A STUDY OF PLANNED HEALTH AND PRODUCTION IN BEEF SUCKLER HERDS

by

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ABSTRACT

The benefits of taking positive action on a herd basis to maintain animal health and efficient production have long been appreciated by the dairy industry. Planned health and production schemes in beef suckler herds have been run successfully in Canada, America and Australia since the late 1970's and their popularity has continued to grow. In the United Kingdom the subject of herd health has recently been fashionable in the dairy and sheep industries however it has had little recognition in the beef industry.

There has been a renewed interest in beef suckler cattle and a move from the traditional extensive hill systems to more intensive systems on upland and lowground farms. Due to consumer pressure there are tighter specifications for carcase quality. Therefore more planned systems of production are necessary to maintain profitability and minimise disease.

In this study it was hoped that after the implementation of planned health and production schemes on a cross section of beef suckler farms there would be an improvement in herd performance. Records of cow calving details and calf weights by the majority of the farmers allowed the monitoring of herd performance. In the herds studied there was great variation in husbandry practices and in the agricultural background of the farmers so advice was tailored to suit each individual. Certain problems were commonly encountered especially diarrhoea and pneumonia in calves and poor reproductive efficiency of cows. The majority of problems were best overcome by changes in farm management. On all farms there were improvements seen as a result of visits as measured by cow reproductive performance, incidence of calf diseases and calf performance.

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ACKNOWLEDGEMENTS

I wish to thank Dr. H. Alison Gibbs, who supervised this work, for her advice and cheerful encouragement throughout the course of the study. I would also like to thank Professor Max Murray for his support and for the opportunity to undertake this study in the Department of Veterinary Medicine.

Special thanks are due to the farmers and all their stockmen without whose co-operation, interest and enthusiasm none of the study would have been possible. I am also very grateful to the veterinary surgeons who allowed me to advise their clients.

Much of the laboratory analysis was carried out in a number of departments within Glasgow University Veterinary School. In this respect I am grateful to all the technical staff involved including: Arlene Macrae, Linda Forrest, John Armstrong, and June Downs of the Department of Veterinary Medicine. To Moira Young and Charlie Cameron of the Department of Veterinary Animal Husbandry. To Christine Marshall and her staff in the Department of Veterinary Biochemistry. To Ken Bairden and his staff in the Department of Veterinary Parasitology and to Douglas Ramsay in the Department of Veterinary Pathology.

I am grateful to Dr. Peter Nettleton at the Moredun Research Institute for the virus serological investigations he and his staff performed and for his helpful comments.

I also express sincere thanks for all the advice I received on computing and statistics from Professor George Gettinby of the University of Strathclyde and from Brian Wright and David Irvine in the Department of Veterinary Medicine.

DECLARATION

I Carolyn Anne Arnold hereby declare that the work presented in this Thesis is original, was carried out by me, and has not been presented for an award of a degree in any other University.

Most of the routine laboratory findings reported were done by the respective Departments in the Faculty of Veterinary Medicine, University of Glasgow. The serological investigations were carried out by the Department of Diagnostic Virology, Moredun Institute, Gilmerton Rd., Edinburgh. Vitamin B_{12} analyses were done by the Scottish Agricultural Colleges, Veterinary Investigation Centre, Auchincruive, Ayr.

CHAPTER 1.

A REVIEW OF THE LITERATURE

1.1. SUCKLED CALF PRODUCTION

The capture of wild Aurochs by the Egyptians around 6000 BC is thought to be the first domestication of cattle (Schwabe, 1978). Domestic cattle are now found on every Continent, and have developed depending on regional climates, land types and population densities. In North and South America, Australia and some parts of Africa the dairy and beef industries are separate, very large beef herds are ranched on the dry ranges and milk production is centred around densely populated areas (Allen and Kilkenny, 1984_a; Allen, 1990_a). In Europe dairy cattle dominate the industry and beef production is largely a by-product of dairying, with historically 75 percent of beef and veal produced from the dairy herd (MLC, 1989).

The United Kingdom has an integrated cattle industry which allows an exchange of breeding stock between beef and dairy herds (Figure 1.1.). This results in the production of higher quality beef cross calves from the dairy herds and the beef suckler herd benefits from the hybrid vigour of dairy cross cows. The only other country to adopt such a system is Ireland. Since the introduction of milk quotas there has been an increase in this integration of beef and dairy systems. This is reflected in the percentage of beef sires used on dairy cows; until the introduction of milk quotas around 33 percent of the bulls used were beef breeds but this figure soon rose to 50 percent (Allen, 1990_a). Many of the heifers from these beef sires become beef suckler cows.

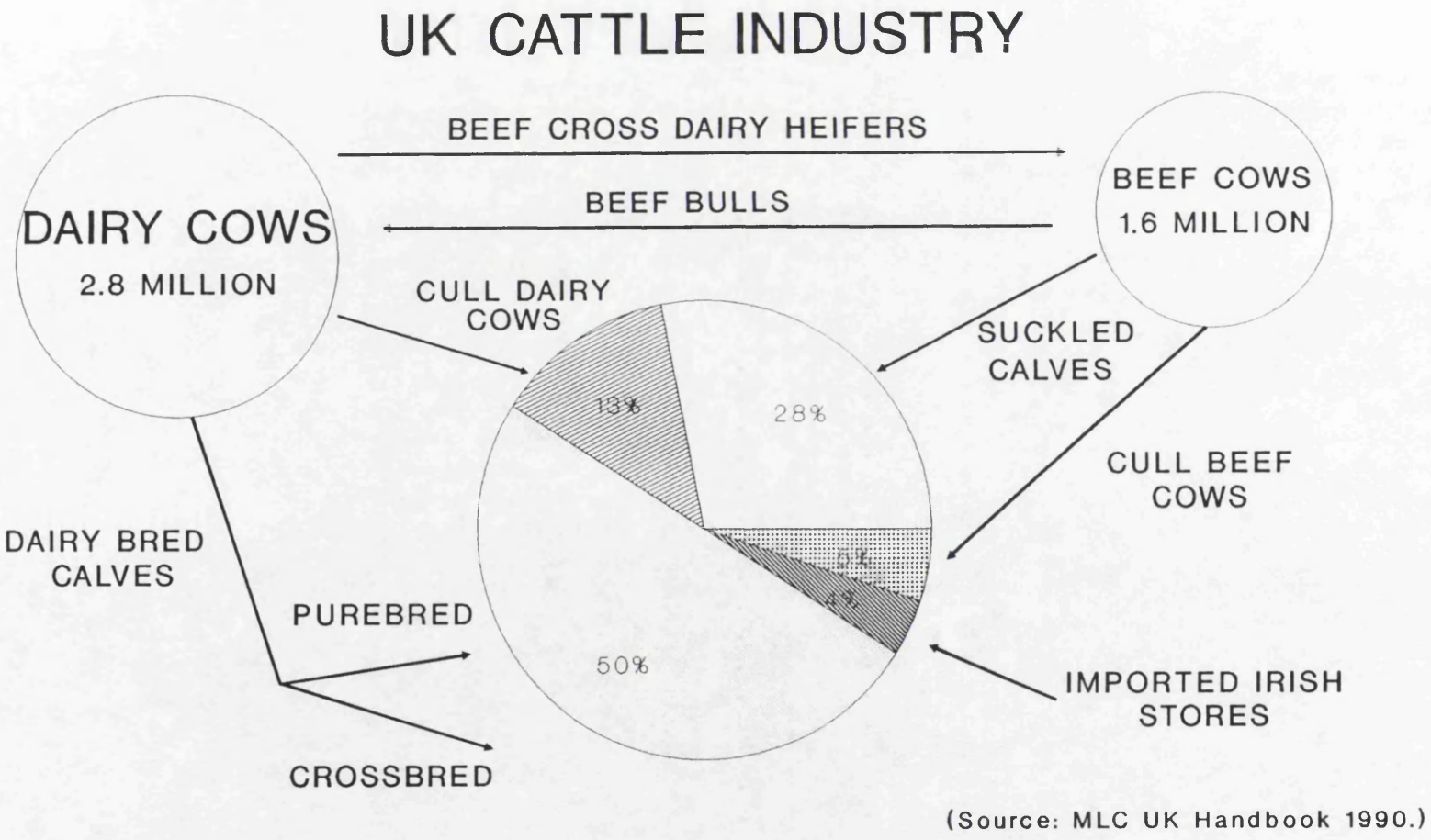


Figure 1.1. Diagramatic representation of UK cattle industry in 1990

The other source of heifers for beef suckler herds are hill cows crossed with White Beef Shorthorn bulls. These crosses, for example the Blue Grey out of the Galloway and the Luing out of the Highland (Mason, 1969), are especially suitable for hill and upland farms. The use of crossbred compared to purebred cows was shown to result in an increase in weight of calf weaned per cow put to the bull (Gaines *et al,* 1978), this was due to both an increase in numbers of calves born (Gaines *et al,* 1966) and to better performance of calves (Hodgson *et al,* 1980; Rollins *et al,* 1969). The nutrient requirements of cows depends on breed, as mature weight of cow and milk yield and quality will dictate energy demands. Large breeds of cow should be avoided when feed supplies are limited, smaller breeds will be more efficient (Carpenter, 1972). Where supplies are abundant and cheap, such as arable units, the increased feed required for the larger cows may well cost less than the increase weight of calf produced, so overall profits will be higher (Lowman, 1988). In recent years there has been an increase in the use of the Holstein breed in the dairy herd which has resulted in a deterioration in conformation of dairy cross suckler cows. In an attempt to combat this poor conformation some producers are using continental cross dairy cows especially Limousin and Simmental crosses (Allen, 1990_b). These large cows are better suited for farms where there are plentiful feed supplies.

Traditionally suckler herds were kept on rough hill ground where it was unsuitable to keep other cattle and, due to a lack of conserved fodder to feed lactating cattle over winter, calving was confined to spring when early lactation coincided with peak grass growth. Calves were weaned in late summer or autumn when they were sold as stores (Thomas, 1983).

Now more upland and lowland farms keep suckler cows where there is adequate stored feed so autumn calving is feasible. This produces older, heavier, more saleable calves for the autumn suckled calf sales. The input for autumn calving herds is higher due to increased feed requirements, but profit per cow is

greater than calving in other seasons (Figure 1.2.). In spring calving herds, where less fodder is conserved over winter, higher stocking rates can be achieved producing greater profits per hectare.

	Calving season		
	Autumn	Spring	Summer
Cattle performance			
Calf sale weight (kg)	339	275	347
Pre-weaning gain (kg/day)	0.89	1.0	0.98
Stocking rate (cows/hectare)	1.21	1.82	1.53
Financial performance (£)			
Calf sales	364	295	351
Variable costs including feeds, veterinary costs, bedding, etc.	145	111	153
Gross margin per cow	**271**	**236**	**256**
Gross margin per hectare	**328**	**430**	**392**

(From MLC Yearbook 1991)

Figure 1.2. Comparison of Autumn, Spring and Summer calving upland herds in 1990.

Winter calving will also enable the production of well grown calves for autumn sales and winter feed costs will be lower than for autumn calving. However the

cows are usually calved indoors which increases disease risk and calf mortality (Allen and Kilkenny, 1984_d).

Summer calving allows rebreeding of cows before winter so conception rates are higher than with autumn calving but as calves are not sold till the following autumn overall feed costs are high (Allen, 1990_b).

Feed costs make up around eighty percent of the total variable costs of producing weaned suckled calves on hill and upland farms (Russel, 1986). When considering the low gross margins achieved today it is pertinent to look at opportunities to reduce these costs without penalizing production (Russel, 1986; Gurnett and Waterhouse, 1985).

In spring calving herds it has been shown that providing condition at the start of winter is adequate and that summer grazing will allow replenishment, low levels of winter feeding have no significant effect on calf birth weight or on subsequent performance of either cows or calves (Powell and Matravers, 1975; Chapple, 1981). If cows are condition score 3.5 at the start of winter they can lose one full condition score over the winter period which means feeding approximately 70% of the requirements to maintain condition over winter (Russel, 1986). This will result in considerable saving in feed costs.

For Autumn calving cows major constraints to the manipulation of body reserves are that to try to avoid dystokia the cows should not be too fat at parturition and that undernutrition should be avoided during rebreeding and implantation. So ideally cows should calf at condition score three and be fed to maintain condition until one month after the end of mating (Lowman, 1986; Russel and Broadbent, 1985). Thereafter feeding to allow a loss of around one condition score is acceptable. The small reduction in calf growth rate which will be encountered as a result of reduced milk yield of the cows can be minimized by offering calves access to roughage *ad libitum* and a maximum of 2kg concentrates per head per day (Russel and Broadbent, 1985).

The fate of suckled calves bought in the autumn will depend on their size. Well grown calves are fed to grow quickly over winter to be sold finished at 15 to 18 months and live weight gains over winter are in the region of 1 kg per day (MLC, 1991). Lighter calves are stored over the winter with live weight gains of around 0.64kg per day in preparation for finishing at grass at 18 to 24 months of age, gaining approximately 0.76 kg per day at grass (MLC, 1991). The latter calves may be finished on the farm where they are wintered or they are traded in the spring to special grass finishers. Very slow growing cattle may be stored for two or three winters before being finished at 30 months or older (Allen and Kilkenny, 1984_c).

On lowland farms where feeds and buildings are available there has been a move to intensify production by overwintering calves to sell as stores, or even finished, in the spring. Bull calves are weaned in early autumn onto cereal diets to finish at 11 to 12 months. An alternative to the cereal finishing is grass/ cereal finishing where calves are weaned early onto a silage/ cereal ration to finish at 13 to 15 months. These systems produce live weight gains of 1.2 to 1.4 kilograms live weight per day (MLC , 1991) and require good stockmanship as there are many potential problems.

There are groups who frequently buy and sell store and finishing cattle, the animals often spending only short periods on any particular holding. These are not really farmers but businessmen who follow the markets carefully, making a living from their trading skills (Allen and Kilkenny, 1984_e; Allen, 1990_c).

The choice of bull breeds for the suckler herds is designed to suit the available resources and the environment in which the cattle will be kept (Armstrong *et al,* 1990). In the traditional systems, where only poor quality feeds are available, the early maturing Hereford and Angus sires have been popular. These calves finished at an early age though slaughter weights were relatively low and the carcases tended to be fat. The continental bulls are more popular

now, they tend to be slow maturing and fast growing so can be fed high quality rations to grow quickly without becoming fat. The first of the continentals to be introduced to the United Kingdom was the Charolais and it is still proving to be one of the most popular breeds. Due to consumer demands the retailer is looking for even leaner meat so premiums are now being paid for the most suitable carcases. The meat and livestock commission have graded carcases for many years but in November 1981 the United Kingdom started to use the EEC classification scheme (Figure 1.3.).

Conformation classes are described by the letters E (excellent) to P (poor) and fatness is by numbers 1 (lean) to 5H (fat). Fat classes and conformation are determined visually using photographic reference scales (Allen and Kilkenny, 1984_b).

Market premiums are evident for carcases with the highest classification and over-fat carcases are often penalized (Figure 1.4.). As finishing systems become more intensive there has been an increase in the use of Limousin bulls as their calves have good conformation and less fat even when finished on intensive cereal rations.

STANDARD EEC BEEF CARCASE CLASSIFICATION SCALE

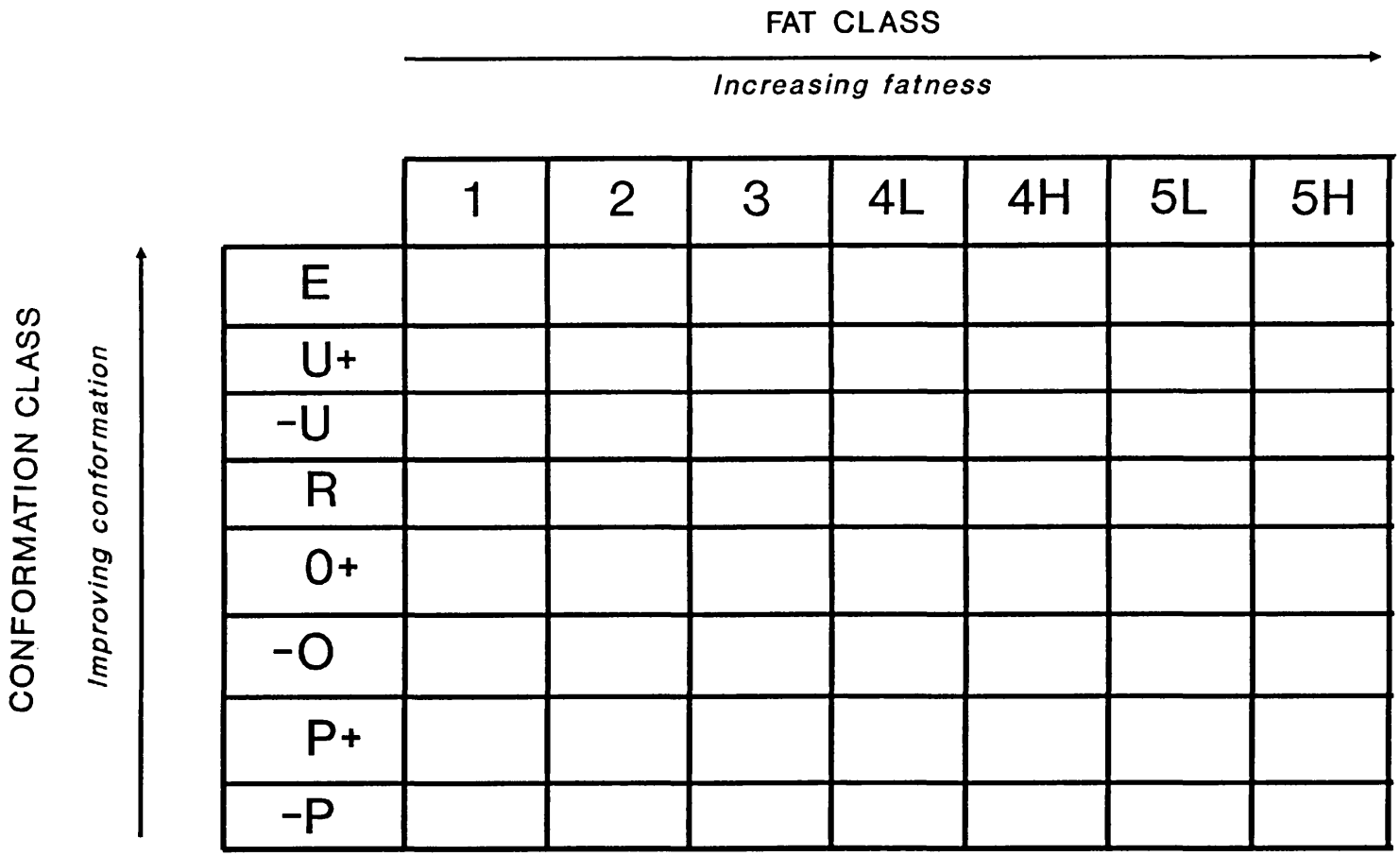
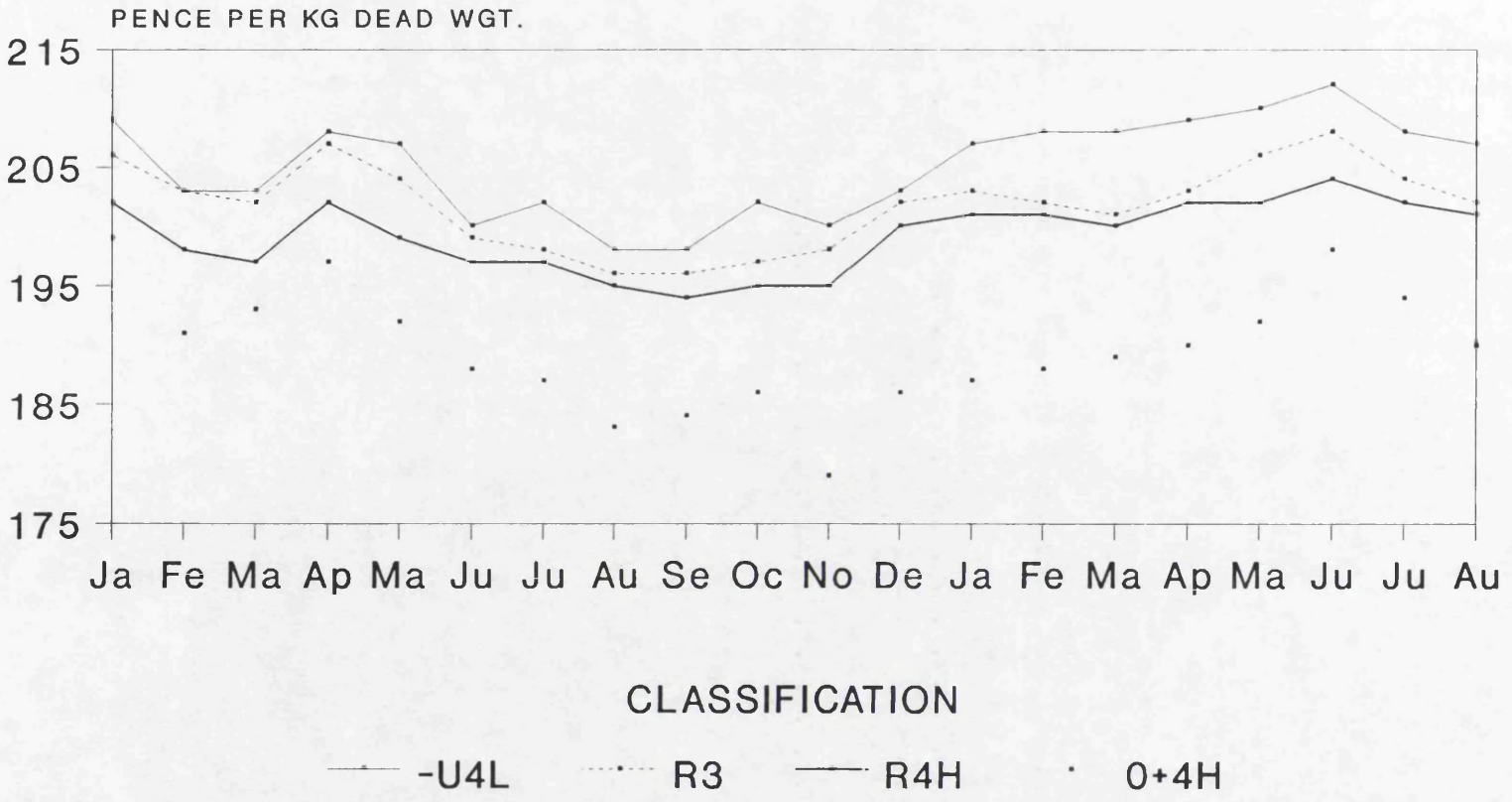


Figure 1.3. Standard EEC beef carcase classification scale.

DEADWEIGHT STEER PRICES IN GREAT BRITAIN JAN 1990 - AUG 1991



(Source: MLC UK Handbook 1991)

Figure 1.4. UK Deadweight steer prices.

1.2. THE BEEF INDUSTRY TODAY

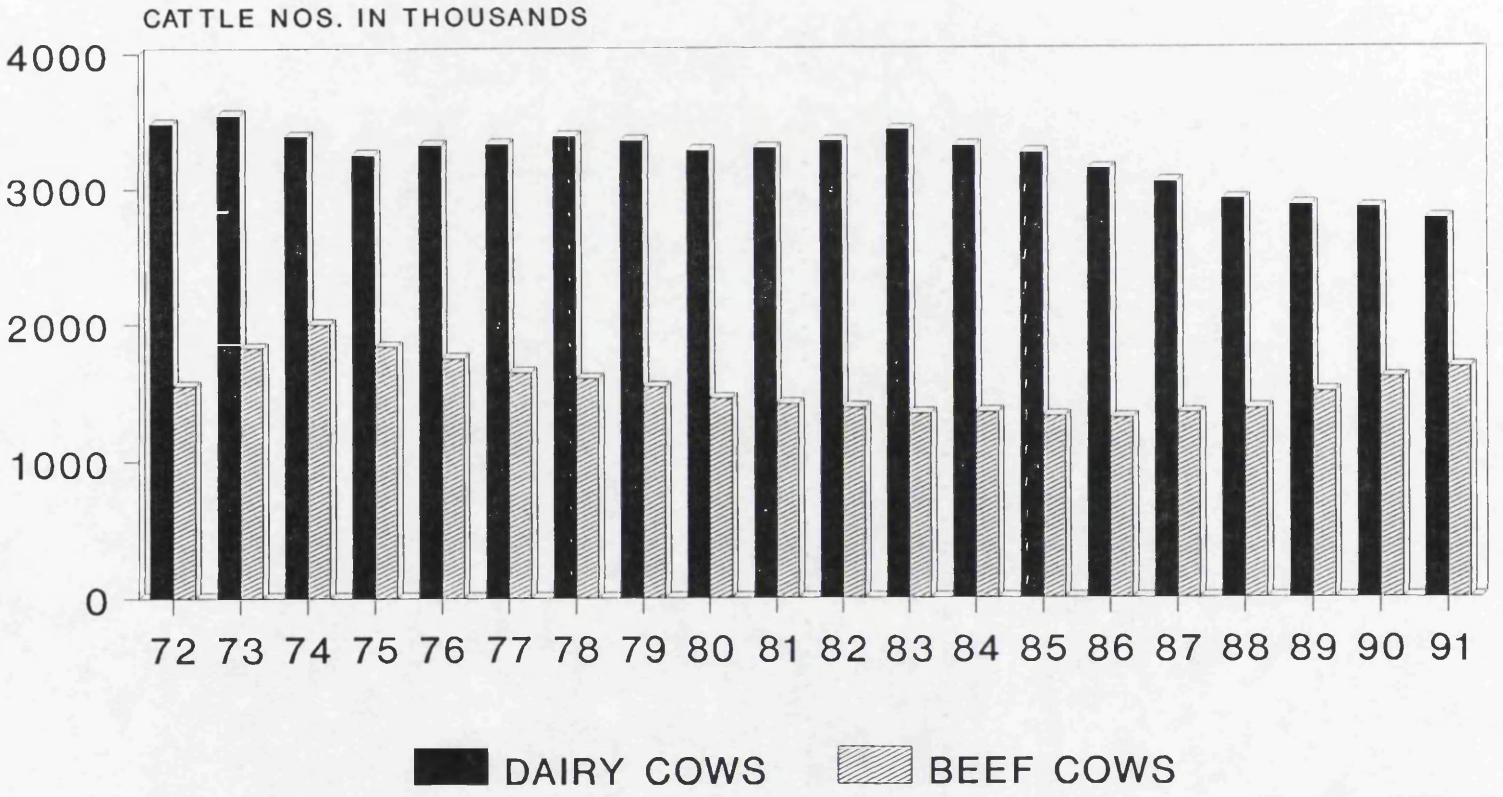
In the 1950's and 1960's beef cattle numbers throughout the world remained relatively static. In the early 1970's there seemed to be an increase in consumer demand for red meats in developed countries which resulted in a rise in beef cattle numbers (Ventura, 1979). Numbers reached a peak in 1974 and after this, due to a world recession, there was a move to an increase in consumption of less expensive white meats. This drop in demand resulted in over-production and a decrease in beef prices so consumption increased again, this led to an increase dependence on beef from the dairy industry since beef cow numbers were still declining (Figure 1.5.).

The imposition of milk quotas in the European Communities in 1984 led to a reduction in dairy cows numbers throughout Europe including the United Kingdom (Figure 1.5.) (Allen, 1990_a). Dairy cow slaughtering increased initially so beef production was maintained but since then beef production has declined. A further restriction on milk quotas in 1987 extended this decrease in dairy cattle and therefore in beef and veal production (Figure 1.6.). There has been a renewed interest in the suckler herd since 1986 (Figure 1.5.), so beef and veal production started to increase again in 1990 (Figure 1.6.).

Another important influence on the United Kingdom cattle industry was the recognition of Bovine Spongiform Encephalopathy (BSE). The first case was recognized in 1985 (Wells *et al*, 1987) and, as a result of increasing publicity, by late 1989 consumer demand for red meats plummeted and the price of slaughter cattle fell dramatically (Figures 1.7. and 1.8.). This reduction in slaughter value resulted in profitability falling for all beef herds in 1990.

There was uncertainty about the transmission of BSE and due to fears of it being a potential zoonosis the export of live calves decreased. An EEC directive

NUMBERS OF BREEDING COWS IN THE UNITED KINGDOM 1972-1991



(Source: MLC Data)

Figure 1.5. Numbers of breeding cows in the UK.

PRODUCTION OF BEEF AND VEAL BY THE EUROPEAN COMMUNITY

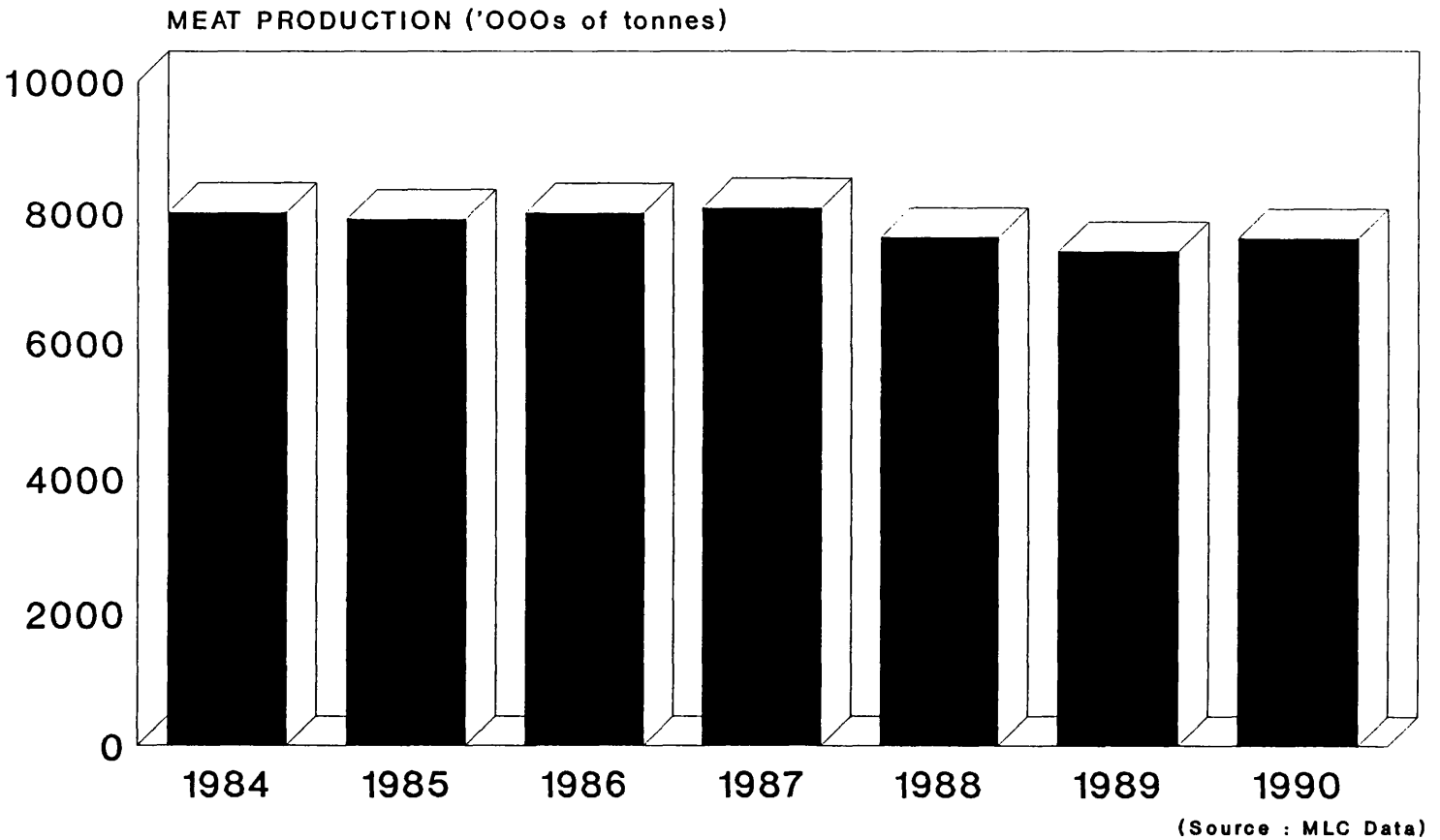


Figure 1.6. Beef and veal production in the EEC.

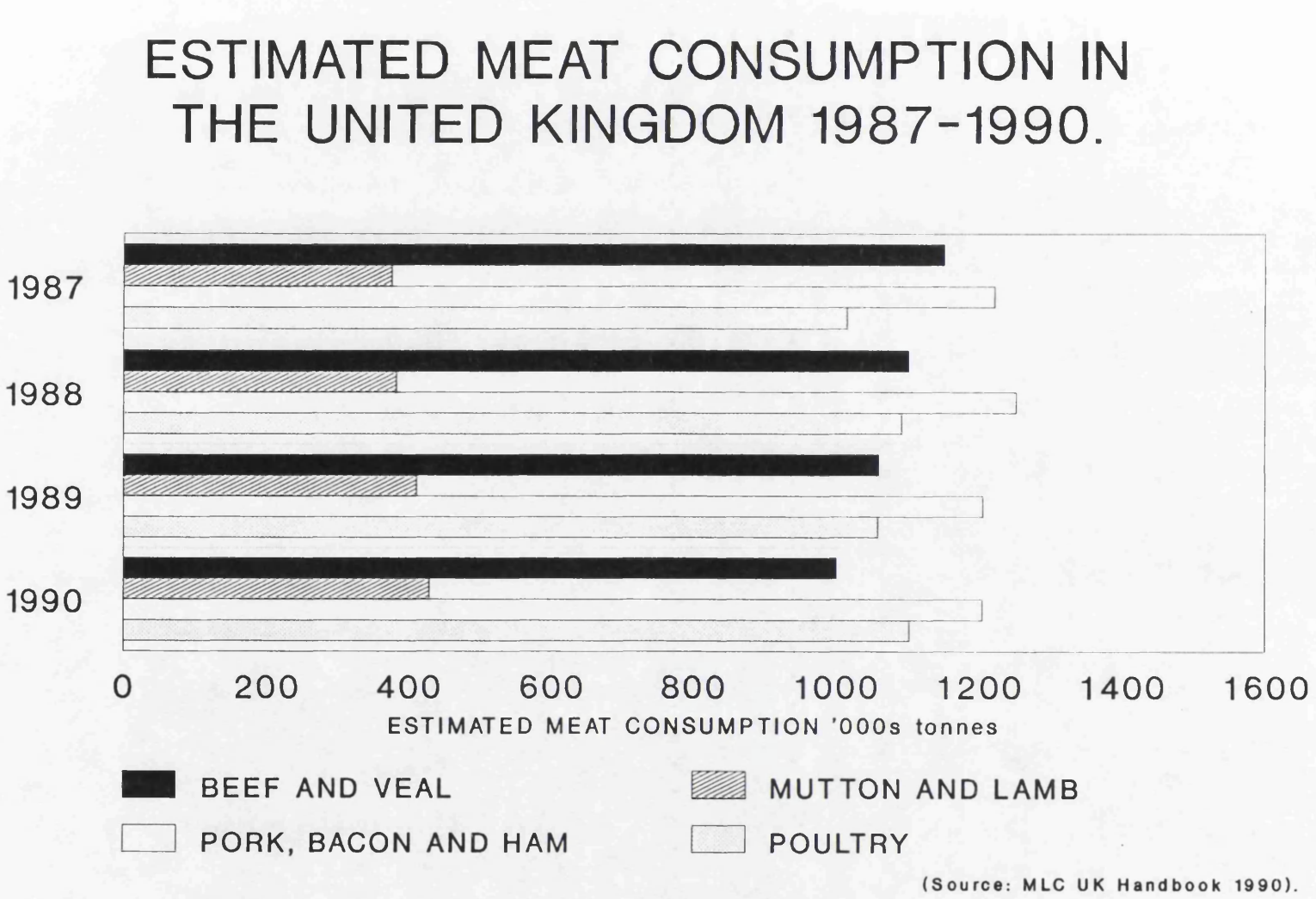
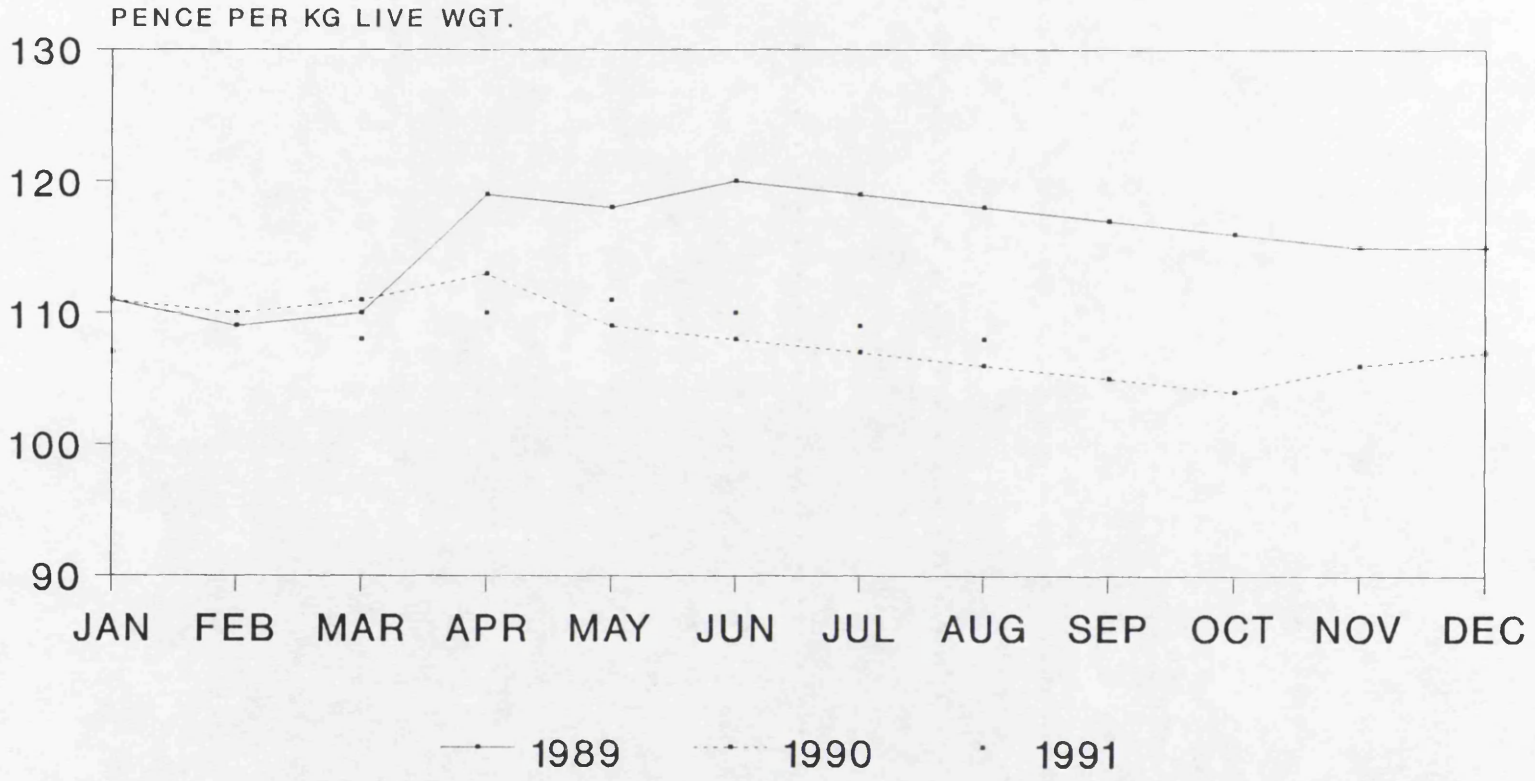


Figure 1.7. Consumption of meat in the UK.

AVERAGE MARKET PRICES FOR SLAUGHTER CATTLE IN GREAT BRITAIN



(Source: MLC UK Handbook 1991.)

Figure 1.8. Average prices for cattle at slaughter.

in February 1990 limited exports to calves less than six months of age and those had to be identified then slaughtered by six months of age.

Export of beef and veal had also plummeted in 1990 when several EEC countries placed restrictions on British beef, however in June 1990 the EEC Agricultural Council ordered lifting of these bans subject to the introduction of certification for exports to other EC countries. This resulted in increased exports, this was partly due to improved trading with Italy and Mexico.

There have been new export initiatives in the 1990 to 1991 period. The first is the Scottish Meat Export Initiative (Scotmex) run by Scottish Enterprise, The Meat and Livestock Commission and the Scottish Quality Meat and Lamb Association; these groups together with the Scottish association of meat wholesalers have developed two new schemes to promote the export of Scottish beef. One is the 'Industry wide' scheme to develop the market overseas. The other is a Scottish Beef Club which aims to establish a group of high quality restaurants who serve Scottish beef to promote the image of the product. There are already club members in Belgium and Italy and expansion to involve Germany, Holland and France is due in 1992.

Another initiative is the British Quality Beef Scheme which combines the development of a quality assurance scheme and promotion of quality beef to overseas wholesalers. There are a set of stringent standards to be adhered to and wholesalers are invited to inspect meat plants. This scheme is already started with Dutch wholesalers and the French will be the next to be approached.

1.3. THE HISTORY OF HERD HEALTH

The first well documented account of control of disease in cattle was in July 1714, when government appointed officials, a surgeon to King George I and several 'cow doctors' decided on recommendations to control an outbreak of cattle plague (Rinderpest) (Ministry of Agriculture, Fisheries and Food (MAFF), 1965). As a result of these recommendations the outbreak was controlled within three months. The value of keeping records was realized even in 1793 when a Board of Agriculture was established to compile agricultural statistics to improve knowledge of livestock (MAFF, 1965). After the outbreaks of Foot and Mouth in 1839 and of Pleuropneumonia in 1840 the English Agricultural Society (formerly the Board of Agriculture) were drawn to the fact that the veterinary colleges, in London (opened 1791) and Edinburgh (opened 1820) (Pattison, 1984), did not take the study of farm livestock seriously (MAFF, 1965), so colleges were persuaded to rectify this deficiency in teaching.

When cattle plague struck in 1865 advice on control was ignored and disaster ensued resulting in devastation of the cattle industry. This helped to spur the formation of a government Animal Health Division whose role was to control disease in the nations livestock (Pattison, 1984).

The real revolution in modern veterinary practice came after the second world war (Radostits, 1987). Research was improving knowledge of diseases, and new treatments such as the Sulphonamides in 1936 (Pattison, 1984) and vaccines were being used in sheep in the early 1930's (Pattison, 1984). There was a sharp increase in living standards with an increase in demands for meat and milk, so farm animals became much more valuable. Large animal veterinary practices were beginning to thrive though much of the work focused on treatment of individual sick animals. (Radostits, 1987).

In the mid 1960's veterinary surgeons and farmers were beginning to appreciate the value of taking positive action to maintain animal health and efficient production on a herd basis (Radostits, 1987). The benefits from taking early action against subclinical disease were realized. Barros (1988) showed from an abattoir survey that subclinical fascioliasis in lambs decreased production for the year at the equivalent cost of 25 percent of total variable costs for the year.

In the 1980's regular scheduled visits by veterinary surgeons to dairy farms were becoming common. In a Canadian survey in 1981 Magwood (1983) found that 80 percent of veterinary surgeons in farm animal practice spent some time involved in herd health management; ten to 20 percent of their time with dairy herds and only two to ten percent with beef suckler herds. By 1982 many dairy farmers in the United Kingdom expected and demanded routine veterinary visits (Stephens *et al*, 1982). Planned health and production on dairy herds was done by the veterinary surgeon alone (Stephens *et al*, 1982; Williamson, 1980) or by a multidisciplinary team advising on health, nutrition and management (Kelly *et al*, 1988; Fetrow *et al*, 1987).

Computerized recording systems have often been used to improve efficiency in planned health schemes. The first computer programmes were based on a central Mainframe to which farmers posted records and after analysis results were posted back (Blood, 1985), this resulted in a slow turn-round of information. These programmes often used sophisticated languages requiring a certain amount of computer knowledge to use (Blood, 1985). The Computerized System for Recording Events affecting Economically important Livestock (COSREEL) used by the Agricultural Research Council utilised Fortran IV which required coding of information by trained staff (Russel and Rowlands, 1983). The advantage of a large central Mainframe was the ability to combine information from several different areas and this may be useful for research purposes (Esslemont and Eddy, 1977; Russel and Rowlands, 1983).

A study in 1978 by the Veterinary Epidemiology and Economic Research Unit (VEERU) at Reading University exposed the need for a more comprehensive system with faster turnaround that smaller computers were more likely to provide (Stephens *et al*, 1982). The first of these programmes 'Daisy' has been marketed since 1978 (Stephens *et al*, 1982).

Most of the computer programmes use a database structure which allows the maximum flexibility in the recording of information. (Martin *et al*, 1982; Udomprasert and Williamson, 1990).

A system to link microcomputer based herd health programmes with other information such as abattoir data, market inspection results, and laboratory results from many different areas has been devised by Dohoo and colleagues at Atlantic Veterinary College, Canada. This involves a large relational database and will increase availability of data on health and production allowing collation and analysis from which results can be used as a basis for future research. (Dohoo, 1988)

1.4. PLANNED HEALTH AND PRODUCTION IN BEEF SUCKLER HERDS

With margins narrowing and specifications for the finished product tightening beef suckler herds in the UK must look to more planned systems of production (Lowman, 1985). Such Planned Health and Production schemes have been well documented in beef herds in Canada (Radostits, 1979) , America (Bitter, 1976), and Australia (Withers, 1984), since the late 1970's, and from these lessons can be gleaned.

The choice of farm is important, farmers may be ruled by more sociological rather than financial goals (Radostits, 1987), for example they are more ruled by traditions of farming and will not change to new systems to improve profitability. Some farmers may find it difficult to appreciate the interaction between nutrition, reproduction, mastitis, milk yield and calf health (Bohlender, 1983).

The initial visit should be planned carefully (Withers, 1984) as each farm is an individual and programmes should be devised to suit a particular situation (Bitter, 1976). A total farm picture must be established including tasks required in other farm enterprises to aid in management decisions (Withers, 1984). Collection and analysis of any records will help to identify any problem areas (Jordan and Bechtol, 1988; Withers, 1984).

Careful animal identification is essential if good records are to be kept (Bohlender, 1986). With the arrival in October 1990 of the new Bovine Animals (Identification, marking and breeding records) Order, which requires the marking of beef calves within seven days of birth and keeping a record of calves and their dams, farmers should become more adept at record keeping. It is useful to advise on two systems for record keeping; a pocket notebook to record all daily events, and a more permanent file with details of all cows and their offspring (Withers, 1984).

Targets should be discussed with the farmer, these are best made attainable and gradually updated towards the ideal goals (Withers, 1984; Howard *et al*, 1986).

A management calendar is a useful reminder of tasks to ensure that they are done on time. Loose leaf type calendars are often forgotten about, so it is worthwhile making a more permanent wall chart tailored to suit each farm, if this is made colourful and aesthetically pleasing it may be noticed and therefore serve its purpose (Lowry, 1985).

The veterinary surgeon often runs schemes on his own or it may be useful to organize a multidisciplinary team including nutritionists and agricultural advisors to meet on farms (Mossman and Hanly, 1984).

Client education plays a key role in evolving and maintaining programmes (Bohlender, 1986). This can be achieved by arranging regular group meetings of participating farmers (Lowry, 1985) which can take the form of minilectures or roundtable discussions (Jordan and Bechtol, 1988).

1.5. NUTRITION AND REPRODUCTIVE PERFORMANCE

The most important single demand in beef suckler herds is a high conception rate in the shortest possible breeding season (Bohlender, 1986). The commonest constraint to this is a prolonged calving interval.

Studies in cow calf herds in Southern Ontario by McDermott *et al* (1991) found that 51% of herds had no specific breeding season and only 15% of these had a breeding season of less than the two month target. In New Zealand a study from 1970-75 of 135 large breeding herds found the average breeding season was three and a half months for cows and four months for heifers (Hanly and Mossman, 1977).

Rogers *et al* (1985) found higher live birth calf crop rates in herds with calving periods of less than three months. Wittum *et al* (1990) found a higher calving rate was associated with a shorter breeding season.

Unlike dairy herds, beef herds derive most of their income from calves born into the herd, making fertility the most important trait (Prince *et al*, 1987). There are two major goals; to increase numbers of females in oestrous early in the breeding season and to improve conception rates. To meet these goals it is imperative to feed cows correctly. The importance of feeding animals to ensure regular ovarian cycles has been known for some time: Restricting both energy and protein in the diets of beef heifers stopped oestrus behaviour and ovarian activity ceased (Bond *et al*, 1958). Wiltbank *et al* (1962) found animals fed half the recommended energy levels in the diet had lower conception rates compared to those fed the recommended levels.

Many authors have found that cows are more likely to have regular oestrus cycles and to conceive if in good condition at calving (Rice, 1986; Dunn, 1980; Houghton *et al*, 1990; Graham, 1982; Corah, 1988).

1.6. CONDITION SCORE AND REPRODUCTIVE PERFORMANCE

Condition was first defined as " The ratio of the amount of fat to the amount of non-fatty matter in the body of the living animal " (Murray, 1919).

Scoring systems have been devised and used as a guide for recommending nutritional advice to farmers. In the United States and Australia there are a number of systems used with up to ten different grades. In the United Kingdom Lowman *et al* (1976) devised a system for beef cattle which defines six grades, zero to five, in terms of the amount of tissue cover over the transverse processes of the lumbar vertebrae and around the tail head. Condition scoring is a

subjective measurement so there can be variations between operators. However Evans (1978) showed that the repeatability between operators gave a high correlation of 0.7.

The relationship between condition score and chemically determined body fat is highly significant (Wright and Russel, 1984). It was been suggested that maintenance energy requirements of adult cows are determined by both live weight and body condition (Russel and Wright, 1983_a) and that this was due to the variation in maintenance energy requirements of protein and fat. In animals of the same weight but differing in body condition the thinner animals had higher maintenance energy requirements.

There are breed differences in the proportions of fat stored in the main body depots, with dairy type breeds having more intra-abdominal fat and beef type more subcutaneous fat. Wright and Russel (1984) compared various breeds and found that the Friesian was 'fattest' at any given condition, followed by the Blue Grey, Luing, Galloway, and the Hereford cross Friesian was the 'thinnest' at any given condition score. The differences were more pronounced with higher condition scores. When recommending appropriate scores to aid nutritional management genotypic differences must be taken into account.

Corah (1988) suggested that cow condition at calving was a key factor in determining the productivity of the cow so he advises to assess body condition 80-100 days pre-calving and to alter the diet accordingly. Wiltbank *et al* (1962) suggested assessing cows one to two months pre-weaning and if in very poor condition calves should be weaned early to ensure cows attain adequate condition by parturition. In the United Kingdom nutritional advice is based on the attainment of target condition scores at critical stages of the annual production cycle (Figure 1.9.).

Season	Target score	Stage of production	
	1 (thin) to 5 (fat)	Spring calver	Autumn calver
Spring	2	Calving	Pregnant/Suckling
Summer	2.5	Mating	Weaning
Autumn	3	Weaning	Calving
Winter	2.5	Pregnant/Dry	Mating

(Source: Allen, 1990_b.)

Figure 1.9. Target condition scores for beef suckler cows.

The prepartum diet will influence condition at calving. If animals are fed to lose weight prepartum the subsequent conception rates will be reduced (Selk *et al*, 1988). If cows are fed to be in good condition at calving the post partum diet will have little effect on interval from calving to first oestrus (Post Partum Interval, PPI) (Richards *et al*, 1986).

Several authors found that cows on a low energy prepartum diet resulting in low condition scores at calving had longer PPI regardless of energy offered postpartum. (Wiltbank *et al*, 1962; Richards *et al*, 1986; Houghton *et al*, 1990). One reason for this was suggested by Downie and Gelman (1976) who found that those in good condition at calving were able to utilize body tissue to compensate for restricted intakes.

However, good body condition at calving does not in itself ensure optimal reproductive efficiency; studies on cows that calved in good condition and then fed on suboptimal energy levels from calving through mating, so that they lost

weight, found lengthened intervals from calving to first oestrus (Rakestraw *et al*, 1986) and reduced conception rates (Rakestraw *et al*, 1986; Somerville *et al*, 1979).

1.7. THE PHYSIOLOGICAL EFFECT OF DIET ON REPRODUCTION

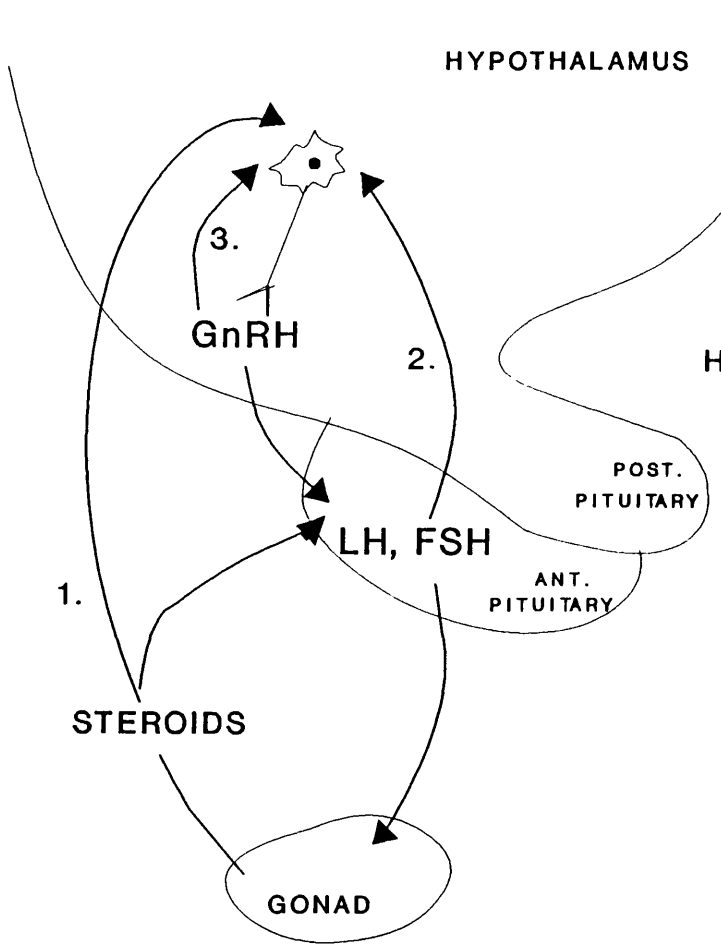
Studies have been done to investigate the effect of diet on fertility by looking at ovarian function and the activity of the gonadotrophins.

The initiation of ovarian activity is dependent on the secretion of the Gonadotrophins (GnTs), Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH), from the anterior pituitary gland. The secretion of Gonadotrophin Releasing Hormones (GnRH) which stimulates secretion of the GnTs is pulsatile. Stores of hormone in hypothalamic nerve terminals are released by rhythmic and synchronous firing of endocrine neurones (Karsch, 1984). There is usually a gradual increase in frequency of pulsatile release of the GnTs as time postpartum proceeds (Nolan *et al*, 1988).

Steroid hormones produced by the ovaries act on the hypothalamus and the anterior pituitary to regulate the secretion of the GnTs. In cycling animals the FSH stimulates the development of follicles which in turn secrete Oestradiol. Follicles secrete increasing amounts of Oestradiol as they grow and when the 'dominant' follicle is mature the amounts of Oestradiol are large enough to exert positive feedback on the hypothalamus and anterior pituitary and induce a massive surge of LH which induces ovulation (Baird, 1984). See Figure 1.10. for an illustration showing how gonadotrophin secretion is regulated.

Rasby *et al* (1986) found that very thin animals had lower weights of ovaries, corpora lutea and follicular fluid compared to those in moderate condition. Prado *et al* (1990) found a greater proportion of cows fed to maintain adequate

GONADOTROPHIN SECRETION AND ITS CONTROL



FEEDBACK ON THE HYPOTHALAMIC-PITUITARY-OVARIAN AXIS .

1. LONG LOOP
2. SHORT LOOP
3. ULTRA SHORT LOOP

Figure 1.10. Gonadotrophin secretion and its control.

condition had a large, healthy, highly oestrogenic follicle at nine weeks postpartum compared to those fed to maintain a poorer condition. These findings suggest that inadequate nutrition affects ovarian function, which may be a result of changes in GnT secretion.

There have been many studies looking at LH activity in cows on restricted diets. Parameters in the experiments have varied enormously which may have led to the variations encountered in the results. When looking at basal LH levels it must be remembered that release is pulsatile and that the frequency of pulse release increases in time postpartum (Nolan *et al* , 1988). LH synthesis has been inhibited by high oestrogen levels in late gestation so stores are depleted at parturition and maximum stores will not be reached till three or four weeks postpartum (Williams, 1990), after which any variations in basal LH levels will be more obvious.

Lactating animals will often have inhibited LH pulses, as will be discussed later, which may also confound results. Condition at the beginning of studies is important to consider as those in good condition are able to utilize body tissue to compensate for restricted intakes (Downie and Gelman, 1976; Beal *et al*, 1978).

The degree of nutritional restriction will also influence results. Richards *et al* (1989_a) and Whisnant *et al* (1985) found lower basal LH levels on an energy restricted diet. However Harrison and Randel (1986), Spitzer *et al* (1978) and Rutter and Randel (1984) found no differences in mean LH concentrations between those fed on adequate or restricted diets. Prado *et al* (1990) found no significant differences in basal LH concentrations in those fed to maintain adequate body condition (ave. 2.8) compared to those fed to maintain a low body condition (ave. 2.35).

