A STUDY OF THE REPRODUCTIVE EFFICIENCY OF THE OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE DAIRY HERD

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INTRODUCTION

The primitive cow produced milk to provide nourishment for her offspring. With domestication there has been a marked improvement in her inherent ability to produce milk, and a continual improvement in management techniques and feeding practices. However, the initiation of the physiological processes for the secretion of milk are still linked to reproductive processes. Also, the stimulus to secrete milk decreases as lactation proceeds, a homology of the primitive condition where the nourishment required from the mother by the offspring decreased as the offspring increased in age. To use these phenomena most efficiently, it is generally agreed by most authorities that a cow should calve every twelve months. Any factor which lengthens this calving interval will tend to decrease the efficiency of milk production, as well as the number of offspring a cow can produce. Therefore, the dairyman of today is dependent on the reproductive efficiency of his herd of cows for an efficiency of production that will give him satisfactory economic returns.

This study was made to observe some of the effects of reproductive efficiency. The data were obtained from the breeding records of the Oklahoma A. & M. College dairy herd, for the twelve year period from January 1, 1944 to January 1, 1956. These records were also analyzed to determine if the services per conception were repeatable in subsequent gestations in this herd.

Because of the complexity of the reproductive process and of the associated environmental influences, reproductive efficiency is affected by a multiplicity of factors. An attempt was made in this study to measure the effect of the following factors on the reproductive efficiency of this herd of dairy cattle: (a) year effect; (b) month effect; (c) breed effect; (d) effect of number of gestations, from first through the tenth or greater; (e) effect of known abortions; (f) effect of cow groups; (g) effect of sire-daughter groups; and (h) the length of estrous cycles following infertile service.

REVIEW OF LITERATURE

Ehlers et al. (17) studied the records of a Holstein herd over a twenty-five year period, which included 2,176 cows with 1 to 16 consecutive gestations. A total of 7,498 gestations and 19,714 services were recorded. The average number of services per conception for 2,119 first gestations was 2.76; for 1371 second gestations, 2.62; 1012 third gestations, 2.26; 805 fourth gestations, 2.31; 628 fifth gestations, 2.57; 491 sixth gestations, 2.54; 360 second gestations, 2.73; 263 eighth gestations, 3.02; 188 ninth gestations, 3.19; 117 tenth gestations, 3.02; 144 greater than tenth gestations, 3.74; and 7498 total gestations, 2.63.

The 771 cows with a single gestation averaged 2.99 services per conception; 714 cows with two consecutive gestations averaged 2.79; 614 of three gestations, 2.64; 684 of four gestations, 2.50; 712 of five gestations, 2.82; 763 of six gestations, 2.45; 663 of seven gestations, 2.59; 618 of eight gestations, 2.40; 655 of nine gestations, 2.73; 418 of ten gestations, 2.57; 888 of more than ten gestations, 2.16.

A tabulation of all calvings of 437 Holstein cows in the University of Nebraska herd in a 44 year period was made by Davis and Brost (13). The 980 calvings involved required 2,467 services averaging 2.52 services per conception. By calvings, the average services needed for each conception were as follows: first, 2.93; second, 2.40; third, 2.22; fourth, 1.89; fifth, 2.48; sixth, 2.08;

seventh, 2.38; eighth, 2.68; ninth, 3.00; tenth and subsequent calvings, 4.81.

Erb, et al. (19) studied the breeding efficiency of the Purdue University dairy herd. The twenty year study included 1440 services resulting in 922 conceptions, or an average of 1.56 services per conception. Services were not included unless the cow produced a calf while she was still in the Purdue herd.

Their data also showed that 72.1 per cent of all conceptions resulted from a single service, 18.7 per cent from the second service, 6.3 per cent from the third service, 2.3 per cent from the fourth service, and 0.65 per cent from over four services.

Lewis and Horwood (31), reported on the breeding efficiency in the Michigan State College dairy herds. The 2,889 natural services resulted in 1,368 conceptions, a rate of 2.11 services per conception.

In a study based on records of the dairy herd of the University of Nebraska for the period 1896 to 1934, Morgan and Davis (39) found that the average number of services required for conception was 2.21, or 3,041 services for 1,375 conceptions.

Inseminations performed in the Wisconsin Experimental Breeding Project from January 24 to May 31, 1945 and from August 13, 1945 to September 30, 1947 were summarized by Barrett et al. (2). Pregnancy examinations were performed, usually 35 to 49 days after insemination. An insemination was considered fertile only when an amniotic vesicle could be palpated; inseminations were considered infertile if the cow was rebred, or if she was diagnosed not pregnant. Inseminations were excluded if the cow had died, been sold, or could not be examined for

any other reason. Of 14,771 inseminations the number in each group from first to seventh service was 8621, 3463, 1443, 631, 308, 152, and 75, respectively. There were 78 inseminations with order numbers higher than seven. The corresponding percentages of inseminations classed as fertile were 54.4, 50.7, 46.5, 38.2, 36.7, 30.1, 27.7, and 16.7. The mean percentage of fertility for the entire 14,771 inseminations was 51.1.

The breeding efficiency from artificial insemination over an eight year period in the University of Nebraska dairy herd was analyzed by Trimberger and Davis (50). Each year a female was bred was defined to be one cow year. Of the 639 cow years studied, 418 represented cows and 221 represented virgin heifers.

Their results indicated that it was not possible to predict any subsequent breeding efficiency from that of the previous year for dairy females of any age. Likewise, the reproductive efficiency of a heifer or cow gave no indication as to the number of services required for the first conception or for the lifetime reproductive efficiency of her daughters. An analysis of the breeding histories for those cows sold as sterile showed that their previous breeding records gave no indication that difficult breeding would follow.

When the services required per conception were tabulated by cow families it was found that among twenty families there was one with very low fertility and two with extremely high fertility.

Analysis of the breeding records for the daughters of nineteen bulls revealed one bull with daughters that required a greater number of services per conception ($P < 0.01$) and another sire that very closely approached this level.

To study the effect of cow families on reproductive efficiency, Chance and Mather (8) analyzed Dairy Herd Improvement Association records on 1168 cows in six herds, covering periods of thirteen to twenty-one years. Groups of cows that had three or more consecutive generations with production records were designated as "families". All cows descending in the direct female line from the foundation cow were included. Records of reproductive efficiency for 882 cows in 89 families were studied by the analysis of variance. Reproductive efficiency differed significantly among families in only one herd. These data supported the contention that, under the systems of breeding common in most herds, families, as designated in this study, were not sufficiently differentiated to receive much consideration in selection.

In their study of the heritability of fertility in dairy cattle, Dunbar and Henderson (15) employed non-returns to first service and calving interval as their measures of fertility. By means of an estimation procedure which yielded unbiased estimates of components of variance in non-orthogonal data, estimates were obtained of the variance due to additive genetic differences among sires. Sire variance was essentially zero in both studies. Therefore their estimate of the heritability of fertility approached zero.

In a later study Dunbar and Henderson (16) used non-returns to first service as the measure of fertility for intra-herd data. Estimates of the repeatability of fertility were as follows: (a) 0.027 for a population of half sisters; (b) 0.051 for cows by different sires; and (c) between 0.027 and 0.051 for an average intra-herd value. The heritability for non-return to first service was

found to be 0.004 and that for calving interval was estimated to be zero.

Inchiosa and Pfau (24) analyzed the data obtained from the records of the Overbrook dairy herd of Cedar Grove, New Jersey. Breeding efficiency was measured by the average number of days in the calving interval. A total of 338 dam-daughter comparisons were involved in comparing the breeding efficiencies of the daughters of eight Holstein sires. Highly significant differences were found between the mean breeding efficiencies of the eight groups of daughters.

The correlation between the breeding efficiency of dams and daughters was calculated to be 0.203. The correlation between paternal half-sisters was found to be 0.176 and the correlation between individual reproductive cycle records of the same cow amounted to 0.135. All three were highly significant values.

