.

Table 2.27 Duration of other behaviour (seconds) in observation period 300 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	34.19	30.24	55.24	49.48
Std. Dev.	49.48	27.41	13.96	15.39
	p<0.005: -- p<0.05: LC/LR p<0.1: --			

Table 2.28 shows the duration of other behaviour six hours post treatment. Here the control animals showed again more other behaviour than the rubber-ring treated animals. This was highly significant between C and R group.

Table 2.28 Duration of other behaviour (seconds) in observation period 360 minutes after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	53.03	39.31	25.80	9.06
Std. Dev.	21.43	27.17	31.88	21.21
	p<0.005: C/R p<0.05: LC/R p<0.1: C/LR			

Table 2.29 shows the duration of other behaviour in observation period 4 on the day after. A reversed pattern was recorded in observation period 4 da when the control groups showed less other behaviour than the rubber-ring treated groups. This was significant between C group and R group.

Table 2.29 Duration of other behaviour (seconds) in observation period 4 of the day after treatment (Red deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	20.31	29.28	51.89	52.18
Std. Dev.	26.94	28.53	22.88	21.22
	p<0.005: -- p<0.05: C/LR, C/R p<0.1: LC/R			

2.3.2.6.1 Summary

Summarising other behaviour, significant differences between the control groups and the rubber ring treated groups could be seen. But the pattern was not consistent when the rubber ring treated animals sometimes showed more, in other observation periods less, other behaviour than the control groups.

An effect of local anaesthesia upon the occurrence or duration of other behaviour could not be found.

2.3.3 Live weight response to treatment

The live weights before and three days after treatment are shown in Table 2.30. Three days post treatment, animals of all four treatment groups showed a weight gain. The LC group gained a mean of 0.31 kg. The C group gained a mean of 0.81 kg. While group LR increased weight by 1.49 kg and group R by 2.13 kg. The differences in live weight between pre- and post treatment between groups were not statistically significant ($p > 0.05$).

Table 2.30 Live weight in kg before and three days after treatment (Red deer)

		Group C	Group LC	Group LR	Group R
Pre-treatment	Mean	70.06	67.42	73.79	74.50
	Std. Dev.	5.41	4.93	5.10	3.86
Post-treatment (3 days)	Mean	71.44	67.64	75.07	76.50
	Std. Dev.	3.90	5.04	5.38	3.46
Weight gain	Mean	0.81	0.22	1.43	2.13
	Std. Dev.	1.46	0.64	1.62	1.85

2.3.4 Pedicle and antler development shortly after application of ring

Based on the assumption that the different treatments as described in 2.1.1 should not have influenced the effect of the rubber-ring treatment upon the pedicle/antler, the animals which were originally in C or LC groups, but which were subsequently subjected to application of rubber rings (LR or R), are included in this presentation.

No distinction is made between the LR and R group as the transitory anaesthesia due to the local anaesthetic is not considered likely to have influenced the effect of the rubber ring treatment upon the pedicle/antler.

Although all rubber rings were placed close to the pedicle skull junction, individual differences of the underlying structure could influence the effect of the constriction by the rubber rings. In order to observe whether the efficiency was influenced by length, the distribution of animals according to pedicle/antler length was recorded.

2.3.4.1 Rubber ring retention

The rubber rings remained on the applied site until either the distal part of the Pedicle/antler fell off or in some cases until the animal was slaughtered.

2.3.4.2 Pedicle/antler growth after treatment

The rubber-ring treatment stopped further antler growth in all animals until regrowth occurred (see 2.3.4.4)

2.3.4.3 Loss of pedicle/antler after treatment

In the literature (Mautz, 1977; Deegan, 1994; see section 1.5.2.2) only loss of antlers is reported but no observation concerning the pedicles is mentioned. In order to quantify the loss of pedicle/antler substance the percentage of loss in relation to original length is presented. In the following Table 2.31 the pedicle/antler is described as lost once a reduction over 25% has taken place. See section 2.2.5.2 for description of pedicle/antler length measurement. These measurements do not describe the protrusion from the frontal bone alone.

Table 2.3.1 Loss of pedicle/antler after treatment (Red deer)

Pedicle-/antler-length	**7-8 cm**	**9-10 cm**	**11-12 cm**	**13-17 cm**
Total number in group	6	13	7	5
After 3 days	0	3	0	0
After 20 days	1	2	3	0
After 4 weeks	3	1	2	1
After 5-9 weeks		1	2	3
Total number of loss	4	7	7	4
Percentage by length	66.6	53.8	100	80

Three animals lost more than 35-43 % of their original pedicle/antler length (10 and 9 cm) within three days of treatment. In all three cases, shrivelled, dry velvet skin was still attached to the skin distal to the rubber ring (see Figure 2.4).

Within 20 days of treatment, a further six animals showed a decrease in pedicle/antler length ranging from 26 -46%.

Between 20 days and four weeks after treatment a loss of pedicle/antler could be observed in a further seven animals.

In six stags within the time-frame of 44-58 days, a reduction ranging from 24-53% in the pedicle length could be seen.

Altogether 22 of 31 (70.9%) stags lost their pedicle/antler after treatment. Regarding the reduction of pedicle/antler material due to rubber rings, a wide range of 25 to 53 percent could be observed.

Of the remaining nine stags, all animals showed a reduction in pedicle/antler length of less than 20% but of these, seven stags had been treated only four weeks prior to the finish of the study.

Generally, once a reduction had taken place, the remaining stumps were further reduced in length in seven animals over a period of two to eight weeks. In each case the remaining bony scar tissue was polished to a smooth surface. This may suggest that the animals rubbed the stumps against a hard surface.

Depending on the percentage of reduction, the remaining pedicle stumps ranged in length from just visible between the hairs of the scalp, about 3.5-4.2 cm measured from the lateral depression of the eye (see 2.1.5 pedicle/antler measurement) to 11.8 cm.

2.3.4.4 Wounds and wound healing

During regular post-treatment examinations (see 2.2.5.3) only one stag showed an open wound, 2 cm in diameter which was covered by freshly coagulated blood as a result of dropping the antler which was later found in the shed (see Figure 2.5). In two further stags small bleeding lesions in the regrowth region (see 2.3.4.5) were seen.

All other stags showed either a remaining stump with a central bony core of approximately 0.5 cm in diameter with the shrivelled remains of the velvet skin still attached. (see Figure 2.4) or a smooth bony circular scar surface of 2-3.5 cm in diameter (see Figure 2.6).

Figure 2.4 Shrivelled antler three days post treatment (Red deer)

Figure 2.5 Open lesion shortly after loss of antler (Red deer)

Figure 2.6 Remaining bony stump after loss of pedicle/antler (Red deer)

2.3.4.5 Regrowth

Twenty out of 31 animals showed regrowth four to twelve weeks after treatment in mid-December. However the length of time between application of rubber rings and slaughter was less for the stags with shorter antlers. No conclusion should be drawn from this data alone.

The regrowth could be visually distinguished from the surrounding skin by a swollen rim around the scar tissue which was characterised by shiny velvety skin as shown in Figure 2.7. Regrowth was observed only when a reduction in pedicle/antler of more than 25 % after treatment had taken place. Figures 2.8 and 2.9 show various stages of regrowth.

The percentage of regrowth observed varied according to the pedicle/antler length at the time of application of ring, as shown in table 2.32.

Table 2.32 Distribution of regrowth according to pedicle/antler length (Red deer)

Pedicle-/antler-length	7-8 cm	9-10 cm	11-12 cm	13-17 cm
Total number in group	6	13	7	5
Regrowth	3	5	5	5
Percentage	50	38.4	71.4	100

The extent of the regrowth until mid-December varied from just visually distinguishable to a maximum of approximately 25 cm in length. The regrowth developed in some cases into a split antler with a frontal and caudal part (see Figure 2.10). In three animals a branched antler, similar to an antler of a two year old stag developed.

2.3.5 Side effects of the treatment

No untoward effects of the treatment were observed.

Figure 2.7 Beginning of regrowth on the rim of the pedicle stump (Red deer)

Figure 2.8 Later stage of regrowth (Red deer)

Figure 2.9 Split antlers with frontal and caudal part (Red deer)

Figure 2.10 Extent of regrowth in one stag in mid-December.

2.4 RESULTS - FALLOW DEER

The presentation of the behavioural data follows the outline given in 2.3.

2.4.1 Behavioural responses to treatment

2.4.1.1 Behavioural scores directly after application of rubber rings

In the LR group no animals showed any response to the application of the rubber rings.

In the R group eight out of ten animals exhibited no response while two bucks showed no response on one pedicle but a strong rapid reaction to the placing of the rings upon the other pedicle (see Table 2.33).

Table 2.33 Behavioural score of rubber group during application of rubber ring (Fallow deer) (see Table 2.7 for scores)

Left antler	Right antler
3	0
0	0
0	0
0	3
0	0
0	0
0	0
0	0
0	0
0	0

2.4.1.2 Locomotion and position (lie, stand, walk)

2.4.1.2.1 Lie

Table 2.34 shows the duration of lying three hours (180 minutes) post-treatment. The R group spent significantly more time lying than the C group in this period. Whether this can be interpreted as an effect due to the application of rubber rings is doubtful as the LR group spent less time lying than the LC group (not significant).

An interpretation of this observation as a result of anaesthesia does not seem to be possible as the anaesthetic effect should be over.

Table 2.34 Duration of lying (seconds) in observation period 180 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	2.46	18.17	6.78	24.26
Std. Dev.	7.81	29.26	20.33	31.32
	p<0.005: -- p<0.05: C/R p<0.1: --			

Table 2.35 shows the duration of lying six hours (360 minutes) post treatment. The R group spent more time lying than the LR group ($p<0.05$).

Table 2.35 Duration of lying (seconds) in observation period 360 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	12.06	21.48	0	21.48
Std. Dev.	25.43	25.77	0	25.77
	p<0.005: -- p<0.05: LR/R p<0.1: --			

2.4.1.2.2 Stand

Table 2.36 shows the duration of standing immediately after treatment. The control groups spent more time standing then the rubber treated groups. This difference was significant when comparing LC and LR group.

Table 2.36 Duration of standing (seconds) in observation period 2 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	27.13	36.88	20.30	20.99
Std. Dev.	13.37	13.13	16.54	17.41
	p<0.005: -- p<0.05: LC/LR, LC/R p<0.1: --			

The next significant difference between treatment groups was observed two hours after treatment (120 minutes) as shown in Table 2.37. The C group spent significantly more time standing than the R group. Whether this effect is due to the application of rubber rings must be doubted as the LR group spent more time standing than the LC group (not significant).

A slight increase in standing could be seen in the C group compared to the LC group ($p<0.1$). To interpret this as an anaesthesia effect does not seem to be appropriate as the R group spent less time standing than the LR group (not significant) and due to the time passed since application of anaesthetic.

Table 2.37 Duration of standing (seconds) in observation period 120 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	37.16	22.76	28.73	18.59
Std. Dev.	15.75	18.91	26.99	19.09
	$p<0.005$: -- $p<0.05$: C/R $p<0.1$: C/LC			

Table 2.38 shows the duration of standing five hours post treatment. Here the groups treated with anaesthesia behaved differently from the non-anaesthetised animals: the LR group stood less than the R group ($p<0.1$).

Table 2.38 Duration of standing (seconds) in observation period 300 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	23.96	21.04	17.47	33.38
Std. Dev.	20.49	17.34	16.34	20.92
	$p<0.005$: -- $p<0.05$: -- $p<0.1$: LR/R			

2.4.1.2.3 Walk

Table 2.39 shows the duration of walking immediately after treatment. The LR group walked more than the LC group ($p<0.1$). This could indicate that the rubber treatment leads to increased walking behaviour. However, no significant differences in behaviour could be found between the C group and the R group.

Table 2.39 Duration of walking (seconds) in observation period 2 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	33.50	23.69	36.77	39.53
Std. Dev.	13.60	13.15	16.67	17.53
	$p<0.005$: -- $p<0.05$: LC/R $p<0.1$: LC/LR			

Table 2.40 shows the duration of walking five hours post treatment. The R group walked less than the LR group ($p<0.1$).

An interpretation of this observation as a result of anaesthesia does not seem to be possible as the anaesthetic effect should be over.

Table 2.40 Duration of walking (seconds) in observation period 300 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	24.66	39.44	36.61	20.80
Std. Dev.	20.72	17.42	20.10	18.26
	p<0.005: p<0.05: LC/R p<0.1: LR/R			

2.4.1.2.4 Summary

Summarising position; no clear pattern can be recognised despite partly significant differences in behaviour as the tendencies are contradictory. However one might see a slight increase in lying and walking and a slight decrease of standing because of the rubber ring treatment.

An anaesthesia effect must be doubted as well when effects are contradictory and can be detected as late as 300 minutes after application.

2.4.1.3 Activities (feed, ruminate)

2.4.1.3.1 Feed

Table 2.41 shows the duration of feeding one hour after treatment. The LR group fed more than the R group ($p<0.1$) during this period. This may indicate an anaesthesia effect.

Table 2.41 Duration of feeding (seconds) in observation period 60 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0.33	2.69	2.20	0
Std. Dev.	1.04	5.74	3.96	0
	p<0.005: -- p<0.05: -- p<0.1: LR/R			

Table 2.42 shows the frequency of feeding one hour after treatment. An anaesthesia effect may be seen 120 minutes post treatment when the LC group fed significantly less frequently than the C group.

Furthermore an effect due to application of rubber ring could be recognised when the R group fed significantly more frequently than the C group.

Table 2.42 Frequency of feeding in observation period 120 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0.80	0.20	0.33	0.20
Std. Dev.	0.42	0.42	0.71	0.42
	p<0.005: -- p<0.05: C/LC, C/R p<0.1: C/LR			

Table 2.43 shows the duration of feeding four hours post treatment (240 minutes). The rubber ring treated animals fed less than the control groups. This effect was significant when comparing C and R groups.

Table 2.43 Duration of feeding (seconds) in observation period 240 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	23.66	11.63	8.24	5.59
Std. Dev.	23.19	23.14	20.23	9.22
	p<0.005: -- p<0.05: C/R p<0.1: --			

Table 2.44 shows the duration of feeding five hours post treatment (300 minutes). The R group fed significantly less than the C group. Whether this is caused by the application of rubber rings must be doubtful as there was nearly no difference in feeding behaviour between LC and LR and due to the time passed since application of anaesthetic.

Table 2.44 Duration of feeding (seconds) in observation period 300 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	13.15	3.93	4.02	0
Std. Dev.	7.24	5.55	12.07	0
	p<0.005: -- p<0.05: C/R, LC/R p<0.1: --			

2.4.1.3.2 Ruminate

No significant differences between the treatment groups occurred

2.4.1.3.3 Summary

Summarising the feeding behaviour, the significantly decreased duration and frequency of feeding of the R group in three observation periods suggest that the application of rubber rings led to decreased feeding behaviour.

An anaesthesia effect must be doubted when effects can be detected as late as 300 minutes after application.

2.4.1.4 Body care (groom, scratch, rub)

2.4.1.4.1 Groom

A slight difference in grooming behaviour could be seen one hour after treatment. Table 2.45 shows that the LC group spent more time grooming than the LR group ($p<0.1$)..

Table 2.45 Duration of grooming (seconds) in observation period 60 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	1.33	5.59	0.33	0.61
Std. Dev.	2.55	7.99	1.00	1.93
	p<0.005: -- p<0.05: -- p<0.1: LC/LR, LC/R			

Table 2.46 shows the frequency of grooming one hour post treatment. In this observation period the LC group showed a significantly higher grooming frequency than the LR group.

The frequencies may indicate a slight anaesthesia effect when the control group groomed less frequently than the LC group ($p<0.1$).

Table 2.46 Frequency of grooming in observation period 60 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0.30	1.10	0.11	0.10
Std. Dev.	0.48	1.20	0.33	0.32
	p<0.005: -- p<0.05: LC/LR, LC/R p<0.1: C/LC			

2.4.1.4.2 Scratch and rub

No significant differences occurred.

2.4.1.5 Flicks (ear, head, body)

2.4.1.5.1 Ear

Table 2.47 shows the frequency of ear flicks one hour post treatment. The R group showed significantly more ear flicks than the C group. The interpretation that this is caused by the application of rubber rings can however not be supported by the comparison of the LC group with the LR group (see Table 2.47).

An anaesthesia effect might be seen in the significantly increased ear flicks of the R group compared to the LR group.

Table 2.47 Frequency of ear flicks in observation period 60 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0.20	2.20	1.00	4.40
Std. Dev.	0.42	3.68	1.12	3.69
	p<0.005: C/R p<0.05: LR/R p<0.1: C/LR			

Table 2.48 shows the frequency of ear flicks two hours post treatment. The same pattern could be seen 120 minutes after treatment. The C group did not show any ear flicks which in comparison with the R group who showed a frequency of around 4, is significant. The LR group showed less ear flicks than the R group $p<0.1$.

Table 2.48 Frequency of ear flicks in observation period 120 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0	0.80	0.56	3.90
Std. Dev.	0	1.62	1.33	5.04
	p<0.005: -- p<0.05: C/R p<0.1: LC/R, LR/R			

Table 2.49 shows the frequency of ear flicks three hours post treatment. In this observation period the pattern was still the same with significant differences between C and R group as well as R and LR group as shown in Table 2.49.

Table 2.49 Frequency of ear flicks in observation period 180 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0.20	0.70	0.33	3.30
Std. Dev.	0.63	1.34	0.71	3.23
	p<0.005: -- p<0.05: C/R, LC/R, LR/R p<0.1: --			

Table 2.50 shows the frequency of ear flicks four hours post treatment. 180 minutes after treatment (240 minutes) both R and LR groups showed more ear flicks than their control counterparts. The difference between C and R group was significant.

Table 2.50 Frequency of ear flicks in observation period 240 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0.40	0.11	0.67	2.20
Std. Dev.	0.84	0.33	1.00	2.25
	p<0.005: -- p<0.05: C/R, LC/R p<0.1: LR/R			

Table 2.51 shows the frequency of ear flicks five hours post treatment. The pattern shown in the first hours after treatment was again detectable 300 minutes after treatment. The R group showed significantly more ear flicks than the C group.

Table 2.51 Frequency of ear flicks in observation period 300 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0.70	1.60	0.11	4.30
Std. Dev.	1.06	2.50	0.33	5.62
	$p<0.005$: -- $p<0.05$: -- $p<0.1$: C/R			

Table 2.52 shows the frequency of ear flicks six hours post treatment. The same pattern as seen at 240 minutes after was repeated. Both R and LR groups showed more ear flicks than their control counterparts. Table 2.52 shows the significant difference between C and R group.

Table 2.52 Frequency of ear flicks in observation period 360 minutes after treatment (Fallow deer)

	Control (C)	Local-control (LC)	Local-rubber (LR)	Rubber (R)
Mean	0	1.60	3.67	2.80
Std. Dev.	0	3.75	4.74	3.91
	$p<0.005$: -- $p<0.05$: C/LR, C/R $p<0.1$: --			

2.4.1.5.2 Head and Body flicks

No significant differences occurred.

2.4.1.5.3 Summary

Concerning the frequency of ear flicks it was obvious that through all observation periods the rubber-ring treated animals showed an increased behaviour. This was significant (60 minutes post treatment highly significant) in difference between the C and R group.

An anaesthetic effect could be detected as well when the rubber group showed significantly (or as trend in periods 120 and 240) more flicks than the LR group.

The higher frequency of ear flicks of the LC group compared to the C group might be caused by irritation due to flies, which are attracted by bleeding from the injection sites.

2.4.1.6 Other behaviour

No significant differences between treatment groups could be found.

2.4.2 Live weight response to treatment

The live weight before and three days after treatment is shown in Table 2.53. The animals of group C, LC and LR lost weight on average whereas the animals of group R gained a mean of 0.78 kg. The difference in live weight between pre-treatment and post treatment was in no case significant.

Table 2.53 Live weight (kg) before and three days after treatment (Fallow deer)

		Group C	Group LC	Group LR	Group R
Pre-treatment	Mean	29.89	29.80	31.38	30.44
	Std. Dev.	2.92	2.92	4.53	2.83
Post-treatment (3 days)	Mean	29.28	29.40	31.06	31.11
	Std. Dev.	2.32	3.03	3.46	2.77
Weight gain	Mean	-0.67	-0.40	-0.19	0.78
	Std. Dev.	1.40	0.52	1.49	2.25

2.4.3 Pedicle and antler development

In this presentation all bucks treated with rubber rings are shown. As described in 2.3.4 the assumption that the local anaesthetic treatment has no influence upon the pedicle/antler was made.

In order to observe whether the efficiency of the rubber ring treatment is influenced by antler length, the distribution of animals according to pedicle/antler length on the pre-treatment days as shown in the following Table 2.54 was recorded.

2.4.3.1 Rubber rings

Five out of six animals with pedicle/antler length of 4-5 cm at the time of treatment lost their rings within three days after treatment. In the group with 6-7 cm pedicle/antler length one out of 12 animals lost the rubber rings. It is apparent that the conical shape of the short pedicles results in the ring rolling up and off.

2.4.3.2 Pedicle/antler growth after treatment

The applied rubber rings stopped further growth in all animals observed 10 days after treatment.

2.4.3.3 Loss of pedicle/antler after treatment

Table 2.54 shows the numbers and percentage of loss according to length prior to treatment. Ten weeks after treatment 16 of 19 animals had lost the distal parts of the pedicle/antler.

Table 2.54 ***Loss of pedicle /antler after treatment (Fallow deer)***

Pedicle-/antler length	4-5 cm	6-7 cm	7-8 cm	
Total number in group	6	12	1	
After 3 days	0	0	0	
After 10 days	0	0	0	
After 10 weeks	4	11	1	
Total number of loss	4	11	1	
Percentage by length	66.6	91.6	100	

2.4.3.4 Wounds and wound healing

No open lesions were observed during the course of the study. In four out of 19 bucks only small approximately 2-3 cm stumps remained. No visible stumps were observed in 15 animals.

2.4.3.5 Regrowth

In two animals that had lost their rings within three days after treatment, the right pedicle/antler developed to a height of approximately 4 and 5 centimetres while the left pedicle was reduced to a small stump.

2.4.4 Side effects of the treatment

No untoward effect of the treatment upon the animals' health was observed.

2.5 DISCUSSION

The present behavioural study has investigated the reaction of red and fallow deer to four different treatments. In the course of the investigation 15 different behaviours were recorded in 14 observation periods after treatment.

2.5.1 Differences in behaviour caused by treatment

2.5.1.1 Observation up to 24 hours post treatment

The behavioural observation revealed significant differences between the control groups C and LC and the treatment groups R and LR in red and fallow deer. Because the comparison on pre-treatment days showed no significant differences between the four groups the significant change in behaviour observed after treatment must be attributed to effects of the treatment. Therefore the differences in behaviour between the groups on the level of $p>0.05$ will not be considered relevant for this discussion.

2.5.1.1.1 Red deer

In red deer, differences in the activity budget after treatment were seen. Stags treated with rubber rings without prior application of local anaesthesia spent less time lying and stood or walked more post treatment than the control animals.

Matthews and Cook (1990) observed the same behavioural elements: walking, standing and lying after removal of the antler, but the authors did not find any significant differences between control and treated animals. Some of the disparity between the results could be explained by the fact that Matthews et al. (1990) and Matthews and Cook (1991) did not observe the first two hours post treatment. However, a group of undisturbed control animals which were not subjected to any of the treatments showed significantly different behaviour. The undisturbed animals spent less time walking, standing and more time lying.