Looking at frequency of LH pulses in cows on restricted postpartum diets results seemed more consistent, those on both low energy (Richards *et al*, 1989_a; Whisnant *et al*, 1985) and low protein (Nolan *et al*, 1988) diets had a decrease in

frequency of LH surges. So it is felt that there is either an inhibition of GnRH release from the hypothalamus or that the anterior pituitary is reduced in responsiveness.

Studies looking at the responsiveness of the anterior pituitary after an intramuscular injection of 100mg of exogenous GnRH found that those on both energy (Rutter and Randel, 1984) and protein (Nolan *et al*, 1988) restricted diets had a decrease in LH response. Whisnant *et al* (1985) gave a dose of 200mg intravenously and found the LH response was greater in those fed low energy diets than those on high energy diets. Troxel *et al* (1980) found that giving increasing doses of GnRH increased the LH response and that giving the GnRH intramuscularly gave a more rapid and higher response than giving it subcutaneously. The high dose given intravenously by Whisnant *et al* (1985) may have stimulated release of LH from total stores of granules in the anterior pituitary as well as the readily available stores lying near the receptors in the plasma membrane. This suggests that total stores could be greater when on a low energy diet due to decreases in pulsatile release. Nolan *et al* (1988) injected large doses of Oestradiol to induce an LH surge and found that those on a protein restricted diet had similar responses to those on adequate diets. So the ability of the hypothalamic and anterior pituitary receptors to react to stimuli seemed unaltered. Nolan *et al* (1988) also found the numbers of GnRH receptors in the anterior pituitary were similar on restricted and adequate diets.

LH pulses are induced by GnRH whose release is controlled by the pulse generator of the hypothalamus. The activity of the pulse generator is regulated by many internal and external factors. There is feedback from gonadal, pituitary and hypothalamic hormones (Karsch, 1984). Echternkamp (1984) found a decrease in pulsatile release of LH in cows put in a crush, haltered and bled from the jugular vein, whereas those previously exposed to this procedure were less affected. This is thought to be an inhibition of presynaptic release of GnRH

either directly or indirectly by corticotrophin releasing factor (Weiner *et al*, 1988). Tactile, olfactory and visual stimuli affect plasma LH levels in rats (Karsch, 1984). The pineal gland responding to changes in day length exerts an effect on the GnRHs via the release of indoles and peptides into the systemic circulation. (Lincoln, 1984; Turek, 1979).

It has been suggested that changes in circulating biochemical parameters as a result of altered nutrition may act on receptors of the hypothalamic-pituitary-ovarian axis to suppress reproductive performance (Randel, 1990); however there is no evidence as yet to support this theory.

McClure (1970) found significantly lower blood glucose levels in cows with low conception rates compared to those with higher conception rates. In experiments in which blood glucose levels were iatrogenically lowered with insulin (McLure, 1968) and with the metabolic inhibitor 2-deoxy-D-glucose (McClure *et al*, 1978), it was found that, using insulin, oestrous intervals lengthened and conception rates were reduced, and, using 2-deoxy-D-glucose corpora lutea were not formed and there was no oestrus observed, nor were classical changes detected by rectal examination and peripheral progesterone levels were unchanged.

Downie and Gelman (1976) found that cows on a restricted postpartum diet continued to lose condition and although blood glucose levels declined initially, after four weeks on a restricted diet they began to rise again. When glucose levels were rising cows showed an increased incidence of fertile heats.

Selk *et al* (1988) found poor correlations between blood glucose levels and conception rates. An explanation for the discrepancies in these findings may be the degree of energy restriction in each study ; blood glucose is under very good homeostatic control so is relatively insensitive to nutritional change (Russel and Wright, 1983_b; Payne and Payne, 1987).

More recently workers have used other blood parameters as an indirect means of assessing energy status. All of these, including glucose act as indices of under-nutrition not magnitude of energy surplus (Payne and Payne, 1987).

In periods of very high energy demand excess ketone bodies (acetone and (Beta-hydroxy-Butyrate) are produced from Acetyl coenzyme A. They are limited in their usefulness to periods of very high energy demand ie. to those at peak lactation or those in late gestation. Their range is very limited (from 0.20 - 0.24 mmol/l) at other times so they have not proven as useful in assessing nutritional status in early postpartum beef cows (Russel and Wright, 1983_b).

The most sensitive indicators of energy status that have been used are blood non-esterified fatty acid (NEFA) levels. Richards *et al* (1989_b) fed restricted diets to non-lactating beef cows displaying normal oestrus until they became anoetrus when they found elevated blood NEFA levels. When body fat is mobilized triglycerides are broken down by lipolysis to glycerol and NEFA which are transferred to the liver where they are used as energy reserves (Payne and Payne, 1987). An increase in NEFA follows rapidly after any nutritional change. This rapid response results in one of their drawbacks, diurnal variation, this is less pronounced in grazing animals where there is a more continuous intake. NEFA levels are sensitive to circulating catecholamines (Russel and Wright, 1983_b). and they also have a very short half life in plasma so rapid analysis is essential.

There have been many other blood parameters studied and found not to be very useful indices of energy status (Huszenicza *et al*, 1988).

It is clear that the interval from parturition to first oestrus in milked and suckled cows is longer than in nonlactating cows (McNeilly, 1988); suckling causes a longer interval compared to that in those milked once or twice daily (Wiltbank and Cook, 1958). Cows suckling two calves have longer intervals from parturition to first oestrus than those suckling one calf (Wettemann *et al*, 1978).

The recovery of postpartum pulsatile release of LH is delayed in suckling animals, who have lower basal LH concentrations and lower pulse frequencies of LH release than in weaned cows (Walters *et al*, 1982; Williams *et al*, 1983; Peters *et al*, 1981; Forrest *et al*, 1979). This implies that suckling interferes with release of GnRH from the hypothalamus and/or that the pituitary gland is unable to respond to GnRH stimulation.

Williams *et al* (1982) found similar responsiveness to GnRH stimulation in suckled and non suckled cows. Walters *et al* (1982) found no differences in pituitary weights nor in LH or FSH concentrations in the pituitary between weaned and suckled cows. These findings imply that suckling influences GnRH release and since GnRH activity is under the control of the hypothalamic pulse generator it may be that suckling has some influence on the generator.

Studies in suckling rats have implicated neurotransmitters as inhibitors of LH secretion, including serotonin, dopamine and endogenous opioid peptides. (Gallo, 1981). More recent studies in cattle have looked at the use of naloxone, an opioid antagonist in suckled anoestrous cows. Whisnant *et al* (1986_a) found that infusions of naloxone increased the frequency of LH pulses and increased basal LH concentrations in serum. Whisnant *et al* (1986_b) found again that naloxone treatment in suckling cows increased serum LH concentrations, however treatment failed to increase LH concentrations in those whose calves were removed for 48 hours. This suggests that suckling may stimulate endogenous opioids that inhibit LH secretions and the removal of suckling removes the opioid inhibition. Malven *et al* (1986) found that cows weaned five weeks postpartum had similar changes in GnRH and opioid peptide concentrations in the neural tissue of preoptic and hypothalamic areas.

The mechanism to stimulate changes in endogenous opioids is unknown. It has been suggested that stimulation of the teats may induce stimuli via the spino-cervical tract. However it has been impossible to induce changes in LH

levels via manual stimulation (Williams, 1990), nor with the presence of a muzzled calf and hand milking (Williams, 1990). It seems the calf itself must suckle to exert an effect.

It had been suggested that high prolactin levels in suckling cows may play a role in inhibition of ovarian activity as in the ewe (Kann *et al,* 1978). It is known that hyperprolactaemia in man and rats inhibits GnRH release (Weiner *et al,* 1988). However several studies have shown that prolactin levels in suckling cows are similar to those in weaned and milked cows. (Smith *et al,* 1981; Williams , 1990; McNeilly, 1988).

There seems to be an additive effect of inhibition of ovarian activity in suckled cows and those on a restricted diet (Whisnant *et al,* 1985; Rice, 1986). Weaning nutritionally restricted anoestrous cows will improve conception rates , (Spitzer, 1986), the benefits are especially marked in very young and very old cows (Laster *et al,* 1973; Fogwell *et al,* 1986).

1.8. CALF PERFORMANCE

1.8.1. PERINATAL MORTALITY

Patterson *et al* (1987) found in a survey of 13,296 beef suckler calves born over a period of 15 years that 75% of calf deaths from birth to weaning were within the first week of life. In the same study Bellows *et al* (1987) found that losses as a result of dystocia exceeded all other causes of death. Laster and Gregory (1973) found that calf losses at or near the time of birth were four times greater ($P < 0.01$) in calves experiencing dystocia (20.4%) compared to those not experiencing dystocia (5.0%).

Dystocia is to a large extent a consequence of incompatibility between the size of a calf and the size of its dams pelvic opening (Philipsson *et al*, 1979; Mennisier, 1975). An important maternal factor influencing dystocia rate is parity and the most important calf factor is birth weight (Philipsson, 1976; Menissier, 1975). Many other factors will influence dystocia; Dufty (1981) found those confined to a pen when calving had higher dystocia rates compared to those calving in a paddock and that the continuous presence of an observer was associated with increased dystocias. However it was found that the presence of an observer led to a decrease in stillbirths in those experiencing dystocia (Dufty, 1981; Hodge *et al*, 1982).

Dystocia has negative effects on subsequent fertility of the dam (Laster and Gregory, 1973; Philipsson *et al*, 1979). It is important to choose appropriate breeds when mating, especially heifers, by including selection for gestation length, birth weight and pelvic measurement (Philipsson, 1976; Menissier, 1975).

The second most common cause of death in calves from birth to weaning is disease, especially diarrhoea and pneumonia (Bellows *et al*, 1987). Calves

deprived of colostrum are especially susceptible to infections (Gay *et al*, 1965; McBeath *et al*, 1971). In a study of calf pneumonia by Davidson *et al* (1981) it was found that calves with serum immunoglobulin less than 4,000 mg/100ml (as measured by radial immunodiffusion assay) at 3-6 days of age had higher morbidity and required treatments earlier and more frequently than those with immunoglobulin values greater than 4,000 mg/100ml. Irwin (1974) found higher mortality rates from salmonellosis in calves with low immunoglobulin levels.

The most important factors determining levels of passive immunity attained from ingested colostrum are age at first feeding and quantity consumed (Selman, 1969; Kruse, 1970; Stott *et al*, 1979_b). There is a progressive decline from birth in the ability to absorb immunoglobulins (Selman, 1969); IgM can be absorbed up to around 16 hours after birth, IgA up to 22 hours and IgG up to 27 hours (Penhale *et al*, 1973). However this cessation of absorption is influenced by the time of the first feed, as feeding is delayed closure is delayed, up to the time of spontaneous closure which is around approximately 24 hours (Stott *et al*, 1979_a). The rate of absorption will decrease in calves exposed to very low environmental temperatures (Olson *et al*, 1980).

Breed of dam will influence colostrum yield with dairy crosses producing larger quantities than pure bred beef breeds (Petrie *et al*, 1984). The nutrition of the dam in late gestation will influence quantity of colostrum but does not seem to affect concentration of immunoglobulins (Logan ,1977). However Blecha *et al* (1981) found evidence to suggest that absorption of the IgG_1 and IgG_2 isotypes may be delayed by decreased crude protein in the dams diet in late gestation.

Management factors play a major role in influencing serum immunoglobulin levels in calves (Selman, 1969). Homebred dairy and market calves had significantly lower plasma immunoglobulin levels compared to suckler calves (McBeath *et al*, 1971). Selman *et al* (1971_a) found that dairy calves born outdoors had significantly higher serum immunoglobulins compared to those

born indoors. Calves from older cows had lower immunoglobulin levels than those from younger cows, this seemed to be associated with poor udder conformation in the older cows (Logan and Gibson, 1975). Mothering per se increases the rate of absorption of immunoglobulins (Selman *et al*, 1971_b).

In spite of the fact that suckler calves are exposed to many beneficial management factors surveys have revealed that suckled calves are often hypogammaglobulinaemic. Logan *et al* (1974) found 23% calves from a suckler herd were hypogammaglobulinaemic and in a later study of a larger group of herds he found that 26% of the calves were hypogammaglobulinaemic (Logan and Gibson, 1975). A study of a herd of 90 beef cows by Houston (1990) found 69% calves to be hypogammaglobulinaemic. Therefore in suckler herds a high standard of stockmanship is necessary to ensure all calves receive adequate colostrum at birth (Logan *et al*, 1974).

1.8.2. CALF PERFORMANCE FROM BIRTH TO WEANING

Breed

The growth potential of a calf is highly dependent on its breeding. The breed of cow will influence both the birth weight and live weight gain (Wilkinson and Tayler, 1973). Small hill breeds have been bred for hardiness at the expense of productivity, producing lightweight calves with low growth potential. Crossbred cows of similar body weight to purebred cows will produce calves with larger birthweights and higher liveweight gains from birth to weaning (Rollins *et al*, 1969).

Sire breed has a major effect on calf growth rates (Figure 1.11.). Breed advantages are seen in all systems however the margins of superiority decline as the environment deteriorates as can be seen when comparing lowland and hill herds in figure 1.11. (Allen, 1990).

There is potential for improved performance using different sires within breeds. This opportunity was first exploited in the early 1930's in the United States when performance testing of bulls was started. Bull calves with the highest live weight gains, on a standard diet and kept in the same environment, were mated with cows and the offspring from these crosses were treated as their sires. This resulted in an improvement in live weight gains in the calves from an average of 0.85 kilograms liveweight per day to 1.05 kilograms liveweight per day in just three years (Black and Knapp, 1936). The first performance testing of bulls in the United Kingdom was done in Herefords in 1964, by the early 1970's all major breeds were being performance tested (Wilkinson and Tayler, 1973).

Sire Breed	Type of herd:	Lowland	Upland	Hill
		Calf 200-day weight (kg)		
Charolais		240	227	205
Simmental		232	222	198
South Devon		231	221	200
Sussex		215	207	186
Limousin		215	204	186
Hereford		208	194	184
Angus		194	182	176

(Source- MLC)

Figure 1.11. Effect of sire breed on calf 200-day weight in commercial beef suckler herds.

Milk Intake

Many workers have shown a significant correlation between milk yield of dam and calf pre-weaning live weight gains (Anderson *et al*, 1986; Beal *et al*, 1990; Alencar and Mello-de-Alencar; 1987; Butson and Berg, 1984). This is particularly important in early life when the calf is wholly dependent on its mother for food. Rahnefield *et al* (1990) found the average yield of the dam accounted for 58% of the variation of calf live weight gain during the early lactation period. Sommerville *et al* (1983) found that for every one kilogram increase in milk yield per day over 150 days there was an increase of nine (+/- 1.3) kilogram in the 150 day weight of the calves.

Milk yield is partly determined by breed, dairy crosses produce higher yields than beef breeds; Russel *et al* (1979) found Hereford cross Friesian cows had higher yields than Galloway cross Beef Shorthorns. There is positive heterosis among beef breeds for milk yields with crossbred cows producing higher yields than purebred cows (Cundiff *et al*, 1974; Gregory *et al*, 1965) and within each breed there is a range of 'milkiness' (Hodgson *et al*, 1980).

Age of dam will influence milk yield and therefore calf weaning weights (Rutledge *et al*, 1971; Leighton , 1980). Yields increase over the first three lactations, remain fairly similar for the next three lactations, after which they decline (Robison *et al*, 1978). Peak yield is around eight years of age (Rutledge *et al*, 1971).

Cows fed less energy will have lower milk yields than those on better diets so calf live weight gains are poorer (Peart *et al*, 1978). Sommerville *et al* (1983) found that as the energy content of the cows' diet was increased over the first 150 days of lactation calf performance improved.

Respiratory Disease

As farmers have moved to more intensive systems of production there has been an increase in incidence if respiratory diseases in calves. Morbidity rates tend to be high and mortalty rates are very variable depending on the pathogens involved (Roy, 1990) and on stockmanship (Gibbs, 1985). Palotay and Newhall (1958) found morbidity rates of 44% and mortality rates of 5.6% in a study of 1000 recently weaned range calves. Gibbs (1985) found that morbidity and mortality rates due to pasteurellosis seemed to be higher in suckled calves at foot (26.7% and 3.7% respectively) compared to weaned calves (10.7% and 0.2% respectively). Many of the weaned calves in the study were bought in so may have been heterogenous with regard to exposure to *Pasteurella haemolytica* whereas the suckled calves were homebred so would be more homogenous.

The actual pathogens involved in pneumonia outbreaks can vary. Gibbs *et al* (1983) found *Pasteurella haemolytica A1* was the commonest isolate in 83% of animals in 17 outbreaks of respiratory disease in weaned suckled calves in Scotland. Jensen *et al* (1976_a) also found pasteurella species were the commonest isolates from feedlot pneumonias in Colorado finding them in 62% of 354 lungs examined post mortem.

In studies of antibodies in paired serum samples many viruses have been implicated as the cause of outbreaks of respiratory disease including Respiratory Syncytial Virus (RSV), Bovine Parainfluenza 3 virus (PI3), Bovine Herpesvirus 1-Infectious Bovine Rhinotracheitis (IBR), Bovine Viral Diarrhoea/Mucosal Disease Virus (BVD) and Bovine Adenoviruses (BAV) (Bryson, 1985). Respiratory Syncytial Virus and Parainfluenza 3 virus were the commonest pathogens isolated in two studies in the United Kingdom; the first was in England and involved eight outbreaks in calves less than six months old (Thomas *et al*, 1982) and the second was a study of 50 outbreaks in Northern Ireland

(Bryson *et al*, 1978). In the latter study in 20 % of the outbreaks more than one virus was implicated. Similar results were found in a study of an outbreak of respiratory disease in weaned suckled calves in Iowa by Lehmkuhl *et al* (1977) who found RSV and PI3 to be the commonest pathogens to which there was seroconversion and in 28.7% of calves there was seroconversion to more than one virus.

Most outbreaks occur in recently housed calves with clinical signs developing within 45 days of housing; Gibbs *et al* (1983) - 4 weeks; Andrews *et al* (1981) - 3 weeks; Jensen *et al* (1976_b) - 45 days. This is thought to be related to housing cattle together in a confined space (Gibbs, 1985) and to poor housing conditions leading to high humidity, severe temperature fluctuaions or a build up of ammonia (Bryson *et al*, 1978).

There have been outbreaks reported in single suckled calves at foot while at grass. Wiseman *et al* (1976) reported an outbreak of pasteurellosis in a group of 6-14 week old calves after a spell of inclement weather.

Parasites

Although clinical parasitic gastro-enteritis is uncommon in single-suckled calves, subclinical infections may lead to poor calf performance.

Spring and summer-born calves do not begin to graze until overwintered larvae are at a low to negligible level on the pasture and only very small infections will arise from the larvae from eggs passed by cows periparturiently. Autumn and winter-born calves on the other hand acquire sufficient infection from overwintered larvae to yield large egg outputs, this is diluted when they are grazing with dams. When the calves are weaned there can be a potentially dangerous build up of larvae on the pasture, this is more a problem in

autumn-born rather than winter-born calves who are weaned later. (Michel *et al,* 1972). Preventive measures are required especially for autumn- born calves (Armour and Urquart, 1974). In farms with very low stocking rates and abundant pasture where worm burdens will be minimal it may be unnecessary to use preventive anthelmintics (Hildersen *et al,* 1990).

The situation for parasitic bronchitis is similar to that for parasitic gasto-enteritis in that spring born calves, grazing with dams, do not commonly develop clinical signs, however autumn born calves especially after weaning ingest increasing numbers of infective larvae developing clinical disease in september and october. Preventive measures should be undertaken to prevent problems in autumn and winter born calves (Armour and Urquart, 1974). Disease often coincides with calf sales and parasitic bronchitis is often an important complicating factor in diagnosis of respiratory disease in recently purchased weaned single suckled calves.

Trace elements

Deficiencies of trace elements are commonly encountered in beef suckler herds due to their reliance on home grown fodder.

The most significant economic losses attributable to deficiencies of trace elements arise due to decreased growth rates or to increased susceptibilty to other diseases. Supplementing calves known to be deficient in copper (Naylor *et al,* 1989), cobalt, (Quirk and Norton, 1982) and selenium (Spears *et al,* 1986) resulted in an increase in weaning weights compared to untreated controls. An increase in incidence of cerebral cortical necrosis was found in sheep deficient in cobalt (Macpherson *et al,* 1976). This was thought to be due to a decrease in rumenal microflora which require cobalt for growth and division (Sanders, 1989).

Diagnosis of deficiencies has traditionally been by laboratory investigation of soil, herbage or the grazing animal, however associations between soil and herbage composition and marginal or functional deficiencies in the grazing animal have not been well defined (Suttle, 1986). It is more reliable to use samples from a representative sample of grazing animals at suitable times to anticipate and avoid lost production (Suttle, 1986).

Methods for treatment and prevention of deficiencies include applications to pasture, supplementation of feed or water and treatment of animals (SAC, 1982). Measures should be taken to provide the cheapest and most practical system to improve the trace element status of each farm. The most popular methods for animal supplementation tend to be those which have the most sustained effects so obviating the need for frequent handling of animals. There are now sustained release boluses available containing the trace elements which many farms have deficiencies of and a number of other less important trace elements and vitamins ('All Trace'- Agrimin, UK, Grimsby.). Two boluses are administered which lie in the reticulorumen where they release material partly by solution and partly by mutual erosion until the bolus weight falls to approximately 15g when they are passed down the digestive tract , they remain in the rumen up to 240 days (Lawson *et al,* 1990).

CHAPTER 2.

MATERIALS AND METHODS

2.1. FARM DETAILS

The farms in this study were all in Lanarkshire, Scotland and were clients of the Glasgow University Veterinary Practice in Lanark or clients of other veterinary practices in the area. Farms were selected on the basis of a having a variety of husbandry systems and levels of herd mangement, a wide range of current problems and the likelihood of good farmer co-operation.

Background information was obtained before the initial visit by the use of a questionnaire (Figure 2.1.)

After the questionnaires were returned and the information evaluated initial visits were planned at a time suitable to the farmer and when discussions could take place without interruptions.

The purpose of this initial visit was to discuss the aims of the farmer together with how the planned health and productivity work would help him to fulfil these aims. A total farm picture was established including details of other farm enterprises. Any previous farm records were collected for photocopying and analysis. At this meeting certain basic requirements were requested, firstly that individual animals should be clearly identified using tags or freeze-brands that could be read at a distance which would to enable useful records to be kept, and that the farmer should carry a pocket notebook where daily events could be recorded. A more permanent file (Figure 2.2.) was given to farms which could be

A. Total number of cows _____

Nos. of each breed 1. _____

2. _____

3. _____

4. _____

5. _____

Ages of cows: Nos. of heifers _____

Nos. in lactation 2-5 _____

Nos. in lactation 6+ _____

B. Total numbers of bulls _____

Nos. and ages of each breed

	Breed	No.	Ages
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____

C. Calving pattern

	Spring	Autumn	Other (Specify)
Date of start			
Date of end			
Total nos. calving			
Nos. calving: Wks 1-3			
Wks 4-6			
Wks 7-9			
Wk 9+			

Figure 2.1.a. Questionnaire on general farm information.

D. Calf details:

Total nos. of calves born _____

Numbers born alive _____

Numbers died in first week _____

Numbers died from 7d - 1 mo. _____

Numbers died from 1 mo.- Wean. _____

Numbers died from weaning to finishing _____

E. Fate of calves:

1. Sold as stores? Approx. weight _____

   Time of year _____

2. Finished? Approx. weight _____

   Time of year _____

Do you way calves ? _____

If so , when ? _____

Figure 2.1.b. Questionnaire on general farm information. (continued).

CALVING DATE	COW NUMBER	CALVING NOTES	BULLING DATE 1ST	BULLING DATE 2ND	PD RESULT	ANY OTHER COMMENTS	CALF NUMBER	CALF SEX	CALF WEIGHTS AT BIRTH	CALF WEIGHTS AT WEANING	OTHER

Figure 2.2. Recording sheets given to farmers in loose leaf files.

regularly updated from the notebook.

From the information gained in the first visit a management calendar was created for each farm (Figure 2.3.), this was designed to be displayed in the farm office as a quick reminder of tasks.

Each farm had very different aims and husbandry systems so future visits were tailored to suit these individual needs. On farms with extended calving intervals and many disease problems visits were sometimes necessary at least once a week especially during disease outbreaks. On other farms where there were few disease or management problems routine monitoring to assess subclinical problems was all that was required, three or four visits per year were arranged to coincide with pregnancy diagnosis, calf weaning, calving and when animals were indoors.

After every visit a written report was sent to the farmer. The report included a summary of what was discussed, any relevent laboratory results and appropriate comments and advice. Once a year a summary report was sent which was essentially a resume of the year's events.

MANAGEMENT CALENDAR FOR AUTUMN CALVERS: 1990

	COWS		CALVES
SEP	Calving starts	Mag mins + silage	Bovicoppa and Deposel at birth Dress umbilicus, weigh + tag.
OCT	Rotavec K99 later calvers		Disbud 7-9days old
	----------HOUSING-		
NOV	Ivomec as house + Cond. Score Feed high Copper min		
DEC	Bull in Calving ends		Creep feed calves
JAN			
FEB	Bull out		
MAR			Castrate non-pedigree calves
APR	Pregnancy diagnosis + Cond. Score		
	----------TURN-OUT-		
MAY		Mag mins	Autoworm as put out Creep feed Pedigree calves
JUN			
JUL			
AUG	Weaning-Leo red i/mamm + Cond. Score		Weigh calves

Figure 2.3. Example of one of the farm management calendars.

2.2. ROUTINE MONITORING

2.2.1. THE COLOSTRAL STATUS OF CALVES

During the herd calving period blood samples were collected regularly from the jugular vein of calves into 7ml plain vacutainers (Becton, Dickinson UK Limited, Oxford. (B-D)), within 72 hours of birth, to assess immunoglobulin status using the Zinc Sulphate Turbidity method (McEwan *et al*, 1970). These were analysed by the Department of Veterinary Medicine, Glasgow University Veterinary School (G.U.V.S.).

2.2.2. CALF WEIGHTS

Calves were weighed within a few hours of birth using bathroom scales. Older calves were weighed using standard cattle weigh crates where available. On one of the farms a weigh crate was not available so a Cattle and pig weighing tape (Dalton Supplies Ltd., Nettlebed, Henley-on-Thames, Oxon, England) was used. This was found to be accurate to within 10 kgs when checked against a weigh crate.

2.2.3. PARASITES

Faecal samples were collected from autumn and winter born calves every month throughout the summer and autumn and from spring born calves in autumn. These were submitted to the Department of Veterinary Parasitology, G.U.V.S. for parasitological investigation. Samples were examined for worm eggs and coccidial oocysts using the McMaster method (Gordon and Whitlock, 1939) and for lungworm larvae using a modified Baerman technique (Henriksen, 1965).

2.2.4. CONDITION SCORING

Cows were condition scored at turn-out, before housing and when being handled for other tasks, eg. pregnancy diagnoses. This was done using the technique described by Lowman *et al*, (1976) to assess the amount of fat cover over the transverse processes of the lumbar vertebrae. Animals were scored from one (very thin) to five (very fat) (see Figure 2.4.).

2.2.5. TRACE ELEMENTS

The trace element status of both cows and calves was assessed on three or four occasions over the first year of the study. Samples were taken approximately a month after any nutritional change ie. after housing, while grazing in the summer and in autumn when the pasture was sparse. Clotted samples for Vitamin B12 analysis were collected into 7ml plain vacutainers (B-D). Samples for copper

Score 0.	The animal is emaciated with the hip bones, tail head, ribs and spinous processes projecting prominently. No fatty tissue can be detected and the neural spines and transverse processes feel sharp.
Score 1.	The hip bones, tail head and ribs are still prominent but appear less obvious and feel less sharp when touched. There is no fat around the tail head and individual spinous processes are still fairly sharp to the touch.
Score 2.	There is still some fat cover around the tail head, over the hip bones and the flank. Individual ribs can still be felt with slight hand pressure but are no longer visually obvious. The spinous processes can be identified individually when touched, but feel rounded rather than sharp.
Score 3.	The areas on either side of the tail head now have a degree of fat cover which can be easily felt.The hip bones are less prominent and feel more rounded, as are the spinous processes, which can be felt only with firm pressure and are smoother than in condition score 2.
Score 4.	Fat cover around the tailhead is evident as slight 'rounds', soft to the touch; while the hip bones are covered with tissue and no longer feel hard. The spinous processes cannot be felt even with firm pressure and folds of fat are beginning to develope over the ribs and thighs of the animal.
Score 5.	The bone structure is no longer noticeable and the animal presents a 'blocky' appearance. The hip bones and tail head are almost completely buried in fat tissue and folds of fat are apparant over the ribs and thighs. The spinous processes are completely covered by fat and the animal's mobility is impaired by the large amount of fat carried.

(Source: Lowman *et al,* 1976)

Figure 2.4. Condition scoring of beef cows

and selenium estimations were collected into 10ml lithium heparin vacutainers (B-D).

Copper and Selenium levels were assessed by the Department of Veterinary Animal Husbandry, G.U.V.S.. Plasma copper was analysed by a modification of a method described by Evenson and Warren (1975) on a Model No. 2380 Perkin-Elmer AA analyser with an HG400 programme. The activity of the selenium containing enzyme Glutathione peroxidase (GSHPx) was used to assess selenium status and, since over 90 percent of blood GSHPx activity is in red blood cells, levels in whole blood were assessed. This was done using a 'Ransel' kit (Randox laboratories) which used an ultraviolet technique (Paglia and Valentine, 1967). Serum Vitamin B12 levels were used as an indication of Cobalt status. This analysis was done by the Vitamin B12 laboratory at the Scottish Agricultural Colleges, West of Scotland Veterinary Investigation Centre, Auchincruive, Ayr. This laboratory was using a microbiological method to analyse samples using *Lactobacillus leishmania.*

The results obtained allowed the design of soil or animal treatment strategies tailored to individual farms to alleviate trace element deficiencies in the cattle. When topdressing of pastures with deficient trace elements was considered soil samples were analysed to assess levels of the deficient elements and other components which would influence the uptake of these elements into plants ie. pH, sulphur, molybdenum, manganese, etc. Several samples were collected from each field assessed and pooled samples from each field were analysed by the Department of Veterinary Animal Husbandry, G.U.V.S. Analyses were done using standard methods (Ministry of Agriculture, Fisheries and Food, 1981).

2.3. DISEASE OUTBREAKS

2.3.1. NEONATAL CALF DIARRHOEA

Further investigations into the aetiology of diarrhoea outbreaks were instigated if more than one calf was affected. The immunoglobulin status of affected calves and of all calves less than 72 hours of age was assessed. Faecal samples were collected from diarrhoeic calves before any treatments wherever possible.

Blood samples were collected from the jugular vein of calves into 7 ml plain vacutainers (B-D) and immunoglobulin levels were estimated by the Department of Veterinary Medicine, G.U.V.S. as described previously.

Faecal samples were submitted to the Department of Veterinary Pathology, G.U.V.S. for examination for the common bacterial enteric pathogens. Samples were screened for Rotavirus using an Enzyme Linked Immunosorbant Assay (ELISA) test kit ('Rotascreen'- Mercia Diagnostics Ltd., Brocades House, West Byfleet, Sussex) and *Cryptosporidium parvum* was looked for in direct smears stained using a modified Ziehl Neelsen technique (Casemore *et al*, 1985).

Faecal samples were submitted to the Scottish Agricultural Colleges, East of Scotland Veterinary Investigation Centre, Bush Estate, Penicuik where they were screened for Coronavirus using an ELISA test kit.

2.3.2. DIARRHOEA IN OLDER CALVES

Where one or more grazing calves had soft or watery faeces for more than a few days faecal samples from affected calves and from a random sample of

unaffected calves were sampled (a minimum of ten percent of a group). These were submitted to the Department of Veterinary Parasitology, G.U.V.S. where they were assessed for worm eggs, coccidial oocysts and lungworm larvae as described earlier.

2.3.3. DIARRHOEA IN ADULTS

Where animals over eighteen months of age had diarrhoea persisting for more than a few days faecal samples were submitted for routine parasitology as described above and faecal smears stained by a Ziehl Neelsen technique (Cunningham and Gilmour, 1959) were examined for *Mycobacterium paratuberculosis.*

2.3.4. BOVINE VIRUS DIARRHOEA / MUCOSAL DISEASE

Individual calves which failed to thrive or those with persistent diarrhoea, and/or oral and/or interdigital ulceration were investigated for infection with Bovine virus diarrhoea/Mucosal disease (BVD/MD). Blood samples were collected into 10ml lithium heparin vacutainers (B-D) for assays of BVD/MD antigen and antibodies using ELISA techniques. These assays were performed by the Department of Diagnostic Virology, Moredun Research Institute, Gilmerton Rd., Edinburgh.

2.3.5. RESPIRATORY DISEASE

When groups of calves had reduced feed intakes, began to cough frequently, looked dull, had increased respiratory rates or nasal discharges respiratory disease was suspected and investigated. After clinical examination of affected animals clotted blood samples were collected into 7ml plain vacutainer tubes (B-D) from the jugular vein of representatively sick animals, a minimum of ten calves was sampled. The samples were centrifuged at 1500 x g for 15 minutes, the sera pipetted into plastic bijou bottles, and stored at -20 c. The same animals were resampled approximately two weeks later. The identified paired samples were sent to the Department of Diagnostic Virology at the Moredun Research Institute, Gilmerton Road, Edinburgh where antibody titres to Bovine Herpesvirus 1, Bovine Respiratory Syncytial and Parainfluenza 3 viruses were measured using ELISAs.

Nasopharyngeal swabs (Human laryngeal swabs, Medical Wire and Equipment Co. Ltd, Corsham, Wilts.) were collected at the same time as the first blood samples and submitted to the Department of Veterinary Pathology, G.U.V.S. for microbiological examination for the common bacterial respiratory pathogens.

2.4. RECORDING DATA

Storage and analyses of all farm records and laboratory results was done using 'The Smart Software System' (Innovative Software, Inc.). Each farm had a group of databases where details for each cow and her calf were stored, one for each year (Figure 2.5.). This system uses relational databases so information was analysed both within and between years. Calculations and statistical analyses were performed using the 'Smart' spreadsheet or the 'Minitab' statistical package (Minitab Inc.). Graphs included in farm reports were produced in the 'Smart' system or using the 'Harvard' graphics package (Software Publishing Corporation), exporting and importing of data between software packages was done using Lotus 1-2-3 files.

```
                                                          +-----+
   +-------+                                         FARM|CW   |
COW|174**  |                          Date 22/04/90      +-----+
   +-------+     AGE: 4        CALVING:
                                       Comments 1LVA
 NNO

  Bulling_Date1 27/07/90Bull_1 BOSSMAN
                                          +------------------+
Bulling_Date2 16/08/90Bull_2 BOSSMAN Any Other|TORN VAG-CULL 2/9|
                                     Comments |1               |
Bulling_Date3 00/00/00Bull_3                  +------------------+

        P.D.Result


                                                  pto---

    +------+
CALF|174   |      Ca_Sex M
    +------+

   Neonatal_Probs ZST-6.6

   Probs_till_Wean 28/1-PNEU

   Probs_till_sold

                          Weight_at_Birth  51
                                                 LWG B-W 1.27
                          Weight_at_Wean. 360

                          Weight_at_TO 470      LWG WEAN-TO 0.80

                          Finishing_Wgt 615 Date sold 02/12/91 LWG TO-F 0.69

     +-------+
TWIN |       |       Calf_sex
     +-------+

    T_Neon.Probs

    T_Prob.-Wean

    T_Prob._Sold

                               T_Birth_Weight   0

                               T_Weaning_Wgt.   0
```

Figure 2.5. Example of entry sheet for farm database.

CHAPTER III

RESULTS

SECTION I. FARM 1

3.1.1. BACKGROUND INFORMATION

This was an upland farm with 85 spring calving beef suckler cows and 200 breeding ewes grazing on improved pastures. The cows were mainly Hereford cross Friesians with a few pure-bred Friesians, and were mated to Charolais bulls. The calves were sold off their dams as stores in the autumn.

Initial contact was made via the local veterinary surgeon who had asked us to help in the diagnosis of the cause of high calf mortality in the 1989 calf crop. In the spring of 1989 78 cows were expected to calve however six calves were stillborn and 23 died within four months of birth.

The farm was purchased in 1986 with the farmer calving his first cows in 1987. Following the initial consultation when the the calf losses were discussed the farmer was keen to have routine visits to advise on all aspects of herd management.

3.1.2. INITIAL VISIT

The initial visit was made on 20th February 1990 when the previous problems were discussed in detail. Records had been kept of calving dates and calf deaths. All cows were tagged with plastic tags which were easily read but calves were left untagged until they were a few months old. The farmer was asked to tag calves, using plastic tags with embossed numbers, so cows and their calves could be readily identified. After discussion of problems several management changes were advised. These included recommendations not to buy-in replacement calves if calves died and radical changes in the management of cows and calves around the calving period.

Records were kept quite diligently and summaries of each year's findings as stored in the database can be found in Appendix 1.

3.1.3. ROUTINE TASKS

DEHORNING

Dehorning had previously been carried out when calves were around three or four months old. It was advised to dehorn calves within the first six weeks of life before colostral immunity had started to wane so decreasing the risk of disease outbreaks after the stress of dehorning. In 1990 dehorning was carried out when calves were approximately 10 weeks old as the farmer found himself too busy with calving and lambing earlier on. This was not ideal so in 1991 a dehorning paste was used on calves within 12 hours of birth.

CASTRATION

Calves had been castrated using a burdizzo at the same time as dehorning. It was mentioned that the stress of carrying out two procedures at the same time would almost certainly increase the risk of a pneumonia outbreak. The farmer was advised to use rubber rings to castrate calves within 24 hours of birth.

CONDITION SCORING

On the first visit in February 1990 the cows were overfat with an average condition score (C.S.) of 3.5. The ideal C.S. at this time would be nearer 2.5 so cows could achieve a target of 1.5 - 2.0 at calving. Overfat cows may be more prone to dystokia and this has certainly been a common problem on the farm in the past. The overfeeding appeared to be a result of the cows receiving too much silage over winter as, on the initial visit, the silage was not eaten by three o'clock in the afternoon having been fed early in the morning. Advice was given on condition scoring techniques and target scores were advised at specific times over the year. Cows were condition scored whenever possible throughout the study and advice on feeding given accordingly.

There was no visit between October and December 1990 during which time the cows had again been overfed silage and were overfat. It was recommended to decrease silage feeding so all the silage would be eaten by lunchtime, however on the next visit in March the cows had an average C.S. of 3.0 which is one whole score over target and this overfatness may have contributed to the large numbers of stillborn calves in the spring of that year.

In 1992 cow condition was much closer to targets and the cows calved at a Condition Score of approximately 2.0.

VACCINATION

In the spring of 1989 Rotavirus was found in the faeces of diarrhoeic calves so it was recommended to inject cows with a vaccine containing inactivated bovine rotavirus and *E. coli* antigens ('Rotavec-K99'- Coopers Pitman-Moore, Crewe) one to three months pre-calving to protect against Rotavirus diarrhoea in the calves.

MANAGEMENT AT CALVING

In previous years the cows that calved before turn-out in April had done so indoors and were kept indoors with their calves until mid- April when the whole herd was turned out. From mid-April onwards cows were brought inside when calving was considered to be imminent and cow and the calf kept inside for variable periods depending on how fit the calf seemed and on the weather conditions. Due to severe navel ill and diarrhoea problems various management changes were recommended.

Three clean buildings were to be set aside for cows to calve in, and approximately 15 cows would calve in each building before the next building was used. Between groups ideally the building was to be mucked out and left empty for a period however if there was no time to muck out then resting the area before bedding with a thick layer of clean straw should prevent a build up of pathogens.

A week before calving the cows were to be carefully examined and the 15 to 20 closest to calving were to be put in the cubicle area closest to the door and the next 10 to 15 to calve in an area adjacent to the first cows. As calving approached, after checking all the cows in the morning, those closest to calving

could be checked more easily. As soon as a cow's pelvic ligaments begin to slacken she was to be moved to the calving area.

Advice was given on the importance of calves receiving adequate colostrum quickly. Also within the first 12 hours of life calves were to be ear-tagged, castrated with a rubber ring and, as from spring 1991, injected with a paste containing barium selenate ('Deposel'- Rycovet Ltd, Glasgow) and a dehorning paste applied. Each morning all calves over 12 hours old were to be turned out with their dams.

All the above recommendations were followed.

At the initial visit the farmer was concerned that the weather could be very inclement in March and April and that there was no shelter in the fields. It was suggested that wind breaks could be put in the fields where calves could shelter. During spring 1990 the area around the shelters became very muddy and was suspected as a source of coccidial oocysts which was maintaining a coccidial diarrhoea problem in calves which started when they were around two months old. After spring 1990 the wind breaks were not used.

3.1.4. DISEASE MONITORING

DIARRHOEA

After the first ten calves were born in late March 1990 the farm was visited and blood samples taken from the calves to assess immunoglobulin levels. Two of the ten calves had zinc sulphate turbidity (ZST) levels of less than ten units and one a level of 19 units where levels greater than 20 units are considered adequate for adequate protection against pathogens (McEwan *et al*, 1970). The farmer was sure that all these calves had adequate colostrum within six hours as he had seen

the calves suck the cow. However it was stressed that it takes variable lengths of time for a calf to suck adequate colostrum depending on how quickly the cow lets her milk down or how strongly the calf sucks. During the visit it was demonstrated to the farmer how to assess if a calf's abomasum was full or empty and it was stressed that if he was unsure to give the calf three litres of colostrum via an oesophageal feeder. During the following visits in late April and early May more samples were collected from calves under 72 hours of age to assess immunoglobulin status, again there were a few with low levels and this was brought to the attention of the farmer.

In late April a few calves developed diarrhoea when they were ten to sixteen days old so faecal samples were collected and examined for enteropathogens. In three out of five samples examined *Cryptosporidium parvum* oocysts were found. Calves were given oral fluid therapy containing sachets of glucose and an electrolyte and glycine mix to be made up to two litres with water ('Lectade'- SmithKline Beecham Animal Health Ltd., Surrey.) and an oral trimethoprim/sulphonamide bolus ('Scorprin'- Willows Francis Veterinary, Crawley.), all responded well to treatment and recovered within two to three days.

In spring 1991 and 1992 there was no diarrhoea in calves under three weeks of age.

There have also been diarrhoea problems in calves of four to eight weeks of age when the calves were passing dark watery faeces often containing blood and mucus and they often strained. This was assumed to be coccidiosis and faecal samples examined during an outbreak in 1990 confirmed this diagnosis. It was suggested that the calves congregating behind wind breaks may have led to a build up of oocysts there so these were taken down. However the coccidiosis has remained a problem in the calves with four or five calves requiring treatment once a week for two or three weeks in May 1991 and 1992. In both these years it

had been very dry in May so grass had become very bare which may have allowed calves to become infected with heavier doses of oocysts resulting in diarrhoea whereas if only low doses were encountered calves would have gradually developed immunity with no signs of disease.

PNEUMONIA

In summer 1989 there was a severe outbreak of pneumonia in the calves resulting in ten deaths. It was thought that this was related to the buying in of thirteen calves from various sources to replace calves that had died in the spring of the year. These may have been the source of respiratory pathogens to which the homebred calves had no immunity. The combined dehorning and castrating and the mixing of calves may have initiated an outbreak of pneumonia.

For the future it was recommended not to buy any calves as replacements and so avoid bringing in new pathogens to which the homebred calves would be immunologically naive.

It was decided to study some of the respiratory pathogens on the farm. In March 1990 as soon as a group of ten calves were born clotted blood samples were collected when the calves were between two and five days old. Repeat samples were then collected monthly for a further six months from the same ten calves until they were sold in October. The clotted samples were centrifuged at 1000 x **g** for 15 minutes and the serum pipetted into glass bijoux. These serum samples were stored at -20°C until sampling was finished. The seventy identified samples were then sent to the Department of Diagnostic Virology, Moredun Research Institute, Gilmerton Road, Edinburgh where antibody levels, to Bovine Herpesvirus 1 (IBR), Bovine Virus Diarrhoea (BVD), Bovine Respiratory Syncytial (RSV) and Bovine Parainfluenza 3 (PI3) viruses, were measured using

FARM 1

RESULTS OF SEROLOGICAL INVESTIGATION OF VIRAL ANTIBODY TITRES IN CALVES FROM MARCH TO OCTOBER 1990

SAMPLE NO.	DATE	ANTIBODY TITRE			
		BVD	IBR	RSV	PI3
Calf 1	23/03/90	>3000	-ve	1779	318
	25/04/90	2066	-ve	382	212
	24/05/90	101	-ve	102	93
	19/06/90	63	-ve	-ve	70
	30/07/90	-ve	-ve	-ve	83
	30/08/90	-ve	-ve	-ve	76
	03/10/90	-ve	-ve	-ve	-ve
Calf 2	23/03/90	>3000	-ve	1474	369
	25/04/90	>3000	-ve	339	191
	24/05/90	192	-ve	155	111
	19/06/90	50	-ve	83	87
	30/07/90	-ve	-ve	-ve	69
	30/08/90	-ve	-ve	-ve	58
	03/10/90	-ve	-ve	-ve	-ve
Calf 3	23/03/90	>3000	-ve	536	540
	25/04/90	1480	-ve	449	290
	24/05/90	110	-ve	169	125
	19/06/90	51	-ve	84	92
	30/07/90	-ve	-ve	55	77
	30/08/90	-ve	-ve	-ve	68
	03/10/90	-ve	-ve	-ve	74
Calf 4	23/03/90	>3000	678	437	270
	25/04/90	>3000	718	204	170
	24/05/90	217	261	58	89
	19/06/90	-ve	156	53	66
	30/07/90	-ve	64	-ve	65
	30/08/90	-ve	54	52	58
	03/10/90	-ve	-ve	-ve	-ve
Calf 5	23/03/90	84	-ve	497	190
	25/04/90	>3000	-ve	1384	160
	24/05/90	92	-ve	116	69
	19/06/90	-ve	-ve	62	60
	30/07/90	-ve	-ve	55	76
	30/08/90	-ve	-ve	-ve	106
	03/10/90	-ve	-ve	-ve	64
Calf 6	23/03/90	>3000	-ve	1048	305
	25/04/90	1960	-ve	279	186
	24/05/90	2078	-ve	900	363
	19/06/90	59	-ve	58	75
	30/07/90	-ve	-ve	52	71
	30/08/90	-ve	-ve	-ve	77
	03/10/90	-ve	-ve	-ve	56
Calf 7	23/03/90	-ve	-ve	1470	577
	25/04/90	>3000	-ve	1844	639
	24/05/90	284	-ve	83	104
	19/06/90	292	-ve	242	219
	30/07/90	117	-ve	190	154
	30/08/90	101	-ve	129	132
	03/10/90	-ve	-ve	55	75
Calf 8	23/03/90	>300	-ve	>3000	796
	25/04/90	1185	-ve	1263	633
	24/05/90	>3000	-ve	2048	566
	19/06/90	791	-ve	644	265
	30/07/90	55	-ve	120	125
	30/08/90	-ve	-ve	64	89
	03/10/90	-ve	-ve	57	74
Calf 9	23/03/90	>3000	-ve	1398	680
	25/04/90	>3000	-ve	1349	504
	24/05/90	810	-ve	260	222
	19/06/90	144	-ve	129	151
	30/07/90	-ve	-ve	57	81
	30/08/90	-ve	-ve	-ve	79
	03/10/90	-ve	-ve	-ve	84
Calf 10	23/03/90	>3000	-ve	1344	649
	25/04/90	2988	-ve	791	704
	24/05/90	1060	-ve	167	380
	19/06/90	61	-ve	64	140
	30/07/90	-ve	-ve	-ve	140
	30/08/90	-ve	-ve	-ve	124
	03/10/90	-ve	-ve	-ve	76

Table 3.1.1. Results of serology in calves for common respiratory viruses from March to October 1990.

FARM 1

Calves serum antibody levels to viral respiratory pathogens over the first seven months of life.

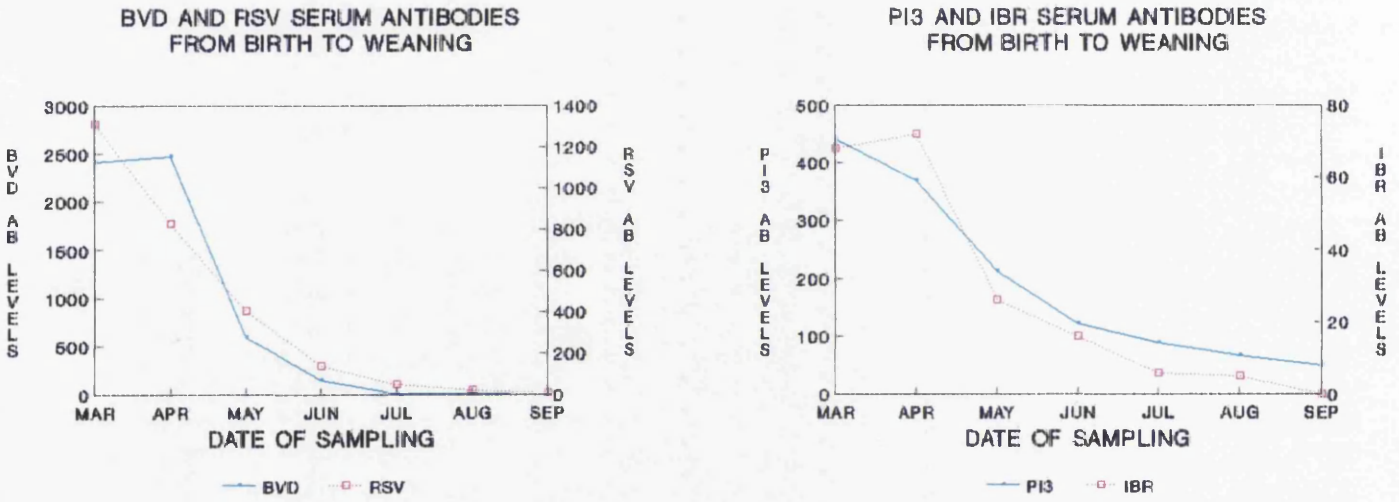


Figure 3.1.1. Serum antibody levels to respiratory pathogens in calves on farm 1.

(Original in colour)

Enzyme Linked Immunosorbant Assays. The results are illustrated graphically in Figure 3.1.1. and listed in Table 3.1.1..

All the calves received high levels of antibodies to BVD, RSV and PI3 viruses from their dams which gradually waned with some of the calves having no detectable antibody to BVD and RSV viruses by June. Antibodies to PI3 virus seemed to persist longer with all calves still having antibodies in late August. Only one calf had antibodies to IBR virus so in general the calves were immunologically naive to this virus. None of the calves seroconverted to any of the viruses studied.

In the middle of June 1990 there was an outbreak of pneumonia in the calves, several calves were tachypnoeic (up to 60 breaths per minute) and hyperpnoeic and had elevated temperatures (from 104-104.5°C). As soon as the outbreak was discovered a visit was made when the farmer was advised to treat affected animals with a short acting oxytetracycine preparation ('Engemycin 5%' - Mycofarm (UK) Ltd, Cambridge) and the most severely affected with adjunctive non-steroidal anti-inflammatary, flunixin meglumine ('Finadyne'- Schering-Plough Animal Health, Suffolk.) and all other calves in the group with a long acting oxytetracycline preparation (Engemycin L.A. - Mycofarm (UK) Ltd, Cambridge.). The calves responded well to treatment and there were no further outbreaks during the summer. One calf became ill again in late June and died. On post-mortem examination a perforated abomasal ulcer was found and there were pneumonic lesions from which *Pasteurella haemolytica* was isolated. It is possible that the pneumonia outbreak was caused by *Pasteurella haemolytica.*

It was recommended to continue the policy of not buying in calves as replacements and this would obviate the need to vaccinate calves against IBR virus to which they were susceptible.

TRACE ELEMENT DEFICIENCY

Over the first year of study samples were collected from cows in March and then calves were checked monthly for trace element status, samples being collected while collecting sera to examine for respiratory pathogens. For results see Appendix 1 (ii).

Throughout winter three ounces per head per day of a concentrated macro and micro-mineral and vitamin mix was sprinkled over the silage fed to cows. This contained copper, cobalt and selenium. The trace element levels in the cows were adequate when they were sampled in March as were the levels in the calves initially. However as summer progressed the levels of cobalt and selenium in the calf samples declined, copper levels remained adequate in all samples.

It was recommended to inject all calves subcutaneously with barium selenate ('Deposel'- Rycovet Ltd., Glasgow.) at birth which is slowly released from the injection site over approximately nine months. To control the cobalt deficiency it was recommended to top-dress grazing pastures with Cobalt sulphate in early spring. Both these recommendations were followed.

STILLBIRTH

Figure 3.1.2. illustrates the numbers of calves dying in each age group over the years. There seemed to be an abnormally high number of calves dead at birth. In 1990 and 1991 all stillborn calves were postmortemed and no reason for the deaths could be found. Most of the dead calves had assisted calvings, many were sired by the same Charolais bull and, as discussed earlier, the cows were overfat at calving in both 1990 and 1991. The farmer was advised to use the problem bull

FARM 1

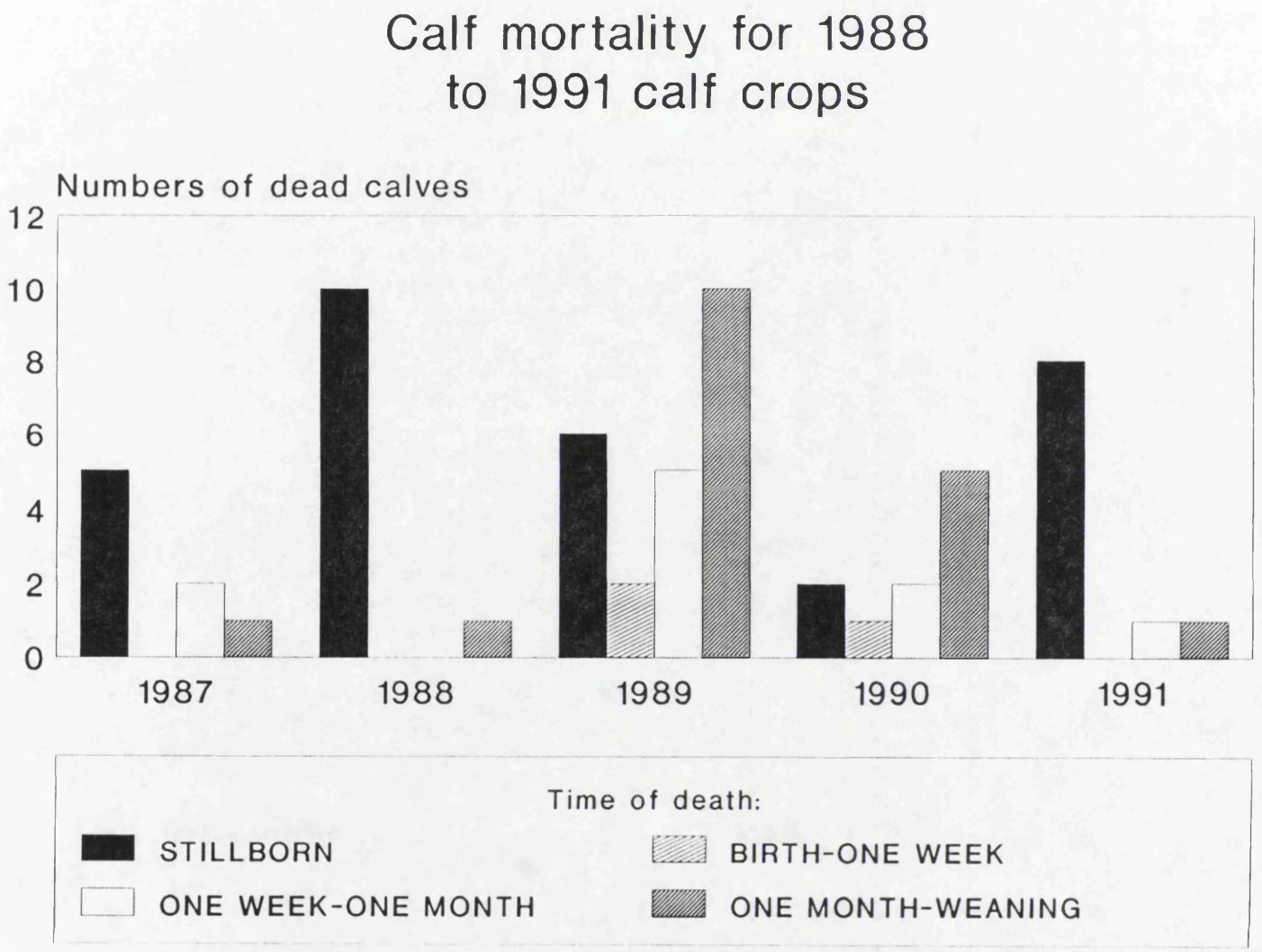


Figure 3.1.2. Calf mortalities on farm 1 from 1988 to 1991.

only on the bigger cows and to ensure cows were not overfat in future years. In 1992 there were no stillbirths.

REPRODUCTIVE PERFORMANCE

The reproductive efficiency of the cows was good with the average calving intervals being 365 days or less (Table 3.1.2.).

