

## CHAPTER TWO

### MATERIALS AND METHODS

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## 2.1. HERD DESCRIPTION

The dairy herd under investigation is situated at Diamondale Dairy Farm, belonging to Galaunia Farms (Private) Limited. The farm is situated 30 kilometres northeast of Lusaka in the Ngwerere district, covering an area of 1,820 hectares.

The herd was established in 1980, with 180 pregnant Israeli-Holstein heifers imported from Israel. The herd has since been expanded to approximately 300 cows in milk, from its own replacement material but remained stagnant for the past 5 years as can be seen from the figures below:

	31/03/86	31/03/87	31/03/88	31/03/89	31/03/90
Cows	375	403	385	394	393
Calves	114	141	195	160	165
Weaners	84	109	83	89	70
Heifers	172	159	158	238	189
Bulls	113	37	101	41	122
Total:	858	849	922	922	939

The herd has in the past 6 years been managed by 8 Dairy Managers, which has been negatively reflected in the herd's performance, due to frequent changes in management techniques.

The breeding techniques have included both natural service and artificial insemination. The feeding system has been based on a complete diet, this changing from flat-rate feeding to feeding according to production. This complete diet feeding has again from time to time been combined with grazing, when available, but

this has been unsuccessful due to poor grazing quality. The grazing has been based on Rhodes grass pastures, but fertilising and stocking recommendations have not been followed.

Breeding, which was based on artificial insemination and supplemented with natural service from time to time with "sweeper" bulls, has lacked a systematic approach. During investigations into selection policies over the past 5 years, 51 different bulls have been found to be used for artificial insemination. These were of Israeli, Canadian, United States, Dutch, British and Zambian origin.

The culling and selection policy was up to recently based purely on reproductive performance with no selection on milking performance, body traits, udder quality or offspring performance. Pregnancy was the only criterion used when deciding that a cow should be retained in the herd. Similarly, the only criterion to cull a cow or heifer from the herd was her inability to conceive, regardless of the reason. This approach to selection has changed only during the past 2 years.

The grouping of cows in physical groups has also been changing between grouping according to fertility status to grouping according to production.

At present the grouping is based on lactation stage and production. The groups are split as follows:

1. **Fresh calvers** - all cows up to 56 days post partum
2. **Super high** - cows producing over 25 lit/day  
- first calvers producing over 22.5 lit/day
3. **High group** - cows producing 17.5-25 lit/day  
- first calvers producing 17.5-22.5 lit/day
4. **Medium group** - cows and heifers producing 10-17.5 lit/day
5. **Low group** - cows and first calvers producing 5-10  
lit/day
6. **Dry cows** - all dry and pregnant cows including  
culled cows
7. **Springing cows** - 4 weeks prior to calving

Re-grouping is done fortnightly according to the previous two milk recordings which are done at weekly intervals.

The young stock section is grouped as follows:

1. **Calves on milk** - weaned at 7-8 weeks
2. **Mixed weaners** - up to 6 months
3. **Senior weaners** - heifers 6-12 months
4. **Yearling heifers** - heifers 12-15 months
5. **Bulling heifers** - heifers 15 months to conception
6. **Pregnant heifers** - heifers conception to 1 month prior to  
calving
7. **Feedlot** - all males from 6 months to slaughter

Milking of cows is carried out twice per day in a Fullwood Herringbone Parlour with 16 points.

The diet for all livestock is prepared in the Diamondale Stockfeed Mill which is situated on the same farm, in a Lackish Feed Mixer with a capacity of 3 tonnes per load. The diet consists of a Dairy meal concentrate mixed with maize silage, whole cotton seed, brewers grain (wet), molasses and hay. The amounts are calculated according to the average expected production per group and fed twice daily to the high producing groups and once to late lactation groups. The calves are fed skimmed milk, calf meal concentrate and hay, whilst the feedlot diet consists of maize bran, chicken manure, whole cotton seed and hay.

## **2.2. RECORDING SYSTEM**

The breeding records on the investigated farm consisted of the following:

1. Individual life-time record cards
2. Farmplan - 1984 Farmplan International Ltd.

### **Dairy Herdsman computer programme**

This programme contains the following main sections:

1. Cow data entry
2. Cow reporting
3. Feed programmes
4. Heifer data entry
5. Heifer reporting
6. Bull programmes

The reporting sections produce output that is of significant help to the management of the herd if used constructively.

The individual life-time cow cards have been in use since 1987 and shown to be extremely useful in breeding management. The information on each card consists of the following:

1. Sire
2. Dam
3. Cow number
4. Calving dates
5. Drying off dates
6. Service dates
7. Rectal examination findings
8. Pregnancy diagnosis results
9. Treatments

During the investigation of the fertility status of this herd, records were the basic tool of information collection.

Information fed into the above described computer programme has been shown to be very unreliable due to numerous data input errors, and therefore all data collection was performed from the individual cards and then processed on a personal computer (Amstrad PC 1512 HD 20) using the SMART programme and establishing spreadsheets which served the needs of this investigation.

The computer programme also had the disadvantage that summaries older than 12 months were automatically erased, and the management did not keep printouts of the same as permanent

records. Therefore information such as actual and projected calving intervals, interservice intervals, calvings per month, conception rates, etc. was lost for all but the last 12 months.

### 2.3. RECTAL EXAMINATION OF GENITAL TRACTS

Rectal examinations have been performed regularly on this herd for the past 5 years. These were performed fortnightly during the rainy season and every 3 weeks during the dry season. The increased frequency of visits during the rainy season was warranted due to the poor hygienic conditions on the farm during the rains and subsequent increased incidence of puerperal endometritis.

Cows were presented in groups and individual animals examined after looking at their breeding record.

The rectal examinations were performed after the animals had been collected in a Cedara College type handling unit and restrained with a headclamp (Cattleway model).

The operator was protected with protective clothing including an overall, rubber apron and disposable long plastic gloves.

The procedure of the rectal examination followed the guidelines given by Roberts (1986a) and the genital tract examined in the following sequence:

1. Location of the cervix near the pelvic brim
2. Palpation of cervix and uterus
3. Palpation of ovaries and adnexes



The recording of findings was done with a system similar to the one described by Studer and Morrow (1981).

#### 2.4. POST-MORTEM EXAMINATION OF THE GENITAL TRACTS

Collection of the genitalia of culled cows was performed at the abbatoir during slaughter. The genital tract was excised after bleeding of the animal and while in hanging position. The abdomen was opened and the genitalia separated by cutting through the ligamenta lata uteri. During this procedure clean disposable plastic gloves were used. After complete intra-abdominal separation of the genital tract a circular incision was made around the vulva and the tract separated from the animal. A ligature was immediately placed around the vagina, approximately halfway between the vulva and cervix in order to prevent any external contamination of the vagina, cervix and uterine lumen. Thereafter the genital tract was placed in a labelled plastic bag and stored in a coolbox with ice, awaiting transport to the School of Veterinary Medicine for further examination.

Slaughter of cows, which were slaughtered in batches of 20 on several occasions, was finished after approximately 2 hours, and thereafter the specimen were transported immediately for further examination.

Gross examination of the specimen was performed in the post-mortem room immediately after arrival and included:

1. Inspection of the tract as a whole .
2. Aseptic collection of swabs for bacteriological examination

3. Measuring of the length of the uterine horns from the bifurcation to the isthmus of the oviduct
4. Measuring of the circumference of both uterine horns approximately halfway between bifurcation and isthmus
5. Testing of the patency of both oviducts. This was performed using a 10 ml disposable syringe and ink. A small (2-3 mm) incision was made in the tip of the respective uterine horn and the syringe inserted. Passage of the ink through the oviducts under very slight pressure was observed until the ink was visibly coming through the fimbriae.
6. Both ovaries were separated from the uterus and their weight measured using an electronic scale (Yamato Model LABTOP). Observations of structures on the external surface were recorded and thereafter the ovary was split into two halves, so that crossections of ovarian structures were visible, and findings recorded again.
7. An incision was made along both uterine horns, uterine body, cervix vagina and vulva. The lumen of the genital tract was observed for any abnormalities.
8. Both ovaries and tissue samples from each uterus were collected and placed into plastic containers with 10% formalin for further histopathological examination. The position from which uterine wall samples were collected depended on macroscopical findings. If any macroscopic changes were observed, the relevant area was sampled, whilst in macroscopically normal uteri, a representative section of the uterine body was excised.

Observations were recorded on a prepared sheet, and findings later transferred onto a spreadsheet for further statistical analysis.

## **2.5. BACTERIOLOGICAL EXAMINATION**

The decision as to which uteri to collect samples from was difficult due to the fact that the majority of uteri appeared normal on gross examination. Swabs were collected from all uteri that appeared abnormal on gross inspection before opening the lumen, and random samples from other uteri.

The guidelines for the bacteriological examination of uterine swabs were followed as described by Wilson et al. (1984), Cottral (1978) and Carter (1984).

### **2.5.1. SAMPLE COLLECTION**

Samples were collected by means of sterile cotton swabs. These were prepared with applicator sticks in glass containers with screw tops. Sterilisation was performed by autoclaving (Autoclav Yamato, Model SDA-30) at 121 degrees Celsius for 20 minutes at a pressure of 1.1 kg/sq.cm.

Swabbing was performed after the uterine surface was disinfected with a cotton tampon soaked in 70% ethanol. The uterus was incised by means of a sterile carbon steel curved scalpel (Swann-Morton, No.12) and the swab removed from the sterile swab container and inserted into the uterus through the incision. The swab was pushed into the lumen of the uterine horn

approximately 50mm. After removal, the swab was immediately transferred into a sterile glass container with dextrose broth used as a transport and incubating medium. The dextrose broth was enriched with 0.1% of sheep blood. This medium is suitable for incubation of both aerobes and anaerobes.

#### **2.5.2. INCUBATION OF SAMPLES**

All samples were incubated overnight at 37 degrees Celsius in dextrose broth medium in a standard microbiological incubator (Incubator Yamato-Model IS-61). This served the purpose of enriching the possibly scarce bacterial population present in the examined uteri.

#### **2.5.3. INOCULATION OF MEDIA**

Inoculation of media was performed by means of sterile platinum microbiological loops and streaking. Glass Petri dishes (Pyrex) were used. All swabs were plated onto MacConkey and blood agar.

#### **2.5.4. INCUBATION OF PLATES**

All plates were incubated both aerobically and anaerobically at 37 degrees Celsius. The jar used for anaerobic incubation was the GasPak Anaerobic System Jar (BBL Microbiology Systems). The anaerobic atmosphere was induced by the use of the Disposable Hydrogen and Carbon dioxide Generator Envelope (GasPak anaerobic

system - BBL Catalogue No.70304). Aerobic incubation was done for 24 hours, whilst anaerobic incubation was done for 48 hours.

#### 2.5.5. PREPARATION OF MEDIA

##### **Dextrose broth**

This is a highly nutritious broth suitable for the initial isolation of microorganisms which are fastidious, attenuated or present in small numbers.

23 grams of dextrose broth (Oxoid Code CM 175) was added to 1 litre of distilled water and mixed well. To improve the medium for growth of both anaerobes and aerobes, agar tablets (Oxoid Code CM 49) at the rate of 1 tablet/100 mls were added during reconstitution. This solution was then distributed into the glass containers and sterilised by autoclaving at 121 degrees Celsius for 15 minutes.

This gave a final formula of the medium as follows:

Lab-Lemco powder	3 g/l
Tryptose	10 g/l
Dextrose	5 g/l
Sodium chloride	5 g/l
pH	7.2 +/- 0.2

##### **Blood agar**

This is a non-selective general purpose medium. It can be enriched by the addition of blood or serum for the growth of

pathogenic or industrial bacteria.

40 grams of blood agar base (Oxoid Code CM 55) was added to 1 litre of distilled water and boiled to dissolve completely. This solution was sterilised by autoclaving at 121 degrees Celsius for 15 minutes. After cooling to 45-50 degrees Celsius, 7% of sterile defibrinated sheep blood was added.

This gave a final formula of the medium as follows:

Lab-Lemco powder	10 g/l
Peptone	10 g/l
Sodium chloride	5 g/l
Agar	15 g/l
pH	appr. 7.3

### **MacConkey broth**

This is a differential medium for the detection of coliform organisms. Single strength broth was used.

40 grams of MacConkey broth (Oxoid Code CM 5) was added to 1 liter of distilled water. This was distributed into glass Petri dishes (Pyrex) and autoclaved at 121 degrees Celsius for 15 minutes.

This gave a final formula of the medium as follows:

Peptone	(Oxoid L 37)	20 g/l
Lactose		10 g/l
Bile salts	(Oxoid L 55)	5 g/l
Sodium chloride		5 g/l
Neutral red		0.075 g/l
pH		appr. 7.4

### 2.5.6. GRAM STAINING

Representative colonies were picked by loop from the inoculated and incubated media and placed on a glass microscope slide and mixed with a drop of normal saline solution (0.9 N NaCl) and spread over the center of the slide. After drying, the slides were fixed by heat over a Bunsen burner. The further steps were performed as described by Wilson et al. (1984).

### 2.5.7. IDENTIFICATION OF BACTERIA

Genus identification of isolates was based on the medium on which they grew, morphology of the colonies (including presence and type of haemolysis) and the microscopical appearance of the bacteria after Gram staining (Gram positive or negative, bacillus, coccobacillus, coccus).

Species identification was performed based on the following biochemical tests (Wilson et al., 1984; Cottral, 1978; Carter, 1984):

Gram positive	Gram negative
Catalase	TSI (Triple sugar iron agar)
Glucose	LIA (Lysine iron agar)
Mannitol	SIM (Sulphide Indol motility medium)
Maltose	Citrate
Sorbitol	Urease
Gelatine	Serology

Gram  
positive

Trehalose

Hemolysis

Coagulase (bound)

Salicin

Lactose

Raffinose

## **2.6. HISTOPATHOLOGICAL EXAMINATION**

The guidelines for the procedures involved in the processing of tissues for histopathological examination were extracted from a manual from the Department of Paraclinical Studies, Pathology Laboratory, School of Veterinary Medicine, University of Lusaka (1990).

### **2.6.1. SAMPLE COLLECTION**

Collection of samples for histopathological examination was performed as described in the Chapter on bacteriological examination. They were stored in sealed histobags in 10% formalin awaiting further examination.

### **2.6.2. TRIMMING**

After removing the uterine samples from the histobags, they were rinsed in running water to remove the formalin. Slices of



tissue from representative areas of the sample were cut 2-3 mm thick and placed into tissue baskets with the protocol number. The samples were washed in tap water in tissue baskets for 2 hours to remove formalin traces.

### 2.6.3. TISSUE PROCESSING

This was performed using a Vacuum Rotary Automatic Tissue Processor (Make Sakura - Model VRX-23). The process involved 3 phases:

- a) Dehydration
- b) Clearing
- c) Impregnation

The tissue processor contained 12 containers with the following solutions and exposure times:

1. 70% Ethanol	120 min.
2. 80% Ethanol	120 min.
3. 90% Ethanol	120 min.
4. 100% Ethanol I	150 min.
5. 100% Ethanol II	150 min.
6. Absolute alcohol I	120 min.
7. Absolute alcohol II	90 min.
8. Xylene I	60 min.
9. Xylene II	40 min.
10. Wax I	20 min.

11.Wax II	20 min.
12.Wax III	20 min.

The absolute alcohol was prepared with Molecular Sieves (Wako Pure Chemical Industries Ltd., Code 134-06095, 3A 1/16 A).

The wax used was a mixture of Paraffin (Wako - Code 164-13345) and Tissue Prep (Combined purified paraffin and synthetic polymer) in a 1:1 ratio. The wax was melted and prepared in a wax oven (Sakura - Model PK-3) at 60 degrees Celsius. Both waxes had a melting point of 56-58 degrees Celsius.

#### 2.6.4. EMBEDDING

A steel tray with melted wax was prepared and the tissue sections removed from the tissue baskets and dipped in the melted wax. A piece of used photographic paper with the protocol number of the sample was placed next to each tissue section. After the tray has been filled with sections it was placed into a basin with cold water in order to speed up cooling of the wax and prevent formation of air bubbles absorbed from the atmosphere. This was also assisted by spraying of cold water on the surface of the wax. The trays were subsequently placed into a refrigerator where the wax solidified and contracted.

#### 2.6.5. BLOCKING OUT

After solidification of the wax block which contained up to 10 samples each, the tissue sections were cut out in rough cubes.

Individual cubes were then further trimmed with a wax axe to approximately 1-2 mm from the edge of the tissue sample. The bottom surface of the same were thereafter warmed with a Takashima electric block warmer and attached onto wooden blocks measuring 1x1.5x2 cm and the protocol number enscribed onto the block side.

#### **2.6.6. MICROTOMY**

The microtome used was of a sliding type (Yamato) with a double blade holder and disposable microtome blades (Feather - S35). The blades were positioned at an angle of 45 degrees towards the longitudinal axis of the microtome and 4-5 degrees towards the cutting surface of the sample block. The thickness of the sections was adjusted at 3.5 micrometers. The slide warmer for stretching of the cut sections was kept at 45 degrees Celsius (Make Sakura - Model PS-51).

After mounting the block onto the block holder, rough trimming with the first blade was performed until the whole surface of the sample was exposed. Thereafter the second blade was used for cutting of sections. The cut sections were picked with a soft brush and floated on the surface of distilled, boiled and cooled water and then picked up onto a precleaned microscope slide. These were then placed onto the slide warmer for drying and straightening for 1-2 hours.

#### 2.6.7. STAINING

After stretching and drying of the sections, they were placed into staining racks and underwent the following procedure:

1. Xylene I	5 min.
2. Xylene II	5 min.
3. 100% Ethanol	1 min.
4. 90% Ethanol	1 min.
5. 80% Ethanol	1 min.
6. 70% Ethanol	1 min.
7. Rinsing in dist.H2O	2 min.
8. Mayer's Haematoxylin	5 min.
9. Blueing in tap water	30 sec.
10.Eosin 1%	1 min.
11.Wash in tap water	30 sec.

#### 2.6.8. DEHYDRATION

1. 70% Ethanol	10 sec.
2. 80% Ethanol	10 sec.
3. 90% Ethanol	20 sec.
4. 100% Ethanol I	1 min.
5. 100% Ethanol II	2 min.
6. Absolute alcohol	5 min.

#### 2.6.9. CLEARING

1. Xylene I	5 min.
2. Xylene II	5 min.

#### 2.6.10. MOUNTING

After removing the slide rack from Xylene II the slides were wiped clean from Xylene on the bottom surface and the end of the top surface. 1-2 drops of Mountant (Eukitt - O.Kindler, W.Germany) were placed at one end of the slide and a cover slip applied on top of it starting from one end in order to avoid trapping of any air under the cover slip.

#### 2.6.11. DRYING

All sections prepared in the above described manner were finally placed into an Incubator (Yamato - Model S-61) overnight at 37 degrees Celsius for final drying.

#### 2.6.12. MICROSCOPIC EXAMINATION

Microscopic examination of prepared sections was performed using an electric Microscope (Olympus Model BH-2).