Because in the present study the control animals exhibited similar behaviour as seen by Matthews (1990) in the undisturbed group, one might conclude that the control treatment did not disturb the stags in the present study. In contrast to this, Pollard et al. (1993b) found a significant effect of handling on both control and treated animals after removal of velvet, although the stags had been habituated to handling for weight recording. Because pre-treatment observation was not mentioned by Pollard et al. (!993b) it is difficult to understand how those authors compare behavioural recordings pre- and post-treatment.

The increased moving and standing activities of the rubber ring treated animals may be interpreted as disruption of normal maintenance activities as described by Rushen (1984). Diverio et al. (1993) compared the behavioural response of sedated with non sedated stags to handling and clipping (as during tuberculosis testing). These authors found a significant decrease in lying and an increase in moving in the non-sedated group, which is similar to the findings of the present study.

Observation of feeding behaviour showed that rubber-ring treated animals fed significantly more, especially in the first three hours. This result is in contrast to the findings of Diverio et al. (1993) but Pollard et al. (1992) found increased feeding in velveted stags. The increased feeding could be connected to the decrease in resting behaviour. On the other hand, feeding could be an expression of displacement behaviour but no references referring to displacement in deer could be found. In humans a correlation between stress, increased cortisol levels and increased food uptake is described (W. Weilburg, pers. communication)

A similar effect on ruminating could not be seen. Ruminating is commonly seen as a behaviour connected with resting (Reinken, 1987). As the rubber-ring treated animals exhibited significantly less resting/lying behaviour than the control animals, they may have been inhibited from ruminating due to this disruption of the resting pattern.

The increased scratching in the R group at 20 minutes past treatment indicates that the deer experienced a local sensation at the site of the rubber ring. According to Gebhardt and Ness (1991) the application of tight rubber rings can cause pain in two ways, the mechanical pressure, which stimulates nociceptors just under the ring, and the ischaemia, caused by occlusion of blood vessels, which can act as a potent stimulus for pain.

2.5.1.1.2 Fallow deer

In fallow deer, despite significant differences in activity budget, few patterns could be observed because the differences in behaviour were often contradictory. This may suggest that the effect of handling overshadowed any effect due to the difference in treatment. This could be partly because the bucks were not observed in their paddock but in an area adjacent to the shed. Diverio et al. (1993) found that the closer the animals were kept to the handling area the more stress-related behaviours were exhibited. This increased level of stress may have masked the effects of the treatment. It could also indicate that some significant differences are due to chance variation, which could be expected given the large number of statistical comparisons made.

However, a consistent effect of treatment over several observation periods could be seen in the frequency of ear flicking. The animals treated with rubber rings without prior anaesthesia show significantly more ear flicking in all observation periods until 6 hours after treatment. Pollard et al. (1993b) reported a highly significant increase in ear flicking in red deer stags after velvet harvesting with prior application of local anaesthetic compared to untreated controls.

2.5.1.2 Behavioural scores to application of rubber rings

The higher incidence of mild to severe behavioural reaction to the application of rubber rings without analgesia in both species compared with deer that had been anaesthetised suggests that the procedure is aversive to some degree to the animal. However it is difficult to quantify the extent of aversiveness as stags under local anaesthesia also showed mild to severe reactions to the application of rubber rings. In principal scoring of behaviour immediately after application of stressors is only of limited value. The subjective nature, the wide definitions and possible observer bias limit any interpretation. Furthermore, the duration of the restraint may influence the findings as in red deer there were more responses to the application of the second ring. At this stage the effects of restraint by hand and the manipulation on the pedicle/antler, and the effect caused by the constriction of tissue due to the rubber ring cannot be distinguished.

2.5.1.3 Effect of anaesthesia

An effect of local anaesthesia could be seen by comparing the control groups C and LC and the treatment groups R and LR.

2.5.1.3.1 Red deer

In red deer the LC and LR groups spent more time lying than their counterparts C and R one hour after treatment. From two hours onwards, post treatment, the anaesthetic effect seems to be gone because both rubber ring treated groups LR and R exhibited less lying behaviour than their controls.

The increased scratching seen in the R group compared to all other groups shortly after treatment, indicates that only the R group experienced irritation/pain at the pedicle site. One must conclude that this irritation can be suppressed by anaesthesia

These findings are in accordance with Matthews et al. (1992) who reported maximal pain relief levels for 30 minutes post application of local anaesthesia and somewhat diminished anaesthetic effect after 120 minutes post application of anaesthesia.

2.5.1.3.2 Fallow deer

In fallow deer only the significantly lower ear flicking frequency of the LR group compared to the R group for three hours post treatment indicated an anaesthetic effect. Although the anaesthetic effect would probably have worn off two hours after treatment, trends for the LR group to flick ears less were still observed four hours post treatment.

Thus the behavioural differences between deer treated with rubber rings only in comparison to deer with local anaesthesia prior to application of rings were small. The possible negative effects such as local irritation/pain seem to be of short duration.

The differences in the behaviour of red and fallow deer could partly be caused by the different setup of the trial (see 2.5.1.1.2). However species specific differences may have contributed to the findings. In the literature (see 1.2.1.3) behavioural observations to farm management procedures are mostly described for red deer only.

2.5.2 Live weight after treatment

In both species the animals treated with rubber rings without prior anaesthesia gained more weight three days after treatment than the control groups.

This corresponds with the increased feeding of the group R observed in red deer. In fallow deer however, feeding behaviour did not follow any pattern but increased or decreased feeding was seen in different observation periods.

Overall, all red deer groups gained weight. In contrast in fallow deer, the control groups and the local rubber group did lose weight. This apparent difference in the performance between the two species could be caused by the slightly different design in the studies. The red deer stags had been yarded and handled at least once a fortnight for a period of three months prior to the start of the study. The fallow deer were only yarded four times prior to treatment. This could indicate that the intensive habituation period of the red deer to the environment and handling caused less stress on the actual day of treatment compared to the fallow deer mob or that fallow deer respond differently to the same stimulus.

2.5.3 Efficiency of treatment

In both species a substantial reduction of the pedicle/antler could be observed shortly after application of rubber rings. However the loss of distal parts of the pedicle/antler varied in percentage and time until the loss However, when the length of the pedicle/antler exceeded 13 cm at the treatment day, the loss of the distal parts seems to take longer than in stags with shorter pedicle/antler length.

The variation (3 to 58 days) in time untill a substantial loss of pedicle/antler material occurred could be influenced by the extent of the ossification of the pedicle/antler. Li and Suttie (1994) described four portions of tissue which are distinguishable at this stage of pedicle/antler development of 2.5-4 cm above the skull. From distal to proximal, the hyperplastic antlerogenic periosteum (perichondrium), the narrow cartilaginous tissue, the osseocartilaginous tissue and the osseous tissue. During further elongation of the pedicle/antler the cartilaginous and osseocartilaginous portion extend.

The loss of pedicle/antler material within three days after treatment could indicate that the part of the pedicle/antler directly underneath the rubber ring was the softer cartilaginous or osseocartilaginous tissue. The pressure of the rubber ring could constrict and deform the softer tissue faster than the harder osseus structure.

The high incidence (66%) of regrowth in red deer however limits the usefulness of this technique. The regrown pedicle/antler was often split or branched and a second application of rubber rings could therefore prove impossible.

The 86 % rate of prevention of antler growth in fallow deer and lack of regrowth after treatment makes the application of rubber rings a viable option for this species. See chapter 3 for efficacy observations on red and fallow commercial deer farms.

2.5.4 Difficulties in the interpretation of behavioural observations

The result of the present study shows a change in some behaviours due to treatment. The essential question is how to interpret these changes.

Alterations of activity budgets such as resting and feeding are reported in animals under stress (Broom, 1988; Diverio et al., 1993; Rushen, 1984). However, the non-specific nature of these responses limits possible interpretations and the essential question remains at what level of change is the welfare of deer compromised.

Concerning the assessment of pain due to the application of rubber rings we are constrained by a number of limitations. The sensation pain is subjective and can never be assessed directly (Loeffler, 1994; Sager, 1993). The individual nature of pain in deer was highlighted by Matthews et al. (1992) who reported individual differences in pain threshold in red deer. Although signs which may indicate pain were described, the pain which an animal feels cannot be quantified (Morton and Griffiths, 1985).

Although an increasing number of studies relating to deer welfare have been published, the conflicting results and the lack of standardised conditions and measurements restrict their usefulness. So far, responses of red deer to aversive situations during handling have been identified (Pollard et al., 1993b; Price et al., 1993) but no clear indicators for deer welfare have been identified or proposed.

When emphasising behavioural changes one should not forget that, even in the absence of behavioural change the animal may still be experiencing pain, stress or distress. Loeffler (1994) pointed out that for specific pain such as headache or toothache animals may not have behavioural signs. Some animals may not show pain because if they did, they may run the risk of increased aggression towards them or losing their place in the hierarchy. Furthermore, the behavioural units chosen in an observational study are limited and may not encompass behavioural elements that do change.

Under the assumption that increased restlessness indicates stress possibly arising from discomfort, irritation or pain, as outlined by Rushen (1984), the results of the present study support the view that the application of rubber rings without prior anaesthesia does cause stress. The extent of the behavioural changes could be interpreted as evidence for the presence of pain or discomfort during the first three hours. However it is important to recognise in the assessment of animal welfare that a multidisciplinary approach is needed to identify and validate indicators for deer welfare. Correlations between physiological markers such as cortisol responses, and behaviour as reported in lambs (Mellor 1991), have to be established before meaningful assessment of deer welfare can be achieved.

2.5.5 Methodological problems

2.5.5.1 Double treatment

An interesting finding of the present study was that animals exposed to a second treatment showed significant behavioural differences when compared with animals treated only once. The perception or recognition of an aversive experience in the crush and the cognitive process, being aware that this emotional (fear) experience will occur when certain conditions are met (being pushed into the crush) may change the behaviour of the individual. Pollard et al. (1991) reported an increase in heart rate prior to the removal of antler in stags that had been exposed to the treatment before and the authors suggest that this may be an anticipatory response.

The design of the present study incorporated a second treatment in order to increase the number of treated animals available for analysis, because behavioural effects of treatment were supposed to be of short duration (24 hours) (Pollard et al., 1993; Matthews and Cook, 1991). In view of the present findings, the incorporation of second treatments or a reversal of treatments as reported in a number of studies (Pollard et al., 1992; Matthews at al., 1990) in a behavioural study warrants further investigation of its validity.

2.5.5.2 Behavioural observations

That the video observation directly after treatment did not reveal any differences between treatment groups, although these could be seen later on in the paddock, suggests that there were effects due to close confinement directly adjacent to the treatment area. This highlights the importance of choosing the environment for behavioural observations.

Behavioural studies indoors do have the advantage that, by reducing the environment to minimal features that are necessary for the animal to express the behaviour under investigation, a number of variables are excluded. However, this advantage may be severely compromised by introducing variables such as disruption of social contacts and introduction of restrictions which will change the behaviour such as increased incidences of aggressiveness.

A further factor that might have influenced the behavioural response of the treated animals is the return of the treated group to the paddock reuniting them with the larger untreated mob. The untreated stags might have acted as a buffer, reducing behavioural change (Diverio et al., 1993)

2.5.5.3 Measurement of pedicle/antler

The measurement of the pedicle/antler by tape from the lateral depression caudal of the orbit to tip of the pedicle/antler proved to be a practical technique in not restrained deer. However a disadvantage of this technique is a variance in measurement of about 0.5 cm. This variation was considered acceptable for the present study.

A device to detect height changes of a millimetre has been constructed (Li, Suttie and Littlejohn, 1994). The detector working on the principle of measuring volume by displacement can detect a minimal change in pedicle height but beside shaving and strict fixation of the head, the placing of this device is crucial as the accuracy of the readings can be greatly affected by the before mentioned factors.

2.5.5.4 Live weight measurement

Accuracy of live weight measurement by commercial scales is confounded by a number of factors. The position of the animal in the scales can cause a deviation in measurement, because a reading will be different when the animal is either close to the exit or entrance or standing in the middle of the scale; a deviation of 2 kg was observed in fallow deer. This inaccuracy certainly limits interpretation when considering the small variation between the treatment groups in this study. However, the inaccuracy of the weighing procedure was at random and should not have affected the study.

2.6 CONCLUSIONS

The present study revealed statistically significant differences in behaviour due to treatment. The interpretation of these behavioural data is difficult because standard indicators or criteria for deer welfare are not yet established. The assumption that increased restlessness could be used as an indicator for stress and possibly pain or discomfort has to be validated by correlating physiological findings before a scientific assessment of the welfare implications of rubber ring application can be made. At this point it can only be concluded that behavioural responses to the treatment exist.

When assessing the possible negative effects of a treatment such as rubber ring application one has to take into consideration what effects other treatments or no treatment at all may have. As described above, a number of publications (Pollard et al., 1992a; Pollard et al., 1993b; Pollard et al., 1994b; Matthews et al., 1990; Matthews and Cook, 1991; Matthews et al., 1994) reported on behavioural effects of velvet removal. Although there is no clear consensus, the findings indicate that removal of velvet under anaesthesia is more aversive than handling only. When considering the option not to remove the pedicles and antlers one has to consider the risk of wounds inflicted by fighting. This risk is elevated in modern deer farm management as herding, yarding and transporting places the animals in close confinement where aggression is elevated. These bruises and wounds may cause the individual stags pain and discomfort, and possible sequence of infection, penetrating wounds, punctured lungs, peritonitis, haemorrhage and shock, which may be fatal

In order to establish a standard of indicators for deer welfare a multidisciplinary approach encompassing physiology and ethology is necessary to identify exact criteria for deer welfare including indicators as well as tolerable intensity of changes.

However, it is ultimately the responsibility of political organisations to decide upon which level of stress/pain is tolerable in farmed animals. This decision must be based upon scientific, political and social consensus.

CHAPTER 3 STUDIES ON THE EFFECTIVENESS OF ELASTRATOR RING APPLICATION IN YEARLING RED DEER AND FALLOW DEER TO PREVENT ANTLER GROWTH

3.1 INTRODUCTION

After completion of the behavioural study described in chapter 2 which showed only a limited number of behavioural effects, a field study with a larger number of animals was undertaken to determine the effectiveness of the rubber ring treatment under commercial farming conditions and to improve the chances to detect possible side effects of the treatment.

3.2 MATERIALS AND METHODS

3.2.1 Experimental design

Forty-five red deer stags and 84 fallow deer bucks aged 9-12 months from two different commercial farms were assigned to the study. The animals of each mob were randomly allocated to two treatment procedures: control (C) and rubber ring (R), as described in Table 3.1.

Table 3.1 Allocation of weaner stags and bucks to treatment groups

	Group C	Group R
red deer	no. = 9	no. = 36
fallow deer	no. = 21	no. = 63

3.2.2 Animals and management

Forty-five yearling red deer stags and 84 yearling fallow bucks were assigned to this study beginning November 1994. The animals were owned and managed by commercial deer farmers. They were grazed at pasture and managed according to normal management practices of the farmer. The fallow deer farm was on steep hill country at Kai Iwi north of Wanganui and the red deer farm was on flat land in the Horowhenua.

For identification in red deer, coloured ear tags were inserted three weeks prior to the commencement of the study. In fallow deer numbered collars were used for identification.

3.2.3 Treatment

Red deer

The deer were herded into a shed and sequentially drafted into a race with a capacity of six animals. The stags were restrained by hand only when they consistently tried to evade the treatment. Every fourth animal in the race was allocated to the control group and no treatment was given. The other deer in the race were allocated to the rubber group. Two rubber rings were applied to the base of the left pedicle (see Figure 2.1) and one rubber ring to the right pedicle in order to investigate if the efficacy of treatment is influenced by the number of rings placed. The rubber rings were expanded with pliers and placed around the base of the pedicle, as close to pedicle skull junction as possible (see Figure 2.2). In some deer the development of pedicle/antler was not sufficient for the retention of the rubber rings and these deer, generally with lower body weight were assigned to controls.

After treatment the animals were released into a paddock.

Fallow deer

The fallow deer bucks were herded into a shed. They were restrained individually in a mechanical drop-floor crush for inspection and treatment. Every fourth animal was allocated to the control group and no treatment was given. Other deer were allocated to the rubber group and two rubber rings per pedicle were applied to the base of the pedicle as close to pedicle skull junction as possible (see Figure 2.2).

After treatment the animals were released into a paddock.

3.2.4 Measurements and observations

The following measurements were taken on both red and fallow deer

Live weight

The animals were weighed on pre-treatment day and day three, and thirty days after treatment to the nearest 0.5 kg (fallow deer) or to the nearest of 0.1 kg (red deer) with a commercial electronic weigh scale.

Pedicle/antler

The pedicle and antler development was measured with a flexible tape from the lateral depression caudal of the orbit to the tip of the pedicle/antler to the nearest of 0.5 cm (see 2.2.5.2 and Figure 2.3). These measurements were taken on the day of treatment.

The physical appearance and consistency of the pedicle/antler were recorded and the pedicle examined for wounds and wound healing three, 16-18 and 28-30 days after the treatment. Fallow deer were observed again thirteen weeks after treatment. This was not possible for the red deer group because most of them had been sent to slaughter by that time.

At each observation period the retention of rings was recorded.

Observation of side effects
The animals were observed to detect untoward effects or any clinical illness at three and and ten days, and four weeks post-treatment. The owners were asked to record any mortalities or untoward effects.

3.2.5 Calculation of data and statistical analysis

The live weight recordings were analysed using analysis of variance (Statistical Analysis Systems Institute Inc., Version 5, SAS Institute Inc.). Descriptive statistics such as means and standard error of the mean were calculated by group.

3.3 RESULTS

3.3.1 Red deer

3.3.1.1 Live weight

Table 3.2 shows the live weights before, three days and thirty days after treatment. Three days post-treatment both groups C and R showed a similar average weight gain. At thirty days post-treatment weight gain compared to the pre-treatment measurement was slightly higher in the C group with 9.8 kg compared to 8.9 kg in the R group but this difference was not statistically significant.

Table 3.2 Live weight in kg before and three and thirty days after treatment (Red deer)

		control	**rubber ring**
Pre-treatment	Mean	70.6	76.2
	Std. Dev.	7.5	8.0
3 days Post-treatment	Mean	73.3	77.2
	Std. Dev.	6.8	8.0
Weight gain	Mean	2.7	1.0
	Std. Dev.	0.8	1.2
30 days Post-treatment	Mean	80.4	85.5
	Std. Dev.	10.2	8.8
Weight gain	Mean	9.8	8.9
	Std. Dev.	3.3	2.6

3.3.1.2 Pedicle/antler development shortly after application of rings

All rubber rings were placed close to the pedicle skull junction as possible but individual differences of the underlying structure could influence the effect of the constriction by the rubber rings. In order to observe whether the efficiency was influenced by length, the distribution of animals according to pedicle/antler measurements was recorded (see Table 3.3).

3.3.1.2.1 Rubber ring retention

Three days post-treatment, three stags with short pedicles (5-6 cm, i. e. approximately 1.25 cm protrusion above the skull) lost all rubber rings. A further three animals lost either one or two rings from one pedicle/antler. The original measurements of their pedicle/antler ranged from 5-7 cm. Three of these six stags that lost rubber rings showed a marked indentation at the original site of the rings. No stags with longer pedicle/antler lost rings.

3.3.1.2.2 Loss of pedicle/antler after treatment

Table 3.3 shows the loss of pedicle/antler three, eighteen days and four weeks after treatment. These data include all deer, those that lost their rings and those that did not loose the rubber rings. Three days after treatment no loss of pedicle/antler occurred as shown in Table 3.3. Eighteen days after treatment three animals had lost one of their antlers. Four weeks after treatment five stags with original pedicle/antler measurements of 5-6 cm had lost both pedicle/antlers. No difference between the treatment with one or two rings could be seen. In the group with original pedicle/antler measurements of 7-8 cm eight animals showed a loss of both pedicle/antlers and one exhibited the loss on one side only. A similar finding was made in the group with original pedicle length of 9-10 cm. Here five stags showed the loss of both pedicle/antlers and one stag exhibited the loss on one side only. In the group with 11-12 cm pedicle/antler growth two stags had lost both pedicle/antlers and one stag had lost only the right pedicle/antler.

Table 3.3 Loss of pedicle/antler after treatment (Red deer)

Pedicle-/antler-measurement	**5-6**		**7-8**		**9-10**		**11-12**	
Total number in group	9		15		9		3	
Number of rings	1	2	1	2	1	2	1	2
3 days after treatment	-	-	-	-	-	-	-	-
18 days after treatment	1	-	-	1	-	-	-	1
4 weeks after treatment	5	5	9	8	6	5	1	2
Total number of loss	6	5	9	9	6	5	1	3
Percentage by length	61.1		60		61.1		66.7	

Looking at the percentage of loss in regard to the original measurements of the pedicle/antler no significant differences were found. The application of one or two rings does not seem to alter the rate of pedicle/antler loss.

3.3.1.2.3 Wounds and wound healing

During post-treatment examinations eleven of thirty-six stags showed an open wound of 1,5 to 2 cm in diameter which was covered by freshly coagulated blood. The distal part of the pedicle/antler could to have been lost shortly prior to the examination.

All other stags showed either a remaining stump with a central bony core of approximately 0.5 cm in diameter or a smooth bony circular scar surface of 2-4 cm in diameter. All wounds healed to become clean and dry and no wound became infected.

3.3.1.2.4 Development of pedicle/antler after loss of rings

As described in 3.3.2.1 six stags lost their rings within three days after treatment. Of the three stags with originally short pedicle/antlers, one animal lost both pedicle/antlers within 18 days after treatment. One stag lost one pedicle antler while the other grew 2 cm within 18 days and the third exhibited antler growth to a height of 8.5 cm four weeks after treatment.

All three stags with pedicle/antler length of 5-7 cm at the time of treatment, which lost their rubber rings within three days of treatment exhibited loss of pedicle/antler within four weeks of the treatment.

3.3.1.2.5 Regrowth

Within the time frame of the study no regrowth occurred.

3.3.1.2.6 Side effects of the treatment

No untoward effect of the treatment upon the animals health were observed.

3.3.2 Fallow deer

3.3.2.1 Live weight

Table 3.4 shows the live weight before, three and thirty days after treatment. Three and thirty days post treatment both groups C and R showed a similar average weight gain. Statistical analysis revealed no significant difference between the treatment groups.

Table 3.4 Live weight in kg before, three and thirty days after treatment (Fallow deer)

		Group C	Group R
Pre-treatment	Mean	31.3	31.5
	Std. Dev.	3.0	3.4
3 days Post treatment	Mean	31.8	31.6
	Std. Dev.	2.9	3.3
Weight gain	Mean	0.5	0.0
	Std. Dev.	1.0	1.2
30 days Post treatment	Mean	35.9	35.9
	Std. Dev.	2.9	3.7
Weight gain	Mean	4.5	4.4
	Std. Dev.	1.4	1.4

3.3.2.2 Pedicle/antler development

In order to see whether the efficiency of the rubber ring treatment was influenced by development of the pedicle/antler at the time of treatment, the individual length of the pedicle/antler was recorded (see Table 3.5).

3.3.2.2.1 Rubber ring retention

Three animals with pedicle/antler measurements of 4-5 centimetres lost both rings on both pedicles within three days post treatment. Four bucks with pedicle/antler length of 5 cm lost both rings on the right side. A further nine bucks with pedicle/antler lengths of 4.4-6.0 cm lost one ring on one or two pedicles within the three days.