Estimates of heritability gave evidence that forty-one per cent of the differences observed between the mates of a sire in regard to their average breeding efficiencies were due to differences in their genetic constitutions.

Koch (27) classified cows according to the number of live calves delivered for a given age in years. For example, five ten year old cows which had produced four, five, six, seven, and eight live calves respectively were assigned to classes of one to five in an ascending order of merit. By the use of this method the breeding performance of difference families could be compared. His data on Spotted cattle in Baden demonstrated that the most widespread cause of culling cows was poor fertility, and animals culled for this reason could usually

be traced to a few stud bulls or cows. For example, among 13 families with a poor breeding record, thirty-four of the fifty-two cows were culled, whereas among fifteen families with a good breeding record, the number of cows culled was one out of seventy-two. It was observed that the different causes of sterility, e.g. nymphomania, failure to conceive, or vaginal prolapse, were usually not associated, but that each tended to recur in certain families. Koch assumed that there were several independent factors causing sterility. Families which had good type and appeared to be constitutionally robust and vigorous, and were, therefore, used extensively in breeding, could have very poor fertility. Among 87 daughters of three bulls, thirty-seven were culled because of sterility, whereas among 140 cows sired by other bulls, there were only eight culls for the same reason.

Legates (30) used the number of services per conception and the length of the interval between calvings to determine the genetic variance in these commonly used measures of reproductive efficiency. The data included conception rates for 2443 calvings by 1129 cows and 2419 calving intervals for 1016 cows. The mean number of services per conception was 1.80 and the mean calving interval was 406 days. The estimate of heritability of services per conception was 0.026, while the intra-cow repeatability was zero. Heritability of calving interval length was zero; although repeatability was 0.133.

Evidence from this study indicated little existing genetic variability in the two measures of reproductive efficiency studied. The number of services per conception for one calving was of no value in predicting the number of services required for a subsequent pregnancy.

The length of calving interval appeared to be slightly more a characteristic of the individual cow than did services per conception.

The breeding efficiency of 6,509 cows and for 2,403 herds was compared for two consecutive years by Olds and Seath (40). As the number of services per cow increased the first year, there was a rather uniform increase in the average number of services required the second year. However, the differences were not great, increasing approximately 0.1 service for each increase of 1.0 in the first year. Nearly fifty-five per cent of the cows required the same number of services both years. The correlation between breeding efficiency for consecutive years was 0.084 ± 0.012.

The predictability of breeding efficiency of herds was about the same as that for cows. About 54 per cent of the herds required approximately the same average number of services per cow both years. Only 9.3 per cent of the "problem herds" (averaging 2.1 or more services per conception) were still problem herds the next year. The total number of problem herds remained about the same both years, i.e., 7.1 per cent the first year and 5.9 per cent the second year.

A study of the inheritance of breeding efficiency in the Beltsville Dairy Herd was made by Pou et al. (46). The results of this investigation indicated that the intraherd repeatability and heritability values of breeding efficiency in dairy cattle were low. When the number of services required for conception, the number of days from first service to conception, or the regularity of the occurrence of estrus were used as measures of breeding efficiency, selection for improvement in breeding efficiency would not be effective.

Environmental factors that appeared to be of relatively minor importance as the causes of variation in breeding performance were age of the cow, season of the year, and time trends.

Spielman and Jones (48) found a correlation of $r = + 0.546 \pm .118$ between the reproductive efficiency of the foundation cows and the mean reproductive efficiency of their female descendants.

The numerical measure of reproductive efficiency used by these authors was based on the assumption that a heifer should be bred at a certain age (depending on breed) and that she should drop a calf every twelve months thereafter, to be one hundred per cent efficient. The total number of reproductive months represented the number of months an animal remained in the breeding herd. Each month of the calving interval was designated as a one hundred per cent month. That portion of the calving interval in excess of twelve months was considered as possessing zero per cent reproductive efficiency. Any cow known to have been pregnant, but subsequently removed from the herd before calving, was allowed one one hundred per cent month for each month of pregnancy. Therefore, their method of measuring reproductive efficiency was:

> "The number of one hundred per cent months divided by the total number of reproductive months X 100 = Per Cent Reproductive Efficiency."

Chapman and Casida (9) found that in clinically normal cows the length of estrous cycles varied from two days up to nearly two hundred days. These were divided into two groups - those which immediately followed an infertile service - and those which were not preceded by

a service. The non-copulatory cycles averaged thirty-two days, whereas the copulatory cycles averaged thirty-seven days. The modal length of both groups was twenty-one days.

Data for 1200 estrual cycles were compared with the return intervals by Hawk et al. (21). The modal length for both estrual cycles and return intervals was twenty-one days. The mean length for estrual cycles and return intervals was 24.11 days and 26.44 days respectively. These means were considerably lower than the 30.8 and 34.9 days for noncopulatory and copulatory cycles reported by Chapman and Casida (9) for clinically normal dairy cattle, and the 30.6 and 35.7 days reported by Olds and Seath (41). The lower means reported here were believed to be due to the closer observation for estrual behavior at the experimental farm than in most dairy herds, as well as the fact that early lost pregnancies which would not ordinarily be distinguished as such were eliminated from these return intervals. Insemination was found to have a significant delaying effect on return to heat ($P < 0.01$).

In their work with Arizona range cows, Lasley and Bogart (29) found that the duration of estrus did not exceed eight hours. The length of the estrous cycle varied between ten and twenty-one days, with a mean of 19.6 ± 0.12 days.

They found that range cows of different ages varied greatly in breeding efficiency. Heifers between two and three years of age were less fertile than the cows in other age groups. They required an average of 2.37 inseminations per calf and produced a calf crop of 66.1 per cent. It was their opinion that if the non-breeding heifers could have been identified and culled from the herd, those remaining

would probably have been as fertile as the older cows. Fertility was highest in the cows between five and seven years of age and gradually declined in the older cows.

Moeller and Van Demark (37) collected data on 4,885 cows, showing the interval between two consecutive artificial inseminations; and the fertility data for each interval as determined by 180 day non-returns to service. The distribution of these intervals showed definite peaks at twenty-one and forty-two days. Based on the total recorded intervals up to and including those of 72 days in length, 56 per cent fell in the 18 to 25 day class, while 82 per cent fell in this class when only the totals for the first 35 days were considered. The fertility levels based on non-returns to service after cows were inseminated 2 to 17, 18 to 25, 26 to 35, 36 to 50, and 51 to 72 days after the previous insemination were 34, 49, 45, 50, and 54 per cent, respectively. Only the fertility of those cows that returned for insemination at intervals of 2 to 17 days differed significantly from the mean fertility level. When all cows were bred, regardless of the interval at which they returned from a previous insemination, as compared to a policy of breeding only those cows which returned between 18 and 25 days after the previous service, there was an increase of approximately 20 per cent in the number of cows settled at any one estrous. This indicated that several cows did not return in the normal interval, but some of those cows with irregular intervals conceived on insemination.

Olds and Seath (41) studied breeding records for the Kentucky Agricultural Experiment Station dairy herd, covering a period of

eighteen years (1928-1946). Estrous cycle lengths were tabulated for 278 cows and included 3,776 intervals or an average of 13.6 intervals per cow. The mean cycle length was 32.4 days with a range of from 1 to 549 days. About 11.6 per cent of the intervals were 53 days or more. There were no cases of known pregnancy or observed abortion included in these long intervals. The modal cycle length was 22 days and this represented about 12 per cent of the intervals. In order to get a mean of approximately 22 days, it was necessary to omit all intervals of 36 days or more. The standard deviation, after eliminating these long intervals, was 4.6 days. In this case, 82.8 per cent of the intervals fell between 17 and 26 days.