YEAR	1988-89	1989-90	1990-91
MEAN CALVING INTERVAL (days)	359.5	365.7	362.4

Table 3.1.2. Mean calving intervals for cows

The spread of calving has gradually been reduced from 197 days in 1988 to 119 days in 1991 (Fig 3.1.3.) and the calving pattern has become tighter as is illustrated in Fig 3.1.4..

Up until to 1991 heifer replacements had been bought in-calf and these would have calved at unknown times, for example in 1991 heifers were calving up to the end of May. To maintain a tight calving pattern heifers should start calving before the cows and be bulled over an eight week period since this would give them plenty of time to recover from their first parturition and be ready to conceive again. It was advised to buy in heifers and bull them on the farm, this was done for the 1992 calving. This proved useful as most of the heifers calved before the cows so more time was available to spend with the heifers for supervision of calving and ensuring their calves got colostrum.

FARM 1.

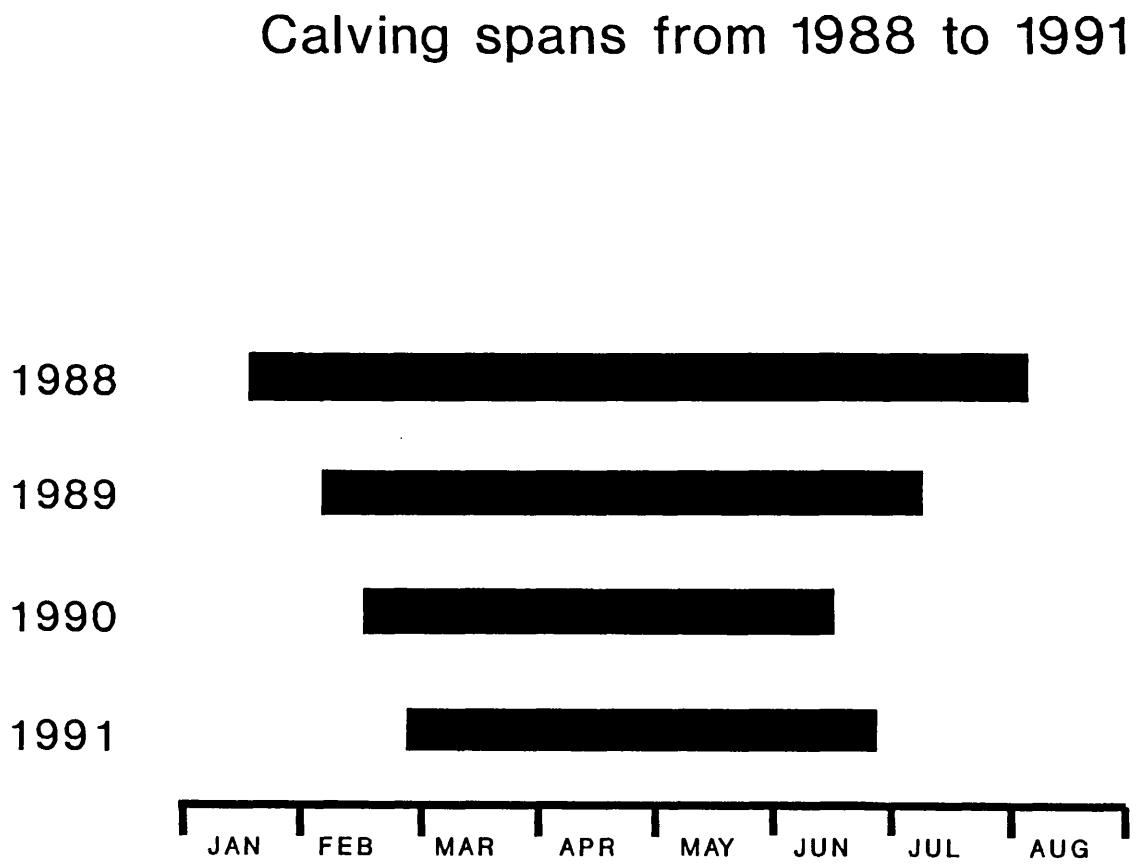


Figure 3.1.3. Calving spans on farm 1.

FARM 1

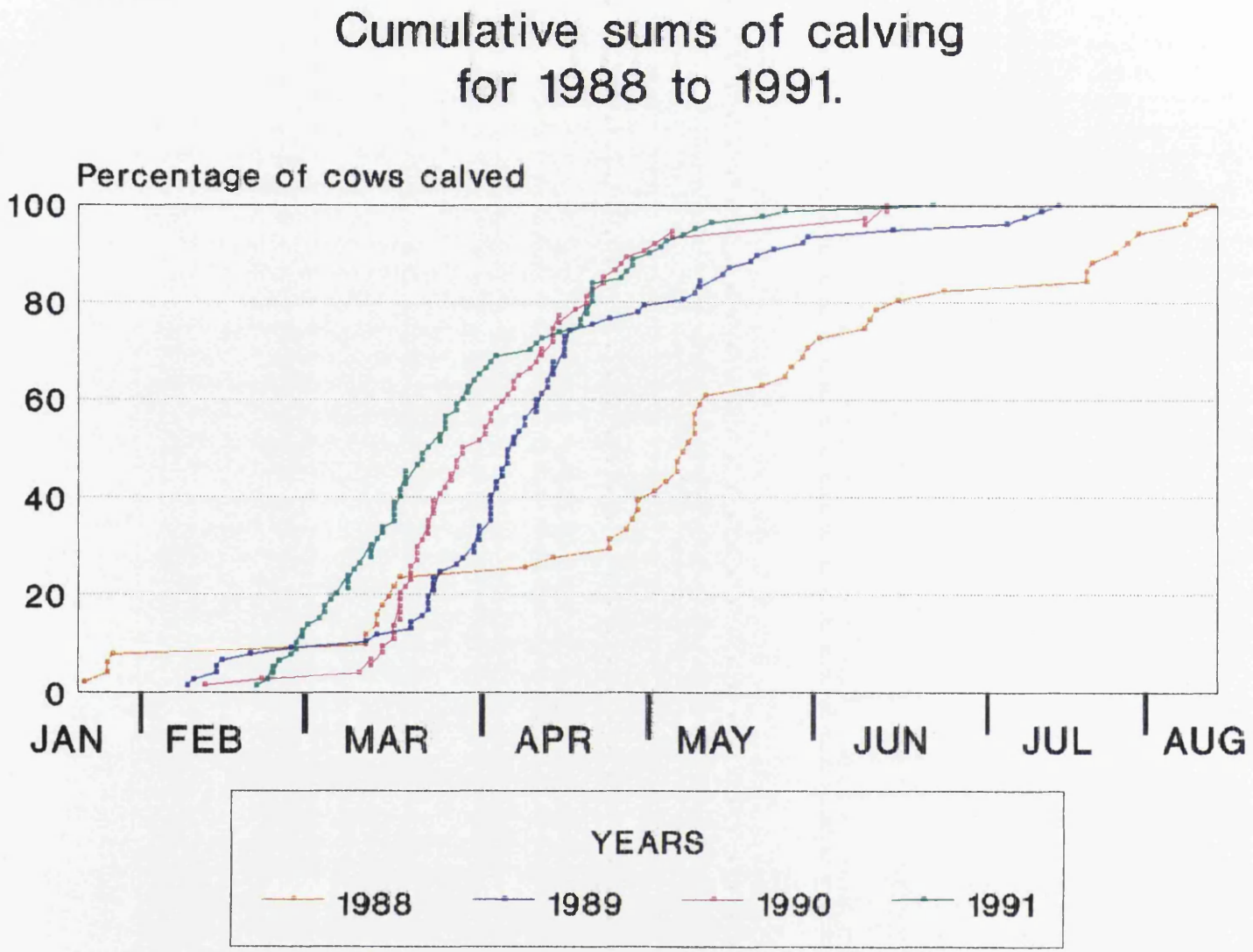


Figure 3.1.4.Calving analysis for farm 1 (Original in colour)

CALF PERFORMANCE

Calves were weighed at weaning 1989, 1990 and 1991 and as from 1990 they were also weighed at birth.

When comparing calf live weight gains in 1990 and 1991 calves seemed to do better in 1991 (Figs 3.1.5. and 3.1.6.), this may have been due to the pneumonia outbreak in the summer of 1990.

Figures 3.1.7 to 3.1.9. show calf birth and weaning weights for 1990 and 1991 born calves in order of when they were born. From these graphs we see that the earlier born calves have higher weaning weights than later born calves.

Figures 3.1.10. to 3.1.13. show calf birth and weaning weights in order of calf birth weight starting with those heaviest at birth. Calves that are heaviest at birth are not always heaviest at weaning, the correlation between birth and weaning weights for 1990 born calves was 0.471 and for 1991 born calves was 0.325 these both indicate poor correlation.

In summer 1990 calves had been creep fed since they were a few weeks old. There had been a few unexpected deaths in calves in 1990; on post-mortem examination abnormal gastro-intestinal tracts were found including abomasal ulceration in two calves and one calf with a very poorly developed rumen for its age. It was felt that the creep feed which was a pelleted feed was too low in fibre and since the calves were still sucking, the creep and milk were all some would take with no grass being consumed as a source of fibre to provoke development of the rumen. It was recommended to stop the creep feeding in 1991 and not to supplement calves until a few weeks before sale to feed a higher fibre concentrate mix. This was done and resulting weights and live weight gains showed that the 1991 born calves performed much better than those born in 1990.

FARM 1.

Cow No.	1989 Calving Date	Cal com	Comments	Cal Sex	Probs 0-1mo	Wean Wgt	1990 Calving Date	Cal Com	Comments	Cal Sex	Probs 0-1mo	Probs 1mo-Wean	Birth Wgt	Wean Wgt	LWG B-W	Sale Wgt	Sale Date	LWG B-S	1991 Calving Date	Cal com	Cal sex	Birth Wgt	Wean Wgt	Sale date	LWG B-W
30	22/04/89			M		185	15/04/90	1L		M			45	270	1.43	287	08/10/90	1.38	04/04/91	1L	M	42	277	14/10/91	1.22
31	01/04/89			F		225	05/04/90	1L		F			37	240	1.22	281	08/10/90	1.31	03/05/91	1LA	M	50	277	14/10/91	1.38
32	21/03/89			F		225	06/04/90	1L		F			37	240	1.22	274	05/11/90	1.11	19/03/91	1L	F	40	279	14/10/91	1.14
34	14/04/89			F		225	16/03/90	1L		M			30	236	1.10	314	09/01/91	0.95	23/03/91	1L	F	40	283	14/10/91	1.19
35	07/04/89			F	DIED 30/5	165	20/03/90	1L		F			37	290	1.38	281	08/10/90	1.21	21/03/91	1L	M	45			
36-F	11/04/89			M	SOLD TO VET SCHOOL		15/06/90	1L		M			40	160	1.25				25/04/91	1L	F	40	283	14/10/91	1.41
36-H	21/05/89			M		180	27/03/90	1L		F			37	250	1.21	281	08/10/90	1.25	27/02/91	2L	M	20	306	14/10/91	1.25
36-O	01/07/89			M		150													27/03/91	1L	F	35	253	28/10/91	1.01
39	10/07/89		SOLD	M	SOLD VET SCHOOL 9/8	115																			
4	09/04/89	1D		M			30/03/90	1L	Calf backwards	F			35	240	1.18	255	05/11/90	1.00							
40	13/02/89			F	SCOUR 28/2		26/03/90	1LA	ABORTED-11/2/91	M		19/6-150KG	48	280	1.31	286	08/10/90	1.21							
41	07/02/89	1D		M	SCOUR		21/03/90	1L		F			37	235	1.09	291	09/01/91	0.86	27/04/91	1D					
42	08/02/89			F	PNEU 26/2		18/03/90	1L		M	NFD	19/6-120KG	45	248	1.10	287	08/10/90	1.19	05/04/91	1LA	M	65	306	14/10/91	1.26
43	12/04/89	1D		F		183																			
436	10/04/89			M		210																			
44	14/04/89			F		155	11/04/90	1L		F			35	220	1.15	314	09/01/91	1.02	26/06/91	1L	F	38	182	11/11/91	1.04
45	25/02/89			F			25/03/90	2L		M		19/6-100KG	35	239	1.15	278	05/11/90	1.08	08/03/91	1L	F	40	279	14/10/91	1.09
46	18/02/89			F			23/03/90	1L		M		19/6-150KG	45	277	1.29	287	08/10/90	1.22	29/03/91	1LA	M	45	312	14/10/91	1.34
47	02/04/89		AB-27/12	M		235																			
48	12/03/89			M		270	05/04/90	1L		M			45	240	1.17	282	05/11/90	1.11	01/04/91	1L	M	45	277	14/10/91	1.18
49							18/04/90	1L		F			30	205	1.14	291	09/01/91	0.98	25/03/91	1L	F	35	234	11/11/91	0.86
5	13/05/89			F		150	28/04/90	1L		F			35	170	0.94	251	09/01/91	0.84	16/03/91	1DA					
50	18/03/89			F		230																			
51	30/03/89		HEIFER	F		225	11/06/90	1L		M			42	170	1.28	228	09/01/91	0.88	27/04/91	1L	F	40	207	11/11/91	0.84
52	30/03/89		HEIFER	F	DIED 8/4	220	14/04/90	1LA		M			45	245	1.27	275	05/11/90	1.12	23/03/91	1L	M	45	306	14/10/91	1.27
53	17/05/89		HEIFER	M		180	17/04/90	1LA		F			37	210	1.12	255	05/11/90	1.08	01/04/91	1L	F	40	253	28/10/91	1.01
54							27/03/90	1L		M		DIED 10/09/90	40						31/03/91	1DA					
55	07/04/89		HEIFER	M	DIED 8/4	230	17/04/90	1L		F			37	274	1.53	255	05/11/90	1.08	24/03/91	1L	F	40	283	14/10/91	1.19
56	29/03/89		HEIFER	F	DIED 24/5	190	21/03/90	1DA		M			45						08/04/91	1LA	M	50	312	14/10/91	1.39
57	21/03/89		HEIFER	M	DIED 4/4	220													17/03/91	1LA	F	42	283	14/10/91	1.14
58	03/04/89		HEIFER	F	DIED 4/6	135	22/03/90	1LA		F			37	236	1.10	274	05/11/90	1.04	15/05/91	1L	M	45	267	28/10/91	1.34
59	12/04/89		HEIFER	F		215	23/03/90	1LA		F			37	270	1.29	281	08/10/90	1.23	11/03/91	1L	F	40	283	14/10/91	1.12
6	01/04/89			F		212	23/03/90	1LA	Calf backwards	M			45	270	1.25	286	08/10/90	1.21	05/04/91	1LA	M	50	306	14/10/91	1.33
60	03/04/89		HEIFER	M	DIED 12/4	240	23/04/90	1L		M			40	230	1.28	314	09/01/91	1.05							
62							01/04/90	1LA		M	NFD		47	235	1.10	275	05/11/90	1.05	12/03/91	1LA	F	40	279	14/10/91	1.11
63	02/04/89		HEIFER	M	DIED 26/6	205													26/04/91	1L	F	40	253	28/10/91	1.15
64	04/04/89		HEIFER	M		215	21/04/90	1L		F			32	190	1.05	251	09/01/91	0.83							
65	12/05/89		HEIFER	M		160	15/06/90	1LA		M	D2D-#sp		45						27/04/91	1DA					
66	27/03/89		HEIFER	M		230	08/04/90	1LA		M		DIED BLOAT 22/6	45						21/03/91	1L	M	45	277	14/10/91	1.12
67	23/03/89		HEIFER	F	DIED 4/6		31/03/90	1L		F		DIED PNEU 25/4	35						23/03/91	1L	F	40	279	14/10/91	1.17
68	11/04/89		HEIFER	M		225	20/03/90	1L		F			37	280	1.33	281	08/10/90	1.21	28/03/91	1LA	M	45	277	14/10/91	1.16
69	01/04/89		HEIFER	M	DIED 22/5	170	10/04/90	1LA		F			37	230	1.19	262	05/11/90	1.08	31/03/91	1L	M	45	277	14/10/91	1.19
7	22/03/89	2L		M		185	21/03/90	1L		F		19/6-150KG	40	285	1.35	281	08/10/90	1.20	10/03/91	2LA	M	40	306	14/10/91	1.22
75	26/05/89			F		135	10/04/90	1L		F			28	190	1.00	251	09/01/91	0.81	25/04/91	1L	F	40	247	28/10/91	1.11
9	11/06/89			F		125	18/04/90	1L		F			30	205	1.14	291	09/01/91	0.98	03/04/91	1L	M	40	267	28/10/91	1.09
93	14/04/89	1DVA	SOLD			225																			
94	14/04/89			M		200	07/04/90	1LA	Calf Backwards	M			45	270	1.35	287	08/10/90	1.32	10/04/91	1L	M	35	277	14/10/91	1.29
98	27/04/89			F	DIED 30/7		04/04/90	1L		F			37	215	1.06	247	05/11/90	0.98	15/03/91	1LA	F	40	262	28/10/91	0.93
C39							04/04/90		HEIFER CALF AT F	F			40	260	1.31	266	08/10/90	1.21	02/03/91	1LA	F	40	279	14/10/91	1.05
ET50*							15/04/90	1LA	OLD-NIC-CULL	M			45	240	1.24	314	09/01/91	1.00							
L210							04/04/90		HEIF CALF AT FOO	F			40	250	1.25	266	08/10/90	1.21							
L30							04/04/90		HEIF CALF AT FOO	F			40	280	1.43	296	08/10/90	1.37	01/04/91	1LA	F	40	283	14/10/91	1.24
036							13/04/90	1L		M			40	235	1.23	314	09/01/91	1.01							
P15	28/04/89			F		205	08/05/90	1L		M			45	220	1.31	314	09/01/91	1.09	07/04/91	1LA	F	35	253	28/10/91	1.07
RF20*							24/03/90	1LA	OLD-CULL	M			45	240	1.09	287	08/10/90	1.22							

Figure 3.1.5. Performance of each cows' subsequent calves for 1989 to 1991. Part 1.

FARM 1.

Cow No.	Calving Date	1989 Cal com	1989 Comments	Cal Sex	Probs 0-1mo	Wean Wgt	Calving Date	Cal Com	Comments	Cal Sex	Probs 0-1mo	1990 Probs 1mo-Wean	Birth Wgt	Wean Wgt	LWG B-W	Sale Wgt	Sale Date	LWG B-S	Calving Date	Cal com	Cal sex	1991 Birth Wgt	Wean Wgt	Sale date	LWG B-W
010	07/07/89			F		120																			
020	06/04/89			M	DIED 16/4	200																			
024							24/04/90	1LA	NIC	M			37	190	1.03	278	09/01/91	0.93							
025							23/04/90	1LA		F			30	210	1.21	291	09/01/91	1.00	25/03/91	1L	F	35	240	11/11/91	0.89
027	01/04/89			M		195													24/03/91	1L	F	40	279	14/10/91	1.17
030							18/03/90	1LA	Calf backwards	F		19/6-150KG	25	190	0.89	258	09/01/91	0.78	06/04/91	1LA	M	50	277	14/10/91	1.19
031							15/02/90	1L		M			35	305	1.25	322	08/10/90	1.22							
050	05/05/89		HEIFER	M		180													11/03/91	1DA					
051							01/04/90	1DA		M			38						09/04/91	1LA	M	50	267	28/10/91	1.07
057																									
059							05/05/90	1LA		F			37	170	0.97	252	09/01/91	0.86							
062							26/04/90	1LA		M		D-23/8-TM	34						03/04/91	1L	F	38	253	28/10/91	1.03
074							29/04/90	1LA		F			32	175	1.00	227	09/01/91	0.76	04/05/91	1L	M	45	238	11/11/91	1.01
1	27/05/89			M		180	08/05/90	1L		F		D 17/5	37						10/05/91	1L	M	45	246	28/10/91	1.18
10	08/05/89			M		160													06/03/91	1DA					
101																			18/05/91	1L	M	38	238	11/11/91	1.13
102																			25/03/91	1LA	M	45	312	14/10/91	1.32
103																			18/04/91	1LA	F	40	247	29/10/91	1.07
104																			13/05/91	1LA	M	42	246	28/10/91	1.21
105																			26/04/91	1L	F	40	247	28/10/91	1.12
106																			27/05/91	1L	M	40	238	11/11/91	1.18
108																			07/05/91	1LA	F	40	234	11/11/91	1.03
10-F																			16/04/91	2LA	M	30	246	28/10/91	1.11
11	04/04/89			M		235	06/04/90	1L		M			45	265	1.33	287	08/10/90	1.31	13/03/91	1LA	M	40	277	14/10/91	1.10
117	12/04/89		SOLD	M	DIED 21/5	205																			
12	26/03/89			M	DIED 3/6	160	17/04/90	1LA		M		D-15/8	45						27/04/91	1L	M	43	306	14/10/91	1.55
120	18/03/89	1D		M		230	29/03/90	1L		M			45	255	1.21	287	08/10/90	1.25	02/05/91	1L	F	40	253	28/10/91	1.19
121	09/04/89			F		210	24/03/90	1L		M		D-PN-26/6	50						09/05/91	1L	F	40	279	14/10/91	1.51
127	07/05/89			F		195	26/04/90	1LA		F			37	210	1.18	255	05/11/90	1.13	04/05/91	1L	F	40	247	28/10/91	1.17
13	04/04/89			F		235	26/03/90	1L		M			45	265	1.24	287	08/10/90	1.23	07/03/91	1L	M	45	306	14/10/91	1.18
14	19/04/89			F		205	28/03/90	1L		M	NFD	19/6-130KG	42	245	1.16	287	08/10/90	1.26	03/03/91	1L	M	45	314	14/10/91	1.20
167	08/05/89			M		180																			
17	05/04/89			F		225	30/03/90	1L		M		19/6-150KG	42	290	1.43	287	08/10/90	1.28	05/03/91	1L	M	45	318	14/10/91	1.22
170	29/03/89			F		235	14/03/90	1L		F			37	270	1.23	281	08/10/90	1.17	20/03/91	1L	M	45	306	14/10/91	1.25
171							25/02/90	1L		F			37	205	0.82				31/05/91	1LA	M	45	246	28/10/91	1.34
180	01/04/89			M		220	27/03/90	1LA	Cow 1 Quarter	M			45	300	1.45	287	08/10/90	1.24	19/03/91	1LA	F	40	283	14/10/91	1.16
1G							11/06/90	1L		F			38	130	0.92	227	09/01/91	0.89							
2	04/07/89			F		120													07/03/91	1D					
20	10/03/89			F	SCOUR	235	24/03/90	1L		F		D-14/8,DH	37						19/03/91	1LA	F	40	283	14/10/91	1.15
21	09/04/89			F		170	21/03/90	1LA		M			50	265	1.18	287	08/10/90	1.18	28/03/91	1L	F	40	283	14/10/91	1.22
22	15/04/89			M		220	03/05/90	1L		F			37	175	0.99	251	09/01/91	0.85	17/04/91	1L	F	40	207	11/11/91	0.80
23	22/03/89			F		185	09/04/90	1L		F			37	205	1.03	251	09/01/91	0.78							
24	22/03/89			M	DIED 24/3		30/04/90	1L	NIC	M			40	180	0.99	251	09/01/91	0.83							
24	20/03/89			M		260	30/04/90	1L	NIC	M			40	180	0.99	251	09/01/91	0.83							
25	30/03/89			M	DIED 21/5	175	26/03/90	1L		F			37	255	1.23	281	08/10/90	1.24	21/04/91	1DA					
26							16/03/90	1LA	CULL	M		19/6-150KG	45	285	1.28	287	08/10/90	1.17	01/03/91	1D					
27	21/03/89	1D		M		245	20/03/90	1LA		M		19/6-170KG	45	295	1.37	287	08/10/90	1.20	15/03/91	1L	F	40	279	14/10/91	1.12
27-F																			02/03/91	1LA	M	45	312	14/10/91	1.18
28	05/04/89			F		210	31/03/90	1L		M			45	235	1.10	314	09/01/91	0.95	15/03/91	1L	F	35	247	28/10/91	0.93
29	18/05/89			F		150													23/03/91	1LA	F	40	279	14/10/91	1.17
3	20/03/89			F		230	21/03/90	1L		F			37	250	1.17	281	08/10/90	1.21	06/03/91	1L	M	45	324	14/10/91	1.26

Figure 3.1.6. Performance of each cows' subsequent calves for 1989 to 1991. Part 2.

FARM 1

Graph to compare birth and weaning weights for 1990 calf crop.

Figure 3.1.7. Farm 1 birth and weaning weights for 1990 born calves in order of calving date.

FARM 1

Graph to compare birth and weaning weights for 1991 calf crop.

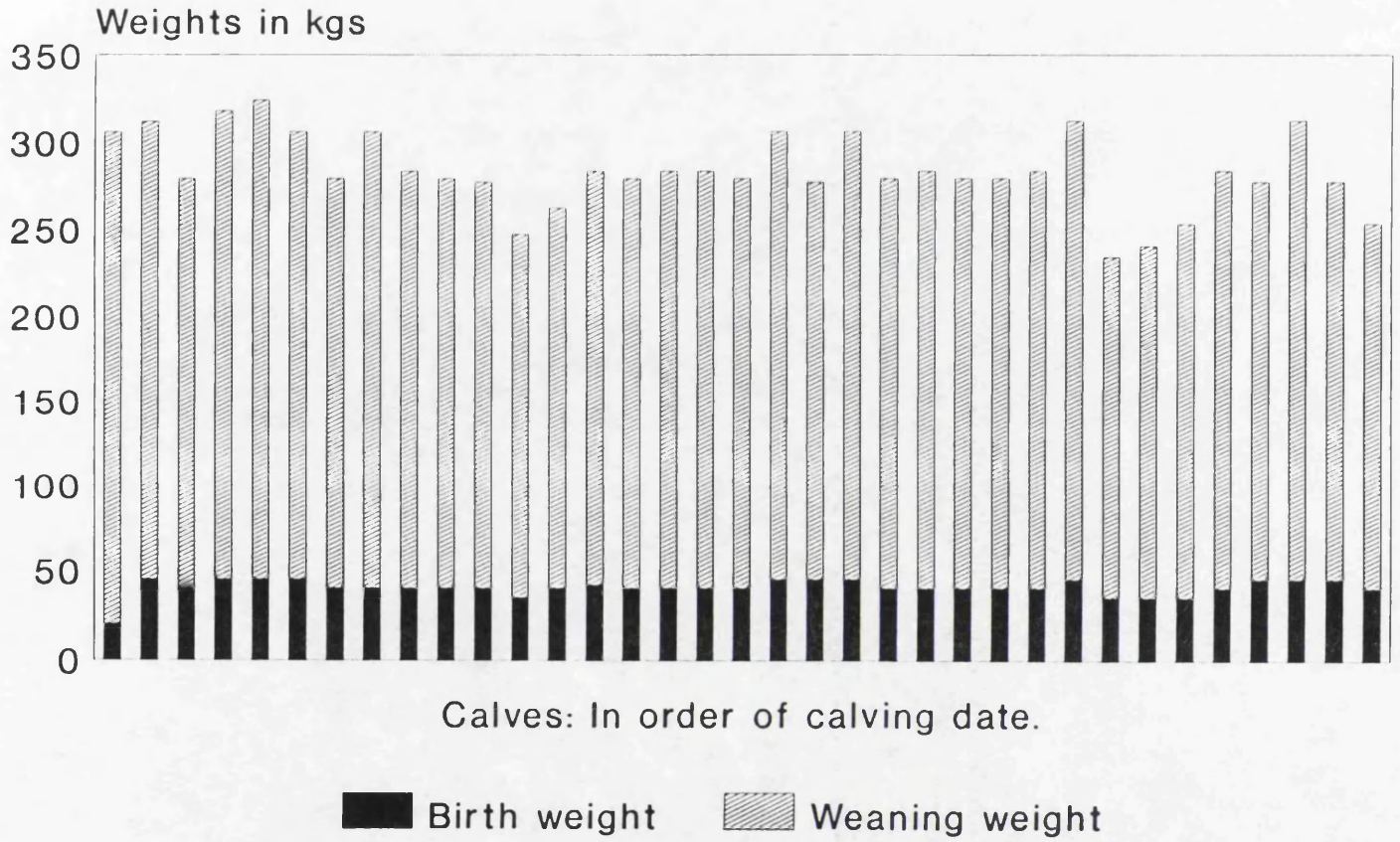


Figure 3.1.8. Farm 1 birth and weaning weights for 1991 born calves in order of calving date. Part A.

FARM 1

Graph to compare birth and weaning weights for 1991 calf crop

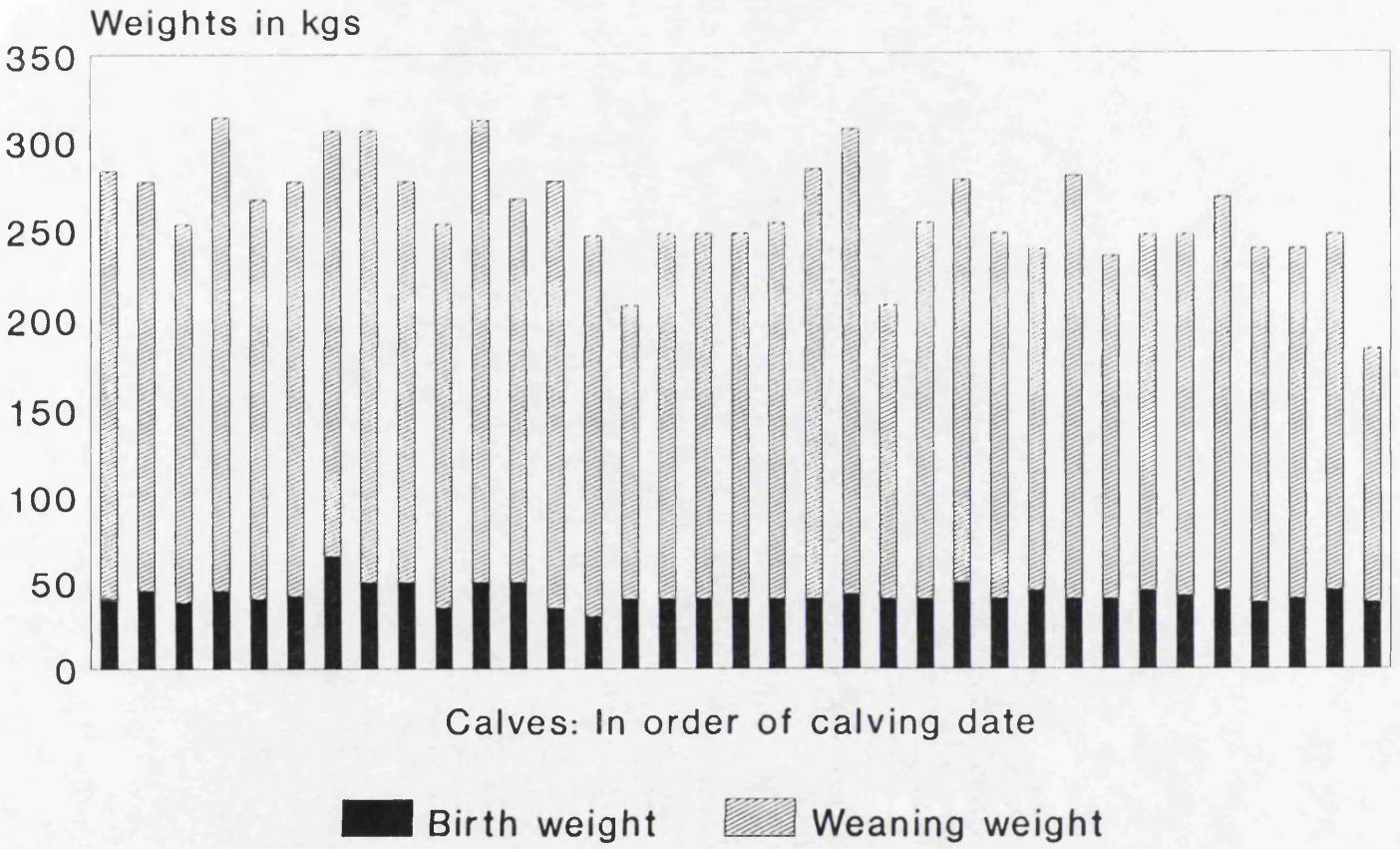


Figure 3.1.9. Farm 1 birth and weaning weights for 1991 born calves in order of calving date. Part B.

FARM 1

Graph to compare birth and weaning weights for 1990 calf crop

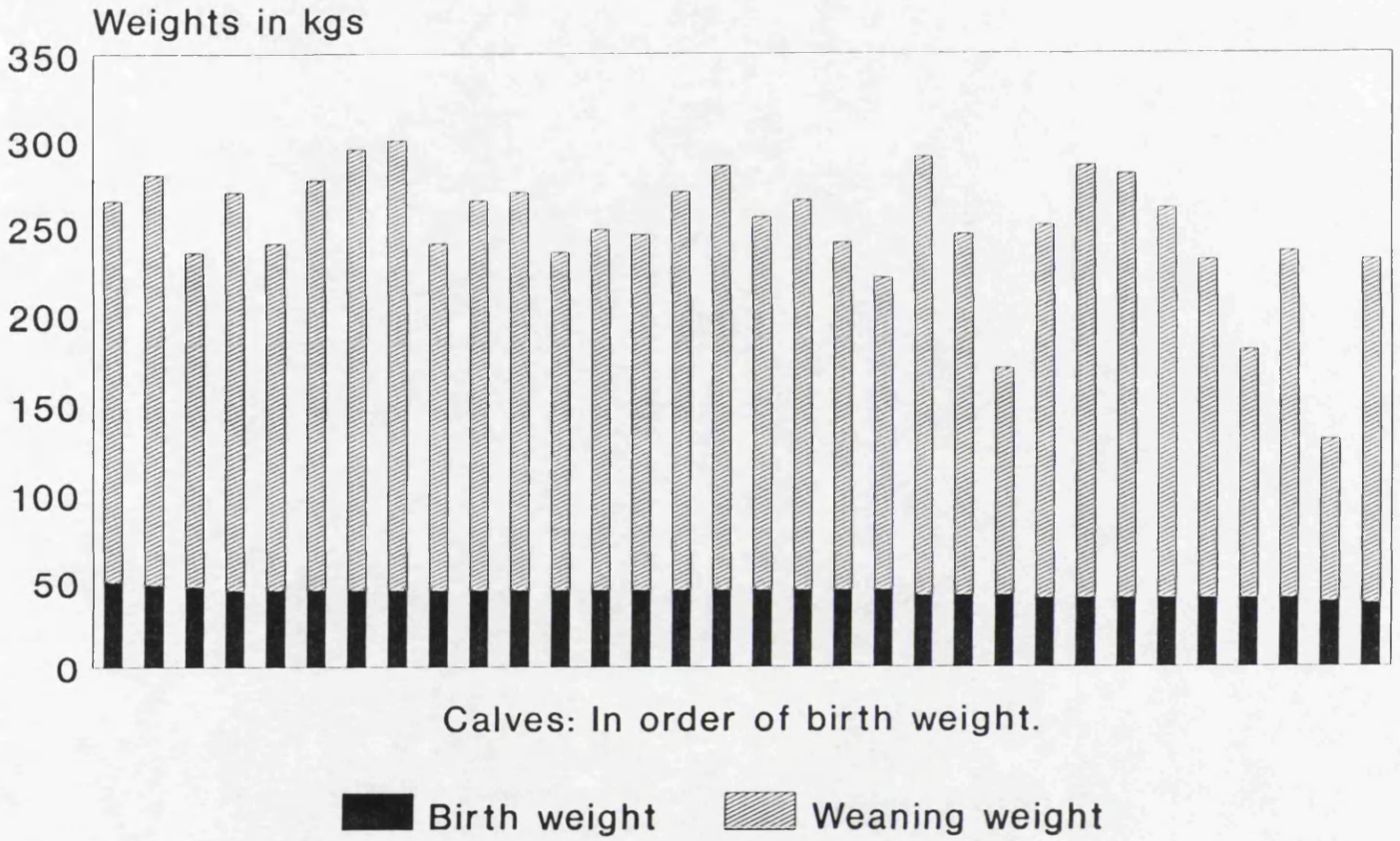


Figure 3.1.10. Farm 1 birth and weaning weights for 1990 born calves in order of birth weight. Part A.

FARM 1

Graph to compare birth and weaning weights for 1990 calf crop

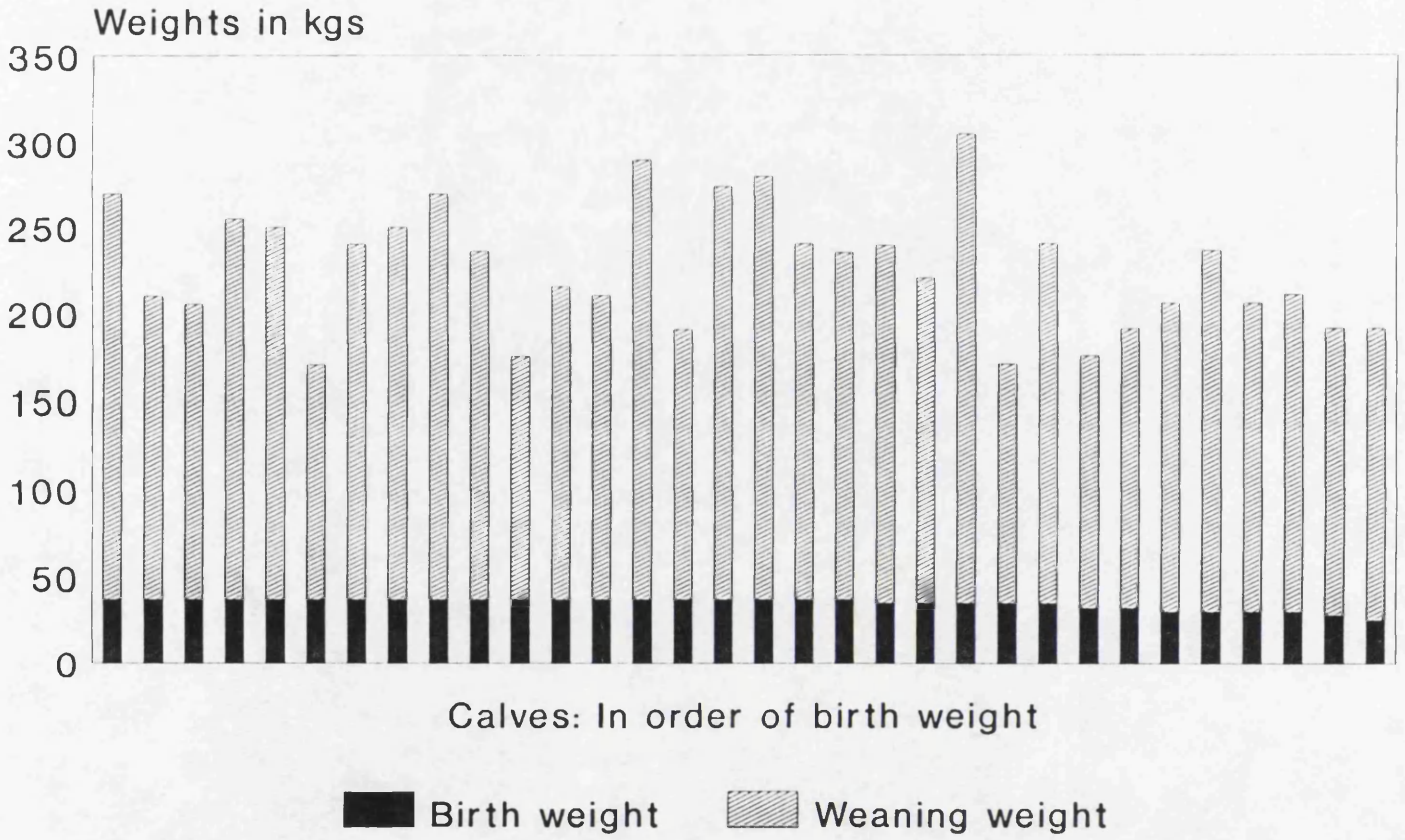


Figure 3.1.11. Farm 1 birth and weaning weights for 1990 born calves in order of birth weight. Part B.

FARM 1

Graph to compare birth and weaning weights for 1991 calf crop.

Figure 3.1.12. Farm 1 birth and weaning weights for 1991 born calves in order of birth weight. Part A.

FARM 1

Graph to compare birth and weaning weights for 1991 calf crop.

Figure 3.1.13. Farm 1 birth and weaning weights for 1991 born calves in order of birth weight. Part B.

SECTION 2. FARM 2

3.2.1. BACKGROUND INFORMATION

This upland farm created a fifty cow beef suckler herd which calved for the first time in the spring of 1986 having previously purchased store calves which were sold finished. The numbers of cows gradually increased with approximately 100 cows calving in the spring of 1989. The cows were a mixture of Friesians crossed with Aberdeen Angus, Simmental and Limousin, the Limousin crosses being the more numerous. Replacement heifers were bought in and artificially inseminated on the farm with known easy calving bulls. The cows were all mated with homebred Limousin bulls and calves were retained on the farm and sold in small groups when finished at one to two years of age.

There was a small herd of around 20 pure-bred Limousin cattle producing pedigree bulls and this was run entirely separately to the suckler cows. In addition there was a flock of 150 commercial breeding ewes.

3.2.2. INITIAL VISIT

During the initial visit in September 1989 the farmer was very positive about the planned health and productivity scheme and was keen to keep accurate and up to date records. Cows had been tagged using plastic tags and the cows were freeze branded in 1990 which was hoped would overcome problems with lost tags and the difficulties of reading tags on cows with hairy ears. Calves had

previously been tagged using small metal tags however it was decided to change to plastic tags to ease identification. There were problems with lost plastic tags so from 1991 both metal and plastic tags were used on all calves providing back-up identification if tags were lost. Good animal identification was especially important as the farmer was keen to monitor calf growth rates and to look at calf performance from each individual cow on a yearly basis.

There had been severe pneumonia outbreaks in calves soon after housing. As a result of this two new calf creep areas were built in the summer of 1989. These had been well designed with careful regard to the importance of adequate space for calves and good ventilation, so it would be interesting to see how calves would now perform.

There had also been problems with diarrhoea in young calves which had resulted in calf losses so this would be investigated more fully.

Very useful records were kept and summaries of each year's records can be found in Appendix 2..

3.2.3. ROUTINE TASKS

DEHORNING

Calves had been disbudded when they were four to six weeks of age with no ill effects so this was left unchanged.

CASTRATION

Calves were castrated in late autumn when six or seven months old. It was suggested that it would be less stressful for the calves if they were castrated using a rubber ring within 24 hours of birth and that this would not affect live weight gains. In 1990 and 1991 calves were castrated using a rubber ring while being dehorned. It was pointed out that this was in fact illegal as rubber rings should be applied within the first week of life. In 1992 rubber rings were applied at birth and the farmer found that dehorning on its own was more rapid and seemed less stressful to the calves than the combined procedure and was happy to continue with the new methods.

CONDITION SCORING

Advice was given on condition scoring techniques and recommendations given on target scores over the year. In the past cows had been kept a bit fatter than recommended targets and at calving in 1990 the average condition score was 3.0. It was recommended to restrict winter feeding in 1991 and to calve cows nearer to a score of 2.0. This advice was taken and seemed to help reduce the number of cows requiring assistance at calving: In 1990 there were 23 assisted calvings and in 1991 only 12.

MANAGEMENT AT CALVING

Cows were turned out in mid-March before calving starts with the early calving cows put in a field next to the house and the other cows put on hill ground. Cows were left outdoors if no assistance was required, however if cows required assistance they were brought in to a straw yard where they remained with their calves for a few days. Once the majority of the early calving cows had calved they were moved to the hill and the later calving cows brought into the field by the house.

It was recommended to try to split the fields into smaller areas and calve approximately 20 cows in each paddock and to calve subsequent groups in clean paddocks. If cows required to be brought indoors for assistance at calving they should be put out as quickly as possible, preferably within 12 hours of calving. The calving area should be cleaned out between cows or at least fortnightly and bedded with fresh straw between each cow.

The farmer was not keen to split fields nor to use more than one calving area indoors as all the space available was required for ewes and lambs. He did however start to keep cows and their calves indoors for a minimal period.

3.2.4. DISEASE MONITORING

DIARRHOEA

In previous years calves had often had prolonged diarrhoea in the first few weeks of life. Cases usually started during the second half of the calving period when morbidity rates often reached 80 percent but mortality was low.

In spring 1990 the first few cows calved between mid-March and mid-April but the majority calved from late April to late May. At the end of April a group of seven calves less than 72 hours old were blood sampled to check immunoglobulin status. Five out of seven of these calves had zinc sulphate turbidity levels less than 20 units. The importance of adequate colostrum was emphasized.

In late April and early May nine calves had diarrhoea starting when they were between 2 and 20 days of age. Five of these calves died soon after the onset of diarrhoea. Faecal samples were examined for enteropathogens. In two calves aged two and three days B-Haemolytic *E-coli* were isolated. In the older calves both Rotavirus and *Cryptosporidium parvum* were found in most samples. It was recommended to inject cows with a vaccine containing inactivated bovine Rotavirus and *E. coli* antigens ('Rotavec-K99'- Coopers Pitman-Moore, Crewe.) one to three months pre-calving to protect against Rotavirus diarrhoea in the calves. All cows not due to calve within the next fortnight were vaccinated. Even if calves did not receive an adequate amount of colostrum within six hours there would be local antibodies to rotavirus in the cows' milk. From mid May onwards the diarrhoea in calves seemed less severe with all calves recovering. All cows would be vaccinated with 'Rotavec-K99' in the future.

In later checks of immunoglobulin status of young calves there were again some calves with inadequate levels. The farmer seemed aware that the calves may be low in colostrum but was not keen on the extra time involved to milk cows manually and feed calves with an oesophageal feeder. It was recommended that calves would do better if they received colostrum from their dam or from another cow on the farm as this would contain antibodies to pathogens likely to be encountered on the farm, however when time was short there were proprietary colostrum substitutes available. He began using the proprietary preparations and found them very easy to prepare and administer so all calves began to be fed some form of colostrum if required.

In 1991 and 1992 there were again diarrhoea outbreaks in calves but all affected animals recovered. *Cryptosporidium parvum* oocysts were found in faecal smears and no other enteropathogens were detected.

OMPHALOPHLEBITIS

There had always been cases of omphalophlebitits in calves that had been indoors and the incidence increased as calving progressed. The measures recommended to improve hygiene indoors by rotating calving pens and keeping pens cleaner should have decreased the incidence. However only some of the recommendations were acted on ie. cows and calves were turned out more quickly, so there were still problems with omphalophlebitis and some of the cases progressed to septic arthritis requiring prolonged treatments.

PNEUMONIA

This farm had a history of outbreaks of pneumonia throughout the housing period in previous years, however there were two new calf creep areas built which should have reduced some of the adverse environmental factors which may have contributed to the pneumonia outbreaks.

In 1989 calves were housed in late November and seemed healthy until Christmas when several of the older age group of calves developed clinical signs of pneumonia. The calves were tachypnoeic, hyperpnoeic, had elevated temperatures and some had mucoid nasal discharges. As soon as the calves were seen to be ill a visit was made when advice on treatment was given. Only the affected calves were treated and they were injected with a long acting amoxycillin preparation ('Betamox LA' - Norbrook Laboratories (GB) Ltd., Bewdly, Worcester.). Calves were re-assessed two days later by the farmer and any which still had elevated temperatures were retreated. Only a few required a second injection and no further treatments were required.

There was an outbreak of pneumonia in the younger age group of calves in early January when 35 out of 50 calves were treated similarly to the older group. There was no recurrence of pneumonia after either of these initial outbreaks.

Paired blood samples were taken from a group of the older calves and antibody levels to common respiratory viruses assessed. All the calves sampled seroconverted to IBR, PI3 and RSV viruses. During the outbreak in the younger calves paired serology was again performed, results showed seroconversion to all three viruses, some calves seroconverting to all three viruses and others to one or two.

It was decided to vaccinate calves in future years with an intranasal

vaccine against IBR and PI3 viruses ('Imuresp RP'- Smithkline Beecham Animal Health, Tadworth, Surrey.) before housing. The farmer was not so keen on the extra handling to vaccinate calves twice before housing with the intramuscular vaccine against RSV virus ('Rispoval'- Smithkline Beecham Animal Health, Tadworth, Surrey.).

In mid-June 1990 there was an outbreak of pneumonia in the young calves grazing on the hill with their dams. When the local veterinary surgeon was called to examine the calves IBR was suspected and all the calves in that group were vaccinated with 'Imuresp RP' that day. Those with clinical signs of elevated rectal temperatures of 104 - 104.5°C and ocular discharges were also injected with a long acting amoxycillin preparation ('Betamox LA'). The response to treatment was good and no other treatments were required. Approximately one week later the remainder of the calves were vaccinated with 'Imuresp RP'. Unfortunately there was no opportunity to blood sample these calves to assess what had caused the pneumonia and even if they had been sampled it would have been difficult to interpret results as vaccination would have affected the serum antibody levels.

In October 1990 there was a further small outbreak of pneumonia in the calves while still at grass, three or four calves were treated with long acting amoxycillin ('Betamox LA') and all recovered.

In late January 1991 there was an outbreak of pneumonia in the calves born in spring 1990. Thirty three calves were affected and treated with 'Betamox LA' to which they responded well. There were no further outbreaks over the winter.

The farm has always bought in replacement calves albeit only from a few known sources when any young calves have died and this introduction of unknown pathogens may have contributed to the outbreaks of pneumonia during the summer. The farmer was unwilling to alter this policy so he was advised to vaccinate calves with 'Imuresp RP' either twice if they were under twelve weeks

of age or once if they were over twelve weeks. It was decided to vaccinate after 12 weeks and hope maternal immunity would protect calves until then.

Unfortunately there was an outbreak of pneumonia in late May 1991 in the early born calves when they were six to eight weeks old. As soon as the outbreak started all the calves were vaccinated with 'Imuresp RP'.

On the 22nd of October there were two cases of pneumonia in calves while still at grass; one of the calves responded well to treatment however the other became progressively worse and died on the 30th October. A post mortem examination revealed lesions consistent with an RSV infection.

There was a further outbreak of pneumonia one week after housing in late November when 20 calves were treated, one calf died, but was not postmortemed, Affected animals responded well to treatment. There were no further outbreaks over the winter period.

In 1992 all calves will be vaccinated against all three viruses however it was stressed that other pathogens, including especially *Pasteurella haemolytica*, may still cause pneumonia in the calves. All calves will be vaccinated with 'Imuresp RP' at three months of age ie. in mid- June and given two intramuscular injections of 'Rispoval', the first when the bull is taken away from the cows in September and the second one month later when worming and clipping calves before housing. So as long as the farm policy remained consistent and calves were bought from the same sources the vaccination policy should help to control respiratory disease.

BOVINE VIRAL DIARRHOEA / MUCOSAL DISEASE

There had been cases of mucosal disease on the farm in the past so it had been decided to blood sample the herd to identify the viral excretors. All excretors

were killed and in future all bought in animals were isolated and blood sampled to check BVD status to ensure no virus carriers were introduced. This has been continued to date and the farmer was warned that the herd will become very susceptible to the BVD/MD virus and that if a carrier was introduced that this may potentially lead to severe problems.

TRACE ELEMENT DEFICIENCY

Calves have routinely been supplemented with injections of potassium selenate and Vitamin E ('Dystosel' - Intervet UK Ltd, Milton Road, Cambridge.) and copper calcium edetate ('Bovicoppa'- BK Veterinary Products Ltd., Bury St Edmonds, Suffolk.) at birth and have been given a multiple trace element bolus containing copper, cobalt, selenium, manganese, zinc, iodine, sulphur and vitamins A, D3 and E ('All Trace'- Agrimin Ltd., Brigg, South Humberside.) at turn-out in spring when one year old. Blood samples were collected to ascertain trace element status in cows and calves: soon after housing, before turn-out, in mid-summer and in autumn. For results see Appendix 2.(ii).

All samples had low to marginal Vitamin B12 levels suggesting cobalt deficiency. Selenium levels were marginal in samples from cows and calves. Copper levels were normal in all samples.

To try to overcome the cobalt deficiency it was recommended to top dress both grazing and silage pastures with cobalt sulphate.

To control selenium deficiency cows would be injected subcutaneously with barium selenate ('Deposel'- Rycovet Ltd., Glasgow.) in mid to late pregnancy, this would be slowly released from the injection site over approximately nine months and levels of selenium in milk would be increased so obviating the need to inject calves with selenium at birth. Calves would still

require the copper calcium edetate injection at birth (Bovicoppa- BK Veterinary Products Limited, Bury ST Edmonds, Suffolk.). During housing calves were fed a mineral preparation including copper, cobalt and selenium mixed with their concentrate feed. At turn-out they would continue to be given the multiple trace-element bolus ('All Trace' - Agrimin Ltd, Brigg, South Humberside.).

REPRODUCTIVE PERFORMANCE

The calving period decreased from 214 days in 1988 to 116 days in 1991 (Fig 3.2.1.). Within this tighter calving period the majority of cows are calving within a shorter period, this is illustrated graphically in Figure 3.2.2..

There had been a problem with endometritis in the cows which had not previously been noticed until the cows were with the bull. In 1990 careful records were kept of assisted calvings and retained foetal membranes which both may have led to endometritis. All cows which had aborted, had assisted calvings or retained foetal membranes were examined three weeks before the bull was put to the cows, this gave a chance for the endometritis to be treated and to resolve before the cows were served.

All cows with endometritis had retained foetal membranes which would increase the likelihood of subsequent endometritis and three of these cows had dead calves which often results in retained foetal membranes and endometritis.

In 1991 suspect cows were again checked before the bull was put in. This time only three cows had endometritis, one had twins, one an assisted calving and the other retained foetal membranes. In 1991 cows were in a leaner condition at calving and had fewer assisted calving, they had also been injected with barium selenate ('Deposel'- Rycovet Ltd., Glasgow.) in late pregnancy. Any or all of these factors may have contributed to the decrease in cases of

FARM 2

Calving spans for 1988 to 1991

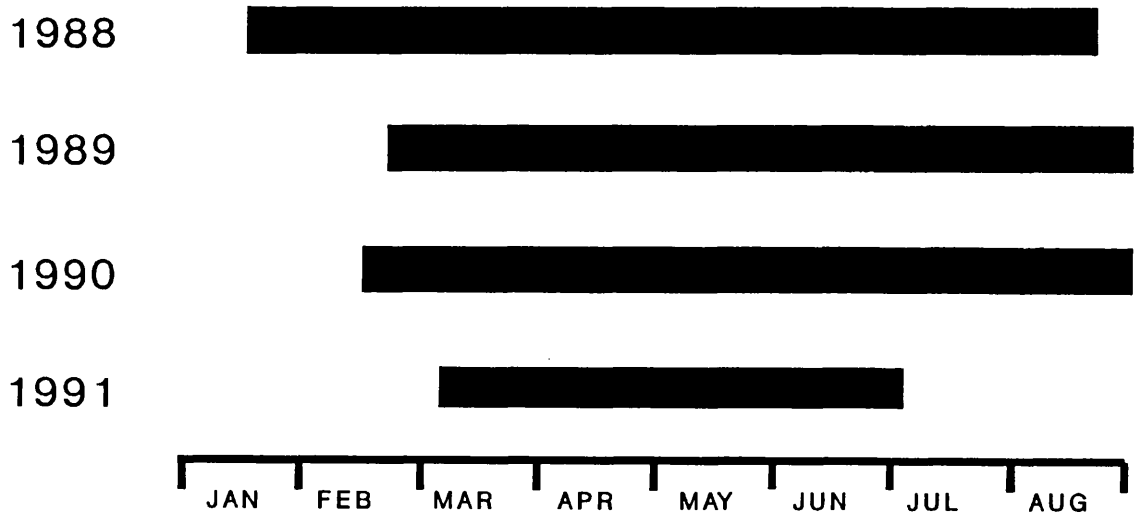


Figure 3.2.1. Calving spans on farm 2.