### 2.7. STATISTICAL ANALYSIS

The guidelines for the statistical analysis of findings have been extracted from Wardlaw (1986). The methods used were:

1. Arithmetic mean
2. Standard deviation
3. T-test
4. Probability

## **CHAPTER THREE**

### **RESULTS**

## **CHAPTER THREE: RESULTS**

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The following are the results of the investigations carried out during this study. They are presented in an order which does not correspond with the chronological order in which they were performed. This is due to the fact that several steps of this study were performed simultaneously, while others as separate entities. For ease of reference and understanding, the following order was decided upon.

### 3.1. RECORDS

The records analysed are split into two groups:

1. Records of all cows that calved during a three year period from 1st January, 1987 to 31st December, 1989. This includes analysis of 1108 calvings and events during the subsequent intergestational periods. Each animal that calved during this period was followed by means of their individual life-time records until the next conception and subsequent calving, disposal or death.
2. Records of culled cows and heifers during 1 year covering the period from 1st January, 1989 to 31st December, 1990. This covers 102 animals, of which 83 were cows and 19 heifers.

While planning these investigations, it was assumed that computer records would be used, but while analysing these, a substantial number of input mistakes were found, which would make the results meaningless. It was therefore decided to use the



manual cow cards for data collection, as these were shown to be correct and meaningful.

Collected data were compiled in a spreadsheet which covers all calvings and intergestational events for the three year period.

The indices calculated from herd records are the following:

1. Number of calvings
2. Cows conceived after last calving
3. Services per conception
4. Calving to first service period in days
5. First service to conception period in days
6. Calving to conception period in days
7. Actual calving interval in days
8. Incidence of failure to conceive
9. Incidence of culling due to reasons other than reproductive
10. Conception rates to services per calving month
11. Abortions per previous calving month
12. Managers reason for disposal of cows
13. Ratio of male and female calves born
14. Incidence of multiple births

### 3.1.1. HERD RECORDS AND SEASONALITY OF PERFORMANCE

1987

The summary of the breeding performance per calving month of cows and heifers calved during 1987 is given in table 1. and figure 1.

Out of a total of 370 calvings during the year, only 232 (62.7%) of these cows conceived again. 100 (27.0%) were culled due to failure to conceive and 41 (11.1%) due to other reasons (see table 8. and figure 13.).

The average number of services per conception was 3.4 (+/-0.1). The calving to first service period was on average 73 (+/-2.1) days, the first service to conception period 43 (+/-3.8) days, the calving to conception period 116 (+/-4.3) days, the actual calving interval 392 (+/-4.5) days and the projected calving interval 396 (+/-4.3) days.

1988

The summary of the breeding performance per calving month of cows and heifers calved during 1988 is given in table 2. and figure 2.

Out of a total of 380 calvings during the year, a total of 258 (67.9%) cows conceived again. 71 cows (18.7%) were culled due to failure to conceive and 54 (14.2%) disposed for other reasons.

The average number of services per conception was 3.0 (+/-0.1), the calving to first service period 61 (+/-1.8) days,

the first service to conception period 47 ( $\pm 3.6$ ) days, the calving to conception period 108 ( $\pm 3.8$ ) days, the actual calving interval 382 ( $\pm 3.9$ ) days and the projected calving interval 387 ( $\pm 3.8$ ) days.

## 1989

The summary of the breeding performance per calving month of cows and heifers calved during 1989 is given in table 3. and figure 3.

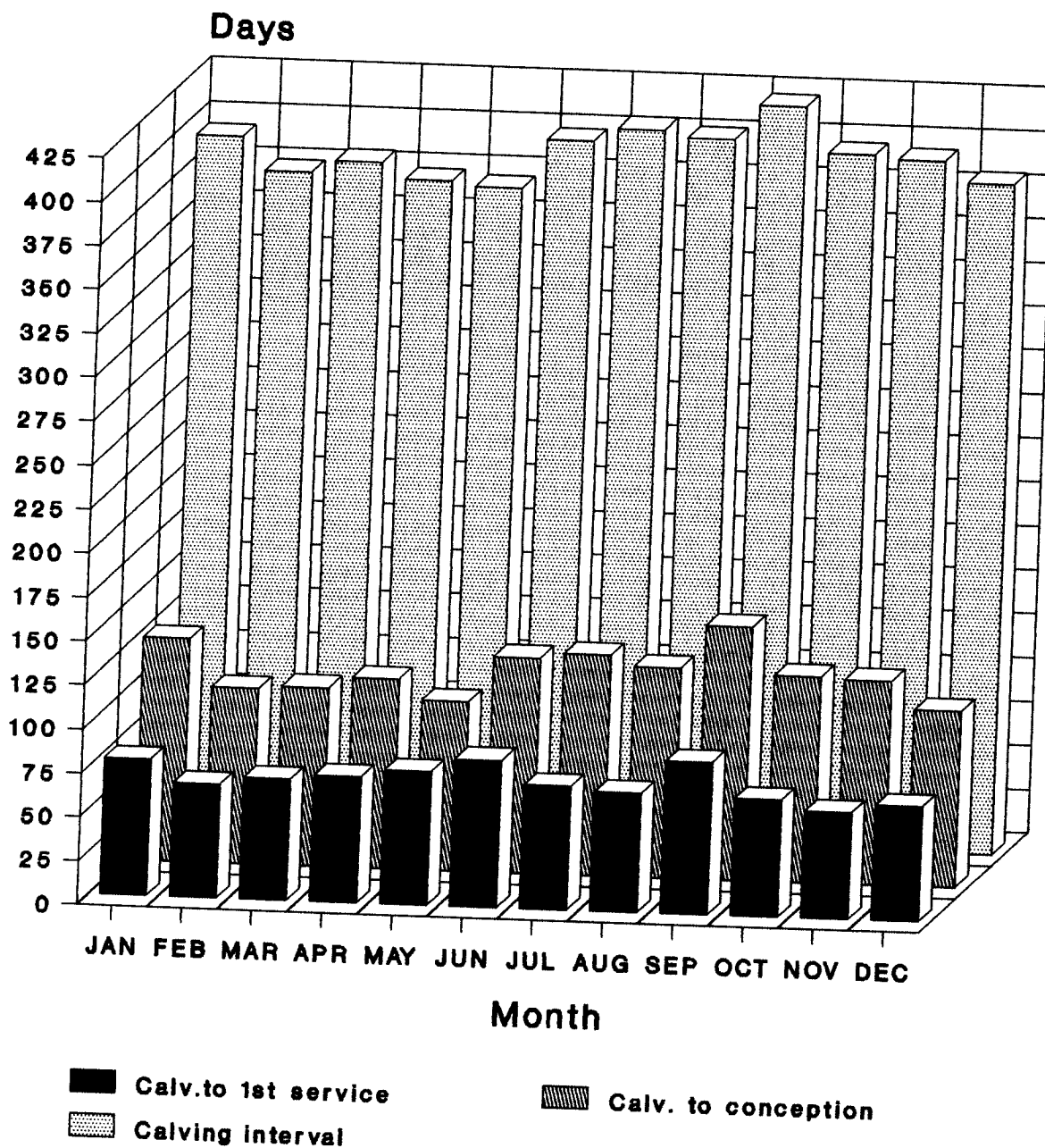
Out of a total of 358 calvings of cows and heifers during 1989 264 (73.7%) conceived again. A total of 51 cows (14.2%) were culled due to failure to conceive and 48 (13.4%) due to other reasons.

The average number of services per conception was 3.1 ( $\pm 0.1$ ), the average period from calving to first service 64 ( $\pm 1.6$ ) days, the first service to conception period 54 ( $\pm 4.0$ ) days, the calving to conception period 118 ( $\pm 4.2$ ) days, the actual calving interval 382 ( $\pm 4.1$ ) days and the projected calving interval 397 ( $\pm 4.2$ ) days.

TABLE 1. SUMMARY OF BREEDING PERFORMANCE PER CALVING MONTH FOR 1987

MONTH	TOTAL CALV.	N CONC.	% CONC.	SERV. /CONC.	CALV. TO 1ST SERV DAYS	1ST SERV TO CONC. DAYS	CALV. TO CONC. DAYS	ACTUAL CI DAYS	PROJ. CI DAYS	N FTC	% FTC	N OTHER	% OTHER
JAN	38	26	68.4	3.0	78	49	127	394	407	9	23.7	3	7.9
FEB	42	22	52.4	4.2	65	36	100	375	380	16	38.1	5	11.9
MAR	33	22	66.7	3.5	69	33	102	382	382	7	21.2	4	12.1
APR	36	21	58.3	4.1	72	36	108	373	388	12	33.3	4	11.1
MAY	30	17	56.7	3.4	76	21	97	370	377	13	43.3	0	0.0
JUN	27	18	66.7	3.2	84	39	123	398	403	7	25.9	3	11.1
JUL	19	14	73.7	3.6	71	56	126	406	406	5	26.3	0	0.0
AUG	32	20	62.5	3.2	68	52	120	402	400	10	31.3	2	6.3
SEP	39	25	64.1	3.1	87	58	145	422	425	9	23.1	5	12.8
OCT	31	20	64.5	3.2	67	52	118	396	395	5	16.1	6	19.4
NOV	16	10	62.5	4.0	61	56	117	394	397	2	12.5	4	25.0
DEC	27	17	63.0	2.8	66	35	101	382	381	5	18.5	5	18.5
AVERAGES:				3.4	73	43	116	392	396				
TOTALS:	370	232	62.7							100	27.0	41	11.1

**FIGURE 1. BREEDING PERFORMANCE  
PER CALVING MONTH 1987**

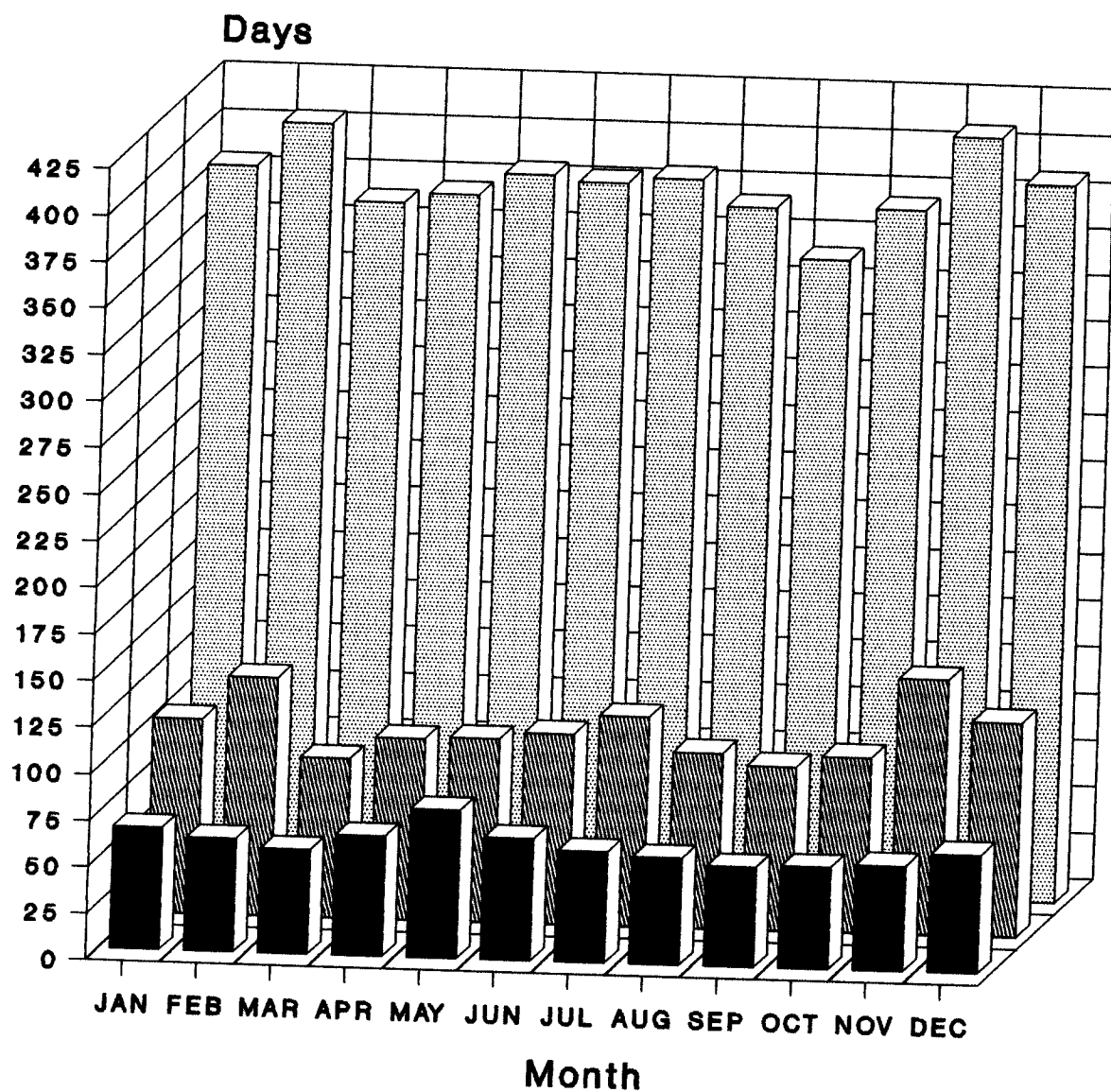


Average calving to 1st service 73 days  
 Average calving to conception 116 days  
 Average calving interval 392 days

TABLE 2. SUMMARY OF BREEDING PERFORMANCE PER CALVING MONTH FOR 1988

MONTH	TOTAL CALV.	N CONC.	% CONC.	SERV. /CONC.	CALV. TO 1ST SERV DAYS	1ST SERV TO CONC. DAYS	CALV. TO CONC. DAYS	ACTUAL CI DAYS	PROJ. CI DAYS	N FTC	% FTC	N OTHER	% OTHER
JAN	37	23	62.2	2.7	66	39	105	383	381	8	21.6	6	16.2
FEB	38	23	60.5	3.5	61	67	128	407	408	8	21.1	7	18.4
MAR	31	16	51.6	3.8	56	30	86	366	361	10	32.3	6	19.4
APR	21	12	57.1	3.5	65	33	98	371	378	5	23.8	4	19.0
MAY	17	11	64.7	2.9	80	19	99	383	379	5	29.4	1	5.9
JUN	28	17	60.7	3.6	66	33	103	380	383	9	32.1	3	10.7
JUL	49	36	73.5	3.2	60	53	113	383	393	6	12.2	7	14.3
AUG	36	25	69.4	3.3	58	37	95	369	375	8	22.2	3	8.3
SEP	23	15	65.2	2.7	54	35	89	342	369	5	21.7	4	17.4
OCT	34	30	88.2	2.2	55	40	95	370	375	1	2.9	3	8.8
NOV	35	29	82.9	2.9	57	80	138	410	418	2	5.7	4	11.4
DEC	31	21	67.7	2.7	64	52	116	386	396	4	12.9	6	19.4
AVERAGES:				3.0	61	47	108	382	387				
TOTALS:	380	258	67.9							71	18.7	54	14.2

**FIGURE 2. BREEDING PERFORMANCE  
PER CALVING MONTH 1988**



■ Calv.to 1st service

▨ Calv.to conception

▤ Calving interval

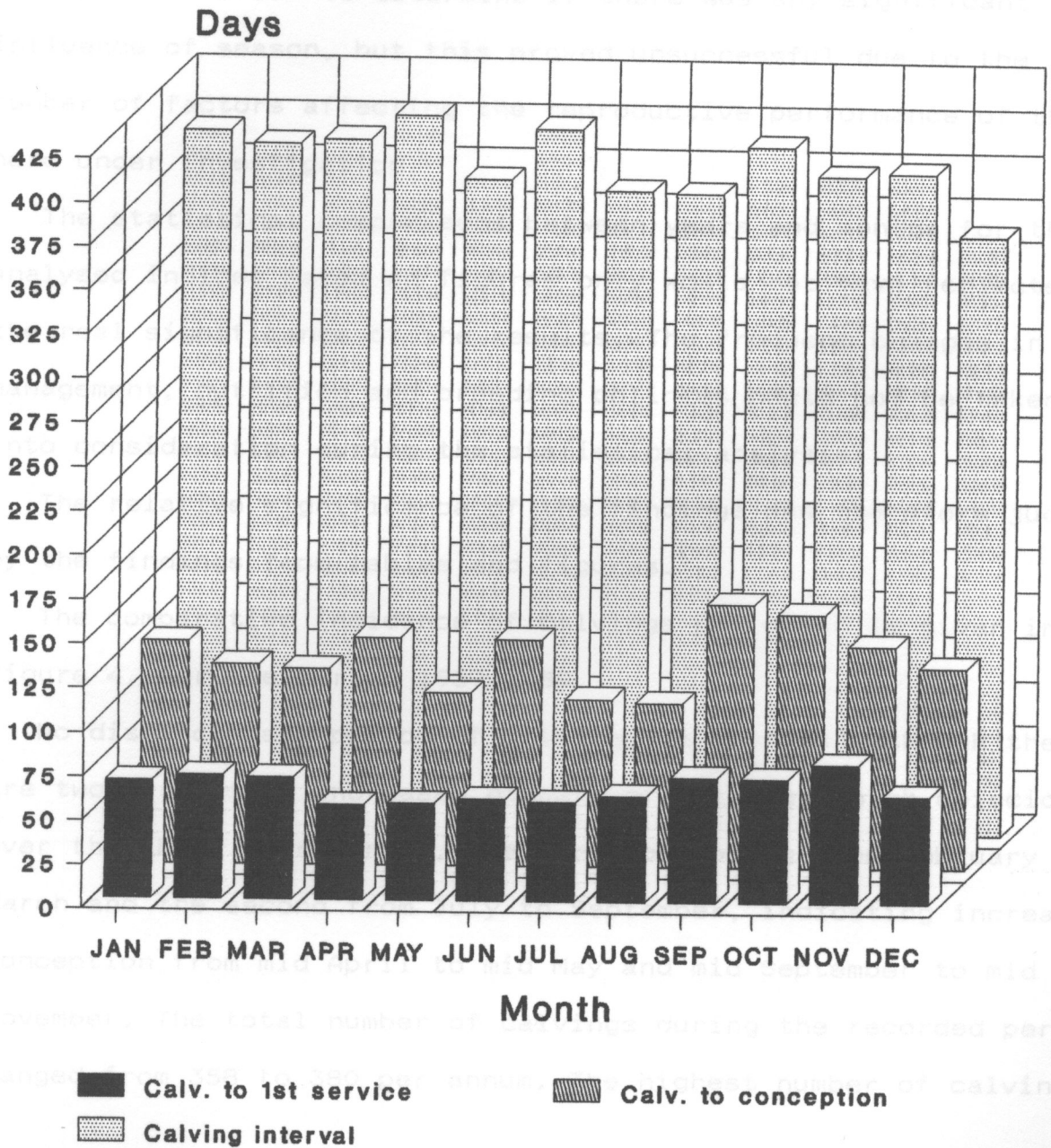
Average Calving to 1st service 61 days  
 Average Calving to conception 108 days  
 Average Calving interval 382 days

TABLE 3. SUMMARY OF BREEDING PERFORMANCE PER CALVING MONTH FOR 1989

MONTH	TOTAL CALV.	N CONC.	% CONC.	SERV. /CONC.	CALV. TO 1ST SERV DAYS	1ST SERV TO CONC. DAYS	CALV. TO CONC. DAYS	ACTUAL CI DAYS	PROJ. CI DAYS	N FTC	% FTC	N OTHER	% OTHER
JAN	28	23	82.1	2.7	67	59	126	396	406	3	10.7	3	10.7
FEB	33	21	63.6	3.1	70	43	113	389	393	4	12.1	8	24.2
MAR	47	32	68.1	2.2	69	41	111	392	391	3	10.6	12	25.5
APR	20	14	70.0	3.1	54	75	129	406	392	2	10.0	4	20.0
MAY	31	27	87.1	2.3	55	43	98	370	378	2	6.5	3	9.7
JUN	24	21	87.5	2.8	58	70	128	399	408	2	8.3	2	8.3
JUL	33	23	69.7	3.7	56	39	95	364	375	10	30.3	1	3.0
AUG	37	25	67.6	3.0	60	35	95	363	375	8	21.6	4	10.8
SEP	40	29	72.5	3.8	71	78	149	390	429	6	15.0	5	12.5
OCT	18	15	83.3	3.3	70	74	144	374	424	2	11.1	1	5.6
NOV	23	16	69.6	4.1	79	47	126	376	406	5	21.7	2	8.7
DEC	24	18	75.0	3.7	61	53	114	340	394	4	16.7	3	12.5
AVERAGES:				3.1	64	54	118	382	397				
TOTALS:	358	264	73.7							51	14.2	48	13.4



**FIGURE 3. BREEDING PERFORMANCE  
PER CALVING MONTH 1989**



Average Calving to 1st service 64 days  
 Average Calving to conception 118 days  
 Average Calving interval 382 days

## **Comparative analysis of indices for the period 1987-1989**

Comparative statistical analysis of reproductive indices was attempted in order to determine if there was any significant influence of season, but this proved unsuccessful due to the number of factors affecting the reproductive performance of the herd under investigation.