Among cows which were not bred at the previous heat, the percentage of cycles in the 17 to 26 day or "normal" group was 15.6 percentage units higher than for cows which were bred. The percentage of intervals in the 27 to 33 day and 53 day or over group for the cows not bred at the previous heat was 8.2 and 5.0 percentage units lower, respectively, than for those in the group following service. These differences were statistically highly significant. No significant differences in copulatory and non-copulatory estruses were found in the 34-52 day group.

An analysis of variance showed that variation in cycle length was significantly greater between cows than within cows. The composition of the mean square indicated a repeatability for single records of 0.069, or 6.9 per cent for length of estrous cycle.

When all intervals of 36 days or over were omitted, the variance due to cows was about one twenty-fifth as great as when all intervals were considered. The repeatability was still only 0.081.

The breeding efficiency of cows following cycles of approximately three weeks, six weeks, or longer was significantly higher than for cows bred following cycles of 1 to 16 or 27 to 33 days.

In an experiment to determine ovarian function, interval between estrus and conception rate in dairy cattle, Trimberger (49) used records from the Cornell University herd for the period from 1948 to 1953. Two hundred cows were used for the control group and 200 cows for the experimental group. When all 500 intervals of estrus were considered for the 200 cows in the experimental group, it was found that 60.4 per cent of the intervals were between 18 and 25 days. Of the total, 37.4 per cent of the intervals were over 25, and 2.2 per cent were less than 18 days, when estrous cycles associated with cystic ovaries were excluded. Silent estrus caused 18.6 per cent of the irregular intervals while 15.2 per cent were caused by a persistent corpus luteum and 3.6 per cent by smooth, non-functional ovaries. Of those intervals of less than 18 days, 0.8 per cent were due to false estrus (estrus without the development of a follicle and/or estrus not followed by the development of a corpus luteum), and 1.4 per cent exhibited estrus within this time.

A high rate of conception (over 60 per cent from one service) was obtained for the cows in the entire group, for cows bred during a silent estrus, during a normal estrus after a silent period, and during delayed estrus due to persistent corpus luteum and smooth, non-functional ovaries. The results indicated that the chances for conception in cows returning at irregular intervals were not decreased except for cows with short intervals and cows with cystic ovaries.

Hawk, et al. (22) made a study to determine the percentage of repeat-breeder cows with normal embryos at the sixteenth day of gestation and the embryonic death rate between sixteen and thirty-four elapsed days. Apparently normal embryos were recovered from the uteri of 29 (58 per cent) of fifty repeat-breeder cows slaughtered sixteen days after the first day of heat; fifty repeat-breeder cows at thirty-four days had fourteen normal embryos (28 per cent). The estimate of embryonic death from sixteen to thirty-four days was 51.7 per cent.

From their study, Kidder, et al. (26) estimated that approximately 40 per cent of the potential young in dairy cattle were lost by 60-90 days after breeding. Calculated as percentages of the potential young producible by a female group, the loss was estimated as 3 per cent due to genital abnormalities of the cow; 9 per cent to defective ova; 12 per cent to failure of fertilization resulting from undetermined causes; and 16 per cent due to death of the embryo.

Hawk, et al. (20) also analyzed a total of 837 services for the effects of sire and system of mating on estimated embryonic mortality by 150 days of gestation. The sire had a highly significant effect on the rate of embryonic death in the females to which he was bred. Outbred embryos had an estimated death rate of 19.8 per cent by 150 days as compared to 22.3 per cent for inbred embryos. Outbred dams had 19.2 per cent embryonic death by 150 days, whereas embryonic mortality in inbred dams was 28.4 per cent. Although the difference between outbreds and inbreds was not statistically significant in either case, the trend was for inbreeding of either embryos or dams, particularly the latter, to increase embryonic mortality.

Ovulation rate, fertilization rate, embryonic survival and genital abnormalities were studied by Burns, et al. (4) in beef cattle of low fertility. Forty-four cows that had failed to calve for either one or two years were assembled and bred to a fertile bull at their first estrus. Twenty-two cows of Brahman breeding were designated as Group I and 22 cows of English breeding were designated as Group II. One half of the cows in each group was killed three days after breeding and the other half was allowed to go 34 days after breeding before being slaughtered. The interval from first exposure to the bull until estrus was 45.1 days for Group I and 12.4 days for Group II. Nine per cent of the cows in Group I did not show estrus while 23 per cent did not ovulate although estrus was manifested and five per cent had unilateral pyosalpinx. Forty-five per cent of the cows in Group II had varying amounts of fluid in the uterus, but apparently this fluid did not interfere with fertilization, although embryonic mortality was high in these cows. Pyometra accompanied by a retained corpus luteum occurred in five per cent of the cows in Group II. Forty per cent of the cows in Group I had normal fertilized ova at three days, whereas only 33 per cent had normal embryos at 34 days, giving an embryonic death loss of 18 per cent. Sixty-two per cent of the cows in Group II had normal fertilized ova at three days whereas none had normal embryos at 34 days, giving an embryonic death loss of 100 per cent. Of the cows which were allowed to live 34 days after breeding, eighteen per cent in Group I and sixty-seven per cent in Group II returned in heat, were bred again, and killed three days after breeding.

Laing (28) presented evidence that suggested mortality of two forms: In the first, the ovum was fertilized, developed for some days, but died before mid-cycle. The corpus luteum regressed as in a normal cycle where fertilization had not occurred and the animal returned to estrus after one normal estrus period without any evidence that fertilization had occurred. In the second, fertilization occurred, and the ovum developed beyond mid-cycle so that the corpus luteum persisted; the embryo then commenced to degenerate and be resorbed, and the corpus luteum regressed, but after a length of time greater than one estrous cycle.

Two groups of twenty-four heifers each were mated, in successive years and under controlled conditions, to determine whether infertility resulted from the death of fertilized ova. The condition was found to occur in both groups, and suggested an incidence of mortality of about thirty per cent. The author suggested that the etiology of infertility may have been associated with anomalies of the later stages of follicle maturation. Multiple factors appeared to be involved.

Morgan and Davis (39) found that during the season from May to October 2.28 services were required for conception, while from November to April 2.14 services were required for bulls of all ages mated to cows of all ages. The monthly variation in number of services per conception varied from 1.94 in December to 2.86 in September.

Mercier and Salisbury (35) studied the seasonal variations in hours of daylight associated with fertility level of cattle under natural breeding conditions. With three herds of cattle located at different latitudes in Eastern Canada, the lowest per cent of successful

services was obtained during the winter and spring and the highest during summer and fall. The differences in fertility level between herds were not significant statistically, but those between seasons were significant at the five per cent level of probability.

The average monthly conception rate of the three herds was significantly correlated with the monthly average length of daylight. There was a lag of approximately one to two months before the maximum effect was recorded. The authors believed that at high latitudes, variations in length of daylight measurably influenced the fertility level in cattle.

The effects of season, hours of daylight, and age of cows on the fertility level of artificially bred cows was also studied by Mercier and Salisbury (36). Their data were collected from about 125,000 cows and 71 bulls in New York State, during the period of 1943 to 1949. Cattle of various ages responded differently and consistently to seasons of the year. The fertility of younger and older cattle was influenced more readily than cattle of intermediate ages. Winter was the poorest breeding season of the year during this period. The fertility level of all bulls kept at the New York station, but artificially bred to cattle in all sections of the State from December, 1945, through November, 1946, was significantly correlated with the length of daylight. There was a lag of one or two months before the effect of daylight reached its maximum effect. For bulls of less than six years of age, the correlation coefficients were not statistically significant. They concluded that young bulls probably were more subject to other influences on fertility than were those from six to ten years of age.