FARM 2

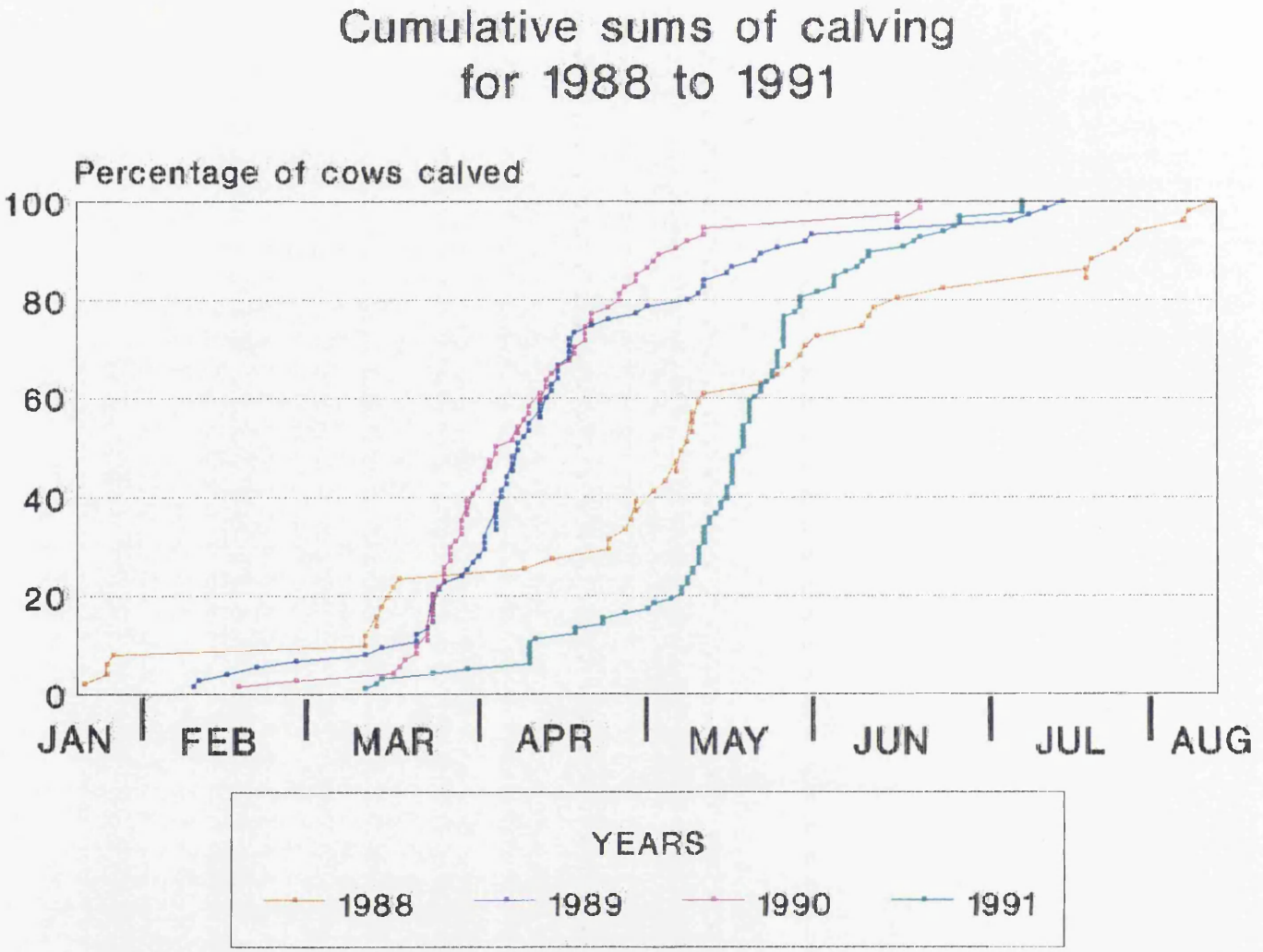


Figure 3.2.2.Calving analysis for farm 2 (Original in colour)

endometritis.

CALF PERFORMANCE

Calves were weighed at birth, during winter around weaning, at turn-out in May and when sold. From these figures live weight gains could be calculated over each period. It was also possible to look at the calf performance of each individual cow on a yearly basis.

Calves born in 1989 were weighed on 28th of February 1990 and again when sold. Calves born in 1990 were weighed at birth, on 21st December, 7th May 1991 and at finishing from May 1991 to April 1992. In these two years there were problems with lost tags (Table 3.2.1.) so not all the calves could be followed through to finishing. The 1991 born calves were weighed at birth, on 16th December 1991 and 13th May 1992 and not many tags were lost.

Table 3.2.1. shows averages of weights for all calves at each of the weighing times and the numbers of calves weighed on each occasion which depended on the number of calves that still had tags. The actual weights at the end of winter every year varied by more than 100 kilograms per calf with the heavier calves being those born earlier (Figs 3.2.3. and 3.2.4.). Live weight gains were fairly uniform for each year with an occasional very poor calf. For example for 1990 born calves the majority had weaning to turn-out live weight gains between 0.6 and 0.8 kilograms per day, two calves whose dams had mastitis in the winter had live weight gains of 0.42 and 0.56 kilograms per day which were poor.

Year of birth	1989	1990	1991
Birth weight (kg)		41.38	41.84
Number of Calves		85	81
Weaning weight (kg)	307.53	279.46	233.76
Date weaned	28/02/90	21/12/90	16/12/91
Number of calves	64	72	80
LWG Birth - Weaning (kg/day)	0.94	1.11	0.92
Turn-out weight (kg)		372.97	366.19
Date weighed		07/05/91	13/05/92
Number of calves		65	72
LWG Weaning - Turn-out(kg/day)		0.67	0.90
Sale weight	476.52	476.34	
Number of calves	46	56	
LWG Weaning - Sale (kg/day)	0.55	0.54	

Table 3.2.1. Average weight gains and live weight gains for 1989 to 1991 calf crops.

FARM 2.

Cow No.	Calf Sex	1989 Probs. 0-1mo	1989 Probs 1mo-we	1989 Wean Wgt.	1989 LWG B-W	1989 Sale Wgt.	1989 Date sold	1989 LWG W-F	Calf Sex	1990 Probs 0-1mo	1990 Probs 1mo-we	1990 Birth Wgt	1990 Wean Wgt	1990 LWG B-W	1990 T-o Wgt	1990 LWG W-TO	1990 Sale Wgt	1990 Date sold	1990 LWG TO-F	Calf Sex	1991 Probs 0-1mo	1991 Probs 1Mo-We	1991 Birth Wgt	1991 Wean Wgt	1991 LWG B-W	1991 TO Wgt	1991 LWG W-TO
30	F			0	-0.1	0		0.00	M			33	210	0.76	260	0.36	495	23/03/92	0.73	M			42	226	0.88	330	0.70
154	F			375	1.01	0		0.01	M	Z-24		39	0	-0.1	0	0.00	0		0.00	F			36	210	0.84	300	0.60
57	M			300	0.88	435	28/01/91	0.40	F		27/1-pn	40	280	1.07	360	0.58	460	02/12/91	0.48	F			44	248	0.98	350	0.68
163	M			360	0.97	525	29/10/90	0.68	M			44	331	1.28	372	0.30	435	07/10/91	0.41	M			42	230	0.90	360	0.87
60	F			310	0.96	495	14/01/91	0.58	M			38	290	1.08	390	0.73	0		0.01	M			50	230	0.87	400	1.14
15	M			268	0.92	490	21/01/91	0.68	F			40	260	1.05	353	0.68	410	13/01/92	0.23	M			46	226	0.87	335	0.73
45	F			320	0.96	440	11/12/90	0.42	F			40	319	1.23	400	0.59	405	09/05/91	2.50	M	SC-31/5		50	290	1.15	430	0.94
145	F			375	1.01	0		0.01	F		28/1-PN	41	285	1.13	385	0.73	430	30/09/91	0.31	M			50	235	0.90	0	-1.5
121	F			235	0.69	440	11/12/90	0.72	F			0	0	0.00	0	0.00	0		0.00	M			42	240	0.84	380	0.94
5				0	0	0		0	M			43	285	1.35	360	0.55	535	20/01/92	0.68	M			50	248	0.97	390	0.95
118	M			285	0.94	0		0.01	M		26/1-PN	50	276	1.04	378	0.74	480	07/10/91	0.67	F		PN-26/11	36	198	0.79	310	0.75
51				0	0	0		0				0	0	0	0	0	0		0	M	Sc-8/6		46	230	0.90	320	0.60
31	F			310	1.00	480	18/12/90	0.58				0	0	0	0	0	0		0	F			36	198	0.80	320	0.82
128	M			375	1.02	505	04/12/90	0.47	M			38	0	-0.1	0	0.00	0		0.00	M		PN-23/11	36	190	0.77	307	0.79
19	M			275	0.94	500	25/02/91	0.62	F		28/1-PN	36	226	1.00	325	0.72	410	03/02/92	0.31	M			38	230	0.96	350	0.81
108	F			310	0.87	0		0.01	M			41	272	1.00	350	0.57	500	30/12/91	0.63	M			45	235	0.95	400	1.11
113	F	D-21/4		0	-0.1	0		0.00	F			45	272	1.06	0	-1.9	0		0.00	M		PN-20/11	42	226	0.93	0	-1.5
41				0	0	0		0				0	0	0	0	0	0		0	F			40	370	1.69	0	-2.4
182				0	0	0		0	M			38	0	-0.1	0	0.00	0		0.00	M			34	186	0.78	280	0.63
53	F			250	0.99	435	29/01/91	0.55	F		24/1-pn	44	244	1.21	320	0.55	475	03/02/92	0.57	F		PN-27/11	42	256	1.11	400	0.97
16	F			0	-0.2	0		0.00	M	D-10/5-S		55	307	1.12	450	1.04	570	04/11/91	0.66	M	PN 12/7	PN-26/11	50	230	0.93	330	0.67
44	M			270	1.01	0		0.01	M		PN-12/10	44	276	1.24	310	0.25	540	09/03/92	0.75	F		PN-25/11	45	235	1.02	360	0.84
171	f			370	0.86	0		0.01	M	S-9/5	D-PN-8/10	40	0	-0.1	0	0.00	0		0.00	M			55	244	1.02	370	0.85
18	F			270	0.91	500	18/02/91	0.65	M		26/1-PN	43	230	1.09	330	0.73	555	30/03/92	0.69	F			44	190	0.79	400	1.41
181				0	0	0		0	F	D-9/5-S		39	345	1.25	443	0.72	0		0.01	M			50	214	0.91	0	-1.4
21	M			255	0.94	490	11/03/91	0.63	M		27/1-PN	40	240	1.20	285	0.33	515	17/02/92	0.80	F			40	178	0.78	270	0.62
14	M			290	0.98	540	11/02/91	0.72	F		28/1-PN	38	248	0.97	340	0.67	445	11/11/91	0.55	M			42	194	0.86	325	0.83
103	F			235	0.80	425	14/01/91	0.59	F		28/1-PN	38	222	1.01	320	0.72	390	30/12/91	0.30	M			44	206	0.92	335	0.87
184				0	0	0		0	M			44	0	-0.1	0	0.00	0		0.00	F			40	190	0.90	0	-1.2
33				0	0	0		0				0	0	0	0	0	0		0	M			40	158	0.71	275	0.79
100	F			300	1.01	455	18/02/91	0.44	M	D-24h	24/1-pn	36	190	1.41	295	0.77	475	03/02/92	0.66				0	0	0	0	0
101	M			0	-0.1	0		0.00	F			42	256	0.97	350	0.69	400	04/11/91	0.28				0	0	0	0	0
104				0	0	0		0	F	D-12H	28/1-PN	44	325	1.43	425	0.73	0		0.01				0	0	0	0	0
115	M			185	0.81	435	22/04/91	0.60				0	0	0	0	0	0		0				0	0	0	0	0
117	M			295	1.01	510	21/01/91	0.66	M			38	202	1.08	0	-1.4	0		0.00				0	0	0	0	0
119	M			300	1.06	500	18/02/91	0.56	F			46	313	1.30	460	1.07	0		0.01				0	0	0	0	0
12				0	-0.2	0		0.00				0	0	0	0	0	0		0				0	0	0	0	0
148	F			310	0.86	425	10/12/90	0.40	M			42	0	-0.1	0	0.00	0		0.00				0	0	0	0	0
17	F			335	1.07	0		0.01				0	0	0	0	0	0		0				0	0	0	0	0
174				0	0	0		0	M	Z-6.6	28/1-PNEU	51	360	1.27	470	0.80	615	02/12/91	0.69				0	0	0	0	0
175				0	0	0		0	F	Sc-10/5	28/1-PNEU	37	280	1.03	410	0.95	390	09/05/91	-10				0	0	0	0	0
20	F			220	0.86	410	14/01/91	0.59	F	PN-12/10	PN-28/1	38	218	1.01	330	0.82	445	16/12/91	0.52				0	0	0	0	0
32	M			168	0.55	460	25/03/91	0.75				0	0	0	0	0	0		0				0	0	0	0	0
33	M			265	0.91	495	28/01/91	0.69	F		28/1-PNEU	38	174	1.00	264	0.66	385	30/12/91	0.51				0	0	0	0	0
35	M			320	1.02	525	18/02/91	0.58	M	ZST-16.6	28/1-PNEU	47	360	1.30	465	0.77	545	25/11/91	0.40				0	0	0	0	0
37	F			315	0.92	0		0.01	M			48	268	1.07	380	0.82	510	16/12/91	0.58				0	0	0	0	0
38	M			160	0.62	0		0.00				0	0	0	0	0	0		0				0	0	0	0	0
40	F			223	0.89	375	28/01/91	0.46	F		28/1-PNEU	42	233	1.07	315	0.62	415	09/12/91	0.46				0	0	0	0	0
41	F			255	1.00	400	18/12/90	0.49	F			50	222	1.11	290	0.50	425	16/12/91	0.61				0	0	0	0	0
49	M			268	0.89	500	28/01/91	0.69				0	0	0	0	0	0		0				0	0	0	0	0
50	F			380	1.15	545	05/11/90	0.66	F		28/1-PN	44	319	1.23	370	0.37	0		0.01				0	0	0	0	0
51	M			285	1.00	475	18/03/91	0.50	M		28/1-PNEU	40	235	1.12	345	0.80	500	20/04/92	0.44				0	0	0	0	0
55				0	0	0		0	F		D-25/4	46	0	-0.1	0	0.00	0		0.00				0	0	0	0	0

Figure 3.2.3. Performance of each cows' subsequent calves for 1989 to 1991. Part 1.

FARM 2.

Cow No.	Calf Sex	1989 Probs 0-1mo	1989 Probs 1mo-we	Wean Wgt.	LWG B-W	Sale Wgt.	Date sold	LWG W-F	Calf Sex	1990 Probs 0-1mo	1990 Probs 1mo-we	Birth Wgt	Wean Wgt	LWG B-W	T-o Wgt	LWG W-TO	Sale Wgt	Date sold	LWG TO-F	Calf Sex	1991 Probs 0-1mo	1991 Probs 1Mo-We	Birth Wgt	Wean Wgt	LWG B-W	TO Wgt	LWG W-TO
56	M			295	0.89	550	18/03/91	0.67	F			40	290	1.20	380	0.66	450	18/11/91	0.36	M			45	260	0.90	427	1.12
152	f			355	0.94	0		0.01	M			42	0	-0.1	0	0.00	0		0.00	F			28	235	0.90	355	0.81
35				0	0	0		0				0	0	0.00	0	0.00	0		0.00	M	SALER		30	248	0.96	390	0.95
12				0	0	0		0				0	0	0.00	0	0.00	0		0.00	M	SALER	Ba-22/10	40	240	0.88	366	0.85
185				0	0	0		0				0	0	0.00	0	0.00	0		0.00	M		P-30/10,D	40	0	-0.1	0	0.00
102	M			265	0.89	540	04/03/91	0.75	M		Pn-26/1	42	313	1.24	410	0.71	520	09/12/91	0.51	M			40	295	1.13	350	0.37
172				0	0	0		0	M	D-13/5	Pn-28/1	46	325	1.25	450	0.91	530	21/10/91	0.48	M		PN-26/11	50	290	1.07	460	1.14
58	F			268	0.81	420	10/12/90	0.53	M		Pn-28/1	42	235	0.86	0	-1.7	0		0.00	M			44	295	1.12	460	1.11
111	M			0	-0.1	0		0.00				0	0	0.00	0	0.00	0		0.00	F			30	230	0.89	0	-1.5
43	F			315	0.92	0		0.01	F		Pn-20/10	40	328	1.33	385	0.42	0		0.01	F		PN-25/11	40	256	0.97	400	0.97
46	F			305	0.92	450	19/11/90	0.55	M			48	352	1.45	0	-2.5	0		0.00	M	SET ON	PN-25/11	0	230	1.03	405	1.17
116	F			300	0.91	440	17/12/90	0.48	F		Pn-26/1	43	301	1.15	390	0.65	0		0.01	F			45	230	0.83	400	1.14
179				0	0	0		0	M			42	319	1.12	460	1.03	500	30/09/91	0.27	M		22/10-PN	40	248	0.93	0	-1.6
114	F			290	0.75	0		0.01	M			40	295	1.09	360	0.47	485	25/11/91	0.62	F			40	222	0.82	310	0.59
173				0	0	0		0	M	Sc		41	0	-0.1	0	0.00	0		0.00	M		PN-26/11	40	218	0.80	345	0.85
177				0	0	0		0	M			39	0	-0.1	0	0.00	0		0.00	M		PN-28/11	50	276	1.02	435	1.07
178				0	0	0		0	F			38	301	1.07	390	0.65	525	11/11/91	0.72	F			40	218	0.80	340	0.82
137	M	D-26/4		0	-0.1	0		0.00	M	D-26/4	SET ON	25	301	1.12	406	0.77	490	11/11/91	0.45	F			42	290	1.12	430	0.94
187				0	0	0		0				0	0	0.00	0	0.00	0		0.00	F	SC 24/5.	PN-20/11	36	206	0.77	380	1.17
180				0	0	0		0	F			35	268	0.95	405	1.00	0		0.01	M			42	235	0.88	386	1.01
172				0	0	0		0	M	D-13/5	Pn-28/1	46	325	1.25	450	0.91	530	21/10/91	0.48	M			38	235	0.90	386	1.01
3	M			400	1.13	0		0.01	F		BL-1/8	38	272	1.00	350	0.57	445	02/12/91	0.45	F			38	260	1.01	370	0.74
59	M			380	1.17	570	04/12/90	0.68	F			40	295	1.10	380	0.62	435	14/10/91	0.34	M	D-18/5		44	272	1.05	435	1.09
186				0	0	0		0				0	0	0.00	0	0.00	0		0.00	F			36	230	0.89	399	1.13
52	M			270	0.77	490	04/03/91	0.60	M		Pn-28/1	46	252	1.11	378	0.92	530	13/01/92	0.61	M	SC 31/5		42	230	0.86	375	0.97
36	F			390	1.19	515	29/10/90	0.51	M			38	285	1.09	390	0.77	550	23/12/91	0.70	M			42	285	1.12	415	0.87
166	F			340	0.94	0		0.01	M		Pn-28/1	41	307	1.14	406	0.72	545	09/12/91	0.64	M	PN-9/7	PN-25/11	44	252	0.96	340	0.59
107	F			355	0.96	455	17/12/90	0.34	M			40	272	0.98	330	0.42	495	09/12/91	0.76	M			42	210	0.77	370	1.07
157	M			425	1.17	0		0.01	M			45	319	1.17	420	0.74	500	28/10/91	0.46	M			44	240	0.90	400	1.07
122	M			405	1.13	0		0.01	M		Pn-24/1	45	280	1.13	370	0.66	515	16/03/92	0.46	F		PN-25/11	40	256	1.00	355	0.66
176				0	0	0		0	F	Z-4.66		50	210	0.70	300	0.66	405	30/09/91	0.72	M			40	170	0.60	295	0.84
183				0	0	0		0	M			28	378	1.26	475	0.71	500	30/09/91	0.17	M			42	230	0.87	390	1.07
105	M			350	0.94	515	03/12/90	0.59	F	Z-19		36	276	0.97	370	0.69	450	11/11/91	0.43	M		PN-26/11	42	240	0.92	370	0.87
R101				0	0	0		0				0	0	0	0	0	0		0	M	D		36	0	-0.1	0	0.00
139	M			355	0.96	510	12/11/90	0.60	F			44	290	1.08	360	0.51	410	04/11/91	0.28	F			40	226	0.87	326	0.67
34	M			350	1.06	460	11/03/91	0.29	M		26/1-PNEU	42	240	0.96	313	0.53	490	02/03/92	0.59	F	SET ON		46	256	0.98	378	0.92
17				0	0	0		0	M		Pn-28/1	50	295	1.15	390	0.69	530	02/12/91	0.67	M			42	260	1.01	420	1.07
13	F			260	0.91	420	04/02/91	0.47	M			40	0	-0.1	0	0.00	0		0.00	M			46	260	1.00	366	0.71
42	F			270	0.87	425	10/12/90	0.54	F		26/1-PNEU	38	264	1.06	340	0.55	440	14/10/91	0.63	F			40	210	0.79	360	1.01
164				0	0	0		0				0	0	0.00	0	0.00	0		0.00	M	D-20/6		46	210	0.77	395	1.24
47				0	0	0		0	F	SET ON		42	331	1.03	420	0.65	385	09/05/91	-17	F		PN-27/11	40	248	0.97	370	0.92
161	M		D-27/6	0	-0.1	0		0.00	M	Z-11		31	256	0.93	360	0.76	470	04/11/91	0.61	F			38	206	0.79	300	0.63
169	F			340	0.94	0		0.01	F		Pn-26/1	38	256	1.12	320	0.47	400	13/01/92	0.32	M			42	248	0.97	400	1.02
123	F			337	0.91	440	17/12/90	0.35	M			45	0	-0.1	0	0.00	0		0.00	M		PN-25/22	44	226	0.86	370	0.97
131	F			300	0.81	470	05/11/90	0.68	F	D-9/5-S		45	264	0.89	0	-1.9	0		0.00	F			38	198	0.75	295	0.65
139	F			315	0.85	425	17/12/90	0.38	M	Z-29		39	0	-0.1	0	0.00	0		0.00	F	SC-31/5		38	186	0.70	320	0.90
109	M			360	1.10	495	29/10/90	0.56	M		Pn-25/1	50	272	1.05	370	0.72	540	09/12/91	0.79	M			50	260	1.00	0	-1.7
170	F			355	1.01	0		0.01	F	S-9/5		35	280	1.02	380	0.73	0		0.01	F			40	202	0.77	380	1.19
39	M			345	1.08	540	26/11/90	0.72	M			40	313	1.18	430	0.85	510	14/10/91	0.50	M			44	230	0.89	395	1.04
105	M			310	1.04	530	04/02/91	0.65	F	Pn-24/5	Pn 24/1	39	301	1.17	378	0.56	455	07/10/91	0.50	F			42	218	0.84	360	0.95
155	F			0	-0.1	0		0.00	M			37	290	1.08	0	-2.1	0		0.00	F			40	244	0.98	375	0.88
136	M			285	0.73	485	24/04/91	0.48				0	0	0.00	0	0.00	0		0.00	M			44	240	0.94	400	1.07

Figure 3.2.4. Performance of each cows' subsequent calves for 1989 to 1991. Part 2.

In 1991 the live weight gains from birth to weaning were poorer than in 1990, this may have been due to the two pneumonia outbreaks in the summer of 1990. The live weight gains from weaning to turn-out in 1991 were higher than for 1990. This was due to there being no pneumonia in calves over the winter of 1991 whereas there were outbreaks over the winter of 1990.

The performance of each cows' calves could be followed in subsequent years and any cows producing consistently poor calves would be culled. (Figs 3.2.3. and 3.2.4.).

Birth, weaning, turn-out and finishing weights, where available for each calf, were represented graphically for each year. See Figs 3.2.5 to 3.2.12.. Statistical analysis was performed to look for any correlations between weights (Table 3.2.2).

	1989	1990	1991
Birth/Weaning		0.091	0.163
Weaning/Turn-out		0.887	0.802
Turn-out/Finishing	0.508		0.409

Table 3.2.2. Correlations between birth, weaning, turn-out and finishing weights for calves.

In the graphs (Figs 3.2.5. to 3.2.8.) where the X-axis is ordered starting with the heaviest birth weights and it can be seen that those heaviest at birth were not the

heaviest at weaning. When correlations were carried out between birth and weaning weights they were found to be very low (Table 3.2.2.).

Weaning and turn-out weights seemed to be similar on the graphs (3.2.9. to 3.2.12.), again this was confirmed statistically when high correlations were found (Table 3.2.2.).

FARM 2

Graph to compare birth, weaning and turn-out weights for 1990 calf crop

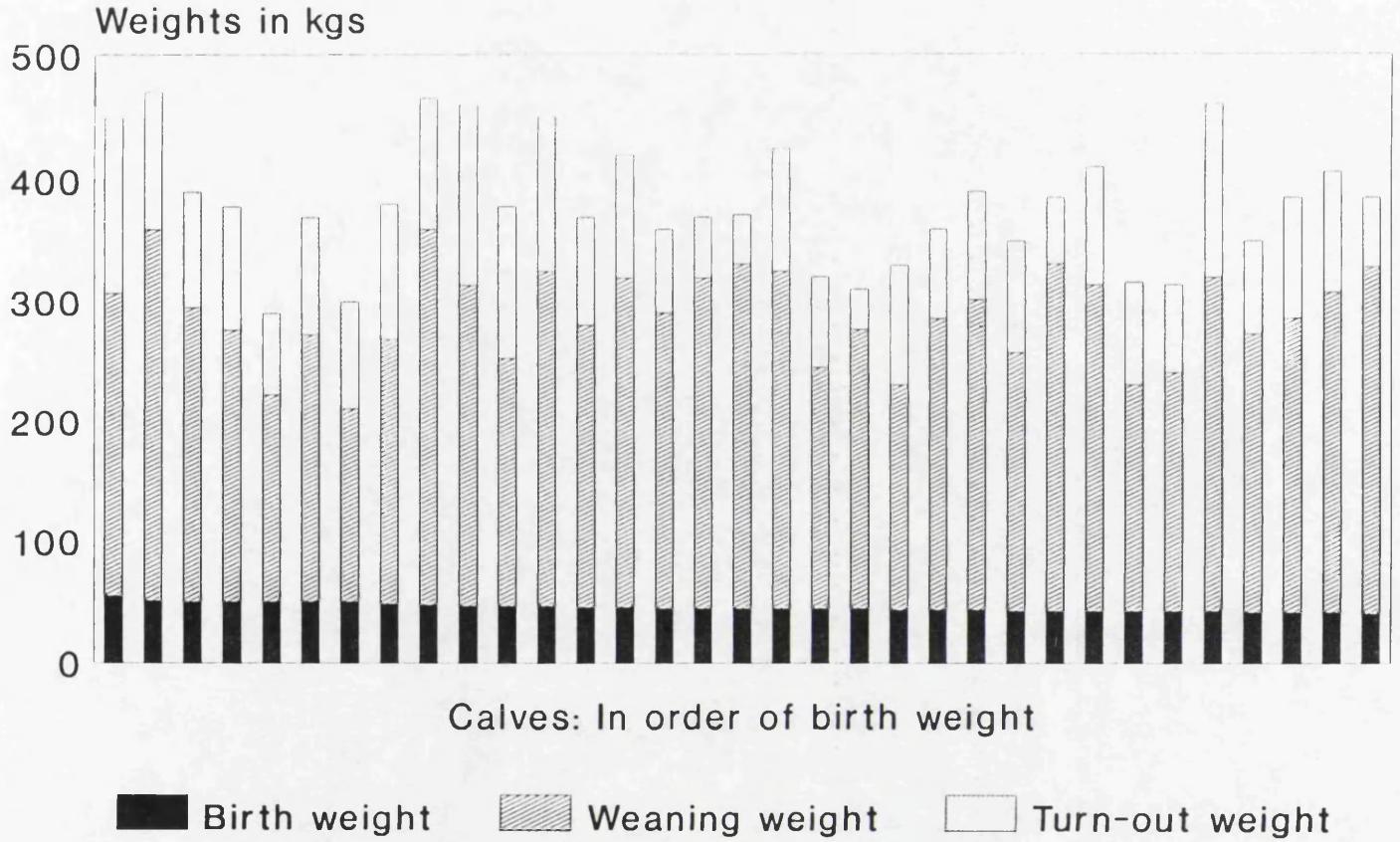


Figure 3.2.5. Farm 2 birth, weaning and turn-out weights for 1990 born calves in order of birth weight. Part A.

FARM 2

Graph to compare birth, weaning and turn-out weights for 1990 calf crop

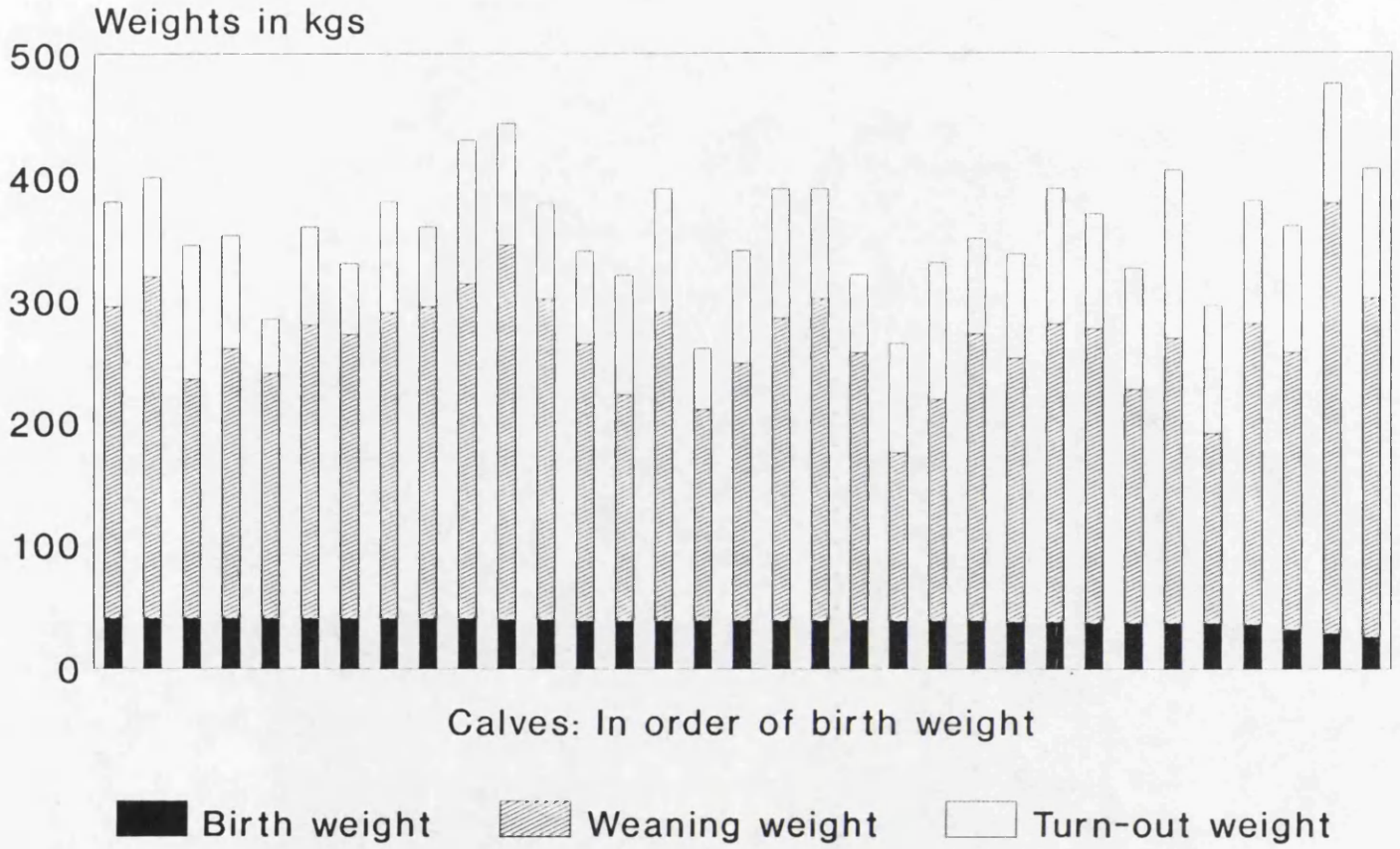


Figure 3.2.6. Farm 2 birth, weaning and turn-out weights for 1990 born calves in order of birth weights. Part B.

FARM 2

Graph to compare birth, weaning and turn-out weights for 1991 calf crop

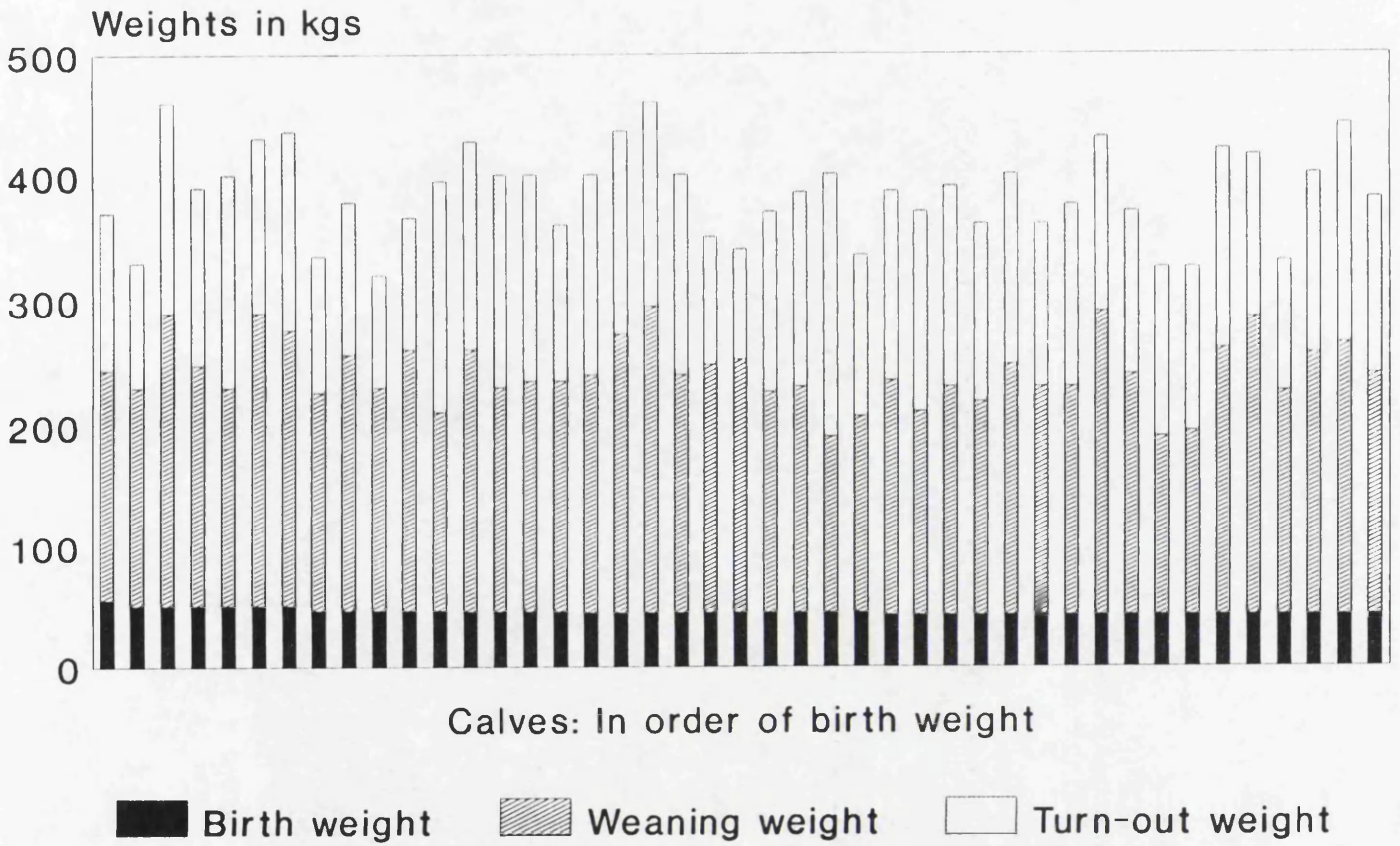


Figure 3.2.7. Farm 2 birth, weaning and turn-out weights for 1991 born calves in order of birth weight. Part A.

FARM 2

Graph to compare birth, weaning and turn-out weights for 1991 calf crop

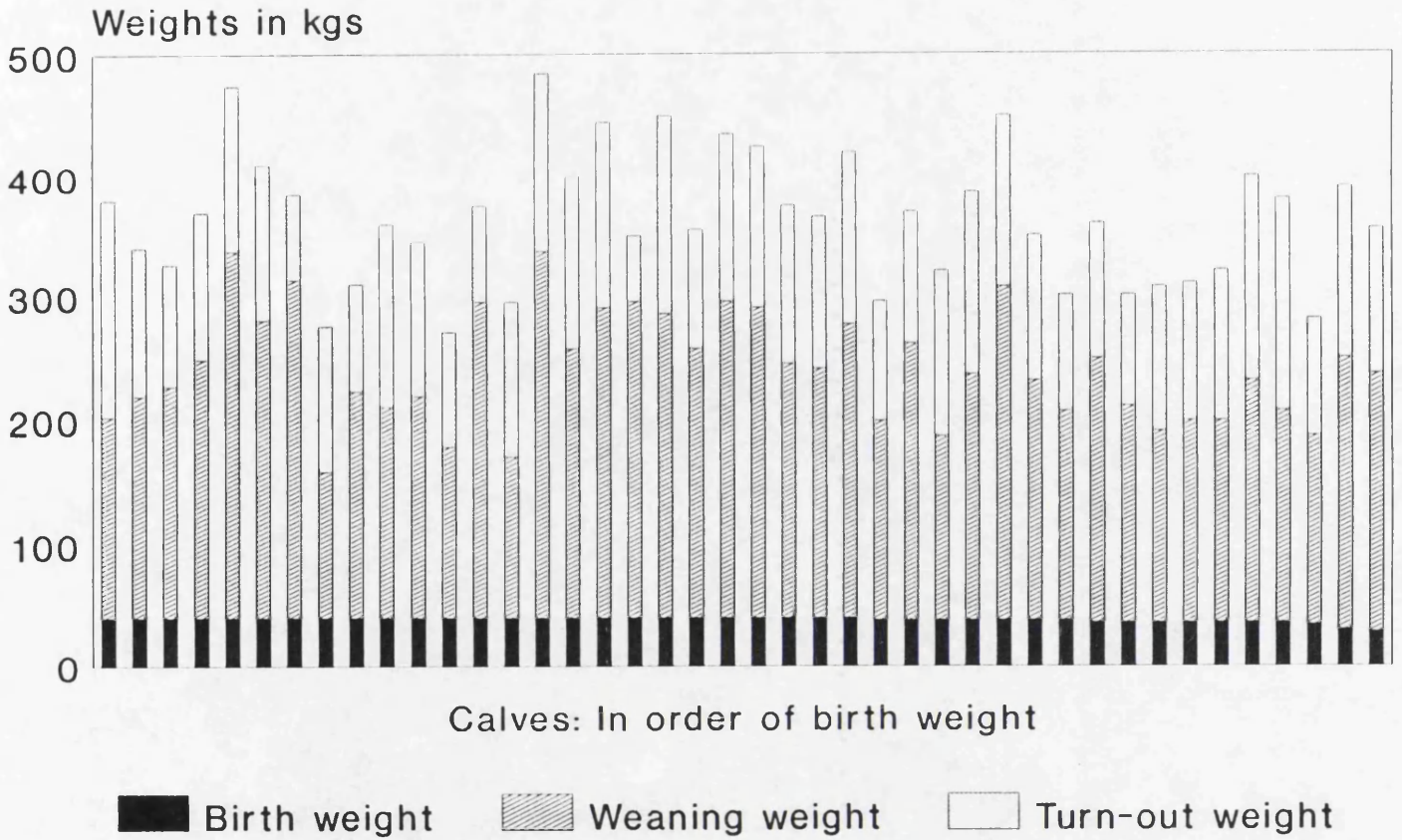


Figure 3.2.8. Farm 2 birth, weaning and turn-out weights for 1991 born calves in order of birth weight. Part B.

FARM 2

Graph to compare birth, weaning and turn-out weights for 1990 calf crop

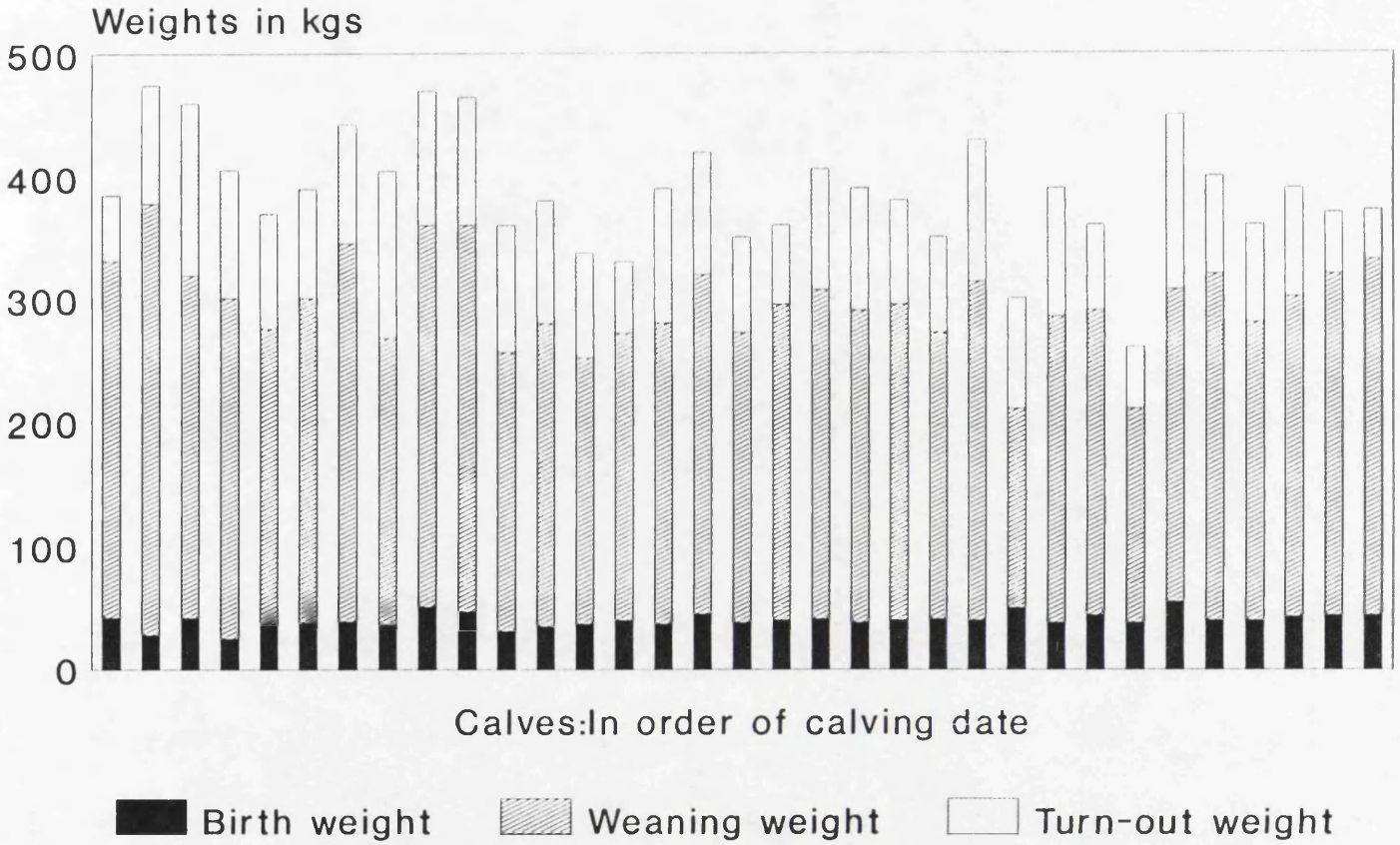


Figure 3.2.9. Farm 2 birth, weaning and turn-out weights for 1990 born calves in order of calving date. Part A.

FARM 2

Graph to compare birth, weaning and turn-out weights for 1990 calf crop

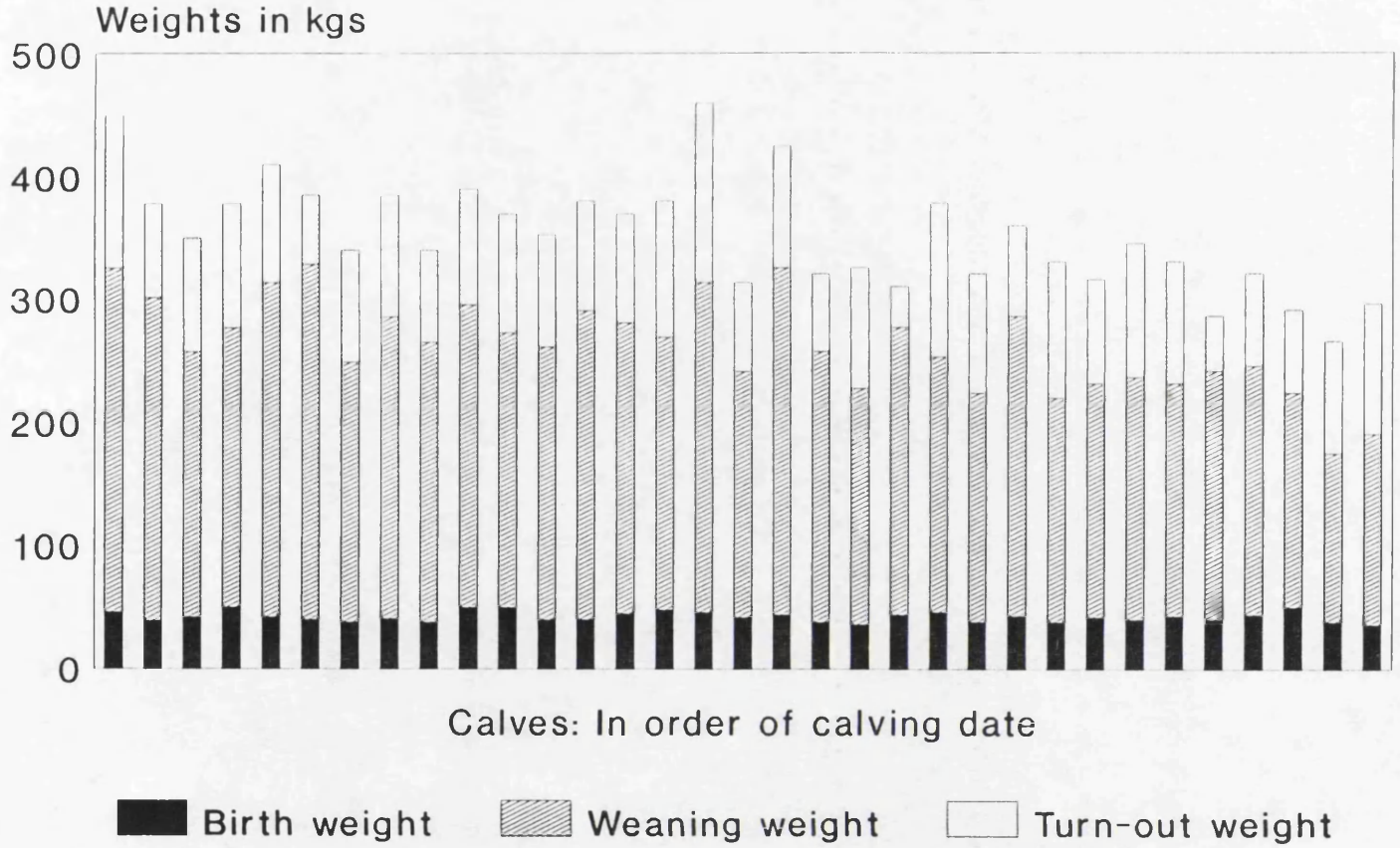


Figure 3.2.10. Farm 2 birth, weaning and turn-out weights for 1990 born calves in order of calving date. Part B.

FARM 2

Graph to compare birth, weaning and turn-out weights for 1991 calf crop

Figure 3.2.11. Farm 2 birth, weaning and turn-out weights for 1991 born calves in order of calving date. Part A.

Graph to compare birth, weaning and turn-out weights for 1991 calf crop

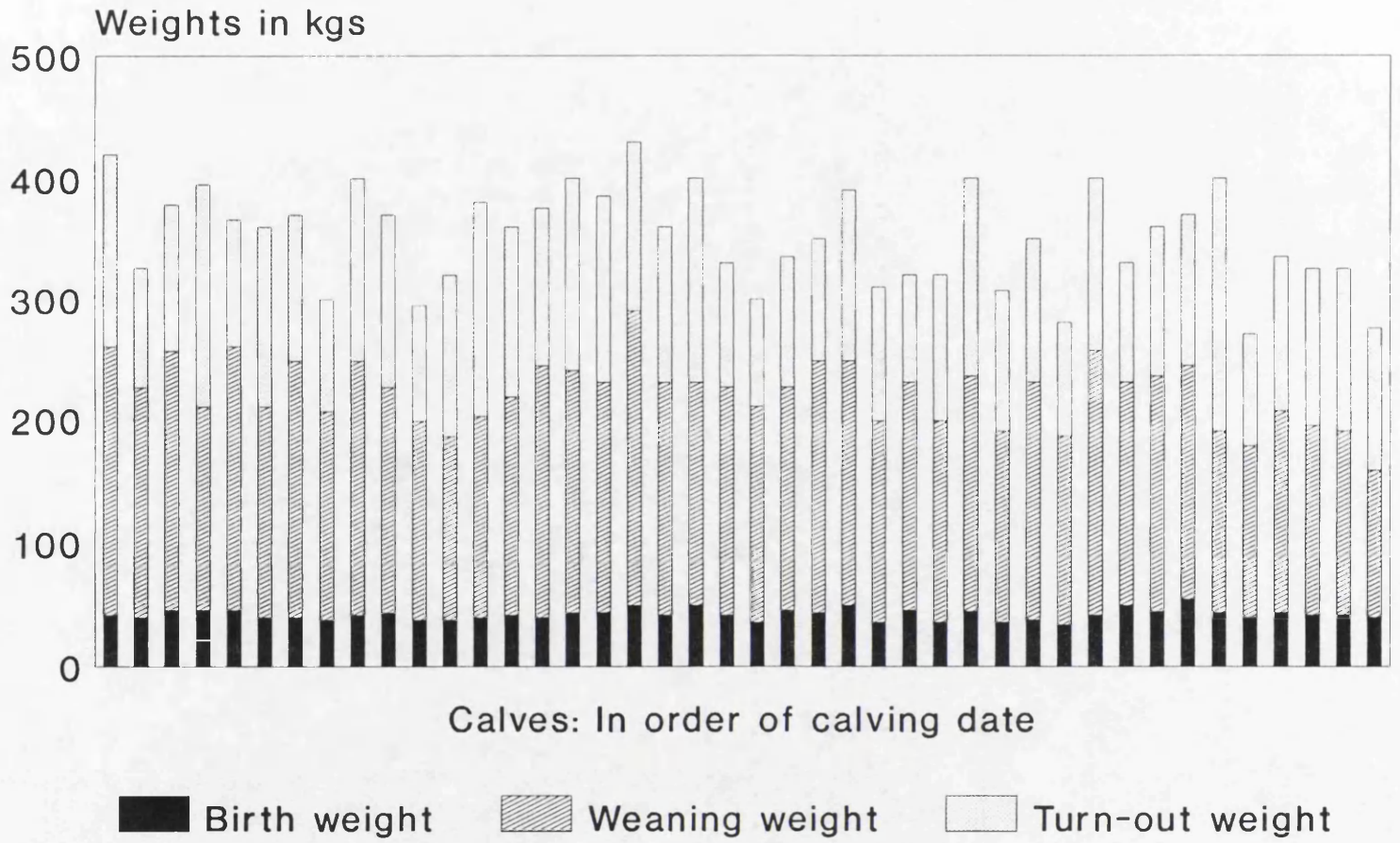


Figure 3.2.12. Farm 2 birth, weaning and turn-out weights for 1991 born calves in order of calving date. Part B.

SECTION 3. FARM 3

3.3.1. BACKGROUND INFORMATION

This was a lowland farm with 100 spring calving and 40 autumn calving cows. The cows were a mixture of Friesian crosses; crossed with Limousin, Simmental, Hereford and Maine-Anjou bulls. Both cows and heifers were mated with Limousin bulls producing commercial calves which were finished on the farm. Calves were weaned in February, turned out in May and sold the following autumn when 18 months of age. Replacement bulling heifers are bought in at approximately eighteen months of age.

There is a flock of 150 crossbred ewes which are mated with Texel rams to produce fat lambs and a small flock of early lambing Bleu-de-Maine ewes producing pedigree lambs for breeding. There was a small herd of around 15 autumn calving pedigree Limousin cattle.

3.3.2. INITIAL VISIT

Previously the farmer had not kept any records on the commercial side, however he was familiar with record keeping as he had kept good records of the pedigree cattle and sheep. Cows were all tagged with easily read plastic tags and all had metal tags which could be used as a back-up if the plastic tags were lost. For the period of study he was keen to keep records of both cow and calf performance. Records kept can be found in Appendix 3.

Disease problems in calves have included widespread pneumonia outbreaks, especially in the spring born calves, soon after housing with their dams. There has also been diarrhoea in young calves, this has tended to start later in the calving period and has been a particular problem in the autumn born calves.

Timing of management tasks were discussed and after the meeting the farmer was sent a management calendar for spring and autumn calving cows (Appendix 3.(ii).).

3.3.3. ROUTINE TASKS

DEHORNING

Calves were usually disbudded when seven to ten days of age so this would be continued.

CASTRATION

Spring born bull calves have been castrated surgically by the veterinary surgeon before housing in October. From autumn 1989 approximately twenty five of the biggest spring born bull calves were to be left entire, weaned in October and fed on an intensive cereal diet. The remaining bull calves would be surgically castrated by the veterinary surgeon in October and kept as before.

PREGNANCY DIAGNOSIS

The spring calving cows had previously been examined routinely for pregnancy by the veterinary surgeon in mid-October. This is an ideal time for this as cows will be from six to fourteen weeks in calf when the stage of calving is easier to assess than in the later stages of pregnancy.

CONDITION SCORING

On the initial visit the farmer seemed aware of Condition Scoring techniques and targets. Spring calving cows were assesed for condition in October, February and July when being handled for pregnancy diagnosis, weaning from calves and moving from one field to the other. Autumn calving cows were assessed in Novembe, April and July when being handled for worming, pregnancy diagnosis and weaning of calves.

In Autumn 1990 the autumn calving cows were on a very bare pasture so lost condition before housing, this may have contributed to the fact that the cows were slow to get back in calf. In future it was advised to buffer feed cows outdoors with silage if the pasture was becoming bare, this would also decrease the risk of hypomagnesaemia which there had been cases of in the past.

On all other occasions cow condition was ideal and all cows were in fairly similar condition.

3.3.4. DISEASE MONITORING

DIARRHOEA

In the past the early spring calving cows calved indoors and remained in the calving pens with their calves until all cows were turned out in early May. These early born calves often had diarrhoea and would contaminate the calving field so later calves would be infected and develop diarrhoea. It was advised to put the early calving cows outdoors a week before calving was due to start and to let them calve outdoors. If assistance was required at calving or if the cow had to be brought inside to hand milk then both the cow and calf should remain indoors for no longer than 12 hours.

Spring calving began in mid-April in 1990 and a visit was made on 19th of April to see how calving was progressing. Blood samples were taken from a group of calves up to three days of age and four out of six of these calves had very low immunoglobulin levels. The farmer subsequently became more vigilant of newly born calves and examined all within four hours of birth by palpating their abdomens to ensure all calves had received adequate colostrum. Further sampling of calves in mid-May found six out of six calves sampled had high immunoglobulin levels. There were no cases of severe diarrhoea in these spring born calves, occasional cases of mild diarrhoea were seen and these responded well to treatment with one bolus containing trimethoprim and sulphadiazine ('Scorprin'- Willows Francis Veterinary, Crawley, West Sussex.)

The farmer was pleased with calving all cows outdoors and this combined with the extra vigilance over colostrum seemed to drastically reduce the diarrhoea problem in spring.

The autumn calving cows have tended to calve over a prolonged period

from September to the end of December. In autumn the earlier calving cows calve outdoors where there are few problems, however in October all cows are brought indoors where there are severe diarrhoea problems in young calves sometimes resulting in deaths. In 1989, soon after the initial visit, a visit was made in mid-October to investigate a diarrhoea outbreak which had started in calves one to two weeks old. The calves affected had all been born indoors. Faecal samples were collected from diarrhoeic calves and blood samples were collected from calves under three days of age to check immunoglobulin status. The results of the blood samples revealed that two out of the five calves sampled had low immunoglobulin levels. Rotavirus and *Cryptosporidium parvum* were found in the faeces samples examined.

It was planned to try to calve all the autumn calving cows within two months in 1990 and to calve them all outdoors and not to bring cows and calves indoors until calves were three weeks old. It was hoped that this change in management would stop the diarrhoea. However there was a problem getting some of the autumn calving cows back in calf in late 1989 and many were not going to calve till November and December 1990 when it would be unsuitable to have cows calving outdoors. It was decided to vaccinate all those due to calve from mid-October onwards with a vaccine containing inactivated bovine rotavirus and *E. coli* antigens ('Rotavec-K99'- Coopers Pitman-Moore, Crewe.) one to three months pre-calving to protect against Rotavirus diarrhoea in the calves.

In autumn 1990 most of the later born calves had diarrhoea however most responded well to treatment. Some were affected at a few days old and others when ten to fourteen days old. Blood samples to look at immunoglobulin status again found some low levels. Faecal samples from the younger calves found non-b-haemolytic *E-Coli* and in samples from older calves *Cryptosporidium parvum* oocysts were seen in smears but there was no Rotavirus found. The

farmer was advised to ensure that all calves received adequate colostrum which should control the *E-Coli* diarrhoea and although there is no means to control or treat diarrhoea caused by *Cryptosporidium parvum*, as long as all other pathogens are minimized calves will usually recover with supportive therapy if required.

PNEUMONIA

In the past there had been severe pneumonia outbreaks especially in the spring born calves soon after housing. A wind tunnel had been put above the calf creep area with fans at either end and vents in the bottom so air was drawn from outdoors down onto the calves to improve ventilation.

In 1989 one quarter of the calves, to be reared intensively, would now be housed elsewhere so this would decrease the stocking density in the calf creep.