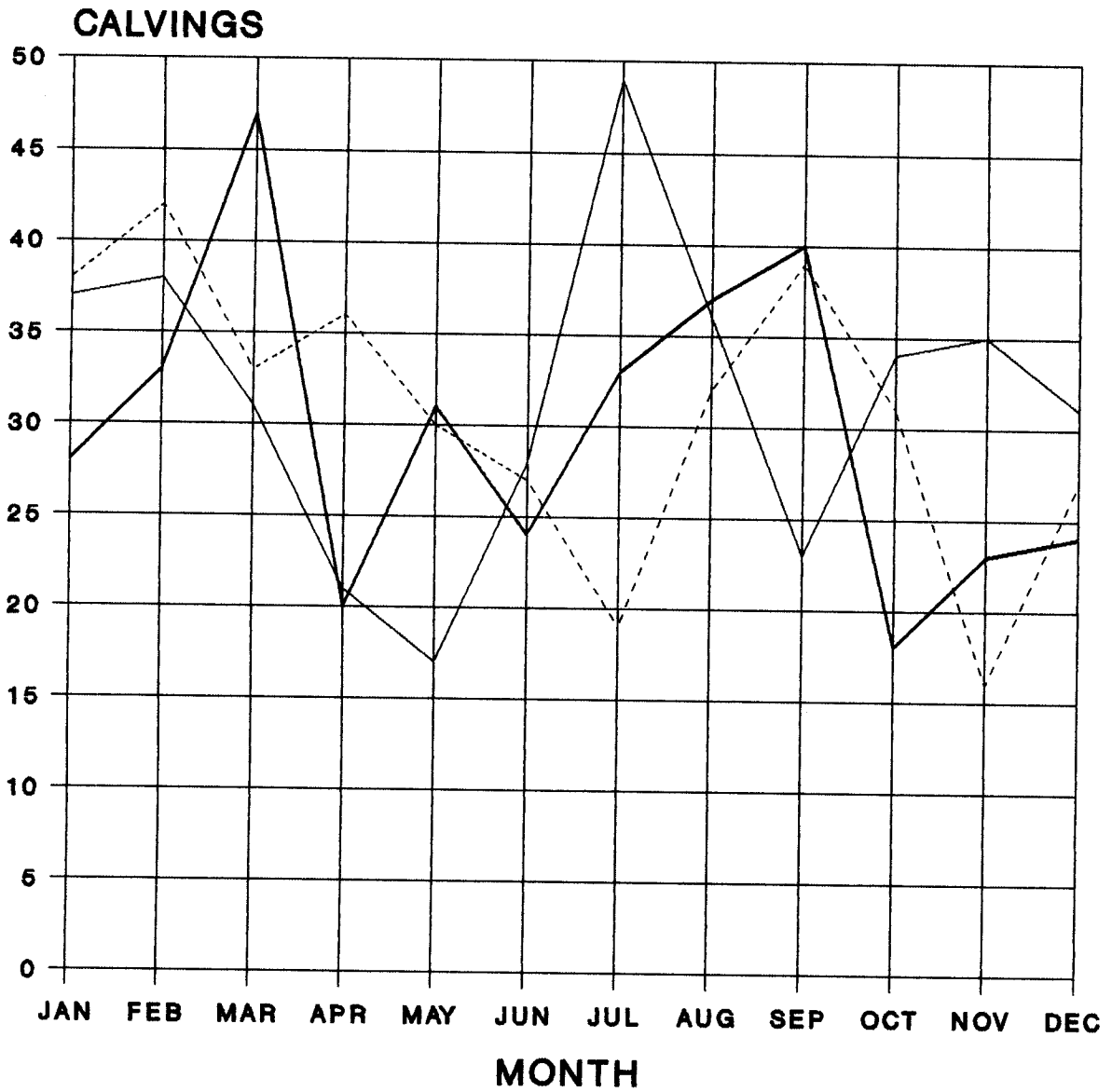
The statistical comparisons between years and months for the analysed indices based on figures only would not have reflected the real significance of the results. The frequent changes in management, nutrition and breeding policies could not be taken into consideration during the statistical analysis.

The relative significance of the findings was therefore judged by the findings from tables and figures.

The comparative incidence of calvings per month is given in figure 4. for the period 1987-1989.

No distinct peak period of calvings is obvious although there are two periods of increased numbers of calvings which coincide over the three year period, the first one being from February to March and the second from July to September, indicating increased conception from mid April to mid May and mid September to mid November. The total number of calvings during the recorded period ranged from 358 to 380 per annum. The highest number of calvings

**FIGURE 4. CALVINGS PER MONTH  
1987-1989**



----- 1987    — 1988    — 1989

Total 1987 370 calvings  
Total 1988 380 calvings  
Total 1989 358 calvings

for any month was 49 and the lowest 16.

The percent of cows that conceived again after the previous calving for the same period is given in figure 5.

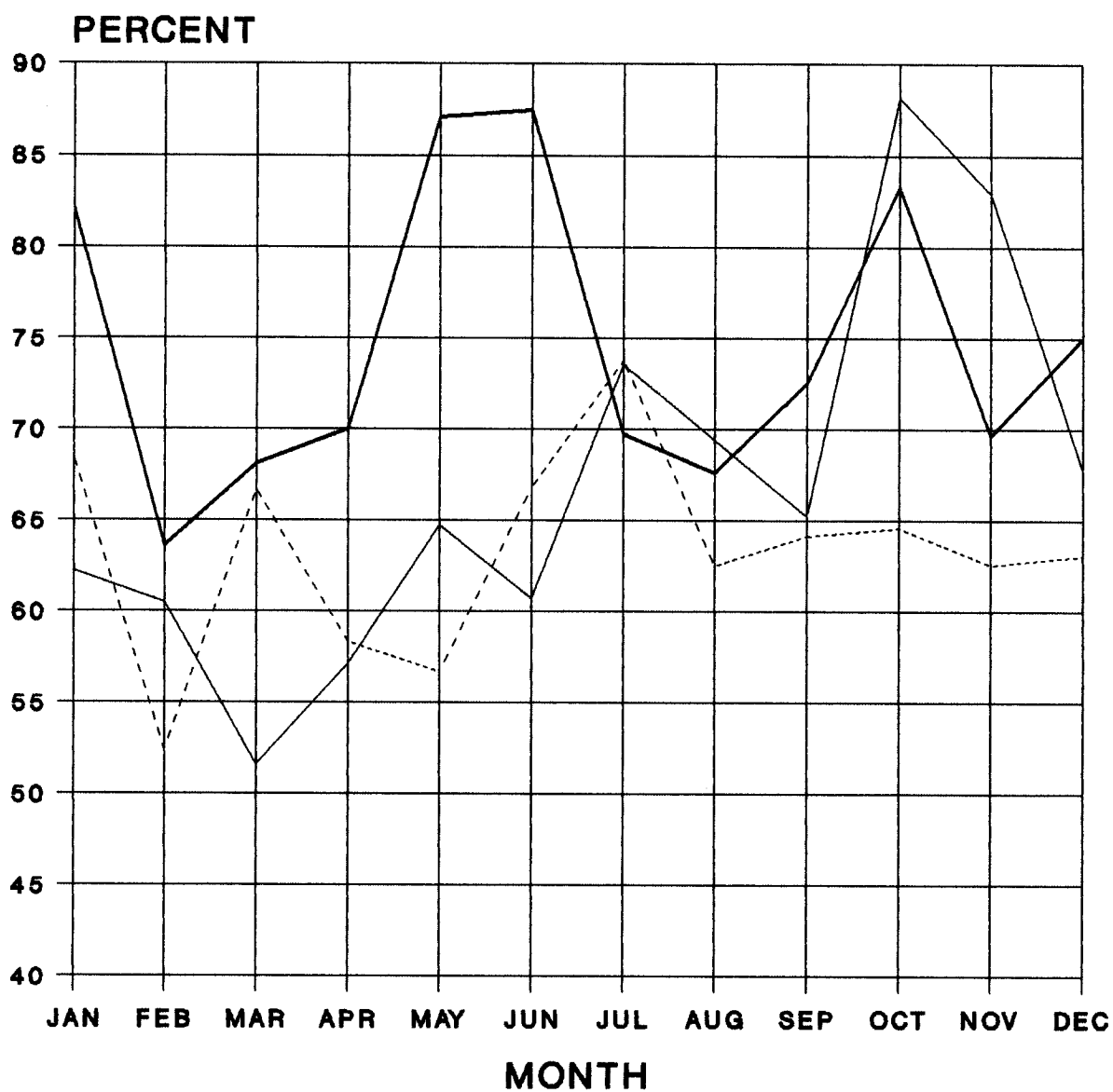
A fairly large variation in the percentage of cows that conceived again is seen between the calving months, but again with no distinct comparative periods during the year. The variation is lowest for 1987 (52.4-73.7%), higher for 1989 (63.6-87.5%) and highest for 1988 (51.6-88.2%). There is a positive trend with regards to the average conception after the previous calving during this period, which increased from 62.7% in 1987 to 73.7% in 1989.

The comparative calving to first service and first service to conception intervals are given in figures 6. and 7.

The calving to first service periods do not show any periods of improved performance which would coincide over the three year period, but each year shows peak periods of better performance when analysed separately, e.g. calving to first service periods during 1987 are shortest in February and November, during 1988 from July to September and during 1989 from April to August.

The same applies to first service to conception periods, which show no distinct periods of coinciding improved performance over the three year period, but rather periods of better performance within each year separately but at different times. During 1989 the periods were fairly even throughout the year with relatively little variation of monthly averages (54-79 days), whilst both 1988 and 1987 show a common period of short first service to conception periods for May calvings (19 and 21 days respectively)

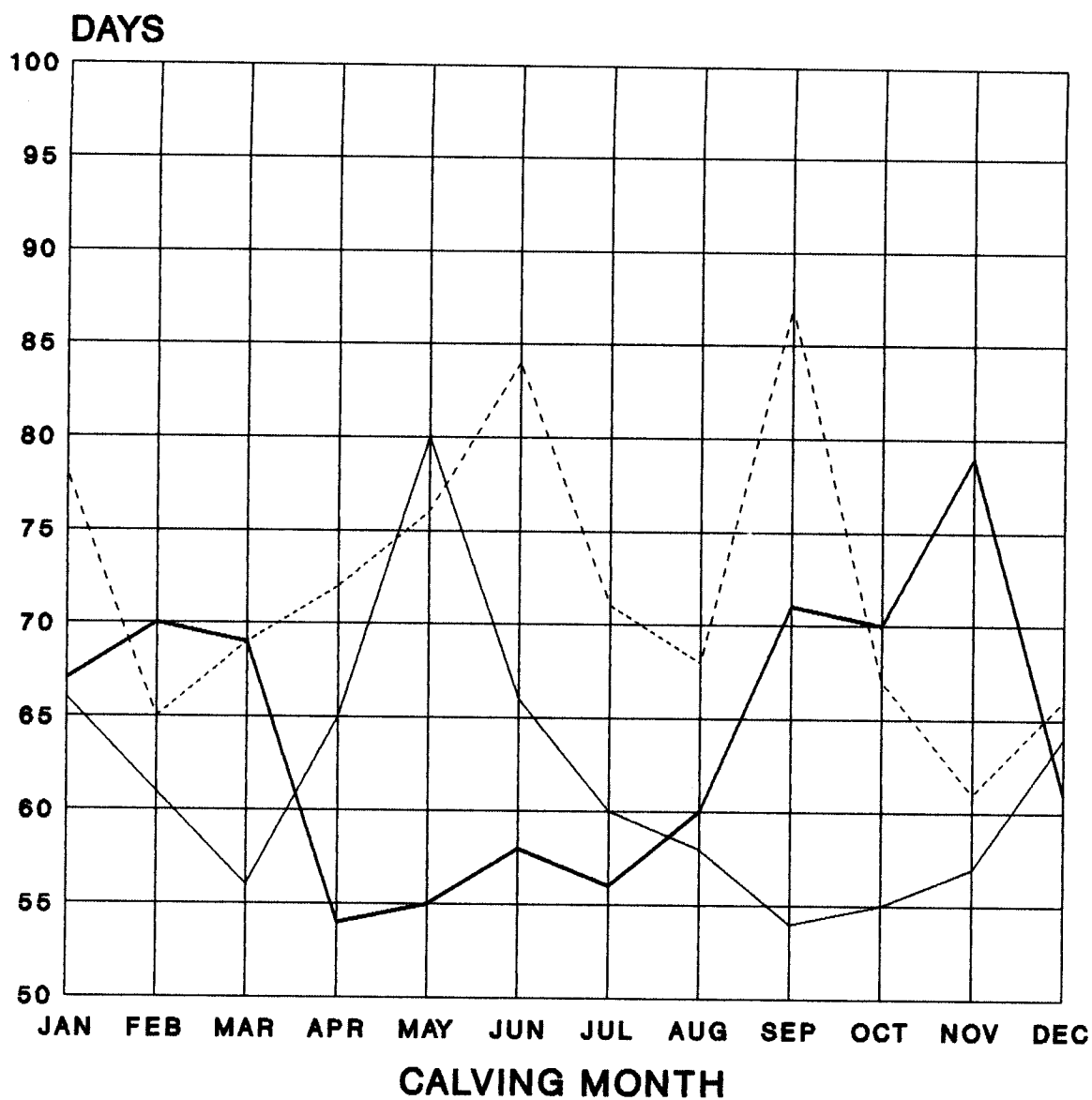
**FIGURE 5. PERCENT CONCEPTION PER  
CALVING MONTH IN COWS 1987-1989**



----- 1987    — 1988    — 1989

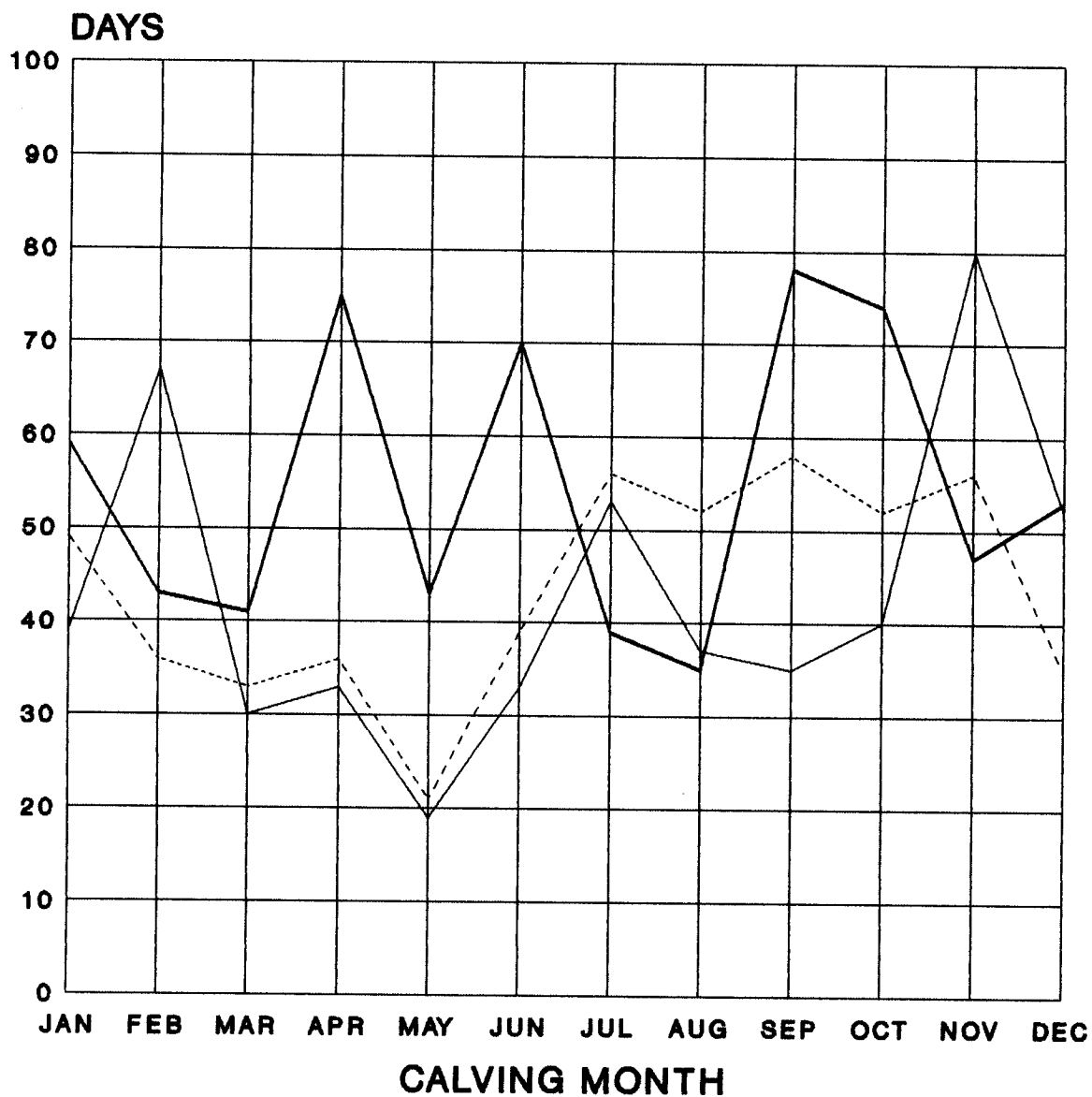
Total 1987 62.7%  
Total 1988 67.9%  
Total 1989 73.7%

**FIGURE 6. CALVING TO FIRST SERVICE  
INTERVALS 1987-1989**



Average 1987 73 days  
 Average 1988 61 days  
 Average 1989 64 days

**FIGURE 7. FIRST SERVICE TO CONCEPTION  
INTERVALS 1987-1989**



----- 1987    — 1988    — 1989

**Average 1987 43 days**  
**Average 1988 47 days**  
**Average 1989 54 days**

with 1988 monthly averages ranging from 19-80 days and 1987 monthly averages from 21-58 days.