3.3.2.2.2 Loss of pedicle/antler after treatment

Three days after treatment no loss of pedicle/antler occurred as shown in Table 3.5. Sixteen days after treatment two bucks showed the loss of one pedicle/antler section distal to the rubber ring.

Four weeks after treatment 51 of the 62 bucks had lost their pedicle/antler distal to the rubber ring. In 23 of these animals the loss must have occurred shortly before the restraint in the crush as they exhibited fresh wounds with a small amount of bleeding. One buck showed a fresh open wound with the pedicle detached from the skull but still connected with a small flap of skin as shown in Figure 3.1.

Figure 3.1 Loss of pedicle/antler (Fallow deer)

Thirteen weeks after the treatment a further 14 bucks showed loss of pedicle/antler. Looking at the percentage of loss in regard to the pedicle /antler measurements before treatment, it seems that the bucks with smaller pedicle/antlers have a higher rate of loss than the more developed bucks. Table 3.5 shows the loss of pedicle/antler after treatment.

Table 3.5 Loss of pedicle/antler after treatment (Fallow deer)

Pedicle-/antler-measurements	4-5	6-7	8-9
Total number in group	14	42	8
3 days after treatment	-	-	-
16 days after treatment	-	1	-
4 weeks after treatment	9	32	3
13 weeks after treatment	4	6	4
Total number of loss	13	39	7
Percentage by length	92.9	92.9	81.3

3.3.2.2.3 Wounds and wound healing

Three days after treatment two bucks showed an open wound of 1.5 cm in diameter which was covered by freshly coagulated blood. Four weeks after treatment 23 bucks exhibited fresh open wounds. In two bucks the pedicle/antler was still attached to the scalp by skin. Twentyeight bucks showed small areas of scar tissue on the former site of the pedicle. The scar tissue was mostly hidden by hair of the surrounding skin. Palpation of the heads revealed an irregular hard surface which was slightly elevated from the surrounding surface. All wounds healed to become clean and dry and no wound became infected.

3.3.2.2.4 Development of pedicle/antler after loss of rings

Five of the seven animals that had lost both rings within three days after treatment exhibited pedicle/antler loss four weeks after treatment. The two remaining bucks retained their pedicle/antler but showed no growth. Thirteen weeks after treatment one of them had developed normal antler growth of 15 cm one side and a remaining small pedicle/antler of 3 cm on the other side. The other buck showed large (3 cm) pedicles but no further antler growth at the end of the trial.

3.3.2.2.5 Regrowth

Thirteen weeks after treatment eleven bucks showed regrowth. Nine of these bucks had lost their antlers within four weeks after treatment while two had retained their pedicle/antlers. Those two animals showed small regrowth (4 cm) of one antler while the rubber ring was still in place.

Looking at the pedicle/antler measurement at time of treatment in relation to the occurrence of regrowth, four animals (28.5%) with a pedicle/antler of 4.5 cm and six bucks (14.2%) with a pedicle/antler length of 6-7 cm before treatment showed regrowth. No regrowth occurred in the eight bucks with longer pedicle/antler measurementss.

3.3.2.2.6 Side effects of the treatment

No untoward effect of the treatment upon the animal's health was observed.

In the course of this study one buck showed a fracture of a neck vertebrae immediately after being herded into the shed. The animal was put down by the farmer. It is unlikely that this incident is connected with the rubber treatment.

3.4 DISCUSSION

The present field study investigated the efficacy of rubber ring application and the possible untoward effects of this treatment upon the deer in commercial farming conditions. In the course of the study, one hundred and twenty nine deer were examined.

3.4.1 Live weight

In both species no significant difference in live weight between the control and rubber treated animals could be seen. The treatment does not seem to influence the live weight performance of the animals.

Live weight development as an expression of food and water intake can be used as a sign of the welfare status of an animal (Morton and Griffiths, 1985; Broom 1981). However, the fact that no significant difference in weight gain between control and treated animals is not a guarantee for the good welfare of the animals (Fox, 1985).

3.4.2 Efficiency of treatment

Red deer

The application of rubber rings stopped further antler growth in 36 of 37 stags thirty days after treatment. The loss of pedicle/antler in 60-66.7 %, the cessation in antler growth, and the absence of regrowth at this stage allows transport of the stags for slaughter during this period. However, because some of the animals had not reached slaughter weight by this time, an assessment of the effectiveness has to take possible regrowth in the immediate future into account. The rate of regrowth reported in experiment one (2.3.4.5.) does limit the use of this technique. K. Drew (pers. communication) reported similar results.

The occurrence of ring loss in stags with little pedicle/antler growth at the time of application shows that the length of pedicle/antler should be above 7 cm when measured by tape from the outer rim of the orbit. This is approximately equal to 4.5 to 5 cm pedicle/antler growth above the level of the skull and represents a point at which the developing pedicle changes from conical to cylindrical in shape so the rubber ring does not gradually roll upwards and off.

The use of one rubber ring compared to two rubber rings did not influence the development or loss of the pedicle/antler sections distal to the rubber ring site. However application of one ring upon rather short pedicle/antlers does increase the risk of rings rolling off.

The loss of distal sections of the pedicle/antler in some animals despite loss of rubber rings within three days after treatment, indicates that restriction of blood supply due to ring pressure for a period of up to three days is sufficient to ensure necrosis and subsequent destruction of the bony connection between skull and pedicle.

Low incidence of swelling and the absence of any further inflammation or infection due to the treatment indicates that the application of rubber rings does not cause adverse side effects.

Fallow deer

The percentage of pedicle/antler loss due to treatment was higher in fallow deer than in red deer. Ninety-three percent pedicle/antler loss occurred in bucks with original antler measurements of 4-7 cm.

The lower rate of pedicle/antler loss (81 %) in bucks with longer original pedicle/antler measurements suggests a greater calcification of the underlying pedicle structure as described by Banks and Newbury (1982). The bony connection with the skull may have been sufficiently solid that the occlusion of external blood vessels by the rubber rings could lead to cessation of further growth and necrotic destruction of the mainly cartilagenous structural parts and superficial tissues of pedicle/antler but the already calcified structural parts remains unchanged.

Alternatively, it could be postulated that the complete occlusion of blood vessels is not always achieved. A possible explanation for this occurrence could be a deeper blood supply of the pedicle/antler region in these animals. One buck with an original pedicle/antler length of 8 cm showed approximately 6 cm pedicle/antler growth with the tip of hardening antler ten weeks after treatment. This suggests that the main blood supply was occluded and the alternative route of supply limited.

The animals with lost pedicle/antler in most cases showed scar tissue level with or only very slightly raised above the level of the skull. The absence of pedicle stumps in most bucks should reduce bruising and carcass damage caused by aggressive interaction between bucks. The aggressive nature of the fallow deer does cause bruising and wounds especially in bucks (Asher 1992; Reinken, 1987). Even remaining pedicle stumps, buttons, can inflict serious bruising (Mulley and English 1991). However, 15 bucks of 64 with retained or regrown pedicle/antler required a second treatment in order to avoid damage.

Most of the bucks had not reached slaughter weight at the conclusion of this study. A final evaluation of effectiveness can only be made once the bucks have reached the necessary weight at around 17 months of age (Mulley and English, 1991) as regrowth might occur during that period. Asher (1992c) reported antler growth two years after the pedicles had been removed and English (pers. communication) indicated that regrowth can occur in surgically polled bucks even three years later..

As described for red deer the loss of rubber ring within three days post treatment did still lead to a loss of pedicle/antler in five out of seven cases. This suggest that the necrosis and subsequent destruction of the bony pedicle/skull junction due to the restriction of blood supply begins rapidly after application of rings.

The result of the present study is in accordance with R. Buckmaster (pers. communication) who found that a rate of 10 percent antler regrowth or retention was to be expected.

Low incidence of swelling and the absence of any further inflammation or infection due to the treatment indicates that the application of rubber rings does not cause side effects.

3.4.3 Methodology

3.4.3.1 Measurement of pedicle/antler

Measurement of the pedicle/antler by tape from the lateral depression caudal of the orbit to the tip of the pedicle/antler proved to be a practical technique in un-restrained deer. However a disadvantage of this technique is a variance in measurement of about 0.5 cm.

The height of the pedicle/antler above the skull is approximately 2-2.5 cm smaller than the height recorded from the lateral depression.

The use of plastic rulers to measure the pedicle/antler height has several disadvantages. The position of the ruler on the skull and the angle the ruler is held may vary and therefore influence the result. In un-restrained deer, the inflexibility of the ruler may lead to a higher risk of injury for the deer as well as for the handler.

A device to detect height changes of a millimetre constructed by Li, Suttie & Littlejohn (1994) is reported to work accurately when the deer are fully restrained and the area around the pedicle shaved (see 2.5.5.3)

The external measurement however is only of limited use because the internal structure which will influence the effectiveness of treatment cannot be observed. Li and Suttie (1994) showed that the appearance of velvet skin at the distal tip of the pedicle/antler is not correlated to a change in the histological structure. Both pedicle and antler have the same ossification pattern.

3.4.3.2 Live weight measurement

Accuracy of live weight measurement by commercial scales is confounded by a number of factors. The position of the animal in the scales can cause a deviation in measurement, because a reading will be different when the animal is either close to the exit or entrance or standing in the middle of the scale; deviation of two kg was observed in fallow deer. This inaccuracy certainly limits any interpretation. However, as there were equal number of animals in the treated and control groups the variation may have increased an therefore the possibility to detect a difference but this should not alter a trend.

3.5 CONCLUSIONS

The present study showed that application of rubber rings to prevent regrowth is an option for both species.

In red deer a major reason for prevention of antler growth is restrictions in transport during the velvet phase of the antlers which coincides with the time when venison schedules are high and when stags are at optimum slaughter weight.. Application of rubber rings will, in the majority of animals, prevent velvet growth but it is essential to time the treatment carefully. Rubber rings should be applied about eight weeks prior to the transport of the stag.

Acceptability of this technique in the farming community will largely depend on the price for spiker velvet. If sale of spiker velvet presents a source of income the farmer is not likely to use the rubber ring technique because this would limit financial gain.

In fallow deer the main reason for prevention of antler growth is the aggressive nature of the buck. Even after surgical removal of the antlers the remaining pedicle stumps can cause bruising and wounds. The removal of the pedicle and prevention of antler growth by application of rubber rings is an advantage of this technique. As spiker velvet from fallow deer is not a saleable item the rubber ring technique may be accepted by fallow deer farmers because it has several advantages compared to other techniques such as surgical polling or early castration. Firstly it is easy to apply and does not require the presence of a specialist. Secondly it does not involve open surgery and the risk of infection is therefore low. Thirdly remaining pedicles after surgical antler removal still cause bruising and wounds in aggressive interaction. This problem is largely eliminated by the application of rubber rings because in most bucks the pedicle is lost as well leaving no remaining stump.

However, welfare implications of this technique must be addressed (see section 2.5) as the well-being of an animal in the farming environment is of concern to the consumer.

CHAPTER 4 GENERAL DISCUSSION AND CONCLUSIONS

Farm animal welfare has become an important issue for the general public, the farming and the scientific community (Beilharz, 1988; Dawkins, 1985; Broom, 1994). Any modern farming technique that could have implications upon the welfare of the animal has to be thoroughly investigated (Stafford and Mellor, 1993). This study investigated welfare implications and efficacy of antler growth prevention by application of elastrator rings in red and fallow deer.

4.1 STUDY DESIGN

4.1.1 Double treatment

The design of one part of the present study (red deer, chapter 2) incorporated a second treatment in order to increase the number of treated animals available for analysis. In the literature behavioural effects of treatment were reported to be of short duration (Pollard et al., 1993b). Therefore the animals designated to the control group were later placed into a treatment group in order to increase the number of deer treated.

This study showed that animals exposed to a second treatment showed significant behavioural differences when compared with animals treated only once. The perception or recognition of an aversive experience in the crush and the cognitive process, being aware that this will occur when certain conditions are met (being pushed into the crush) may change the behaviour of the individual.

In view of the present findings, the incorporation of second treatments or a reversal of treatments as reported in the literature (Pollard et al., 1992; Matthews et al., 1990) warrants further investigation of its validity.

4.1.2 Differences study design due to surroundings

As described in 2.2.4.2.1 for red deer and 2.2.4.2.2 for fallow deer the study procedures differed. This was due to the different environment.

The red deer stags, originally from different mobs were habituated to the management at Jennersmead Animal Health Service Center for a period of two month before commencement of the trial. They were herded into a shed on a weekly to fortnightly basis for a period of four months. The behavioural observations took place at pasture. During this period the stags became habituated to the handling procedure and their flight distance decreased.

The fallow deer trial took place on a commercial farm where personal and financial restrictions made a weekly handling of the animals unfeasible. The fallow bucks were herded into the shed only twice prior to the treatment and the behavioural observations took place in an area adjacent to the shed. The original paddock the bucks stayed on was too large for observation. As discussed in 2.5.1.1.2 the proximity of the shed and the unfamiliar surrounding could have induced a level of stress that may have masked the effects of the treatment.

4.1.3 Behavioural scores

The scoring of the behaviour immediately after application of the rubber rings revealed a higher incidence of behavioural reactions to the application of rubber rings without analgesia in both species compared with deer that had been anaesthetised. The reactions ranged from mild to moderate and severe response (see Table 2.7 for scoring system). This suggests that the procedure may be aversive to some degree to the animal. However it is difficult to quantify the extent of aversiveness as some stags under local anaesthesia also showed mild to severe reactions to the application of rubber rings.

In principal scoring of behaviour immediately after application of stressors is only of limited value. The subjective nature, the wide definitions and possible observer bias limit any interpretation. Furthermore, the duration of the restraint may influence the findings as in red deer there were more responses to the application of the second ring. At this stage the effects of restraint by hand and the manipulation on the pedicle/antler, and the effect caused by the constriction of tissue due to the rubber ring cannot be distinguished.

4.1.4 Video recording

The video recordings of red deer in the shed immediately after treatment revealed no significant difference in behaviour between the treatment groups and was therefore not repeated in the fallow deer trial. The video recording took place directly adjacent to the treatment area and the close confinement as well as the unusual level of activity and noise within the shed may have masked an effect of treatment.

4.1.5 Duration of observation

Due to the above described restrictions at the fallow deer farm, the behavioural observation periods pre and post treatment were less for fallow deer in comparison to red deer.

4.1.6 Measurement of pedicle/antler

The measurement of the pedicle/antler by tape from the lateral depression caudal of the orbit to tip of the pedicle/antler proved to be a practical technique in un-restrained deer. However a disadvantage of this technique is a variance in measurement of about 0.5 cm. This variation was considered acceptable for the present study.

4.2 STUDY RESULTS

4.2.1 Differences in behaviour

The behavioural observation revealed significant differences between the treatment groups in red as well as fallow deer. Because the comparison on pre-treatment days showed no significant differences between the four groups the significant change in behaviour observed after treatment must be attributed to effects of the treatment. Only differences in behaviour between the groups on the level of $p<0.05$ will be considered relevant for this discussion.

4.2.1.1 Red deer

In red deer, significant differences in the activity budget after treatment were seen between the C and the R group. Table 4.1 (this and all following Tables see 4.2.3) shows the observation periods in which certain behavioural elements differed significantly between these groups. Stags treated with rubber rings without prior application of local anaesthesia spent less time lying and stood more post-treatment than the control animals. The behavioural differences mainly occurred within three hours post-treatment. This result corresponds with the findings reported by Pollard et al. 1993b). Those authors found significantly increased moving activity and a corresponding decrease in lying within two hours after velvet antler removal compared to an untreated control group. The increased moving and standing activities of the rubber ring treated animals may be interpreted as disruption of normal maintenance activities (Rushen, 1984; Diverio et al., 1993).

Observation of feeding behaviour showed that rubber-ring treated animals fed significantly more one hour post-treatment. The increased feeding could be connected to the decrease in resting behaviour. On the other hand, feeding could be an expression of displacement behaviour but no references in the literature referring to displacement in deer could be found. The increase in time spend feeding could mean a higher food intake to counteract an increase in metabolic rate due to stress. However, the feeding time may be increased without a corresponding higher food intake because the activity sequence of feeding may be disrupted by other behaviour such as head-lifting and therefore prolong the time frame for feeding. Alados et al. (1996) described a disruption in feeding-non-feeding behaviour in female Spanish ibex (Carpa pyrenaica) with a parasitic infection compared with a healthy control group. In humans a correlation between stress, increased cortisol levels and increased food uptake is described.

The increased scratching in the R group at 20 minutes post-treatment indicates that the deer experienced a local sensation at the site of the rubber ring. The application of tight rubber rings may cause pain in two ways; the mechanical pressure, which stimulates nociceptors just under the ring, and the ischaemia, caused by occlusion of blood vessels, which can act as a potent stimulus for pain (Molony and Kent, 1993).

4.2.1.2 Fallow deer

In fallow deer, despite significant differences in activity budget, few patterns could be observed because the differences in behaviour were often contradictory. This may suggest that the effect of handling overshadowed any effect due to the difference in treatment. This could be partly explained because the bucks were not observed in their paddock but in an area adjacent to the shed. This increased level of stress may have masked the effects of the treatment.

However, a consistent effect of treatment over several observation periods could be seen in the frequency of ear flicking. The animals treated with rubber rings without prior anaesthesia show significantly more ear flicking than the control animals, in all observation periods until 6 hours after treatment as shown in Table 4.5.

Table 4.7 shows the observation periods in which behavioural elements differed significantly between LR and R groups. Here the significant difference in the frequency of ear flicks is significant in two cells.

4.2.2 Effect of anaesthesia

4.2.2.1 Red deer

Table 4.3 shows the observation periods with significant behavioural differences between the control group and the local-control group. The incidence of one cell with a significant difference suggest that there are no relevant effects of anaesthesia, if applied alone (without further treatment like rubber ring application).

Table 4.4 shows the observation periods with significant differences differed between LR and R group. surprisingly only a minimal effect can be found (compare 4.2.3).

4.2.2.2 Fallow deer

Table 4.7 shows that there was one behavioural element that differed significantly in one observation period between the control group and the local-control group suggesting that there is no effect of anaesthesia, if applied alone (without further treatment like rubber ring application).

Table 4.8 shows that two behavioural elements, lying and ear flicks differed in three observation periods differed between LR and R group.

In fallow deer the significantly higher frequency of ear flicks observed in the rubber ring treated group without prior anaesthesia compared to the LR group indicates an anaesthetic effect. Although the anaesthetic effect will probably have worn off two hours after treatment, the higher incidence of ear flicks was still present three hours post treatment. A possible explanation could be that due to the slightly smaller diameter of the pedicles in fallow deer, the pressure of the rubber rings was lower compared to the red deer and that occlusion of the superficial blood vessels took longer. However, if this would be the case, an increase in ear flicking should be observed in the anaesthetised group once the anaesthetic effect has worn off.

4.2.3 Summarising behavioural changes

The comparison between the control and rubber group in Table 4.1 reveals significant behavioural differences caused by application of rubber rings for red deer (11 cells). Table 4.5 shows similar values (10 cells) in the comparison between control and rubber group in fallow deer.

Table 4.2 shows the reduction of the behavioural changes caused by application of rubber-rings in red deer if local anaesthesia is applied. Compared to the control group the local rubber group shows only 5 cells of significant different behaviour. An even greater effect of anaesthesia is revealed (Table 4.6) for fallow deer.

Because of these results one might expect, as a logical consequence, a large number of significant behavioural changes comparing the local rubber group with the rubber group. However, Table 4.4 (red deer) and Table 4.8 (fallow deer) reveal only small differences.

A possible argument that the lack of differences between local rubber and rubber negates the necessity of anaesthesia prior to treatment cannot be sustained because it would ignore the differences found between control and rubber ring treatments.

However, these inconsistent data warrant further investigations.

Table 4.1 Obervation periods with significant differences in behaviour between control and rubber ring group (Red deer)

Time	Lie	Stand	Walk	Groom	Scr	Rub	Feed	Rumin	other	Ear flick	Head shake	Body shake	Aggr+	Aggr-
5 min														
20 min		■			■									
60 min							■		■					
120 min														
180 min	■	■												
240 min														
300 min														
360 min								■	■					
420 min														
1 da														
2 da	■	■												
3 da														
4 da									■					
5 da														

min: minutes after treatment; da: day after treatment; scr: scratch; rumin: ruminate; aggr+: aggressive active; aggr-: aggressive passive

Table 4.2 Obervation periods with significant differences in behaviour between control and local rubber ring group (Red deer)

Time	Lie	Stand	Walk	Groom	Scr	Rub	Feed	Rumin	other	Ear flick	Head shake	Body shake	Aggr+	Aggr-
5 min														
20 min														
60 min									■					
120 min														
180 min									■					
240 min														
300 min														
360 min														
420 min														
1 da														
2 da	■	■												
3 da														
4 da									■					
5 da														

min: minutes after treatment; da: day after treatment; scr: scratch; rumin: ruminate; aggr+: aggressive active; aggr-: aggressive passive

Table 4.3 Obervation periods with significant differences in behaviour between control and local control group (Red deer)

Time	Lie	Stand	Walk	Groom	Scr	Rub	Feed	Rumin	other	Ear flick	Head shake	Body shake	Aggr+	Aggr-
5 min														
20 min														
60 min	■													
120 min														
180 min														
240 min														
300 min														
360 min														
420 min														
1 da														
2 da														
3 da														
4 da														
5 da														

min: minutes after treatment; da: day after treatment; scr: scratch; rumin: ruminate; aggr+: aggressive active; aggr-: aggressive passive

Table 4.4 Obervation periods with significant differences in behaviour between local-rubber and rubber ring group (Red deer)

Time	Lie	Stand	Walk	Groom	Scr	Rub	Feed	Rumin	other	Ear flick	Head shake	Body shake	Aggr+	Aggr-
5 min														
20 min														
60 min	■													
120 min														
180 min														
240 min														
300 min														
360 min														
420 min														
1 da														
2 da														
3 da														
4 da														
5 da														

min: minutes after treatment; da: day after treatment; scr: scratch; rumin: ruminate; aggr+: aggressive active; aggr-: aggressive passive

Table 4.5 Obervation periods with significant differences in behaviour between control and rubber ring group (Fallow deer)

Time	Lie	Stand	Walk	Groom	Scr	Rub	Feed	Rumin	other	Ear flick	Head shake	Body shake	Aggr+	Aggr-
2 min														
20 min														
60 min										■				
120 min		■					■			■				
180 min	■									■				
240 min							■			■				
300 min														
360 min							■			■				

min: minutes after treatment; scr: scratch; rumin: ruminate; aggr+: aggressive active; aggr-: aggressive passive

Table 4.6 Obervation periods with significant differences in behaviour between control and local rubber group (Fallow deer)

Time	Lie	Stand	Walk	Groom	Scr	Rub	Feed	Rumin	other	Ear flick	Head shake	Body shake	Aggr+	Aggr-
2 min														
20 min														
60 min														
120 min														
180 min														
240 min														
300 min														
360 min										■				

min: minutes after treatment; scr: scratch; rumin: ruminate; aggr+: aggressive active; aggr-: aggressive passive

Table 4.7 Obervation periods with significant differences in behaviour between control and local control group (Fallow deer)

Time	Lie	Stand	Walk	Groom	Scr	Rub	Feed	Rumin	other	Ear flick	Head shake	Body shake	Aggr+	Aggr-
2 min														
20 min														
60 min														
120 min							■							
180 min														
240 min														
300 min														
360 min														

min: minutes after treatment; scr: scratch; rumin: ruminate; aggr+: aggressive active; aggr-: aggressive passive

Table 4.8 Obervation periods with significant differences in behaviour between local rubber and rubber ring group (Fallow deer)

Time	Lie	Stand	Walk	Groom	Scr	Rub	Feed	Rumin	other	Ear flick	Head shake	Body shake	Aggr+	Aggr-
2 min														
20 min														
60 min										■				
120 min														
180 min										■				
240 min														
300 min														
360 min	■													

min: minutes after treatment; scr: scratch; rumin: ruminate; aggr+: aggressive active; aggr-: aggressive passive

4.2.4 Difficulties in the interpretation of behavioural observations

The results of the present study show a change in some behaviours due to treatment. The essential question is how to interpret these changes.