In their study of the effects of season on the spermatogenic activity and fertility of dairy bulls used in artificial insemination, the data of Mercier and Salisbury (34) showed a low level of sperm production during June and July, accompanied by lower than average levels of fertility for those two months. Ten mature Holstein bulls and ten mature Guernsey bulls, averaging 6.1 ± 2.6 years of age, belonging to the New York Artificial Breeders Cooperative, Inc. were used. Fertility continued downward during August before starting its usual increase during the fall months.

Hilder, et al. (23), found that the most noticeable effect of season on breeding efficiency was the relatively large number of services required for conception during midsummer, followed by a sharp decrease in the fall.

Erb and Waldo (18) studied the seasonal changes in fertility of dairy bulls in northwestern Washington. The per cent of sixty-to-ninety day nonreturns to 93,113 first and second service inseminations for Guernsey, Jersey, and Holstein bulls used for artificial breeding purposes in northwestern Washington over a six year period were tabulated for this study. Monthly variation was highly significant, with January showing the lowest and September the highest average nonreturn rates. Nonreturn rate was lowest during January, February, March, and April and gradually increased to the highest level in September, October, and November. This pattern of breeding efficiency essentially paralleled the results observed by Mercier and Salisbury (34, 35, 36) from data collected in New York and eastern Canada.

Monthly correlations of sperm concentration, initial motility, motility after thirty minutes incubation at forty-five degrees Centigrade and drop in motility during incubation with nonreturn rates, revealed great variation in the relationships from one period of the year to the next. Only 591 semen samples collected during one year were involved, but the data strongly suggested that the value of semen quality measurements could not be accurately estimated during experimental periods of less than one year.

Erb, et al. (19) made a study of the breeding efficiency in the Purdue University dairy herd for the twenty year period (1920-1940) which revealed considerable seasonal variation. The month of May with 74.3 per cent had the highest average efficiency and the month of August with 58.2 per cent the lowest average efficiency for those years. The twenty year study included 1440 services resulting in 922 conceptions. No services were included unless they resulted in calving while the animals were still in the Purdue herd.

Seath, et al. (47) working with dairy cattle in Louisiana, also found seasonal differences in breeding efficiency, with the highest efficiency occurring in fall and winter and the lowest in spring and summer.

Trimberger and Davis (50) in their analysis of the breeding records of the University of Nebraska dairy herd, found that the summer months required more services per conception than did the months during the other seasons of the year. August was high with 2.24 services per conception and this was significantly different from the other months ($P < 0.01$).

Using data from eight U.S.D.A. Experiment Stations located in all sections of the United States, Dawson (14) found that there was a tendency for the fertility of proved sires to be somewhat higher during the months of February, April, July, and October when the fertility averaged 42.9 per cent. The low trends came in June, September, and November, when the average fertility was 36.5 per cent.

Boyd, et al. (3) made a study of the correlation between milk production and breeding efficiency on 519 cows in 29 herds which were members of the Kentucky Artificial Breeding Association and D. H. I. A. Production for the first 120 days after calving for the 519 cows on an M. E., FCM basis averaged 4,520 pounds with a standard deviation of 1,123 pounds, while the mean number of services for successful conception was 1.68 with a standard deviation of 0.74.

The correlation coefficient between milk production and the number of services per conception was -0.04, a relationship not statistically significant. When tested by the analysis of covariance so as to segregate differences due to herd and level of production, no statistical significance was found between the level of production and the number of services required for conception.

When each of the 29 herds was considered separately, the range in the intra-herd correlation between milk production and breeding efficiency was from -0.52 to 0.79, indicating an erratic relationship. The dispersion of coefficients calculated for individual herds closely approached a normal distribution, which would occur by chance alone where no actual relationship existed.

Carman (6) investigated the interrelations of milk production and breeding efficiency in dairy cows. His results indicated that the repeatability and heritability of breeding efficiency, when these were measured by days to first estrus, days to conception, and services per conception, were zero, or nearly so. The interval from parturition to first estrus was found to be correlated with level of production in the previous lactation, which indicated that differences in production level had some carry-over effect on whether estrus occurred early or late in the following lactation. Days to first estrus showed little or no relation to present production, but days to conception increased as present production level increased.

Lewis and Horwood (33) found that cows which began a lactation at a high level of production were not rebred as quickly and did not conceive as readily as those producing at lower levels.

Olds and Seath (42) found that the level of milk production accounted for about 0.9 per cent of the variation in time from calving to first heat.

The effect of age of bulls on breeding efficiency has been studied by several workers. Morgan and Davis (39) found that young bulls under two years of age showed the smallest number of services per conception. From two years through eight years, the number of services required varied very little. They did not have enough data for older bulls to permit conclusions.

Olds and Seath (44) found no significant effect of age in their analysis of 353 bulls used in eighteen artificial breeding organizations in the United States. The ages of the bulls ranged from two to thirteen years.

Erb, et al. (19) found considerable variation in breeding efficiency between sires used in the Purdue University dairy herd during the twenty year period from 1920 to 1940. One and two-year-old bulls had the highest breeding efficiency, but showed a gradual decline with age thereafter.

Cupps, et al. (12), University of California, investigated the relation of certain semen-quality tests to breeding efficiency. The laboratory tests included concentration, motility, fructolysis index, per cent of dead sperm, and the per cent of abnormal sperm. The two latter tests were most closely related to fertility, as measured by 30-60 day nonreturns.

They also found that a deficiency of follicle-stimulating hormone appeared to be one of the factors involved in the production of low-quality semen by certain related bulls. Leuteinizing hormone and testosterone appeared to be secreted in normal amounts in these bulls.

Olds, et al. (43) studied interrelationships between the site of semen deposition, dosage, and number of spermatozoa in diluted semen and fertility of dairy cows inseminated artificially. Four sites of deposition were used: (1) half-way through the cervix; (2) body of the uterus; (3) both uterine horns; and (4) both uterine horns, body of the uterus, and the cervix. The four dosages used were: 0.25 ml.; 0.5 ml.; 1.0 ml.; and 2.0 ml. The two concentrations used were 16 million spermatozoa per ml. and 24 million spermatozoa per ml.

There were 9,558 cows bred during the experimental period, or an average of 298.7 cows for each combination of site, dosage, and concentration used. No statistically significant differences in the

fertility were obtained by the various methods of insemination. However, there was a tendency for the higher concentrations, larger dosages, and deeper depositions to produce higher fertility, with an average increase of 1.2 per cent in nonreturns for each 10 million additional sperm deposited. The total number of spermatozoa deposited varied from 4 to 48 million. It appeared that fertility declined about 3.3 percentage units when the number of spermatozoa per insemination was decreased from 12 million to 8 million. There was apparently no difference in the fertility obtained by depositing 4, 6, or 8 million spermatozoa per insemination.

Kidder, et al. (26) made a study of ovulations in six families of Holstein-Friesians. The incidence of multiple ovulations in the Emmons Blaine, Jr. herd of experimental Holstein cows was found to be 13.10 per cent, while the incidence of twinning was 1.92 per cent, a highly significant difference. The incidence of multiple ovulations was not significantly influenced by reproductive period, family, or length of time after parturition. There was a significant monthly variation in frequency of multiple ovulation in the first reproductive period and the monthly variation in the second period approached significance, being high in May and low in September in both cases. A highly significant tendency for multiple ovulations to follow in sequence was found. Significantly higher fertility was noted when cows were bred at an estrus from which only a single corpus luteum was formed as compared to an estrus from which two or more corpora lutea were formed.

The incidence of "quiet" ovulations (44.3 per cent) was significantly higher during the first 60 days after parturition than during the period 61 to 308 days postpartum. During this latter period their incidence was still sufficiently high (11.0 per cent) to constitute an important problem to the breeder.

Of the ovulations, 56.5 per cent were from the right ovary. Studies of family and parity failed to show any significant deviations from this ratio. No apparent tendency was found for cows to have a systematic sequence of ovulations from one ovary or the other.