The comparative calving to conception periods for 1987-1989 are presented in figure 8.

These values show again wide variations but there is one distinct and common period of relatively short calving to conception periods for all three analysed years for May calvings.

This month gives the smallest and most concentrated range of averages (97-99 days) whilst the extreme average values for the rest of the year range from 87-149 days. There is no other period of common good or poor performance, e.g. the worst performance with regards to this indicator is in September 1987 and 1989, whilst the best performance in this regard is in September 1988.

The incidence of conception to first service per previous calving month for the period 1987-1989 is presented in figure 9.

Although the performance figures with regards to conception to first service are well below target figures throughout the three years, a common peak period for with highest conception to first service values is noticable for May calvings for all three years, whilst they vary considerably throughout the rest of the year. While the average conception to first service is approximately 30% for each year the highest performance for 1987 is 36.7%, for 1988 50.0% and 1989 44.8%, all for May calvings.

The conception rates per calving month to the first to sixth service and conception rates to all services for the period 1987-1989 are given in tables 4., 5. and 6.

The variations for these values are considerable for all three years, e.g. average conception rates to all services for 1987



range from 42.4-58.6%, for 1988 from 37.7-73.3% and for 1989 from 33.3-53.3% per calving month. No distinct period of improved conception to all services is noted.

The percentage of failure to conceive per previous calving month for the period 1987-1989 is presented in figure 10.

It is necessary to mention here that the figures given in tables 1., 2. and 3. for failure to conceive, culling due to other reasons and cows conceived do not sum up exactly to the total number of calvings during that particular year. This is due to the fact that some cows died each year during pregnancy due to various disease problems. They have therefore been included into reproductive performance calculations as they did breed successfully. The numbers of such cases is 3 for 1987, 3 for 1988 and 5 for 1989.

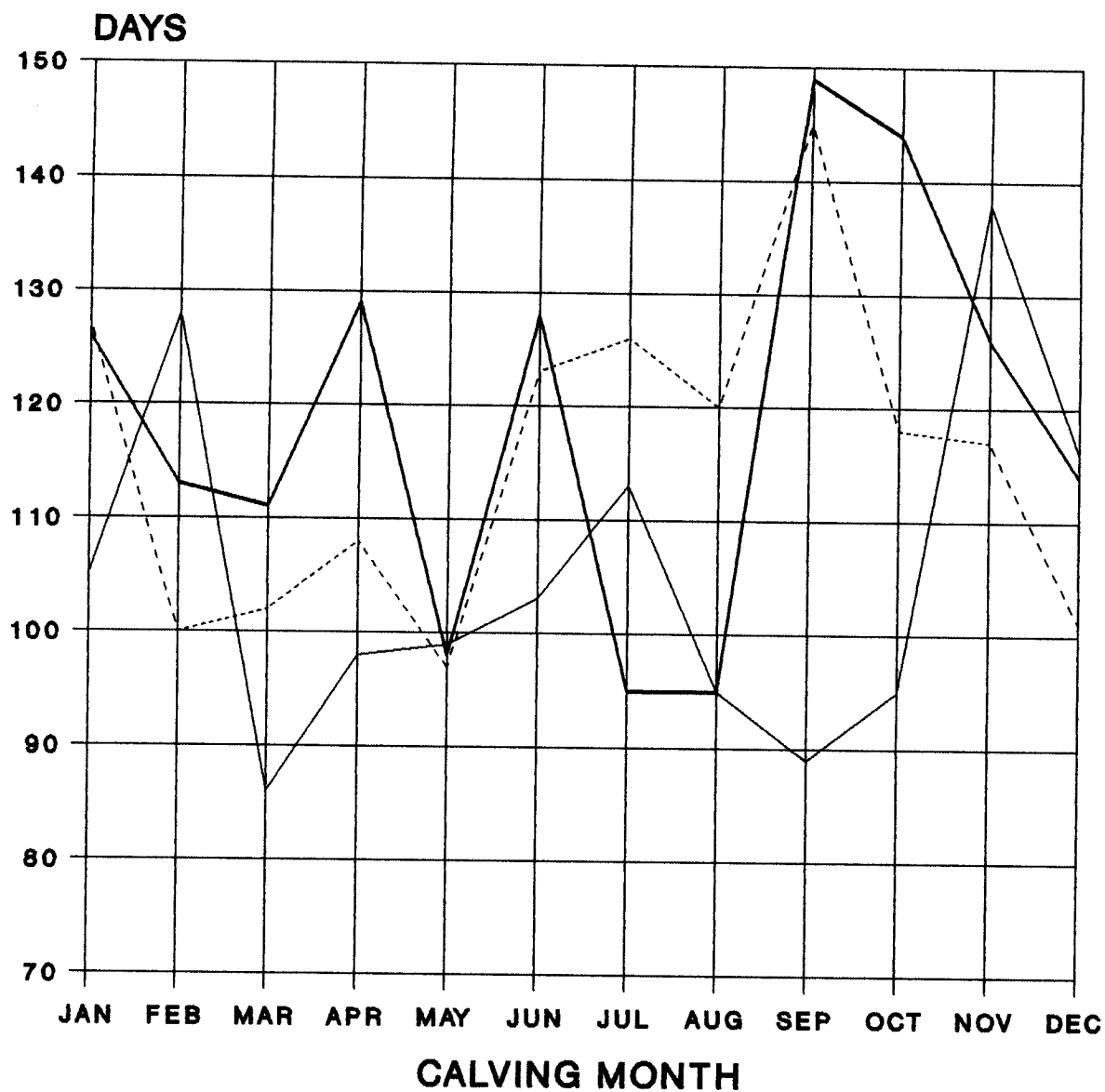
The positive trend with regards to reduced culling for failure to conceive is obvious for this period. Culling for failure to conceive has reduced from 27.0% of all calved cows in 1987 to 14.2% in 1989. The peak periods for the three year period do not coincide for any particular time of the year.

The values for actual calving intervals for the period 1987-1989 is given in figure 11.

These findings coincide with the findings for calving to conception intervals as presented in figure 8. with a common period with least variation (370-382 days) and relatively good performance for May calvings. All other months show considerable variations with extreme values ranging from 343-422 days.

The incidence of confirmed conceptions which terminated as abortions is given in table 7. and figure 12. for the period

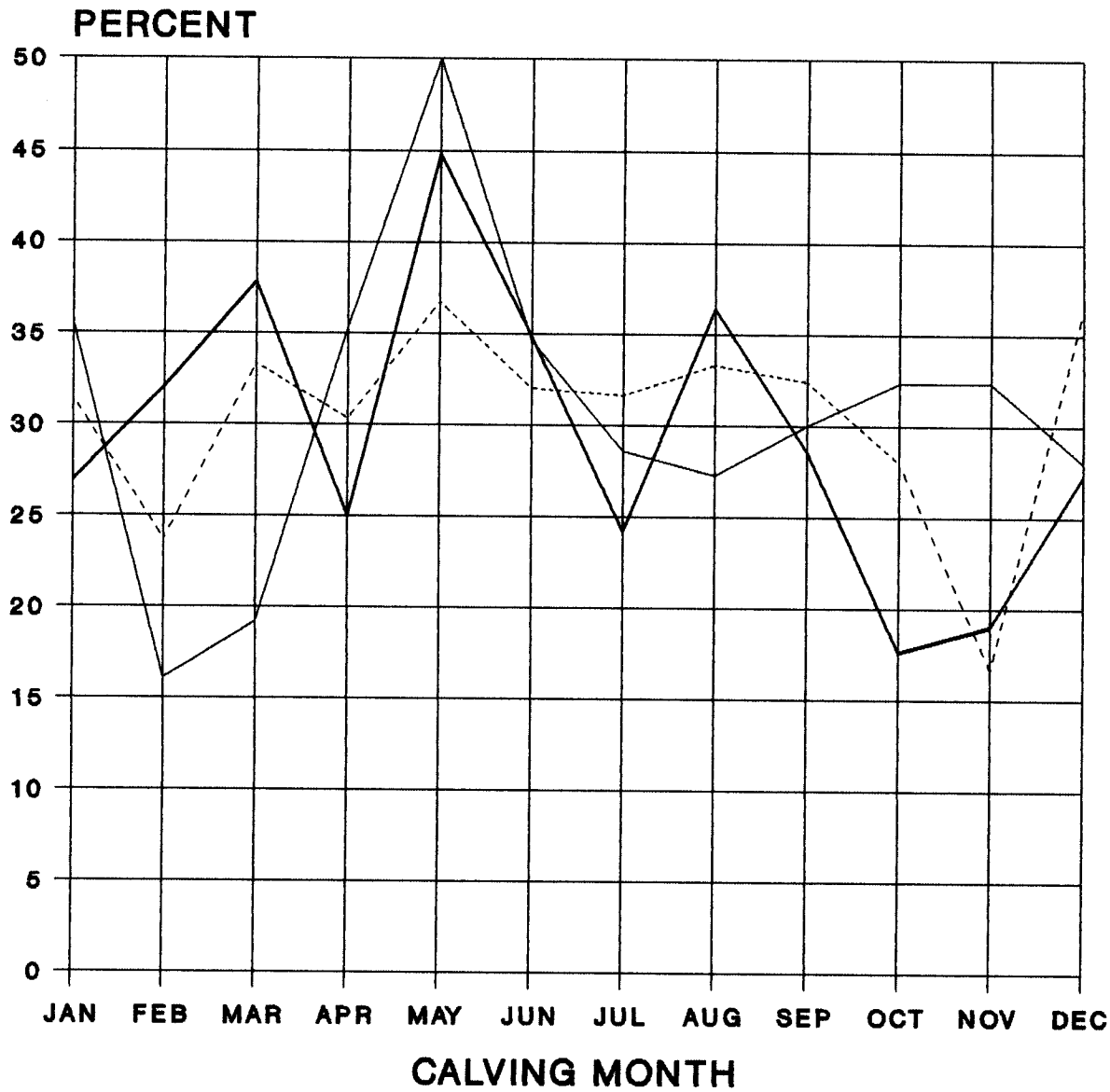
**FIGURE 8. CALVING TO CONCEPTION  
INTERVALS 1987-1989**



----- 1987    — 1988    — 1989

Average 1987 116 days  
Average 1988 108 days  
Average 1989 118 days

**FIGURE 9. CONCEPTION TO FIRST SERVICE  
PER CALVING MONTH 1987-1989**



----- 1987    — 1988    — 1989

Average 1987 30.9%  
Average 1988 29.8%  
Average 1989 30.6%

TABLE 4. CONCEPTION RATES PER SERVICE PER CALVING MONTH 1987

MONTH CALVED	COWS CALVED	COWS SERVED	1ST SERVICE		2ND SERVICE		3RD SERVICE		4TH SERVICE		5TH SERVICE		6TH SERVICE		CONCEPTION TO ALL SERV.
			N	%	N	%	N	%	N	%	N	%	N	%	%
JAN	38	35	11	31.4	6	17.1	7	20.0	2	5.7	0	0.0	0	0.0	50.00
FEB	42	38	9	23.7	6	15.8	5	13.2	1	2.6	1	2.6	0	0.0	48.89
MAR	33	27	9	33.3	8	29.6	3	11.1	2	7.4	0	0.0	0	0.0	47.62
APR	36	33	10	30.3	5	15.2	4	12.1	1	3.0	1	3.0	0	0.0	51.22
MAY	30	30	11	36.7	1	3.3	3	10.0	1	3.3	1	3.3	0	0.0	54.84
JUN	27	25	8	32.0	6	24.0	1	4.0	2	8.0	1	4.0	0	0.0	50.00
JUL	19	19	6	31.6	3	15.8	2	10.5	1	5.3	1	5.3	1	5.3	42.42
AUG	32	30	10	33.3	6	20.0	1	3.3	1	3.3	2	6.7	0	0.0	51.28
SEP	39	34	11	32.4	6	17.6	5	14.7	0	0.0	0	0.0	3	8.8	44.64
OCT	31	25	7	28.0	6	24.0	3	12.0	2	8.0	2	8.0	0	0.0	43.48
NOV	16	12	2	16.7	5	41.7	0	0.0	1	8.3	1	8.3	1	8.3	37.04
DEC	27	22	8	36.4	6	27.3	3	13.6	0	0.0	0	0.0	0	0.0	58.62
TOTAL:	370	330	102		64		37		14		10		5		
PERCENT:				30.9		19.4		11.2		4.2		3.0		1.5	48.34

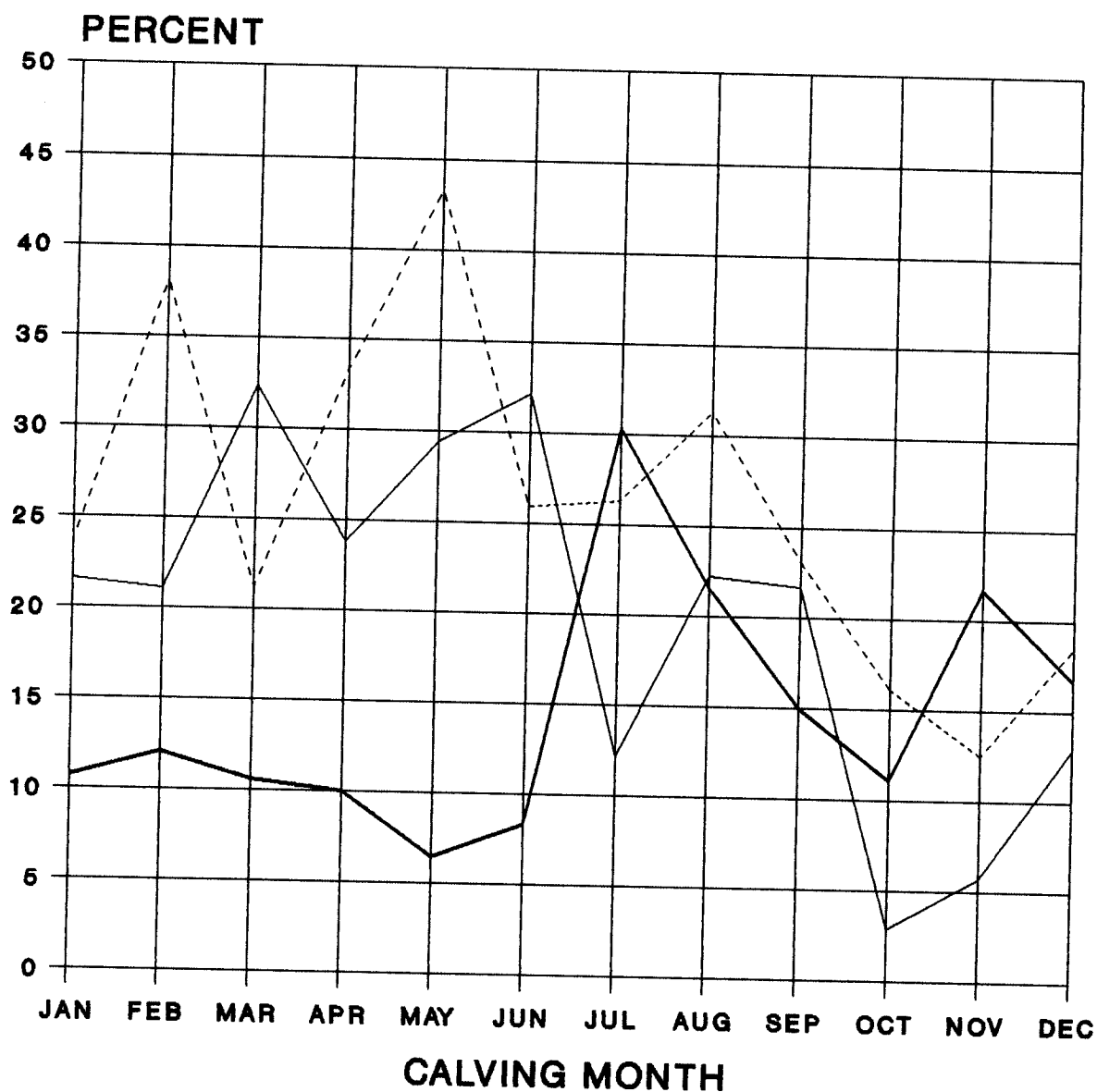
TABLE 5. CONCEPTION RATES PER SERVICE PER CALVING MONTH 1988

MONTH CALVED	COWS CALVED	COWS SERVED	1ST SERVICE		2ND SERVICE		3RD SERVICE		4TH SERVICE		5TH SERVICE		6TH SERVICE		CONCEPTION TO ALL SERV.
			N	%	N	%	N	%	N	%	N	%	N	%	%
JAN	37	31	11	35.5	5	16.1	2	6.5	3	9.7	2	6.5	0	0.0	46.94
FEB	38	31	5	16.1	7	22.6	7	22.6	1	3.2	1	3.2	2	6.5	37.70
MAR	31	26	5	19.2	8	30.8	2	7.7	1	3.8	0	0.0	0	0.0	51.61
APR	21	17	6	35.3	3	17.6	3	17.6	0	0.0	0	0.0	0	0.0	57.14
MAY	17	16	8	50.0	2	12.5	1	6.3	0	0.0	0	0.0	0	0.0	73.33
JUN	28	26	9	34.6	4	15.4	0	0.0	3	11.5	1	3.8	0	0.0	50.00
JUL	49	42	12	28.6	10	23.8	7	16.7	5	11.9	2	4.8	0	0.0	43.37
AUG	36	33	9	27.3	9	27.3	4	12.1	2	6.1	1	3.0	0	0.0	48.08
SEP	23	20	6	30.0	6	30.0	2	10.0	1	5.0	0	0.0	0	0.0	53.57
OCT	34	31	10	32.3	13	41.9	2	6.5	3	9.7	1	3.2	1	3.2	46.15
NOV	35	31	10	32.3	6	19.4	7	22.6	2	6.5	2	6.5	2	6.5	39.73
DEC	31	25	7	28.0	7	28.0	5	20.0	1	4.0	1	4.0	0	0.0	46.67
TOTAL:	380	329	98		80		42		22		11		5		
PERCENT:				29.8		24.3		12.8		6.7		3.3		1.5	49.53