Early in December 1989 approximately six weeks after housing there was an outbreak of pneumonia in the spring born calves. The farm was visited and the affected animals assessed. Approximately one quarter of the group were affected having elevated temperatures, tachypnoea and hyperpnoea. All affected animals were injected with an a sulphadimidine preparation ('Sulfoxine 33' - Univet, Bicester, Oxfordshire.) and a non-steroidal anti-inflammatory drug, flunixin meglumine ('Finadyne'- Schering-Plough Animal Health, Mildenhall, Suffolk.) and the remainder of the calves were treated with a long acting antibacterial preparation containing sulphamethoxypyridazine ('Sulfoxine LA' , Univet.). The calves responded well to treatment and there were no more outbreaks of respiratory disease throughout the housing period.

Paired samples were collected for serology however the samples were mislaid by the laboratory so no results were obtained.

In early November 1990 a fortnight after housing, there was an outbreak

of pneumonia in the spring born calves and approximately 50% were affected. The calves were dull with increased temperatures and some had nasal discharges. Treatment was similar to that in 1989 and the response was good with no relapses. Identified serum samples were taken from a group of calves at the first signs of disease and repeat samples were collected from the same group two weeks later. Results were very low titres and no seroconversion to either RSV, PI3 or IBR viruses.

From these results it was not deemed necessary to vaccinate calves against the common respiratory viruses so long as the management on the farm remained constant. It was re-emphasized that stress at housing should be minimized to decrease the severity of respiratory disease outbreaks by worming and clipping calves before, rather than at, housing.

TRACE ELEMENT DEFICIENCY

In the past low serum copper and vitamin B_{12} levels have been found. To combat copper deficiency in calves injections of copper calcium edetate ('Bovicoppa'- BK Veterinary Products Ltd., Bury St Edmonds, Suffolk.) are given at birth, high copper minerals are added to concentrates fed over winter and, while at grass, they have access to high copper minerals. The cows have access to high copper minerals while housed.

To try to control the deficiency of cobalt some of the grazing fields are top-dressed with cobalt sulphate in spring.

Both cows and calves were sampled at intervals over the first year of the study, for results see Appendix 3 (iii). Vitamin B_{12} levels in spring calving cows and their calves in December 1989 and January 1990 were within normal ranges and this may have coincided with the fact that these animals had grazed pastures

treated with Cobalt Sulphate in the spring. The autumn calving cows who grazed untreated pastures had marginal vitamin B_{12} levels when sampled in January 1990. It was recommended in future to treat all pastures including those to be cut for silage.

Copper levels remained within normal ranges in all groups on all occasions therefore control measures seemed to be adequate and were continued.

A selenium deficiency had not previously been diagnosed on the farm, however the free access minerals offered to cows over the winter and to calves during the summer had high levels of selenium. The results of blood samples found adequate glutathione peroxidase levels in most samples apart from some marginal levels in autumn born calves in February 1990. It seemed likely that the levels of selenium on the farm were marginal but that the free access minerals were helping to maintain blood levels. It was suggested that calves should be injected with barium selenate ('Deposel'- Rycovet Ltd., Glasgow.) at birth which would be slowly released from the injection site over approximately nine months. This should ensure adequate levels over the period of maximum risk. Thereafter the free access minerals would be available.

It was suggested that a multiple trace element bolus be given to year old calves at turn-out so all calves would be known to be supplemented rather than offering free access minerals. However for the future the farmer would rather continue with free access minerals.

BULL BEEF CALVES

In October 1990 approximately 25 of the better bull calves were weaned and put onto an intensive cereal diet in an endeavour to try to sell them finished in April 1990 at approximately one year of age. In February 1990 a few of these calves were noted to be lame. On examination there was no particular heat, pain or swelling in any joints, bones or muscles but the animals appeared to have a stiff gait especially in the hindlimbs. The calves were approximately 350kg in weight and were being fed 8kg of concentrates per head per day and average quality silage was available. The concentrates were home mixed and consisited of 75% barley, 22% Sugar beet pulp and 3% high protein concentrates. It was calculated that these calves would be receiving around 24g calcium and 23g phosphorous each day. The recommended levels for large frame bull calves with an expected live weight gain of 1 kg/ day are 32g calcium and 19g phosphorous (NRC, 1984).

The animals were therefore receiving insufficient calcium. Low calcium levels in the blood stimulate production of Parathyroid hormone which acts to increase levels of calcium in the blood. One of the mechanisms of action is to mobilise calcium from bone. If this happens over a period of time especially in young animals where bones are still growing an osteodystrophy may occur, this can take the form of bone and/or joint changes. This syndrome which is sometimes called secondary nutritional hyperparathyroidism is recognised in many species including cattle (Jonsson *et al,* 1972).

The farmer was advised to increase the levels of calcium in the home mix ration.

REPRODUCTIVE PERFORMANCE

The spring calving cows have been well managed in previous years and the calving period extends for approximately ten weeks (Fig 3.3.1.). The heifers are bulled to start calving two weeks before the cows so are allowed a little longer to get back in calf the following year. This has resulted the farm maintaining good tight calving periods (Fig 3.3.2.). The average calving interval for the spring calving cows between the 1990 and 1991 calving was 362 days which is below the target of 365 days (see Appendix 3.(iv).).

The autumn calving period tends to be more prolonged, some of this is due to the pedigree cattle being bulled using artificial insemination. In late autumn 1989 the Limousins were not conceiving, it was suspected that the timing of the artificial insemination was not correct. Progesterone impregnated sponges ('Prid'- Sanofi Animal Health Ltd., Watford, Hertfordshire.) were used to synchronize oestrus in these cows and they were served using artificial insemination at a fixed time after withdrawal of the sponges. This procedure proved successful with the cows conceiving.

Some of the autumn calving commercial cows tended to have calving intervals of greater than the target of one year. In 1990 this may have been due to severe weight loss in late autumn so cows had prolonged intervals from calving to first oestrus and reduced conception rates. Since the introduction of buffer feeding of silage the calving intervals are nearer to the target of one year.

In the future no commercial cows will calve in autumn, those calving in autumn at present will be kept until they require culling.

FARM 3

Calving spans for 1990 and 1991

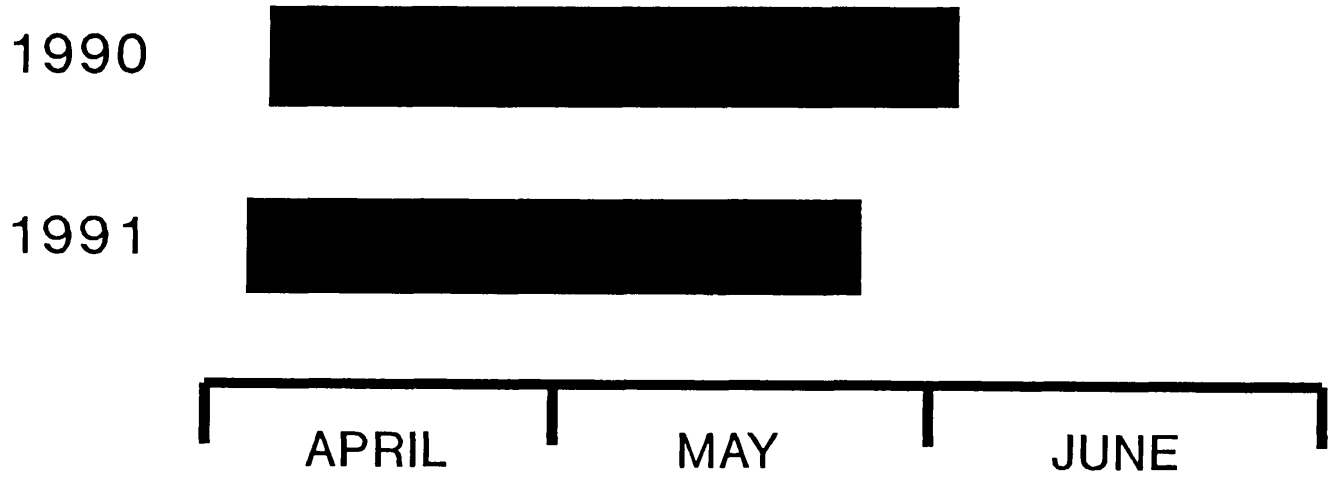


Figure 3.3.1. Calving spans on farm 3.

FARM 3

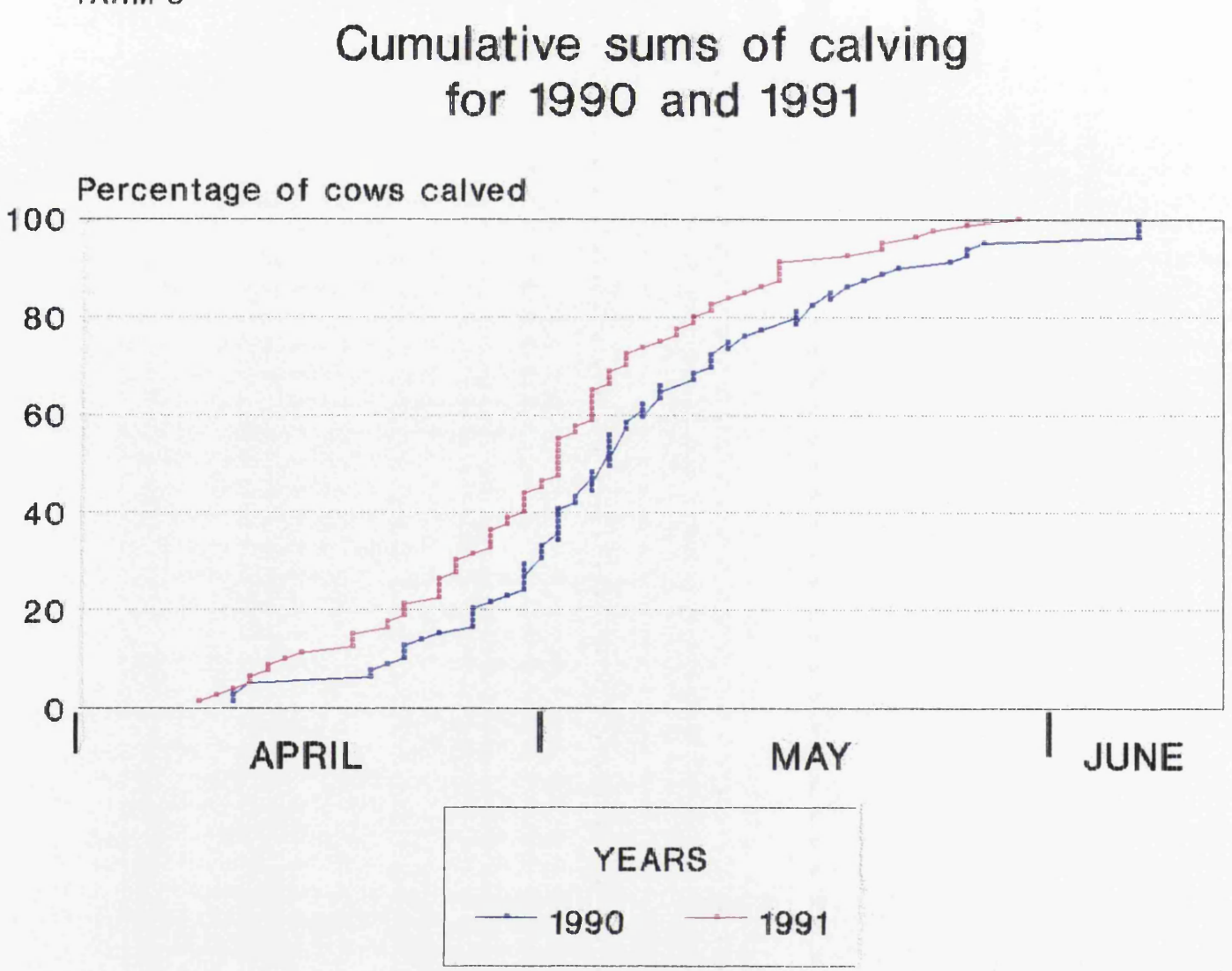


Figure 3.3.2.Calving analysis for farm 3

(Original in colour)

CALF PERFORMANCE

Calves born in spring 1990 were weighed at birth and again at weaning time. The bull beef calves were not included in any of the figures. Unfortunately many of the tags were lost in the interim period as can be seen by the number of blanks in Fig 3.3.3.. Live weight gains recorded were very good and fairly consistent. The average LWGs from birth in spring to weaning in February was 0.85 kg/day which is high.

The weights were plotted on a graph in order of calves heaviest at birth (Fig 3.3.4.). From the graph there seemed to be no correlation between calves heaviest at birth and those heaviest at weaning. This was confirmed by statistical analysis when correlation was found to be 0.23 which is very low.

Performance records for 1990 spring born calves

Calf Sex	Calf Breed	Birth Wgt	Weaning Wgt
F	LIM	39	340
F		40	370
F	LIM	42	330
F	LIM	44	290
F	LIM	44	315
F	LIM	42	310
F	LIM	42	300
F	LIM	43	280
F	LIM	51	350
F	LIM	36	
F	LIM	42	
F	LIM	39	325
F	LIM	40	
F	LIM	40	370
F	LIM	0	
F	LIM	43	300
F	LIM	39	300
F	LIM	39	
F	LIM	40	
F	LIM	44	330
F	LIM	43	
F	LIM	42	325
F	LIM	41	
F	LIM	44	
F	LIM	43	
F	MJ	45	315
F	LIM	41	
F	LIM	41	380
F	LIM	44	350
F	LIM	44	320
F		0	
F	LIM	43	360
F	LIM	40	240
F	LIM	40	
F	LIM	44	280
F	MJ	38	
F	LIM	39	310
F	LIM	45	
F	LIM	46	280
F		0	
F	LIM	42	
M	LIM	45	380

Figure 3.3.3. Performance records for 1990 spring born calves.

FARM 3

Performance records for 1990 spring born calves

Calf Sex	Calf Breed	Birth Wgt	Weaning Wgt
M		40	435
M	MJ	40	
M	LIM	43	300
M	MJ	45	
M	LIM	42	325
M	MJ	58	400
M	LIM	43	340
M	LIM	46	
M	LIM	45	
M	LIM	50	
M		43	
M	LIM	43	350
M	LIM	45	
M	LIM	36	
M	MJ	49	
M	LIM	42	395
M	MJ	50	400
M	LIM	43	340
M	LIM	46	
M	LIM	42	
M	LIM	43	
M	LIM	41	
M	MJ	48	
M	LIM	43	330
M	LIM	44	390
M	LIM	39	320
M	LIM	43	
M	LIM	0	
M	LIM	43	
M	LIM	46	300
M	LIM	42	
M	LIM	40	
M	LIM	43	
M	LIM	45	340
M	LIM	42	
M	LIM	45	320
M	LIM	44	330

Total nos. of birth weights : 75

Total nos. of weaning weights : 41

% 45.3% calves lost tags

Average weaning wgt: 333.3 kg

Average LWG B-W : 0.85 kg/day

Average LWG Bull calves : 0.9 kg/day

Average LWG Heifer calves : 0.81 kg/day

Figure 3.3.3. Performance records for 1990 spring born calves. (continued)

FARM 3

Graph to compare birth and weaning weights for 1990 calf crop.

Figure 3.3.4. Farm 3 birth and weaning weights for 1990 born calves in order of birth weight.

SECTION 4. FARM 4

3.4.1. BACKGROUND INFORMATION

This herd was re-established in autumn 1989 following slaughter of the previous herd under the Brucellosis Order after isolation of Brucella abortus on the farm.

A total of 171 autumn calving cows with calves at foot were bought from three different sources. The cows were Friesians crossed with either Hereford or Limousin and were first or second calving cows. It was planned to sell the calves as store cattle in the autumn sales.

Spring calving cows were bought from two sources and were pregnant, 20 cows from one source were bought with their calves at foot and 50 from another source had already been weaned. The spring born calves would be sold as store cattle in October.

3.4.2. INITIAL VISIT

On the initial visit everything was starting afresh so policies for future management of the herd were discussed. Records would be kept of cow performance including calving details, bulling details and any treatments given. The farmer was not willing to keep individual calf details of either diseases or weights.

A summary of records kept can be found in the Appendix 4. At the end of each year the farmer was sent a summary of individual cow histories for his own

records (Fig 3.4.1.).

3.4.3. ANIMAL MONITORING BEFORE MOVING TO FARM

Before being moved to the farm ten percent of cows from each source were blood sampled to assess serum antibody status to Leptospira, Bovine Herpesvirus 1 and Bovine Viral Diarrhoeal virus. All the autumn calving groups had variable antibody titres to all three pathogens so cows from the three sources had been exposed to the pathogens. The autumn born calves were vaccinated with a vaccine against IBR and PI3 viruses ('Imuresp RP'- Smithkline Beecham Animal Health, Tadworth, Surrey.) before being brought onto the farm.

Serum antibody titres to the three pathogens checked were negative or very low in both spring calving groups so these cows and calves were considered naive and would be kept separate from the autumn calving cows and any replacements would be screened and mixed carefully.

3.4.4. ROUTINE TASKS

DEHORNING

Calves would be disbudded between three and seven weeks of age.

FARM 4

INDIVIDUAL COW HISTORIES

COW NUMBER C42

CALVING DATE 1990 14/03/90 CALVING INTERVAL
CALVING DATE 1991 09/04/91 391 DAYS

1990 CALVING DETAILS

CALVING COMMENTS 1L

BREEDING:

BULLING DATES 25/07/90 GOLDIE

CALF: SEX F
BREED CHAR
COLOUR DUN

PD +VE

COMMENTS: COW SORE LEG

1991 CALVING DETAILS

CALVING COMMENTS 1LA

BREEDING:

BULLING DATES 20/06/91 GOLDIE
14/07/91 SOLO
05/08/91 SOLO

CALF: SEX F
BREED SIM
COLOUR BR

PREDICTED CALVING DATE 21/05/92
PD +VE

COMMENTS: 6/8-FERTAGYL INJ.

Figure 3.4.1. Example of individual cow histories during 1990 and 1991.

CASTRATION

Calves would be castrated by the farmer using a burdizzo when approximately six months old.

PREGNANCY DIAGNOSIS

Spring calving cows were examined for pregnancy in October and the autumn calving cows examined in February. The cows were therefore examined when six to fourteen weeks in calf so the actual stage of pregnancy would be reasonably accurately assessed.

WEANING

Spring born calves would be sold off the dam and autumn born calves weaned in mid-June.

3.4.5. DISEASE MONITORING

DIARRHOEA

There were no cases of diarrhoea throughout the period of study.

OMPHALOPHLEBITIS

In 1990 there were no problems in young calves. However in spring 1991 there was a recurring problem with omphalophlebitis in young calves with a few cases leading to septic arthritis. Cows were moved to a well bedded calving pen just before calving and were turned out with calves within 24 hours of calving. The same area was used to calve all the cows. Despite the area being bedded regularly with fresh straw there had obviously been build up of bacteria in the pen. All calves had their navels dressed with an iodine solution as soon as possible after birth. It was recommended to use tincture of iodine to dress navels as the alcohol included would help dry the navel more quickly, it was also recommended to repeat the dressing twice daily until the calves were turned out.

In future years it was suggested that at least two areas should be set aside to calve cows and to calve a maximum of twenty animals in each area before calving in a new area, and if possible to clean the first area out before re-using.

The autumn calving cows calved outdoors and there were no diseases in young calves throughout the study.

PNEUMONIA

All calves were vaccined against IBR and PI3 viruses ('Imuresp RP'- Smithkline Beecham Animal Health, Tadworth, Surrey.) before housing, the later autumn born calves required a second vaccination once housed which was done when they were disbudded around mid-October.

There were no outbreaks of pneumonia in the calves.

TRACE ELEMENT DEFICIENCY

Cows and calves were monitored over the first year. For results see Appendix 4 (ii).

Selenium levels gradually declined over winter and many were low by April and remained low throughout the summer. It was recommended to inject cows subcutaneously with barium selenate ('Deposel'- Rycovet Ltd., Glasgow.) in mid to late pregnancy, this would be slowly released from the injection site over approximately nine months and levels of selenium in milk would be elevated so calves would receive sufficient selenium so long as milk was their main source of nutrients ie. up to approximately three months of age.

On the majority of occasions copper levels were adequate apart from two of the later spring calving cows that had marginal levels in April 1990. There were a few marginal cobalt levels especially in February and May. It was decided to increase the amount of minerals added to the concentrates fed to calves over winter.

PARASITES

Autumn born calves were vaccinated against lungworm before turn-out using an aqueous suspension of partially inactivated third stage infective lungworm larvae ('Dictol'- Pitman-Moore Ltd., Crewe, Cheshire.) Clean grazing strategies were used to control gastro-intestinal parasites, this consisted of ensuring autumn born calves were grazed on pastures not grazed by calves earlier in the year and not grazed by calves in the spring and early summer of the previous year.

These control measures seemed adequate as no worm eggs or lungworm larvae were found in faecal samples collected monthly during the summer.

REPRODUCTIVE PERFORMANCE

In 1990 calving periods were dictated by when the cows had calved the previous year. The spring calving cows had been bulled before coming on to the farm and pregnancy diagnosis revealed that they would calve from February to June 1990. The management of the later calving cows was very important to try to get them back in calf as quickly as possible. Due to a shortage of silage the farmer had decided to feed the spring calving cows on straw with a high urea liquid supplement ('Granstock-ICI) for the first period of winter. He would then offer silage *ad libitum* from three weeks before the start of calving until turn-out. It was advised that the cows may lose a lot of condition when on the straw and 'Granstock' and that it was not usual to put cows on an improved diet in the last stages of pregnancy when excess fat may be laid in the pelvic canal and calf weight may suddenly increase and both these factors may increase the likelihood of dystokia. An alternative suggested was to feed cows a silage and straw mix throughout the winter and to carefully monitor cow condition so that weight loss was gradual and alter the ratio of silage to straw accordingly. Condition score at turn-out should be 1.5 to 2.0 and if cows were on reasonable spring pastures they should increase condition to achieve a score of 2.5 to 3.0 by the time they were put with the bull. The farmer chose his own option: ie. to feed straw with granstock until three weeks pre-calving when they would be fed silage *ad libitum.*

The calving in spring 1990 was over quite an extended period however, the calving in 1991 over a shorter period (Fig 3.4.2.) as the bull was only with the cows for a fixed time. Within the calving period of 1991 cows calved within a very tight period as illustrated in the graph showing the cumulative sum of calving (Fig 3.4.3.). However there were a group of spring calving cows that were in poor condition at turn-out (C.S. 1.0 - 1.5) which included first calved heifers and those that were bought with calves at foot. These cows proved to be difficult to rebreed

FARM 4

Calving spans for spring 1990 and 1991

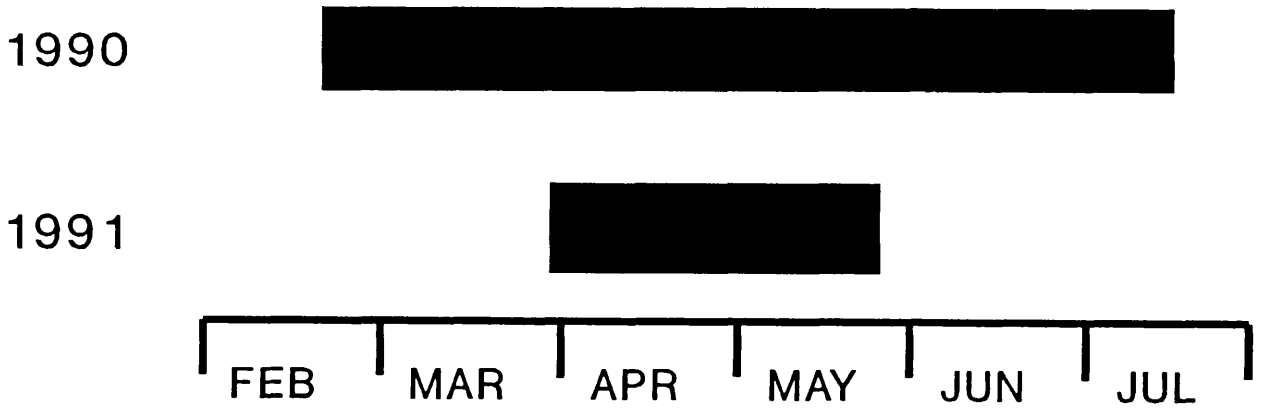


Figure 3.4.2. Periods of calving in spring 1990 and 1991.

FARM 4

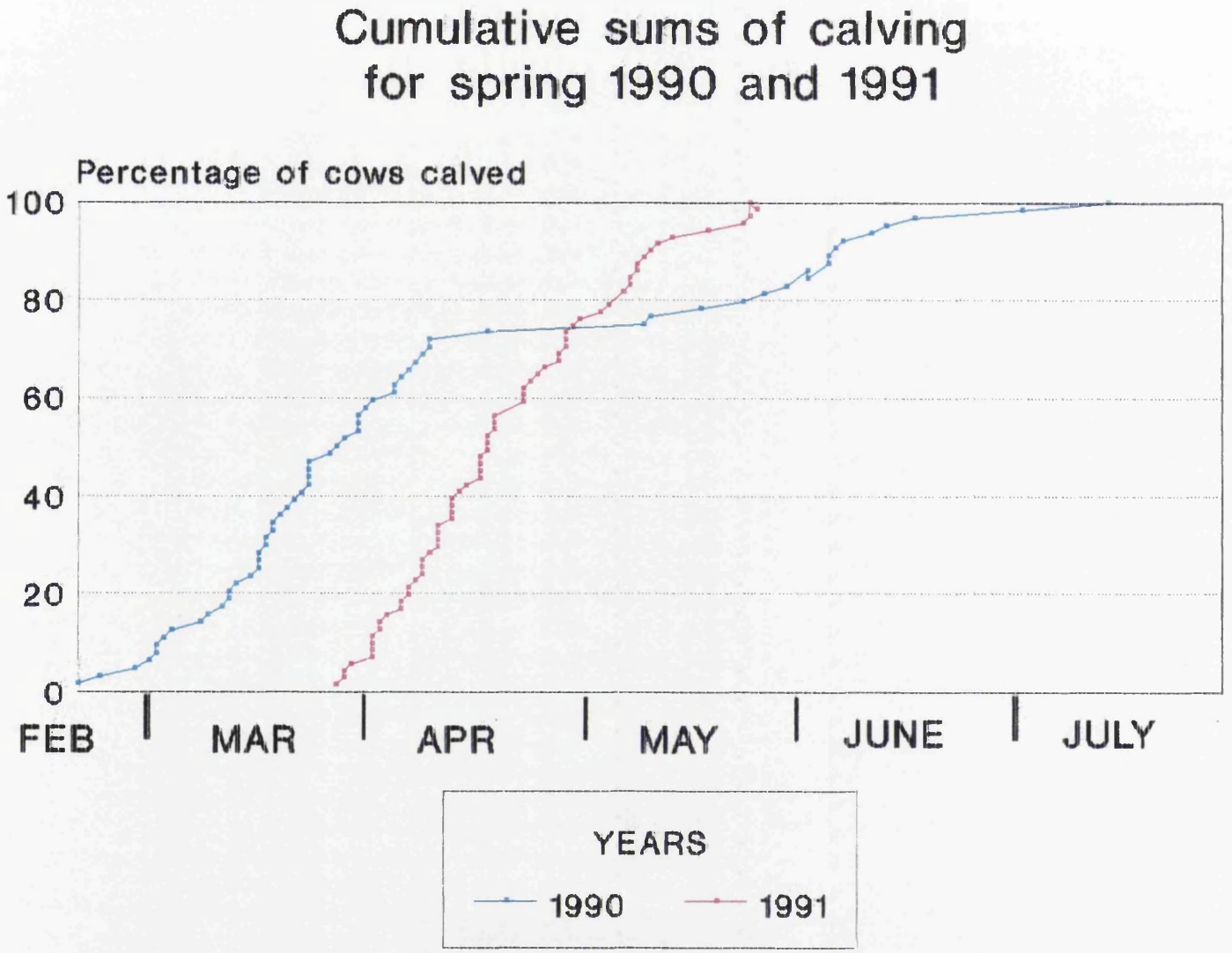


Figure 3.4.3. Calving analysis for farm 4. Spring calvers. (Original in colour)

so the average calving interval between 1990 and 1991 for spring calving cows was prolonged at 390 days. Those not in calf were taken from the bull at the end of August and then put with the bull again with the autumn calving cows.

In spring 1991 the first calving cows were again in poor condition and some were again slow to rebreed. The poor nutrition was going to effect the overall reproductive efficiency of the herd and more and more cows would be calving in the autumn.

The autumn calving cows were bulled on the farm for the 1990 calving season though again the time of calving was dictated by when they calved in 1989. The calving period in 1990 was from August to mid-November. The condition of these cows was well managed and when the grass became scarce in August they were offered silage outdoors. The average calving interval for the autumn calving cows between 1990 and 1991 was 365 days which is ideal. The calving period for 1991 was shorter than the calving period for 1990 (Fig. 3.4.4.) and the cumulative sums for calving both years were similar (Fig. 3.4.5.) indicating that cows had similar reproductive efficiency in both 1990 and 1991.

CALF PERFORMANCE

There were no records kept of calf weights and during the study there was very little clinical disease in the calves. The calves seemed to thrive and many of the autumn born calves were sold finished at one year of age weighing 380 - 430 kgs rather than as stores as initially planned. Some of the smaller calves were sold as stores.

The spring born calves seemed to perform well and due to the tight calving looked a good even group for sale as stores in October.

FARM 4

Calving spans for autumn 1990 and 1991

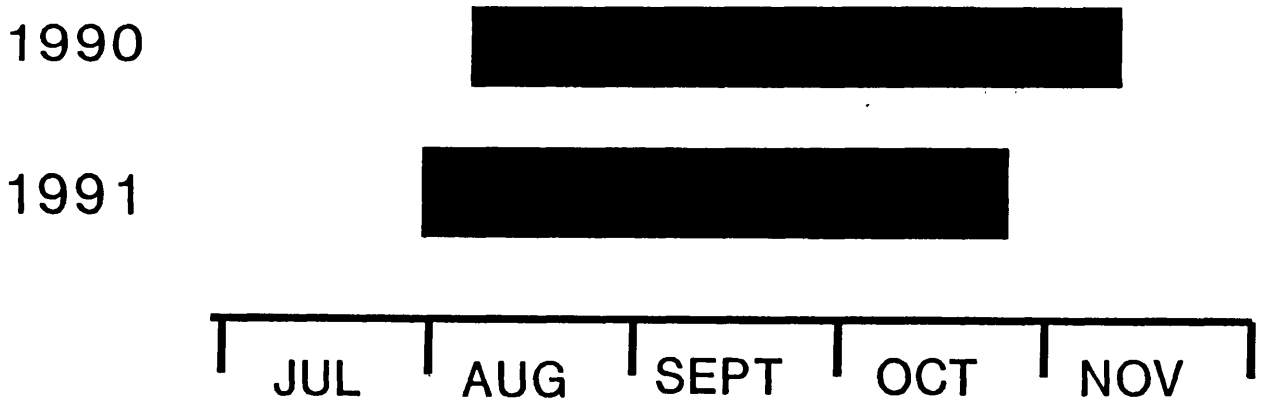


Figure 3.4.4. Periods of calving in autumn 1990 and 1991.

FARM 4

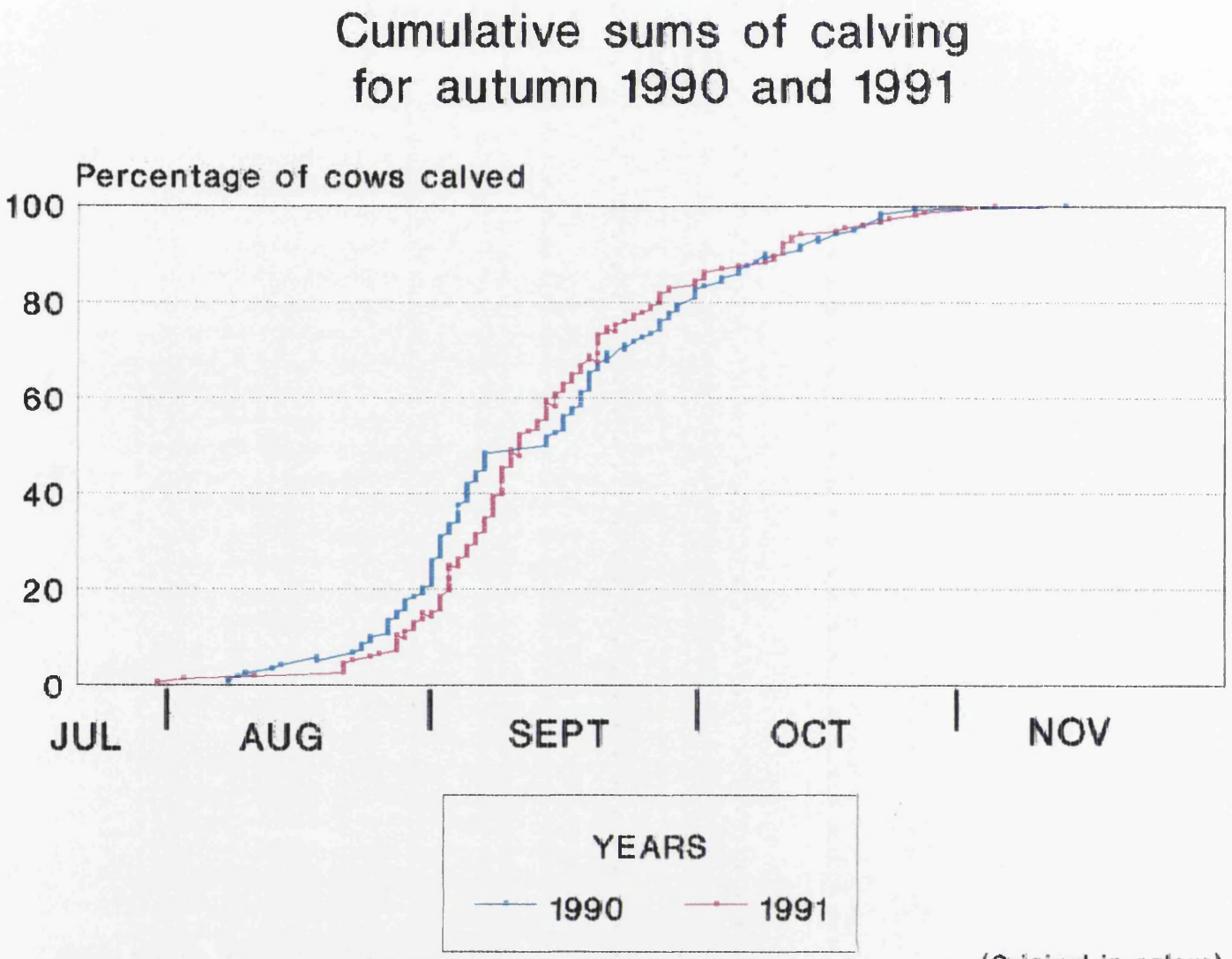


Figure 3.4.5. Calving analysis for farm 4. Autumn calvers.

(Original in colour)

SECTION 5 . FARM 5

3.5.1. BACKGROUND INFORMATION

This was a very large mixed unit. There were 200 Friesian dairy cows, and approximately 50 Friesian multiple suckler cows each used to rear two or three calves, the latter were removed from the milking herd because they were fractious or as a result of a previous mastitis episode were no longer producing milk in all four quarters. Aberdeen Angus and Charolais bulls were mated with these Friesian cows and Aberdeen Angus cross heifers were kept as replacements for the beef suckler herd. The bull calves and the Charolais cross heifers were sold around one year of age as store calves. The Friesians were also bred using artificial insemination , Friesian bulls were chosen to produce heifer replacements for the dairy herd and some Hereford and Limousin bulls were chosen to produce alternative beef cross replacement heifers for the beef suckler herd.

The beef suckler herd had 350 cows whose average age was six years. Calving took place all year round with cows kept in approximately three batches calving from January to April, May to August, and September to December. All calves were sold in the spring or autumn as stores when approximately one year of age.

There were around 1000 breeding ewes, most of these were Scottish Blackfaces and were grazed on hill ground, in addition there were 200 Greyface ewes grazed on in-bye fields. The farm was self sufficient for animal feed and straw, growing a large amount of barley some of which was sold to the brewing industry. There was also a large acreage of potatoes.

3.5.2. INITIAL VISIT

Cow identification on the farm was by the use of three ear tags, a large plastic tag with the number embossed, a small coloured plastic button where the colour indicated the year the cow was born and a metal tag as a back up if the plastic tag was lost. None of the calves were tagged.

Record keeping was very variable, in the past records were kept of when each cow calved. The farmer was asked to keep a pocket note-book and note all daily events including bulling dates, treatments for mastitis or endometritis and calf treatments for diarrhoea or pneumonia, etc. Unfortunately this was not carried out and there were periods when calving dates were not noted, however as calving periods became tighter and disease problems were becoming controlled the farmer was less rushed and found time to keep better records. A summary of records kept can be found in Appendix 5..

The major problem on the farm was disease in calves. More than ninety percent of calves had diarrhoea within the first few weeks of life and soon after housing there were severe pneumonia outbreaks which recurred throughout the housing period with 30 to 40 calves requiring treatment every day.

When finding out about the timing of management events on the farm there were changes advised on the first visit which would decrease handling of animals.

3.5.3. ROUTINE TASKS

DEHORNING

Dehorning of calves had usually been done when calves were three or four months old, it was advised to change this to within the first six weeks of life before colostral immunity had started to wane so decrease the susceptibility of calves to disease after the stress of dehorning.

CASTRATION

Castration had previously been done using a burdizzo when calves were a few months old, it was recommended to castrate calves within 24 hours of birth using a rubber ring. Although initially worried that this may upset calves at such an early stage the farmer soon found that this was not the case and has been very pleased with this change in management which saves a task later on.

PREGNANCY DIAGNOSIS

Pregnancy diagnosis had never been routinely carried out on the farm. It was advised to do this over the period of study when the farmer could decide if he found it was useful and it would provide an opportunity for assessment of cow condition and discussion of problems. This was timed to coincide with weaning.

PARASITE CONTROL

All cattle were injected with Ivermectin ('Ivomec'- MSD Agvet, Hoddesdon, Hertfordshire.) soon after housing every year and calves were clipped along the back to decrease sweating. It was recommended that these procedures should be done before housing to avoid stressing calves once housed which may exacerbate pneumonia outbreaks.

CONDITION SCORING

Due to the fact that cows calved all year round it was difficult to organize regular condition scoring of the cows. All cows were assessed when they were being examined for pregnancy. This tended to coincide with weaning of calves so the decision of when exactly to wean could be decided depending on stage of pregnancy and cow condition. Cow condition was maintained within targets.

3.5.4. DISEASE MONITORING

DIARRHOEA

There have been diarrhoea problems on the farm for many years and now more than 90 percent of calves have diarrhoea within the first few weeks of life. The diarrhoea starts when calves are between five and ten days old and affected animals often require treatment for up to two weeks. Previous investigations have found rotavirus in diarrhoeic faeces so from autumn 1988 all cows

have been injected with a vaccine containing inactivated bovine rotavirus and *E. coli* antigens ('Rotavec-K99'- Coopers Pitman-Moore, Crewe.) one to three months pre-calving so calves acquire antibodies to Rotavirus and enterotoxogenic E-coli in colostrum and later in the dams milk. Since vaccination there has been no rotavirus isolated from diarrhoeic faeces.

Soon after the initial visit another visit was arranged to further investigate the cause diarrhoea. Blood samples were collected from fifteen calves within 72 hours of birth for estimation of serum immunoglobulin status. In general the serum immunoglobulin levels as measured using a Zinc sulphate turbidity test were well over 30 units so calves seemed to be receiving adequate colostrum. The odd cases with low levels were already known to the farmer who seemed to already appreciate the importance of colostrum. Routine monitoring of calf immunoglobulin status throughout the period of the study found consistently high levels.

Faeces samples were collected from all diarrhoeic calves to look for pathogens. In smears of all faecal samples large numbers of *Cryptosporidium parvum* oocysts were found and no other enteropathogens were found in any of the samples. It seemed that cryptosporidiosis was a major problem on the farm.

Advice was given to calve approximately twenty cows in one field and to put the next twenty cows to calve in a clean field, this should have helped to keep contamination to a minimum, decreasing the dose of oocysts encountered by young calves so diarrhoea should not have been so severe. This change in management did not alter the course of the disease in calves so we decided to investigate the possibility that cows were a potential source of infection.

Faeces from a group of fifteen cows was examined for oocysts and in direct smears only one or two oocysts were found, however when faecal samples were concentrated using sucrose flotation and oocyst numbers quantified it was found that the cows excreted an average of 900 oocysts per gram of faeces. Since

an average cow excretes approximately 40 kilograms of faeces each day the cows examined were each excreting around 700 million oocysts every day, so these cows were very likely to be a source of infection for their calves.

A field trial of an new antibacterial preparation was carried out on the farm and it seemed when first used in the diarrhoeic calves that those treated recovered more quickly than those not treated. However when a more formal trial was carried out and numbers of *Cryptosporidium parvum* oocysts counted before and for a week after treatment there were no differences found between treated and control calves.

There is no effective chemotherapeutic agent against *Cryptosporidium parvum* and colostrum does little to influence the severity or duration of disease so to try to minimize the severity of disease a few measures have been advised. To ensure all calves receive adequate colostrum to help protect against other enteropathogens which might complicate infections, to give calves supportive fluid therapy as required , to calve in small groups in fields not used for calving cows previously in the year and to try to keep stocking density to a minimum around calving.

PNEUMONIA

Calves born between May to late October are housed in late November with their dams in a large cubicle house where calves born until to January are housed alongside the older calves once they reach four or five weeks of age. Outbreaks of pneumonia usually start within two or three weeks of housing and there are continuous episodes in various parts of the building throughout the housing period.

The major drawbacks are the size of the building and the fact that calves

of different ages are housed in the same airspace. The long term plan is for all the cows to calve from May to October with the majority calving in early summer which should enable calves of similar ages to be housed together and should obviate the need to bring later born ie. younger calves into the building every few weeks throughout housing.

The building is extremely wide with two rows of cubicles at either side and a large silage clamp between. The calf creep area is between the two rows of cubicles and seems rather airless. The air inlets are feed barriers so are very low, encouraging draughts at calf level. On the right side of the building is a progressive obstruction of the air inlet by rising ground, in fact the eaves at the far right corner are at ground level. There was no air outlet. A visit was made to assess the ventilation in this building. When cubic capacity was measured the amount of airspace per animal was adequate. Inlet areas were adequate but outlet area was inadequate. When smoke bombs were used to look at air flow in the calf creep area the smoke was very slow to move. The farmer was advised to remove the central ridge cappings to help to draw air through the building, and to open the doors at either end of the building to improve ventilation and this would allow the calves go outside where there are concrete yards.

After the ridge had been removed another visit was made to reassess air movement which was still very poor in the calf creep area. The speed of smoke clearance on the left side of the building had improved but the speed on the right side was similar to before so although the outlet in the roof was helping to draw air through the building the obstructed air-inlets on the right side were still a problem. It was felt that ventilation of the building could still be improved and two options were put to the farmer. The first was to put air inlets above animal level by either putting Yorkshire boarding above the feed barriers on both sides of the shed or to cut slits in the roof. The other option was to use mechanical means to improve air flow, plastic tunnels with outlets on the ventral surface

could be put above the calf creep area with fans at either end to draw air from outside through the tunnels and down onto the calves.

The farmer decided initially to wait until the calving period had been tightened and all the cows were calving in the summer and autumn and to see if this alone would stop the pneumonia.

TRACE ELEMENT DEFICIENCY

Blood samples were collected from cows and calves from each of the summer, autumn and winter calving groups in late winter before turn-out, in mid-summer, in late autumn before housing and in early January. These were analysed to assess levels of copper, cobalt and selenium. Results varied over the year but all groups tended to have similar levels of trace elements on each of the sampling occasions. There were low or marginal Vitamin B12 levels on many occasions. Copper levels were low in cows and young calves sampled during the housing period. Selenium levels were low in samples taken in late winter and summer.

After discussing the various possible options to control the trace element deficiencies it was decided to give all cows a multiple trace element bolus containing copper, cobalt, selenium, manganese, zinc, iodine, sulphur and vitamins A, D3 and E ('All Trace'- Agrimin Ltd., Brigg, South Humberside.) in late pregnancy.

REPRODUCTIVE PERFORMANCE

The reproductive efficiency of the cows was excellent with the average calving interval for 1989 being less than a year (Fig 3.5.1.), this is helped by the fact that cows are kept in good condition. All year round calving does create a lot of work for the farmer and the problems with calf diseases are perpetuated as pastures and buildings are never rested. A tighter calving period would make management much easier and allow fields and buildings to be rested. The farmer was a little unsure of changing calving policy initially especially since it would require either culling of cows or holding cows back to calf to calve later which would reduce the output of these cows. With the tight margins involved in farming it was necessary for the farmer to be sure of the long term benefits before making any radical changes.

Heifer management would have to be altered to calve the heifers a few weeks before the cows and only allow them to run with the bull for eight weeks so calving will be kept tight in future years. Unfortunately there were 32 heifers due to calve from February to late April 1990 so these would have to be held back one to three month to calve the following May. The farmer was not keen to hold these heifers back that year so they calved again over winter in 1991. However the silage in winter 1991 was not very good and the cows lost a lot of condition and the weather was very inclement and all the calves had severe diarrhoea and pneumonia requiring prolonged and repeated treatments, and were the poorest calves at sale time. So a decision was made to hold the young cows back and put them to the bull in August to calve the following May. There was still a group of older cows calving over winter, all those over eight years of age were culled and the younger cows were held back. Winter 1992 was the first year when no cows were calving. Figure 3.5.2. illustrates the calving pattern since 1988, some of the figures are estimates by the farmer of numbers calving in that

FARM 5 Calving Intervals from 1988 to 1991 (DAYS)

1988-1989	1989-1990	1990-1991
398	305	269
391	310	299
391	327	300
389	328	305
384	339	317
382	340	323
381	348	325
381	348	329
381	349	330
380	352	332
377	355	333
374	356	337
373	356	338
372	361	340
370	362	341
367	366	343
366	369	343
363	372	345
363	376	349
360	377	349
359	378	349
358	379	350
355	384	351
352	389	352
352	390	353
351	391	357
350	392	359
348	394	362
347	399	364
343	400	364
342	414	366
337	421	367
332	479	368
326	505	369
324	512	369
323	517	370
322	533	370
318	655	371
317	675	372
315	678	372
314	699	373
314		373
		374
		374
		374
		378
		378
		378
		379
		380
		380
		382
		386
		388
		392
		396
		406
		408
		410
		416
		420
		425
		427
		433
		448
		451
		489
		524
		673

Average calving intervals (days)

1988-1989	1989-199	1990-1991
356 days	414 days	374 days

Figure 3.5.1. Calving intervals for cows on farm 5 between 1988 and 1991.

FARM 5

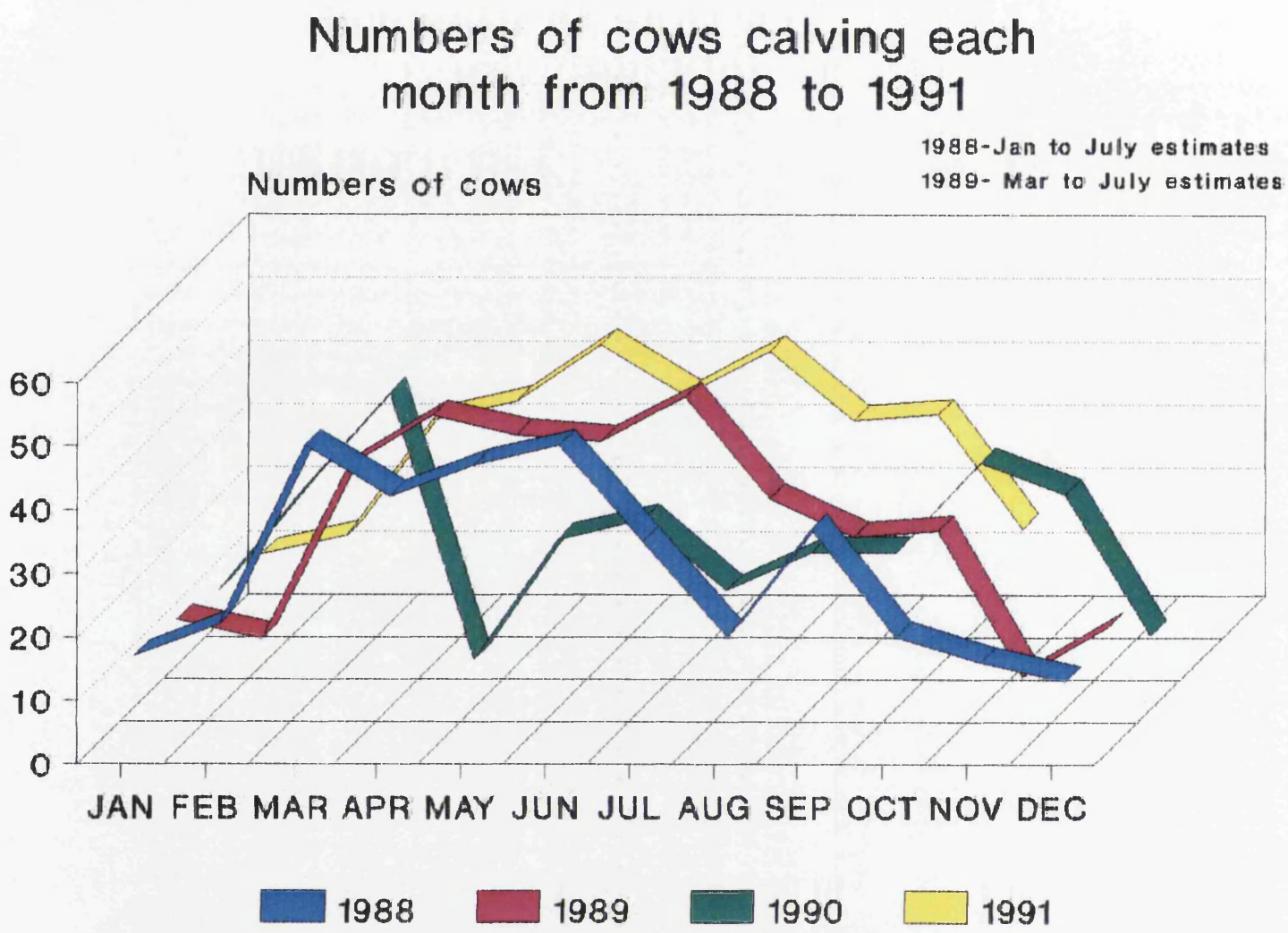


Figure 3.5.2.Calving analysis for farm 5

(Original in colour)

month as in very busy periods records were not kept up to date. It can be seen that the calving period is very gradually moving to the target of summer and autumn.

SECTION 6. FARM 6

3.6.1. BACKGROUND INFORMATION

This was a large hill farm which calved 170 cows each year. Cows were various breeds including Blue-grey, Irish Black, Friesian crossed with: Hereford, Aberdeen Angus and Limousin. Charolais bulls were used and calves were sold in October as stores. Heifer replacements were bought in at a few weeks of age and reared on the farm.

Cows were kept in four groups with each group calving over four to five months. The largest group of 100 cows calved from August to January and these cows were housed over the winter. They were grazed on hill ground in the summer where they started calving and then in October they were brought to lowground pastures where they were kept until housing in late November. Two smaller groups of 15 and 35 cows calved between December and June and were outwintered. There were 24 heifers which calved from July to September and were housed separately to the rest of the herd.

There were around 2000 Scottish Black-Face ewes, these were mated to Suffolk rams and lambed in March and April and the lambs were sold as stores in August or September.

3.6.2. INITIAL VISIT

The farmer seemed keen to have regular advisory visits to try to reduce some of the herd problems but was not so keen to alter any of the current management procedures. No records of any sort had been kept in the past however the cows were tagged with plastic tags so could be identified and for the period of the study it was planned to record when cows calved.

Previous problems in adult cows have included cases of hypomagnesaemia in spring and autumn and poor fertility in all groups. There have been severe diarrhoea outbreaks in young calves within the first few weeks of life and repeated outbreaks of pneumonia in housed calves over the winter.

3.6.3. ROUTINE TASKS

DEHORNING

Spring born calves were dehorned in June or July by the farmer. It was suggested that this should be done when calves were younger which would reduce the problems with flies laying eggs in the wounds and calves would have higher colostral antibody titres to protect them against disease.

The autumn born calves were dehorned as they were housed. It was suggested that this extra stress at housing should be avoided and that calves should be disbudded when four to six weeks old. From after the first visit all calves were disbudded when four to six weeks of age and this did not seem to cause any problems.

CASTRATION

Autumn born calves were castrated in late March when they were three to eight months old. The older bull and heifer calves had sometimes reached puberty before the bull calves were castrated and there had been some unplanned pregnancies. It was recommended to castrate calves when younger, preferably by using rubber rings at birth, however the farmer was keen to continue as before. It was then suggested that bull and heifer calves should be housed separately to stop the heifers being served and that this would also stop the bull calves chasing the heifers which tended to disrupt other cattle and which may have contributed to the pneumonia outbreaks. Unfortunately this advice was not heeded.

The bull calves have also tried to serve the later calving adult cows, if the fertility of the cows could be improved and cows calved and rebred sooner then this should not continue.

PREGNANCY DIAGNOSIS

The spring calving cows were examined for pregnancy in November to coincide with the cows being wormed and treated for fascioliasis. In November 1989 14 out of 61 spring calving cows were not in calf , seven of these cows were over ten years of age and were culled, the other seven were kept and bulled with the autumn calving cows. It was suspected that the reason for the high numbers of non pregnant cows was poor condition in the early summer.

The autumn calving cows were usually examined for pregnancy in March , in 1990 the bull was still with the cows in March and a number of the cows were not palpably pregnant so were re-examined in April. Again it was suspected that this poor fertility was due to poor nutrition.

PARASITE CONTROL

Autumn born calves were injected subcutaneously with a solution containing Ivermectin ('Ivomec'- MSD-Agvet, Hoddesdon, Hertfordshire.) three, eight and thirteen weeks after turn-out in spring. When faecal samples were collected from calves before they were sold in October all samples were negative for worm eggs and lungworm larvae. It seemed therefore that these control measures were adequate and should be continued.

All cows were injected with 'Ivomec' once a year in October or November. Adult cows were also given a suspension containing triclabendazole ('Fasinex'- Ciba-Geigy Agrochemicals, Whittlesford, Cambridge.) to minimize infestation of pastures with fluke eggs.

CONDITION SCORING

During the initial visit in September 1989 the autumn calving cows were very lean (Condition Score (C.S.) - 1.5-2.0). After discussion about control of hypomagnesaemia it was decided to feed these cows cobs containing high levels of magnesium after they had been moved from hill to lowground pastures. This extra feeding would hopefully improve condition so cows would be in adequate condition to rebreed. Cow condition in December had generally improved (C.S. 2.0-2.5) with the exception of cows that just calved for the second time (C.S. 1.5). The cows were fed on silage over the winter on a self feed basis from a pit. The amount of silage available each day was very restricted and the available feeding space per animal was very limited so the younger cows were not able to obtain enough feed due to competition from the older cows. It was recommended to increase the feed space available by putting silage in ring feeders or feed wagons

in the yards. The farmer felt that this extra feed space was not necessary and would be too difficult to organize.

The spring calving cows also seemed in poor condition during the initial visit. The leanest cows in the past had been over-wintered indoors and the others were outwintered. In December 1989 all the spring calving cows were condition scored. It is usual with spring calving cows to be condition score (C.S.) 2.5 - 3.0 at the end of autumn after which they can afford to lose approximately one C.S. over winter to calve at C.S. 1.5 - 2.0. The cows that were indoors were C.S. 0.5 - 1.0 and seemed to have lost condition since September. It was recommended that these cows be fed to improve condition so they calved at C.S. 1.5 - 2.0 . The cows outdoors were C.S. 1.5 - 2.0. There was very little grass in the field and the cows were being supplemented with approximately one pound of cobs per head per day. It was recommended to feed these cows some extra forage so silage was taken to the cows in a feed wagon. In January during a visit it was noted that there were only 28 spaces at the feed wagon for the 36 cows outdoors and that the fitter cows were eating but the leaner cows were unable to feed and stood near to the wagon looking hungry. It was decided to feed two bales of hay each day. In late January these cows were again examined and were C.S. 2.0 - 2.5 and the cows that were housed, who were now being fed a little more (unspecified amount), were C.S. 1.0 - 1.5.

By calving time the spring calving cows were C.S. 1.5, but after calving they were put on pastures already heavily grazed by ewes and lambs. It was advised that at this period it was important that the cows were on good pasture so they could improve condition for mating. Unfortunately there was no suitable area to put the cows. The younger fitter cows would manage to eat most feed over the winter and be in adequate condition at calving to conceive in June or July without needing to improve condition, however the older and leaner cows would be bullied by the fitter cows and lose condition over the winter and these

cows would take a long time before they began to cycle after calving so would calve later each year. It was likely that there would always be a shortage of grass in June and July when there were many ewes and lambs competing for grass and when fields were being left for silage which would be cut in late July. It was therefore important that these spring calving cows should not be allowed to lose condition over winter so if they calved at C.S. 2.0 - 2.5 they would not need to improve condition to start cycling. If, as in previous years, there was a shortage of silage over winter then silage and / or hay would need to be bought in.

3.6.4. DISEASE MONITORING

HYPOMAGNESAEMIA

There had been cases of hypomagnesaemia in cows in both spring and autumn which sometimes resulted in deaths. To try to prevent this all cows were given two magnesium boluses ('Rumbol'- Agrimin Limited, Brigg, South Humberside.) at turn-out in spring and there was a high magnesium syrup available throughout spring and early summer and again in late summer and autumn. In late summer the autumn calving cows received two magnesium boluses before the start of calving in August.