A study of atretic large follicles in six sire-groups of Holstein-Friesian cows was made by Wiltbank, et al. (53). They reported the incidence of atretic large follicles to be affected significantly by line of breeding, reproductive period, stage of postpartum interval, month, and individuality. The highest incidence of atretic large follicles occurred from 15 to 44 days postpartum and during the month of November, while April and August were the low months. Atretic large follicles were not found to be affected significantly by inherent producing ability, time from parturition to involution of the uterus, or early loss of pregnancy.

Twenty per cent (or 27 of 135) of the cows in the herd had the atretic follicle condition. The cows in seven of the reproductive periods showed symptoms of nymphomania.

Most cows having atretic large follicles recovered from them without treatment. Breeding efficiency was appreciably lowered in affected cows of most lines because of this condition, but the magnitude of the response was dependent upon the line of breeding.

EXPERIMENTAL PROCEDURE

The breeding records of the Oklahoma Agricultural and Mechanical College dairy herd were summarized to determine certain aspects of the reproductive efficiency of the herd. The measures of breeding efficiency used in this thesis were services per conception (used most frequently) which is determined by $\frac{\text{No. Services}}{\text{No. Conceptions}}$; the per cent conception, determined by $\frac{\text{No. Conceptions}}{\text{No. Services}} \times 100$; length of estrus following infertile service; and incidence of abortions.

Located at Stillwater, Oklahoma, the A. & M. College dairy herd is comprised of four breeds: Holstein, Guernsey, Ayrshire, and Jersey.

To examine differences in the breeding efficiency that might be attributed to individual bulls, each bull that had been used for one or more services during the period from January 1, 1944 to January 1, 1956 was studied. The total services, total conceptions, and average number of services per conception were summarized for each year the bull was used, then totaled and averaged over years. These yearly totals were grouped by breed to show any differences in breeding efficiency that might be attributed to breed effect or to year effect.

The total services and conceptions were tabulated by bulls for each month of the year or years in which a bull had been in service. These data were then grouped over bulls, within breeds, to obtain a monthly breeding efficiency for all years.

To obtain the average number of services per conception for each cow and for each gestation, from the first through the tenth or

greater, all cows with a breeding record that were in the herd during the period from January 1, 1944 to January 1, 1956 were listed, together with the number of services per conception in each gestation. Only those gestations were used in which a known conception occurred. For all breeds, a total of 674 cows, with 1790 gestations were involved. The first recorded gestation, for those cows that were in the herd at the time the records began (January 1, 1944) was placed in the second gestation column.

The repeatability of services per conception for cows was also computed from the above data by an analysis of variance with the formula $\frac{\sigma_c^2}{\sigma_c^2 + \sigma_e^2}$, where σ_c^2 represented the variance among cows, and σ_e^2 represented the variance within cows.

The length of estrus following an infertile service was tabulated on a total of 382 cows with 580 gestations and 1780 intervals between estruses. The number of successive intervals between estruses following infertile service ranged from one to as many as fifteen for some cows. Each gestation was listed separately for those cows having more than one gestation with estruses following infertile services. The period of time included in these data was from November 26, 1950 through May 22, 1956 for the Holstein and Guernsey breeds; November 26, 1950 through May 24, 1956 for the Ayrshire breed; and November 26, 1950 through May 25, 1956 for the Jersey breed.

The incidence and length of known abortions by breed and over breeds was ascertained from the breeding records to determine their effect on the breeding efficiency of the herd.

To measure the effect of cow family on breeding efficiency, the average number of services per conception was computed for each member of the cow family that had a breeding record. These, in turn, were averaged to get the number of services per conception for the cow family group. Only those cows which were purchased were considered as foundation cows, making it necessary to use breeding records for years as early as 1926. The services per conception were taken from the permanent herd record sheets for all cows whose breeding records did not fall within the period of January 1, 1944 to January 1, 1956. For a cow that was bred, with subsequent disposal before pregnancy was diagnosed, the total services were used. For a cow that was bred and conceived one or more times, but had not yet conceived for the last attempted gestation, the average of the total services for all attempted conceptions was used (i.e., $\frac{\text{known } \not\text{ attempted conc.}}{\text{sv. for known } \not\text{ sv. for attempted conc.}}$).

To measure the effect of sire group on breeding efficiency the average number of services per conception for each daughter of a sire that was in the herd for the period of January 1, 1944 to January 1, 1956 for at least one gestation was listed. These services per conception were averaged to get the number of services per conception for a sire group. Breeding efficiency was determined by the procedure used for cow families.

RESULTS AND DISCUSSION

The numbers of services, conceptions, and average number of services per conception for the bulls in the years they were used are listed in Appendix Table I.

The analysis of variance for services per conception over years and over breeds, showed a definite year effect ($P < 0.01$), but no significant differences due to breed. The years which differed, at the 1 per cent level of significance, are indicated in Table 1.

It was difficult to compare the breeding efficiency of the different bulls because of the large year effect, and the wide variation in the number of services. However, it was obvious from the data in Appendix Table I that within any one year, there were some bulls with higher reproductive efficiency than others.

The breedings by months, over years, and over breeds is presented in Appendix Table II. In an analysis of variance of these data (see part B of Table 1), it was found that there were differences between breeds ($P < 0.05$). The average services per conception for the Jersey and Ayrshire breeds differed significantly at the 1 per cent level, while the Guernsey and Ayrshire breeds were significantly different at the 5 per cent level.

No significant differences due to month effect were found when the F test was applied to the A.O.V. mean squares. However, in testing for significance between means, the month of October with

TABLE 1

Analysis of Variance for Services per Conception for Bulls

A. Analysis of Variance for Services per Conception by Breed and by Year

	d.f.	S.S.	M.S.
Total	47	66.86	- -
Between Years	11	32.90	2.99** ($P < 0.01$)
Between Breeds	3	5.34	1.78
Within Years	33	28.62	0.87

New Multiple Range Test for Testing Differences Between Means:

Means Ranked in Order from Lowest to Highest:

'47	'48	'45	'46	'52	'44	'51	'49	'50	'54	'53	'55
1.8	2.1	2.5	2.5	2.6	2.8	3.0	3.2	3.5	3.6	3.7	4.6

Note: Any two means not underscored by the same line are significantly different. Any two means underscored by the same line are not significantly different.

Standard Error of Mean: 0.281.

B. Analysis of Variance for Services per Conception by Breed and by Month

	d.f.	S.S.	M.S.
Total	47	19.87	- -
Between Months	11	3.69	0.34
Between Breeds	3	4.55	1.52* ($P < 0.05$)
Within Months	33	11.63	0.35

Significant Differences Between Means:

Jersey and Ayrshire ($P < 0.01$)
Guernsey and Ayrshire ($P < 0.05$)

Standard Error of Mean: 0.171.

October and December ($P < 0.05$)

Standard Error of Mean: 0.296.

2.44 average services per conception differed from the month of December with 3.53 average services per conception ($P < 0.05$).

The number of services per month varied from 305 in August to 579 in December. December with 579 services and January with 568 services were the months in which the highest number of services per conception were recorded. Although the relationship of the number of services to the number of services per conception for the remaining months was not as close as for these two months, there appeared to be a tendency for the number of services per conception to rise with an increase in the number of services per month.

The average per cent conception for the twelve year period of January 1, 1944 to January 1, 1956 was 33.57 per cent or 2.98 services per conception. During the season from May to October inclusive, the per cent conception was 36.10 per cent, or 2.77 services per conception; while from November to April inclusive, the per cent conception was 31.74 or 3.15 services per conception. These seasonal differences in breeding efficiency are in agreement with the results obtained by Mercier and Salisbury (35, 36), and Erb and Waldo (18).