TABLE 6. CONCEPTION RATES PER SERVICE PER CALVING MONTH 1989

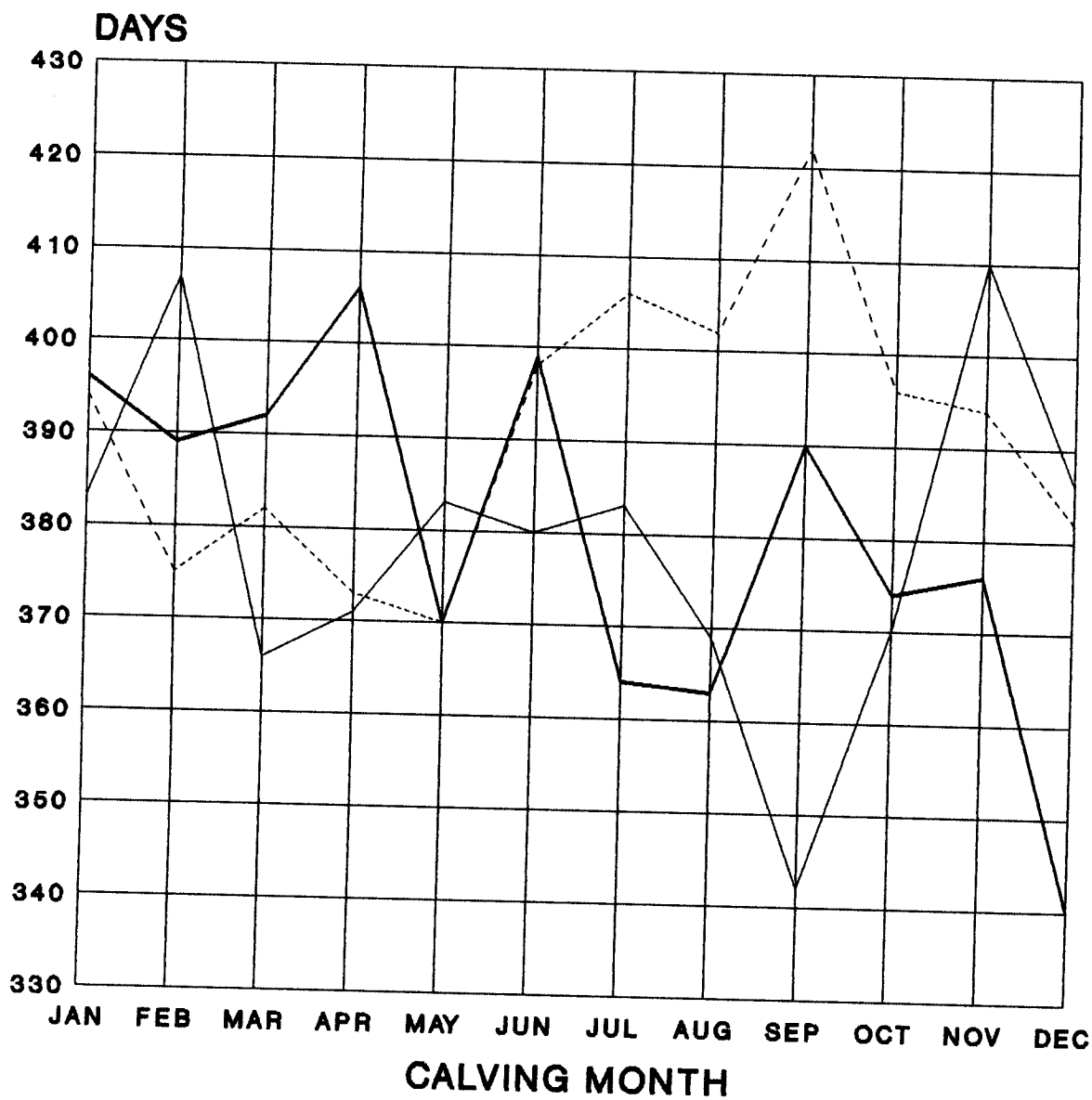
MONTH CALVED	COWS CALVED	COWS SERVED	1ST SERVICE		2ND SERVICE		3RD SERVICE		4TH SERVICE		5TH SERVICE		6TH SERVICE		CONCEPTION TO ALL SERV.
			N	%	N	%	N	%	N	%	N	%	N	%	
JAN	28	26	7	26.9	8	30.8	8	30.8	0	0.0	0	0.0	0	0.0	48.94
FEB	33	25	8	32.0	7	28.0	3	12.0	3	12.0	0	0.0	0	0.0	48.84
MAR	47	37	14	37.8	11	29.7	4	10.8	3	8.1	0	0.0	0	0.0	53.33
APR	20	16	4	25.0	3	18.8	2	12.5	1	6.3	2	12.5	2	12.5	33.33
MAY	31	29	13	44.8	8	27.6	1	3.4	3	10.3	2	6.9	0	0.0	50.00
JUN	24	23	8	34.8	5	21.7	2	8.7	4	17.4	1	4.3	1	4.3	41.18
JUL	33	33	8	24.2	8	24.2	5	15.2	1	3.0	1	3.0	0	0.0	47.92
AUG	37	33	12	36.4	7	21.2	5	15.2	0	0.0	0	0.0	1	3.0	53.19
SEP	40	35	10	28.6	3	8.6	7	20.0	3	8.6	1	2.9	5	14.3	34.52
OCT	18	17	3	17.6	5	29.4	1	5.9	3	17.6	3	17.6	0	0.0	34.88
NOV	23	21	4	19.0	3	14.3	5	23.8	4	19.0	0	0.0	0	0.0	39.02
DEC	24	22	6	27.3	3	13.6	5	22.7	0	0.0	4	18.2	0	0.0	38.30
TOTAL:	358	317	97		71		48		25		14		9		
PERCENT:				30.6		22.4		15.1		7.9		4.4		2.8	43.62

**FIGURE 10. PERCENT FAILURE TO CONCEIVE PER CALVING MONTH 1987-89**



Total FTC 1987 27.0 %  
 Total FTC 1988 18.7 %  
 Total FTC 1989 14.2 %

**FIGURE 11. ACTUAL CALVING INTERVALS PER  
CALVING MONTH 1987-1989**



Av. calving interval 1987 392 days  
 Av. calving interval 1988 382 days  
 Av. calving interval 1989 382 days



1987-1989.

These incidences are listed per previous calving month due to the fact that in the majority of cases the abortion date was unknown and the event as such had only been noted from records or findings during routine veterinary fertility examinations of these cows.

The overall incidence of confirmed conceptions which terminated as abortions was 7.3% for 1987, 7.8% for 1988 and 6.1% for 1989. The incidences varied between 0.0-25.0% per previous calving month, and again no common periods of increased or reduced incidence have been found.

The managers' stated reasons for disposal of cows calved during the period from 1987-1989 are listed in table 8. and figure 13.

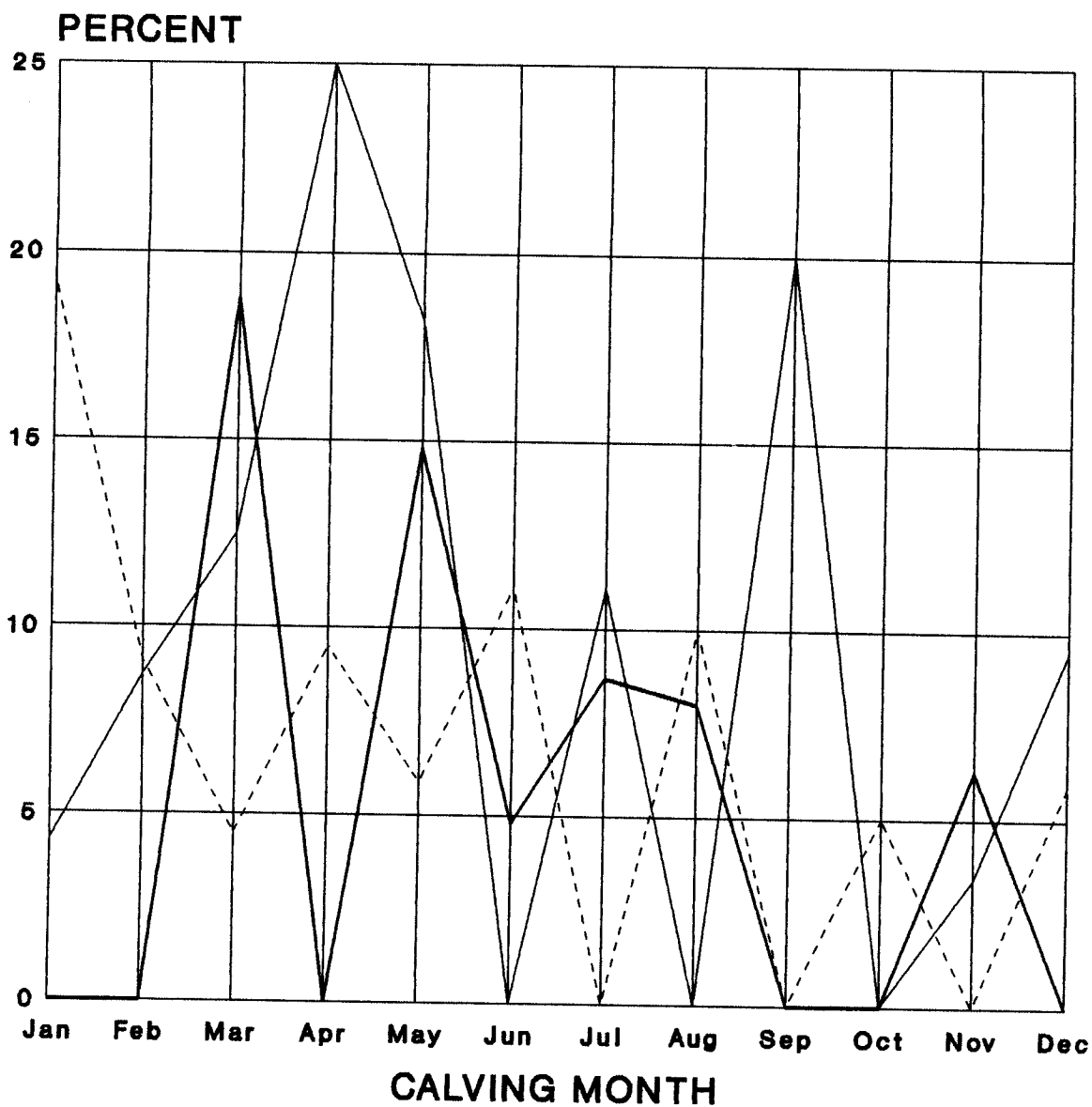
Five categories of reasons were given, and in cows which were culled for more than one reason, the main reason for disposal was used. The only noticable difference over the analysed period was disposal due to failure to conceive, which reduced from 27.0% in 1987 to 14.2% in 1989. The overall incidence of disposal regardless of reason decreased from 38.1% in 1987 to 27.7% in 1989. The culling for voluntary reasons such as udder conformation, mastitis and production remained low throughout the three year period. This was due to high culling for failure to conceive, which remained above the budgeted 10%.

The incidence of twin births out of the total of 1108 calvings for the period 1987-1989 was 31, giving 2.8% of twin births. One set of triplets was born (0.09%), of which only one male calf survived.

TABLE 7. INCIDENCE OF ABORTIONS PER PREVIOUS CALVING MONTH 1987-1989

CALVING MONTH	1987			1988			1989		
	CONCEIVED N	ABORTED N	PERCENT %	CONCEIVED N	ABORTED N	PERCENT %	CONCEIVED N	ABORTED N	PERCENT %
JAN	26	5	19.2	23	1	4.3	23	0	0.0
FEB	22	2	9.1	23	2	8.7	21	0	0.0
MAR	22	1	4.5	16	2	12.5	32	6	18.8
APR	21	2	9.5	12	3	25.0	14	0	0.0
MAY	17	1	5.9	11	2	18.2	27	4	14.8
JUN	18	2	11.1	17	0	0.0	21	1	4.8
JUL	14	0	0.0	36	4	11.1	23	2	8.7
AUG	20	2	10.0	25	0	0.0	25	2	8.0
SEP	25	0	0.0	15	3	20.0	29	0	0.0
OCT	20	1	5.0	30	0	0.0	15	0	0.0
NOV	10	0	0.0	29	1	3.4	16	1	6.3
DEC	17	1	5.9	21	2	9.5	18	0	0.0
TOTAL:	232	17	7.3	258	20	7.8	264	16	6.1

**FIGURE 12. ABORTIONS PER PREVIOUS  
CALVING MONTH 1987-1989**



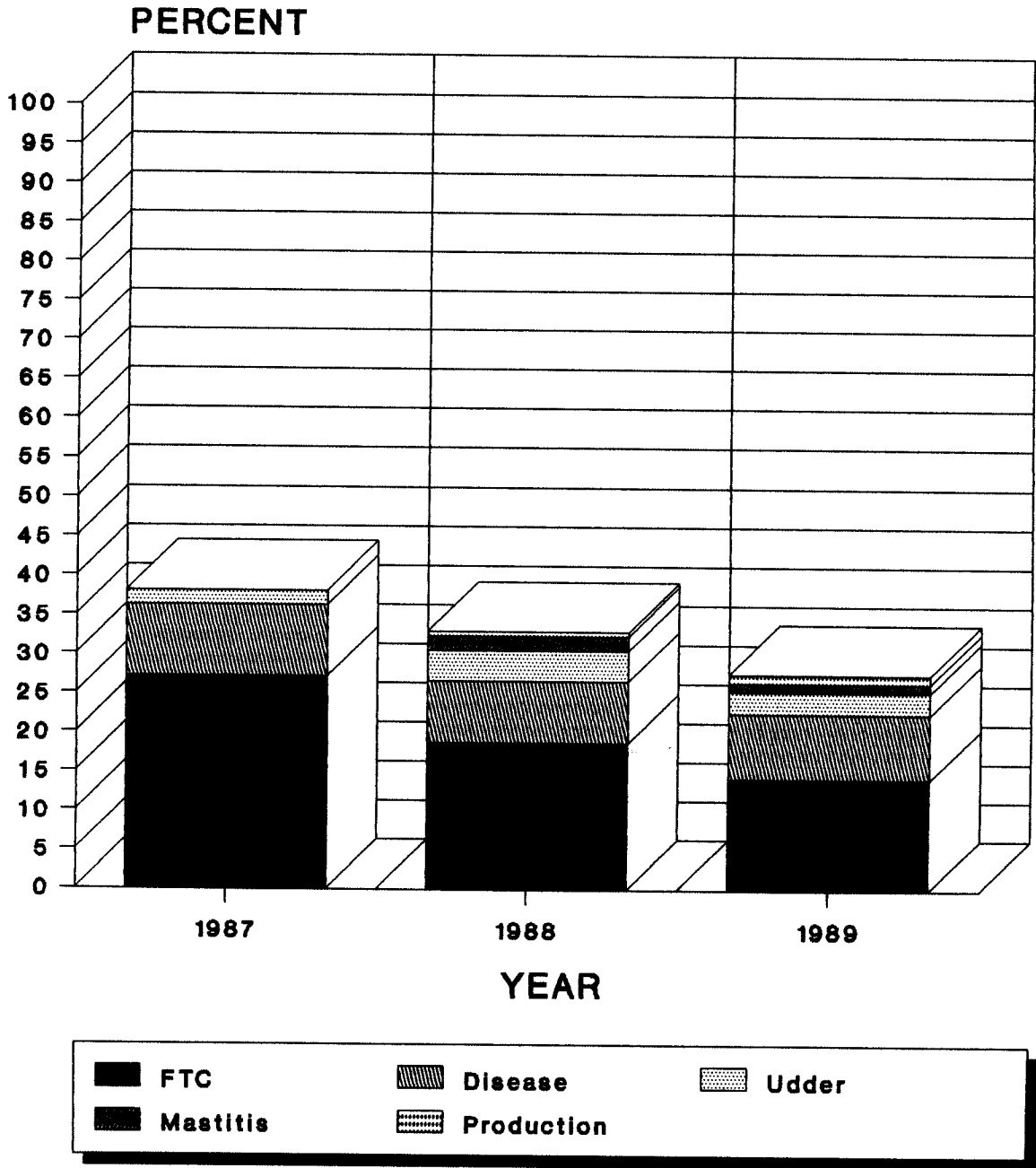
----- 1987    — 1988    — 1989

Total abortions 1987 7.3%  
 Total abortions 1988 7.8%  
 Total abortions 1989 6.1%

TABLE 8. MANAGERS REASON FOR DISPOSAL OF DAIRY COWS PER ANNUM 1987-1989

REASON	1987		1988		1989	
	N	%	N	%	N	%
FAILURE TO CONCEIVE	100	27.0	71	18.7	51	14.2
DISEASE	34	9.2	30	7.9	30	8.4
UDDER CONFIRMATION	7	1.9	15	3.9	10	2.8
MASTITIS	0	0.0	7	1.8	4	1.1
PRODUCTION	0	0.0	2	0.5	4	1.1
TOTAL:	141	38.1	125	32.9	99	27.7
TOTAL COWS:	370		380		358	
PERCENT CULLED:	38.1		32.9		27.7	

**FIGURE 13. MANAGERS REASON FOR DISPOSAL  
OF COWS CALVED DURING 1987-1989**



Total culled 1987 38.1%  
Total culled 1988 32.9%  
Total culled 1989 27.6%

The ratio of male and female calves born over the recorded three year period is given below. The overall incidence is in favour of male calves (51.67%), while the variations within the three years were as follows:

Year	Male	Percent	Female	Percent
1987	203	53.70	175	46.30
1988	193	49.49	197	50.51
1989	193	51.88	179	48.11
<b>Total:</b>	<b>589</b>	<b>51.67</b>	<b>551</b>	<b>48.33</b>

The variations between years are considerable with a range of 46.30% to 50.51% (4.21%) of female calves born per year, but this would most likely even out if more years were analysed.

### 3.1.2. CULL COW RECORDS

The analysis of records of cows culled during 1990 included the number of lactations prior to culling, the number of services per cow, lengths of interservice intervals prior to culling and the managers' stated reason for disposal.

The average number of lactations prior to culling for the 73 cows culled during the year was 2.5 (+/-0.2), this excluding the 6 cows slaughtered pregnant and the 4 cows with record problems:

Lactation	Culled	Percent
1	16	21.9
2	29	39.7
3	13	17.8
4	6	8.2
5	7	9.6
6	2	2.7

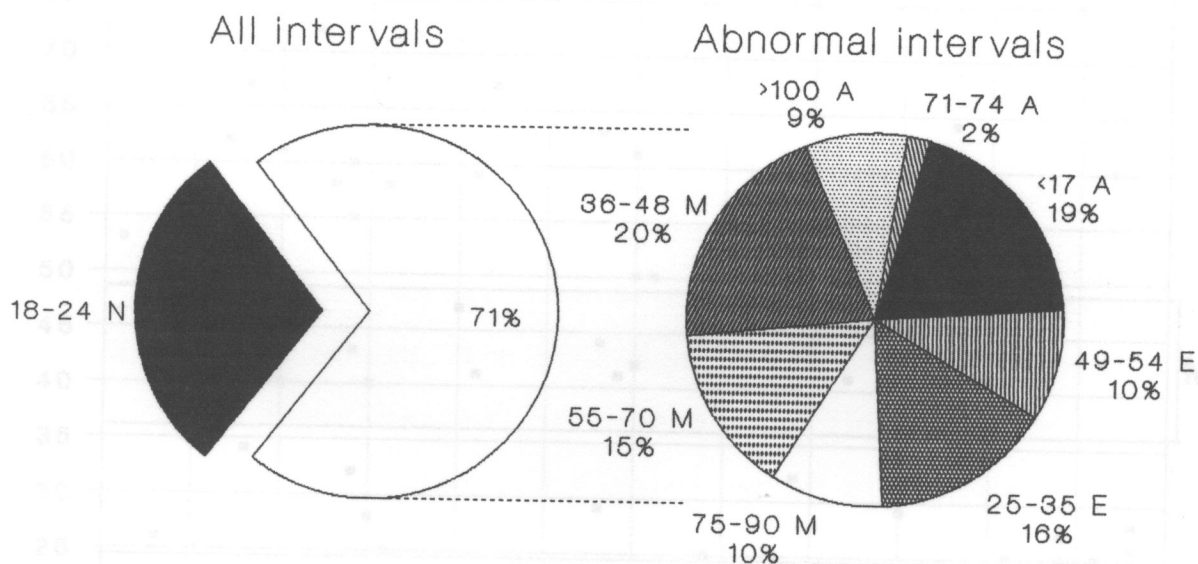
Out of the total of 73 culled cows, 58 were served and 15 not served prior to culling. 145 services were used on the 58 served cows, giving an average of 2.5 ( $\pm 0.2$ ) services per cow prior to culling.