The non-specific nature of these responses limits possible interpretations and the essential question remains at what level of change the welfare of deer is compromised.

Concerning the assessment of pain due to the application of rubber rings we are constrained by a number of limitations. The sensation pain is subjective and can never be assessed directly (Loeffler, 1994). Although signs which may indicate pain were described by Morton and Griffiths, 1985, the pain which an animal feels cannot be quantified (Dawkins, 1985; Sager, 1993). When emphasising behavioural changes one should not forget that, even in the absence of behavioural change the animal may still be experiencing pain, stress or distress. For a specific pain such as headache animals may not have behavioural signs. Some animals may not show pain because if they did, they may run the risk of increased aggression towards them or losing their place in the hierarchy (Fraser and Broom, 1990). Furthermore, the behavioural units chosen in an observational study are limited and may not encompass behavioural elements that do change (Lehner, 1979)

Although an increasing number of studies relating to deer welfare have been published, the conflicting results and the lack of standardised conditions and measurements restrict their usefulness as described in 1.1.3.2.. So far, responses of red deer to aversive situations during handling have been identified (Pollard et al., 1992a; Pollard et al., 1994b) but no clear indicators for deer welfare have been identified or proposed.

It is important to recognise in the assessment of animal welfare that a multidiscciplinary approach is needed to identify and validate indicators for animal welfare (Fraser and Broom, 1990; Barnett and Hemsworth, 1990). Correlation between physiological markers such as cortisol responses, and behaviour have to be established before a meaningful assessment of animal welfare can be achieved (Stafford and Mellor 1993)

In sheep, the reliability of some behavioural indices used for the recognition of acute pain after castration and tail docking have been validated by corresponding cortisol responses (Mellor, 1991; Wood et al., 1991). Lester et al.(1996) pointed out that in sheep the relative intensities of distress caused by different procedures for castrating and tail docking cannot be assessed by comparing the behavioural response alone but must be accompanied by physiological indices.

In the present study an assessment of plasma cortisol levels was not possible due to financial restraints.

4.2.5 Live weight after treatment

In both species no significant difference in live weight between the control and rubber treated animals could be seen. The treatment does not seem to influence the live weight performance of the animals. However, the fact that no significant difference in weight gain between control and treated animals is not a guarantee for the good welfare of the animals (Fox, 1985).

4.2.6 Efficiency of treatment

In both species a substantial reduction of the pedicle/antler could be observed two to four weeks after application of rubber rings. However the loss of distal parts of the pedicle/antler varied in percentage and time until the loss.

The variation (3 to 58 days) in time until a substantial loss of pedicle/antler material occurred could be influenced by the extent of the ossification of the pedicle/antler.

The loss of pedicle/antler material within three days after treatment could indicate that the part of the pedicle/antler directly underneath the rubber ring was the softer cartilaginous or osseocartilaginous tissue. The pressure of the rubber ring could constrict and deform the softer tissue faster than the harder osseus structure.

In both species the retention of pedicle/antler despite the application of rubber rings occurred. The percentage of retention was around 45% in red deer and around 10% in fallow deer.

The higher rate of retention in red deer could be caused by a higher degree of ossification of the underlying structure. Alternatively, it could be postulated that the complete occlusion ofblood vessels is not always achieved. A possible explanation for this occurrence could be a deeper blood supply of the pedicle/antler region in these animals.

The loss of distal sections of the pedicle/antler in some animals despite loss of rubber rings within three days after treatment, however, indicates that restriction of blood supply due to ring pressure for a period of up to three days can be sufficient to ensure necrosis and subsequent destruction of the bony connection between skull and pedicle.

4.2.6.1 Red deer

The application of rubber rings stopped further antler growth in 36 of 37 stags thirty days after treatment. The loss of pedicle/antler in 60-66.7 %, the cessation in antler growth, and the absence of regrowth at this stage allows transport of the stags for slaughter during this period. However, because some of the animals had not reached slaughter weight by this time, an assessment of the effectiveness has to take possible regrowth in the immediate future into account. The rate of regrowth reported in experiment one (2.3.4.5.) does limit the use of this technique.

4.2.6.2 Fallow deer

In fallow deer 93% pedicle/antler loss occurred in bucks with original antler length of 4-7 cm. The animals with lost pedicle/antler in most cases showed scar tissue level with or only very slightly raised above the skull. The absence of pedicle stumps in most bucks should reduce bruising and carcass damage caused by aggressive interaction between bucks. However, 15 bucks of 64 with retained or regrown pedicle/antler require a second treatment.

Most of the bucks had not reached slaughter weight at the conclusion of this study. A final evaluation of effectiveness can only be made once the bucks have reached the necessary weight at around 17 months of age. Given seasonal effects on antler growth it is unlikely that antler growth would occur.

The use of one rubber ring compared to two rubber rings did not influence the development or loss of the pedicle/antler sections distal to the rubber ring site. However, application of one ring upon rather short pedicle/antlers does increase the risk of rings rolling off.

Low incidence of swelling and the absence of any further inflammation or infection due to the treatment indicates that the application of rubber rings does not cause adverse side effects.

4.3 CONCLUSIONS

This study shows behavioural responses to application of rubber rings to the pedicle of deer. However, lack of standardised indicators of welfare limit our ability to interpret these results. The evaluation of intensity and duration of possible distress caused by the treatment cannot be assessed by comparison of behavioural observations alone.

At the present stage, the results of this study, the occurrence and subsequent disappearance of behavioural change suggests that application of rubber rings could lead to impaired animal welfare. Because in the present form of deer farm management in New Zealand the removal of antlers is necessary to reduce the risk of injury and bruising, application of local anaesthesia prior to application of elastrator rings seems indicated in order to avoid any possible impairment of deer welfare.

Further investigations encompassing physiology and ethology are necessary to identify exact criteria for deer welfare including indicators as well as tolerable intensity of changes.

However, it is ultimately the responsibility of a range of organisations to decide upon which level of stress/pain is tolerable in farmed animals. This decision must be based upon scientific, political and social consensus.

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Appendix 2 Conversion Table

Conversion rate for Cortisol

1 ng/dl	= 0.1 μg/100 ml
	= 2.76 nmol/l
1nmol/l	= 0.363 ng/ml
	= 0.0363 μg/ 100 ml

Appendix 3 Tabulated raw data

Glossary

A	Identification Number of animal-period
B	Date of observation
C	Identification of treatment group (C: control, LC: local-control, LR: local-rubber, R: rubber)
D	Time of observation
E	Duration of observation
F	Frequency lying
G	Duration lying
H	Frequency standing
I	Duration standing
J	Frequency walking
K	Duration walking
L	Frequency grooming
M	Duration grooming
N	Frequency scratching
O	Duration scratching
P	Frequency rubbing
Q	Duration rubbing
R	Frequency feeding
S	Duration feeding
T	Frequency ruminating
U	Duration ruminating
V	Frequency other behaviour head up
W	Duration other behaviour head up
X	Frequency other behaviour head level
Y	Duration other behaviour head level
Z	Frequency other behaviour head down
&	Duration other behaviour, head down
§	Frequency ear flick
*	Frequency head shake
#	Frequency Body shake
µ	Frequency aggressive active
0	Frequency aggressive passive

Red-deer - day of treatment - p. 1 of 4

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	●	R	S	T	U	V	W	X	Y	Z	&	§	*	#	μ	()
05-2	08-25-1994	C	12:30:08	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	1	60.4	0	0	0	0.0	0	0	0	0	0
07-1	08-25-1994	C	11:18:51	60.50	0	0.0	2	35.3	2	25.2	0	0	0	0	0	0	0	0.0	0	0	0	0.0	0	0	1	60.5	0	0	0	0	0
07-2	08-25-1994	C	12:17:58	60.70	1	60.7	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	1	60.7	0	0	0	0.0	0	0	0	0	0
02-1	08-30-1994	C	10:56:26	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0.0	0	0	1	60.3	0	0	0	0	0
02-2	08-30-1994	C	11:58:48	60.70	1	60.7	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	1	60.7	0	0	0	0.0	0	0	0	0	0
25-1	08-30-1994	C	10:51:27	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0.0	0	0	1	60.9	0	0	0	0	0
25-2	08-30-1994	C	11:52:44	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	1	11.7	0	0	1	48.6	0	0	0	0	0
27-1	08-25-1994	C	11:29:45	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0.0	0	0	1	60.6	0	0	0	0	1
27-2	08-25-1994	C	12:26:44	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	1	58.9	0	0	1	1.5	0	0	0	0	0
05-1	08-25-1994	C	11:33:45	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0.0	0	0	1	60.6	0	0	0	0	0
52-1	09-16-1994	C	10:27:42	60.70	0	0.0	1	60.7	0	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0.0	0	0	1	60.7	0	0	0	0	0
52-2	09-16-1994	C	11:27:54	60.60	0	0.0	2	58.3	1	2.3	0	0	0	0	0	0	1	13.8	0	0	0	0.0	0	0	1	46.8	0	0	0	0	0
55-1	09-16-1994	C	10:22:34	60.60	0	0.0	1	60.6	0	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0.0	0	0	1	60.6	0	0	0	0	0
55-2	09-16-1994	C	11:22:30	60.60	0	0.0	2	14.9	3	45.7	0	0	0	0	0	0	0	0.0	0	0	0	0.0	0	0	1	60.6	0	0	0	0	0
08-1	09-16-1994	C	10:25:03	60.30	1	16.8	2	41.4	1	2.1	0	0	0	0	0	0	0	0.0	0	0	2	18.9	0	0	2	41.4	0	0	0	0	1
08-2	09-16-1994	C	11:25:02	61.00	0	0.0	1	61.0	0	0.0	0	0	0	0	0	0	1	61.0	0	0	0	0.0	0	0	0	0.0	0	0	0	0	0
02-3	08-30-1994	C	13:00:41	61.00	1	61.0	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
02-4	08-30-1994	C	13:56:25	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
02-5	08-30-1994	C	14:56:24	61.10	0	0.0	1	61.1	0	0.0	0	0	0	0.0	0	0	1	61.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
25-3	08-30-1994	C	12:56:11	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0
25-4	08-30-1994	C	13:51:33	60.20	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	32.1	0	0	1	28.1	0	0	0	0	0
25-5	08-30-1994	C	14:51:30	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
27-3	08-25-1994	C	13:18:40	61.10	0	0.0	1	61.1	0	0.0	0	0	1	7.2	0	0	2	53.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
27-4	08-25-1994	C	14:30:00	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
27-5	08-25-1994	C	15:24:18	60.10	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.1	0	0	0	0.0	0	0	0	0	0
05-3	08-25-1994	C	13:23:12	60.30	0	0.0	2	39.2	1	21.1	0	0	0	0.0	0	0	2	38.6	0	0.0	0	0.0	0	0	1	21.7	0	0	0	0	0
05-4	08-25-1994	C	14:33:27	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	36.5	0	0	1	23.9	0	0	0	0	0
05-5	08-25-1994	C	15:27:20	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
52-3	09-16-1994	C	12:27:10	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
52-4	09-16-1994	C	13:27:11	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
52-5	09-16-1994	C	14:26:50	60.40	0	0.0	2	25.9	2	34.5	0	0	0	0.0	0	0	1	28.4	0	0.0	0	0.0	0	0	2	32.0	0	0	0	0	0
55-3	09-16-1994	C	12:20:15	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
55-4	09-16-1994	C	13:22:40	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
55-5	09-16-1994	C	14:22:26	60.80	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
07-3	08-25-1994	C	13:10:43	60.60	0	0.0	1	60.6	0	0.0	0	0	0	0.0	0	0	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
07-4	08-25-1994	C	14:21:22	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
07-5	08-25-1994	C	15:17:44	60.70	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
08-3	09-16-1994	C	12:22:32	60.20	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
08-4	09-16-1994	C	13:24:56	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
08-5	09-16-1994	C	14:24:38	60.90	0	0.0	1	60.9	0	0.0	0	0	0	0.0	0	0	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
02-6	08-30-1994	C	16:02:41	61.10	1	61.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0	0	0	0
25-6	08-30-1994	C	15:57:31	61.10	1	61.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	61.1	0	0.0	0	0	0	0.0	0	0	0	0	0
27-6	08-25-1994	C	15:24:18	60.10	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.1	0	0	0	0.0	0	0	0	0	0
05-6	08-25-1994	C	15:27:20	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
52-6	09-16-1994	C	15:26:59	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
55-6	09-16-1994	C	15:22:26	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
07-6	08-25-1994	C	15:17:44	60.70	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
08-6	09-16-1994	C	15:24:41	61.00	1	61.0	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	46.8	0	0	1	14.2	0	0	0	0	0

Red-deer - day of treatment - p. 2 of 4

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
09-1	08-25-1994	LC	11:25:32	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0
09-2	08-25-1994	LC	12:22:14	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
14-1	09-16-1994	LC	10:30:00	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0
14-2	09-16-1994	LC	11:30:21	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
17-1	08-25-1994	LC	11:35:53	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
17-2	08-25-1994	LC	12:31:37	60.50	1	50.4	1	10.1	0	0.0	0	0	0	0	0	0	0	0.0	1	25.0	0	0.0	0	0	1	35.5	0	0	0	0	0
18-1	08-30-1994	LC	10:50:13	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
18-2	08-30-1994	LC	11:51:06	61.10	1	61.1	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	61.1	0	0	0	0.0	0	0	0	0	0
19-1	08-25-1994	LC	11:22:52	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
19-2	08-25-1994	LC	12:19:55	60.10	1	60.1	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
21-1	09-16-1994	LC	10:20:14	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	20.5	0	0	1	40.3	0	0	0	0	0
21-2	09-16-1994	LC	11:20:11	60.90	0	0.0	1	35.5	1	25.4	0	0	0	0	0	0	1	37.2	0	0.0	0	0.0	0	0	1	23.7	0	0	0	0	0
53-1	09-16-1994	LC	10:28:52	61.00	1	32.3	1	28.7	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	4.0	0	0	2	57.0	0	0	0	0	0
53-2	09-16-1994	LC	11:29:12	60.60	0	0.0	1	60.6	0	0.0	0	0	0	0	0	0	0	0.0	1	27.8	0	0.0	0	0	1	32.8	0	0	0	0	0
59-1	09-16-1994	LC	10:32:14	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
59-2	09-16-1994	LC	11:34:41	60.90	0	0.0	3	37.2	3	23.7	0	0	0	0	0	0	0	0.0	1	11.8	0	0.0	0	0	1	49.1	0	0	0	0	1
14-3	09-16-1994	LC	12:29:25	60.80	1	60.8	0	0.0	0	0.0	0	0.0	1	0.7	0	0	0	0.0	0	0.0	1	10.6	0	0	1	49.5	0	0	0	0	0
14-4	09-16-1994	LC	13:29:34	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	49.4	0	0	1	11.3	0	0	0	0	0
14-5	09-16-1994	LC	14:29:06	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	0	0	0
14-6	09-16-1994	LC	15:29:11	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
17-3	08-25-1994	LC	13:24:52	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
17-4	08-25-1994	LC	14:34:49	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
17-5	08-25-1994	LC	15:28:45	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
17-6	08-25-1994	LC	16:29:49	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
18-3	08-30-1994	LC	12:54:57	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0	0	0	0
18-4	08-30-1994	LC	13:50:23	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	51.9	0	0	1	8.6	0	0	0	0	0
18-5	08-30-1994	LC	14:50:19	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	61.0	0	0	0	0.0	0	0	0	0	0
18-6	08-30-1994	LC	15:56:20	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	13.0	0	0.0	0	0	1	47.4	0	0	0	0	0
19-3	08-25-1994	LC	13:12:24	60.50	0	0.0	1	60.5	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
19-4	08-25-1994	LC	14:23:11	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	25.6	0	0	1	35.3	0	0	0	0	0
19-5	08-25-1994	LC	15:19:49	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	32.9	1	27.7	0	0	0	0.0	0	0	0	0	0
19-6	08-25-1994	LC	16:17:55	60.00	0	0.0	0	0.0	1	60.0	0	0.0	0	0.0	0	0	1	35.1	0	0.0	0	0.0	0	0	1	24.9	0	1	0	0	0
21-3	09-16-1994	LC	12:15:19	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	20.3	0	0	1	40.6	0	0	0	0	0
21-4	09-16-1994	LC	13:20:18	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
21-5	09-16-1994	LC	14:20:12	60.60	0	0.0	1	60.6	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
21-6	09-16-1994	LC	15:20:11	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
53-3	09-16-1994	LC	12:28:17	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.2	0	0	0	0.0	0	0	0	0	0
53-4	09-16-1994	LC	13:28:26	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0	0	0	0
53-5	09-16-1994	LC	14:27:58	60.50	1	26.3	1	34.2	0	0.0	0	0.0	0	0.0	0	0	2	33.8	0	0.0	2	18.6	0	0	1	8.1	0	1	0	0	0
53-6	09-16-1994	LC	15:28:06	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	32.9	0	0	2	27.6	0	0	0	0	0
59-3	09-16-1994	LC	12:31:40	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
59-4	09-16-1994	LC	13:31:52	60.60	0	0.0	2	36.7	2	23.9	1	8.6	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	2	52.0	0	0	0	0	0
59-5	09-16-1994	LC	14:31:22	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	2	54.9	0	0.0	0	0	1	5.3	0	0	0	0	0
59-6	09-16-1994	LC	15:31:26	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	28.9	0	0	1	31.8	0	0	0	0	0
09-3	08-25-1994	LC	13:14:33	60.40	0	0.0	1	15.5	1	44.9	0	0.0	0	0.0	0	0	2	35.8	0	0.0	0	0.0	0	0	1	24.6	0	0	0	0	0
09-4	08-25-1994	LC	14:25:03	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
09-5	08-25-1994	LC	15:21:17	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
09-6	08-25-1994	LC	16:20:33	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0

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A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
04-1	08-25-1994	LR	11:12:34	60.90	0	0.0	0	0.0	1	60.9	0	0.0	0	0	0	0	1	55.6	0	0.0	0	0.0	0	0.0	1	5.3	0	0	0	0	0
04-2	08-25-1994	LR	12:09:12	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	9.5	0	0.0	1	51.4	0	0	0	0	0
13-1	08-25-1994	LR	11:15:57	60.90	0	0.0	1	17.8	1	43.1	0	0.0	0	0	0	0	2	47.3	0	0.0	0	0.0	0	0.0	1	13.6	0	0	0	0	0
13-2	08-25-1994	LR	12:13:55	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	0
15-1	08-25-1994	LR	11:27:44	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0
15-2	08-25-1994	LR	12:24:35	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.3	0	0.0	0	0.0	0	0	0	0	0
16-1	10-20-1994	LR	11:29:21	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
16-2	10-20-1994	LR	12:30:29	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.7	0	0	0	0	0
26-1	10-20-1994	LR	11:27:03	60.70	0	0.0	1	60.7	0	0.0	0	0.0	0	0	0	0	1	27.9	0	0.0	1	2.0	0	0.0	2	30.8	0	0	0	0	0
26-2	10-20-1994	LR	12:27:58	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	41.3	0	0.0	1	19.1	0	0	0	0	0
28-1	08-30-1994	LR	10:55:17	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	41.8	0	0.0	1	18.5	0	0	0	0	0
28-2	08-30-1994	LR	11:57:41	60.90	1	5.1	1	55.8	0	0.0	1	8.8	0	0	0	0	0	0.0	0	0.0	2	11.3	1	8.7	3	32.1	0	2	0	1	0
58-1	10-20-1994	LR	11:34:02	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0
58-2	10-20-1994	LR	12:35:06	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
13-3	08-25-1994	LR	13:07:12	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
13-4	08-25-1994	LR	14:17:19	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.1	0	0	0	0	0
13-5	08-25-1994	LR	15:14:10	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
13-6	08-25-1994	LR	16:11:02	61.10	0	0.0	1	58.6	1	2.5	0	0.0	0	0.0	0	0	1	60.1	0	0.0	0	0.0	0	0.0	1	1.0	0	0	0	0	0
15-3	08-25-1994	LR	13:16:50	61.00	0	0.0	1	58.5	1	2.5	0	0.0	0	0.0	0	0	1	52.4	0	0.0	0	0.0	0	0.0	1	8.6	0	0	0	0	0
15-4	08-25-1994	LR	14:26:49	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0	0	0	0
15-5	08-25-1994	LR	15:22:49	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	0
15-6	08-25-1994	LR	16:22:41	61.10	0	0.0	1	49.8	1	11.3	0	0.0	1	10.9	0	0	2	50.2	0	0.0	0	0.0	0	0.0	0	0.0	0	1	1	0	0
16-3	10-20-1994	LR	13:28:52	60.70	0	0.0	1	60.7	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
16-4	10-20-1994	LR	14:28:17	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	1	16.0	0	0.0	0	0.0	0	0.0	1	45.0	0	0	0	0	0
16-5	10-20-1994	LR	15:28:15	60.00	1	60.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.0	0	0	0	0	0
16-6	10-20-1994	LR	16:31:44	60.50	1	46.3	1	11.2	1	3.0	0	0.0	0	0.0	0	0	1	2.2	0	0.0	1	34.8	0	0.0	1	23.5	0	0	0	0	1
26-3	10-20-1994	LR	13:26:39	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
26-4	10-20-1994	LR	14:26:00	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0	0	0	0
26-5	10-20-1994	LR	15:25:59	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	0	0	0	0	0
26-6	10-20-1994	LR	16:29:27	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.9	0	0.0	0	0.0	0	0	0	0	0
28-3	08-30-1994	LR	12:59:34	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0
28-4	08-30-1994	LR	13:55:17	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.9	0	0.0	0	0.0	0	0	0	0	0
28-5	08-30-1994	LR	14:55:14	60.50	0	0.0	2	37.5	2	23.0	0	0.0	0	0.0	0	0	2	36.9	0	0.0	0	0.0	0	0.0	2	23.6	0	0	0	0	0
28-6	08-30-1994	LR	16:01:34	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
04-3	08-25-1994	LR	13:04:11	60.10	0	0.0	1	60.1	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
04-4	08-25-1994	LR	14:13:44	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0
04-5	08-25-1994	LR	15:10:40	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.8	0	0	0	0	0
04-6	08-25-1994	LR	16:07:14	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
58-3	10-20-1994	LR	13:34:03	60.60	1	31.4	1	29.2	0	0.0	0	0.0	0	0.0	0	0	1	22.2	0	0.0	1	7.6	0	0.0	1	30.8	0	0	0	0	0
58-4	10-20-1994	LR	14:32:47	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.9	0	0	0	0	0
58-5	10-20-1994	LR	15:32:48	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0	0	0	0
58-6	10-20-1994	LR	16:36:37	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
01-1	08-25-1994	R	11:32:01	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0
01-2	08-25-1994	R	12:28:20	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
06-1	08-25-1994	R	11:14:19	60.00	0	0.0	0	0.0	1	60.0	0	0.0	0	0.0	0	0.0	1	49.2	0	0.0	0	0.0	0	0	1	10.8	0	0	0	0	0
06-2	08-25-1994	R	12:11:55	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0.0	0	0	0	0	0
12-1	10-20-1994	R	11:21:14	60.10	0	0.0	2	34.6	2	25.5	0	0.0	0	0.0	0	0.0	2	37.6	0	0.0	0	0.0	0	0	2	22.5	0	0	0	0	0
12-2	10-20-1994	R	12:23:15	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	24.6	0	0	1	36.0	0	0	0	0	0