Repeatability of Services per Conception for Cows

In Table 2 and Figure 1 are presented the services per conception for cows by gestation. These data cover the period from January 1, 1944 to January 1, 1956. Only those gestations were used in which a known conception occurred. The first gestation required more services per conception than did the second, third, fourth, and fifth gestations,

TABLE 2

Services per Conception for Cows by Gestation

	GESTATION										
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Total
HOLSTEIN											
Services	396	354	175	120	68	46	23	26	5	--	1213
Conceptions	147	139	92	53	34	20	10	8	4	--	507
Svc's/Conc.	2.70	2.55	1.90	2.26	2.00	2.30	2.30	3.25	1.25	--	2.40
GUERNSEY											
Services	272	222	139	107	45	27	10	4	1	--	827
Conceptions	130	118	70	47	28	12	5	2	1	--	413
Svc's/Conc.	2.09	1.86	1.99	2.28	1.60	2.25	2.00	2.00	1.00	--	2.00
AYRSHIRE											
Services	310	240	140	83	65	45	20	4	--	--	907
Conceptions	121	129	69	49	32	22	9	2	--	--	433
Svc's/Conc.	2.56	1.86	2.00	1.70	2.00	2.00	2.30	2.00	--	--	2.09
JERSEY											
Services	299	282	160	78	64	74	28	8	12	9	1014
Conceptions	118	128	71	44	32	22	11	4	3	4	437
Svc's/Conc.	2.53	2.20	2.25	1.77	2.00	3.36	2.55	2.00	4.00	2.25	2.32
ALL BREEDS											
Services	1277	1098	614	388	242	192	81	42	18	9	3961
Conceptions	516	514	302	193	126	76	35	16	8	4	1790
Svc's/Conc.	2.47	2.14	2.03	2.01	1.92	2.53	2.31	2.63	2.25	2.25	2.21

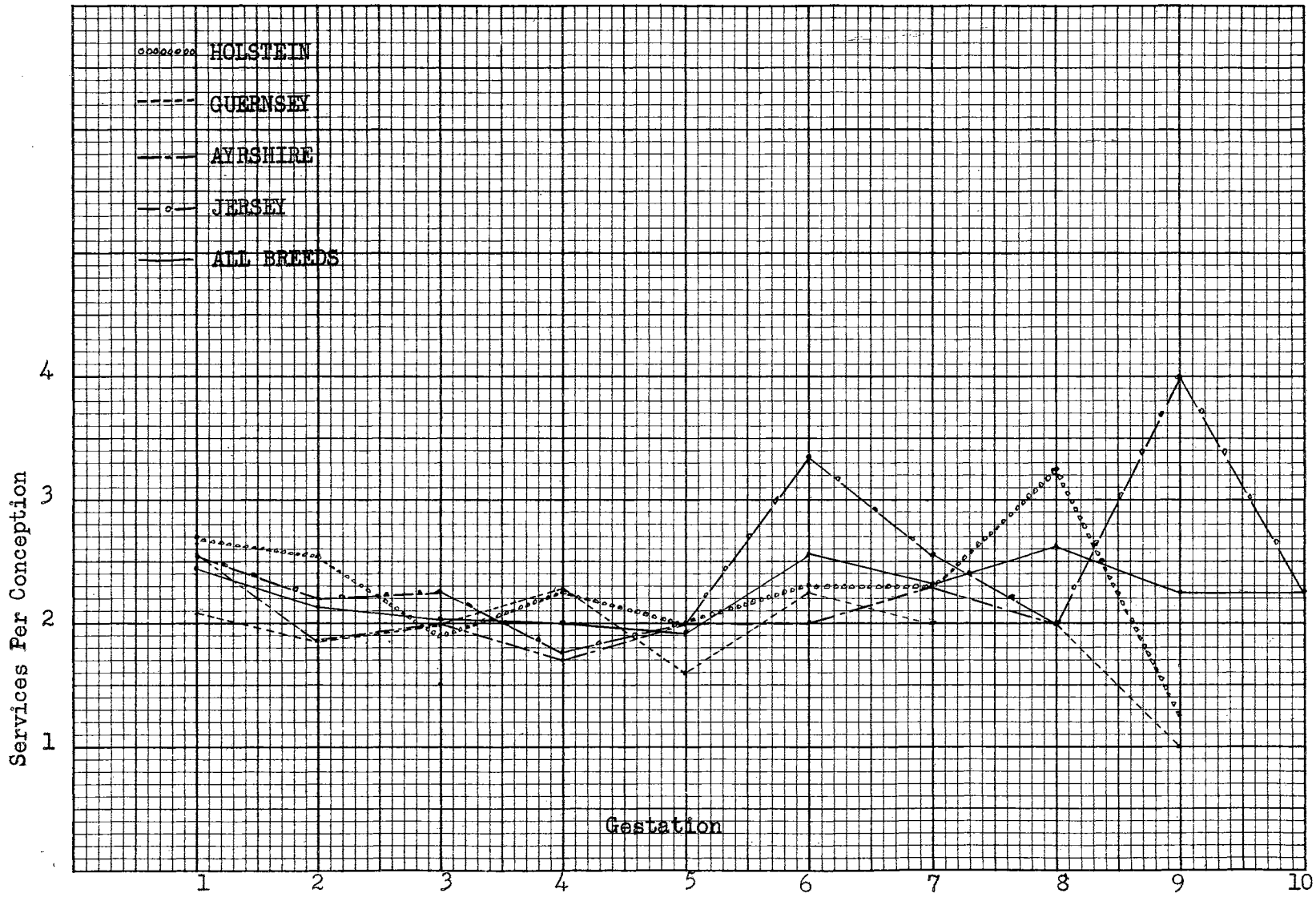

Figure 1. Services Per Conception For Cows By Gestation

with a gradual decrease to the fifth gestation which had the lowest number of services per conception in these data. These results are in essential agreement with those reported by Ehlers, et al. (17) and Davis and Brost (13). No definite trend was observable for those gestations from the sixth through the tenth or greater, however, the numbers of services were small.

The analysis of variance for repeatability of services per conception is given in Table 3. Although there was some variation of repeatability estimates among the breeds, no estimate was high enough to make it feasible to select for reproductive efficiency. The repeatability estimate, over breeds, of 0.0098 is in agreement with most of the estimates found in the literature, especially those reported in recent studies (15, 16, 30, 40).

Estrous Cycle Length of Cows Following Infertile Service

Information available in the literature would indicate the normal length of the estrous cycle in dairy cows is in the range of eighteen to twenty-four days. Comparisons of the means of noncopulatory and copulatory cycles were reported by Chapman and Casida (9) to be 30.8 and 34.9 days. Olds and Seath (41) reported means of 30.6 days for noncopulatory and 35.7 days for copulatory estrous cycles.

In this report, the length of estrous cycles following infertile service was used. The data reported in Appendix Table III represents the breeding history of all cows in the Oklahoma A. & M. dairy herd between the period of October, 1950 through May, 1956. During this time there were 107 Holstein, 81 Guernsey, 113 Ayrshire and 93

TABLE 3

Analysis of Variance for Repeatability of Services per Conception for Cows

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Squares
HOLSTEIN			
Total	506	1647	- - -
Between Cows	184	456	2.478
Within Cows	322	1191	3.699
Repeatability = -.14			
GUERNSEY			
Total	412	861	- - -
Between Cows	164	338.5	2.064
Within Cows	248	522.5	2.107
Repeatability = -.00823			
AYRSHIRE			
Total	432	1173	- - -
Between Cows	163	567	3.478
Within Cows	269	606	2.253
Repeatability = .17			
JERSEY			
Total	436	1561	- - -
Between Cows	159	614.5	3.865
Within Cows	277	946.5	3.470
Repeatability = .04			
ALL BREEDS			
Total	1789	5288	- - -
Between Cows	673	2022	3.004
Within Cows	1116	3266	2.927
Repeatability = .0098			

Jersey cows that fell in this category one or more times. There were 13 Holstein, 16 Guernsey, 12 Ayrshire, and 14 Jersey bulls used during this same time period.