The durations of interservice intervals in cows prior to culling are presented in figures 14. and 15.

Figure 14. shows the allocation of interservice intervals into normal and abnormal intervals and a breakdown of abnormal intervals as such, intervals which suggest embryo loss and intervals which suggest missed heats. The incidence of normal interservice intervals was 29% and abnormal intervals 71%. The breakdown of abnormal intervals shows 30% of intervals with unexplained abnormal duration, 26% intervals suggest embryo loss and 44% suggest missed heats.

Figure 15. presents the distribution of interservice intervals around an area of normal expected intervals between 18-24 days and clearly shows the wide and irregular distribution outside the expected area with extreme values ranging from 3-100 days.

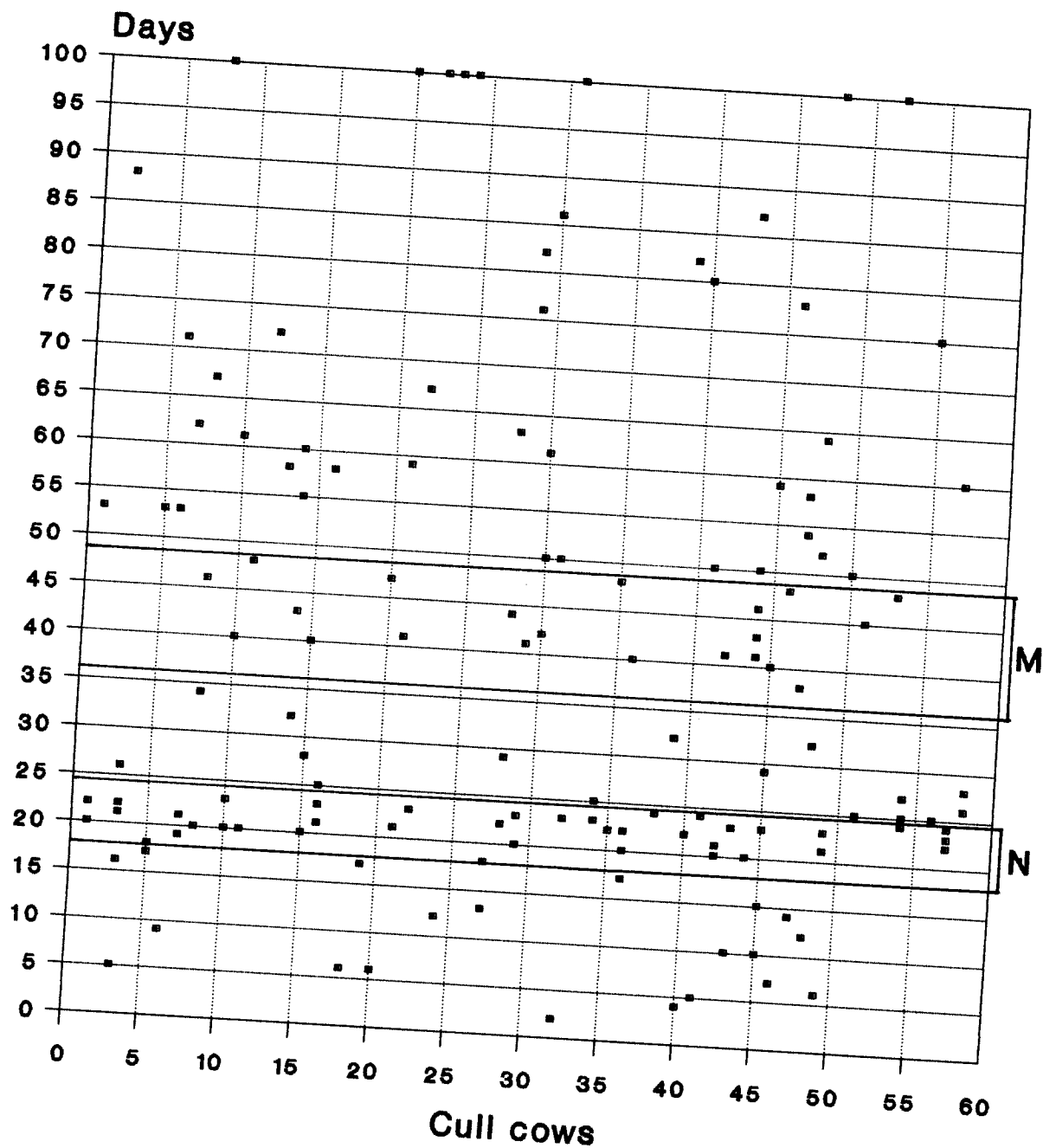
**FIGURE 14. INTERSERVICE INTERVALS IN CULLED COWS PRIOR TO CULLING**



N=normal A=abnormal  
M=missed heats E=embryo loss  
All intervals expressed in days



**FIGURE 15. DISTRIBUTION OF INTERSERVICE INTERVALS IN COWS PRIOR TO CULLING**



73 culled cows  
 58 served (6 served once only)  
 145 intervals, N=normal, M=missed heat

### 3.1.3. CULL HEIFER RECORDS

The analysis of records of heifers culled during 1990 includes the age at first service, number of services, interservice intervals and managers' stated reason for disposal.

Out of a total of 19 heifers culled during 1990, 11 were served, with an average age at first service of 17.5 ( $\pm 0.7$ ) months.

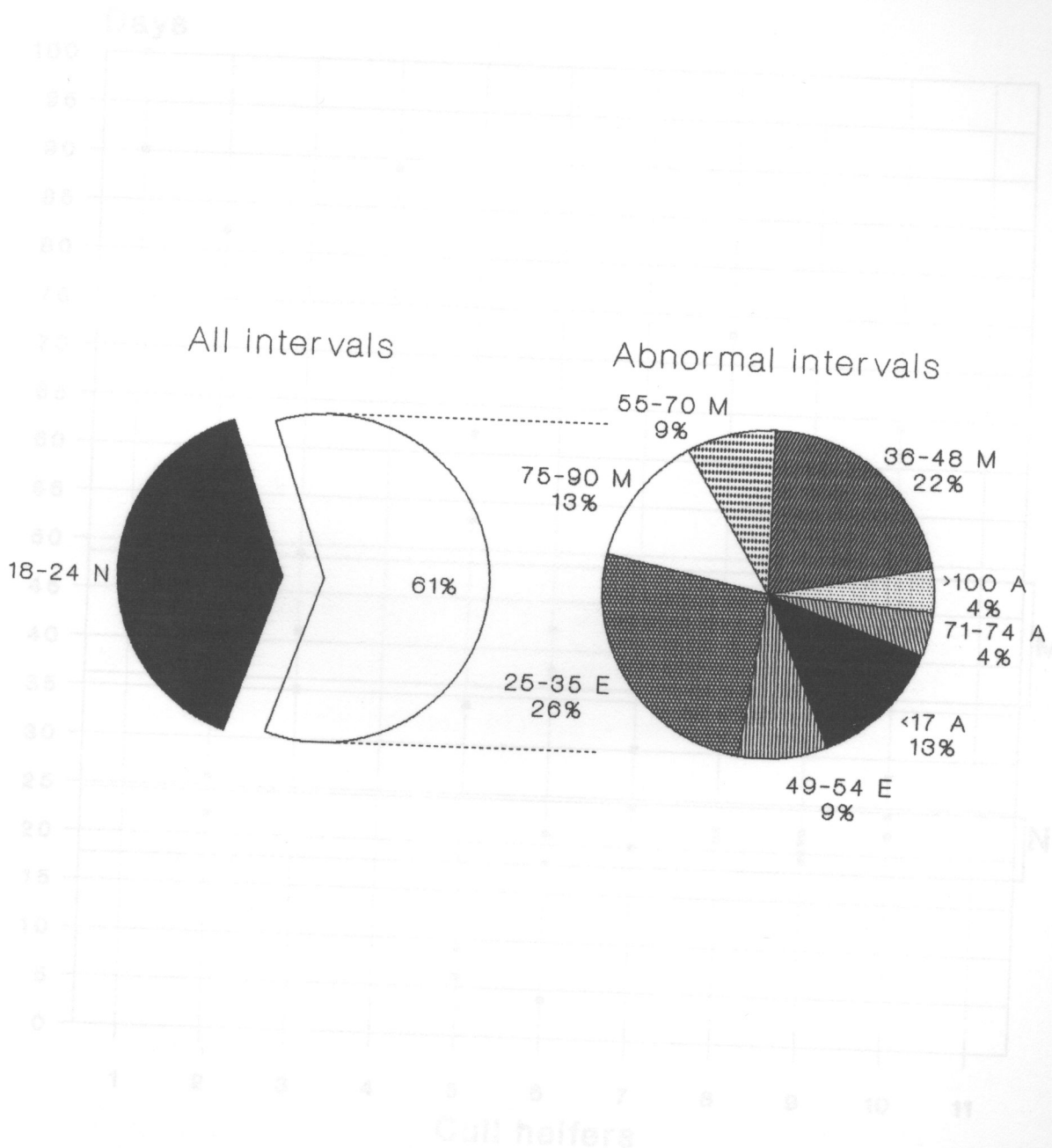
The average number of services per served heifer was 4.5 ( $\pm 0.6$ ).

The analysis of interservice intervals in served heifers is given in figure 16. and figure 17. A total of 49 services giving 38 interservice intervals are presented.

The incidence of normal interservice intervals was 39% and abnormal intervals 61%. The breakdown of abnormal intervals shows 21% of unexplained abnormal intervals, 35% intervals suggesting embryo loss and 44% intervals suggestive of missed heats.

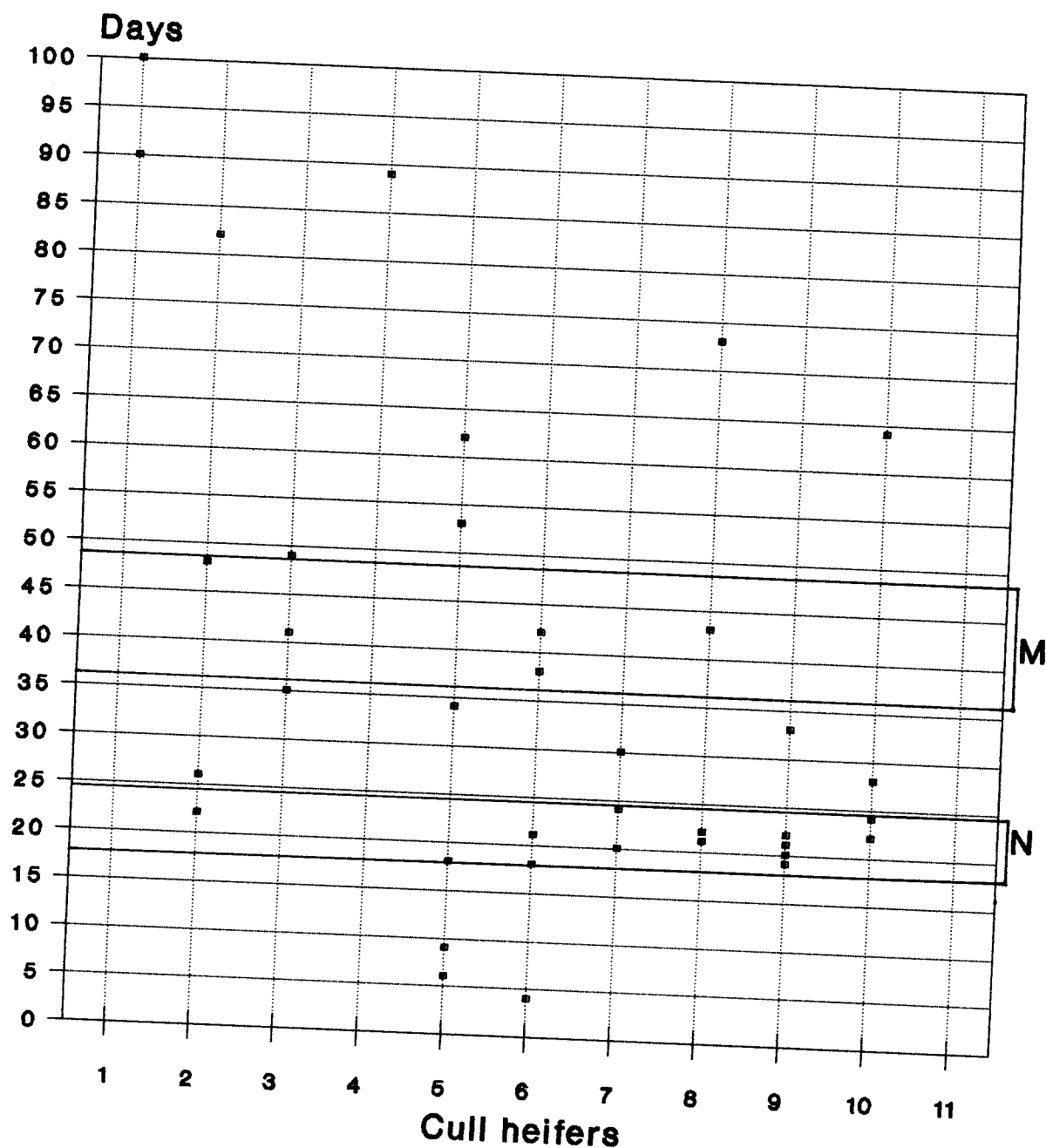
Figure 17. shows the distribution of intervals around an expected area of normal intervals of 18-24 days, and again shows a wide distribution around the target area with extreme values ranging from 4-100 days.

**FIGURE 16. INTERSERVICE INTERVALS IN CULLED HEIFERS PRIOR TO CULLING**



N=normal A=abnormal  
M=missed heats E=embryo loss  
All intervals expressed in days

**FIGURE 17. DISTRIBUTION OF INTERSERVICE INTERVALS IN HEIFERS PRIOR TO CULLING**



19 culled heifers  
 11 served (1 served once only)  
 38 intervals, N=normal, M=missed heat

#### 3.1.4. MANAGERS' REASON FOR DISPOSAL

The managers' stated reason for disposal of cows and heifers during 1990 is presented in table 9.

For cows five categories of reasons are listed, the most important one being failure to conceive (74%), followed by dropped udder (13.7%), poor production (5.5%), abortion (5.5%) and mastitis (1.4%).

For heifers, three reasons for disposal are listed, the main being failure to conceive (63.2%), followed by abortion (21.1%) and freemartinism (15.8%).

#### 3.2 POST-MORTEM FINDINGS

The macroscopic examination of each genital tract of culled cows and heifers during 1990 included the measurement of the length of the uterine horns, circumference of uterine horns and weight of the ovaries.

The findings are listed in table 10, for cows and heifers separate, and right and left uterine horns and ovaries.

Statistical analysis of the lengths and circumferences of uterine horns both in cows and heifers revealed no significant differences ( $p=0.02$ ). The analysis of the weights of ovaries revealed that in cows the weight of the right ovary is significantly greater than the left ( $p=0.05$ ), whilst in heifers the left was significantly greater than the right ( $p=0.001$ ).

TABLE 9. MANAGERS REASON FOR DISPOSAL OF BREEDING FEMALES  
EXAMINED DURING 1990

1. COWS

Reason:	Number:	Percent:
Failure to conceive	54	74.0
Dropped udder	10	13.7
Poor producer	4	5.5
Abortion	4	5.5
Mastitis	1	1.4
Total:	73	100.0

2. HEIFERS

Reason:	Number:	Percent:
Failure to conceive	12	63.2
Abortion	4	21.1
Freemartin	3	15.8
	19	100.0

Breeding females examined:	92
Cows slaughtered pregnant	6
Record problems	4
Total cows slaughtered:	102

TABLE 10. POST-MORTEM MEASUREMENTS ON CULLED COWS AND HEIFERS  
EXAMINED DURING 1990

FINDINGS IN COWS		RIGHT	LEFT
AVERAGE LENGTH OF UTERINE HORN	CM	30.45	30.19
AVERAGE CIRCUMFERENCE	CM	8.52	9.91
AVERAGE WEIGHT OF OVARIES	GR	11.81	9.98
COWS EXAMINED	73		
FINDINGS IN HEIFERS		RIGHT	LEFT
AVERAGE LENGTH OF UTERINE HORN	CM	28.86	28.50
AVERAGE CIRCUMFERENCE	CM	7.00	7.59
AVERAGE WEIGHT OF OVARIES	GR	9.44	10.11
HEIFERS EXAMINED	19		

### 3.2.1. MACROSCOPIC FINDINGS IN CULL COWS

Macroscopic findings in 73 cull cows examined during 1990 are listed in table 11.

The findings are divided between findings on the uterus including the body and both horns, the fallopian tubes and the ovaries, each of them separate for the right and left side.

Out of the 73 cull cow tracts examined, only 3 (4.1%) revealed pathological lesions on the uterus, namely one case of endometritis, one perimetritis and one abscess in the wall of the uterine body.

From the 146 fallopian tubes examined for macroscopic lesions, 1 (0.68%) was occluded, 2 (1.37%) showed hydrosalpinx and 2 (1.37%) adhesions, giving a total of 3.42% fallopian tubes with macroscopically visible pathological lesions.

The findings of structures and pathological lesions on the ovaries are presented for right and left ovaries separate, as well as the total incidence in the 146 ovaries examined.

The total incidence of pathological lesions which include single follicular cysts, multiple follicular cysts, luteal cysts, bursal adhesions and inactivity was 16.4% for right ovaries, 15.1% for left ovaries and 15.7% for all ovaries.

There is a marked difference between the incidence of follicular cysts, including both single and multiple follicular cysts, in the right and left ovary, the total incidence being 10.96% on the right ovary, versus only 4.11% on the left ovary. The number of cases of bursal adhesions and luteal cysts was low with only one of each on the right ovary, and none on the left.



Inactivity is again present with a marked difference, with two cases (2.74%) on the right ovary and 8 cases (10.96%) on the left ovary.

The most frequent pathological finding on all ovaries, regardless of the side, is inactivity (6.85%) followed by multiple follicular cysts (4.79%), single follicular cysts (2.74%), luteal cysts (0.68%) and bursal adhesions (0.68%).

### 3.2.2. MACROSCOPIC FINDINGS IN CULL HEIFERS

Macroscopic findings in genital tracts of 19 culled heifers examined during 1990 are listed in table 12. These are again listed separately for the uterine body, uterine horns, fallopian tubes and ovaries, right and left side.

On uterine bodies three cases of abnormalities were found, due to freemartinism (15.79%). One case of bilateral segmental aplasia of the uterine horns was observed (5.26%). All other uterine bodies appeared normal. This gives a total of 4 (21.1%) cases with hereditary disorders.