There have still been cases of hypomagnesaemia especially in the autumn in recently calved cows after the cows had moved from the hill to the lowground fields. The magnesium bullets would provide extra magnesium for a maximum of three weeks and the cases were seen after this period. It was suggested to feed the cows forage when the grass became bare however this was not possible. It was then suggested that cobs containing high levels of magnesium were fed to

cows once they were moved to the lowground fields. The cobs would provide extra energy in addition to the extra magnesium. The cost of cobs was actually cheaper than giving further magnesium bullets, the bullets would cost £2.70 per head for three weeks and the cobs £2.62 per head for the same period. This was started in autumn 1990 after which there have been no cases of hypomagnesaemia. The farmer was very pleased with the fact that cow condition improved on the cobs so started offering high magnesium cobs instead of the magnesium boluses at to cows at turn-out in spring. It was hoped that this would help the spring calving cows improve condition before rebreeding.

DIARRHOEA

There have been severe problems with diarrhoea in young calves which has resulted in many calf deaths. Cows were vaccinated with a combined vaccine containing formalin killed cells of selected strains of *Escherichia coli* of bovine origin, strains of *Salmonella dublin, Salmonella typhimurium* and Roberts Types 1, 2, 3 and 4 of *Pasteurella multocida* ('Bovivac plus'- Hoechst Animal Health, Milton Keynes, Buckinghamshire) to try to protect calves against Colibacillosis and Salmonellosis.

In March 1990 after a number of the spring calving cows had calved and there was diarrhoea in the calves a visit was made to investigate the diarrhoea problem. The cows had calved in the fields where they were outwintered. When the visit was made there were many diarrhoeic calves ranging in age from two days to twenty days. There were also two calves that had died as a result of severe diarrhoea but these had been dead for a number of days so autolytic change was too severe for a post mortem examination to be yield useful results. Treatment had been using oral antibacterial boluses containing Trimethoprim

and Sulphadiazine ('Scorprin'- Willows Francis Veterinary, Crawley, West Sussex.) and 'home made' fluid replacement which consisted of drenching calves with a solution of one teaspoonful of salt and one teaspoonful of sugar mixed with one pint of water three times a day. This preparation contained too high a concentration of salt, too low a concentration of sugar and was given at too low a volume. The stockman was immediately advised that the diarrhoeic calves were not receiving enough fluid replacement and was supplied with oral rehydration therapy containing sachets of glucose and an electrolyte and glycine mixture which should be made up to 2 litres with water ('Ion-Aid'- Rhone Merieux Limited, Harlow, Essex.) He was also given an oesophageal feeder and careful instructions on administration.

Six calves under three days of age were blood sampled to check immunoglobulin status. Three of the six calves had levels under ten units. The stockman had intimated that all these calves had been born unassisted and that they had all got up and sucked their dams quite quickly. The farmer was advised of the low immunoglobulin status of the calves and it was hoped he and the stockman together would manage to improve the colostral status of calves. He was recommended to ensure all calves suckled within four hours of birth and after seen to suckle the calf's abdomen should be palpated to ensure the abomasum was full. A mixture of pathogens were found in faecal samples from affected calves including Rotavirus, Coronavirus, Cryptosporidia and both non haemolytic and B-haemolytic E-Coli. On the basis of the antibiotic sensitivities of the bacteria found boluses containing Amoxycillin Trihydrate and potassium clavulanate were recommended ('Synulox'- Smithkline Beecham Animal Health, Tadworth, Surrey.). It was stressed that colostrum was very important especially when the calves were encountering so many pathogens. The availability of a vaccine against Rotavirus was discussed and the fact that this may be more useful for these calves than the 'Boviviac plus', however the farmer preferred to

continue as before.

Unfortunately none of the recommendations were followed and diarrhoea problems continued.

PNEUMONIA

Each year soon after housing there were outbreaks of pneumonia in the autumn born calves. The calves were born from July to January and the later born calves were born outdoors and brought inside with the rest of the group when they were two to three weeks old. As a preventive measure the calves were vaccinated with 'Bovivac plus'. The calves were injected subcutaneously with the vaccine when housed and again three weeks later. Adult cows are also vaccinated with this preparation in late pregnancy to ensure young calves receive antibodies to these pathogens in colostrum.

The buildings where the cattle were housed consisted of a large cubicle shed with a building at either end where only calves had access (calf creep). The cubicle house was open at one end allowing cows and calves access to the self-feed silage from a pit which ran down the middle of the shed. There were fifty cows and calves on each side. There was no ventilation in the cubicle shed apart from the open end. The calf creep to the right side of the shed had recently been rebuilt and was ideal with plenty space for calves, an open ridge in the roof and air inlet areas above calf level on three sides of the building. The creep on the left side was extremely small and would not hold fifty calves at one time. There was no ventilation in this creep until winter 1990 when part of the roof blew off ! after which the straw bedding became extremely wet and the calves were reluctant to use the creep at all preferring to lie in the cubicle area. It was planned to build a new creep on the left side in summer 1991.

On 14th December 1989 there was an outbreak of pneumonia which affected both sides of the house. Calves with elevated temperatures were injected with amoxycillin Trihydrate ('Betamox LA'- Norbrook Laboratories Ltd., Bewdley, Worcestershire.) and the remainder of the calves were injected with sulphamethoxypyridazine ('Sulfoxine LA'- Univet Ltd., Bicester, Oxfordshire.) In general the response to treatments was good however a few calves required repeated treatments. There were further less severe outbreaks of pneumonia throughout the winter in calves on the left side, only affected calves were treated with 'Betamox LA' and most responded to treatment though again two or three calves required repeated treatments. When the farmer first noted clinical signs of pneumonia in calves eg. coughing and nasal discharges he visited the local veterinary practice where he purchased therapeutics which he administered himself. He felt that a visit by the veterinary surgeon was not necessary and further investigation was not possible as no notification was given of the problem. Details were obtained after the event.

In autumn 1990 calves were vaccinated intranasally with a preparation containing live PI3 and IBR viruses ('Imuresp RP'- Smithkline Beecham Animal Health, Tadworth, Surrey.) on housing. This was used in place of the 'Bovivac plus'. In winter 1990/91 there were again several outbreaks of pneumonia in the calves especially those housed to the left side of the building.

TRACE ELEMENT DEFICIENCY

The farmer was quite concerned that there were trace element deficiencies on the farm so was happy for the cows and calves to be sampled regularly to ascertain levels of trace elements on the farm. Samples were taken from ten percent of groups of cattle in October / November, March, July and again in

October. On all occasions all cattle had adequate copper levels. On all occasions some animals in all groups had marginal or low levels of both cobalt and selenium. The spring calving cows and their calves had the lowest levels of both cobalt and selenium especially in July.

Topdressing of pastures was not considered practical so to improve the cobalt status it was decided to give the spring born calves a cobalt bullet ('Permaco C'- Coopers Pitman-Moore, Crewe, Cheshire.) when they were three months old. To control selenium deficiency it was recommended to inject cows with a paste containing barium selenate ('Deposel'- Rycovet, Glasgow.) in late pregnancy.

The autumn born calves were fed creep feed over winter to which a mineral mix would be added and when turned out in spring these calves would be injected with Deposel and given a cobalt bullet.

CALF PERFORMANCE

Although around fifty percent of the autumn born calves had diarrhoea in the first few weeks of life and around thirty percent required treatments for pneumonia over winter most performed quite well over the year. The calves were creep fed over winter with a barley mix and fed *ad libitum* until they were consuming around three kilograms per day. Calves were weaned when turned out in spring and put onto the best pasture available and wormed regularly. In early autumn they were supplemented at grass with a bought-in concentrate mix containing 14% crude protein, this was gradually increased every fortnight till they were receiving four kilograms per head per day for the final two weeks before sale. At the sale the early born calves would be around 350 - 400 kilograms live weight however, since calving is spread over such a long period

there was a wide variation in calf weights.

The spring born calves were sold at foot and received no supplementary feeding. These calves were again very mixed in size due to the extended calving period and none were very well grown which may be due to the fact that they were grazed on very bare pastures.

FINAL VISIT

In January 1991 approximately 16 months after the first contact with the farm an afternoon was set aside for a discussion on future policies.

It was advised that the farm was overstocked and that radical changes were required if cow fertility was to improve as it was believed to be undernutrition that was causing the poor fertility.

It was suggested that the spring calving cows could be sold and that cows should calve only in the autumn as both autumn calving cows and their calves seem to do much better than the spring calving cows. This would cut down the grazing pressures and mean there would be more stored forage for the rest of the cattle. All cows and calves would be housed over winter as although the farm used to stock hardy hill breeds like the Galloway and Aberdeen Angus in a bid for more commercial calves there had been a shift to dairy cross cows which could not maintain condition outdoors.

The autumn calving cows should also be calved over a much shorter period. If the bull was not put in until a month later so all cows calved in September and October then cows could be brought to lowground pastures for calving so assistance at calving and handling of young calves would be much easier. The bull should only run with cows for eight to ten weeks and any cows not in calf should be sold. Initially this would seem hard but as the calving

became tighter feeding management would become easier and cow fertility would improve.

The farmer was not prepared to change but was hoping to purchase more ground and hopefully this may have more buildings where the spring calving cows could be housed. He would not consider buying in extra forage so he could feed cattle better over the winter.

After discussion it was felt that if the farmer was unwilling to alter management policies then production could not improve. The farmer was pleased he had received extra veterinary input and was interested in hearing other options but did not want to change any policies at the time.

After a written report on this final visit there was no further involvement on this farm.

CHAPTER 4.

DISCUSSION AND CONCLUSIONS

DISCUSSION

In the United Kingdom planned health and production schemes have been widely applied in the dairy and sheep industries, but this form of veterinary input has had little recognition by the beef industry. This study aimed to introduce planned health and production schemes on a number of farms and to try to assess any benefits. Performance in beef suckler herds is generally measured in terms of the weight of the calf weaned by each cow on a yearly basis. To monitor this it was necessary for the farmers to keep careful records of cow calving details and of calf weights. This was not possible on all the farms but other parameters including the calving intervals of cows and the levels of disease in calves also acted as indicators of any changes in performance.

In this discussion each farm will be dealt with individually and then a general discussion will follow.

Farm one was an upland farm purchased by the present owner in 1986. He calved his first 31 suckler cows in the spring of 1987 when he also lambed 50 ewes. In the spring of 1989 he calved 78 cows and lambed 200 ewes. There were many disease problems in calves in the spring of 1989 including diarrhoea, omphalophlebitis and septic arthritis and the resulting mortality was very high with 13 of the 78 calves born dying within the first month of life. In early summer

of 1989 there was a severe outbreak of pneumonia in the calves resulting in ten deaths and in total there were 25 deaths before weaning. There was also a high dystocia rate with high numbers of stillborn calves.

The sudden increase in stock on the farm in 1989 coupled with the relative inexperience of the farmer resulted in him not having time to carry out management tasks effectively which led to problems. As the animals became diseased extra time was required to catch and treat affected animals and this in turn led to more problems.

Major husbandry changes were recommended to try to minimize disease and to improve time management. A few weeks before calving the cows were separated so those closest to calving were together and therefore easier to supervise. Three calving areas were made available each to be used for a maximum of fifteen cows before a clean area was used. All cows would now stay indoors until after calving which avoided having to chase around fields to bring those requiring assistance indoors. Cows and calves would be turned out within 24 hours of calving so minimizing the build up of pathogens in the calving areas.

It was carefully demonstrated to the farmer how to assess if a calf had sucked enough colostrum and how to feed calves with an oesophageal feeder if necessary.

Dehorning and castration of calves was brought forward to be done within 24 hours of birth to avoid stressing calves when they were around three months of age when their colostral antibody levels would be at their lowest.

The cows were overfat at calving time which probably contributed to the high dystocia rate. Condition scoring techniques were demonstrated and targets recommended. Initially the farmer still tended to over feed cows over the winter and it took until the spring of 1992 for cow condition at calving to be ideal. This coincided with a decrease in stillborn calves.

Another major change was to stop the buying in of replacement calves.

These calves had been bought from various sources so carried pathogens to which the homebred stock were immunologically naive. The bought in calves had unknown colostral history and would be susceptible to pathogens on the farm and from each other.

A serological survey of calves over the first seven months of life was carried out in 1990. This found high levels of antibodies to Bovine Respiratory Syncytial Virus, Bovine Parainfluenza 3 Virus and Bovine Viral Diarrhoea Virus but negligible levels to Bovine Herpesvirus 1. If no replacements were mixed with the herd until after weaning there would be no need to vaccinate calves against these respiratory viruses.

The control measures adopted worked well and there was no disease in calves in 1991 and 1992 and the performance of calves gradually improved with live weight gains from birth to weaning improving each year.

The excellent client co-operation resulted in great improvements being made within a short time as measured by the decrease in calf disease. The immediate response may in part have been due to the shock of so many calf deaths in 1989.

Farm two had also only started to calve suckler cows in the spring of 1986. The owner had previously purchased store calves to fatten and sell finished. The farmer had a degree in agriculture and his father, who had kept dairy cattle, was also heavily involved in the farm. They had very fixed ideas on husbandry procedures so although it was relatively easy to convince them to use medical strategies to control disease it was more difficult to get them to alter management practices. The farmer was very keen to be involved in the planned health and production visits and kept very good records and took a great interest in analysis of these but was slower to respond to some of the recommendations.

The major problem was again disease in calves, young calves suffered

diarrhoea and omphalophlebitis and older calves had pneumonia both at grass during the summer and soon after housing. During bulling time a high incidence of endometritis was noted in cows.

Castration of calves had been carried out without using anaesthetic when calves were six to seven months of age. This is against welfare regulations (Protection of Animals (Anaesthetics) Acts 1954 and 1964 (Amendment) Order 1982) which state that it is an offence to castrate bulls over 2 months of age without an anaesthetic. This task was gradually brought forward until in the spring of 1992 calves were castrated using a rubber ring within 24 hours of birth.

Management at calving was a major factor contributing to disease in young calves. All the cows calved in the same field and any cows and calves requiring attention were brought into the same pen. There was a build up of pathogens as calving progressed both in the calving field and in the pen leading to disease such as diarrhoea and omphalophlebitis in calves. The farmer was unwilling to change his management to avoid the continual use of the field and pen. He agreed to keep cows and calves indoors for as short a time as possible and to keep the pen well bedded with clean straw.

The farmer was aware of when calves had received enough colostrum but was not keen to hand milk cows to feed the calves. It was suggested that proprietary colostral substitutes could be used and this was adopted.

Ideal cow body condition had been a matter for debate between the farmer and his father. In the first winter of the study it was suggested that the cows were overfat and that this was probably the reason for the high incidence of assisted calvings in the following spring. Details of recommended target scores were given to the farmer and since then cow condition has been maintained at these targets. The decrease in condition would have contributed to the decline in assisted calvings in subsequent years and therefore the numbers of stillborn calves. After finding low blood Glutathione peroxidase levels in cows they were

given injections of barium selenate ('Deposel'- Rycovet Ltd., Glasgow.) in mid to late pregnancy and this may have contributed to the decrease in numbers of stillborn calves, decreased incidence of retained foetal membranes and improved reproductive performance as found by (Jaskowski, 1990). Examining any suspect cows routinely post calving resulted in the endometritis being diagnosed and treated before the cows were put with the bull.

The policy of buying in calves to replace dead calves was thought to contribute to the outbreaks of pneumonia in calves at grass over the summer. The farmer was not happy to let cows go on without a calf if their own had died. To try to overcome this it has been suggested that older cows or those that have lost use of quarters as a result of mastitis could be bred from and have their calves removed at birth and these calves could act as replacements. This is being considered by the farmer and will probably be a farm policy in spring 1993. Serology found high levels of antibody to Bovine Herpesvirus 1, Bovine Respiratory Syncytial Virus and Bovine Parainfluenza 3 Virus so vaccination of calves was recommended. Calves were initially vaccinated in mid-summer. If no replacements were bought in it can be recommended to vaccinate calves against respiratory diseases when the calves are older ie. nearer housing when maternal immunity has waned further and is less likely to affect vaccination.

It was also suggested to the farmer that calves were being overfed over their first winter so would lose out on the compensatory growth at turn out that is usually seen in suckler calves. It was felt that although his calves seemed in better condition than other similar aged calves at the end of winter by the end of the following summer there was no difference. The farmer did not seem to consider ideal sward heights (Wright, 1992) in his calf grazing management which was probably the reason why his calves were in fact poorer than those on some of the other farms by the end of summer.

Although the farmer did not act on all the advice given the visits seemed to

be appreciated and he was keen for them to continue beyond the study. It is felt that in time more of the management changes that were recommended would be acted on so herd performance would improve further.

The farmer on farm 3 was a close personal friend of his veterinary surgeon so spent many evenings discussing farm problems and possible options to overcome these problems. Due to these close liaisons his veterinary surgeon was telephoned soon after every visit to discuss any recommendations. This was in addition to the written report about visits being sent for the veterinary surgeon's files as was done for all farms. This combined effort meant that all recommendations were acted on quickly.

The main problems encountered were diarrhoea in young calves and poor fertility and cases of hypomagnesaemia in autumn calving cows.

The major problem on the farm was diarrhoea in young calves which was controlled in the spring born calves by changing management at calving. The diarrhoea in the late born autumn calves would be more difficult to control as there was no large enough area to house cows with young calves separately to the rest of the autumn calvers and the area in which they were all housed was very small. If one calf had diarrhoea the pathogens would soon be spread to all other susceptible calves in the pen. The long term aim to calve all the autumn calvers outdoors and to eventually only calve pedigree Limousin cows in autumn should reduce the incidence of diarrhoea in autumn born calves.

The buffer feeding of silage to autumn calving cows in late autumn when the pastures became bare seemed to overcome their poor reproductive performance and since its introduction there have been no cases of hypomagnesaemia.

A calcium and phosphorous imbalance in the diet of the bull beef animals was found to be the cause of a lameness problem. After adding limestone to their feed there have been no more problems and this may have resulted in

involvement on this farm. There were problems that were diagnosed and recommendations were given however there was very poor client co-operation. The farmer has expressed a wish for visits to continue so perhaps in time he would act on advice and performance would improve.

Farm 5 has proved the most rewarding farm with which to be involved. This very large farm had been in the family for generations and the husbandry methods had been practised for years. The number of suckler cows on the farm had increased considerably over the past fifteen years and in recent years disease problems had become out of control. Diagnosis and treatment of disease by farm staff was very good and there were no deaths in calves despite almost all calves having diarrhoea within the first few weeks of life and having repeated pneumonia episodes throughout the housing period.

The major reason for the problems was all year round calving on the farm so there was a continual build up of disease in buildings and in-bye fields where the cows calved. The majority of cattle were housed in a large cubicle house in the same airspace and the ages of calves in this building were from a few weeks of age to nine month of age. The only long term solution to the disease in calves was to tighten the calving period. After discussion it was decided that no more cows should calve in the winter and that the majority should calve in late spring, after the ewes had lambed. Over the study the calving periods in summer and autumn have gradually tightened and winter 1991 was the last year that cows would calve between December and April.

There were only three bulls for the beef suckler cows on the farm which is very few for 360 cows. The ideal ratio of cows to bulls depends on several factors including age of bull, length of breeding season and terrain (Bitter, 1976) but a maximum of 50 cows to one bull is recommended (Hanly and Mossman, 1977). Two of the bulls were very old and became lame and refused to work so were

culled. Two young replacements were bought however neither proved to be fertile and both were sold fat. This resulted in the calving periods in 1990 and 1991 remaining spread and proved a good lesson for the future to test the fertility of all newly bought bulls well before they are required to work. Calving in 1992 would hopefully be tighter as cow condition has always been well maintained and in time the cows should all be calved by early October.

The severe diarrhoea in calves caused by *Cryptosporidium parvum* proved very difficult to control but it is hoped it may eventually become less severe as calving becomes tighter and pastures and buildings are rested. After discovering that the cows were a source of oocysts for calves the diarrhoea in the dairy calves on the farm has been controlled by removing calves from their dams as soon as they are born.

Unfortunately, due to the time involved in achieving a tighter calving period, it is unknown at the present time what effect this will have on the incidence of pneumonia in the housed calves.

Changes are slowly being made on this farm and disease incidence should gradually decline. The visits proved popular and due to the large numbers of animals and disease problems visits were required relatively frequently.

Farm 6 proved to be the most unrewarding farm although after the initial visit when so many problem areas were discovered it was hoped that great improvements would be made.

The major problem was too many stock on the farm leading to a lack of food. There were also problems with management around calving when calves did not receive enough colostrum. This lack of immunity and a build up of pathogens due to prolonged calving periods meant many calves succumbed to diseases especially diarrhoea. The poor nutrition of cows resulted in reduced fertility so calving became more spread, this in turn led to poorer supervision

around calving and more calf disease.

The farmer was neither prepared to reduce numbers nor to feed more and very few of the recommendations suggested were acted upon. In January 1991 it was decided to discontinue the visits to this farm.

During this study farms varied not only in size and geographical location but also in the aims of each farmer. It was found that the response to advice varied depending on several factors; the background of the farmer including how long he had been farming, if he had any formal training in agriculture, if he read farming literature or went to local farmers meetings to keep up to date with new ideas. Similarly Bohlender (1983) having run herd health programmes for clients since the mid-1970's emphasized the need to treat each owner as an individual and Radostits (1987) suggested that the success of herd health programmes depended on the desire and ability of the farmer to carry out the recommendations of the veterinary surgeon.

It was found to be easier to persuade the farmers to use costly medical strategies to combat problems than to convince them to change the husbandry on the farm especially those who had been trained in agriculture. Most of the problems encountered were best overcome by changes in management.

On farm 6 resources were very overextended before the visits began and this may have contributed to the problems encountered when management changes were suggested. It was suggested by Radostits (1987) to avoid choosing farms where resources were already overstretched as they would be unable to make any changes in management.

The provision of easily read and permanent animal identification was a problem especially for calves as they commonly lost tags. Metal tags were usually retained but these were difficult to read and the plastic tags which were easy to read even from a distance were easily lost, no matter what design was tried. The

solution was to use two tags, one plastic and one metal which could be used as a back-up if the plastic tag was lost. Planned health and production schemes in New Zealand in the early late 1980's encountered similar problems with animal identification, their solution was to use plastic ear tags and a tattoo in the ear as back-up (Withers, 1984). It seems that the ideal system has yet to be invented. Current research is trying to improve on some of the qualities of the micro-chips available for identification of dogs. These consist of tiny micro-chips ('Identichip'- Animal Care, York.) that are injected subcutaneously into the dogs neck area, they contain a ten digit code which can be read using a hand held scanner within one foot of the animal. There is a central registration of all animals with the micro-chip where the names, addresses, etc of owners is stored, this service is administered by Mipet Ltd (Huntingdon, Cambs.). These micro-chips are also marketed for other species including horses and cattle (Genus Animal Health, Lower Wick, Worcester.) however their cost, approximately £4.00 per chip, is considered too expensive to make them a viable option in cattle herds. However it is hoped that by the end of 1992 that the hand held scanner will incorporate a mini-computer which will enable manipulation of stored data on each of the animals while working with the animals. The information from the micro-computer can then be down loaded into larger terminals where all herd information is stored. The great increase in scope for use that these hand held micro-computers will allow will make them a very marketable commodity for those involved in herd health work.

In farms where record keeping was good the reasons for any shortfalls in performance were quickly found emphasizing the usefulness of accurate and comprehensive records. It seemed that farmers who would not keep adequate records did not want to know the true status of health and production on their farms, which was also suggested by Radostits (1987) after his work.

When discussing herd policies on dehorning and castration it was found that

some farms were carrying out both procedures at the same time. The extra stress on calves when combining the procedures may increase the likelihood of calves succumbing to pneumonia especially if also combined with other tasks, such as housing, worming, vaccinating, as was previously done on farm 6.

Another point that was often not considered was that some of the procedures would be carried out when the colostral immunity of the calves had waned, ie. at three to six months of age, so they were very susceptible to disease, especially pneumonia.

Castration techniques can vary due to local tradition, at some markets it is preferred that castrated calves still have a scrotum. It is also often felt by farmers that calves will perform better the longer they are left entire. It is more painful to castrate calves at a later stage and an anaesthetic should be used (Protection of Animals (Anaesthetics) Acts 1954 and 1964 (Amendment) Order 1982). A study by Bagley *et al* (1989) found that castrating calves at birth compared to at three months of age had no significant effect on calf performance or body characteristics. By the end of the study three out of the six farms had been persuaded to castrate calves using rubber rings within 24 hours of birth. The farmers found that the ease of doing the task at this early age coupled with the fact that there was one job less to do later seemed to overcome any other reservations.

On farms where the calving period was prolonged rectal examination for pregnancy in the early stages of gestation could help decide on management of individual cows. The cows could be grouped according to predicted calving date and managed separately. If examination is left until weaning time it is not possible to assess the stage of pregnancy so accurately by rectal palpation. On farms with tighter calving periods knowing the exact stage of pregnancy is not so important, however other advantages gained from pregnancy examination are usually of more use if gleaned earlier rather than later in gestation eg.

identification of barren cows, assessment of bull performance and identification of abortions in early and mid- pregnancy.

Pregnancy diagnosis is considered important but not essential for achieving optimum reproductive efficiency (Withers, 1984) so during the study it was suggested to farmers as a useful tool but not a necessity.

Achievement of a tight calving period was closely associated with correct feeding of the dam. For example in farm six where calving was very prolonged and there were problems in rebreeding the main reason for this appeared to be undernutrition of the cows as condition scores at calving and breeding were well below targets. On farm three where there were problems in getting autumn calvers back in calf, once cows were buffer fed silage their fertility improved. On farm 4 where the heifers were very lean at calving the calving intervals were prolonged. This agrees with evidence from many workers that cows are more likely to have regular oestrus cycles and conceive if in good condition at calving (Rice, 1986; Houghton *et al*, 1990_a; Graham, 1982; Corah, 1988).

In this study it was found that calf birth weight had no influence on subsequent calf performance. In all farms where weights were recorded the correlation between birth and weaning weights were low for example 0.091, 0.163, 0.230. This is in contrast with some studies which have suggested that calves with higher birth weights will, through an appetite effect, consume more milk than lighter calves so grow more quickly (Sommerville *et al*, 1983). It has been found that there are significant correlations between pre-weaning weight gains and milk yield of the dam (Anderson *et al*, 1979; Beal *et al*, 1990). Therefore factors which affect milk yield are therefore extremely important in dictating calf performance. Relatively fixed factors include the breed of the dam (Russel *et al*, 1979) and the age of the dam (Rutledge *et al*, 1971). However farm management practices will have a significant role, especially dietary management of dams (Peart *et al*, 1978).

In this study the most important factor affecting calf performance was birth date. The earlier born calves were the heaviest at weaning, and weaning and finishing weights were always highly correlated. This agrees with the findings of Bohlender (1986) that to achieve an even group of calves the most important single demand is a high conception rate in the shortest possible breeding season.

Deficiencies in the trace elements cobalt and selenium were common on the farms in the study. Most of the farms grazed animals on improved pastures which may lead to these deficiencies as a result of draining, liming, reseeding and applying large amounts of nitrogen (Scottish Agricultural Colleges, 1982). The long term study of trace element levels by sampling a cross section of both cows and calves four times over a year gave a more complete picture than a single sample and from this a useful control strategy could be planned. It was felt that although the trace element deficiencies would result in reduced calf performance it was more important to decrease the clinical disease in the calves.

The major factor in the development of diarrhoea on the farms was poor husbandry. Logan *et al,* (1974) stated that a high standard of stockmanship was necessary to ensure all calves received enough colostrum at birth and it has been stressed that adequate colostrum must be consumed soon after birth (Selman , 1969). It was common for farmers to assume that if they had seen a calf sucking and seen that a cow's udder had been sucked then the calf must have consumed adequate colostrum. It was pointed out that it may not be the cow's own calf that had sucked her udder and that the amount consumed was unknown. The routine sampling of calves which often demonstrated low levels of colostral antibodies in calves that the farmers thought had sucked was good at encouraging the farmers to examine the calf's abdomen to ensure it was full of colostrum. On farm one where stockmanship was very poor initially but where the farmer followed advice carefully, after being instructed on the importance of colostrum and how to check calves the disease incidence in young calves decreased dramatically.

The diarrhoea problems were most severe in calves born indoors or in calves born in fields where many cows had calved recently. Changing management around calving to try to prevent a build up of pathogens decreased the disease in the calves as seen on farms one and three.

The most commonly encountered diarrhoea pathogen on the farms was Rotavirus and vaccinating cows with a vaccine containing inactivated bovine Rotavirus and *E. coli* antigens ('Rotavec-K99'- Coopers Pitman-Moore, Crewe.) seemed to control this very well. The calf would absorb antibodies gained from colostrum ingested soon after birth and later there would be a local protection from antibodies in milk. The second most commonly encountered pathogen was *Cryptosporidium parvum* and this became the commonest pathogen after the Rotavirus had been controlled. Unfortunately there are no measures available to control this protozoan, but on the farms we found that if *Cryptosporidium parvum* was the sole pathogen calves would recover with supportive fluid therapy.

The finding that healthy adult cows excreted *Cryptosporidium parvum* oocysts helped in the understanding of the disease and how it persists in herds with short calving periods. It also means that in dairy herds, calves can be removed from the dam at birth to avoid contact with the dam's infected faeces.

Respiratory disease problems proved the most difficult to control which was probably due to their multifactorial aetiology. On farms with good calf housing where there was a well ventilated, roomy and comfortable creep area for calves with a separate air space to the cow housing the problems were less severe. There were also less problems when the calves were closest in age and size. Some farms clipped, wormed, and vaccinated calves at the same time as housing and these extra stresses and close mixing of calves in the handling pens would increase the chances of calves succumbing to respiratory disease. If calves were not handled during housing there were not usually any further episodes of disease over the winter period whereas on farm 5 where young calves were

introduced every few weeks and mixed with older calves the respiratory disease was continuous throughout winter.

The farms that got respiratory disease in calves when at grass were those that bought in young calves as replacements eg. Farms 1 and 2. In farm one after the buying in of replacement calves stopped and when handling over the summer was no longer required for dehorning there was no more respiratory disease. On farm 2 where calves continued to be bought in problems continued even though calves were not handled. The replacement calves would be carrying pathogens to which the cows and calves on the farm would be immunologically naive.

Control programmes for pneumonia must be tailored to the farm unit, management practices and pathogens involved. In this study on some farms there was no evidence from serological investigation that viral pathogens were involved in the outbreaks of respiratory disease and it was concluded that vaccination would be of no benefit. In cases where mixed infections were found then vaccination may be of some value in reducing the severity of disease outbreaks.

On all the farms studied the actual cause of respiratory disease was presumed to be multifactorial, however controlling some of the factors for example improving ventilation or vaccination stopped the problem completely or the disease tended to be less severe and calves recovered.

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CONCLUSIONS

The farms chosen for this study differed widely in husbandry practices, disease problems and the agricultural background of the farmers. As a result of these differences the benefits obtained from the planned health and production visits were variable.

The major disease problems encountered on the farms included diarrhoea and omphalophlebitis in calves under one month of age and pneumonia outbreaks were common in calves both over the summer and again while housed over the winter.

Farms which calved all year round had the highest incidence of disease in calves, whereas on farms where the calving spread was tighter, disease in calves was more easily controlled. This may have been related to poor hygiene around calving which was found to be an important factor in the development of disease in young calves. On many of the farms all the cows calved in the same field and / or if assistance was required cows were brought indoors to calve in one pen which was used continuously. This meant that as calving progressed there was a build up of pathogens and the longer calving continued the more the disease problems escalated.

There was a high incidence of low colostral immunoglobulin levels in young calves and this has been found by other workers. Many of the farmers believed that insufficient colostral intake would not occur in suckler calves. However when routine sampling found low immunoglobulin levels this proved to be enough to encourage the farmers to examine calves more carefully.

Outbreaks of pneumonia in calves were most common soon after housing. These were less severe in herds where calves were closest in age. Control measures recommended included; the stopping of any handling of calves at housing, for example, worming injections, clipping or vaccinating; and on some

farms there were modifications made to buildings to improve ventilation. The implementation of the recommendations generally resulted in a decrease in severity of pneumonia outbreaks.

Pneumonia outbreaks during the summer were seen mostly on farms who bought in replacement calves in spring. These calves present a risk to both the homebred calves and to each other and it was recommended to stop this policy.

Poor fertility tended to be related to nutritional problems. On some farms the cows calving in late autumn lost condition from before calving and throughout mating. These cows proved difficult to get back in calf and had extended calving intervals. Buffer feeding helped to overcome this however in the longer term a shorter calving period earlier in autumn would result in cows calving in better condition so would start to cycle and conceive more quickly.

In two of the farms cows were overfat at calving time leading to high dystocia rates and large numbers of stillborn calves. The dystocias lead to retained foetal membranes and endometritis so many of these cows were slow to get back in calf. Advice was given on condition scoring techniques and recommended targets and once cows were closer to target scores the dystocia and other problems decreased.

In three out of the six farms studied calves were weighed at intervals to monitor performance. It was interesting to note that calf birth weights were not correlated to weaning weights in any of the farms. Weaning weights were closely associated with weights at sale whether sold as store calves or as finished. The major factor affecting weaning weight was date of birth. So to achieve an even group of calves at sale a tight calving interval is essential.

In conclusion, from this study it was felt that although all the farms benefited from the planned health and production visits the extent of any improvements varied according to the background of the farm and the attitude of the farmer. The major problems encountered were best overcome by tightening the calving

period, improving management of cows and calves around calving and stopping buying in replacement calves. It was interesting to note that although medical intervention could reduce the severity of diseases it was better to prevent the problems occurring by altering the farm husbandry practices.

KEY TO APPENDICES

COW BREED Includes:

AA or AX	= Aberdeen Angus cross Friesian.
HX	= Hereford cross Friesian
RH	= Red and white coloured Hereford cross Friesian.
BH	= Black and white coloured Hereford cross Friesian.
BG	= Blue grey
G	= Galloway

CAL COM Calving comments, includes:

1D	= One calf born dead.
2L	= Two calves born alive.
ILA	= One live calf, assisted calving.
IDVA	= One calf born dead, assisted calving requiring veterinary assistance.
AB	= Aborted, Calf born dead at less than 270 days of gestation.
ILC	= One live calf born via caesarian section.

COMMENTS Any other comments about cow. Includes:

RFM	= Retained foetal membranes
WH	= Whites, lay term for Endometritis.
CL	= Cleaned cow, lay term for manual removal of foetal membranes.
LUT	= Lutalyse, drug containing the luteolytic Dinoprost

(Upjohn Ltd., Animal Health Division, Crawley, W. Sussex.)

MET = Metrijet, intrauterine injection including, Oxytetracycline, Furazolidone, Clioquinol and Ethinyloestradiol (Intervet UK Ltd., Cambridge.)

WO = Wash out cow, lay term for using Metrijet to treat Endometritis.

ADH. = Adhesions

PRID = Intravaginal spiral device impregnated with progesterone and with an attached gelatin capsule containing oestradiol benzoate. Used to control ovarian activity. (Sanofi Animal Health Ltd., Hertfordshire.)

FERT = Injection containing gonadorelin (Intervet UK Ltd., Cambridge.)

MF = Milk fever, lay term for Hypocalcaemia.

CALF SEX Includes Male or Female (M or F) and Bull or Heifer (B or H)

CALF PROBS Calf problems:

Period 1 = Birth to one month of age.

Period 2 = From one month of age till sold.

PNEU or **PN** = Pneumonia

DH = Dehorning

BLOAT = Rumenal tympany

SC = Scour

ROTA = Rotavirus

CR = Cryptosporidiosis

D or **DI** = Died

CHD = Congenital heart disease.

IBR = Infectious bovine rhinotracheitis, Bovine Herpesvirus 1.

ZST = Zinc sulphate turbidity test result.

CALF WEIGHTS All weights in kilograms:

LWG = Live weight gain (kilograms per day)

B-W = Period from birth to weaning.

W-TO = Period from weaning to turn-out.

TO-S = Period from turn-out to when sold.

APPENDICES

FARM 1
Summary of records for 1988

COW NO.	CALVING DATE	CAL COM	COMMENTS	CALF SEX	CALF PROBS
14	20/01/88		HEIFER	M	
13	24/01/88		HEIFER	M	
11	24/01/88		HEIFER	F	
12	25/01/88		HEIFER	M	
32	09/03/88	1D	HEIFER		
126	09/03/88	1D			
25	11/03/88			F	
26	11/03/88		HEIFER	F	
23	12/03/88		HEIFER	F	
98	13/03/88			M	
20	14/03/88		HEIFER	F	
28	15/03/88		HEIFER	M	
39	06/04/88			M	
170	11/04/88			M	DIED 7/8
94	21/04/88	1D			
50	21/04/88			F	
36-H	24/04/88	1D	HEIFER		
436	25/04/88			M	
24	26/04/88		HEIFER	M	
M2	26/04/88			F	
127	29/04/88	1D			
120	01/05/88			F	
35	03/05/88	1D	HEIFER		
27	03/05/88	1D	HEIFER		
21	04/05/88	1D	HEIFER		
36-O	05/05/88			M	
117	06/05/88			M	
93	06/05/88			M	
34	06/05/88	1D	HEIFER		
BP	07/05/88	1D	SOLD COW		
31	08/05/88		HEIFER	F	
44	18/05/88			M	
P15	22/05/88			M	
29	23/05/88		HEIFER	M	
22	25/05/88		HEIFER	M	
30	26/05/88		HEIFER	F	
19	28/05/88			M	
18	05/06/88			F	
1G	06/06/88			M	
035	07/06/88			M	
83	11/06/88			M	
148	19/06/88			M	
1	14/07/88			M	
10	14/07/88			F	
9	15/07/88			M	
75	19/07/88			F	
10F	21/07/88			F	
5	23/07/88			F	
16	31/07/88			F	
8	01/08/88			M	
2	05/08/88			M	

Appendix 1. Summary of records for farm 1.

FARM 1
Summary of records for 1989

COW NO.	CALVING DATE	CAL COM	COMMENTS	CALF SEX	CALF PROBS	WEANIN WGT(kg
41	07/02/89	1D		M	SCOUR	
42	08/02/89			F	PNEU 26/2	
40	13/02/89			F	SCOUR 28/2	
46	18/02/89			F		
45	25/02/89			F		
20	10/03/89			F	SCOUR	235
48	12/03/89			M		270
50	18/03/89			F		230
120	18/03/89	1D		M		230
3	20/03/89			F		230
24	20/03/89			M		260
27	21/03/89	1D		M		245
32	21/03/89			F		225
57	21/03/89		HEIFER	M	DIED 4/4	220
7	22/03/89	2L		M		185
24	22/03/89			M	DIED 24/3	
23	22/03/89			F		185
67	23/03/89		HEIFER	F	DIED 4/6	
12	26/03/89			M	DIED 3/6	160
66	27/03/89		HEIFER	M		230
56	29/03/89		HEIFER	F	DIED 24/5	190
170	29/03/89			F		235
51	30/03/89		HEIFER	F		225
25	30/03/89			M	DIED 21/5	175
52	30/03/89		HEIFER	F	DIED 8/4	220
69	01/04/89		HEIFER	M	DIED 22/5	170
31	01/04/89			F		225
6	01/04/89			F		212
180	01/04/89			M		220
63	02/04/89		HEIFER	M	DIED 26/6	205
47	02/04/89		ABORTED 27/12/89 SOLD 29/1/90	M		235
60	03/04/89		HEIFER	M	DIED 12/4	240
58	03/04/89		HEIFER	F	DIED 4/6	135
64	04/04/89		HEIFER	M		215
13	04/04/89			F		235
11	04/04/89			M		235
28	05/04/89			F		210
17	05/04/89			F		225
020	06/04/89			M	DIED 16/4	200
35	07/04/89			F	DIED 30/5	165
55	07/04/89		HEIFER	M	DIED 8/4	230
121	09/04/89			F		210
4	09/04/89	1D		M		
21	09/04/89			F		170
436	10/04/89			M		210
68	11/04/89		HEIFER	M		225
36-F	11/04/89			M	SOLD TO VET SCHOOL	
117	12/04/89		SOLD	M	DIED 21/5	205
43	12/04/89	1D		F		183
59	12/04/89		HEIFER	F		215
44	14/04/89			F		155
34	14/04/89			F		225
93	14/04/89	1DVA	SOLD			225
94	14/04/89			M		200

Appendix 1. Summary of records for farm 1.(continued)

FARM 1
Summary of records for 1989

COW NO.	CALVING DATE	CAL COM	COMMENTS	CALF SEX	CALF PROBS	WEANING WGT(kg)
22	15/04/89			M		220
14	19/04/89			F		205
30	22/04/89			M		185
98	27/04/89			F	DIED 30/7	
P15	28/04/89			F		205
050	05/05/89		HEIFER	M		180
127	07/05/89			F		195
167	08/05/89			M		180
10	08/05/89			M		160
65	12/05/89		HEIFER	M		160
5	13/05/89			F		150
53	17/05/89		HEIFER	M		180
29	18/05/89			F		150
36-H	21/05/89			M		180
75	26/05/89			F		135
1	27/05/89			M		180
9	11/06/89			F		125
2	04/07/89			F		120
010	07/07/89			F		120
39	10/07/89		SOLD	M	SOLD VET SCHOOL 9/89	115
027	01/04/89			M		195
36-O	01/07/89			M		150

Appendix 1. Summary of records for farm 1.(continued)

Appendix 1. Summary of records for farm 1.(continued)

FARM 1
Summary of records for 1990

COW NO.	CALVING DATE	CAL COM	COMMENTS	CALf SEX	CALF PROBS	CALF PROBS-2	BIRTH WGT(kg)	WEAN WGT(kg)	LWG B-W (kg/day)	SALE WGT(kg)	DATE SOLD	LWG B-S (kg/day)
031	15/02/90	1L		M			35	305	1.25	322	08/10/90	1.22
171	25/02/90	1L		F			37	205	0.82	0		0.00
170	14/03/90	1L		F			37	270	1.23	281	08/10/90	1.17
26	16/03/90	1LA	CULL	M			45	285	1.28	287	08/10/90	1.17
34	16/03/90	1L		M			30	236	1.10	314	09/01/91	0.95
42	18/03/90	1L		M			45	248	1.10	287	08/10/90	1.19
030	18/03/90	1LA	Calf backwards	F			25	190	0.89	258	09/01/91	0.78
27	20/03/90	1LA		M			45	295	1.37	287	08/10/90	1.20
68	20/03/90	1L		F			37	280	1.33	281	08/10/90	1.21
35	20/03/90	1L		F			37	290	1.38	281	08/10/90	1.21
41	21/03/90	1L		F			37	235	1.09	291	09/01/91	0.86
21	21/03/90	1LA		M			50	265	1.18	287	08/10/90	1.18
7	21/03/90	1L		F			40	285	1.35	281	08/10/90	1.20
56	21/03/90	1DA		M			45	0		0		0.00
3	21/03/90	1L		F			37	250	1.17	281	08/10/90	1.21
58	22/03/90	1LA		F			37	236	1.10	274	05/11/90	1.04
46	23/03/90	1L		M			45	277	1.29	287	08/10/90	1.22
59	23/03/90	1LA		F			37	270	1.29	281	08/10/90	1.23
6	23/03/90	1LA	Calf backwards	M			45	270	1.25	286	08/10/90	1.21
121	24/03/90	1L		M		DIED PNEU 26/6	50	0		0		0.00
RF20	24/03/90	1LA	OLD-CULL	M			45	240	1.09	287	08/10/90	1.22
20	24/03/90	1L		F		DIED AFTER DH 14/8	37	0		0		0.00
45	25/03/90	2L		M			35	239	1.15	278	05/11/90	1.08
40	26/03/90	1LA	ABORTED-11/2/91	M			48	280	1.31	286	08/10/90	1.21

FARM 1
Summary of records for 1990

COW NO.	CALVING DATE	CAL COM	COMMENTS	CALf SEX	CALF PROBS	CALF PROBS-2	BIRTH WGT(kg)	WEAN WGT(kg)	LWG B-W (kg/day)	SALE WGT(kg)	DATE SOLD	LWG B-S (kg/day)
25	26/03/90	1L		F			37	255	1.23	281	08/10/90	1.24
13	26/03/90	1L		M			45	265	1.24	287	08/10/90	1.23
36-H	27/03/90	1L		F			37	250	1.21	281	08/10/90	1.25
54	27/03/90	1L		M		DIED 10/09/90	40	0		0		0.00
180	27/03/90	1LA	Cow 1 Quarter	M			45	300	1.45	287	08/10/90	1.24
14	28/03/90	1L		M			42	245	1.16	287	08/10/90	1.26
120	29/03/90	1L		M			45	255	1.21	287	08/10/90	1.25
17	30/03/90	1L		M			42	290	1.43	287	08/10/90	1.28
4	30/03/90	1L	Calf backwards	F			35	240	1.18	255	05/11/90	1.00
67	31/03/90	1L		F		DIED PNEU 25/4	35	0		0		0.00
28	31/03/90	1L		M			45	235	1.10	314	09/01/91	0.95
62	01/04/90	1LA		M			47	235	1.10	275	05/11/90	1.05
051	01/04/90	1DA		M			38	0		0		0.00
98	04/04/90	1L		F			37	215	1.06	247	05/11/90	0.98
31	05/04/90	1L		F			37	240	1.22	281	08/10/90	1.31
48	05/04/90	1L		M			45	240	1.17	282	05/11/90	1.11
32	06/04/90	1L		F			37	240	1.22	274	05/11/90	1.11
11	06/04/90	1L		M			45	265	1.33	287	08/10/90	1.31
94	07/04/90	1LA	Calf Backwards	M			45	270	1.36	287	08/10/90	1.32
66	08/04/90	1LA		M		DIED BLOAT 22/6	45	0		0		0.00
23	09/04/90	1L		F			37	205	1.03	251	09/01/91	0.78
75	10/04/90	1L		F			28	190	1.00	251	09/01/91	0.81
69	10/04/90	1LA		F			37	230	1.19	262	05/11/90	1.08
44	11/04/90	1L		F			35	220	1.15	314	09/01/91	1.02

FARM 1
Summary of records for 1990

COW NO.	CALVING DATE	CAL COM	COMMENTS	CALf SEX	CALF PROBS	CALF PROBS-2	BIRTH WGT(kg)	WEAN WGT(kg)	LWG B-W (kg/day)	SALE WGT(kg)	DATE SOLD	LWG B-S (kg/day)
036	13/04/90	1L		M			40	235	1.23	314	09/01/91	1.01
52	14/04/90	1LA		M			45	245	1.27	275	05/11/90	1.12
ET50*	15/04/90	1LA	OLD-NIC-CULL	M			45	240	1.24	314	09/01/91	1.00
55	17/04/90	1L		F			37	274	1.53	255	05/11/90	1.08
30	15/04/90	1L		M			45	270	1.43	287	08/10/90	1.38
53	17/04/90	1LA		F			37	210	1.12	255	05/11/90	1.08
12	17/04/90	1LA		M		DIED 15/8	45	0		0		0.00
9	18/04/90	1L		F			30	205	1.14	291	09/01/91	0.98
49	18/04/90	1L		F			30	205	1.14	291	09/01/91	0.98
64	21/04/90	1L		F			32	190	1.05	251	09/01/91	0.83
60	23/04/90	1L		M			40	230	1.28	314	09/01/91	1.05
025	23/04/90	1LA		F			30	210	1.21	291	09/01/91	1.00
024	24/04/90	1LA	NIC	M			37	190	1.03	278	09/01/91	0.93
062	26/04/90	1LA		M		DIED 23/8-TOR MESEN	34	0		0		0.00
127	26/04/90	1LA		F			37	210	1.18	255	05/11/90	1.13
5	28/04/90	1L		F			35	170	0.94	251	09/01/91	0.84
074	29/04/90	1LA		F			32	175	1.00	227	09/01/91	0.76
24	30/04/90	1L	NIC	M			40	180	0.99	251	09/01/91	0.83
22	03/05/90	1L		F			37	175	0.99	251	09/01/91	0.85
059	05/05/90	1LA		F			37	170	0.97	252	09/01/91	0.86
P15	08/05/90	1L		M			45	220	1.31	314	09/01/91	1.09
1	08/05/90	1L		F		DIED 17/5	37	0		0		0.00
1G	11/06/90	1L		F			38	130	0.92	227	09/01/91	0.89
51	11/06/90	1L		M			42	170	1.28	228	09/01/91	0.88
36-F	15/06/90	1L		M			40	160	1.25	0		0.00
65	15/06/90	1LA		M	DIED 2DD FRAC.SPINE		45	0		0		0.00

FARM 1
Summary of records for 1990

COW NO.	CALVING DATE	CAL COM	COMMENTS	CALf SEX	CALF PROBS	CALF PROBS-2	BIRTH WGT(kg)	WEAN WGT(kg)	LWG B-W (kg/day)	SALE WGT(kg)	DATE SOLD	LWG B-S (kg/day)
L30	04/04/90		HEIF CALF AT FOOT	F			40	280	1.43	296	08/10/90	1.37
C39	04/04/90		HEIFER CALF AT FOOT	F			40	260	1.31	266	08/10/90	1.21
L210	04/04/90		HEIF CALF AT FOOT	F			40	250	1.25	266	08/10/90	1.21

Appendix 1. Summary of records for farm 1.(continued)

FARM 1
Summary of records for 1991

COW NO	CALVING DATE	CAL COM	COMMENTS	CALf SEX	CALF PROBS	CALF PROBS-2	BIRTH WGT(kg)	SALE WGT(kg)	SALE DATE	LIVE WEIGHT GAIN BIRTH-SALE(kg/day)
36-H	27/02/91	2L		M			20	306	14/10/91	1.25
26	01/03/91	1D					0			0.00
27-F	02/03/91	1LA		M			45	312	14/10/91	1.18
C39	02/03/91	1LA		F			40	279	14/10/91	1.06
17	05/03/91	1L		M			45	318	14/10/91	1.22
3	06/03/91	1L		M			45	324	14/10/91	1.26
10	06/03/91	1DA					0			0.00
2	07/03/91	1D					0			0.00
13	07/03/91	1L		M			45	306	14/10/91	1.18
45	08/03/91	1L		F			40	279	14/10/91	1.09
7	10/03/91	2LA		M			40	306	14/10/91	1.22
051	11/03/91	1DA			SET ON CALF DIED 3/4		0			0.00
59	11/03/91	1L		F			40	283	14/10/91	1.12
62	12/03/91	1LA		F			40	279	14/10/91	1.11
11	13/03/91	1LA		M			40	277	14/10/91	1.10
28	15/03/91	1L		F			35	247	28/10/91	0.93
98	15/03/91	1LA		F			40	262	28/10/91	0.98
5	16/03/91	1DA					0			0.00
57	17/03/91	1LA		F			42	283	14/10/91	1.14
27	15/03/91	1L		F			40	279	14/10/91	1.12
20	19/03/91	1LA		F			40	283	14/10/91	1.16
180	19/03/91	1LA		F			40	283	14/10/91	1.16
32	19/03/91	1L		F			40	279	14/10/91	1.14
170	20/03/91	1L	HURT AT CALVING-CULL 22/3	M			45	306	14/10/91	1.25
66	21/03/91	1L		M			45	277	14/10/91	1.12
35	21/03/91	1L		M			45			0.00

Appendix 1. Summary of records for farm 1.(continued)

FARM 1
Summary of records for 1991

COW NO	CALVING DATE	CAL COM	COMMENTS	CALf SEX	CALF PROBS	CALF PROBS-2	BIRTH WGT(kg)	SALE WGT(kg)	SALE DATE	LIVE WEIGHT GAIN BIRTH-SALE(kg/day)
52	23/03/91	1L		M			45	306	14/10/91	1.27
67	23/03/91	1L		F			40	279	14/10/91	1.17
34	23/03/91	1L		F			40	283	14/10/91	1.19
29	23/03/91	1LA		F			40	279	14/10/91	1.17
030	24/03/91	1L		F			40	279	14/10/91	1.17
55	24/03/91	1L		F			40	283	14/10/91	1.19
102	25/03/91	1LA		M			45	312	14/10/91	1.32
49	25/03/91	1L		F			35	234	11/11/91	0.86
025	25/03/91	1L		F			35	240	11/11/91	0.89
36-0	27/03/91	1L		F			35	253	28/10/91	1.01
21	28/03/91	1L		F			40	283	14/10/91	1.22
68	28/03/91	1LA		M			45	277	14/10/91	1.16
46	29/03/91	1LA		M			45	312	14/10/91	1.34
69	31/03/91	1L		M			45	277	14/10/91	1.18
54	31/03/91	1DA					0			0.00
53	01/04/91	1L		F			40	253	28/10/91	1.01
L30	01/04/91	1LA		F			40	283	14/10/91	1.24
48	01/04/91	1L		M			45	277	14/10/91	1.18
062	03/04/91	1L		F			38	253	28/10/91	1.03
14	03/03/91	1L		M			45	314	14/10/91	1.20
9	03/04/91	1L		M			40	267	28/10/91	1.09
30	04/04/91	1L		M			42	277	14/10/91	1.22
42	05/04/91	1LA		M			65	306	14/10/91	1.26
6	05/04/91	1LA		M			50	306	14/10/91	1.33
031	06/04/91	1LA		M			50	277	14/10/91	1.19
P15	07/04/91	1LA		F			35	253	28/10/91	1.07
56	08/04/91	1LA		M			50	312	14/10/91	1.39
057	09/04/91	1LA		M			50	267	28/10/91	1.07
94	10/04/91	1L		M			35	277	14/10/91	1.29
10-F	16/04/91	2LA		M			30	246	28/10/91	1.11

Appendix 1. Summary of records for farm 1.(continued)

FARM 1
Summary of records for 1991

COW NO	CALVING DATE	CAL COM	COMMENTS	CALf SEX	CALF PROBS	CALF PROBS-2	BIRTH WGT(kg)	SALE WGT(kg)	SALE DATE	LIVE WEIGHT GAIN BIRTH-SALE(kg/day)
22	17/04/91	1L		F			40	207	11/11/91	0.80
103	18/04/91	1LA		F			40	247	29/10/91	1.07
25	21/04/91	1DA					0			0.00
75	25/04/91	1L		F			40	247	28/10/91	1.11
105	26/04/91	1L		F			40	247	28/10/91	1.12
63	26/04/91	1L		F			40	253	28/10/91	1.15
36-F	25/04/91	1L		F			40	283	14/10/91	1.41
12	27/04/91	1L		M			43	306	14/10/91	1.55
51	27/04/91	1L		F			40	207	11/11/91	0.84
41	27/04/91	1D					0			0.00
65	27/04/91	1DA					0			0.00
120	02/05/91	1L		F			40	253	28/10/91	1.19
31	03/05/91	1LA		M			50	277	14/10/91	1.38
127	04/05/91	1L		F			40	247	28/10/91	1.17
074	04/05/91	1L		M			45	238	11/11/91	1.01
121	09/05/91	1L		F			40	279	14/10/91	1.51
108	07/05/91	1LA		F			40	234	11/11/91	1.03
1	10/05/91	1L		M			45	246	28/10/91	1.18
104	13/05/91	1LA		M			42	246	28/10/91	1.21
58	15/05/91	1L		M			45	267	28/10/91	1.34
101	18/05/91	1L		M			38	238	11/11/91	1.13
106	27/05/91	1L		M			40	238	11/11/91	1.18
171	31/05/91	1LA		M			45	246	28/10/91	1.34
44	26/06/91	1L		F			38	182	11/11/91	1.04

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 1

Normal ranges:

	Adequate	Marginal	Deficient
Copper (mmol/l)	**9.4-23.6**	**4.7-9.4**	**<4.7**
Selenium (Gshpx Units/mlPCV)	**>23**	**8-23**	**<8**
Cobalt (Vitamin B12 ng/l)	**>200**	**150-200**	**<150**

* Indicates marginal result.
** Indicates deficient result.

DATE	ANIMALS	COPPER	COBALT	SELENIUM
22/2/90/	Cows	15	290	72
		15	220	76
		17	200	72
		16	230	96
		21	190*	102
		20	310	69
		17	150*	88
		16	175*	121
		18	225	71
		17	225	89
23/3/90	Calves	12	210	73
		10	380	69
		16	150*	47
		15	150*	82
		11	690	73
		13	280	96
		10	430	84
		8*	690	82
		11	390	53
		8*	1250	98
25/4/90	Calves	11		39
		13		35
		15		24
		14		19*
		12		36
		16		44
		13		58
		8*		52
		18		57
		11		42

Appendix 1.(ii)
Results of trace element analyses for farm 1.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 1 (continued)

DATE	ANIMALS	COPPER	COBALT	SELENIUM
24/5/90	**Calves**	17		39
		13		48
		14		32
		10		27
		12		19
		11		47
		17		46
		12		58
		12		47
		14		47
21/6/90	**Calves**	20	75**	19*
		19	95**	24
		17	65**	22*
		16	850	23
		21	90**	8*
		21	115**	38
		15	120**	40
		18	230	54
		22	90**	32
		24	125**	27
31/7/90	**Calves**	14		15*
		14	185*	20*
		13	60**	17*
		15	90**	4**
		16	55**	5**
		13	110**	27
		14	75**	25
		16	165**	48
		13	80**	11*
		13	95**	16*

Appendix 1.(ii)
Results of trace element analyses for farm 1.