In Table 4 the average interval length, in days, between estruses following infertile service is presented. Each interval was listed, from the one between first and second copulatory estruses to the interval between the fifteenth and sixteenth copulatory estruses.

The overall average length between estruses following infertile service was 41.66 days, with a standard deviation of 33.1 days. The length of intervals ranged from 2 to 324 days.

In Appendix Table IV the frequencies of estruses following infertile service are listed by length in days, and by their occurrence between the different estrus periods. This material is also presented in graphic form in Figure 2. The greatest number of estruses occurred in the normal range of 18-24 days, with the highest number being at 21 days. A second peak in the curve occurred at 41 days, and a third small peak at 62 days. This would indicate that probably the greatest factor in the return to estrus following service was that the egg was not fertilized, of if fertilized, the embryo did not live long enough to affect the hormonal mechanism for bringing the cow into estrus again in the normal time period. Semen of low fertility, ova of low viability, improper timing of service due to early or late ovulation, and/or breeding too soon or too late in the estrus period, are possible factors to be considered. For the second and third peaks, there is also to be considered the possibility of silent heat periods, and heat periods that were missed because of short duration, or other

TABLE 4

Average Length in Days Between Indicated Estruses, Following Infertile Estrus

	Estrus Intervals														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
HOLSTEIN															
Total days	8532	5192	3310	1407	1154	515	196	185	19	19	21	44			
No. Estruses	184	117	75	39	30	15	8	5	1	1	1	1			
Avg. Length	46.37	44.38	44.13	36.08	38.47	34.33	24.50	37.00	19.00	19.00	21.00	44.00			
GUERNSEY															
Total Days	4711	3150	2251	1437	913	901	292	270	376	206	166	199	175	88	89
No. Estruses	121	86	52	31	21	17	10	9	9	6	4	4	4	3	2
Avg. Length	38.93	36.63	43.29	46.35	43.48	53.00	29.20	30.00	41.78	34.33	41.50	49.75	43.75	29.33	44.50
AYRSHIRE															
Total Days	6988	4294	2513	1797	1352	435	307	288	86	95	40	20			
No. Estruses	168	109	75	48	32	12	8	3	2	1	1	1			
Avg. Length	41.60	39.39	33.51	37.44	42.25	36.25	38.38	96.00	43.00	95.00	40.00	20.00			
JERSEY															
Total Days	6323	4041	3321	2295	1201	726	960	432	328	226	180	83			
No. Estruses	139	98	74	48	33	23	16	12	9	5	5	2			
Avg. Length	45.49	41.23	44.88	47.81	36.39	31.57	60.00	36.00	36.44	45.20	36.00	41.50			
ALL BREEDS															
Total Days	26554	16677	11395	6936	4620	2577	1755	1175	809	546	407	346	175	88	89
No. Estruses	612	410	276	166	116	67	42	29	21	13	11	8	4	3	2
Avg. Length	43.39	40.68	41.29	41.78	39.83	38.46	41.79	40.52	38.52	42.00	37.00	43.25	43.75	29.33	44.50

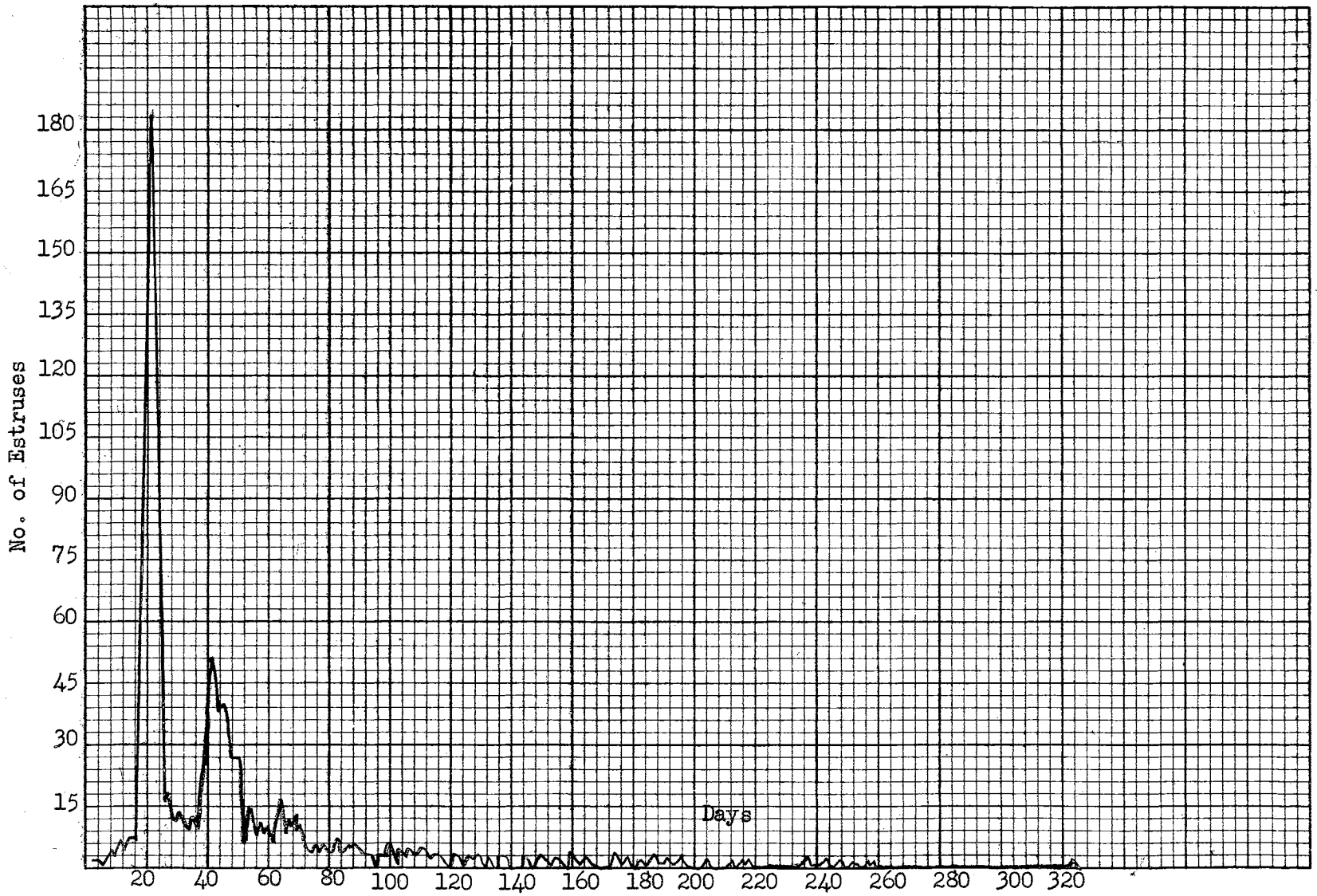

Figure 2. Frequency of Estrous Cycles Following Infertile Services

reasons. Other factors that may have an effect on the length of the interval between estruses would include persistent corpus luteum and disease factors. A positive daignosis for vibriosis was made for this herd in 1956, and this disease has undoubtedly affected the length of intervals between infertile estruses, as well as the overall reproductive efficiency of the herd.

From Table 5 it was found that 41.2 per cent or 734 of the 1780 estruses following infertile service occurred in the 18 to 24 day interval. Of the total estruses, 18.9 per cent occurred in the 36-48 day interval; and 10.2 per cent occurred in the 54-72 day interval. These intervals would allow for the inclusion of all those estruses following infertile service that would likely have been due to unobserved heat periods. They would also include those intervals of abnormal length which were due to other factors of either a nonpathologic or pathologic nature, and it is impossible to assign a definite cause for the intervals which do not fall in the expected range. However, it will be noted that many of the estruses appeared in interval lengths which would most probably be due to embryonic mortality. Only 3.7 per cent of the estruses were in the interval of 2-17 days, indicating that nymphomania was a minor factor.