Red-deer - day of treatment - p. 4 of 4

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
22-1	10-20-1994	R	11:25:50	61.10	1	37.4	1	23.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.1	0	0	2	57.0	0	0	0	0	0
22-2	10-20-1994	R	12:26:46	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
29-1	08-25-1994	R	11:17:23	60.10	0	0.0	1	2.1	1	58.0	0	0.0	0	0.0	0	0.0	2	44.3	0	0.0	0	0.0	0	0	2	15.8	0	0	0	0	0
29-2	08-25-1994	R	12:16:05	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
51-1	10-20-1994	R	11:24:09	60.90	0	0.0	1	24.3	1	36.6	1	18.8	1	11.7	0	0.0	1	13.1	0	0.0	0	0.0	0	0	2	17.3	0	0	0	0	0
51-2	10-20-1994	R	12:25:39	60.40	1	60.4	0	0.0	0	0.0	1	5.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	2	54.9	0	0	0	0	0
54-1	10-20-1994	R	11:30:33	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
54-2	10-20-1994	R	12:31:36	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0.0	0	0	0	0.0	0	0	0	0	0
57-1	09-16-1994	R	10:26:22	60.20	1	16.6	1	43.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
57-2	09-16-1994	R	11:26:09	61.10	0	0.0	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	1	35.9	0	0.0	0	0.0	0	0	1	25.2	0	0	0	0	0
01-3	08-25-1994	R	13:21:07	60.20	0	0.0	1	28.6	1	31.6	0	0.0	0	0.0	0	0	1	14.3	0	0.0	0	0.0	0	0	2	45.9	0	0	0	0	0
06-3	08-25-1994	R	13:05:44	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
01-4	08-25-1994	R	14:31:43	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
01-5	08-25-1994	R	15:25:42	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
01-6	08-25-1994	R	16:26:05	60.60	0	0.0	1	5.1	1	55.5	0	0.0	0	0.0	0	0	1	53.1	0	0.0	0	0.0	0	0	2	7.5	0	0	0	0	0
12-3	10-20-1994	R	13:21:22	60.30	0	0.0	1	60.3	0	0.0	0	0.0	1	1.5	0	0	2	58.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
12-4	10-20-1994	R	14:21:17	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
12-5	10-20-1994	R	15:21:29	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	29.1	0	0.0	0	0	1	31.1	0	0	0	0	0
12-6	10-20-1994	R	16:23:26	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
22-3	10-20-1994	R	13:25:33	60.20	0	0.0	1	60.2	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
22-4	10-20-1994	R	14:24:53	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	61.0	0	0	0	0.0	0	0	0	0	0
22-5	10-20-1994	R	15:24:51	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	32.5	0	0.0	0	0	1	27.9	3	0	0	0	0
22-6	10-20-1994	R	16:27:35	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.9	0	0.0	0	0	0	0.0	0	0	0	0	0
29-3	08-25-1994	R	13:08:45	60.50	0	0.0	1	60.5	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
29-4	08-25-1994	R	14:19:35	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	42.3	0	0	1	18.3	0	0	0	0	0
29-5	08-25-1994	R	15:16:25	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	43.3	0	0	1	17.5	0	0	0	0	0
29-6	08-25-1994	R	16:12:58	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	56.2	0	0.0	0	0	1	3.9	0	0	0	0	0
51-3	10-20-1994	R	13:24:27	60.70	0	0.0	1	60.7	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
51-4	10-20-1994	R	14:23:46	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
51-5	10-20-1994	R	15:23:45	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
51-6	10-20-1994	R	16:25:45	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.4	0	0.0	0	0	0	0.0	0	0	0	0	0
54-3	10-20-1994	R	13:29:58	61.00	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
54-4	10-20-1994	R	14:29:26	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
54-5	10-20-1994	R	15:29:22	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
54-6	10-20-1994	R	16:32:56	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	0	0	0
57-3	09-16-1994	R	12:24:42	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
57-4	09-16-1994	R	13:26:03	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	27.4	0	0	1	33.3	0	0	0	0	0
57-5	09-16-1994	R	14:25:43	60.20	0	0.0	1	60.2	0	0.0	1	7.5	0	0.0	0	0	1	18.7	0	0.0	0	0.0	0	0	2	34.0	0	0	0	0	0
57-6	09-16-1994	R	15:25:47	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	31.9	0	0	2	29.2	0	0	0	0	0
06-4	08-25-1994	R	14:15:46	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
06-5	08-25-1994	R	15:12:22	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
06-6	08-25-1994	R	16:09:05	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.7	0	0.0	0	0	0	0.0	0	0	0	0	0

Red-deer - day before treatment - p. 1 of 4

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
05-1	08-23-1994	C	12:30:51	60.10	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
05-2	08-23-1994	C	13:20:42	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	8.0	0	0.0	0	0	1	52.6	0	0	0	0	0
05-3	08-23-1994	C	14:25:09	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
05-4	08-23-1994	C	15:39:51	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
05-5	08-23-1994	C	16:25:07	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	60.5	0	0.0	0	0	0	0.0	0	0	0	0	0
05-6	08-23-1994	C	17:22:04	61.00	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	1	61.0	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
07-1	08-23-1994	C	12:19:26	60.10	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
07-2	08-23-1994	C	13:10:46	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
07-3	08-23-1994	C	14:11:10	60.10	0	0.0	1	60.1	0	0.0	0	0	0	0.0	0	0	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
07-4	08-23-1994	C	15:29:05	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
07-5	08-23-1994	C	16:17:02	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	60.4	0	0.0	0	0	0	0.0	0	0	0	0	0
02-1	08-28-1994	C	12:21:53	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
02-2	08-28-1994	C	13:21:30	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	25.9	0	0.0	0	0	1	34.7	0	0	0	0	0
02-3	08-28-1994	C	14:21:22	61.10	1	61.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	61.1	0	0	0	0.0	0	0	0	0	0
02-4	08-28-1994	C	15:26:34	60.70	0	0.0	1	60.7	0	0.0	0	0	0	0.0	0	0	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
02-5	08-28-1994	C	16:21:12	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
02-6	08-28-1994	C	17:21:35	61.10	1	61.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	61.1	0	0.0	0	0	0	0.0	0	0	0	0	0
25-1	08-28-1994	C	12:16:49	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
25-2	08-28-1994	C	13:16:39	60.20	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
25-3	08-28-1994	C	14:16:42	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	60.9	0	0.0	0	0	0	0.0	0	0	0	0	0
25-4	08-28-1994	C	15:16:37	61.10	0	0.0	1	55.4	1	5.7	0	0	1	3.3	0	0	1	38.9	0	0.0	0	0.0	0	0	2	18.9	0	0	0	0	0
25-5	08-28-1994	C	16:16:35	61.00	1	61.0	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
25-6	08-28-1994	C	17:16:23	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	0	0	0
27-1	08-23-1994	C	12:26:20	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	60.9	0	0.0	0	0	0	0.0	0	0	0	0	0
27-2	08-23-1994	C	13:17:55	60.20	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
27-3	08-23-1994	C	14:20:40	60.20	0	0.0	1	60.2	0	0.0	0	0	0	0.0	0	0	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
27-4	08-23-1994	C	15:36:43	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
27-5	08-23-1994	C	16:22:26	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
27-6	08-23-1994	C	17:18:33	60.70	0	0.0	1	60.7	0	0.0	0	0	0	0.0	0	0	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
52-1	09-13-1994	C	12:22:43	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
52-2	09-13-1994	C	13:22:49	60.10	0	0.0	1	60.1	0	0.0	0	0	0	0.0	0	0	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
52-4	09-13-1994	C	15:21:57	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
52-5	09-13-1994	C	16:22:11	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
52-6	09-13-1994	C	17:22:25	60.80	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
55-1	09-13-1994	C	12:17:56	60.10	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	48.2	0	0	1	11.9	0	0	0	0	0
55-2	09-13-1994	C	13:17:36	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
55-3	09-13-1994	C	14:17:32	61.00	1	61.0	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	0	0	0
55-4	09-13-1994	C	15:17:26	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
55-5	09-13-1994	C	16:17:37	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
55-6	09-13-1994	C	17:17:50	60.40	0	0.0	1	60.4	0	0.0	0	0	0	0.0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
07-6	08-23-1994	C	17:11:03	60.30	0	0.0	1	60.3	0	0.0	0	0	0	0.0	0	0	1	38.5	0	0.0	0	0.0	0	0	1	21.8	0	0	0	0	0
08-1	09-13-1994	C	12:20:22	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
08-2	09-13-1994	C	13:20:28	61.00	1	37.1	1	6.3	1	17.6	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
08-3	09-13-1994	C	14:21:43	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
08-4	09-13-1994	C	15:19:40	60.20	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
08-5	09-13-1994	C	16:19:53	60.70	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
08-6	09-13-1994	C	17:20:06	60.10	0	0.0	1	60.1	0	0.0	0	0	0	0.0	0	0	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
09-1	08-23-1994	LC	12:22:37	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0

Red-deer - day before treatment - p. 2 of 4

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
09-3	08-23-1994	LC	14:14:33	60.20	0	0.0	1	60.2	0	0.0	1	7.8	0	0	0	0	1	52.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
09-4	08-23-1994	LC	15:32:36	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
09-6	08-23-1994	LC	17:14:03	60.50	0	0.0	1	60.5	0	0.0	0	0.0	0	0	0	0	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
14-1	09-13-1994	LC	12:25:10	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
14-2	09-13-1994	LC	13:25:07	60.70	0	0.0	1	60.7	0	0.0	0	0.0	0	0	0	0	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
14-3	09-13-1994	LC	14:25:10	60.40	0	0.0	2	40.4	1	20.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
14-4	09-13-1994	LC	15:24:13	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
14-5	09-13-1994	LC	16:24:26	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	0	0	0
14-6	09-13-1994	LC	17:26:03	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0	0	0	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
17-1	08-23-1994	LC	12:32:29	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
17-2	08-23-1994	LC	13:22:07	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.6	0	0.0	0	0	0	0.0	0	0	0	0	0
17-3	08-23-1994	LC	14:26:41	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	2	33.2	0	0.0	0	0	1	27.1	0	0	0	0	0
17-4	08-23-1994	LC	15:41:57	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	2	40.1	0	0	1	20.0	0	0	0	0	0
17-5	08-23-1994	LC	16:26:23	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
17-6	08-23-1994	LC	17:24:15	60.80	0	0.0	0	0.0	1	60.8	0	0.0	0	0	0	0	1	56.6	0	0.0	0	0.0	0	0	1	4.2	0	0	0	0	0
18-1	08-28-1994	LC	12:15:38	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
18-2	08-28-1994	LC	13:15:31	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	17.4	0	0	1	43.4	0	0	0	0	0
18-3	08-28-1994	LC	14:15:31	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
18-4	08-28-1994	LC	15:15:26	61.10	0	0.0	1	61.1	0	0.0	0	0.0	0	0	0	0	1	52.0	0	0.0	0	0.0	0	0	1	9.1	0	0	0	0	0
18-5	08-28-1994	LC	16:15:26	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.6	0	0	0	0.0	0	0	0	0	0
18-6	08-28-1994	LC	17:15:14	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0	0	0	0
19-1	08-23-1994	LC	12:21:05	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.7	0	0.0	0	0	0	0.0	0	0	0	0	0
19-2	08-23-1994	LC	13:12:17	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
19-3	08-23-1994	LC	14:12:33	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0	0	0	1	55.8	0	0.0	0	0.0	0	0	1	5.1	0	0	0	0	0
19-4	08-23-1994	LC	15:30:51	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.2	0	0	0	0.0	0	0	0	0	0
19-5	08-23-1994	LC	16:18:22	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	0	0	0
19-6	08-23-1994	LC	17:12:30	60.80	0	0.0	1	60.8	0	0.0	0	0.0	0	0	0	0	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
21-1	09-13-1994	LC	12:15:28	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	25.3	0	0.0	0	0	2	34.8	0	0	0	0	0
21-2	09-13-1994	LC	13:15:16	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	42.6	0	0.0	0	0	1	17.9	0	0	0	0	0
21-3	09-13-1994	LC	14:15:14	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	1	24.3	0	0.0	0	0.0	0	0	1	36.1	0	0	0	0	0
21-4	09-13-1994	LC	15:15:09	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
21-5	09-13-1994	LC	16:15:20	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	38.3	0	0.0	0	0	1	22.7	0	0	0	0	0
21-6	09-13-1994	LC	17:15:34	60.50	0	0.0	1	46.3	1	14.2	1	8.6	0	0	0	0	1	40.6	0	0.0	0	0.0	0	0	2	11.3	0	0	0	0	0
53-1	09-13-1994	LC	12:23:56	61.10	0	0.0	1	61.1	0	0.0	1	18.8	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	2	42.3	0	0	0	0	0
53-2	09-13-1994	LC	13:23:57	60.50	0	0.0	1	60.5	0	0.0	0	0.0	0	0	0	0	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
53-3	09-13-1994	LC	14:24:03	60.30	1	35.5	1	24.8	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
53-4	09-13-1994	LC	15:23:05	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
53-5	09-13-1994	LC	16:23:18	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	20.2	0	0	1	40.7	0	0	0	0	0
53-6	09-13-1994	LC	17:24:55	61.00	0	0.0	1	33.3	1	27.7	0	0.0	0	0	0	0	1	33.9	0	0.0	0	0.0	0	0	1	27.1	1	0	0	0	0
59-1	09-13-1994	LC	12:27:32	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
59-2	09-13-1994	LC	13:28:33	61.00	0	0.0	1	61.0	0	0.0	0	0.0	0	0	0	0	1	61.0	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
59-3	09-13-1994	LC	14:27:37	60.90	0	0.0	1	56.5	1	4.4	1	5.4	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	2	55.5	0	0	0	0	0
59-4	09-13-1994	LC	15:26:59	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.2	0	0	0	0.0	0	0	0	0	0
59-5	09-13-1994	LC	16:26:51	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.3	0	0.0	0	0	0	0.0	0	0	0	0	0
59-6	09-13-1994	LC	17:28:22	60.80	0	0.0	1	60.8	0	0.0	0	0.0	0	0	0	0	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
09-5	08-23-1994	LC	16:20:09	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
04-1	08-23-1994	LR	12:13:26	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	0	0	0
04-2	08-23-1994	LR	13:03:48	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	61.0	0	0	0	0.0	0	0	0	0	0

Red-deer - day before treatment - p. 3 of 4

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
04-3	08-23-1994	LR	14:02:54	60.70	0	0.0	1	1.9	1	58.8	0	0.0	0	0	0	0	1	56.1	0	0.0	0	0.0	0	0	1	4.6	0	0	0	0	0
04-4	08-23-1994	LR	15:19:25	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
04-5	08-23-1994	LR	16:07:35	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	0	0	0
04-6	08-23-1994	LR	17:03:27	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0	0	0	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
13-1	08-23-1994	LR	12:16:37	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	23.6	0	0.0	0	0	1	36.6	0	0	0	0	0
13-2	08-23-1994	LR	13:07:02	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
13-3	08-23-1994	LR	14:06:13	60.80	0	0.0	1	7.6	1	53.2	0	0.0	0	0	0	0	2	50.6	0	0.0	1	0.8	0	0	2	9.4	0	0	0	0	0
13-4	08-23-1994	LR	15:22:29	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
13-5	08-23-1994	LR	16:14:08	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
13-6	08-23-1994	LR	17:07:20	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
15-1	08-23-1994	LR	12:24:23	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	46.3	0	0.0	0	0	1	14.3	0	0	0	0	0
15-2	08-23-1994	LR	13:15:54	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
15-3	08-23-1994	LR	14:17:41	60.10	0	0.0	1	60.1	0	0.0	0	0.0	0	0	0	0	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
15-4	08-23-1994	LR	15:34:41	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
15-5	08-23-1994	LR	16:28:16	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	61.1	0	0	0	0.0	0	0	0	0	0
15-6	08-23-1994	LR	17:16:55	61.00	0	0.0	1	61.0	0	0.0	0	0.0	0	0	0	0	1	55.3	0	0.0	0	0.0	0	0	1	5.7	0	0	0	0	0
16-1	10-19-1994	LR	12:11:37	60.70	0	0.0	1	60.7	0	0.0	0	0.0	0	0	0	0	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
16-2	10-19-1994	LR	13:08:47	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	3.0	0	0.0	0	0	1	57.7	0	0	0	0	0
16-3	10-19-1994	LR	14:08:53	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
16-4	10-19-1994	LR	15:17:11	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
16-5	10-19-1994	LR	16:16:47	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.2	0	0.0	0	0	0	0.0	0	0	0	0	0
16-6	10-19-1994	LR	17:09:13	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
26-1	10-19-1994	LR	12:09:12	60.20	0	0.0	1	60.2	0	0.0	0	0.0	0	0	0	0	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
26-2	10-19-1994	LR	13:06:28	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
26-3	10-19-1994	LR	14:05:56	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	39.6	0	0	1	21.3	0	0	0	0	0
26-4	10-19-1994	LR	15:14:55	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
26-5	10-19-1994	LR	16:14:32	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
26-6	10-19-1994	LR	17:06:57	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0	0	0	0
28-1	08-28-1994	LR	12:20:33	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
28-2	08-28-1994	LR	13:20:04	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.7	0	0	0	0.0	0	0	0	0	0
28-3	08-28-1994	LR	14:20:05	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.9	0	0	0	0.0	0	0	0	0	0
28-4	08-28-1994	LR	15:25:00	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
28-5	08-28-1994	LR	16:20:04	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	31.7	0	0	1	29.2	0	0	0	0	0
28-6	08-28-1994	LR	17:20:27	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	0	0	0
58-1	10-19-1994	LR	12:16:20	60.20	0	0.0	1	60.2	0	0.0	0	0.0	0	0	0	0	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
58-2	10-19-1994	LR	13:13:17	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	11.0	1	28.8	0	0	1	20.4	0	0	0	0	0
58-3	10-19-1994	LR	14:13:26	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	0	0	0
58-4	10-19-1994	LR	15:21:50	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.6	0	0	0	0.0	0	0	0	0	0
58-5	10-19-1994	LR	16:21:32	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	2	42.4	0	0	1	18.4	0	0	0	0	0
58-6	10-19-1994	LR	17:13:48	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.6	0	0.0	0	0	0	0.0	0	0	0	0	0
01-1	08-23-1994	R	12:28:43	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	2	33.4	0	0.0	0	0	1	27.6	0	0	0	0	0
01-2	08-23-1994	R	13:19:13	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.8	0	0	0	0.0	0	0	0	0	0
01-3	08-23-1994	R	14:23:44	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
01-4	08-23-1994	R	15:37:57	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	35.5	0	0.0	0	0	2	24.7	0	0	0	0	0
01-5	08-23-1994	R	16:23:49	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
01-6	08-23-1994	R	17:20:39	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0	0	0	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
06-1	08-23-1994	R	12:14:56	60.00	1	60.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.0	0	0.0	0	0	0	0.0	0	0	0	0	0
06-2	08-23-1994	R	13:05:39	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0

Red-deer - day before treatment - p. 4 of 4

A	B	C	D	E	F	G	H	1	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
06-3	08-23-1994	R	14:04:44	60.60	0	0.0	1	60.6	0	0.0	0	0.0	0	0	0	0	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
06-4	08-23-1994	R	15:20:49	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
06-5	08-23-1994	R	16:08:52	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.2	0	0	0	0.0	0	0	0	0	0
06-6	08-23-1994	R	17:05:47	60.60	0	0.0	1	60.6	0	0.0	0	0.0	0	0	0	0	1	54.7	1	1.0	0	0.0	0	0	1	4.9	0	0	0	0	0
12-1	10-19-1994	R	12:02:47	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	34.3	0	0	1	26.6	0	0	0	0	0
12-2	10-19-1994	R	13:01:45	61.10	1	14.9	1	46.2	0	0.0	1	7.8	0	0	0	0	0	0.0	1	19.5	0	0.0	0	0	1	33.8	0	0	0	0	0
12-3	10-19-1994	R	14:01:17	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.2	0	0	0	0.0	0	0	0	0	0
12-4	10-19-1994	R	15:09:21	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	0	0	0
12-5	10-19-1994	R	16:03:15	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.8	0	0.0	0	0	0	0.0	0	0	0	0	0
12-6	10-19-1994	R	17:01:20	60.40	1	24.7	1	35.7	0	0.0	0	0.0	0	0	0	0	0	0.0	1	27.0	2	11.4	0	0	2	22.0	0	0	0	0	1
22-1	10-19-1994	R	12:06:34	54.30	0	0.0	2	47.7	1	6.6	1	7.4	0	0	0	0	2	22.2	0	0.0	0	0.0	0	0	1	24.7	0	0	0	0	0
22-2	10-19-1994	R	13:05:20	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	2	34.8	0	0.0	0	0	2	26.2	0	0	0	0	0
22-3	10-19-1994	R	14:04:45	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.2	0	0	0	0.0	0	0	0	0	0
22-4	10-19-1994	R	15:13:41	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	2	39.6	0	0.0	0	0.0	0	0	1	20.7	0	0	0	0	0
22-5	10-19-1994	R	16:13:25	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.9	0	0	0	0.0	0	0	0	0	0
22-6	10-19-1994	R	17:05:48	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	0	0	0
29-1	08-23-1994	R	12:17:58	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
29-2	08-23-1994	R	13:08:48	58.80	1	58.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	2	37.6	0	0	1	21.2	0	0	0	0	0
29-3	08-23-1994	R	14:08:17	60.90	0	0.0	1	50.9	1	10.0	0	0.0	0	0	0	0	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
29-4	08-23-1994	R	15:24:34	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
29-5	08-23-1994	R	16:15:37	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	0	0	0
29-6	08-23-1994	R	17:08:58	60.40	0	0.0	1	55.7	1	4.7	0	0.0	0	0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
51-1	10-19-1994	R	12:05:19	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
51-2	10-19-1994	R	13:04:12	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	30.9	0	0.0	0	0	1	30.1	0	0	0	0	0
51-3	10-19-1994	R	14:03:38	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.9	0	0	0	0.0	0	0	0	0	0
51-4	10-19-1994	R	15:12:30	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	51.5	0	0	1	9.2	0	0	0	0	0
51-5	10-19-1994	R	16:12:18	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
51-6	10-19-1994	R	17:04:40	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.3	0	0.0	0	0	0	0.0	0	0	0	0	0
54-1	10-19-1994	R	12:12:47	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
54-2	10-19-1994	R	13:09:54	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
54-3	10-19-1994	R	14:10:00	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
54-4	10-19-1994	R	15:18:22	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	26.4	0	0	1	34.4	0	0	0	0	0
54-5	10-19-1994	R	16:17:59	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.8	0	0	0	0.0	0	0	0	0	0
54-6	10-19-1994	R	17:10:21	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
57-1	09-13-1994	R	12:21:33	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
57-2	09-13-1994	R	13:21:39	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
57-3	09-13-1994	R	14:22:54	60.80	1	60.8	0	0.0	0	0.0	1	6.3	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	2	54.5	0	0	0	0	0
57-4	09-13-1994	R	15:20:49	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
57-5	09-13-1994	R	16:21:03	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.5	0	0.0	0	0	0	0.0	0	0	0	0	0
57-6	09-13-1994	R	17:21:13	61.10	0	0.0	1	61.1	0	0.0	0	0.0	0	0	0	0	1	61.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0