Appendix 2. Summary of records for farm 2. (continued)

FARM 2
Summary of records for 1990

COW NO.	NEW NO.	COW AGE	CALVING DATE	CAL COM	COMMENTS	CAL SEX	CALF PROBS-1	CALF PROBS-2	BIRTH WGT(KG)	WEAN WGT(KG)	LWG B-W (KG/DAY)	TURN-OUT WGT(KG)	LWG W-TO (KD/DAY)
121	88	5	14/05/90	AB	RFM-WH-LUT 6/6	F			0	0	0.00	0	0.00
101	47	5	14/05/90	1L		F			42	256	0.97	350	0.69
118	60	5	17/05/90	1L		M		26/1-PNEU	50	276	1.04	378	0.74
102	56	5	17/05/90	1L		M		26/1-PNEU	42	313	1.24	410	0.71
14	87	6	19/05/90	1L	MASTITIS-7 /3/91	F		28/1-PNEU	38	248	0.97	340	0.67
43	64	8	19/05/90	1L		F		PN-12/10.2 6/1-PN	40	328	1.33	385	0.42
13	61	6	19/05/90	1L		M			40	0		0	0.00
145	37	5	20/05/90	1L		F		28/1-PNEU	41	285	1.13	385	0.73
113	63	5	21/05/90	1L		F			45	272	1.06		
42	95	8	22/05/90	1L	RFM	F		26/1-PNEU	38	264	1.06	340	0.55
17	75	6	22/05/90	1L		M		28/1-PNEU	50	295	1.15	390	0.69
182	27	4	22/05/90	1LA		M			38	0		0	0.00
109	94	5	24/05/90	1L		M		25/1-pneu	50	272	1.05	370	0.72
31**		8	25/05/90	1D	TWISTED WOMB-CALF DEAD-CULL				0	0	0.00	0	0.00
46	76	8	26/05/90	1L		M			48	352	1.45	0	
56	67	8	26/05/90	1L		F			40	290	1.20	380	0.66
15	57	6	26/05/90	1LA		F			40	260	1.05	353	0.68
122	89	5	27/05/90	1L		M		24/1-pneu	45	280	1.13	370	0.66
37 **		8	29/05/90	1L	WHITES-11/ 3/91-CULL	M			48	268	1.07	380	0.82
119**		5	29/05/90	1L	Bulling Jan-Cull	F			46	313	1.30	460	1.07
34	83	8	29/05/90	1L		M		26/1-PNEU	42	240	0.96	313	0.53
104**		6	07/06/90	1LA	CULL 2/91	F	D12H-SET ON	28/1-PNEU	44	325	1.43	425	0.73
169	79	5	09/06/90	1L		F		26/1-PNEU	38	256	1.12	320	0.47
19	58	6	14/06/90	1L		F		28/1-PNEU	36	226	1.00	325	0.72
44	84	8	17/06/90	1L	MASTITIS-1 0/3/91	M		PN 12/10	44	276	1.24	310	0.25
52	92	8	18/06/90	1L		M		24/1-pneu	46	252	1.11	378	0.92

Appendix 2. Summary of records for farm 2. (continued)

FARM 2
Summary of records for 1990

COW NO.	NEW NO.	COW AGE	CALVING DATE	CAL COM	COMMENTS	CAL SEX	CALF PROBS-1	CALF PROBS-2	BIRTH WGT(KG)	WEAN WGT(KG)	LWG B-W (KG/DAY)	TURN-OUT WGT(KG)	LWG W-TO (KD/DAY)
103	59	5	21/06/90	1L		F		28/1-PNEU	38	222	1.01	320	0.72
5	62	6	25/06/90	1L		M			43	285	1.35	360	0.55
20**		6	26/06/90	1L	Mastitis-2 5/1 CULL 2/91	F		PN-12/10.2 8/1-PN	38	218	1.01	330	0.82
40		8	29/06/90	1L		F		28/1-PNEU	42	230	1.07	315	0.62
51	91	8	30/06/90	1L		M		26/1-PNEU	40	235	1.12	345	0.80
18	55	6	03/07/90	1LA		M		26/1-PNEU	43	230	1.09	330	0.73
21	70	6	08/07/90	1L		M		27/1-PNEU	40	240	1.20	285	0.33
53	93	8	09/07/90	1L		F		24/1-pneu	44	244	1.21	320	0.55
41	78	6	19/07/90	1L		F			50	222	1.11	290	0.50
117	96	5	22/07/90	1L		M			38	202	1.08	0	
33	80	6	07/08/90	1L		F		28/1-PNEU	38	174	1.00	264	0.66
100		5	03/09/90	1LA	RFM	M	D 24H-SET ON	24/1-pneu	36	190	1.41	295	0.77
128		2							0	0	0.00	0	0.00
31**	10	2			culled 16/12/91				0	0	0.00	0	0.00
164	7	2							0	0	0.00	0	0.00
187	1	2							0	0	0.00	0	0.00
111	4	2							0	0	0.00	0	0.00
12	12	2							0	0	0.00	0	0.00
38	6	2							0	0	0.00	0	0.00
48		2							0	0	0.00	0	0.00
115	9	2							0	0	0.00	0	0.00
186	8	2							0	0	0.00	0	0.00
185	2	2							0	0	0.00	0	0.00
PAMPA		0							0	0	0.00	0	0.00
ANNE		0							0	0	0.00	0	0.00
VALER		0							0	0	0.00	0	0.00
CATHY		0			BVD V +VE 2/91				0	0	0.00	0	0.00
CHRIS		0							0	0	0.00	0	0.00
BARBA		0							0	0	0.00	0	0.00
120	17	0							0	0	0.00	0	0.00

Appendix 2. Summary of records for farm 2. (continued)

FARM 2
Summary of records for 1991

COW NO.	NEW NO.	COW AGE	CALVING DATE	CAL COM	COMMENTS	CAL SEX	CALF PROBS-1	CALF PROBS-2	BIRTH WGT(KG)	WEAN WGT(KG)	LWG B-W (KG/DAY)	TURN-OUT WGT(KG)	LWG W-TO (KD/DAY)
	15	3	09/03/91	1L		F	22/5-PN		40	295	0.90	375	0.54
	16	3	11/03/91	1L		F	24/5-PN		38	307	0.96	450	0.96
	11	3	12/03/91	1L		M	22/5-PN		40	337	1.06	475	0.93
	13	3	21/03/91	1L		M	22/5-PN	PN-DIED-25 /11	38	0		0	0.00
	14	3	27/03/91	1L		F	PN 20/6	PN-23/11	40	280	0.91	410	0.87
	100	0	07/04/91	1L		F			40	290	0.99	445	1.04
	98	0	07/04/91	1L		F			40	313	1.08	385	0.48
	97	0	07/04/91	1L		M			40	295	1.01	435	0.94
	96	0	07/04/91	1L		F		PN-25/11	40	285	0.97	450	1.11
	99	0	07/04/91	1L		F			40	337	1.17	485	0.99
117**	96*	6	08/04/91	AB	CULL				0	0	0.00	0	0.00
	39	0	15/04/91	1L		F			40	276	0.96	420	0.97
	19	0	15/04/91	1L		F	PN 1/7	PN-26/11	40	290	1.02	425	0.91
	68	0	20/04/91	1L		M			36	248	0.88	360	0.75
56	67	9	20/04/91	1L	RFM-CHECK 15/7-OK	M			45	260	0.90	427	1.12
121	88	6	24/04/91	1L		M			42	240	0.84	380	0.94
	5	3	28/04/91	1LA		M	PN-7/6		42	264	0.96	440	1.18
152	32	6	29/04/91	1LA	RFM-CHECK 15/7-OK	F			28	235	0.90	355	0.81
38	6	3	02/05/91	1L		M	SALER		30	248	0.96	390	0.95
12	12	3	04/05/91	1L		M	SALER	BA-22/10-T -OK	40	240	0.88	366	0.85
185	2	3	04/05/91	1LA		M		PN-30/10-D	40	0		0	0.00
172	26	5	05/05/91	1LA		M		PN-26/11	50	290	1.07	460	1.14
102	56	6	05/05/91	1L	CH. WH 15/7-OK	M			40	295	1.13	350	0.37
58	81	9	06/05/91	1LA		M			44	295	1.12	460	1.11
111	4	3	06/05/91	1L		F	PN-7/6		30	230	0.89	0	
43	64	9	07/05/91	1L		F		PN-25/11	40	256	0.97	400	0.97
179	41	5	07/05/91	1L		M		22/10-PN	40	248	0.93	0	
46**	76*	9	07/05/91	1L	CULL	M		PN-25/11	0	230	1.03	405	1.17
116	77	6	07/05/91	1L		F			45	230	0.83	400	1.14
114	48	6	08/05/91	1L		F			40	222	0.82	310	0.59

FARM 2
Summary of records for 1991

COW NO.	NEW NO.	COW AGE	CALVING DATE	CAL COM	COMMENTS	CAL SEX	CALF PROBS-1	CALF PROBS-2	BIRTH WGT(KG)	WEAN WGT(KG)	LWG B-W (KG/DAY)	TURN-OUT WGT(KG)	LWG W-TO (KD/DAY)
173	18	5	08/05/91	1L		M		PN-26/11	40	218	0.80	345	0.85
177	29	5	08/05/91	1LA	SL WH-LUT 15/7.+PARE D FOOT.	M		PN-28/11	50	276	1.02	435	1.07
178	30	5	08/05/91	1L		F			40	218	0.80	340	0.82
137	43	6	09/05/91	1L		F			42	290	1.12	430	0.94
187	1	3	09/05/91	1L		F	SC24/5-CR	PN-20/11	36	206	0.77	380	1.17
180	38	5	10/05/91	1L		M			42	235	0.88	386	1.01
172	52	5	11/05/91	1L		M			38	235	0.90	386	1.01
3	44	7	11/05/91	1L		F			38	260	1.01	370	0.74
59	90	9	12/05/91	1L		M	D-18/5-?CN S		44	272	1.05	435	1.09
186	8	3	12/05/91	1L		F			36	230	0.89	399	1.13
52	92	9	12/05/91	1L		M	SC 31/5-CR		42	230	0.86	375	0.97
36	69	9	13/05/91	1L		M			42	285	1.12	415	0.87
166	35	6	13/05/91	1L		M	PN 9/7	PN-25/11	44	252	0.96	340	0.59
107	42	6	13/05/91	1L		M			42	210	0.77	370	1.07
157	23	6	13/05/91	1L		M			44	240	0.90	400	1.07
122	89	6	13/05/91	1L		F		PN-25/11	40	256	1.00	355	0.66
176	20	5	13/05/91	1L		M			40	170	0.60	295	0.84
183	33	5	14/05/91	1L		M			42	230	0.87	390	1.07
106	36	6	15/05/91	1L		M		PN-26/11	42	240	0.92	370	0.87
R101*	19*	6	15/05/91	1LA	CULLED	M	CALF DIED		36	0		0	0.00
17	75	7	15/05/91	1L		M			42	260	1.01	420	1.07
139	46	6	15/05/91	1L		F			40	226	0.87	326	0.67
34**	83*	9	15/05/91	1DA	RFM-CULL	F			46	256	0.98	378	0.82
164	7	3	16/05/91	1L		M	D CHD-20/6	SET ON	46	210	0.77	395	1.24
13	61	7	16/05/91	1L		M			46	260	1.00	366	0.71
42**	95*	9	16/05/91	1L	CULL	F			40	210	0.79	360	1.01
47	54	9	16/05/91	1L		F		PN-27/11	40	248	0.97	370	0.82
161	34	6	16/05/91	1L		F			38	206	0.79	300	0.63
169	79	6	17/05/91	1L		M			42	248	0.97	400	1.02
123	51	6	18/05/91	1L		M		PN-25/22	44	226	0.86	370	0.97
131	53	6	18/05/91	1L		F			38	198	0.75	295	0.65
138	49	6	19/05/91	2L	WH-15/7-LU	F	SC 31/5-CR		38	186	0.70	320	0.90

Appendix 2. Summary of records for farm 2. (continued)

Appendix 2. Summary of records for farm 2. (continued)

FARM 2
Summary of records for 1991

COW NO.	NEW NO.	COW AGE	CALVING DATE	CAL COM	COMMENTS	CAL SEX	CALF PROBS-1	CALF PROBS-2	BIRTH WGT(KG)	WEAN WGT(KG)	LWG B-W (KG/DAY)	TURN-OUT WGT(KG)	LWG W-TO (KD/DAY)
					T+ADH?								
109	94	6	20/05/91	1L		M			50	260	1.00	0	
170	50	6	20/05/91	1L		F			40	202	0.77	380	1.19
105	65	6	21/05/91	1L		F			42	218	0.84	360	0.95
155	28	6	21/05/91	1L		F			40	244	0.98	375	0.88
126	73	6	21/05/91	1L	CHECK 15/7-WH-OK .	M			44	240	0.94	400	1.07
39	85	9	21/05/91	1L		M			44	230	0.89	385	1.04
45	86	9	22/05/91	1LA		M	SC-31/5-CR		50	290	1.15	430	0.94
163	21	6	22/05/91	1L		M			42	230	0.90	360	0.87
60	72	9	22/05/91	1L		M			50	230	0.87	400	1.14
30	74	9	22/05/91	1L		M			42	226	0.88	330	0.70
154	22	6	22/05/91	1L		F			36	210	0.84	300	0.60
15	57	7	22/05/91	1L		M			46	226	0.87	335	0.73
57	82	9	22/05/91	1L		F			44	248	0.98	350	0.68
145	37	6	24/05/91	1L	RFM-WHITES -15/7.LUT.	M			50	235	0.90	0	
5	62	7	25/05/91	1L		M			50	248	0.97	390	0.95
118	60	6	25/05/91	1L		F		PN-26/11	36	198	0.79	310	0.75
51**	91	9	25/05/91	1L		M	SC-8/6		46	230	0.90	320	0.60
31	10	3	28/05/91	1L		F			36	198	0.80	320	0.82
108	40	6	31/05/91	1L		M			45	235	0.95	400	1.11
128	3	6	31/05/91	1L		M		PN-23/11	36	190	0.77	307	0.79
19	58	7	31/05/91	1L		M			38	230	0.96	350	0.81
113	63	6	02/06/91	1L		M		PN-20/11	42	226	0.93	0	
41**	78*	7	04/06/91	1L	CULL	F			40	370	1.69	0	
182	27	5	05/06/91	1L		M			34	186	0.78	280	0.63
53	93	9	06/06/91	1L		F		PN-27/11	42	256	1.11	400	0.97
16	25	7	06/06/91	1L		M	PN 12/7	PN-26/11	50	230	0.93	330	0.67
44	84	9	12/06/91	1L		F		PN-25/11	45	235	1.02	360	0.84
171	71	5	14/06/91	1LA		M			55	244	1.02	370	0.85
18	55	7	15/06/91	1LA		F			44	190	0.79	400	1.41
181	24	5	19/06/91	1L		M			50	214	0.91	0	
21	70	7	21/06/91	1L		F			40	178	0.78	270	0.62

Appendix 2. Summary of records for farm 2. (continued)

FARM 2
Summary of records for 1991

COW NO.	NEW NO.	COW AGE	CALVING DATE	CAL COM	COMMENTS	CAL SEX	CALF PROBS-1	CALF PROBS-2	BIRTH WGT(KG)	WEAN WGT(KG)	LWG B-W (KG/DAY)	TURN-OUT WGT(KG)	LWG W-TO (KD/DAY)
103	59	6	22/06/91	1LVA		M			44	206	0.92	335	0.87
14	87	7	22/06/91	1L		M			42	194	0.86	325	0.88
	31	0	03/07/91	1D	2- 1/4S ONLY	M	SET ON		42	190	0.89	325	0.91
184	45	5	03/07/91	1L		F			40	190	0.90	0	
33**	80*	7	03/07/91	1L	CULL	M			40	158	0.71	275	0.79

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 2

Normal ranges:

	Adequate	Marginal	Deficient
Copper (mmol/l)	9.4-23.6	4.7-9.4	<4.7
Selenium (Gshpx Units/mlPCV)	>23	8-23	<8
Cobalt (Vitamin B12 ng/l)	>200	150-200	<150

* Indicates marginal result.
** Indicates deficient result.

DATE	ANIMALS	COPPER	COBALT	SELENIUM
12/89				
1988 spring calves:		14	215*	24
- All Trace t.o.		15	125**	33
now access to min		*insuffic.*	130**	23
- No mins over		17	140**	48
summer. Now access		22	95**	61
to min mix.		13	140**	71
- No mins over		16	165*	31
summer and none		15	135**	24
now.		16	135**	34
1989	Spring	20	145**	28
	calves	14	225	77
		14	130**	89
		11	180*	59
		17	145**	35
	Cows	18	185*	33
		17	715	50
		14	175*	37
		16	220	35
		15	180*	73
		20	170*	50
		28	145**	44
2/90	Calves	13	200*	54
		22	155*	65
		12	175*	66
		13	135**	71
		14	185*	81
		12	285	68
		16	185*	77
		13	160*	62
		12	175*	69
		17	195*	57

Appendix 2.(ii)
Results of trace element analyses for farm 2.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 2 (Continued)

DATE	ANIMALS	COPPER	COBALT	SELENIUM
2/90	Cows	11	175	60
		13	220	34
		15	145	23*
		16	125	52
		22	215	18*
6/90	Cows	14	<50**	41
		10	<50**	38
		11	<50**	16*
		13	<50**	28
		13	65**	38
		13	<50**	24
		11	495	23*
9/90	Calves	18	185*	11*
		15	235	26
		14	125*	12*
	Cows	14	210	21.5*
		13	200*	10*
		15	330	8.2**
		13	180*	23*
		12	350	45
		12	220	18*
		12	150*	28
		14	330	30

Appendix 2.(ii)
Results of trace element analyses for farm 2.

Appendix 3. Summary of records for farm 3.

FARM 3
Summary of records for 1989

COW NO	CALVING DATE	CAL COMM.	BULLING DATE-1ST	BULLING DATE-2ND	BULLING DATE-3RD	COMMENTS	CALF SEX	CALF PROBS	BIRTH WGT (KG)
12	28/08/89	2L				RFM	M		
BLAN	17/09/89	1L					F		
BALER	18/09/89	1L	18/12/89				F	LOW ZST	
1	28/09/89	1L					F		
BLISS	28/09/89	1LA	01/12/89				F		
ALEXI	29/09/89	1L				PRID 20/12	M		
ANNE	01/10/89	1L				CULL	M		
ULTRA	13/10/89	1L	01/12/89				M		
ABBA	22/10/89	1L					M		37
RINA	22/10/89	1L	02/01/90	27/01/90		PRID 20/12	F		43
BERNA	22/10/89	1L	27/11/89				M		38
76	23/10/89	1LA					M		42
78	23/10/89	2L					M	CONG.CARDIAC	30
ROAN	24/10/89	1L					M		45
TINKE	24/10/89	1LA	04/11/89				F		40
77	29/10/89	1L					M		42
54	27/10/89	1L					M		45
60	29/10/89	1L					M		45
49	29/10/89	1L					F		35
VIOL	04/11/89	1L	18/12/89	04/01/90			M		41
94	05/11/89	1L					F		35
84	06/11/89	1L					M		38
21	12/11/89	1L					M		32
ORTIE	15/11/89	1L	01/12/89				M		35
8	20/11/89	1L					M		55
59	07/12/89	1L					M	DIED PNEU 11/12	40
PANTH	11/12/89	1L					M		43
44	09/12/89	AB				COW DIED SUDDENLY 4/1/90			
58	26/12/89	1LA-C					F		

FARM 3
Summary of Records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX	CALF PROBS.	BIR WGT(KG)	WEAN WGT(KG)	LIVE WEIGHT GAIN BIRTH-WEAN.(KG/DAY)
19	18/02/90	1L		F		40	370	0.80
86	21/02/90	1LA		M	SCOUR	40	435	0.97
33	09/04/90	1LA	TWISTED WOMB	M		45	0	
91	09/04/90	1L		M		40	0	
72	09/04/90	1L		M		41	0	
06	10/04/90	1L		M		50	0	
57	17/04/90	1L	10 DAYS PREM.	M		36	0	
120	17/04/90	1L		F		39	300	0.74
119	18/04/90	1LA		M		42	395	1.01
100	19/04/90	1LA		F		51	350	0.85
CHAR	19/04/90	1L		F		36	0	
62	19/04/90	1L		M		45	0	
71	20/04/90	1L		F		42	300	0.74
22	21/04/90	1L		F		40	0	
48	23/04/90	1L		F		40	370	0.95
50	23/04/90	2L		M		45	0	
67	23/04/90	1L		F		43	300	0.74
80	23/04/90	1L		F	DIED 28/4	41	0	
16	24/04/90	1L		M		45	320	0.80
41	25/04/90	1L		F		40	0	
85	26/04/90	1L		M		43	340	0.87
24	26/04/90	1L		M		45	380	0.98
110	26/04/90	1L		M		43	340	0.87
39	26/04/90	1L		F		42	330	0.84
66	26/04/90	1L		F		44	0	
96	27/04/90	1LA		M		48	0	
68	27/04/90	1LA		M		58	400	1.00
10	27/04/90	1L		F		42	325	0.83
97	28/04/90	1L		M		39	320	0.82
28	28/04/90	1L		M		43	0	
25	28/04/90	1LA		F		44	320	0.81
75	28/04/90	1L		M		43	0	
13	28/04/90	1L		F		39	325	0.84

Appendix 3. Summary of records for farm 3. (continued)

Appendix 3. Summary of records for farm 3. (continued)

FARM 3
Summary of Records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX	CALF PROBS.	BIR WGT(KG)	WEAN WGT(KG)	LIVE WEIGHT GAIN BIRTH-WEAN.(KG/DAY)
30	28/04/90	1L		M		42	325	0.83
43	29/04/90	1LA		M		40	0	
09	29/04/90	1L		F		40	240	0.59
56	30/04/90	1L		F		43	0	
15	30/04/90	1L		F		44	280	0.70
73	30/04/90	1L		F		41	380	1.00
90	30/04/90	1L		F		39	310	0.80
51	01/05/90	2L		F		38	0	
69	01/05/90	1L		M		43	300	0.76
26	01/05/90	1LA		M		43	350	0.91
23	01/05/90	1LA		M		46	0	
46	01/05/90	1L		F		44	290	0.73
34	01/05/90	1L		F		44	315	0.80
36	02/05/90	1L		F		42	310	0.80
44	02/05/90	1L		F		43	360	0.94
79	03/05/90	1L		F		43	280	0.71
02	03/05/90	1L		F		44	350	0.91
07	03/05/90	1L		F		46	280	0.70
42	04/05/90	1L		F		39	340	0.90
111	04/05/90	1L		M		49	0	
R19	04/05/90	1LA-C		M		43	0	
18	06/05/90	1LA	TORN VULVA	M		50	400	1.05
CHRIS	06/05/90	1LA		F	FREEK!	0	0	0.00
101	07/05/90	1LA		M		45	340	0.89
87	07/05/90	1L		M		42	0	
64	07/05/90	1L		F		39	0	
99	08/05/90	1L		F		42	0	
104	08/05/90	1LA		F		44	330	0.86
BLOND	09/05/90	1L		M		46	0	
109	10/05/90	1LA		M		42	0	
R40	12/05/90	1LA		M		43	0	
61	12/05/90	1LA		F	DIED 24/5	45	0	
88	12/05/90	1LA		F		43	0	
03	13/05/90	1L		M		43	330	0.88

FARM 3
Summary of Records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX	CALF PROBS.	BIR WGT(KG)	WEAN WGT(KG)	LIVE WEIGHT GAIN BIRTH-WEAN.(KG/DAY)
11	14/05/90	1L		M		44	390	1.06
38	14/05/90	1L		F		41	0	
29	15/05/90	1L		M		44	330	0.88
95	16/05/90	2L		M		0	0	0.00
107	17/05/90	1L		F		42	0	
124	18/05/90	1L		M		46	300	0.79
47	21/05/90	1L		M		42	0	
BELLA	22/05/90	1L		F		40	0	
20	22/05/90	1L		M		43	0	
55	23/05/90	1L		F		45	315	0.85
35	01/06/90	1L				0	0	0.00
37	01/06/90	1L		F		0	0	0.00
32	01/06/90	1L		F		0	0	0.00

Appendix 3. Summary of records for farm 3. (continued)

FARM 3
Summary of records for 1991

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX
107	07/04/91	1L		F
108	08/04/91	1L		M
77	09/04/91	1L		F
109	10/04/91	1L		M
110	10/04/91	1L		M
115	11/04/91	1LA		M
114	11/04/91	1L		F
33	12/04/91	1L		B
92	13/04/91	1L		M
91	16/04/91	1L		F
62	16/04/91	1L		F
119	16/04/91	1LA		M
71	18/04/91	1L		M
57	18/04/91	1L		M
06	19/04/91	1L		F
100	19/04/91	1L		M
16	19/04/91	1L		M
24	21/04/91	1L		F
80	21/04/91	1LA		M
72	21/04/91	1L		M
41	21/04/91	1LA		M
22	22/04/91	1L		F
112	22/04/91	1LA		F
85	22/04/91	1L		M
67	23/04/91	1LA		F
39	24/04/91	1L		M
15	24/04/91	1L		M
73	24/04/91	1L		M
25	24/04/91	1L		F
09	25/04/91	1L		M
53	25/04/91	1LA		M
96	26/04/91	1LA		M
75	26/04/91	1L		M
66	26/04/91	1L		M
10	26/04/91	1LA		M
97	27/04/91	1LA		F
28	27/04/91	1L		F
50	28/04/91	1LA		M
43	28/04/91	1L		F
30	28/04/91	1L		M
13	28/04/91	1L		M
68	28/04/91	1LA		M
56	28/04/91	1L		F
R19	28/04/91	1L		F
26	29/04/91	1LA		F
23	29/04/91	1L		M
42	30/04/91	1L		M
111	30/04/91	1L		M
34	30/04/91	1L		F
90	30/04/91	1L		M
70	30/04/91	1LA		M
51	30/04/91	1L		M
44	01/05/91	1L		F

Appendix 3. Summary of records for farm 3. (continued)

FARM 3
Summary of records for 1991

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX
18	01/05/91	1LA		F
07	01/05/91	1L		F
69	02/05/91	1L		F
36	02/05/91	1L		M
02	02/05/91	1L		M
52	03/05/91	1L		F
46	04/05/91	1L		M
106	05/05/91	1L		F
87	05/05/91	1L		M
105	06/05/91	1L		F
104	06/05/91	1LA		M
R40	07/05/91	1L		F
64	07/05/91	1L		M
61	08/05/91	1LA		M
99	09/05/91	1L		M
38	10/05/91	1L		M
1	11/05/91	1L		F
03	11/05/91	1L		M
29	11/05/91	1L		F
95	11/05/91	1L		F
21	15/05/91	1L		F
47	17/05/91	1L		M
20	17/05/91	1LA		M
58	19/05/91	1L		M
35	20/05/91	1LA		M
27	22/05/91	1L		M
32	25/05/91	1L		F

Appendix 3. Summary of records for farm 3. (continued)

MANAGEMENT CALENDAR FOR AUTUMN CALVERS: 1990

	COWS		CALVES
SEP	Calving starts	Mag mins + silage	Bovicoppa and Deposel at birth Dress umbilicus, weigh + tag.
OCT	Rotavec K99 later calvers		Disbud 7-9days old
	----------HOUSING-		
NOV	Ivomec as house + Cond. Score Feed high Copper min		
DEC	Bull in Calving ends		Creep feed calves
JAN			
FEB	Bull out		
MAR			Castrate non-pedigree calves
APR	Pregnancy diagnosis + Cond. Score		
	----------TURN-OUT-		
MAY		Mag mins	Autoworm as put out Creep feed Pedigree calves
JUN			
JUL			
AUG	Weaning-Leo red i/mamm + Cond. Score		Weigh calves

Appendix 3(ii).Example of management calendar for farm 3.
For autumn calving cows.

MANAGEMENT CALENDAR FOR SPRING CALVERS: 1990

	COWS		CALVES
SEP		Mag. mins	
OCT	Pregnancy diagnosis + Ivomec cows and calves + Cond. Score		Castrate calves-save 25 biggest for Bull Beef Take indoors with dam
IN-NOV			----------wean in 10 days----HOUSING-
	Offer high Copper mins.		
DEC			
JAN			
FEB	Weaning-Cond. Score		Weigh calves
MAR			
			----------TURN-OUT-
APR	Calving starts	Mag. mins	Bovicoppa and Deposel at birth. Dress umbilicus, tag and weigh. Disbud 7-10 days old.
MAY			Weigh last years calves as turn out
JUN	Calving ends		
JUL	Cond. score Bull in		
AUG			Start creep feed

Appendix 3(ii).(continued) Example of management calendar for farm 3. For spring calving cows.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 3

Normal ranges:

	Adequate	Marginal	Deficient
Copper (mmol/l)	9.4-23.6	4.7-9.4	<4.7
Selenium (Gshpx Units/mlPCV)	>23	8-23	<8
Cobalt (Vitamin B12 ng/l)	>200	150-200	<150

* Indicates marginal result.
** Indicates deficient result.

DATE	ANIMALS	COPPER	COBALT	SELENIUM
12/89	Sp. calves	16	375	28
		25	255	31
		10	275	31
		16	470	44
		15	305	37
		31	310	45
		15	265	21*
1/90	Cows (aut)	16	170*	
		11	180*	
		10	145**	
	Cows (sp)	10	240	
		11	250	
		13	270	
		19	230	
		17	270	
		13	210	
		16	270	
2/90	Aut born calves	12	150*	23
		14	190*	15*
		21	170*	26
		11	75**	8**
		25	370	19*
		14	165*	8**
		21	210	43
4/90	Calves born spring 1989	15	230	37
		22	200	64
		17	235	69
		13	155*	42
		16	215	57
		17	335	40
		17	155*	38
		13	260	58

Appendix 3 (iii)
Results of trace element analyses for farm 3.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 3 (Continued)

DATE	ANIMALS	COPPER	COBALT	SELENIUM
4/90	Sp cows	10	115**	48
		12	100**	54
		18	95**	62
		11	175*	21*
		12	95**	33
	Aut calves	12	365	34
		10	110**	61
		17	145**	29
		12	145**	38

Appendix 3 (iii)
Results of trace element analyses for farm 3.

COW NUMBER	CALVING DATE 1991	CALVING COMMENTS	CALF SEX	CALVING DATE 1990	CALVING COMMENTS	CALF SEX	CALVING INTERVAL 1990-1991(days)
02	02/05/91	1L	M	03/05/90	1L	F	364
03	11/05/91	1L	M	13/05/90	1L	M	363
06	19/04/91	1L	F	10/04/90	1L	M	374
07	01/05/91	1L	F	03/05/90	1L	F	363
09	25/04/91	1L	M	29/04/90	1L	F	361
1	11/05/91	1L	F				
10	26/04/91	1LA	M	27/04/90	1L	F	364
100	19/04/91	1L	M	19/04/90	1LA	F	365
101				07/05/90	1LA	M	
104	06/05/91	1LA	M	08/05/90	1LA	F	363
105	06/05/91	1L	F				
106	05/05/91	1L	F				
107	07/04/91	1L	F	17/05/90	1L	F	325
108	08/04/19	1L	M				
109	10/04/91	1L	M	10/05/90	1LA	M	335
11				14/05/90	1L	M	
110	10/04/91	1L	M	26/04/90	1L	M	349
111	30/04/91	1L	M	04/05/90	1L	M	361
112	22/04/91	1LA	F				
114	11/04/91	1L	F				
115	11/04/91	1LA	M				
119	16/04/91	1LA	M	18/04/90	1LA	M	363
120				17/04/90	1L	F	
124				18/05/90	1L	M	
13	28/04/91	1L	M	28/04/90	1L	F	365
15	24/04/91	1L	M	30/04/90	1L	F	359
16	19/04/91	1L	M	24/04/90	1L	M	360
18	01/05/91	1LA	F	06/05/90	1LA	M	360
19				18/02/90	1L	F	
20	17/05/91	1LA	M	22/05/90	1L	M	360
21	15/05/91	1L	F				
22	22/04/91	1L	F	21/04/90	1L	F	366
23	29/04/91	1L	M	01/05/90	1LA	M	363
24	21/04/91	1L	F	26/04/90	1L	M	360
25	24/04/91	1L	F	28/04/90	1LA	F	361
26	29/04/91	1LA	F	01/05/90	1LA	M	363
27	22/05/91	1L	M				
28	27/04/91	1L	F	28/04/90	1L	M	364
29	11/05/91	1L	F	15/05/90	1L	M	361
30	28/04/91	1L	M	28/04/90	1L	M	365
32	25/05/91	1L	F	01/06/90	1L	F	358
33	12/04/91	1L	B	09/04/90	1LA	M	368
34	12/04/91	1L	F	01/05/90	1L	F	364
35	20/05/91	1LA	M	01/06/90	1L		353
36	02/05/91	1L	M	02/05/90	1L	F	365
37				01/06/90	1L	F	
38	10/05/91	1L	M	14/05/90	1L	F	361
39	24/04/91	1L	M	26/04/90	1L	F	363
41	21/04/91	1LA	M	25/04/90	1L	F	361
42	30/04/91	1L	M	04/05/90	1L	F	361
43	28/04/91	1L	F	29/04/90	1LA	M	364
44	01/05/91	1L	F	02/05/90	1L	F	364
46	04/05/91	1L	M	01/05/90	1L	F	368
47	17/05/91	1L	M	21/05/90	1L	M	361
48				23/04/90	1L	F	

Appendix 3 (iv).
Cow calving dates and calving intervals.

FARM 3 Calving intervals between 1990 and 1991

COW NUMBER	CALVING DATE 1991	CALVING COMMENTS	CALF SEX	CALVING DATE 1990	CALVING COMMENTS	CALF SEX	CALVING INTERVAL 1990-1991
50	28/04/91	1LA	M	23/04/90	2L	M	370
51	30/04/91	1L	M	01/05/90	2L	F	364
52	03/05/91	1L	F				
53	25/04/91	1LA	M				
55				23/05/90	1L	F	
56	28/04/91	1L	F	30/04/90	1L	F	363
57	18/04/91	1L	M	17/04/90	1L	M	366
58	19/05/91	1L	M				
61	08/05/91	1LA	M	12/05/90	1LA	F	361
62	16/04/91	1L	F	19/04/90	1L	M	362
64	07/05/91	1L	M	07/05/90	1L	F	365
66	26/04/91	1L	M	26/04/90	1L	F	365
67	23/04/91	1LA	F	23/04/90	1L	F	365
68	28/04/91	1LA	M	27/04/90	1LA	M	366
69	02/05/91	1L	F	01/05/90	1L	M	366
70	30/04/91	1LA	M				
71	18/04/91	1L	M	20/04/90	1L	F	363
72	21/04/91	1L	M	09/04/90	1L	M	377
73	24/04/91	1L	M	30/04/90	IL	F	359
75	26/04/91	1L	M	28/04/90	1L	M	363
77	09/04/91	1L	F				
79				03/05/90	1L	F	
80	21/04/91	1LA	M	23/04/90	1L	F	363
85	22/04/91	1L	M	26/04/90	1L	M	361
86				21/02/90	1LA	M	
87	05/05/91	1L	M	07/05/90	1L	M	363
88				12/05/90	1LA	F	
90	30/04/91	1L	M	30/04/90	1L	F	365
91	16/04/91	1L	F	09/04/90	1L	M	372
92	13/04/91	1L	M				
95	11/05/91	1L	F	16/05/90	2L	M	360
96	26/04/91	1LA	M	27/04/90	1LA	M	364
97	27/04/91	1LA	F	28/04/90	1L	M	364
99	09/05/91	1L	M	08/05/90	1L	F	366
BELLA				22/05/90	1L	F	
BLOND				09/05/90	1L	M	
CHAR				19/04/90	1L	F	
CHRIS				06/05/90	1LA	F	
R19	28/04/91	1L	F	04/05/90	1LA-C	M	359
R40	07/05/91	1L	F	12/05/90	1LA	M	360
					Average calving interval for 1990-1991		362 days

Appendix 3 (iv).
Cow calving dates and calving intervals.

Appendix 4. Summary of records for farm 4.

FARM 4
Summary of records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	BULLING DATE-1	BULL -1	BULLING DATE-2	BULL -2	BULLING DATE-3	BULL -3	CALF SEX	CALF'S SIRE	CALF COLOUR
C11	21/02/90	1DAb	Aborted	20/07/90	GOLDIE							
C14	24/02/90	2L								F	CHAR	GREY
C24	01/03/90	1L								M	CHAR	GREY
C44	03/03/90	1L								F	CHAR	BR
C26	04/03/90	1D		30/06/90	GOLDIE							
C3	04/03/90	1L		19/06/90	GOLDIE					F	CHAR	GREY
C16	05/03/90	1L								M	CHAR	GREY
C31	06/03/90	1LVA	INJ.3DD POST CAL							M	CHAR	BR+WH
C8	10/03/90	1L		17/07/90	THUMPE					M	CHAR	BR
C30	11/03/90	1LA		08/08/90	GOLDIE					F	CHAR	BR
C32	13/03/90	1DVA	INJS.4DD POST CAL	19/07/90	GOLDIE							
C42	14/03/90	1L	COW SORE LEG	25/07/90	GOLDIE					F	CHAR	DUN
C35	14/03/90	1L		08/07/90	GOLDIE					F	CHAR	GREY
C9	15/03/90	1L		09/07/90	SOLO					F	CHAR	BR
C23	17/03/90	1L								M	CHAR	DUN+WH
C25	18/03/90	1DA	RFM-CL-INJ 3DD									
C46	18/03/90	1L		29/06/90	GOLDIE					F	CHAR	BR
C1	18/03/90	1LVA		16/07/90	GOLDIE					F	CHAR	BR
C6	19/03/90	1L		13/07/90	GOLDIE					F	CHAR	DUN
C7	19/03/90	1LA		19/07/90	GOLDIE					F	CHAR	BR
C27	20/03/90	1L		28/07/90	GOLDIE					M	CHAR	BR
C4	20/03/90	1L		24/06/90	GOLDIE					M	CHAR	GREY
C12	21/03/90	1L	RFM-22/3 CL.	20/06/90	GOLDIE					M	CHAR	DUN
C36	22/03/90	1L								F	CHAR	DUN
C39	23/03/90	1LVA								M	CHAR	DUN
C29	24/03/90	1L	MASTITIS FR LEFT	19/06/90	GOLDIE					F	CHAR	DUN
C34	25/03/90	1L								M	CHAR	BR
C21	25/03/90	1L		24/06/90	SOLO					F	CHAR	DUN
C28	25/03/90	1L	PRID-28/11	10/12/90	COFFEE	31/12/90	SOLO	03/01/91	SO/DAN	M	CHAR	BR

Appendix 4. Summary of records for farm 4.(continued)

FARM 4
Summary of records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	BULLING DATE-1	BULL -1	BULLING DATE-2	BULL -2	BULLING DATE-3	BULL -3	CALF SEX	CALF'S SIRE	CALF COLOUR
			.FERT-3/1/91									
C10	25/03/90	1L								F	CHAR	DUN
C22	28/03/90	1L		11/07/90	SOLO					M	CHAR	GREY
K20	29/03/90	1L		26/06/90	GOLDIE					M	LIM	BR
C19	30/03/90	1L		15/07/90	SOLO	09/08/90	SO/GOL			M	CHAR	BR
C43	01/04/90	1LA		21/06/90	SOLO	15/07/90	SO/DYN			M	CHAR	DUN+WH
K38	01/04/90	1L	RFM-2/4 CL.	18/11/90	COFFEE					M	CHAR	GREY
K17	01/04/90	1L		29/06/90	SOLO					F	LIM	BL+WH
K18	02/04/90	1L		01/07/90	SOLO					M	LIM	BLACK
C13	03/04/90	1LA		03/07/90	SOLO					M	CHAR	BR
C41	06/04/90	1L	RFM-CL.							F	CHAR	DUN
C40	06/04/90	1L								F	CHAR	BR
C5	07/04/90	1L		04/07/90	SOLO	25/07/90	SOLO			F	CHAR	BR
C2	08/04/90	1L		09/07/90	SOLO					M	CHAR	BR
C33	09/04/90	1L		06/07/90	SOLO					M	CHAR	BR
K19	10/04/90	2L		09/08/90	SO/GOL					M	LIM	BR
C37	11/04/90	1LVA	DEPO-3DD POST CAL	13/12/90	COFFEE					F	CHAR	BR
C20	11/04/90	1L		29/07/90						M	CHAR	DUN+WH
C15	19/04/90	1L								M	CHAR	BR
98	11/05/90	1L								F	LIM	BR
C45	12/05/90	1L								F	CHAR	BR
92	19/05/90	1L		26/07/90	SOLO					M	LIM	BLACK
J5	25/05/90	1LA								F	LIM	BR
99	28/05/90	1LA		19/07/90	TH/SOL					M	LIM	BR
66	31/05/90	1L								F	LIM	BR
87	03/06/90	1L								F	LIM	BR
J2	03/06/90	1L	RFM-CL.	29/06/90	DAN					M	LIM	BR
104	06/06/90	1LA		12/07/90	DAN					M	LIM	BR
J6	06/06/90	1L		08/08/90	SOLO					F	LIM	BLACK
72	07/06/90	1L		30/06/90	DAN					F	LIM	BLACK
76	08/06/90	1L		15/06/90	DAN					M	LIM	BR
J3	12/06/90	1LA		13/07/90	DAN					M	LIM	BLACK

Appendix 4. Summary of records for farm 4.(continued)

FARM 4
Summary of records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	BULLING DATE-1	BULL -1	BULLING DATE-2	BULL -2	BULLING DATE-3	BULL -3	CALF SEX	CALF'S SIRE	CALF COLOUR
102	14/06/90	1LA								F	LIM	BLACK
C18	18/06/90	1L		09/07/90	DAN					F	CHAR	BR
K85**	03/07/90	AB	CULL COW									
27	15/07/90	1L		01/07/90	SOLO					M	CHAR	BR
K93	07/08/90	AB	TWINNED ON CALF LUT-24/11	20/11/90	solo					F	SIM	BR
K26	08/08/90	1L		11/11/90	COF/DU					F	CH	BR
K13	09/08/90	1L	LUT-03/12	15/12/90	COFFEE					F	LIM	BL
K22	12/08/90	1L		27/12/90	DU/COF					F	LIM	BL
K52c	13/08/90	1L	TWINNED ON ANO	15/11/90	DAN	08/12/90	CO/DAN			F	SIM	BL+WH
K4	17/08/90	1L		15/11/90	CO/DU					M	LIM	BR
K10c	17/08/90	1L								M	CH	BR
K89	21/08/90	2L								F	SIM	BR+WH
K90	22/08/90	1L								M	SIM	BR
K57	22/08/90	1L		25/11/90	COFFEE					M	CH	BR
19	23/08/90	1L		06/12/90	THUMPE					F	SIM	BR+WH
K29	23/08/90	1L		24/11/90	DUKE					F	CH	BR
K83	25/08/90	1L		10/11/90	GOLDIE					F	SIM	
58	25/08/90	1L		11/11/90	COFFEE	04/12/90	COFFEE			F	LIM	BR
K3	25/08/90	1L		10/11/90	DUKE					F	LIM	BL
63	25/08/90	2D	ABS TO COW-TWIN ON .FERT-24/12	13/11/90	COFFEE	03/12/90	DAN/CO	24/12/90	COFFEE			
101	26/08/90	1L		12/11/90	DUKE					M	CH	BR
88	26/08/90	1L		04/12/90	CO/DAN					M	LIM	
9	27/08/90	1L								F	SIM	
35	27/08/90	1L		11/11/90	DU/COF					F	SIM	BR+WH
67	27/08/90	1L								M	SIM	
65	28/08/90	1L								F	CH	GR
K51	29/08/90	1L		27/11/90	DUK/CO					F	CH	DUN
K14	29/08/90	1LVA		21/11/90	GOLDIE					F	SIM	BL

Appendix 4. Summary of records for farm 4.(continued)

FARM 4
Summary of records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	BULLING DATE-1	BULL -1	BULLING DATE-2	BULL -2	BULLING DATE-3	BULL -3	CALF SEX	CALF'S SIRE	CALF COLOUR
K25	30/08/90	1L								M	SIM	DUN
K88	30/08/90	1L	?WHITES-04 /12	03/12/90	DAN/CO	25/12/90	DAN			F	SIM	
K69	30/08/90	1L								F	SIM	
K35	30/08/90	1L		28/11/90	SOL/CO					M	LIM	
11	30/08/90	2L		11/11/90	THUMP					M	SIM	BL+WH
K1	30/08/90	1L		10/11/90	GOLDIE					M	CH	DUN
K64	30/08/90	1L								M	SIM	
K55	31/08/90	1L	?VET 12/1/91	23/11/90	DUK/CO	09/01/91	CO/DAN			M	CH	BR
K73	31/08/90	2LA								M	CH	GREY
K31**	31/08/90	1LVA	COW DIED ABO ULCER							M	CH	GR
K33	31/08/90	1L		11/12/90	DAN/SO					M	LIM	BR
106	31/08/90	1L	9/1/91-FER T	27/11/90	DU/CO	18/12/90	CO/DAN	08/01/91	COFFEE	M	CH	BR
K45	31/08/90	1L		23/11/90	DU/CO					M	CH	BR
85	01/09/90	1L		15/11/90	DUKE					M	CH	BR
1	01/09/90	1L		20/12/90	GOLDIE					F	SIM	BL+WH
K28	01/09/90	1L		10/11/90	DUK/CO					F	LIM	BL
117	02/09/90	1L		18/11/90	COF	10/12/90	CO/DAN	03/01/90	CO/DAN	M	SIM	
118	02/09/90	1L		12/11/90	DUKE					M	LIM	BR
114	02/09/90	1L		15/11/90	DAN					F	SIM	
89	02/09/90	1L		13/11/90	COFFEE		E			M	LIM	BR
K82	02/09/90	1L		18/11/90	DAN					F	CH	GR
K56	03/09/90	1L								M	SIM	
59	03/09/90	1L								F	SIM	
38	03/09/90	1L		13/11/90	THUMP	01/01/91	THUMP			M	SIM	BL+WH
K91	03/09/90	1L		18/11/90	THUMP					M	SIM	
K16	03/09/90	1L		15/11/90	DUK/SO						SIM	
K40	04/09/90	1L		21/11/90	DUKE	14/12/90	DAN			M	SIM	BR
K49	04/09/90	1L		20/11/90	DAN	14/12/90	DAN			F	SIM	
K98	04/09/90	1LA		19/11/90	THUMPE		R			M	CH	GR
107	05/09/90	1L		23/11/90	DUK/CO					M	SIM	
K44	05/09/90	1L								M	LIM	BL

Appendix 4. Summary of records for farm 4.(continued)

FARM 4
Summary of records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	BULLING DATE-1	BULL -1	BULLING DATE-2	BULL -2	BULLING DATE-3	BULL -3	CALF SEX	CALF'S SIRE	CALF COLOUR
26	05/09/90	1LA		29/11/90	GOLDIE					M	SIM	BL
K7	05/09/90	1L		15/11/90	DUK/CO					F	LIM	BR
7	05/09/90	1L								F	SIM	BL
K87	11/09/90	1L1D		12/11/90	DYNA	05/12/90	DYNA			M	LIM	
29	12/09/90	1L								M	CH	
K84	12/09/90	1L		02/12/90	GOL	24/12/90	GO/DYN			F	SIM	
K65	12/09/90	1L		18/11/90	CO/DAN					M	SIM	
K32	13/09/90	1L		19/11/90	DAN					F	LIM	BR
82	14/09/90	1L		11/11/90	DUKE					F	SIM	BR
115	14/09/90	1L	WH-WO-26/11	14/11/90	SOLO	17/12/90	CO/DAN			M	SIM	
K96	14/09/90	1L		18/11/90	DAN					M	LIM	
K23	14/09/90	1L		20/11/90	COFFEE					M	SIM	
K39	15/09/90	1L		03/12/90	COFFEE					F	SIM	
116	15/09/90	1L		11/11/90	SOLO					F	SIM	BR
K72	16/09/90	1L		27/11/90	SOLO					M	LIM	
K47	16/09/90	1L		13/11/90	GOLDIE					M	LIM	
8	16/09/90	1L		18/11/90	GOLDIE					M	SIM	BR+WH
K95	16/09/90	1L		11/11/90	THUMP					M	SIM	
K58	17/09/90	1L		15/11/90	DUKE					M	LIM	
K8	17/09/90	1L		17/12/90	GO/DYN					M	SIM	
84	17/09/90	1L								M	LIM	BL
K53	17/09/90	1L		20/11/90	CO/DAN					M	SIM	BR+WH
K12	17/09/90	1L		19/11/90	GOL/DY	10/12/90	DYN			F	LIM	
K92	18/09/90	1L		22/11/90	DYN					F	SIM	
94	18/09/90	1L		21/11/90	COFFEE					M	SIM	BR+WH
K61	19/09/90	1L								F	SIM	
93	19/09/90	1L								M	SIM	BR+WH
K94	19/09/90	1D	TWIN ON K89-T									
K24	21/09/90	1L		18/11/90	DAN					F	SIM	DUN
113	21/09/90	1L		15/11/90	COFFEE					F	SIM	BR
111	22/09/90	1L		14/11/90	DUKE					F	SIM	BR
K74	23/09/90	1L		12/11/90	DYN					F	CH	
K59	24/09/90	1L		02/12/90	CO/DAN					M	LIM	BR

Appendix 4. Summary of records for farm 4.(continued)

FARM 4
Summary of records for 1990

COW NO.	CALVING DATE	CAL COMM.	COMMENTS	BULLING DATE-1	BULL -1	BULLING DATE-2	BULL -2	BULLING DATE-3	BULL -3	CALF SEX	CALF'S SIRE	CALF COLOUR
109	25/09/90	1L		21/11/90	CO/DAN					M	SIM	BR
2	25/09/90	1L		13/11/90	THUMPE					F	CH	GR
K15	26/09/90	1L								F	LIM	
K99	26/09/90	1L								M	LIM	
NT	26/09/90	1L								F	SIM	
K42	27/09/90	1L		19/11/90	GOLDIE					M	SIM	BR+WH
K34	27/09/90	1L								M	SIM	
K50	27/09/90	1L		12/11/90	DYNA					M	CH	
K37	29/09/90	1L								M	LIM	BL
K76**	29/09/90	1L	CULL-26/10							M	LIM	BL
34	29/09/90	1L		10/12/90	THUMPE					F	CH	BR
K86	30/09/90	1L								M	CH	
6	02/10/90	1L		17/11/90	GOL	29/11/90	GOL			F	CH	GR
109	02/10/90	1L								M	LIM	BL
K97	04/10/90	1L		24/12/90	GOLDIE					M	SIM	BR+WH
K21	04/10/90	1L		11/11/90	DYNA					F	LIM	BR
110**	05/10/90	1LA	CULL-29/10							F	LIM	BR
K66	06/10/90	1L								F	SIM	BR+WH
64	07/10/90	1L		26/11/90	GO/DYN					F	SIM	BR+WH
75	07/10/90	1L		10/11/90	GOLDIE					F	SIM	BR+WH
K80	11/10/90	1LA								F	CH	BR
69	11/10/90	1L								F	LIM	BR
10	13/10/90	1LA		14/11/90	THUMPE					F	CH	BR
14	13/10/90	1L		20/11/90	GOLDIE					F	CH	GR
4	15/10/90	1L								F	CH	GR
K79	17/10/90	1LA								F	LIM	BR
18	18/10/90	1LA		24/12/90	GOLDIE					M	CH	GR
103	20/10/90	1L								F	LIM	BL
K36	20/10/90	1L		28/11/90	DYN					M	SIM	BL
K81	20/10/90	1L		08/12/90	THUMPE					F	CH	GR
32	24/10/90	1LVA		20/12/90	THUMP					F	CH	GR
61	10/11/90	1L		26/12/90	THU/CO					M	LIM	BL

COW NO.	CALVING DATE	NOTES	BULLING DATE-1	BULL 1	BULLING DATE-2	BULL 2	BULLING DATE-3	BULL 3	PRED CAL DATE	PD RES	COMMENTS	CALF NO.	SEX	CALF BREED	CALF COLOUR
J4	29/03/91	IL							17/10/00	+VE		J4	F	SIM	BR
C10	30/03/91	IIA	28/07/91	DAN	06/08/91	DAN			17/10/00	NIC	2/8-WH-LUT.6/11 WH LUT	C10	F	SIM	BL
C40	30/03/91	IL	05/08/91	SOLO					17/10/00	NIC	2/8-WH-LUT.OK 6/11	C40	F	SIM	BL
C16	31/03/91	IL	01/07/91	GOLDIE					16/04/92	+VE		C16	M	CH	
C45	03/04/91	IIA	06/07/91	DAN					17/10/00	NIC	RIM-VET CL.OK 6/11	C45	F	SIM	
C23	03/04/91	IDVA							17/10/00		RIM-VET CL				
C4	03/04/91	IIA							17/10/00		RIM-VET CL	C4	M	CH	BR
C9	03/04/91	IIA	17/07/91	COFFEE					02/05/92	+VE	RIM-VET CL	C9	F	CH	BR+WH
C29	04/04/91	IL							17/10/00			C29	F	CH	GR
C3	04/04/91	IL	01/07/91	GOLDIE					16/04/92	+VE		C3	F	CH	BR
C12	05/04/91	IL							17/10/00			C12	M	CH	GR
98	07/04/91	IL							17/10/00			98	M	LIM	DUN
C24	07/04/91	IL							17/10,00			C24	F	CH	GR
C21	08/04/91	IIA	04/07/91	DYN					19/04/92	+VE		C21	M	SIM	BL
C41	08/04/91	IIA	01/07/91	DYN					16/04/92	+VE		C41	M	CH	GR
C42	09/04/91	IIA	20/06/91	GOLDIE	14/07/91	SOLO	05/08/91	SOLO	21/05/92	+VE	6/8-FERT	C42	F	SIM	BR
B10	10/04/91	IL							17/10,00	+VE		B10	M	SIM	BL
B39	10/04/91	IL	21/06/91	GOLDIE					06/04/92	+VE		B39	M	SIM	BR+WH
B35	10/04/91	IL	26/06/91	GOLDIE					11/04/92	+VE		B35	F	SIM	BR+WH
C14	11/04/91	IL	04/07/91	GOLDIE					19/04/92	+VE		C14	M	CH	GR
C2	12/04/91	IL	07/07/91	GOLDIE	18/07/91	SOLO	01/08/91	SOLO	17/05/92	+VE	2/8-OK	C2	F	SIM	BR+WH
66	12/04/91	IL	24/06/91	COFFEE					09/04/92	+VE		66	F	LIM	BL
C15	12/04/91	IL	06/07/91	GOLDIE					21/04/92	+VE		C15	M	SIM	BR+WH
25	12/04/91	IL							17/10/00	+VE		25	F	SIM	BR+WH
C36	14/04/91	IL	05/07/91	COFFEE					20/04/92	+VE		C36	F	CH	GR
B28	14/04/91	IL	30/06/91	GOLDIE	21/07/91	SOLO			06/05/92	+VE	2/8-?LEFT OVARY	B28	M	SIM	BR+WH
B34	14/04/91	IL	06/07/91	GOLDIE	17/07/91	??			02/05/92	+VE		B34	M	SIM	BL+WH
32	14/04/91	IL	08/07/91	DUKE	16/07/91	DUKE	06/08/91	DUKE	22/05/92	+VE	6/8-EXAM VET-OK	32	F	SIM	BL
105	15/04/91	IL	06/07/91	COFFEE					21/04/92	+VE		05	M	SIM	BL
C46	16/04/91	IL	28/07/91	DAN					13/05/92	+VE		C46	M	CH	GR
C44	18/04/91	IL	26/06/91	DAN	16/07/91				01/05/92	+VE		C44	M	CH	GR
C38	18/04/91	IL	03/07/91	DAN	24/07/91				09/05/92	+VE	2/8-VET EXAM-OK	C38	F	SIM	DUN
J5	18/04/91	IL	27/06/91	COFFEE					12/04/92	+VE		J5	M	LIM	BR
B45	18/04/91	IL							17/10/00	+VE		B45	M	SIM	BL+WH
C13	19/04/91	IL							17/10/00	NIC	6/11-LUT.OK	C13	M	SIM	BR+WH
C31	19/04/91	IL	01/07/91	GOLDIE	15/08/91	SOLO			31/05/92	+VE	15/8-FERT	C31	F		BR
C18	19/04/91	IL	06/07/91	DYN	30/07/91	SOLO			15/05/92	+VE	2/8-EXAM-OK	C18	M	LIM	BR
C22	20/04/91	IL	30/06/91	COFFEE					15/04/92	+VE		C22	F	SIM	DUN
K2	20/04/91	IL	26/06/91	DYN					11/04/92	+VE		K2	M	SIM	BR
C25	20/04/91	IL	01/07/91	DYN					16/04/92	+VE		C25	F	SIM	BR
33	25/04/91	IL							17/10/00	+VE		33	M	SIM	BR
B14	24/04/91	IIA							17/10,00	+VE		B14	M	SIM	BL+WH
K17	24/04/91	IL	10/07/91	DAN					25/04/92	+VE		K17	M	SIM	BL
K18	24/04/91	IL	21/06/91	COFFEE					06/04/92	+VE		K18	M	SIM	BR+WH
C43	25/04/91	IL	22/06/91	DYN	14/07/91	GOL/DY			29/04/92	+VE		C43	F	CH	BR
C35	26/04/91	IIA							17/10/00	+VE		C35	M	CH	GR
B11	27/04/91	IIA	24/07/91	COFFEE	15/08/91	COFFEE			17/10/00	NIC	26/7-WH-WO.15/8-FERT.OK 6/11	B11	M	SIM	BR+WH
C8	29/04/91	IL	13/07/91	SOLO					28/04/92	+VE		C8	F	SIM	BL+WH
C32	29/04/91	IIA	21/06/91	DYN	11/07/91	SOLO			26/04/92	+VE	26/7-EXAM-OK	C32	M	CH	GR
C7	30/04/91	IIA	01/07/91	DYN	02/08/91	SOLO			17/10/00	NIC	2/8-LUT.BULLING 6/11	C7	F	CH	GR+WH
87	30/04/91	IL	20/06/91	COFFEE					05/04/92	+VE		87	F	LIM	BL
104	30/04/91	IL							17/10/00	+VE		104	F	LIM	BR
C1	01/05/91	IL	24/06/91	DYN					09/04/92	+VE		C1	F	CH	GR
99	02/05/91	IL	06/07/91	COFFEE					17/10/00	NIC	6/11.RGT OVARY-?ADH.BLIND 1/4	99	M	SIM	BR+WH
72	05/05/91	IL	22/06/91	COFFEE	11/07/91	DAN	02/08/91	DAN	18/05/92	+VE		72	M	LIM	BL
76	06/05/91	IL	06/07/91	COFFEE					21/04/92	+VE		76	F	LIM	BR
K20	06/06/91	IIA	24/06/91	COFFEE					09/04/92	+VE		K20	F	CH	DUN