On examination of fallopian tubes, two cases of unilateral obstruction were observed (5.26%), one case of bilateral adhesions of tubes to the uterine horn (5.26%) and three cases with deformities of tubes due to freemartinism (15.79%).

Pathological findings on 38 ovaries examined included multiple follicular cysts, bursal adhesions and inactivity. Multiple follicular cysts were found on 5 ovaries (2 right and 3 left) giving a total incidence of 13.16%. Unilateral bursal adhesions were observed on one left ovary (5.26%) and inactivity on 2 right

TABLE 11. MACROSCOPIC FINDINGS ON CULLED COWS EXAMINED DURING 1990

UTERUS	BODY	PERCENT	R/HORN	PERCENT	L/HORN	PERCENT
NORMAL	64	87.67	62	84.93	58	79.45
OESTRAL MUCUS	6	8.22	9	12.33	11	15.07
HAEMORRHAGIC MUCOSA	0	0.00	0	0.00	2	2.74
ENDOMETRITIS	1	1.37	1	1.37	1	1.37
PERIMETRITIS	1	1.37	1	1.37	1	1.37
ABSCCESS IN UTERINE WALL	1	1.37	0	0.00	0	0.00
TOTAL:	73	100.00	73	100.00	73	100.00

FALLOPIAN TUBES	RIGHT	PERCENT	LEFT	PERCENT	TOTAL	PERCENT
NORMAL	71	97.26	70	95.89	141	96.58
OCCLUDED	0	0.00	1	1.37	1	0.68
HYDROSALPINX	1	1.37	1	1.37	2	1.37
ADHESIONS	1	1.37	1	1.37	2	1.37
TOTAL:	73	100.00	73	100.00	146	3.42

OVARIES	RIGHT	PERCENT	LEFT	PERCENT	TOTAL	PERCENT
GRAAFIAN FOLLICLE	8	10.96	11	15.07	19	13.01
RIPENING TERTIARY FOLLICLES	27	36.99	31	42.47	58	39.73
OVULATION SITE	1	1.37	0	0.00	1	0.68
SINGLE FOLLICULAR CYST	3	4.11	1	1.37	4	2.74
MULTIPLE FOLLICULAR CYSTS	5	6.85	2	2.74	7	4.79
CORPUS LUTEUM HAEMORRHAGICUM	10	13.70	6	8.22	16	10.96
MATURE CORPUS LUTEUM	10	13.70	7	9.59	17	11.64
REGRESSING CORPUS LUTEUM	16	21.92	13	17.81	29	19.86
CYSTIC CORPUS LUTEUM	6	8.22	6	8.22	12	8.22
LUTEAL CYST	1	1.37	0	0.00	1	0.68
BURSAL ADHESIONS	1	1.37	0	0.00	1	0.68
INACTIVE	2	2.74	8	10.96	10	6.85
TOTAL:	73		73		146	

TABLE 12. MACROSCOPIC FINDINGS ON CULLED HEIFERS EXAMINED DURING 1990

UTERUS	BODY	PERCENT	R/HORN	PERCENT	L/HORN	PERCENT
NORMAL	15	78.95	13	68.42	12	63.16
OESTRAL MUCUS	1	5.26	1	5.26	2	10.53
HAEMORRHAGIC MUCOSA	0	0.00	0	0.00	1	5.26
SEGMENTAL APLASIA	0	0.00	1	5.26	1	5.26
FREEMARTIN	3	15.79	3	15.79	3	15.79
ABNORMAL CONTENT	0	0.00	1	5.26	0	0.00
TOTAL:	19	100.00	19	100.00	19	100.00

FALLOPIAN TUBES	RIGHT	PERCENT	LEFT	PERCENT	TOTAL	PERCENT
NORMAL	14	73.68	14	73.68	28	73.68
OCCLUDED	1	5.26	1	5.26	2	5.26
FREEMARTIN	3	15.79	3	15.79	6	15.79
ADHESIONS	1	5.26	1	5.26	2	5.26
TOTAL:	19	100.00	19	100.00	38	100.00

OVARIES	RIGHT	PERCENT	LEFT	PERCENT	TOTAL	PERCENT
GRAAFIAN FOLLICLE	3	15.79	3	15.79	6	15.79
RIPENING TERTIARY FOLLICLES	6	31.58	4	21.05	10	26.32
MULTIPLE FOLLICULAR CYSTS	2	10.53	3	15.79	5	13.16
CORPUS LUTEUM HAEMORRHAGICUM	1	5.26	0	0.00	1	2.63
MATURE CORPUS LUTEUM	0	0.00	3	15.79	3	7.89
REGRESSING CORPUS LUTEUM	2	10.53	4	21.05	6	15.79
CYSTIC CORPUS LUTEUM	3	15.79	1	5.26	4	10.53
BURSAL ADHESIONS	0	0.00	1	5.26	1	2.63
INACTIVE	2	10.53	0	0.00	2	5.26
TOTAL:	19		19		38	

ovaries (10.53%).

### 3.3. HISTOPATHOLOGICAL FINDINGS

Histopathological examinations were performed on 74 uterine samples from culled cows of which one sample was taken from 53 cows (71.6%) and two samples from 21 cows (28.4%), giving a total of 95 sections.

The examination of sections included the following:

- |                        |                              |
|------------------------|------------------------------|
| 1. Epithelium          | - type                       |
| 2. Cell infiltration   | - type and intensity         |
| 3. Neutrophils         | - presence and concentration |
| 4. Eosinophils         | - presence and concentration |
| 5. Basophils           | - presence and concentration |
| 6. Lymphocytes         | - presence and concentration |
| 7. Plasma cells        | - presence and concentration |
| 8. Macrophages         | - presence and concentration |
| 9. Glandular secretion | - activity                   |
| 10. Presence of debris | - presence and location      |
| 11. Endometrial oedema | - presence and intensity     |
| 12. Haemorrhage        | - presence and intensity     |
| 13. Stratum musculare  | - abnormalities              |
| 14. Stratum serosum    | - abnormalities              |

No significant histopathological findings were observed in any of the examined sections including the section of apparently normal uterine tissue from the cow which had a large abscess in

the uterine wall and from which *Actinomyces pyogenes* was isolated and the second cow with the same bacteriological isolate but in which no gross changes were observed.

#### 3.4. BACTERIOLOGICAL FINDINGS

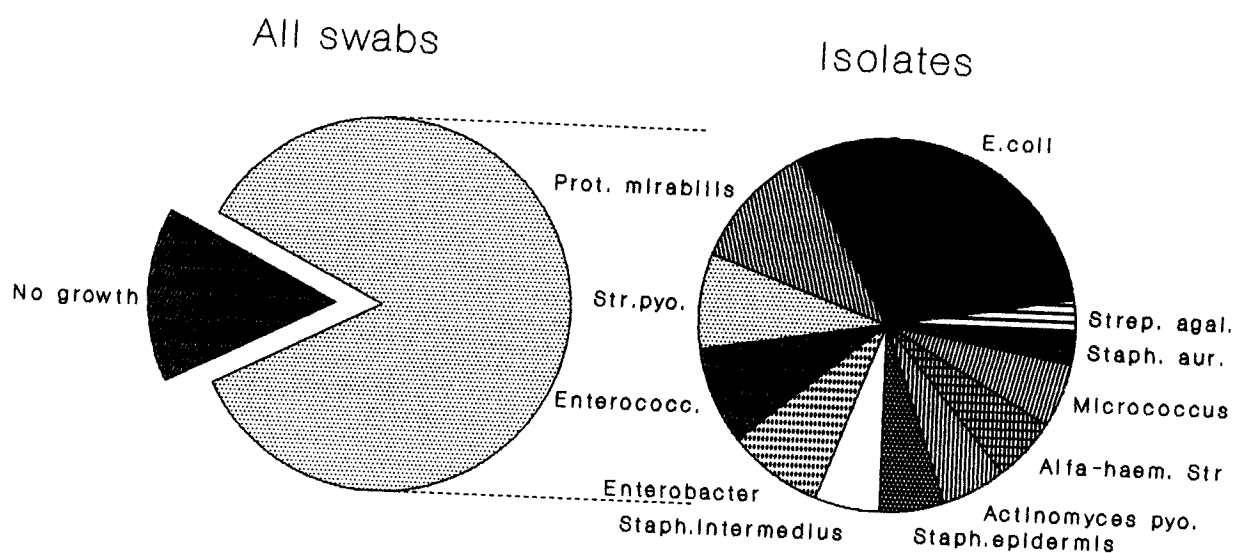
The bacteriological findings from uterine swabs collected from 33 culled cows are presented in table 14. and figure 18.

Out of the total of 33 samples 28 (84.8%) yielded bacterial cultures, of which 20 (60.6%) were single isolates and 8 (24.2%) mixed isolates. Five swabs (15.2%) gave no growth. The most frequent isolate was *Escherichia coli* (26.8%), followed by *Proteus mirabilis* (9.8%) and other isolates, including two cases of *Actinomyces pyogenes*, as listed.

TABLE 13. BACTERIOLOGICAL RESULTS FROM UTERINE SWABS FROM CULLED COWS  
EXAMINED DURING 1990

Cow No.:	Isolate 1:	Isolate 2:	Frequency:	Number:	Percent:
ZB 22	Actinomyces pyo.	E.coli	E.coli	11	26.8
YB 44	Proteus mirabilis	-	Proteus mirabilis	4	9.8
YB 72	Staph.intermedius	-	Strep.pyogenes	3	7.3
YB 88	E.coli	-	Enterococcus	3	7.3
YB 131	E.coli	-	Enterobacter	3	7.3
YC 137	No growth	-	Staph.intermedius	2	4.9
YC 142	No growth	-	Staph.epidermis	2	4.9
YT 161	No growth	-	Actinomyces pyo.	2	4.9
YC 190	E.coli	-	Alfa-haem.Strep.	2	4.9
ZC 216	Staph.aureus	-	Micrococcus	2	4.9
YC 242	No growth	-	Staph.aureus	1	2.4
YC 305	Strep. agalactiae	-	Strep.agalactiae	1	2.4
TW 346	Strep.pyogenes	E.coli	No growth	5	12.2
YT 383	Actinomyces pyo.	-	Total:	41	100
YW 424	Proteus mirabilis	-			
YW 432	Alfa-heam. Strepto.	-			
ZT 452	Strep.pyogenes	E.coli			
ZU 465	Staph.intermedius	-			
ZU 476	Proteus mirabilis	-			
ZU 540	Enterococcus	E.coli			
ZX 558	E.coli	-			
YT 572	Proteus mirabilis	-			
YX 616	Alfa-heam. Strepto.	-			
YX 617	Enterobacter	-			
ZT 658	Strep.pyogenes	Micrococc.	Summary:	Number:	Percent:
YX 712	Enterococcus	-	No isolates:	5	15.2
YA 827	Micrococcus	-	Single isolates:	20	60.6
GA 864	Enterococcus	E.coli	Mixed isolates:	8	24.2
YA 898	No growth	-	Total samples:	33	100.0
YA 914	Staph.epidermis	-			
ZB 990	Enterobacter	E.coli			
ZC 202	Enterobacter	E.coli			
YC 222	Staph.epidermis	-			

**FIGURE 18. BACTERIOLOGICAL ISOLATES  
FROM UTERINE SWABS FROM 33 CULLED COWS**



No isolates	5
Single Isolates	20
Mixed isolates	8

## CHAPTER FOUR

### DISCUSSION



An attempt will be made in this Chapter to correlate facts from the previous Chapter to the findings in the Literature and compile a list of measures to improve the reproductive performance of the herd under investigation.

## **Herd records**

The examination of fertility records of this dairy, which employs a double system of manual and computerised records revealed that the manual life-time cow cards were far more reliable than the computerised parallel records. Input of incorrect data into the computer programme, or complete absence of data which should be entered regularly according to a laid out schedule for the farm record office, made the data available unreliable and meaningless. Although the computerised recording system has been in use for almost three years, no summarised output sheets such as action reminder lists were actually used, but all information required for lists such as cows due for pregnancy diagnosis, service after calving, drying off, steaming up and changing of production groups were extracted from manual records due to the fact that the staff on the dairy itself did not have the confidence to rely on the computerised output. In the case of computerised records one tends to accept them completely or reject them; on the other hand, when dealing with manual records, although mistakes might be found, one would try to rectify them in conjunction with other available records, such as pregnancy diagnosis result lists, daily insemination sheets, routine fertility examination result lists,

etc.

Although corrections could be made with computerised records, and is strongly advocated on this dairy, there seems to be a psychological factor involved which tends to satisfy the dairy staff more when manual records are handled. It is wasteful and counterproductive to allow this situation to continue on a dairy farm of this size, as the described computer programme will produce meaningful, productive and reliable output, provided the input problem is resolved. This is of special importance in view of the size of the dairy herd. Blowey (1984) clearly stated that the evaluation of records and the obtaining of relevant figures by means of manual records is almost impossible when the herd size approached 150-200 animals.

This situation implies a serious problem with the level of management on this dairy, which will later be revealed for other problems as well. The dairy has in the last six years been managed by nine different managers, denying it a continuous stable management level which is so vital for the successful running of a dairy herd of this size and for the success of veterinary therapeutic and preventative measures.

The analysis of herd records for the period from 1987 to 1989 included all major fertility indices in use to determine the reproductive efficiency of a given herd.

The **actual calving intervals** were 392, 382 and 382 days for 1987, 1988 and 1989 respectively. This is in sharp contrast to the figure of 424 days given by Igboeli (1973b) for six investigated Zambian dairy herds. Muys (1989) in an unpublished report on the reproductive performance of eight commercial dairy

herds in the Mazabuka district recorded an average calving interval of 393 days. Vandeplassche (1982) reported that in the tropics a calving interval of 13 months is acceptable and in some instances even desirable. The given results for this herd are well within these limits and this shows that the herd has a good reproductive potential.

No other reports on the reproductive performance of commercial dairy herds in Zambia are available, and the two reports mentioned do not include all indices covered in this study. It is therefore difficult to draw any more comparisons for local conditions. The study by Bessell and Daplyn (1976) included some indices such as calving intervals, conception rates and abortion rates, but it was stated that they had great difficulties in obtaining relevant information. Unfortunately, the Israel Cattle Breeders' Association annual reports on production and reproduction do not include calving interval values for their herds.

The other recorded indices over the analysed period will be summarised again for ease of comparison and explanation:

		1987	1988	1989
1. Conceived post partum	(%)	62.7	67.9	73.7
2. Services per conception	(n)	3.4	3.0	3.1
3. Calving to 1st service (days)		73	61	64
4. 1st service to conc. (days)		43	47	54
5. Calving to conception (days)		116	108	118
6. Failure to conceive	(%)	27.0	18.7	14.2
7. Culled for other reasons	(%)	11.1	14.2	13.4

8. Total disposal rate	(%)	38.1	32.9	27.6
9. Abortion rate	(%)	7.3	7.8	6.1

Whilst some indices show significant improvements for the recorded period during which a fertility control programme was implemented, although not backed-up by the necessary management, others show no improvement.

The number of **cows that conceived again** after the previous calving has substantially increased from 62.7% to 73.7%, the **incidence of failure to conceive** and therefore culled for fertility reasons reduced from 27.0% to 14.2% and therefore remained still high compared to the target figure of <10% given by Blood and Radostits (1985).

This improvement is attributed to the fertility control programme which was implemented on this farm during the period of this investigation.

The **number of services per conception**, which include services used on cows which failed to conceive, remained very high at 3.1-3.4, as compared to the target figure of <1.5 given by Blood and Radostits (1989) and 1.7 given by Vandeplasseche (1982) for developing countries. Igboeli (1973b) recorded an average of 3.8 services per conception for dairy herds in Zambia. The cause of this will be discussed with the findings from cull cow and cull heifer records, and is assumed to be due to poor heat detection and timing of insemination, as concluded from the analysis of interservice intervals in cull cows and heifers.

The **calving to first service intervals** have shortened slightly and the **first service to conception periods** increased, and

therefore the **calving to conception periods** increased. This is not reflected in the actual calving intervals which have decreased by 10 days during the recorded three year period. This may be due to the fact that analysis of calving to first service and first service to conception intervals also included cows which conceived but did not carry out their pregnancies to term, due to abortion or disposal for reasons other than reproductive problems. The actual calving intervals are based only on completed pregnancies, therefore the discrepancy between calving to conception intervals which were 116, 108 and 118 days respectively for 1987-1989, whilst the actual calving intervals were 392, 382 and 382 days respectively.

**Culling for reasons other than reproductive failure** has slightly increased from 11.1% to 13.4%, which in the given situation is desirable, as it represents reasons such as udder conformation, mastitis and production, which should benefit the herd as a whole. The following diseases, which have been confirmed on this farm, are also included in this category: Leptospirosis, Johne's disease (Pandey et al., 1987), Bovine viral diarrhoea infection, Infectious bovine rhinotracheitis, Staphylococcal mastitis, Coliform mastitis and various types of lameness (acute and chronic laminitis, solar ulcers, pododermatitis, arthritis), the deleterious effect of these on the reproductive performance in the bovine being well documented (Toussaint Raven, 1985; Blood and Radostits, 1989).

The **total disposal percentage** for the investigated period has decreased from 38.1% in 1987 to 27.6% in 1989, this being solely due to the decrease in culling due to failure to conceive. This

is again above the target figure of 20% given by Peters and Ball (1987), but very near a desirable 25% for local conditions (Vandeplassche, 1982) which do not support longevity of dairy animals. This is due to the substantial disease challenge and difficult environmental conditions during the rainy season, although the same conditions are favourable during the rest of the year.

The **incidence of abortions** showed a slight decline from 7.3% to 6.1%, which is above the target figure of 3% given by Vandeplassche (1982) and Blood and Radostits (1989). No figures for Zambia are available in published studies. This relatively high incidence of abortions is not surprising taking into consideration the disease situation on the farm. The seasonality of the incidence of abortions has been worked out only according to the previous calving month, which is not meaningful. This is due to the fact that many abortions occurred unnoticed and were discovered only through record analysis, and the dates were therefore unknown. The same applies to the stage of pregnancy when abortion occurred. The actual causes of these abortions have not been diagnosed due to the lack of diagnostic facilities.

The **incidence of stillbirths** per annum was 6.4% for the recorded period, as compared to the 8.6% recorded by Igboeli (1973b). He found a peak of stillbirths in October and minimum in January, which was assumed to be due to the climatic and feed supply conditions, while in this study no seasonality of the incidence of stillbirths was observed. This could be explained by the feeding system on this dairy, which consists of a total diet and zero-grazing system throughout the year.

The **secondary sex ratio** for the recorded three year period was 51.67% male calves born, which coincides with the stated 51.12% by Roberts (1986a) and variations for *Bos taurus* from 48.60 to 51.10%.

The **incidence of twin births** of 2.79% was higher than the average of 1.04% as stated by Roberts (1986a). The one set of triplets recorded gives an incidence of 0.09%, as compared to 0.00014% stated in the same study. Peters and Ball (1987) stated that the incidence of twinning is generally higher in dairy cattle, and this suggests that there might be a genetic basis for the incidence of twinning. They recorded an average of 1-2% of twin births.