Red-deer - day after treatment - p. 1 of 3

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
02-1	08-31-1994	C	08:38:08	60.50	0	0.0	1	60.5	0	0.0	0	0.0	0	0	0	0	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
02-2	08-31-1994	C	09:22:27	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
02-3	08-31-1994	C	10:24:34	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
02-4	08-31-1994	C	11:28:57	60.60	0	0.0	3	20.1	2	40.5	0	0.0	0	0	0	0	2	29.9	0	0.0	1	3.9	0	0	2	26.8	0	0	0	1	0
02-5	08-31-1994	C	12:22:56	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
05-1	08-26-1994	C	08:30:45	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
05-2	08-26-1994	C	09:29:00	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
05-3	08-26-1994	C	10:27:37	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	28.6	0	0	1	32.3	0	0	0	0	0
05-4	08-26-1994	C	11:30:13	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	50.2	0	0.0	0	0	1	10.8	0	0	0	0	0
07-1	08-26-1994	C	08:22:01	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
07-2	08-26-1994	C	09:21:17	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	32.7	0	0	1	28.3	0	0	0	0	0
07-3	08-26-1994	C	10:20:03	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	27.4	0	0	1	33.0	0	0	0	0	0
07-4	08-26-1994	C	11:20:32	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
08-1	09-17-1994	C	08:24:45	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
08-2	09-17-1994	C	09:24:44	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
08-3	09-17-1994	C	10:25:13	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	2	55.9	0	0	1	4.5	0	0	0	0	0
08-4	09-17-1994	C	11:25:09	60.10	0	0.0	1	60.1	0	0.0	0	0.0	0	0	0	0	1	60.1	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
08-5	09-17-1994	C	12:24:45	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	29.6	0	0	1	31.4	0	0	0	0	0
25-1	08-31-1994	C	08:31:49	61.00	0	0.0	1	61.0	0	0.0	0	0.0	0	0	0	0	1	61.0	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
25-2	08-31-1994	C	09:17:04	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.2	0	0.0	0	0	0	0.0	0	0	0	0	0
25-3	08-31-1994	C	10:17:18	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
25-4	08-31-1994	C	11:16:57	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
25-5	08-31-1994	C	12:17:29	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
27-1	08-26-1994	C	08:28:05	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	32.0	0	0.0	0	0	1	28.6	0	0	0	0	0
27-2	08-26-1994	C	09:26:33	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
27-3	08-26-1994	C	10:24:41	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.6	0	0	0	0.0	0	0	0	0	0
27-4	08-26-1994	C	11:26:13	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	1	0	0	0
52-1	09-17-1994	C	08:27:47	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
52-2	09-17-1994	C	09:26:57	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
52-3	09-17-1994	C	10:27:31	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.3	0	0.0	0	0	0	0.0	0	0	0	0	0
52-4	09-17-1994	C	11:27:25	60.20	0	0.0	1	60.2	0	0.0	0	0.0	0	0	0	0	1	60.2	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
52-5	09-17-1994	C	12:27:00	60.50	1	24.9	1	35.6	0	0.0	2	11.9	0	0	0	0	0	0.0	0	0.0	4	38.1	0	0	1	10.5	0	0	0	0	0
55-1	09-17-1994	C	08:22:31	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
55-2	09-17-1994	C	09:22:28	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0	0	0	0
55-3	09-17-1994	C	10:22:58	60.80	0	0.0	2	50.6	1	10.2	0	0.0	0	0	0	0	1	29.6	0	0.0	0	0.0	0	0	1	31.2	0	0	0	0	0
55-4	09-17-1994	C	11:22:54	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
55-5	09-17-1994	C	12:22:32	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
14-1	09-17-1994	LC	08:30:03	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0
14-2	09-17-1994	LC	09:29:13	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.6	0	0	0	0.0	0	0	0	0	0
14-3	09-17-1994	LC	10:29:49	60.70	1	60.7	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
14-4	09-17-1994	LC	11:30:20	60.80	0	0.0	1	60.8	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
14-5	09-17-1994	LC	12:29:12	60.10	1	60.1	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.1	0	0	0	0.0	0	0	0	0	0
17-1	08-26-1994	LC	08:32:14	60.80	1	60.8	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
17-2	08-26-1994	LC	09:30:19	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	1	60.5	0	0.0	0	0	0	0.0	0	0	0	0	0
17-3	08-26-1994	LC	10:28:54	60.20	1	60.2	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
17-4	08-26-1994	LC	11:31:46	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	1	53.4	0	0.0	0	0	1	7.0	0	0	0	0	0
18-1	08-31-1994	LC	08:30:30	60.60	0	0.0	1	60.6	0	0.0	0	0	0	0	0	0	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0

Red-deer - day after treatment - p. 2 of 3

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
18-2	08-31-1994	LC	09:15:45	60.80	1	52.7	1	8.1	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	5.9	0	0	2	54.9	0	0	0	0	0
18-3	08-31-1994	LC	10:16:01	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
18-4	08-31-1994	LC	11:15:23	60.50	0	0.0	1	60.5	0	0.0	0	0	0	0	0	0	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
18-5	08-31-1994	LC	12:15:51	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
19-1	08-26-1994	LC	08:23:26	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	1	60.5	0	0.0	0	0	0	0.0	0	0	0	0	0
19-2	08-26-1994	LC	09:22:26	60.10	1	60.1	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.1	0	0	0	0.0	0	0	0	0	0
19-3	08-26-1994	LC	10:21:11	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
19-4	08-26-1994	LC	11:21:40	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
21-1	09-17-1994	LC	08:20:19	61.00	1	61.0	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
21-2	09-17-1994	LC	09:20:11	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0
21-3	09-17-1994	LC	10:20:44	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	1	60.5	0	0.0	0	0	0	0.0	0	0	0	0	0
21-4	09-17-1994	LC	11:20:37	60.60	0	0.0	2	19.6	2	41.0	0	0	0	0	0	0	2	22.1	0	0.0	0	0.0	0	0	2	38.5	0	0	0	0	0
21-5	09-17-1994	LC	12:20:17	60.80	0	0.0	1	60.8	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
53-1	09-17-1994	LC	08:28:54	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
53-2	09-17-1994	LC	09:28:04	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
53-3	09-17-1994	LC	10:28:40	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	1	60.9	0	0.0	0	0	0	0.0	0	0	0	0	0
53-4	09-17-1994	LC	11:28:32	60.40	0	0.0	1	60.4	0	0.0	0	0	0	0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
53-5	09-17-1994	LC	12:28:06	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
59-1	09-17-1994	LC	08:32:19	60.90	1	60.9	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0
59-2	09-17-1994	LC	09:32:00	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	1	60.3	0	0.0	0	0	0	0.0	0	0	0	0	0
59-3	09-17-1994	LC	10:32:11	60.50	1	60.5	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
59-4	09-17-1994	LC	11:32:44	60.60	0	0.0	1	60.6	0	0.0	0	0	0	0	0	0	1	53.3	0	0.0	0	0.0	0	0	1	7.3	0	0	0	0	0
59-5	09-17-1994	LC	12:31:28	60.70	1	60.7	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.7	0	0	0	0.0	0	0	0	0	0
09-1	08-26-1994	LC	08:25:05	60.60	1	60.6	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
09-2	08-26-1994	LC	09:23:37	60.30	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
09-3	08-26-1994	LC	10:22:19	60.40	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
09-4	08-26-1994	LC	11:23:07	60.20	1	60.2	0	0.0	0	0.0	0	0	0	0	0	0	0	0.0	0	0.0	1	39.5	0	0	1	20.7	0	0	0	0	0
13-1	08-26-1994	LR1	08:19:16	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
13-2	08-26-1994	LR1	09:18:56	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.6	0	0.0	0	0	0	0.0	0	0	0	0	0
13-3	08-26-1994	LR1	10:17:43	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	31.9	0	0	2	29.0	0	0	0	0	0
13-4	08-26-1994	LR1	11:18:11	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
15-1	08-26-1994	LR1	08:26:53	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.7	0	0.0	0	0	0	0.0	0	0	0	0	0
15-2	08-26-1994	LR1	09:25:08	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	24.4	0	0.0	0	0	2	36.4	0	0	0	0	0
15-3	08-26-1994	LR1	10:23:29	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
15-4	08-26-1994	LR1	11:24:32	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
16-1	10-21-1994	LR1	08:36:11	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
16-2	10-21-1994	LR1	09:38:05	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
16-3	10-21-1994	LR1	10:38:18	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.7	0	0.0	0	0	0	0.0	0	0	0	0	0
16-4	10-21-1994	LR1	11:38:47	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
16-5	10-21-1994	LR1	12:38:08	60.70	0	0.0	1	37.3	1	23.4	0	0.0	0	0.0	0	0	1	38.7	0	0.0	0	0.0	0	0	1	22.0	0	0	0	0	0
26-1	10-21-1994	LR1	08:33:56	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
26-2	10-21-1994	LR1	09:35:48	60.50	0	0.0	1	60.5	0	0.0	1	13.1	1	1.7	0	0	1	6.0	0	0.0	0	0.0	0	0	3	39.7	0	0	0	0	0
26-3	10-21-1994	LR1	10:35:45	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.5	0	0.0	0	0	0	0.0	0	0	0	0	0
26-4	10-21-1994	LR1	11:36:20	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0	0	0	0
26-5	10-21-1994	LR1	12:35:51	60.30	1	51.1	1	9.2	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	1
28-1	08-31-1994	LR1	08:36:51	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0	2	46.2	0	0.0	0	0.0	0	0	1	14.7	0	0	0	0	0
28-2	08-31-1994	LR1	09:20:58	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	48.5	0	0	1	12.1	0	0	0	0	0
28-3	08-31-1994	LR1	10:22:51	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0

Red-deer - day after treatment - p. 3 of 3

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
28-4	08-31-1994	LR1	11:27:27	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
28-5	08-31-1994	LR1	12:21:36	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
04-1	08-26-1994	LR1	08:15:40	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
04-2	08-26-1994	LR1	09:15:24	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	41.8	0	0.0	0	0	1	18.7	0	0	0	0	0
04-3	08-26-1994	LR1	10:15:20	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	61.1	0	0	0	0.0	0	0	0	0	0
04-4	08-26-1994	LR1	11:15:31	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
58-1	10-21-1994	LR1	08:40:41	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	61.0	0	0.0	0	0	0	0.0	0	0	0	0	0
58-2	10-21-1994	LR1	09:42:33	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
58-3	10-21-1994	LR1	10:42:45	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	28.7	0	0	1	31.7	0	0	0	0	0
58-4	10-21-1994	LR1	11:43:15	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	60.7	0	0	0	0.0	0	0	0	0	0
58-5	10-21-1994	LR1	12:42:40	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
01-1	08-26-1994	R1	08:29:16	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
01-2	08-26-1994	R1	09:27:43	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
01-3	08-26-1994	R1	10:25:50	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
01-4	08-26-1994	R1	11:27:36	61.10	0	0.0	1	61.1	0	0.0	1	7.3	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	53.8	2	2	1	0	0
12-1	10-21-1994	R1	08:29:27	60.70	0	0.0	1	60.7	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.7	0	0	0	0	0
12-2	10-21-1994	R1	09:31:13	61.00	0	0.0	1	59.6	1	1.4	0	0.0	0	0	0	0	1	60.2	0	0.0	0	0.0	0	0	1	0.8	0	0	0	0	0
12-3	10-21-1994	R1	10:31:16	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0	0	0	0
12-4	10-21-1994	R1	11:31:16	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.9	0	0	0	0.0	0	0	0	0	0
12-5	10-21-1994	R1	12:31:17	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
22-1	10-21-1994	R1	08:32:49	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0	0	0	0
22-2	10-21-1994	R1	09:34:37	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
22-3	10-21-1994	R1	10:34:35	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
22-4	10-21-1994	R1	11:34:39	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.4	0	0	0	0.0	0	0	0	0	0
22-5	10-21-1994	R1	12:34:43	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0	0	0	1	60.3	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
29-1	08-26-1994	R1	08:20:32	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.9	0	0	0	0	0
29-2	08-26-1994	R1	09:20:07	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	61.0	0	0	0	0.0	0	0	0	0	0
29-3	08-26-1994	R1	10:18:52	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
29-4	08-26-1994	R1	11:19:22	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
51-1	10-21-1994	R1	08:31:39	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.5	0	0	0	0	0
51-2	10-21-1994	R1	09:33:30	60.80	0	0.0	1	60.8	0	0.0	0	0.0	0	0	0	0	1	60.8	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
51-4	10-21-1994	R1	11:33:31	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.5	0	0	0	0.0	0	0	0	0	0
51-5	10-21-1994	R1	12:33:35	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	60.3	0	0	0	0.0	0	0	0	0	0
51-3	10-21-1994	R1	10:33:29	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
54-1	10-21-1994	R1	08:37:18	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.4	0	0	0	0	0
54-2	10-21-1994	R1	09:39:13	60.70	0	0.0	1	60.7	0	0.0	0	0.0	0	0	0	0	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0	0	1	0
54-3	10-21-1994	R1	10:39:24	60.30	1	60.3	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
54-4	10-21-1994	R1	11:39:55	60.80	1	60.8	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.8	0	0	0	0	0
54-5	10-21-1994	R1	12:39:17	60.90	0	0.0	2	45.0	3	15.9	0	0.0	0	0	0	0	1	38.2	0	0.0	0	0.0	0	0	2	22.7	0	0	0	0	0
57-1	09-17-1994	R1	08:25:54	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.3	0	0	0	0	0
57-2	09-17-1994	R1	09:25:50	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	61.0	0	0	0	0	0
57-3	09-17-1994	R1	10:26:21	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	45.9	0	0.0	0	0	1	15.0	0	0	0	0	0
57-4	09-17-1994	R1	11:26:18	60.50	0	0.0	1	60.5	0	0.0	0	0.0	0	0	0	0	1	60.5	0	0.0	0	0.0	0	0	0	0.0	0	0	0	0	0
57-5	09-17-1994	R1	12:25:52	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	19.1	0	0	1	42.0	0	0	0	0	0
06-1	08-26-1994	R1	08:18:00	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.6	0	0	0	0	0
06-2	08-26-1994	R1	09:16:36	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	1	60.9	0	0.0	0	0	0	0.0	0	0	0	0	0
06-3	08-26-1994	R1	10:16:33	60.20	1	60.2	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	0	0.0	0	0	1	60.2	0	0	0	0	0
06-4	08-26-1994	R1	11:16:54	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0	0.0	0	0.0	1	11.7	0	0	1	48.8	0	0	0	0	0

Fallow-deer - day of treatment - p. 1 of 6

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
121-2	11-30-1994	C	10:40:21	60.60	0	0.0	4	33.0	4	27.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
121-3	11-30-1994	C	12:46:55	60.90	0	0.0	2	20.8	2	40.1	1	5.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	55.7	0	0	0	0	0
121-4	11-30-1994	C	13:47:10	60.60	0	0.0	1	20.3	1	40.3	0	0.0	0	0.0	0	0.0	1	11.2	0	0.0	1	1.1	0	0.0	2	48.3	0	0	0	0	0
121-5	11-30-1994	C	14:43:57	60.90	0	0.0	1	21.5	1	39.4	0	0.0	0	0.0	0	0.0	1	27.2	0	0.0	1	4.5	0	0.0	2	29.2	0	0	0	0	0
121-6	11-30-1994	C	15:33:58	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0
121-7	11-30-1994	C	16:37:32	60.20	0	0.0	3	37.1	2	23.1	0	0.0	0	0.0	0	0.0	1	13.2	0	0.0	0	0.0	0	0.0	1	47.0	0	0	0	0	0
121-8	11-30-1994	C	17:39:45	60.20	0	0.0	2	43.5	1	16.7	0	0.0	0	0.0	1	6.8	0	0.0	0	0.0	0	0.0	0	0.0	2	53.4	0	0	0	0	0
125-2	11-30-1994	C	11:27:16	60.80	0	0.0	3	28.4	3	32.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.2	0	0.0	1	59.6	0	0	0	0	0
125-3	11-30-1994	C	12:48:41	60.40	0	0.0	2	40.2	1	20.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	8.9	0	0.0	3	51.5	0	0	0	0	0
125-4	11-30-1994	C	13:48:42	60.30	0	0.0	3	35.0	2	25.3	0	0.0	0	0.0	0	0.0	1	16.0	0	0.0	0	0.0	0	0.0	1	44.3	0	0	0	0	0
125-5	11-30-1994	C	14:45:30	60.60	1	24.7	1	23.7	1	12.2	0	0.0	0	0.0	0	0.0	1	6.7	1	16.5	0	0.0	0	0.0	2	37.4	0	0	0	0	0
125-6	11-30-1994	C	15:35:20	60.20	0	0.0	2	44.1	1	16.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.2	0	0.0	2	58.0	0	0	0	0	0
125-7	11-30-1994	C	16:41:27	61.00	0	0.0	2	20.7	2	40.3	0	0.0	0	0.0	0	0.0	1	6.2	0	0.0	0	0.0	0	0.0	2	54.8	1	0	0	0	0
125-8	11-30-1994	C	17:41:06	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0
129-2	12-02-1994	C	11:07:31	61.00	0	0.0	3	35.3	2	25.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0	0	0	0
129-3	12-02-1994	C	12:10:41	60.50	0	0.0	2	44.8	2	15.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.7	1	0.7	3	58.1	1	0	0	0	0
129-4	12-02-1994	C	13:05:01	60.50	0	0.0	2	46.4	2	14.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0	0	0	0
129-5	12-02-1994	C	13:56:05	60.60	0	0.0	2	23.4	3	37.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
129-6	12-02-1994	C	14:57:54	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	1	10.8	0	0.0	1	45.4	0	0.0	1	4.1	0	0	0	0	0
129-7	12-02-1994	C	16:01:35	60.60	0	0.0	1	5.8	2	54.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	3.4	0	0.0	3	57.2	0	0	0	0	0
129-8	12-02-1994	C	16:58:54	60.70	0	0.0	2	12.4	3	48.3	0	0.0	0	0.0	0	0.0	1	2.7	0	0.0	1	4.8	0	0.0	1	53.2	0	0	0	0	0
056-2	12-02-1994	C	10:22:06	60.60	0	0.0	2	37.2	3	23.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
056-3	12-02-1994	C	11:45:03	60.90	0	0.0	2	54.5	1	6.4	0	0.0	0	0.0	0	0.0	0	0.0	1	9.1	0	0.0	0	0.0	1	51.8	0	0	0	0	0
056-4	12-02-1994	C	13:11:26	60.70	0	0.0	1	36.0	1	24.7	2	13.6	0	0.0	0	0.0	1	10.2	0	0.0	1	10.2	0	0.0	3	26.7	0	0	0	0	0
056-5	12-02-1994	C	13:39:20	60.70	0	0.0	1	9.5	1	51.2	0	0.0	0	0.0	0	0.0	0	0.0	1	15.6	2	3.0	0	0.0	4	42.1	0	0	0	0	0
056-6	12-02-1994	C	14:39:46	60.80	0	0.0	2	46.2	1	14.6	1	2.7	1	5.6	0	0.0	1	37.8	0	0.0	1	4.6	0	0.0	1	10.1	2	0	0	0	0
056-7	12-02-1994	C	15:40:58	60.80	0	0.0	1	58.7	1	2.1	2	11.4	0	0.0	0	0.0	1	36.8	0	0.0	0	0.0	0	0.0	2	12.6	0	0	0	0	0
056-8	12-02-1994	C	16:39:29	60.30	0	0.0	1	8.6	2	51.7	0	0.0	0	0.0	0	0.0	1	41.2	0	0.0	2	6.3	0	0.0	2	12.8	0	0	0	0	0
068-2	11-30-1994	C	11:24:30	60.60	0	0.0	2	10.7	2	49.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
068-3	11-30-1994	C	12:10:07	60.70	0	0.0	2	28.4	2	32.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	5.0	0	0.0	3	55.7	0	0	0	0	0
068-4	11-30-1994	C	13:10:54	60.40	0	0.0	1	56.7	1	3.7	0	0.0	0	0.0	0	0.0	1	59.3	0	0.0	1	1.1	0	0.0	0	0.0	0	0	0	0	0
068-5	11-30-1994	C	14:16:24	60.10	0	0.0	2	21.6	2	38.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.3	0	0.0	2	55.8	0	0	0	0	0
068-6	11-30-1994	C	15:08:32	60.40	0	0.0	1	10.7	1	49.7	0	0.0	0	0.0	0	0.0	2	13.2	0	0.0	0	0.0	0	0.0	2	47.2	0	0	0	0	0
068-7	11-30-1994	C	16:04:59	61.00	0	0.0	1	11.9	1	49.1	1	2.1	0	0.0	0	0.0	3	38.5	0	0.0	0	0.0	0	0.0	2	20.4	2	0	0	0	0
068-8	11-30-1994	C	17:10:53	61.10	0	0.0	1	11.0	1	50.1	0	0.0	0	0.0	0	0.0	1	9.1	0	0.0	1	2.3	0	0.0	2	49.7	0	0	0	0	0
074-2	11-30-1994	C	10:49:41	60.20	0	0.0	3	33.7	3	26.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	2.9	0	0.0	3	57.3	0	0	0	0	0
074-3	11-30-1994	C	12:13:28	60.20	0	0.0	2	41.2	1	19.0	1	6.9	0	0.0	0	0.0	1	3.3	0	0.0	1	3.4	0	0.0	3	46.6	0	0	0	0	0
074-4	11-30-1994	C	13:16:11	60.80	0	0.0	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
074-5	11-30-1994	C	14:19:13	60.50	0	0.0	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
074-6	11-30-1994	C	15:11:20	60.20	0	0.0	1	60.2	0	0.0	0	0.0	0	0.0	0	0.0	1	60.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
074-7	11-30-1994	C	16:09:14	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
074-8	11-30-1994	C	17:13:56	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	35.0	0	0.0	0	0.0	0	0.0	1	25.1	0	0	0	0	0
080-2	11-30-1994	C	11:12:20	60.30	0	0.0	3	31.2	2	29.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	0	0	0	0	0
080-3	11-30-1994	C	12:03:55	60.70	0	0.0	3	55.1	2	5.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	4.8	1	2.9	5	53.0	0	0	0	0	0
080-4	11-30-1994	C	13:05:47	60.40	0	0.0	2	38.1	1	22.3	0	0.0	0	0.0	0	0.0	1	3.4	0	0.0	2	5.0	0	0.0	3	52.0	0	0	0	0	0
080-5	11-30-1994	C	14:10:56	60.10	0	0.0	2	38.9	2	21.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.2	0	0.0	2	57.9	2	0	0	0	0
080-6	11-30-1994	C	15:02:03	60.90	0	0.0	1	7.4	2	53.5	0	0.0	0	0.0	0	0.0	1	18.9	0	0.0	1	3.5	0	0.0	1	38.5	0	0	0	0	0
080-7	11-30-1994	C	15:59:59	61.00	0	0.0	2	50.5	1	10.5	0	0.0	0	0.0	0	0.0	1	36.8	0	0.0	0	0.0	0	0.0	1	24.2	3	0	0	0	0