COW NO.	CALVING DATE	NOTES	BULLING DATE-1	BULL 1	BULLING DATE-2	BULL 2	BULLING DATE-3	BULL 3	PFED CAL. DATE	PD RES	COMMENTS	CALF NO.	SEX	CALF BREED	CALF COLOUR
92	08/05/91	1L	22/06/91	COFFEE					07/04/92	+VE		92	M	SIM	BR+WH
J3	09/05/91	1L	26/06/91	COFFEE	19/07/91	DAN			04/05/92	+VE		J3	F	LIM	BR
C26	09/05/91	1L	20/06/91	COFFEE					05/04/92	+VE		C26	F	CH	GR
C20	10/05/91	1L	25/06/91	DAN					10/04/92	+VE		C20	M	CH	
C5	10/05/91	1L	13/07/91	SOLO					28/04/92	+VE		C5	F	SIM	
C39	11/05/91	1L							17/10/00	+VE		C39	M	SIM	
C11	12/05/91	1L	08/07/91	DAN					23/04/92	+VE		C11	M	CH	
C6	13/05/91	1L							17/10/00	+VE		C6	F	CH	GR
C30	15/05/91	1L							17/10/00	+VE		C30	M	CH	BR
J2	20/05/91	1L	04/08/91	DAN					17/10/00	NIC	5/8-FERT	J2	F	LIM	BR
102	25/05/91	1L	02/07/91	COFFEE					17/10/00	NIC	CYST RGT OV-FERT 6/11	102	F	LIM	BL
K19	26/05/91	1LA	11/07/91	DAN	01/08/91	GOLDIE			17/10/00	NIC	OK-6/11	K19	F	CH	BR
C19	27/05/91	1LA	14/07/91	COFFEE					17/10/00	NIC	26/7-WO.6/11 BULLING.CLEAN.	C19	M	CH	GR
J6	26/05/91	1L	23/06/91	COFFEE	12/07/91	DAN			17/10/00	+VE		J6	M	SIM	BR+WH
K13	30/07/91	1D							17/10/00		ABORTED	K13	F	SIM	BL
K30	02/08/91	1D							17/10/00		ABORTED	K30	M	SIM	BL
M20	10/08/91	1L							17/10/00			M20	M	LIM	BL
M16	20/08/91	1L							17/10/00			M16	M	LIM	BR
2	20/08/91	1L							17/10/00		SOLD	2	M	SIM	BL
21	20/08/91	1L							17/10/00			21	F	CH	GR
K50	20/08/91	1L							17/10/00			K50	F	CH	GR
10	21/08/91	2L							17/10/00			10	M	SIM	BL
K25	23/08/91	1L							17/10/00			K25	F	SIM	
K16	24/08/91	1LVA							17/10/00			K16	M	SIM	DUN
K3	26/08/91	1LA							17/10/00			K3	M	SIM	BL
K7	26/08/91	1L							17/10/00			K7	M	SIM	BL
K28	26/08/91	1L							17/10/00			K28	M	LIM	BR
91	26/08/91	1L							17/10/00			91	M	SIM	DUN
75	27/08/91	1L							17/10/00			75	F	CH	GR
K1	26/08/91	1L							17/10/00			K1	M	CH	GR
K73	27/08/91	1L							17/10/00			K73	F	LIM	
M12	28/08/91	1LVA							17/10/00		TORN	M12	F	LIM	BL
7	28/08/91	2L							17/10/00			7	M	SIM	
111	28/08/91	1L							17/10/00			111	M	SIM	
K46	29/08/91	1L							17/10/00			K46	F	LIM	BR
11	30/08/91	1L							17/10/00			11	M	LIM	
K45	29/08/91	2L							17/10/00		SOLD 1 TWIN	K45	M	LIM	BR
K26	31/08/91	1L							17/10/00			K26	M	LIM	BL
10L	31/08/91	1L							17/10/00			10L	M	LIM	BL
82	31/08/91	1L							17/10/00			82	F	LIM	BR
59	31/08/91	1L							17/10/00			59	M	LIM	BL
K68	01/09/91	1L							17/10/00			K68	F	CH	GR
118	30/08/91	1L							17/10/00			118	M	LIM	
8	31/08/91	1L							17/10/00			8	F	CH	
101	01/09/91	1L							17/10/00			101	M	LIM	
14	01/09/91	1L							17/10/00			14	F	LIM	
K11	01/09/91	1L							17/10/00			K11	M	LIM	BL
K92	01/09/91	1L							17/10/00			K92	F	CH	GR
K58	02/09/91	1L							17/10/00			K58	F	LIM	BL
97	02/09/91	1L							17/10/00			97	M	LIM	BR
M18	01/09/91	1L							17/10/00			M18	M	LIM	BR
K10	01/09/91	1L							17/10/00			K10	F	SIM	
K99	02/09/91	1L							17/10/00			K99	M	CH	GR
21	02/09/91	1L							17/10/00			21	F	SIM	
K86	03/09/91	1L							17/10/00			K86	M	SIM	BL+WH
K14	03/09/91	1LA							17/10/00			K14	M	CH	BR
K24	03/09/91	1L							17/10/00						

Appendix 4. Summary of records for farm 4.(continued)

Appendix 4. Summary of records for farm 4.(continued)

COW NO.	CALVING DATE	NOTES	BULLING DATE-1	BULL 1	BULLING DATE-2	BULL 2	BULLING DATE-3	BULL 3	PRED CAL DATE	PD RES	COMMENTS	CALF NO.	SEX	CALF BREED	CALF COLOUR
K89	03/09/91	1L							17/10/00			K89	F	LIM	
K23	04/09/91	1L							17/10/00			K23	F	LIM	
LIM	04/09/91	1L							17/10/00			LIM	M	LIM	BR
M7	04/09/91	1L							17/10/00			M7	F	LIM	BR+WH
K56	04/09/91	1L							17/10/00			K56	F	LIM	
86	05/09/91	1LA							17/10/00			86	M	LIM	BL
K96	05/09/91	1L							17/10/00			K96	M	LIM	BL
89	05/09/91	1L							17/10/00			89	M	LIM	
K82	05/09/91	1L							17/10/00			K82	F	LIM	
M9	05/09/91	1LA							17/10/00			M9	F	LIM	
K57	06/09/91	1L							17/10/00			K57	M	LIM	
K42	06/09/91	1LA							17/10/00			K42	F	LIM	
K47	06/09/91	1LA							17/10/00			K47	F	CH	
107	06/09/91	1L							17/10/00			107	M	LIM	BL
K9	06/09/91	1L							17/10/00			K9	M	CH	GR
K5	06/09/91	1L							17/10/00			K5	F	LIM	BL
K32	06/09/91	1L							17/10/00			K32	M	LIM	BL
114	07/09/91	1L							17/10/00			114	M	LIM	BR
K93	07/09/91	2LVA							17/10/00			K93	F	SIM	BL+WH
4L	07/09/91	1L							17/10/00			4L	F	LIM	
K4	07/09/91	1L							17/10/00			K4	F	SIM	
K29	07/09/91	1L							17/10/00			K29	F	LIM	
K41	07/09/91	1L							17/10/00			K41	F	LIM	
5	07/09/91	1L							17/10/00			5	F	SIM	
M19	08/09/91	1L							17/10/00			M19	F	LIM	BL
108	08/09/91	1L							17/10/00			108	F	LIM	BR
K36	08/09/91	1L							17/10/00			K36	F	LIM	
K66	08/09/91	1L							17/10/00			K66	F	SIM	
K53	08/09/91	1L							17/10/00			K53	F	LIM	
94	08/09/91	1L							17/10/00			94	M	LIM	
109	08/09/91	1L							17/10/00			109	M	LIM	
K38	09/09/91	1L							17/10/00			K38	M	LIM	BR
1L09	09/09/91	1L							17/10/00			1L	F	LIM	BL
0									17/10/00			11L	F	LIM	BL
11L	09/09/91	1L							17/10/00			64	M	SIM	
64	09/09/91	1L							17/10/00			K6	F	SIM	
K6	09/09/91	1L							17/10/00			K90	M	SIM	
K90	09/09/91	1L							17/10/00			M5	F	LIM	
M5	10/09/91	1L							17/10/00			61	M	LIM	BR
61	10/09/91	1L							17/10/00			K33	F	SIM	BR+WH
K33	11/09/91	1L							17/10/00			K44	M	LIM	BR
K44	11/09/91	1L							17/10/00			K37	M	CH	BR
K37	11/09/91	1L							17/10/00			M11	F	LIM	BL
M13	12/09/91	1LVA							17/10/00			84	M	LIM	BR
84	12/09/91	1LVA							17/10/00			M27	M	LIM	BL
K27	12/09/91	1L							17/10/00			M13	M	LIM	BL
M11	12/09/91	1L							17/10/00			64	M	CH	
64	12/09/91	1L							17/10/00			6	M	CH	
6	12/09/91	1L							17/10/00			13L	M	SIM	BR+WH
13L	13/09/91	1L							17/10/00			9L	M	LIM	BR
9L	13/09/91	1L							17/10/00			21	M	SIM	BR+WH
21	13/09/91	1L							17/10/00			K51	M	LIM	BR
K51	14/09/91	1L							17/10/00			24	M	CH	GR
24	14/09/91	1L							17/10/00			M8	M	LIM	BR
M8	14/09/91	1L							17/10/00			13	F	CH	
13	15/09/91	1L							17/10/00			M2	M	LIM	BR
M2	15/09/91	1LA							17/10/00			28	F	CH	BR

Appendix 4. Summary of records for farm 4.(continued)

COW NO.	CALVING DATE	NOTES	BULLING DATE-1	BULL 1	BULLING DATE-2	BULL 2	BULLING DATE-3	BULL 3	PRED CAL DATE	FD RES	COMMENTS	CALF NO.	SEX	CALF BREED	CALF COLOUR
BL	16/09/91	IL							17/10/00			88	M	LIM	BR
88	16/09/91	IL							17/10/00			K69	M	SIM	
K69	16/09/91	IL							17/10/00			58	M	LIM	BL
58	18/09/91	IL							17/10/00			M4	F	LIM	BR+WH
M4	17/09/91	ILA							17/10/00			K22	F	LIM	
K22	17/09/91	IL							17/10/00			K35	M	LIM	
K35	18/09/91	IL							17/10/00			9	M	SIM	BL
9	19/09/91	IL							17/10/00			K59	F	LIM	BL
K59	19/09/91	IL							17/10/00			3	M	SIM	
3	18/09/91	IL							17/10/00			65	F	LIM	
65	18/09/91	IL							17/10/00			K70	M	LIM	
K70	18/09/91	IL							17/10/00			K54	M	LIM	
K54	18/09/91	IL							17/10/00			K83	M	CH	GR
K83	20/09/91	2L							17/10/00			M1	M	LIM	BR
M1	19/09/91	ILA							17/10/00			19	F	SIM	
19	20/09/91	IL							17/10/00			85	F	LIM	
85	21/09/91	IL							17/10/00			113	F	LIM	
113	22/09/91	IL							17/10/00			M14	M	LIM	BR
M14	22/09/91	CAES							17/10/00			K83	M	CH	GR
K12	23/09/91	1D							17/10/00			K74	F	CH	WH
K74	24/09/91	IL							17/10/00			35	M	LIM	BR
35	24/09/91	IL							17/10/00			K40	F	LIM	BR
K40	25/09/91	IL							17/10/00			K67	F	SIM	BL+WH
K67	25/09/91	2L							17/10/00			M17	M	LIM	BR
M17	25/09/91	IL							17/10/00			K87	F	CH	BR
K87	25/09/99	IL							17/10/00			26	F	LIM	
26	26/09/91	IL							17/10/00			K65	M	SIM	
K65	26/09/91	IL							17/10/00			K43	M	LIM	BR
K43	29/09/91	IL							17/10/00			C37	M	SIM	
C37	29/09/91	IL							17/10/00			1	F	CH	BR
1	30/09/91	IL							17/10/00			K52	F	LIM	BR
K52	30/09/91	IL							17/10/00			K39	M	LIM	
K39	30/09/91	IL							17/10/00			K8	F	CH	GR
K8	02/10/91	IL							17/10/00			K12	M	CH	
115	04/10/91	1D							17/10/00			2L	M	LIM	BR
2L	07/10/91	IL							17/10/00			K49	F	LIM	BR
K49	08/10/91	IL							17/10/00			K84	M	SIM	
K84	08/10/91	IL							17/10/00			100	F	CH	GR
100	09/10/91	IL							17/10/00			61	M	LIM	BR
61	10/09/91	IL							17/10/00			K15	F	SIM	
K15	09/10/91	IL							17/10/00			K78	M	SIM	
K78	09/10/91	IL							17/10/00			K97	M	CH	
K97	10/10/91	IL							17/10/00			4	M	CH	
4	10/10/91	ILVA							17/10/00			6J	M	LIM	
6J	11/10/91	IL							17/10/00			C28	F	SIM	BR
C28	15/10/91	IL							17/10/00			14L	F	LIM	BR
14L	16/10/91	IL							17/10/00			K88	M	LIM	BR+WH
K88	18/10/91	ILA							17/10/00			117	F	LIM	BR
117	20/10/91	IL							17/10/00			M22	M	LIM	BR
M22	21/10/91	IL							17/10/00			93	M	LIM	BL
93	24/10/91	ILA							17/10/00			5L	M	LIM	BL
5L	30/10/91	IL							17/10/00			106	M	LIM	BL
106	02/11/91	IL							17/10/00			103		CH	BR
103	25/10/91	IL													

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 4

Normal ranges:

	Adequate	Marginal	Deficient
Copper (mmol/l)	9.4-23.6	4.7-9.4	<4.7
Selenium (Gshpx Units/mlPCV)	>23	8-23	<8
Cobalt (Vitamin B12 ng/l)	>200	150-200	<150

* Indicates marginal result.
** Indicates deficient result.

DATE	ANIMALS	COPPER	COBALT	SELENIUM
27/11/89	Calves	16		35
		14		38
		18		54
		16		32
		16		29
23/1/90	Cows	12	560	22*
		13	420	30
		16	280	37
		12	245	50
		20	200	41
		18	235	25
		15	255	15*
		14	220	37
29/1/90	Cows	16	245	18*
		17	410	22*
		18	225	41
		15	>1250	30
		17	205	43
		17	685	54
		17	195*	54
5/2/90	Calves	11	265	39
	Sp born	*insuffic.*	155*	18*
		15	350	34
		21	240	31
		18	260	24
		17	195*	28
	Calves	18	250	13*
	Aut born	24	130**	8**
		insuffic	190*	24
		insuffic	165*	26
		insuffic	220	4**
	Cows	18	160*	38
	Sp calvers	15	180*	60

Appendix 4 (ii)
Results of trace element analyses for farm 4.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 4 (Continued)

DATE	ANIMALS	COPPER	COBALT	SELENIUM
18/04/90	Cows	9*	365	21*
	Sp calvers	8*	240	23*
		16	365	22*
		17	430	26
3/5/90	Cows	::	210	13*
	Aut calvers	::	300	17*
		::	220	17*
		::	280	25
		::	170*	30
		::	220	20
		::	250	11*
		::	185*	9*
		::	260	10*
		::	240	19*
		::	210	26
		::	230	25
		::	220	17*
20/11	Calves	18	305	27
	Sp born	13	215	33
		13	365	30
		21	145**	31
		18	165*	14*
		20	280	29
		11	230	62
	Cows	16	375	36
	Sp calvers	16	295	16*
		17	405	24
		15	300	66
		21	465	28
		13	365	31
		15	425	49

Appendix 4 (ii)
Results of trace element analyses for farm 4.

FARM 5
Summary of records for 1988

COW NO.	COW BREED	CALVING DATE	CAL COM	CALF BREED
202	AX	11/08/88		LIM
26	AX	13/08/88	1DA	CH
WC	AX	18/08/88	2	LIM
873	AX	18/08/88		CH
861	RH	20/08/88		CH
928	BG	21/08/88		CH
153	AX	24/08/88		CH
126	AX	26/08/88		CH
NOT2	AX	27/08/88	2	CH
RC	AX	27/08/88		CH
8	BH	27/08/88		CH
48	AX	27/08/88		CH
776	AX	29/08/88		LIM
993	AX	29/08/88		LIM
220	AX	29/08/88		CH
152	BH	30/08/88		CH
805	AX	31/08/88		CH
868	AX	31/08/88	1LA	CH
853	RH	01/09/88		CH
788	AX	02/09/88		CH
107	LX	03/09/88		CH
860	BH	03/09/88		CH
773	BH	03/09/88		CH
231	AX	04/09/88		CH
176	AX	05/09/88		CH
978	AX	06/09/88		CH
211		06/09/88		CH
237		06/09/88		CH
790		09/09/88		CH
NT	AX	11/09/88		CH
133	AX	11/09/88		CH
874	BH	11/09/88		CH
874	AX	12/09/88		CH
785	BG	12/09/88	ILA	CH
747		16/09/88		CH
192	AX	16/09/88		CH
NT	RH	17/09/88	2A	
NT	RH	17/09/88	1LA	
197	BG	18/09/88		CH
786	AX	19/09/88		CH
127	AX	19/09/88		CH
307	AX	20/09/88		CH
807	AX	21/09/88		CH
783	AX	22/09/88		CH
803	AX	22/09/88		CH
207	AX	23/09/88		CH
875	AX	24/09/88	1DU	CH
892	AX	24/09/88		LIM
852	AX	26/09/88		CH
245	AX	27/09/88		CH
774	X	27/09/88		
774	AX	28/09/88		
781	AX	29/09/88		

Appendix 5. Summary of records for farm 5.

FARM 5
Summary of records for 1988

COW NO.	COW BREED	CALVING DATE	CAL COM	CALF BREED
46	BG	04/10/88	1DA	
165	BG	04/10/88		
417	BG	04/10/88		
858	AX	08/10/88		CH
NT	AX	11/10/88		CH
140	BH	14/10/88		CH
83	AX	17/10/88		CH
RC	AX	17/10/88		CH
217	BG	17/10/88		CH
899		18/10/88		CH
791		20/10/88		LIM
63	BG	20/10/88		CH
190	BG	28/10/88		LIM
897	BH	29/10/88		LIM
898	AX	29/10/88		LIM
105	BG	29/10/88		LIM
893	BG	29/10/88		CH
28	AX	30/10/88		CH
NT	BH	06/11/88		CH
795	BH	07/11/88		CH
321	AX	07/11/88		CH
NT	AX	07/11/88		LIM
321	BH	09/11/88	ILA	CH
42	BG	10/11/88		CH
91	BG	12/11/88		CH
760	G	18/11/88		CH
NT	G	19/11/88		LIM
505	AX	20/11/88		CH
802	AX	23/11/88		CH
905	BG	25/11/88		LIM
23	RH	27/11/88		CH
36	AX	30/11/88		CH
NT	AX	01/12/88		CH
223	AX	01/12/88		CH
987	AX	02/12/88		LIM
416	AX	07/12/88		LIM
865	AX	10/12/88	1LA	CH
7	BG	17/12/88		LIM
109	BG	20/12/88		LIM
504	AX	23/12/88		LIM
111	AX	27/12/88	ILA	CH
706	G	28/12/88		CH
147	BG	31/12/88		CH

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1989

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
		0				
583	AX	83	03/01/89			+VE
29	AX	0	03/01/89			
222	AX	0	03/01/89			
941	AX	0	03/01/89			
212	AX	83	04/01/89			+VE
97	AX	83	06/01/89			+VE
896	BG	79	07/01/89			+ve
395		0	09/01/89			
503		0	13/01/89			
890		0	15/01/89			
506	BH	80	23/01/89			+VE
101	G	0	25/01/89	1LA		
69	G	0	26/01/89			
216	AX	83	30/01/89			+VE
574	AX	0	04/02/89			
891	BH	0	09/02/89			
318	AX	0	09/02/89			
576	AX	0	10/02/89			
140	AX	78	13/02/89			+VE
74	BH	0	18/02/89			
575	AX	79	24/02/89			+VE
739	AX	0	01/08/89			
773	RH	0	01/08/89			
153	AX	83	06/08/89			+VE
588	AX	81	08/08/89			+VE
26	AX	80	08/08/89			+VE
465	RH	86	08/08/89		CULL	_VE
458	AX	86	08/08/89			+VE
468	BH	83	09/08/89			+VE
543	G	86	09/08/89			+VE
464	AX	85	10/08/89			+VE
466	AX	82	10/08/89			+VE
459	AX	82	11/08/89			+VE
126	AX	82	13/08/89			+VE
460	BG	86	13/08/89			+VE
461	AX	0	14/08/89			
531	AX	0	15/08/89			
587	AX	80	16/08/89			+VE
141	AX	83	17/08/89			+VE
529	AX	0	18/08/89			
527	AA	81	21/08/89			+VE
473	AA	80	22/08/89			+VE
536	AX	86	25/08/89			+VE
133	BH	83	25/08/89		7/8/90-SUMMER MASTITIS	+VE
523	RH	79	26/08/89		CULL	_VE
776	AX	0	27/08/89			
868	AX	83	29/08/89			+VE
439	BG	76	30/08/89		CULL	-VE
207	AX	83	01/09/89			+VE
463	BG	83	03/09/89			+VE

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1989

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
443		0	04/09/89			
545	AX	86	04/09/89			+VE
441	AX	81	05/09/89			+VE
160	BG	76	06/09/89			+VE
993	AX	0	06/09/89			
105	BG	0	08/09/89		JOHNES-CULL	
63	BG	0	08/09/89		JOHNES-CULL	
127	AX	83	09/09/89			+VE
231	AX	82	09/09/89			+VE
898	AX	0	09/09/89			
471	AX	84	10/09/89			+VE
525	RH	84	11/09/89		7/8/90-SUMMER MASTITIS	+VE
107	LX	83	12/09/89			+VE
524	RH	85	12/09/89			+VE
516	AX	79	13/09/89			+VE
202	AX	83	13/09/89			+VE
535	AX	80	16/09/89			+VE
445	BH	79	17/09/89			+VE
805	AX	0	17/09/89			
48	AX	83	20/09/89			+VE
237	BG	83	25/09/89			+VE
138	BH	76	25/09/89			+VE
152	BH	83	25/09/89			+VE
139	BG	80	27/09/89			+VE
874	AX	0	27/09/89			
897	BH	0	01/10/89			
176	AX	0	01/10/89			
192	AX	81	02/10/89			+ve
42	BG	80	02/10/89			+VE
462	AX	83	03/10/89		7/8/90-SUMMER MASTITIS	+VE
46	BG	83	05/10/89			+VE
312	BH	0	05/10/89			
875	BG	76	06/10/89			+VE
28	AX	79	07/10/89			+VE
533	AX	82	07/10/89			+VE
528	AX	85	09/10/89		CULL	-ve
579	AX	83	09/10/89			+VE
110	LX	83	09/10/89			+VE
417	BG	83	11/10/89			+VE
217	AX	0	11/10/89		DIED-STAGG.	
916		0	12/10/89			
223	AX	83	15/10/89			+VE
530	AX	81	15/10/89			+VE
23	RH	80	15/10/89	1DA	CALF BED OUT-WHIT	+VE

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1989

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
					ES-T	
580	AX	82	15/10/89			+VE
539	AX	81	17/10/89			+VE
416	AX	0	17/10/89			
585	AX	81	20/10/89			+VE
584	AX	80	20/10/89			+VE
893	BG	83	22/10/89		CULL	-VE
582	BH	82	25/10/89			+VE
91	BG	79	29/10/89	1DA		+VE
581	AX	0	30/10/89			
583	AX	83	05/11/89			+VE
212	AX	83	05/11/89			+VE
504	AX	82	05/11/89			+VE
147	BG	83	20/11/89			+VE
941		0	20/11/89			
858		0	05/12/89	2DA	CULL COW AFTER CALVED	
109	BG	80	07/12/89			+VE
111	AX	83	12/12/89			+VE
97	AX	83	12/12/89			+VE
865	AX	83	12/12/89			+ve
503	AX	0	13/12/89			
896	BG	79	14/12/89			+VE
578	AX	0	14/12/89			
216	AX	83	15/12/89			+VE
506	BH	80	16/12/89			+VE
36	AX	0	16/12/89			
502	AX	0	25/12/89			
891	BH	7	25/12/89		CULL	NIC

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1990 250

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
889	AX	0	13/01/90			
987	G	80	14/01/90			+ve
29	AX	80	15/01/90			+ve
575	AX	79	17/01/90			+VE
134	AX	80	24/01/90			+ve
576	AX	0	24/01/90		CULL-NO MILK	
148	AX	81	26/01/90			+ve
82	AX	80	27/01/90			+ve
568	AX	80	28/01/90			+ve
876	AX	81	28/01/90			+ve
553	AX	83	29/01/90			+ve
457	RH	78	30/01/90			+ve
546	RH	80	03/02/90			+ve
512	AX	80	04/02/90			+ve
048	AX	87	04/02/90			+ve
513	RH	0	05/02/90	1DAB		
561	AX	80	05/02/90			+ve
467	BH	83	07/02/90			+ve
0-133	BG	81	07/02/90			+ve
016	AX	87	07/02/90			+ve
125	BG	83	08/02/90			+ve
029	AX	0	10/02/90			
044	AX	87	12/02/90			+VE
034	AX	0	12/02/90			
022	AX	87	14/02/90			+ve
025	AX	87	15/02/90			+ve
013	AX	87	16/02/90			+ve
596	AX	82	18/02/90			+ve
137	AX	82	19/02/90			+ve
041	AX	87	20/02/90			+ve
855	AX	83	20/02/90			+ve
017	AX	87	21/02/90			+ve
357	BH	81	21/02/90			+ve
030	AX	87	23/02/90			+ve
015	LX	87	23/02/90			+VE
08	AX	87	24/02/90			+VE
039	AX	87	25/02/90			+VE
565	G	0	27/02/90			
863	AX	80	27/02/90			+VE
06	AX	87	27/02/90	1DC		+VE
155	BG	83	06/03/90			+VE
193	RH	81	10/03/90			+VE
032	AX	87	11/03/90			+VE
020	AX	87	11/03/90			+VE
135	AX	82	11/03/90			+VE
018	AX	87	12/03/90			+VE
74	BH	83	14/03/90			+VE
34	AX	0	14/03/90			
02	AX	87	14/03/90			+VE
023	AX	87	14/03/90			+VE
24	AX	82	15/03/90			+VE
019	AX	87	17/03/90			+VE

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1990

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
09	AX	87	18/03/90			+VE
518	AX	0	19/03/90			
011	L	87	19/03/90			+VE
300	BH	80	20/03/90		CHANGE NO.-148o	+VE
809	AA		21/03/90	1L		
854	AA		21/03/90			
0-27	AA	3	21/03/90	1L		
0-33	AA	2	21/03/90			
0-40	AA	3	21/03/90			
0-43	AA	3	21/03/90			
0-45	AA	2	21/03/90			
0-47	AA		21/03/90			
0-12	AA	3	21/03/90			
794	AX	0	21/03/90		CULL-MAS TITIS	
0-24	AA	3	21/03/90	1L		
0-07	AA	3	21/03/90			
819	AX	83	21/03/90			+VE
0-11	AA	3	21/03/90			
0-04	AA	3	21/03/90			
0-14	AA	3	21/03/90			
554	AA		23/03/90			
205	AA		23/03/90			
276	AA		23/03/90			
595	AA		23/03/90			
800	AA		23/03/90		JOHNES	
442	AA		24/03/90	1L		
884	AA		24/03/90			
879	AA		24/03/90			
250	AA		24/03/90			
570	AA		24/03/90			
810	AA		24/03/90			
0-49*	AA	3	14/04/90	1L	CULLED 9/8/91	
0-79	AA	3	01/05/90	1L		
0-87	BG	3	01/05/90	1L		
475	AA	11	01/05/90	1L		
275	AA	11	01/05/90	1L		
599	AA	5	01/05/90			
0-58	AA		01/05/90	1L		
560	HX	7	01/05/90	1L		
364	AA		01/05/90	1L		
456	HX	7	01/05/90	1L		
52	AA		01/05/90	1L		
72	AA		01/05/90	1L		
573	HX	11	01/05/90	1L		
591**	AA	5	01/05/90	1L	CULLED 31/7/91	
816	AA		01/05/90	1L		
566	AA	12	01/05/90	1L		
449	AA	4	01/05/90	1L		
50	AA	4	01/05/90	1L		

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1990

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
0-56	AA		01/05/90	1L		
0-57	AA	3	01/05/90	1L		
0-36	AA	3	01/05/90	1L		
0-66	AA	3	14/06/90	1LA		
0-10	AA	3	14/06/90	1L		
540	AA	5	14/06/90	1L		
846	AA		14/06/90	1L		
839	AA	5	14/06/90	1L		
0-59	AA	3	14/06/90	1L		
555	AA	6	14/06/90			
552	AA	10	14/06/90	1L		
0-28	AA	3	14/06/90	1L		
451	AA	2	14/06/90	1L		
389	AA	11	14/06/90	1L		
136	AA		14/06/90	1L		
452	AA	3	14/06/90	1L		
453**	HX		14/06/90	1L	COW CULLED	
589	AA	12	14/06/90	1L		
398	AA	7	14/06/90	1L		
503	BG	5	14/06/90	1L		
818	AA		14/06/90	1L		
537	G	4	14/06/90	1L		
0-81	LX	3	14/06/90	1L		
0-50	AA	4	14/06/90	1L		
0-76	AA	3	14/06/90	1L		
594	AA	10	14/06/90	1L		
571	AA	6	14/06/90	1L		
40	HX	12	14/06/90	1L		
456	HX	7	14/06/90	1L		
448	AA	8	14/06/90	1L		
600	HX	13	14/06/90	1L		
830	AA		14/06/90	1L		
0-126	BG	7	14/06/90	1L		
840	AA	5	14/06/90	1L		
450	AA	5	14/06/90	1L		
510	BG	14	14/06/90	1L		
0-42	LX	3	14/06/90	1L		
178	AA	13	14/06/90	1L		
564	BG	7	14/06/90	1L		
0-35	BG	3	14/06/90	1L		
0-26	AA	3	14/06/90	1L		
446	AA		14/06/90	1L		
572	AA		14/06/90	1L		
0-101	AA		14/06/90	1L	CULLED 1/5/91	
0-03	AA	3	14/06/90	1L		
541	AA	5	14/06/90	1L		
101	AA	8	14/06/90	1L		
474	AA	5	14/06/90	1L		
0-38	AA	3	14/06/90	1L		
590	AA	5	14/06/90	1L		
511	AA	10	14/06/90	1L		

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1990

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
					PREM.CUL L COW 17/7	
529	AA	10	22/08/90	1L		
587	AA		29/08/90	1L		
868	AA		30/08/90	1L		
515	AA	6	01/09/90	1L		
0-129	AA	4	02/09/90	1LA		
524	AA	6	03/09/90	1L		
464	AA	8	05/09/90	1L	MASTITIS -2 1/4s	
535	HX	6	06/09/90	1L		
126	AA	7	07/09/90	1L		
202	AA	9	10/09/90	1L		
0-131	AA	7	10/09/90	1L		
466	AA	9	14/09/90	1LA		
48	AA	7	16/09/90	1L		
42	BG	9	16/09/90	1L		
545	AA	4	18/09/90	1L		
231	AA	4	20/09/90	1L		
473	AA	7	25/09/90	1L	HYPOCALC AEMIA	
153	AA	7	26/09/90	1L		
533	AA	10	26/09/90	1A		
588	AA	7	27/09/90	1A		
441	AA	10	28/09/90	1L		
527	AA	10	01/10/90	1LA	ENDOMETR ITIS-t	
462	AA	5	02/10/90	1L	SOLD	
237	BG		02/10/90	1L		
152	BH	7	03/10/90	1L		
0-123	BH		04/10/90	1L		
530	AA	8	05/10/90	1L		
525	AA	6	05/10/90	1L		
0-138	AA	13	05/10/90	1L	CULLED 25/7/91	
160	BG	13	05/10/90	1L		
0-127	AA	5	06/10/90	1L		
536	AA	10	07/10/90	1L	SOLD,no milk.	
0-125	AA	3	08/10/90	1L		
471	AA	5	08/10/90	1L		
543	BG	4	10/10/90	1L		
875	BG		11/10/90	1L		
416	AA		11/10/90	1L	NO TAG	
445	HX	10	12/10/90	1L		
516	AA	8	13/10/90	1L		
148	HX	10	15/10/90	1LA		
26	AA		18/10/90	1L		
192	AA	10	20/10/90	1L		
539	AA		22/10/90	1L		
584	AA		22/10/90	1L		
107	LX	6	25/10/90	1L		

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1990

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
139	GX		25/10/90	1L		
460	AA		26/10/90	1L		
585	AA	9	28/10/90	1L		
133	HX	7	29/10/90	1L		
0-141	LX		29/10/90	1DA	ENDOMETRITIS	
582	AA	8	30/10/90	1L		
46	BG	7	30/10/90	1L		
580	BG	7	30/10/90	1L		
124	BH		01/11/90	1DA		
91	BG		05/11/90	2LA		
468	BG		05/11/90	1LA		
207	AA	7	06/11/90	1L		
0-142	AA	7	06/11/90	1L		
343	FR	6	06/11/90	1LA	HYPOCAL AND PAST POST CALVING	
586	BH	9	06/11/90	1L		
0-130	AA	5	06/11/90	1L		
896	BG	12	07/11/90	1L		
147	BG	6	07/11/90	1L		
0-143	AA	7	08/11/90	1L		
110	LX	7	08/11/90	1L		
417**	BG		09/11/90	1L	JOHNES-CULL	
506	BH	8	09/11/90	1L		
579	AA	7	10/11/90	1L		
28	AA	9	10/11/90	1L		
310	FR	10	11/11/90	1L		
109	BG		11/11/90	1L		
583	AA	6	12/11/90	1L		
504	AA	7	15/11/90	1L		
17	FR	8	17/11/90	1L		
85	AA	8	20/11/90	1L		
0-144	AA	9	20/11/90	1L		
0-150	AA	10	20/11/90	1L		
889	AA		21/11/90	1L		
865	AA	7	25/11/90	1L	SUCKS OTHER COWS	
458	LX	6	30/11/90	1L		
23	HX	9	03/12/90	1L		
212	AA	8	04/12/90	1L		
216	AA	9	06/12/90	1L		
223	AA	8	10/12/90	1L		
111	AA	8	31/12/90	1L	SUCKS OTHER COWS	

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1990

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	P.D. RESULT
0-51	LX	3	14/06/90	1L		
882**	AA	13	14/06/90	1L	CULLED 25/7/91	
598	AA	5	14/06/90	1L		
521	AA	11	14/06/90	1L		
559	HX	7	14/06/90	1L		
0-127	AA	6	14/06/90	1L		
0-53	AA		14/06/90	1L		
592	AA	10	20/06/90	1L		
503**	AA	12	20/06/90	1L		
549	AA	4	20/06/90	1L		
0-34	AA	3	20/06/90	1L		
597	AA		20/06/90	1L		
542	AA	5	20/06/90	1L		
260	AA	13	20/06/90	1L		
222	AA	10	20/06/90	1L		
548	AA	4	20/06/90	1L		
0-05	AA	3	20/06/90	1L		
0-54	AA	3	20/06/90	1L		
538	AA	9	20/06/90			
461	AA	4	20/06/90	1L		
0-21	LX	3	20/06/90	1L		
198	AA		20/06/90	1L		
0-63	AA	3	20/06/90	1L		
0-86	AA	3	20/06/90	1L		
0-61	AA	3	20/06/90	1L		
0-65	AA	3	01/07/90	1L		
132	AA		01/07/90	1L		
0-01	AA	3	01/07/90	1L		
0-69	AA	3	01/07/90	1L		
0-75	AA	3	01/07/90	1L		
0-86	AA	3	01/07/90	1L		
513	AA	10	01/07/90	1L		
514	G	12	01/07/90	1D		
0-68	AA	3	01/07/90	1L		
0-52	AA	2	01/07/90	1L		
531	AA	6	01/07/90	1L		
574	BG	14	01/07/90	1L		
0-67	AA	3	04/08/90	1L		
0-64	AA	3	04/08/90	1L		
547	AA	8	05/08/90	1L		
0-128	AA	2	10/08/90	1L		
0-71	AA	3	10/08/90	1L		
443	HX	11	10/08/90	1L		
0-73	AA	3	11/08/90	1L		
0-70	AA	3	11/08/90	1L		
0-84	AA	3	11/08/90	1D		
0-62	AA	3	11/08/90	1L		
0-77	AA	3	11/08/90	1L		
447	AA		11/08/90	1L		
0-55	AA	3	11/08/90	1DA		
83	AA		20/08/90	1L		
197	BG	13	20/08/90	1L	CALF	

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1991

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX
97	AA	8	08/01/91	1L		
459	AA	9	09/01/91	1L		
987	G	0	17/01/91	1L		
546	RH	11	18/01/91	1L		
855	AA	8	19/01/91	1L		F
575	AA		22/01/91	1L		
0-133	BG	12	25/01/91	1L		F
457	RH	12	29/01/91	1L		
0-146	AA	9	01/02/91	1D		
467	BH	8	30/01/91	1L		
0-30	AA	4	30/01/91	1L		
148	AA	9	31/01/91	1L		
512	AA	10	03/02/91	1D		
863	AA	8	05/02/91	1L		
137	AA		03/02/91	1L		B
82	AA	12	03/02/91	1L		H
553	AA	6	12/03/91	1L		H
0-02	AA	4	12/02/91	1L		H
0-14	AA	4	12/02/91	1L		B
561	AA	11	14/02/91	1L		B
0-22	AA	4	22/02/91	1L		
193	RH	12	14/02/91	1L		H
0-25	AA	4	24/02/91	1L		B
0-11	LX	4	27/02/91	1L		H
0-147	BH	8	08/03/91	1L		H
0-21	AA	6	28/02/91	1L		
0-09L	LX		11/03/91	1L		
876	AA		28/02/91	1L		
0-40	AA	4	01/03/91	1L		
0-145	AA	4	05/03/91	1L		
0-18	AA	40	06/09/91	1L		
596	AA	10	05/03/91	1L		
357	BH	12	06/03/91	1L		
819	AA	6	09/03/91	1L		B
568	AA	11	10/03/91	1L		H
238	AA	9	15/03/91	1L		H
155	BG	8	08/03/91	IDA		
0-34	AA	4	18/03/91	1L		
74	BH		11/03/91	1L		
Y-24	AA	9	02/03/91	1L		H
0-24	AA	4	07/03/91	1L		H
0-41	AA	4	15/03/91	1L		
469	AA	11	20/03/91	1L		
0-20	AA	4	18/03/91	1L		
0-32A	AA	4	20/03/91	1L		
0-23	AA	4	23/03/91	1L		
0-06	AA	4	23/03/91	1L		
800	AA		24/03/91	1L	SOLD	
556	AA	15	24/03/91	1L		B
0-15	LX	4	24/03/91	1L		B
0-08	AA	10	25/03/91	1L	SOLD	
0-19	AA	4	27/03/91	1L		
0-150	AA	11	28/03/91	1L	NO MILK - SOLD	

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1991

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX
472	AA	13	28/03/91	1L		
O-43	AA	4	30/03/91	1L		
O-44	AA	4	30/03/91	1L		
O-33	AA	3	30/03/91	1D	SOLD	
442	AA	12	31/03/91	1L		
160**	AA	4	01/04/91	1L	SOLD 29/7/91	
O-27*	AA	4	02/04/91	1L	SOLD 9/8	
300	BH	9	02/04/91	1L	NEW NO. O-148	
O-39	AA	4	03/04/91	1L		
O-17	AA	4	04/04/91	1L		
O-134	AA	10	05/04/91	2L		
O-135	AA	8	08/04/91	1L		
125	BG	8	09/04/91	1L		
570	RH	12	10/04/91	1L		
29	AA		08/04/91	1L		
O-48	AA	4	09/04/91	1L		
595	AA	10	13/04/91	1L		
538	AA	10	13/04/91	1L		
156	AA	10	05/04/91	1L		B
456	BH	8	09/04/91	1D		B
565	AA	6	13/04/91	1L		H
839	AA	6	15/04/91	1L		B
O-88	AA	3	15/04/91	1L		H
O-07	AA	4	16/04/91	1L		
O-169	AA	9	16/04/91	1L		B
461	AA	5	16/04/91	1L		B
O-74	AA	3	18/04/91	1L		H
275	AA	12	18/04/91	1L		B
O-46		4	15/04/91	1L		
O-81	AA	4	25/04/91	1L		
455	AA	6	17/04/91	1L		H
357	AA	12	17/04/91	1L		B
O-163	AA	2	24/04/91	1L		H
O-102	AA	3	24/04/91	1L		H
O-05	AA	4	25/04/91	1L		H
O-79	AA	4	25/04/91	1L		H
572	AA		17/05/91	1LA		
510	BG	15	18/05/91	1L		
549	AA	5	19/05/91	1L		
518	AA	6	20/05/91	1L		
474	AA	6	20/05/91	1L		
O-57	AA	4	20/05/91	1L		
51	AA	6	20/05/91	1L		
511	AA	11	21/05/91	1L		
Y-101	AA	9	22/05/91	1L		
O-165	AA	2	23/05/91	1L		
O-160	AA	2	24/05/91	1L		
O-840	AA	3	25/05/91	1L		
O-122	AA	3	24/05/91	1L		
44	AA	9	25/05/91	1L		
O-97	AA	3	25/05/91	1LA	D-2 WKS LATER	H
6	AA	13	28/05/91	1L		
541	AA	6	29/05/91	1L		

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1991 258

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX
49	AA	6	29/05/91	ID		B
537	AA	5	27/04/91	1L		H
O-149	AA	4	29/04/91	1L		B
O-13	AA	4	30/04/91	1L		H
552	AA	11	03/05/91	1L		H
540	AA	4	03/05/91	1L		B
590	AA	6	05/05/91	2L		
450	AA	6	10/05/91	1L		H
O-104	AA	3	08/05/91	1LA		
O-118	AA	3	10/05/91	1L		
O-50	AA	5	10/05/91	1L		B
O-59	AA	4	10/05/91	1L		
128	AA	6	11/05/91	1L		
18	AA	6	12/05/91	1L		
566	AA	13	14/05/91	1L		
181	AA	6	15/05/91	1L		
548	AA	5	16/05/91	1L	D-2 WKS LATER	
110	AA	8	16/05/91	1DA		
135	AA	6	01/05/91	1L		
99	AA	3	01/05/91	1L		
O-35	BG	4	01/05/91	1L		
O-155	AA	9	01/05/91	1L		
O-162	AA	9	01/05/91	1L		
O-107	AA	3	01/05/91	1L		
O-98	AA	3	01/05/91	1L		
O-105	AA	3	01/05/91	1L		
O-156	AA	9	01/05/91	1L		
O-157	AA	3	01/05/91	1LN		
O-78	AA	3	01/05/91	1L	BLIND CALF	
600	RH	14	30/05/91	1L		B
93	LX		01/06/91	1L		
462	AA	6	02/06/91	1L		
451AA	AA	2	04/06/91	1L		
O-127	AA	6	05/06/91	1L		H
O-132	AA	11	06/06/91	1L		B
O-161	AA	2	07/06/91	1L		
O-152	AA	2	07/06/91	1L		
398	AA	8	08/06/91	1L		H
O-10	AA	4	10/06/91	1L		
O-51	AA	4	11/06/91	1L		
O-62	AA	4	12/06/91	1L		B
O-121	AA	3	13/06/91	1L		B
O-89	AA	3	14/06/91	1L		H
O-128	AA	3	14/06/91	1LA		B
503	BG	6	18/06/91	1LA		
O-87	BG	4	18/06/91	1L		H
446	AA		20/06/91	1L		B
882	AA	14	20/06/91		SOLD	H
536	AA	11	20/06/91	1L		B
O-66	RH	4	21/06/91	1DA		H
O-30	AA	4	22/06/91	1L	MASTITIS	B
O-76	AA	4	23/06/91	1L	BAD MAST(CA-NAV-ILL)	H
452	AA	4	23/06/91	1L		H

Appendix 5. Summary of records for farm 5. (continued)

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX
555	AA	7	23/06/91	1L		H
564	BG	8	22/06/91	1L	BAD MAST(Ca-ORAL ULC-3 WEEKS	H
O-28	AA	4	22/06/91	1L		B
O-167	AA	2	24/06/91			H
178**	AA	14	22/06/91	1L	SOLD	
O-63	AA	4	26/06/91			B
O-42	LX	4	27/06/91			B
O-21	LX	4	27/09/91	1L		B
O-55	AA	4	27/06/91	1L		B
O-61A	A4		27/06/91	1L		B
O-38L	LX	4	27/06/91	1L		H
O-54A	A4		29/06/91	1L		
O-60	AA		30/06/91	1DA		B
O-144	BG	3	30/06/91	1L		H
O-153	AA	2	01/07/91			B
O-158	AA	2	02/07/91	1L		B
O-106	AA	4	02/07/91	1L		B
O-68	AA	4	03/07/91			H
O-67	AA	4	03/07/91	2LA		B
O-108	AA	2	03/07/91	1L		B
O-01	LX	4	03/07/91	1L		B
443	BH	12	05/07/91	1L		H
O-116	AA	3	07/07/91	1L		H
222	AA	11	04/07/91	1L	D 5/7	H
O-109	AA	3	04/07/91	1L		B
O-64	AA	4	04/07/91	1L		H
O-45	AA	3	08/07/91	1L		B
531	AA	7	08/07/91	1L		H
O-69	AA	4	08/07/91	1L		H
573**	BG	12	08/07/91	1L	SOLD 13/8	H
O-85	AA	4	09/07/91	1L		H
O-449	AA	5	09/07/91	1L		H
O-31L	LX	4	10/07/91	1LA		B
O-80	AA	3	14/07/91	1L		B
O-84	LX	4	15/07/91	1L	PROLAPSED UTERUS	H
O-176	AA	2	17/07/91	1L		B
559	AA	8	11/07/91	1L		B
O-119	AA	3	12/07/91	1L		B
O-86	AA	4	11/07/91	1L	SUCKER	H
513**	AA	11	14/07/91	1L	TOO OLD (Bad limp)	B
O-164	AA	2	16/07/91	1L		
O-65	AA	4	15/07/91	1L		H
O-70	AA	4	15/07/91	1L		H
574	BG	15	16/07/91	1L		B
569	AA	13	17/07/91	ILA		B
100	AA		18/07/91	1L		B
508	BG		19/07/91	1L		H
O-117	AA	4	20/07/91	1LA	BAD MAST	B
390	AA	12	22/07/91	1L	MF	H
O-71	AA	4	22/07/91	1L		B
514**	G		24/07/91	10	SOLD	B
O-166	AA	13	25/07/91	1L		B
554	BG	12	25/07/91	1LA	DRY FOR 1 YEAR	B

Appendix 5. Summary of records for farm 5. (continued)

FARM 5
Summary of records for 1991

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX
72	AA		26/07/91	1LA	MF	B
589**	AA	13	27/07/91	1L	MF,BAD MAST	B
454	AA	6	28/07/91	1L	MF+MAST	H
868	AA		28/07/91	1L		
0-181	AA	4	17/04/91	1L		H
0-95	AA	3	05/08/91	1LA		
0-58	AA	4	04/08/91	1L		F
0-26	AA	4	04/08/91	1L		M
0-185	L	4	06/08/91	1L		M
0-170	AA	3	06/08/91	1DA		
573	RH	12	07/08/91	1LA	SOLD-AWAY 13/8	M
0-154	AA	2	09/08/91	1L		M
0-38	AA	4	09/08/91	1DA		
529	AA	11	09/08/91	1D	CALF PREM	
592	AA	11	10/08/91	1L		M
0-177	AA	2	11/08/91	1L		F
0-171	AA	2	11/08/91	1DA	HURT AT CALVING- SOLD 13/8	
0-151	L	2	12/08/91	1DAA	CAES	
0-29	AA	3	13/08/91	1L		M
0-152	AA	2	14/08/91	1LA	CAES	M
470	AA	6	16/08/91	2L		F
0-75	AA	4	15/08/91	1L		F
0-178	AA	2	13/08/91	1LA		F
0-73	AA	4	17/08/91	1L		F
61	AA	3	18/08/91	1L		F
0-27	AA	4	19/08/91	1L	REM. 1 CLIT	M
547	AA	11	22/08/91	1L	NOW 513	M
0-91	AA	2	23/08/91	1L		F
0-174	AA	2	25/08/91	1LA		F
0-77	AA	4	28/08/91	1L		F
598	AA	6	29/08/91	1L		F
526	AA	10	30/08/91	1L		F
0-08	L		31/08/91	1L		M
594	AA	11	30/08/91	1L		
0-179	AA	4	09/09/91	1DA	CULL-HURT AT CALVING	
153	AA	8	30/08/91	1L		
126	AA	8	31/08/91	1L		F
533	AA	11	31/08/91	1L		F
471	AA	6	02/09/91	1L		B
516	AA	9	02/09/91	1L	MF	M
588	AA	8	08/09/91	1L		M
0-04	AA	4	08/09/91	1LA		M
587	AA		07/09/91	1L		F
133	BH	8	08/09/91	1L		
202	AA	10	11/09/91	1L		F
231	AA	5	11/09/91	1LA		F
525	AA	7	12/09/91			
0-182	AA	7	14/09/91	1L	MASTITIS-11/9.MF	F
464	AA	9	14/09/91	1L		M
0-545	AA		10/09/91	1L		F
138	BH	8	08/09/91	1L	NOW-0-101	F
0-140	BH	11	07/09/91	1L		M
48	AA	8	12/09/91	2L	MF	MF

Appendix 5. Summary of records for farm 5. (continued)

COW NO.	COW BREED	COW AGE	CALVING DATE	CAL COMM.	COMMENTS	CALF SEX
524	AA	7	11/09/91	1L		M
207	AA	8	11/09/91	1L		M
0-142	AA	8	21/09/91	1L		M
504	AA	8	24/09/91	1L		F
0-131	AA	8				M
152	BH	8	17/09/91	1L		M
583	AA	7	25/09/91	1L	MF	M
42	BG	10	23/09/91	1L	BAD DIARR	F
466	AA	10	25/09/91	1LA	MF	M
530	AA	9	21/09/91	1L	NO DRY PERIOD	F
579	AA	8	28/09/91	1L		M
26	AA		28/09/91	1L	MF	F
543	BG	5	29/09/91	1L		F
130	AA	8	01/10/91	1L		F
144	AA		01/10/91	1L	MF	F
109	AA		26/09/91	2L		MF
127	AA	8	01/10/91	1L	MAST-2 TEATS-CULL 8/10	F
441	AA	11	30/09/91	1L	MF	M
0-37	AA		30/09/91	1L		M
473	AA	8	02/10/91	1L	MF	M
0-188	AA		03/10/91	1L	WAS 416	M
222	AA	11	03/10/91	1L		M
445	RH	11	04/10/91	1L		F
107	L	7	05/10/91	1L		M
139	BG		05/10/91	1LA	2 TEATS-CULLED 8/10	M
184	AA		07/10/91	1L	MF	F
125	AA	8	09/10/91	1L		F
465	BG	11	09/10/91	1L	WAS 109	M
515	AA	7	10/10/91	1LA		M
535	RH	7	11/10/91	1LA	MF	M
0-129	AA	5	13/10/91	1L		F

Appendix 5. Summary of records for farm 5. (continued)

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 5

Normal ranges:

	Adequate	Marginal	Deficient
Copper (mmol/l)	9.4-23.6	4.7-9.4	<4.7
Selenium (Gshpx Units/mlPCV)	>23	8-23	<8
Cobalt (Vitamin B12 ng/l)	>200	150-200	<150

* Indicates marginal result.
** Indicates deficient result.

DATE	ANIMALS	COPPER	COBALT	SELENIUM
29/9/89	Cows-Aut	18	210	
		18	210	
		18	155*	
		16	180*	
		15	155*	
		18	155*	
		19	220	
		16	155*	
		19	210	
26/10/89	Cows-Sp	8*	165*	7**
		13	130**	28
	Calves-Sp	13	55**	22*
		15	50**	24
10/11/89	Calves-Sp	19	245	37
		14	95**	21*
		12	505	28
17/11/89	Calves-Sp	16	345	72
		23	160*	48
7/1/90	Cows-Sp	8*	330	36
		23	375	70
		12	255	51
		16	295	42
		16	150*	41
		16	400	75
		13	295	54
20/3/90	Calves-Sp	10	250	25
		13	335	29
		6*	305	11*
		13	200	46
	Calves-Aut	8*	180*	52
		7*	240	34
		8*	270	48

Appendix 5 (ii)
Results of trace element analyses for farm 5.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 5 (Continued)

DATE	ANIMALS	COPPER	COBALT	SELENIUM
25/3/90	Cows-Win	8*	220	35
		13	200*	21*
		13	150*	51
25/3/90	Cows-Sp	9*	180*	19*
		16	250	15*
		8*	175*	32
		5*	275	13*
7/8/90	Cows-Sp	15	115**	11*
		19	85**	18*
		12	85**	12*
		15	215	12*
	Cows-Aut	12	175*	34
		15	180*	21*
		15	80**	12*
		13	150*	18*
	Calves-Win	18	75**	13*
		17	80**	12*
		15	85**	5**
		14	75**	8*
	Calves-Aut	15	150*	15*
		12	175*	25
		19	75**	18*

Appendix 5 (ii)
Results of trace element analyses for farm 5.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 6

Normal ranges:

	Adequate	Marginal	Deficient
Copper (mmol/l)	**9.4-23.6**	**4.7-9.4**	**<4.7**
Selenium (Gshpx Units/mlPCV)	**>23**	**8-23**	**<8**
Cobalt (Vitamin B12 ng/l)	**>200**	**150-200**	**<150**

* Indicates marginal result.
** Indicates deficient result.

DATE	ANIMALS	COPPER	COBALT	SELENIUM
3/10/89	Calves	23	175*	4**
	Born Aut 88	19	170*	32
		19	125**	20*
		19	170*	6**
		20	170*	3**
9/10/89	Cows-Aut	27	235	44
	Calving	22	245	39
		23	305	30
		17	300	29
		26	340	19*
		20	430	38
		25	350	27
		20	410	22*
	Calves			
	Born Aug 89	24	170*	47
		26	305	26
		21	285	49
		25	325	33
		17	225	47
		20	325	61
		26	185*	37
		18	185*	49
10/11/89	Cows-Sp	17	330	28
		18	300	16*
		15	305	25
		12	200*	6**
		16	310	20*
		11	285	16*
		19	335	25
		26	225	36

Appendix 6
Results of trace element analyses for farm 6.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 6 (Continued)

DATE	ANIMALS	COPPER	COBALT	SELENIUM
	Calves	16	140**	26
	Born Sp 89	20	215	29
		24	220	20*
		16	145**	23*
		24	215	19*
		15	190*	15*
		14	125**	11*
		14	340	9*
20/3/90	Cows-Aut	12	200	39
		14	305	23
		17	250	38
		17	295	33
		13	195*	27
		14	400	49
		18	310	22*
		22	300	38
	Calves-Aut	28	310	28
		16	285	21*
		20	330	38
		17	220	29
		16	195*	30
		15	200	19*
		20	170*	27
11/7/90	Calves-Aut	10	150*	22*
		10	90**	30
		11	110**	39
		14	130**	16*
		16	135**	19*
		15	160*	32
		14	70**	8**
		10	100**	20**
		12	65**	17*
		12	90**	19*
	Cows-Sp	11	180*	60
		12	170*	42
		10	155*	19*
	Calves-sp	10	120**	15*
		10	150**	55
		9	115**	22*

Appendix 6
Results of trace element analyses for farm 6.

RESULTS OF TRACE ELEMENT ANALYSES FOR FARM 6 (Continued)

10/10/90	**Calves-Aut**	15	245	22*
		15	155*	18
		16	185*	19*
		20	280	37
		14	115**	13*
		18	185*	28
		13	170*	32
		15	115**	19*
		16	135**	42
		15	150*	16*

Appendix 6
Results of trace element analyses for farm 6.

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