A substantial number of the recorded fertility indices depend on conception rates to first and all services. These will again be summarised for easier analysis:

	1987	1988	1989
1. Conception to first service(%)	30.9	29.8	30.6
2. Conception to all services (%)	48.3	49.5	43.6

As can be seen, the **conception to first service** remained extremely low throughout the three years, while the conception rate to all services decreased. The performance figures for Israel, whence this herd was imported in 1980, give an average conception to first service of 45% and conception to all services of 40% (ICBA, 1985; ICBA, 1986; ICBA, 1987a; ICBA, 1987b). These are rather low figures and are assumed to be due to

the climatic conditions and high milk yields in these cows. The target figures for conception to first service as given by Blood and Radostits (1989) are 70% for first service and 58% for all services in temperate regions. This poor performance can again be attributed to heat detection problems which will necessarily result in poor timing of insemination.

The managers' stated reasons for disposal of cows have changed considerably with regards to culling due to failure to conceive, followed by disease which remained stagnant but in high proportion:

		1987	1988	1989
1. Failure to conceive	(%)	27.0	18.7	14.2
2. Disease	(%)	9.2	7.9	8.4
3. Udder conformation	(%)	1.9	3.9	2.8
4. Mastitis	(%)	0.0	1.8	1.1
5. Production	(%)	0.0	0.5	1.1

Again the only comparisons for Zambian conditions can be made with the study by Igboeli (1973a) who recorded an annual average of 13.62% total disposal of dairy cows. This was an overall low disposal rate and the main reason for disposal was reproductive failure which accounted for 20% of all disposals. This is not very indicative of the overall incidence of reproductive failure as 48% of disposals were due to the actual death of the animal which were mainly due to old age, accidents, snake bites, tick-borne and other diseases. In this herd the incidence of disposal due to disease calculated as a percentage of total disposal is also high with values of 24.15% (1987), 24.01% (1988) and 30.43% (1989).



It is important to describe the environmental conditions on the investigated farm at this point, as they adversely affect both reproduction and production. The farm has been operating over 10 years, and is situated on a low lying area with very poor possibilities for drainage of paddocks during the rainy season. This is again reflected in the poor availability and quality of the available grazing. Conditions in paddocks, sheds and handling areas become so poor during the rainy season, that there are areas impassable by animals or farm machinery during that period.

The effect of these conditions on the disease situation is also of paramount importance. Contamination of paddocks during many years of use without rotation or rest periods leads to conditions in favour of build-up of contamination with disease-causing agents, and are very favourable for the spread of the same. The disease situation has been described previously.

An important object to the investigation of the breeding performance of this herd was to determine if there is any **influence of the season on the reproductive performance** of dairy cows in Zambian conditions.

Past practical experiences by the author showed improved reproductive performance during the dry and cool winter period which lasts from April to July, and this was expected to be confirmed by the analysis of performance records.

Analysed indices such as **calvings per month, calving to first service intervals, first service to conception intervals, calving to conception intervals, percent conception after previous calving, failure to conceive, calving intervals and incidence of abortions** per previous calving month showed no

coinciding periods over the three years analysed, but varied widely throughout each year.

It is interesting to note that the only noticeable difference for the analysed indices was that the highest **conception rate to first service** for all three years occurred for May calvings.

This situation of no clear and well defined season of improved reproductive performance during the year which would be supported by more than one positive indicator is assumed to be due to the multiple factors involved in determining the same. If there were more stable management, better available infrastructure and environment control, it is very likely that this performance improvement would be far more distinct and substantiated by more objective indices.

Igboeli (1973b) reported a peak incidence of calvings from June to October, indicating peak conception periods during the rainy season, which does not compare with the findings of this study. The same applies to calving intervals, which he reported to be shortest for August and September calvings.

Taking into consideration the relatively poor reproductive performance with regards to conception rates for the rest of the year, a substantial improvement in other indices could be expected if the majority of the herd would calve during May, which represents the beginning of winter in Zambia, when ambient temperatures drop to an average of 8.9 degrees Celsius from 27 degrees and humidity drops to 59% from 89% during the preceeding rainy season. The month of May is also well into the dry season which ends around March, when environmental problems such as muddy conditions on the farm have improved, reducing stress on

the animals.

### **Cull cow records**

The analysis of fertility records and indices of cows and heifers culled during a one year period during 1990 was expected to highlight the reasons for disposal of the animals from records. Here again, computer records failed to assist this investigation, as no printouts of historical records of cull cows and heifers were filed. The computer programme automatically erases records of animals which leave the herd, regardless of the exit reason. It was therefore necessary to print out complete historical records of these cows prior to declaring them exits from the herd, which was not adhered to. All data were therefore extracted from the cull cows' manual life-time records.

The analysis of the **length of interservice intervals** in cows prior to culling revealed a very low incidence of only 29% of intervals of normal length of 18-24 days. Igboeli (1973b) reported an even worse incidence of only 18% of interservice intervals of one cycle length. The remaining 71% of intervals were split into abnormal (30%), suggested missed heats (44%) and presumed embryo loss (26%). These findings point towards a situation of very poor heat detection, this being substantiated by the results of post-mortem, histopathological and bacteriological examinations, which did not reveal any significant pathological findings which would be responsible for the reproductive failure of the examined cows.

The **average number of services** per cow prior to culling was 2.5 ( $\pm 0.2$ ) and a range of 1-6, which is less than the average number of services per conception for cows which conceived over the last three years analysed. This clearly indicates that the cull cows were less frequently observed on heat and served, and had therefore less chances for conception. The time factor was then the deciding factor for culling of these cows as they dried off prior to having had a chance to conceive. This is due to the high incidence of long interservice intervals. These were caused either by missed heats (44%) or presumed embryo loss (26%). Service of cows not in true oestrus (19% had intervals  $< 17$  days) also represents a significant problem. The rest of intervals was covered by extremely long intervals (11%  $> 100$  days). This breakdown points to a situation of very poor heat detection, especially in view of the fact that the incidence of inactivity on the examined ovaries was low (2.7% for right ovaries and 11% for left ovaries).

The high incidence of presumed embryo loss (26% of all abnormal intervals) warrants more a more detailed investigation of this problem.

The **average number of lactations** prior to culling was also very low at 2.5 ( $\pm 0.2$ ) and a range of 1-6, while Igboeli (1973a) reported an average of 3.4 lactations prior to culling. These cows had therefore not reached their productive peak which should occur during the third and fourth lactation, when a dairy cow will start giving a return on the investment necessary to bring her to this stage.

This high incidence of culling during the second lactation

(39.7%) is assumed to be due to the fact that there is severe competition during the second lactation between production and fertility (Peters and Ball, 1987), as the production during the second lactation is significantly higher compared to the first.

The managers' most frequently stated **reason for disposal** of these cows was failure to conceive (74%). This is in sharp contrast with the recommended level of 33% of total disposal due to reproductive failure (Peters and Ball, 1987), and the figure of 20% given by Igboeli (1973a). This is again assumed to be due to poor heat detection, as the performance of the rest of the herd indicates that they have a good reproductive potential.

#### **Cull heifer records**

The analysis of records of cull heifers during 1990 included records of 19 heifers. These were analysed with regards to age at first service, number of services prior to culling, length of interservice intervals prior to culling and managers' stated reason for disposal.

The **average age at first service** was 17.5 ( $\pm 0.7$ ) months, which seems late for the type of animals bred on this dairy. The policy on the farm is to breed heifers at 15 months of age and 350 kgs liveweight. Both these conditions had to be met prior to service. The Israeli-Holsteins are easily capable to meet both these indicators at the same time.

The **average number of services** prior to culling was very high at 4.5 ( $\pm 0.6$ ) services per heifer. The average number of

services per conception in other heifers on the farm is 1.8. This indicates slack monitoring of heifer performance by the management, as heifers should be culled using far stricter criteria than cows with regards to age and number of services. The policy on this dairy is to cull after three services and not conceived by 20 months of age, but this is obviously not implemented.

The analysis of **interservice intervals** showed an incidence of only 39% of intervals of the expected length of 18-24 days. The remaining 61% were again split into abnormal (21%), suggested missed heats (44%) and presumed embryo loss (35%). Here again, presumed embryo loss represents a major contribution to the poor reproductive performance of the herd, and warrants more investigations.

The **managers' stated reasons for disposal** of these 19 heifers was failure to conceive in the majority of cases (63.2%), followed by abortion (21.1%) and freemartinism (15.8%). Here again, the main disposal reason was due to reproductive failure, which is unacceptable in heifers. This is assumed to be due to heat detection problems as reflected in the analysis of interservice intervals, rather than actual reproductive problems.

During the recorded period no heifers were culled due to disease problems. The quality of replacement heifers on this farm is respectable and in this group there are generally few problems encountered. This indicates a lack of fertility oriented management as the vast majority of problems in this dairy herd arise once the animals enter the active reproductive cycle.

It is appropriate to mention at this point that out of a total

of 102 slaughtered breeding females during 1990, six (5.9%) were found pregnant during post-mortem examination at various stages of pregnancy (35 days-4 months), all in cows. This occurred during one slaughter batch only, and these cows were not presented for a final pregnancy diagnosis prior to culling which is normally always done a few days prior to slaughter of culled animals.

### **Post-mortem examination of genital tracts**

The post-mortem examination of genital tracts of all cull cows and heifers was carried out in order to trace any visible disorders which could be responsible for the reproductive failure of the disposed animals.

The statistical analysis (probability) of the measurement of the length and circumference of the right and left uterine horns in culled cows revealed no significant difference ( $p=0.02$ ) between the two sides, while the weight of the right ovary was significantly greater than the left ( $p=0.05$ ). This is explained by the fact that the right ovary is physiologically more active (Roberts, 1986a).

The same analysis for heifers also revealed no significant difference between the length and circumference of the right and left uterine horns ( $p=0.02$ ), whilst the weight of the left ovaries was significantly greater ( $p=0.001$ ). This is contrary to the findings in cows and might be due to the size of the sample, which comprised of only 14 pairs of ovaries, whilst the cow sample comprised of 73 pairs of ovaries. The number of mature,

regressing and cystic corpora lutea was greater on the left ovaries, which will greatly contribute to the increase in ovarian weight.

The overall incidence of macroscopic pathological lesions which might be responsible for reproductive failure in the 73 examined cows was 4.1% on uteri, 3.4% of fallopian tubes and 15.7% for ovaries. This gives a total of 23.2% of genital tracts of cows which showed macroscopical lesions. None of these occurred concurrently in the same animal. Hartigan et al. (1972b) recorded an incidence of 53% of anoestrus in 120 slaughtered non-pregnant cows, followed by 25% endometritis. Alam (1984) recorded a total incidence of 28.7% pathological findings on 2,435 examined genital tracts of dairy cows.

In the author's opinion, none of the disorders found on the uteri and fallopian tubes, which represented only 7.5% of all disorders observed, were treatable under local conditions and diagnostic facilities available, namely uterine wall abscess, chronic endometritis, perimetritis, occluded uterine tubes, hydrosalpinx and tubal adhesions. The uterine wall abscess had a typical location in the dorsal portion of the uterine body, indicating injury with an insemination pipette.

The situation with ovarian disorders seems very different, as the majority of disorders, which included single and multiple follicular cysts, luteal cysts and inactivity, except one case of bursal adhesions could have been treated successfully, had the animals been presented and treated on time. This is important as ovarian disorders, which were observed in 15.7% of tracts, represent 67.7% of all disorders found on the examined genital



tracts. This is substantiated by the authors' experience with successful treatment of the same disorders in the rest of the herd.

The incidence of disorders found in genital tracts of heifers was higher than in cows, including three cases of freemartinism, one case of bilateral segmental aplasia of the uterine horns, two cases of unilateral tubal obstruction, one case of bilateral tubal adhesions, five cases of unilateral multiple follicular cysts, one case of unilateral bursal adhesions and two cases of unilateral ovarian inactivity.

The higher incidence of follicular cysts on the right ovary and the higher incidence of inactivity on the left ovary is again explained by the fact that the right ovary is physiologically more active than the left, therefore these findings can be expected.

This gives a total of 13 animals (68.4%) of heifers with visible disorders of the genital tract. Only five animals (26.3%) showed changes which could make an animal sterile (three cases of freemartinism, one case of bilateral segmental aplasia of the uterine horns and one case of bilateral tubal adhesions). Other disorders were only unilateral on fallopian tubes and ovaries, which would still give the animal a chance to conceive eventually, e.g. ovulation occurs on the ovary on the same side where fallopian tube is functional. The five ovaries with multiple follicular cysts and two ovaries with inactivity, which all occurred unilaterally in different animals, were in the author's opinion again treatable, provided they had been presented on time and treated accordingly. This gives a total of

36.8% of treatable conditions, which would reduce the culling of heifers from 19 to 12, or by 37%.

### Histopathological examination of uterine sections

Histopathological examination of 95 sections from 74 cows revealed no pathological findings, including the cows from which *Actinomyces pyogenes* was isolated. *Actinomyces pyogenes* is regarded to be a specific pathogen for the uterus (Roberts, 1986a).

The examination of slides was carried out in a sequence which is described under materials and methods to ensure that all indices were covered on all sections. All indices were scored subjectively, and scores adjusted during several examinations of all slides, as initial comparisons were important in order to score the findings as fairly as possible during subsequent examinations.

The high incidence of positive cultures and no pathological findings on histopathological sections confirm the statements of Hartigan et al. (1972b), who found no correlation between uterine infection and histopathological findings. The same conclusion was made by Williams et al. (1988) during similar investigations.

These findings could be explained by the enormous potential of the local defense mechanisms available in the uterine tissue post partum. Up to 100% of cows acquire uterine infections up to day 15 post partum, which declines to 30% by day 30-40 post partum and 10-20% by day 60 post partum (Rolle and Mayr, 1966; Roberts,

1986a).

The same has been observed by the author during routine examinations of smears of uterine discharges stained with Gram stain at various stages post partum on which the active defences such as leukocyte infiltration and phagocytosis could be observed, as described by Vandeplassche (1982).

### **Bacteriological examination of uterine swabs**

The results of bacteriological examination of uterine swabs from 33 cows revealed a wide variety of isolates. 13 different identifications were made which occurred in 2.4-26.8% of samples.

The incidence of 84.8% of samples which yielded bacteria is high compared to the findings of Hartigan et al. (1972b) which had only 43% yield from 68 cultured uteri. It is accepted that the samples collected in this study might not be very representative, as the vast majority of uteri appeared normal on gross examination, and therefore only random samples were collected from approximately every third specimen.

All but two isolates (4.9%) of *Actinomyces pyogenes* are regarded as opportunistic infections (Roberts, 1986a), especially in view of the high incidence of isolates such as *Escherichia coli*, *Proteus spp.*, *Staphylococcus spp.*, *Streptococcus spp.* and other *Enterobacteria*, which are not regarded as true pathogens for the uterus (Hartigan et al., 1972b). This is substantiated by the gross findings of only one case of endometritis and one case of perimetritis.

Here again, the influence of the management level on

infectious infertility for this dairy has to be mentioned. The incidence of clinical endometritis observed during routine examinations of cows 20-40 days post-partum over the past five years, has stood at an unacceptable level of approximately 30% of all calved cows, mainly due to environmental conditions and lack of hygienic calving facilities. This has decreased to a reasonable <5% during the last year, after calving facilities with 4 loose boxes for the cows have been built. These boxes were occupied by the freshly calved cows for three days post-partum, until colostrum collection and feeding was over. These were regularly disinfected after each cow. This high incidence of prolonged postparturient endometritis must have had a significant influence on indices such as calving to first service intervals and conception rates to first service (Francos and Mayr, 1988b).

## Summary

All the above described findings will now be summarised and then an attempt will be made to draw conclusions and construct a list of recommendations in order to further improve the reproductive performance of the investigated herd.

1. The available computer programme is not used to its full potential.
2. The manual recording system is good enough for routine management activities with regards to fertility oriented operations, but fails completely to highlight problem situations and individual problem cows and heifers, as no summaries are produced from these records.

3. The level of management on this particular dairy is below standard and this is reflected in the reproductive performance of this herd.
4. The reproductive performance of cows which did conceive after the previous calving is acceptable for local conditions, although the number of services per conception is high.
5. The number of cows which fail to conceive and are therefore culled, has substantially reduced, but is still unacceptably high.
6. No statistically significant seasonal influence on the reproductive performance of dairy cows in the investigated dairy herd could be confirmed, due to the multifactorial nature of the problem. However, there is an indication for improved reproductive performance for May calvings, which should be taken into consideration when planning the breeding policy of dairy herds in Zambia.
7. The cull cow records reveal a significant problem with regards to the length of interservice intervals, indicating poor heat detection. The incidence of presumed embryo loss is high and requires further investigations.
8. The cull heifer records reveal a high number of services prior to culling and again a high incidence of abnormal lengths of interservice intervals. The incidence of presumed embryo loss is extremely high.
9. The incidence of untreatable disorders found during macroscopic examination of genital tracts of both cows and heifers is very low.
10. The histopathological examination of uterine sections

revealed no pathological changes which could be responsible for the reproductive failure of the examined cows.

11. The results of bacteriological examinations revealed no significant incidence of infectious causes of infertility.

### **Recommendations and conclusion**

It is the author's opinion that the vast majority of problems in this dairy herd can be resolved by implementing the following recommendations:

1. Improve the management level. This will improve the situation with regards to recordkeeping, environment control and timely recognition of problems.
2. Improve heat detection by further training of the heat detector personnel and the use of available aids for heat detection such as tail paint, heat mount detectors and computer printouts with projected expected heat dates for individual cows.
3. Improve on timely presentation of problem animals for veterinary examination.
4. Take into consideration the possible positive seasonal influence on reproductive performance.
5. Investigate possible reasons for the high incidence of embryo loss.

The complete examination of this herd revealed no significant pathological changes in the culled animals responsible for reproductive failure. The records reveal a lack of opportunities being given to the animals to successfully breed.

## Comment

The author is aware of several shortfalls within this study. The problems were noticed mainly during the writing of the discussion, and they present in the author's opinion an integral part of the learning process. As the compilation of this thesis was at that time in an advanced stage, it was impossible to rectify all observed shortfalls, but will be recollected during future studies.

For example, the number of first calvers per month and year has not been calculated, therefore the replacement rate could not be worked out. The normal heifer performance, such as conception rates and age at first service and calving have not been investigated for comparative purposes with cull heifers. No conclusions have been substantiated with hormonal investigations, this being due to the non-availability of facilities locally.

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**LEGEND**

## LEGEND

### Abbreviations used in tables and figures:

Actinomyces.pyo.	- Actinomyces pyogenes
Alfa-haem.Str.	- Alpha-haemolytical Streptococcus
Apr	- April
Aug	- August
Av.	- Average
Body	- Uterine body
Calv	- Calving
CI	- Calving interval
Conc	- Conception
Dec	- December
E.coli	- Escherichia coli
Enterococc.	- Enterococcus
Feb	- February
Ftc	- Failure to conceive
Jan	- January
Jun	- June
Jul	- July
L/Horn	- Left uterine horn
Mar	- March
N	- Number
Nov	- November
Oct	- October
Proj.CI	- Projected Calving interval
Prot.mirabilis	- Proteus mirabilis

R/Horn	- Right uterine horn
Sep	- September
Serv	- Service
Staph.aur.	- Staphylococcus aureus
Staph.epidermis	- Staphylococcus epidermis
Staph.intermedius	- Staphylococcus intermedius
Strep.agal.	- Streptococcus agalactiae
Str.pyo.	- Streptococcus pyogenes