Fallow-deer - day of treatment - p. 2 of 6

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
080-8	11-30-1994	C	17:05:50	61.00	0	0.0	2	11.5	2	49.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	4.2	0	0.0	3	56.8	0	0	0	0	0
084-2	11-30-1994	C	11:31:50	60.10	0	0.0	2	45.7	1	14.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0	2	59.1	0	0	0	0	0
084-3	11-30-1994	C	12:19:36	60.50	1	10.1	1	1.2	1	49.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.6	0	0.0	2	55.9	1	0	0	0	0
084-4	11-30-1994	C	13:23:22	60.20	0	0.0	2	34.7	2	25.5	0	0.0	0	0.0	0	0.0	1	11.8	0	0.0	0	0.0	0	0.0	2	48.4	0	0	0	0	0
084-5	11-30-1994	C	14:23:05	60.90	0	0.0	2	33.3	2	27.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.5	0	0.0	2	58.4	0	0	0	0	0
084-6	11-30-1994	C	15:15:22	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	1	56.7	0	0.0	0	0.0	0	0.0	1	3.6	0	0	0	0	0
084-7	11-30-1994	C	16:13:15	60.60	0	0.0	1	23.2	1	37.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	2	59.8	0	0	0	0	0
084-8	11-30-1994	C	17:19:48	60.10	0	0.0	1	5.9	2	54.2	0	0.0	0	0.0	0	0.0	1	3.4	0	0.0	2	4.5	0	0.0	2	52.2	0	0	0	0	0
089-2	12-02-1994	C	10:23:43	61.10	0	0.0	2	7.1	3	54.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.1	0	0	0	0	0
089-3	12-02-1994	C	11:59:17	60.80	0	0.0	2	8.0	2	52.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.8	0	0	0	0	0
089-4	12-02-1994	C	12:55:01	60.80	0	0.0	1	36.6	1	24.2	0	0.0	0	0.0	0	0.0	0	0.0	1	40.7	0	0.0	0	0.0	1	20.1	0	0	0	0	0
089-5	12-02-1994	C	13:48:05	60.60	0	0.0	3	27.4	2	33.2	0	0.0	0	0.0	0	0.0	0	0.0	1	31.0	2	4.5	0	0.0	1	25.1	0	0	0	0	0
089-6	12-02-1994	C	14:49:17	60.30	0	0.0	1	20.8	1	39.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	2	0	0	0	0
089-7	12-02-1994	C	15:52:07	61.00	0	0.0	3	31.7	3	29.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	1	0	0	0	0
089-8	12-02-1994	C	16:50:00	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
091-2	11-30-1994	C	11:22:33	61.00	0	0.0	3	9.0	2	52.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	2	60.4	0	0	0	0	0
091-3	11-30-1994	C	12:30:02	60.50	0	0.0	1	60.5	0	0.0	1	1.2	1	3.1	0	0.0	0	0.0	0	0.0	1	1.3	0	0.0	3	54.9	0	0	0	0	0
091-4	11-30-1994	C	13:34:23	60.10	1	41.3	1	7.0	1	11.8	0	0.0	0	0.0	0	0.0	1	46.8	0	0.0	0	0.0	0	0.0	1	13.3	0	0	0	0	0
091-5	11-30-1994	C	14:30:36	60.10	0	0.0	1	22.2	1	37.9	0	0.0	0	0.0	0	0.0	2	44.7	0	0.0	0	0.0	0	0.0	1	15.4	0	0	0	0	0
091-6	11-30-1994	C	15:23:02	60.30	0	0.0	1	16.1	1	44.2	0	0.0	0	0.0	0	0.0	1	39.0	0	0.0	0	0.0	0	0.0	1	21.3	0	0	0	0	0
091-7	11-30-1994	C	16:25:40	60.20	1	60.2	0	0.0	0	0.0	1	1.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	58.4	0	0	0	0	0
091-8	11-30-1994	C	17:26:43	61.00	0	0.0	1	61.0	0	0.0	1	3.9	0	0.0	0	0.0	2	34.2	0	0.0	2	8.5	0	0.0	1	14.4	0	0	0	0	0
110-2	11-30-1994	LC	11:17:04	60.70	0	0.0	3	43.5	2	17.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.6	0	0.0	2	59.1	0	0	0	0	0
110-3	11-30-1994	LC	12:36:03	60.40	0	0.0	1	4.0	2	56.4	1	3.1	0	0.0	0	0	0	0.0	0	0.0	2	3.2	0	0.0	4	54.1	5	0	0	0	0
110-4	11-30-1994	LC	13:41:12	60.50	1	53.3	1	7.2	0	0.0	0	0.0	1	4.0	0	0	0	0.0	1	34.3	0	0.0	0	0.0	1	22.2	0	0	0	0	0
110-5	11-30-1994	LC	14:35:50	61.00	1	61.0	0	0.0	0	0.0	1	7.0	0	0.0	0	0	1	29.9	0	0.0	0	0.0	0	0.0	1	24.1	0	0	0	0	0
110-6	11-30-1994	LC	15:28:39	60.70	1	31.4	1	29.3	0	0.0	0	0.0	0	0.0	0	0	0	0.0	2	33.9	1	22.0	0	0.0	1	4.8	0	0	0	0	0
110-7	11-30-1994	LC	16:31:22	60.30	0	0.0	3	22.0	2	38.3	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	0	0	0	0	0
110-8	11-30-1994	LC	17:33:07	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0
131-2	11-30-1994	LC	10:47:50	60.70	0	0.0	5	37.9	4	22.8	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.7	0	0	0	0	0
131-3	11-30-1994	LC	12:50:15	60.50	0	0.0	2	25.0	2	35.5	0	0.0	0	0.0	0	0	1	11.6	0	0.0	0	0.0	0	0.0	2	48.9	0	0	0	0	0
131-4	11-30-1994	LC	13:50:31	60.20	0	0.0	4	32.5	3	27.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.4	0	0.0	2	58.8	0	0	0	0	0
131-5	11-30-1994	LC	14:47:13	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.1	0	0	0	0	0
131-6	11-30-1994	LC	15:37:25	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.4	0	0.0	0	0.0	0	0.0	0	0	0	0	0
131-7	11-30-1994	LC	16:44:44	60.30	0	0.0	1	4.7	1	55.6	4	28.2	0	0.0	0	0	1	7.5	0	0.0	1	3.1	0	0.0	4	21.5	0	0	0	0	0
131-8	11-30-1994	LC	17:43:07	61.00	1	6.6	1	54.4	0	0.0	0	0.0	0	0.0	0	0	1	56.3	0	0.0	0	0.0	0	0.0	1	4.7	0	0	0	0	0
137-2	11-30-1994	LC	11:10:21	60.20	0	0.0	3	21.6	2	38.6	0	0.0	0	0.0	0	0	0	0.0	1	60.2	0	0.0	0	0.0	0	0.0	0	1	0	0	0
137-3	11-30-1994	LC	12:54:28	60.80	0	0.0	1	6.0	1	54.8	1	13.4	0	0.0	0	0	0	0.0	0	0.0	1	4.0	0	0.0	2	43.4	0	0	0	0	0
137-4	11-30-1994	LC	13:52:30	60.20	0	0.0	2	5.6	1	54.6	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.7	1	2.6	3	55.9	0	0	0	0	0
137-5	11-30-1994	LC	14:48:51	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	36.7	0	0.0	0	0.0	1	23.9	0	0	0	0	0
137-6	11-30-1994	LC	15:39:07	60.10	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	56.5	0	0.0	0	0.0	1	3.6	0	0	0	0	0
137-7	11-30-1994	LC	16:46:53	60.80	0	0.0	1	18.7	1	42.1	0	0.0	0	0.0	0	0	1	15.6	0	0.0	0	0.0	0	0.0	2	45.2	0	0	0	0	0
137-8	11-30-1994	LC	17:44:33	60.40	1	60.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	23.6	0	0.0	0	0.0	1	36.8	0	0	0	0	0
140-2	12-02-1994	LC	10:45:27	60.10	0	0.0	3	50.4	3	9.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.1	0	0	0	0	0
140-3	12-02-1994	LC	12:15:13	60.60	0	0.0	3	14.1	2	46.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	2.6	0	0.0	2	58.0	0	0	0	0	0
140-4	12-02-1994	LC	13:08:28	60.50	0	0.0	2	17.5	3	43.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	2.3	0	0.0	2	58.2	5	0	0	0	0
140-5	12-02-1994	LC	13:59:09	60.70	0	0.0	1	34.5	2	26.2	1	3.7	1	2.4	0	0	1	11.8	0	0.0	0	0.0	0	0.0	4	42.8	0	0	0	0	0
140-7	12-02-1994	LC	16:04:49	60.80	0	0.0	1	21.1	1	39.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.3	0	0.0	2	59.5	4	0	0	0	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
140-8	12-02-1994	LC	17:01:51	60.50	0	0.0	1	11.0	2	49.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	2	0	0	0	0
049-2	12-02-1994	LC	10:25:12	60.60	0	0.0	5	47.5	4	13.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	1
049-3	12-02-1994	LC	11:41:10	60.50	0	0.0	2	17.1	2	43.4	1	1.4	0	0.0	0	0	0	0.0	0	0.0	1	3.4	1	0.8	3	54.9	0	0	0	0	0
049-4	12-02-1994	LC	12:37:32	60.20	0	0.0	2	53.3	2	6.9	0	0.0	0	0.0	0	0	0	0.0	0	0.0	4	16.0	0	0.0	5	44.2	0	0	0	0	0
049-5	12-02-1994	LC	13:34:44	61.10	0	0.0	2	4.7	2	56.4	0	0.0	3	13.8	0	0	0	0.0	1	7.3	0	0.0	0	0.0	3	40.0	2	0	0	0	0
049-6	12-02-1994	LC	14:36:17	60.40	0	0.0	1	59.7	1	0.7	0	0.0	1	1.7	0	0	0	0.0	0	0.0	1	0.6	0	0.0	3	58.1	0	0	0	0	0
049-7	12-02-1994	LC	15:37:56	60.10	0	0.0	1	32.3	1	27.8	0	0.0	1	2.2	0	0	0	0.0	0	0.0	2	3.0	1	0.8	5	54.1	7	0	0	0	0
049-8	12-02-1994	LC	16:36:17	60.80	0	0.0	1	15.1	1	45.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	10.9	0	0.0	3	49.9	12	0	0	0	0
053-2	12-02-1994	LC	10:47:06	60.80	0	0.0	5	38.1	4	22.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.8	0	0	0	0	0
053-3	12-02-1994	LC	11:43:30	60.80	0	0.0	2	14.8	2	46.0	1	2.0	0	0.0	0	0	0	0.0	0	0.0	1	2.2	0	0.0	3	56.6	0	0	0	0	0
053-4	12-02-1994	LC	12:39:32	60.80	0	0.0	1	48.9	2	11.9	2	38.1	1	2.0	0	0	0	0.0	1	1.8	2	7.3	0	0.0	4	11.6	1	0	0	0	0
053-5	12-02-1994	LC	13:37:17	60.60	0	0.0	3	26.1	4	34.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
053-6	12-02-1994	LC	14:37:55	60.10	0	0.0	1	60.1	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	11.7	1	2.3	0	0.0	2	46.1	0	0	0	0	0
053-7	12-02-1994	LC	15:39:29	60.70	0	0.0	3	28.5	3	32.2	0	0.0	0	0.0	0	0	1	8.8	0	0.0	1	3.1	0	0.0	1	48.8	0	0	0	0	0
053-8	12-02-1994	LC	16:37:49	60.60	0	0.0	2	51.2	1	9.4	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	2.5	0	0.0	2	58.1	0	0	0	0	0
054-3	12-02-1994	LC	11:50:22	60.60	0	0.0	1	60.6	0	0.0	1	4.2	1	2.3	0	0	0	0.0	0	0.0	0	0.0	0	0.0	3	54.1	8	0	0	0	0
054-4	12-02-1994	LC	12:46:03	60.50	0	0.0	2	36.4	2	24.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	12.8	0	0.0	2	47.7	2	0	0	0	0
054-5	12-02-1994	LC	13:42:23	61.10	0	0.0	2	13.1	2	48.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	3	5.3	0	0.0	3	55.8	4	0	0	0	0
054-6	12-02-1994	LC	14:43:11	60.10	0	0.0	1	4.1	1	56.0	1	3.1	0	0.0	0	0	0	0.0	0	0.0	2	6.7	0	0.0	4	50.3	0	0	0	0	0
054-7	12-02-1994	LC	15:43:58	60.60	0	0.0	3	18.1	3	42.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	3.4	0	0.0	3	57.2	0	3	0	0	0
054-8	12-02-1994	LC	16:42:38	60.70	0	0.0	2	17.1	2	43.6	1	1.2	0	0.0	0	0	1	9.4	0	0.0	1	5.0	0	0.0	3	45.1	0	0	0	0	0
075-2	12-02-1994	LC	10:39:17	60.70	0	0.0	4	43.6	3	17.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.7	1	0	0	0	0
075-3	12-02-1994	LC	11:54:57	61.00	0	0.0	1	61.0	0	0.0	4	25.1	2	6.6	0	0	0	0.0	0	0.0	0	0.0	0	0.0	7	29.3	9	0	2	0	0
075-4	12-02-1994	LC	12:49:21	61.10	1	55.6	1	5.5	0	0.0	0	0.0	0	0.0	0	0	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
075-5	12-02-1994	LC	13:45:18	60.90	0	0.0	2	18.3	1	42.6	0	0.0	0	0.0	0	0	2	16.3	0	0.0	3	25.2	0	0.0	4	19.4	1	0	0	0	0
075-6	12-02-1994	LC	14:46:08	60.80	0	0.0	1	60.8	0	0.0	0	0.0	0	0.0	0	0	1	49.3	0	0.0	0	0.0	0	0.0	1	11.5	0	0	0	0	0
075-7	12-02-1994	LC	15:48:15	60.20	0	0.0	1	60.2	0	0.0	0	0.0	0	0.0	0	0	1	7.4	0	0.0	1	2.4	0	0.0	2	50.4	4	0	0	0	0
075-8	12-02-1994	LC	16:46:42	60.00	0	0.0	1	60.0	0	0.0	0	0.0	0	0.0	0	0	2	45.5	0	0.0	0	0.0	0	0.0	2	14.5	2	0	0	0	0
087-2	11-30-1994	LC	11:20:23	60.70	0	0.0	2	9.5	2	51.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	0.5	0	0.0	2	60.2	0	0	0	0	0
087-3	11-30-1994	LC	12:25:54	60.50	0	0.0	1	58.2	1	2.3	2	6.7	0	0.0	0	0	3	15.3	0	0.0	2	10.9	0	0.0	3	27.6	0	0	0	0	0
087-4	11-30-1994	LC	13:28:51	60.20	0	0.0	2	19.0	2	41.2	0	0.0	0	0.0	0	0	1	51.5	0	0.0	0	0.0	1	8.7	0	0.0	0	0	0	1	0
087-5	11-30-1994	LC	14:26:09	60.40	0	0.0	2	57.5	1	2.9	0	0.0	0	0.0	0	0	1	20.4	0	0.0	1	0.7	0	0.0	2	39.3	0	0	0	0	0
087-6	11-30-1994	LC	15:18:05	61.00	0	0.0	1	7.4	1	53.6	0	0.0	0	0.0	0	0	2	55.4	0	0.0	0	0.0	0	0.0	1	5.6	1	0	0	0	0
087-7	11-30-1994	LC	16:17:14	60.30	0	0.0	2	4.8	2	55.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	0	1	0	0	0
087-8	11-30-1994	LC	17:22:42	61.40	0	0.0	1	51.7	1	9.7	0	0.0	0	0.0	0	0	1	35.4	0	0.0	2	4.4	0	0.0	1	21.6	0	0	0	0	0
090-2	11-30-1994	LC	11:30:01	60.60	0	0.0	2	39.8	1	20.8	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.4	0	0.0	1	59.2	0	0	0	0	0
090-3	11-30-1994	LC	12:28:06	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.9	0	0	0	0	0
090-4	11-30-1994	LC	13:31:12	61.00	0	0.0	1	1.7	1	59.3	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0	0	0	0
090-5	11-30-1994	LC	14:27:42	60.70	0	0.0	1	60.7	0	0.0	0	0.0	0	0.0	0	0	1	15.8	1	0.5	0	0.0	0	0.0	2	44.4	0	0	0	0	0
090-6	11-30-1994	LC	15:19:53	60.60	0	0.0	2	22.8	2	37.8	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
090-7	11-30-1994	LC	16:20:37	60.70	0	0.0	0	0.0	1	60.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.6	0	0.0	2	59.1	1	0	0	0	0
090-8	11-30-1994	LC	17:24:36	61.00	0	0.0	1	2.3	1	58.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	6.1	0	0.0	2	54.9	0	0	0	0	0
102-2	12-02-1994	LR	10:55:50	60.40	0	0.0	3	6.3	4	54.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
102-3	12-02-1994	LR	12:02:47	60.40	0	0.0	2	19.9	3	40.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.0	0	0.0	2	59.4	1	0	0	0	0
102-4	12-02-1994	LR	12:59:03	60.50	0	0.0	2	13.0	3	47.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	4	0	0	0	0
102-5	12-02-1994	LR	13:51:07	61.00	0	0.0	1	35.2	1	25.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.4	0	0.0	2	59.6	0	0	0	0	0
102-6	12-02-1994	LR	14:52:29	60.10	0	0.0	3	14.4	4	45.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	5.6	0	0.0	3	54.5	0	0	0	0	0
102-7	12-02-1994	LR	15:54:59	60.30	0	0.0	1	14.3	2	46.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	0	0	0	0	0

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	μ	()
102-8	12-02-1994	LR	16:54:28	60.80	0	0.0	3	43.7	2	17.1	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	4	4.2	0	0.0	5	56.2	1	0	0	0	0
106-2	12-02-1994	LR	11:04:38	61.00	0	0.0	4	17.0	3	44.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0	0	0	0
106-3	12-02-1994	LR	12:05:44	60.30	0	0.0	1	58.4	1	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	14.4	0	0.0	4	45.9	0	0	0	0	0
106-4	12-02-1994	LR	13:00:31	61.00	0	0.0	2	17.4	2	43.6	3	20.9	0	0.0	0	0.0	0	0.0	0	0.0	1	0.9	0	0.0	3	39.2	0	0	0	0	0
106-5	12-02-1994	LR	13:52:45	60.40	0	0.0	1	27.2	1	33.2	0	0.0	0	0.0	0	0.0	1	11.5	0	0.0	3	19.3	0	0.0	3	29.6	1	0	0	0	0
106-6	12-02-1994	LR	14:53:58	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	55.5	0	0.0	0	0.0	1	5.4	2	0	0	0	0
106-7	12-02-1994	LR	15:56:30	62.50	0	0.0	2	37.6	2	24.9	2	10.7	0	0.0	0	0.0	1	36.2	0	0.0	0	0.0	0	0.0	2	12.2	9	0	0	0	0
106-8	12-02-1994	LR	16:56:03	60.80	0	0.0	2	44.7	2	16.1	0	0.0	0	0.0	0	0.0	1	18.9	0	0.0	1	2.5	0	0.0	1	39.4	6	3	0	0	0
119-2	12-02-1994	LR	10:36:15	60.40	0	0.0	3	7.2	4	53.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
119-3	12-02-1994	LR	12:16:38	60.30	0	0.0	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	1	11.6	0	0.0	0	0.0	0	0.0	2	48.7	1	0	0	0	1
119-4	12-02-1994	LR	13:09:48	60.80	0	0.0	2	55.8	1	5.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	4.8	0	0.0	4	56.0	1	0	0	0	0
119-5	12-02-1994	LR	14:00:56	60.60	0	0.0	3	28.5	2	32.1	0	0.0	1	3.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	57.3	0	0	0	0	0
119-6	12-02-1994	LR	15:03:15	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	2	0	0	0	0
119-7	12-02-1994	LR	16:06:19	61.10	0	0.0	1	24.2	1	36.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.5	0	0.0	2	59.6	9	0	0	0	0
119-8	12-02-1994	LR	17:03:23	60.20	0	0.0	0	0.0	1	60.2	0	0.0	1	5.4	0	0.0	0	0.0	0	0.0	2	5.5	0	0.0	4	49.3	15	0	0	0	0
120-2	11-30-1994	LR	11:39:56	60.10	0	0.0	1	7.0	1	21.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	28.5	0	0	0	0	0
120-3	11-30-1994	LR	12:43:53	60.10	0	0.0	2	51.5	1	8.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	2	59.5	0	0	0	0	0
120-4	11-30-1994	LR	13:44:36	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.7	0	0	0	0	0
120-5	11-30-1994	LR	14:41:12	60.40	0	0.0	1	24.7	1	35.7	0	0.0	0	0.0	0	0.0	1	28.0	0	0.0	0	0.0	0	0.0	2	32.4	2	0	0	0	0
120-6	11-30-1994	LR	15:32:29	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
120-7	11-30-1994	LR	16:35:56	60.50	0	0.0	3	7.3	3	53.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	2	60.0	0	0	0	0	0
120-8	11-30-1994	LR	17:37:55	60.90	0	0.0	2	20.3	1	40.6	0	0.0	0	0.0	0	0.0	1	11.8	0	0.0	1	7.8	0	0.0	2	41.3	2	0	0	0	0
066-2	12-02-1994	LR	10:30:56	60.40	0	0.0	3	17.4	3	43.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
066-3	12-02-1994	LR	11:51:55	60.30	0	0.0	1	5.1	2	55.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	2	59.8	2	0	0	0	0
066-4	12-02-1994	LR	12:47:53	60.40	0	0.0	1	2.9	2	57.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
066-5	12-02-1994	LR	13:43:55	61.00	0	0.0	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.4	0	0.0	1	57.6	0	0	0	0	0
066-6	12-02-1994	LR	14:44:41	60.80	0	0.0	2	5.6	2	55.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.3	0	0.0	2	58.5	0	0	0	0	0
066-7	12-02-1994	LR	15:45:18	60.70	0	0.0	0	0.0	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	11.3	0	0.0	3	49.4	0	0	0	0	0
066-8	12-02-1994	LR	16:44:52	60.90	0	0.0	1	18.1	1	42.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.9	1	0	0	0	0
067-2	11-30-1994	LR	10:54:52	60.50	0	0.0	2	37.1	2	23.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	2	59.9	0	0	0	0	0
067-3	11-30-1994	LR	12:07:29	61.10	0	0.0	3	19.1	2	42.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	2.7	1	0.6	4	57.8	2	0	0	0	0
067-4	11-30-1994	LR	13:09:10	60.10	0	0.0	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	2	36.2	0	0.0	1	3.9	0	0.0	3	20.0	0	0	0	0	0
067-5	11-30-1994	LR	14:15:05	60.80	0	0.0	1	60.8	0	0.0	0	0.0	0	0.0	0	0.0	2	52.2	0	0.0	0	0.0	0	0.0	1	8.6	0	0	0	0	0
067-6	11-30-1994	LR	15:07:03	60.10	0	0.0	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.1	0	0	0	0	0
067-7	11-30-1994	LR	16:03:20	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.9	1	0	0	0	0
067-8	11-30-1994	LR	17:09:13	61.10	0	0.0	2	7.6	2	53.5	0	0.0	0	0.0	0	0.0	1	14.5	0	0.0	0	0.0	0	0.0	1	46.6	0	0	0	0	0
083-2	11-30-1994	LR	11:07:58	60.40	0	0.0	1	19.5	2	40.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
083-3	11-30-1994	LR	12:17:16	60.30	0	0.0	3	42.4	2	17.9	0	0.0	0	0.0	0	0.0	1	4.6	0	0.0	2	9.7	0	0.0	1	46.0	3	0	0	0	0
083-4	11-30-1994	LR	13:18:19	60.10	0	0.0	1	48.8	1	11.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.1	0	0	0	0	0
083-5	11-30-1994	LR	14:20:45	60.40	0	0.0	2	18.1	1	42.3	0	0.0	0	0.0	0	0.0	1	41.9	0	0.0	1	3.6	0	0.0	2	14.9	0	0	0	0	0
083-6	11-30-1994	LR	15:13:14	60.30	0	0.0	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	1	13.3	0	0.0	0	0.0	0	0.0	2	47.0	2	0	0	0	0
083-7	11-30-1994	LR	16:11:17	61.00	0	0.0	1	31.2	1	29.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	1	0	0	0	0
083-8	11-30-1994	LR	17:16:32	60.50	0	0.0	2	47.1	2	13.4	0	0.0	0	0.0	0	0.0	1	44.1	0	0.0	0	0.0	0	0.0	1	16.4	5	0	0	0	0
085-2	11-30-1994	LR	11:00:51	61.00	0	0.0	2	56.5	1	4.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0	0	0	0
085-3	11-30-1994	LR	12:23:40	60.70	0	0.0	2	56.9	1	3.8	0	0.0	0	0.0	0	0.0	1	3.6	0	0.0	1	2.9	0	0.0	3	54.2	0	0	0	0	0
085-4	11-30-1994	LR	13:25:55	60.60	0	0.0	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
085-5	11-30-1994	LR	14:24:44	60.90	0	0.0	2	48.2	1	12.7	0	0.0	0	0.0	0	0.0	1	39.9	0	0.0	0	0.0	0	0.0	1	21.0	0	0	0	0	0
085-6	11-30-1994	LR	15:16:45	60.90	0	0.0	2	44.3	1	16.6	0	0.0	0	0.0	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0

Fallow-deer - day of treatment - p. 6 of 6

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
063-6	11-30-1994	R	15:04:49	60.90	0	0.0	0	0.0	1	60.9	0	0.0	1	6.2	0	0	1	5.1	0	0.0	1	0.7	0	0.0	3	48.9	1	0	0	0	0
063-7	11-30-1994	R	16:01:49	60.60	1	3.6	3	18.4	2	38.6	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	3.2	0	0.0	2	57.4	2	0	0	0	0
063-8	11-30-1994	R	17:07:22	60.30	1	17.0	1	2.9	2	40.4	0	0.0	0	0.0	0	0	1	23.9	0	0.0	0	0.0	0	0.0	2	36.4	0	0	0	0	0
070-2	11-30-1994	R	11:18:27	60.20	0	0.0	2	45.2	2	15.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	0.9	0	0.0	2	59.3	0	0	0	0	0
070-3	11-30-1994	R	12:11:54	60.30	0	0.0	1	26.8	1	33.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	2.9	0	0.0	3	57.4	3	0	0	0	0
070-4	11-30-1994	R	13:14:12	60.60	0	0.0	1	10.4	1	50.2	1	10.7	1	4.3	0	0	0	0.0	0	0.0	1	2.8	0	0.0	2	42.8	10	0	0	0	0
070-5	11-30-1994	R	14:17:45	60.30	0	0.0	2	10.8	2	49.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	8.7	0	0.0	2	51.6	8	0	0	0	0
070-6	11-30-1994	R	15:09:56	60.40	0	0.0	1	60.4	0	0.0	0	0.0	0	0.0	0	0	1	24.2	0	0.0	0	0.0	0	0.0	1	36.2	0	0	0	0	0
070-7	11-30-1994	R	16:06:29	60.90	1	60.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	13	0	0	0	0
070-8	11-30-1994	R	17:12:24	60.70	1	51.6	1	9.1	0	0.0	0	0.0	0	0.0	0	0	1	15.5	1	24.2	1	1.6	0	0.0	2	19.4	3	0	0	0	0
082-2	12-02-1994	R	10:42:49	60.20	0	0.0	2	11.4	2	48.8	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.2	0	2	0	0	0
082-3	12-02-1994	R	11:56:41	60.80	0	0.0	2	17.6	2	43.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	5	8.2	0	0.0	6	52.6	0	0	0	0	0
082-4	12-02-1994	R	12:51:18	60.20	0	0.0	2	56.1	2	4.1	2	13.1	0	0.0	0	0	1	21.7	0	0.0	1	4.9	0	0.0	4	20.5	0	0	0	0	0
082-5	12-02-1994	R	13:46:41	60.30	0	0.0	3	24.7	3	35.6	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.0	0	0.0	2	59.3	6	0	0	0	0
082-6	12-02-1994	R	14:47:44	60.00	0	0.0	2	51.7	2	8.3	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.0	0	0	0	0	0
082-7	12-02-1994	R	15:49:50	60.70	0	0.0	3	47.2	2	13.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.7	1	0	0	0	0
082-8	12-02-1994	R	16:48:13	60.10	0	0.0	2	19.9	2	40.2	1	2.6	0	0.0	0	0	2	22.7	0	0.0	1	0.6	0	0.0	4	34.2	1	0	0	0	0
092-2	11-30-1994	R	11:33:14	61.00	0	0.0	2	22.9	2	38.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0	0	0	0
092-3	11-30-1994	R	12:31:47	60.20	1	9.1	1	13.5	1	37.6	0	0.0	0	0.0	0	0	0	0.0	1	10.1	0	0.0	0	0.0	1	50.1	0	0	0	0	0
092-4	11-30-1994	R	13:37:51	60.70	1	60.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.7	0	0.0	0	0.0	0	0.0	0	0	0	0	0
092-5	11-30-1994	R	14:32:50	60.10	0	0.0	1	60.1	0	0.0	0	0.0	0	0.0	0	0	1	60.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
092-6	11-30-1994	R	15:25:40	60.10	0	0.0	1	35.5	1	24.6	1	11.7	3	20.1	0	0	0	0.0	0	0.0	0	0.0	0	0.0	2	28.3	2	0	0	0	0
092-7	11-30-1994	R	16:27:42	61.00	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	5	0	0	0	0
092-8	11-30-1994	R	17:29:21	60.50	1	60.5	0	0.0	0	0.0	1	18.3	0	0.0	0	0	0	0.0	1	17.5	0	0.0	0	0.0	1	24.7	2	0	0	0	0
093-2	12-02-1994	R	10:48:32	60.20	0	0.0	2	53.1	1	7.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.2	0	4	0	0	0
093-3	12-02-1994	R	12:01:15	60.10	0	0.0	3	9.3	4	50.8	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	0.9	0	0.0	2	59.2	0	0	0	0	0
093-4	12-02-1994	R	12:57:27	60.90	0	0.0	1	6.3	1	54.6	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	16.3	0	0.0	2	44.6	10	0	0	0	0
093-5	12-02-1994	R	13:49:44	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.6	0	0.0	0	0.0	0	0.0	5	0	0	0	0
093-6	12-02-1994	R	14:50:53	60.50	0	0.0	1	13.8	2	46.7	0	0.0	0	0.0	0	0	1	5.8	0	0.0	3	6.5	0	0.0	4	48.2	1	0	0	0	0
093-7	12-02-1994	R	15:53:27	60.40	0	0.0	2	14.6	1	45.8	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	1.9	0	0.0	3	58.5	0	0	0	0	0
093-8	12-02-1994	R	16:52:03	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0	0	0	0

Fallow-deer - day of treatment - p. 5 of 6

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
085-7	11-30-1994	LR	16:15:09	60.30	0	0.0	2	40.7	1	19.6	0	0.0	0	0.0	1	2.7	0	0.0	0	0.0	0	0.0	0	0.0	2	57.6	0	0	0	0	0
085-8	11-30-1994	LR	17:21:10	60.60	0	0.0	1	39.1	1	21.5	1	10.5	0	0.0	0	0.0	1	36.0	0	0.0	1	5.4	0	0.0	2	8.7	0	0	0	0	0
098-2	11-30-1994	LR	10:45:14	61.00	0	0.0	2	14.7	2	46.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	1	0	0	0
098-3	11-30-1994	LR	12:33:59	60.70	0	0.0	1	60.7	0	0.0	1	3.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	57.7	0	0	0	0	0
098-4	11-30-1994	LR	13:39:48	60.60	1	60.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0.0	0	0.0	0	0.0	0	0	0	0	0
098-5	11-30-1994	LR	14:34:25	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
098-6	11-30-1994	LR	15:27:17	60.00	1	60.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
098-7	11-30-1994	LR	16:29:43	60.30	0	0.0	1	1.9	1	58.4	1	11.0	0	0.0	0	0.0	0	0.0	0	0.0	1	4.7	0	0.0	2	44.6	5	0	0	0	0
098-8	11-30-1994	LR	17:31:14	60.30	0	0.0	1	21.3	1	39.0	0	0.0	1	8.8	0	0.0	1	27.0	0	0.0	1	2.5	0	0.0	1	22.0	3	1	0	0	0
117-2	11-30-1994	R	11:02:17	60.70	0	0.0	1	2.7	2	58.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.7	0	0	0	0	0
117-3	11-30-1994	R	12:39:37	60.40	0	0.0	2	45.2	1	15.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	0.5	0	0.0	2	59.9	10	0	0	0	0
117-4	11-30-1994	R	13:42:44	60.30	0	0.0	1	2.9	1	57.4	0	0.0	1	3.6	0	0	0	0.0	0	0.0	1	18.5	0	0.0	2	38.2	1	0	0	0	0
117-5	11-30-1994	R	14:38:14	60.10	0	0.0	2	26.6	2	33.5	1	2.1	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	2	58.0	2	0	0	0	0
117-6	11-30-1994	R	15:30:33	60.60	1	50.7	0	0.0	1	9.9	1	11.2	0	0.0	0	0	0	0.0	1	17.5	1	10.9	0	0.0	2	21.0	2	0	0	0	0
117-7	11-30-1994	R	16:32:50	60.90	0	0.0	1	60.9	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	2.7	0	0.0	2	58.2	16	0	0	0	0
117-8	11-30-1994	R	17:34:50	60.10	1	13.5	1	8.0	1	38.6	2	13.2	0	0.0	0	0	0	0.0	0	0.0	1	1.4	0	0.0	4	45.5	5	0	0	0	0
124-2	12-02-1994	R	10:37:35	60.50	0	0.0	3	7.0	3	53.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0	0	0	0
124-3	12-02-1994	R	12:08:47	60.20	0	0.0	1	9.0	2	51.2	1	6.1	0	0.0	0	0	0	0.0	0	0.0	2	2.4	1	1.7	5	50.0	7	0	0	0	0
124-4	12-02-1994	R	13:02:26	60.60	0	0.0	2	8.5	3	52.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	12	0	0	0	0
124-5	12-02-1994	R	13:54:18	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	60.5	0	0.0	0	0.0	0	0.0	0	0	0	0	0
124-6	12-02-1994	R	14:55:34	61.00	0	0.0	3	39.5	2	21.5	1	1.8	0	0.0	0	0	1	20.8	0	0.0	1	0.7	0	0.0	2	37.7	3	0	0	0	0
124-7	12-02-1994	R	15:58:21	60.10	0	0.0	3	37.7	4	22.4	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	2.1	0	0.0	2	58.0	0	0	0	0	0
124-8	12-02-1994	R	16:57:34	60.90	0	0.0	1	50.2	1	10.7	0	0.0	0	0.0	0	0	1	43.4	0	0.0	0	0.0	0	0.0	1	17.5	2	0	0	0	0
133-2	12-02-1994	R	10:50:11	60.80	0	0.0	1	18.4	2	42.4	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	2.0	1	2.4	3	56.4	1	2	0	0	0
133-3	12-02-1994	R	12:12:18	60.50	0	0.0	2	9.6	2	50.9	0	0.0	0	0.0	0	0	0	0.0	0	0.0	4	5.7	0	0.0	5	54.8	6	0	0	0	0
133-4	12-02-1994	R	13:07:00	61.00	1	32.0	3	14.3	2	14.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	8.9	0	0.0	2	52.1	6	0	0	0	0
133-5	12-02-1994	R	13:57:47	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	3	0	0	0	0
133-6	12-02-1994	R	14:59:53	60.50	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	7	0	0	0	0
133-7	12-02-1994	R	16:03:10	60.50	0	0.0	2	22.3	2	38.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	3	0	0	0	0
133-8	12-02-1994	R	17:00:17	60.80	0	0.0	2	53.9	1	6.9	1	2.6	1	2.8	0	0	0	0.0	0	0.0	1	0.4	0	0.0	3	55.0	13	0	0	0	0
139-2	11-30-1994	R	10:38:36	60.40	0	0.0	2	5.7	2	54.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	2	0	0	0
139-3	11-30-1994	R	12:56:45	60.00	0	0.0	1	60.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.0	4	0	0	0	0
139-4	11-30-1994	R	13:56:58	62.20	1	29.9	1	32.3	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	30.8	0	0.0	0	0.0	1	31.4	0	0	0	0	0
139-5	11-30-1994	R	14:50:10	61.00	1	61.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	61.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
139-6	11-30-1994	R	15:40:45	61.10	1	61.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0.0	1	61.1	0	0.0	0	0.0	0	0.0	1	0	0	0	0
139-7	11-30-1994	R	16:52:07	60.40	0	0.0	2	22.0	2	38.4	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	0.9	0	0.0	2	59.5	2	0	0	0	0
139-8	11-30-1994	R	17:46:18	61.00	1	11.7	1	49.3	0	0.0	0	0.0	0	0.0	0	0	1	42.0	1	13.4	0	0.0	0	0.0	1	5.6	0	0	0	0	0
058-2	12-02-1994	R	10:41:15	60.50	0	0.0	2	32.8	2	27.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	15	0	0	0
058-3	12-02-1994	R	11:48:50	61.00	0	0.0	2	6.8	3	54.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.0	1	1.1	3	58.9	5	1	0	0	0
058-4	12-02-1994	R	12:43:33	60.40	0	0.0	2	10.3	2	50.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
058-5	12-02-1994	R	13:40:56	60.70	0	0.0	1	40.1	1	20.6	0	0.0	2	6.4	0	0	0	0.0	0	0.0	1	2.4	0	0.0	4	51.9	8	0	0	0	0
058-6	12-02-1994	R	14:41:35	61.10	0	0.0	2	39.3	3	21.8	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.4	0	0.0	2	59.7	5	0	0	0	0
058-7	12-02-1994	R	15:42:24	60.80	0	0.0	1	49.7	2	11.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	3.1	0	0.0	1	57.7	1	0	0	0	0
058-8	12-02-1994	R	16:41:18	60.60	0	0.0	0	0.0	1	60.6	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	8.2	0	0.0	2	52.4	2	0	0	0	0
063-2	11-30-1994	R	11:14:13	60.70	0	0.0	2	10.7	2	50.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.1	0	0.0	2	59.6	0	0	0	0	0
063-3	11-30-1994	R	12:05:56	60.50	0	0.0	2	26.2	2	34.3	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	20.4	0	0.0	1	40.1	9	0	0	0	0
063-4	11-30-1994	R	13:07:29	60.50	0	0.0	2	44.8	2	15.7	0	0.0	0	0.0	0	0	1	60.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0	0	0	0
063-5	11-30-1994	R	14:12:58	60.40	0	0.0	1	22.1	1	38.3	0	0.0	0	0.0	0	0	1	20.8	0	0.0	1	5.2	0	0.0	2	34.4	1	0	0	0	0

Fallow-deer - before treatment - p. 1 of 1

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	&	§	*	#	µ	()
121-1	11-30-1994	C	09:47:10	60.60	0	0.0	3	44.8	2	15.8	1	2.9	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	0	0.0	3	57.2	0	0	0	0	0
125-1	11-30-1994	C	09:49:34	60.30	0	0.0	1	8.4	1	51.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	1.9	0	0.0	2	58.4	0	0	0	0	0
080-1	11-30-1994	C	09:15:58	60.20	0	0.0	4	40.1	3	20.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	3.0	0	0.0	2	57.2	0	0	0	0	0
084-1	11-30-1994	C	09:23:22	60.30	0	0.0	2	15.0	2	45.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	0	0	0	0	0
089-1	12-02-1994	C	09:41:45	60.90	0	0.0	3	38.1	3	22.8	2	5.2	0	0.0	0	0.0	0	0.0	0	0.0	1	2.8	0	0.0	4	52.9	0	0	0	0	0
091-1	11-30-1994	C	09:32:09	60.30	0	0.0	1	60.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	0	0	0	0	0
110-1	11-30-1994	LC	09:38:57	60.80	0	0.0	3	38.5	3	22.3	1	2.5	0	0.0	0	0	0	0.0	0	0.0	1	0.4	0	0.0	3	57.9	0	0	0	0	0
131-1	11-30-1994	LC	09:51:25	62.90	0	0.0	2	19.8	2	43.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	5	19.5	0	0.0	5	39.1	0	0	0	0	0
137-1	11-30-1994	LC	09:53:36	60.80	0	0.0	3	27.2	3	33.6	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	4.1	0	0.0	2	56.7	0	0	0	0	0
140-1	12-02-1994	LC	09:54:06	60.30	0	0.0	3	43.9	3	16.4	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	0	0	0	0	0
049-1	12-02-1994	LC	09:24:48	60.00	0	0.0	2	29.8	2	30.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.0	0	0	0	0	0
053-1	12-02-1994	LC	09:31:01	60.70	0	0.0	4	44.0	3	16.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.7	0	0	0	0	0
054-1	12-02-1994	LC	09:35:45	60.20	0	0.0	2	24.1	2	36.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.2	0	0	0	0	0
075-1	12-02-1994	LC	09:38:36	61.50	0	0.0	2	32.0	2	29.5	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	2.3	0	0.0	2	59.2	0	0	0	0	0
087-1	11-30-1994	LC	09:27:25	60.30	0	0.0	2	44.9	1	15.4	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.5	0	0.0	2	58.8	0	0	0	0	0
090-1	11-30-1994	LC	09:29:50	60.60	0	0.0	2	31.4	2	29.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
102-1	12-02-1994	LR	09:44:37	60.40	0	0.0	5	15.7	4	44.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.4	0	0	0	0	0
106-1	12-02-1994	LR	09:46:13	60.50	0	0.0	3	30.9	4	29.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	10.2	0	0.0	1	50.3	0	0	0	0	0
120-1	11-30-1994	LR	09:45:04	60.80	0	0.0	2	30.0	2	30.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	2	60.2	0	0	0	0	0
066-1	12-02-1994	LR	09:37:10	60.50	0	0.0	1	3.0	2	57.5	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.5	0	0	0	0	0
067-1	11-30-1994	LR	09:19:31	60.80	0	0.0	1	7.7	2	53.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.8	0	0	0	0	0
083-1	11-30-1994	LR	09:21:20	60.80	0	0.0	2	54.0	1	6.8	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.8	0	0	0	0	0
085-1	11-30-1994	LR	09:25:31	60.30	0	0.0	2	48.3	2	12.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	3.0	0	0.0	3	57.3	0	0	0	0	0
098-1	11-30-1994	LR	09:36:06	60.40	0	0.0	4	35.3	3	25.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	2.6	0	0.0	2	57.8	0	0	0	0	0
117-1	11-30-1994	R	09:40:36	60.70	0	0.0	4	38.5	3	22.2	0	0.0	0	0.0	0	0	0	0.0	0	0.0	2	2.6	0	0.0	3	58.1	0	0	0	0	0
124-1	12-02-1994	R	09:48:32	60.60	0	0.0	4	36.6	5	24.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.6	0	0	0	0	0
133-1	12-02-1994	R	09:52:08	60.50	0	0.0	3	44.1	2	16.4	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	10.6	0	0.0	2	49.9	0	0	0	0	0
139-1	11-30-1994	R	09:55:07	60.90	0	0.0	4	35.2	4	25.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.3	0	0.0	2	59.6	0	0	0	0	0
058-1	12-02-1994	R	09:34:08	60.10	0	0.0	3	44.2	2	15.9	0	0.0	0	0.0	0	0	0	0.0	0	0.0	1	1.5	0	0.0	2	58.6	0	0	0	0	0
063-1	11-30-1994	R	09:17:50	60.30	1	0.5	1	24.1	1	35.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.3	1	0	0	0	0
082-1	12-02-1994	R	09:40:04	60.90	0	0.0	4	46.9	3	14.0	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.9	0	0	0	0	0
092-1	11-30-1994	R	09:34:28	60.10	0	0.0	3	40.0	2	20.1	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.1	0	0	0	0	0
093-1	12-02-1994	R	09:43:12	60.10	0	0.0	2	16.4	3	43.7	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	1	60.1	0	0	0	0	0

Appendix 4 Event protocol

Example No. 1

Date of observation: 08-25-1994

Start time of observation: 10:17:39

Total duration: 60.2 seconds

Time	position	main-action	flicks	aggression
0.0	ly	othe,up	-	-
29.6	stan		-	-
35.5			-	agg+
60.2 {end}				

Example No. 2

Date of observation: 09-16-1994

Start time of observation: 10:09:38

Total duration: 60.4 seconds

Time	position	main-action	flicks	aggression
0.0	ly	othe,up	-	-
60.4 {end}				

Appendix 5 Summary Tables: Significant behavioural differences between double and single treatment

Local-rubber-group

Obervation period	Frequency or Time of Action	p	Mean/Std.-Dev. single treatment	Mean/Std.-Dev. double treatment
1	T-Other-up	0.0163	18.37±21.56	45.60±16.65
2	F-Other-below	0.0204	0.86±0.69	0.13±0.35
4	F-Other-below	0.0019	0.14±0.38	0.88±0.35
5	F-Other-up	0.0152	1.00±0.58	0.25±0.46
5	T-Other-up	0.0013	46.61±24.74	5.59±13.11
6	F-Walking	0.0401	0.43±0.54	0.0±0.0

Rubber-group

Obervation period	Frequency or Time of Action	p	Mean/Std.-Dev. single treatment	Mean/Std.-Dev. double treatment
1	F-Lying	0.0192	0.50±0.54	1.0±0.0
1	F-Standing	0.0421	0.75±0.71	0.13±0.35
1	F-Walking	0.0323	0.63±0.74	0.0±0.0
1	F-Feeding	0.0313	0.75±0.89	0.0±0.0
1	T-Lying	0.0014	21.94±27.27	60.36±1.22
1	T-Standing	0.0261	16.04±17.72	0.43±1.20
1	T-Walking	0.0305	22.51±26.46	0.0±0.0
1	T-Feeding	0.0357	18.03±21.94	0.0±0.0
5	F-Other-up	0.0044	1.13±0.35	0.38±0.52
5	T-Other-up	0.0086	44.06±18.19	13.11±22.19
6	T-Other-below	0.0409	3.99±11.28	27.28±26.99