Table 6 emphasizes the tremendous amount of time lost due to infertile services. From these data it appears that the length between estrus periods following infertile service may be longer than has been previously recognized and that reduced breeding efficiency may be a greater factor in the economic efficiency of a dairy herd than has been previously recognized.

TABLE 5

Distribution of Estruses Following Infertile Service

Interval (days)	No. of estruses	% of total estruses
2 - 17	65	3.7
18 - 24	734	41.2
25 - 38	244	13.7
39 - 44	216	12.1
45 - 59	172	9.7
60 - 67	103	5.8
68 - 77	54	3.0
78 - 86	53	3.0
87 -324	139	7.8
TOTAL	1780	100.0

TABLE 6

Summary of Estrus Intervals Following Infertile Service

Breed	No. of cows	Total estruses	Average days between infertile estruses	Average no. infertile estruses/ cow	No. gestations (excluding abortions)	Avg. no. estruses following infertile service per gestation	Total days lost
Holstein	107	477	43.17	4.46	184	2.59	20,594
Guernsey	81	379	40.17	4.68	121	3.13	15,224
Ayrshire	113	460	39.60	4.07	169	2.72	18,215
Jersey	93	464	43.35	4.99	139	3.34	20,116
ALL BREEDS	394	1780	41.66	4.52	613	2.90	74,149

Known Abortions

The effect of the known abortions on the breeding efficiency of this herd of dairy cows was of a minor nature, as can be seen in Table 7. Only 21 recognized abortions occurred in the time interval from November 26, 1950 through May 22, 1956, representing a total loss of 3856 days, as compared to 74,149 days lost due to infertile estruses.

Reproductive Efficiency of Cow Groups

A total of 895 cows in 96 cow groups averaged 2.33 services per conception. A cow group consisted of two or more generations with a breeding record. No appreciable differences were noted between breeds in the average number of services per conception. The Holstein and Guernsey groups averaged 2.3 services per conception; Ayrshire groups averaged 2.2 services per conception; and the Jersey groups averaged 2.4 services per conception. The number of cows in a group ranged from two to as many as eighty-three in one group of Jerseys.

Although there were differences in the reproductive efficiency of the cow groups as noted in Table 8, it must be recognized that there was a wide variation in the years in which the breeding records of different cow groups were recorded, i.e.: in some cow groups the majority of breeding records would fall in a time period where the breeding efficiency of the herd was high, while others would have a preponderance of breeding records in a time period where the reproductive efficiency of the herd was at a low level. It was evident from the original data that this factor had a definite influence on

TABLE 7

Abortions

Breed	No. of abortions	Average length of interrupted pregnancy	Total no. of estruses in same time interval	Total days lost by abortion
Holstein	7	189 days	5	1326
Guernsey	4	150 "	10	599
Ayrshire	5	210 "	4	1051
Jersey	5	176 "	43	880
ALL BREEDS	21	184 days	170	3856

TABLE 8

Reproductive Efficiency of Cow Groups by Breed

HOLSTEIN			GUERNSEY			AYRSHIRE			JERSEY		
Cow Group	No. Cows in Group	Avg. Sv/C	Cow Group	No. Cows in Group	Avg. Sv/C	Cow Group	No. Cows in Group	Avg. Sv/C	Cow Group	No. Cows in Group	Avg. Sv/C
19	2	1.0	17	3	1.2	12	3	1.1	24	2	1.0
15	8	1.4	26	2	1.2	8	16	1.5	25	2	1.0
20	3	1.7	12	4	1.3	3	5	1.5	7	13	1.4
12	6	2.0	1	8	1.5	9	37	1.6	3	18	1.8
3	23	2.1	21	2	1.5	13	16	1.6	10	3	1.8
7	16	2.1	2	16	1.6	7	4	1.6	18	13	1.9
10	16	2.1	9	9	1.6	15	3	1.9	26	3	2.0
4	18	2.2	14	6	1.6	18	3	1.9	8	8	2.1
22	10	2.2	5	4	1.6	10	10	2.1	5	13	2.2
16	7	2.2	20	5	1.7	11	9	2.1	11	7	2.2
21	2	2.2	3	5	1.9	16	4	2.2	1	83	2.3
8	15	2.3	6	28	2.0	2	12	2.3	2	25	2.3
6	30	2.4	28	2	2.0	5	11	2.4	6	5	2.5
14	7	2.4	11	4	2.1	1	22	2.6	16	2	2.5
9	4	2.4	19	3	2.2	14	3	2.6	20	5	2.6
1	3	2.5	4	18	2.4	19	4	2.8	27	3	2.6
11	3	2.5	7	3	2.4	4	40	2.9	23	3	2.7
17	8	2.6	8	13	2.5	6	20	2.9	4	14	2.9
18	13	2.7	18	7	2.6	17	2	3.1	17	2	3.0
2	24	2.8	10	9	2.7		224	2.2	14	13	3.2
5	12	3.1	23	3	2.8				9	2	3.2
13	3	3.7	13	6	3.0				15	2	3.2
	233	2.3	15	5	3.3				12	2	3.3
			25	3	3.8				22	2	3.4
			27	2	3.8				13	2	3.5
			22	3	5.7				21	7	3.7
			24	2	6.1				19	5	6.4
			16	4	6.3					259	2.4
				179	2.3						

ALL BREEDS - 895 Cows in 96 Cow Groups Avg. Services per Conception - 2.33

the average services per conception of a cow group. Also, the number of cows in a group apparently had an effect on the average number of services per conception. The extreme low and the extreme high average numbers of services per conception were recorded for groups that were small in number. The groups with large numbers of cows tended to be near the breed average.

Reproductive Efficiency of Sire Groups

Those cows in the herd for the period from January 1, 1944 to January 1, 1956 were grouped by sires, and the average number of services per conception determined for these sire groups. All sires with four or more daughters were used, with the services per conception of all the daughters gestations which occurred in this time period.

Table 9 lists the average number of services per conception for each sire group. To get the breed average, as used in this table, only those years in which a sire's daughters had gestations were averaged. This afforded a more accurate figure for comparison, because of the wide variation in the services per conception for the different years.

When comparing the sire group average services per conception after correction with the breed average, no group with low reproductive efficiency was noted. The tendency was for most of the sire groups to be above the breed average in reproductive efficiency. The factor that probably had the greatest influence on this situation was that a bull's daughters that proved low in reproductive efficiency were disposed of before a sufficient number of daughters to comprise a sire group were obtained, leaving only the daughters of the more highly regarded bulls to be included in this study.

In the Holstein breed, five of the nine sire groups averaged at least one service per conception better than the breed average, with one sire group averaging 2.13 services per conception better than the breed average. Four of the six Guernsey groups had more than one service per conception advantage over the breed average. The sire group with the greatest plus deviation from the breed average in the Guernsey breed, as well as in all breeds, was the Maxim group, which was 3.21 services per conception better than the breed average. In the Ayrshire groups, the highest deviation was 0.73 service per conception. Four of the eight sire groups of the Jersey breed averaged more than one service per conception above the breed average.

From these data it would appear that there were differences in the reproductive efficiency of different sire groups.

TABLE 9

Average Rate of Conception for the Daughters of Sires

Sire	Breed	No. Daus.	Yrs. in which gestations occurred	Avg. No. Sv/Conc.	Breed Avg. Sv/Conc.	Breed Avg. minus Sire Avg.
1. Belmont	Hol.	49	44-49	2.91	2.81	- 0.10
2. Skylark	"	33	44-50	2.36	2.93	≠ 0.57
3. Valiant	"	32	49-55	2.28	3.43	≠ 1.15
4. Pontiac	"	18	44-52	2.17	2.98	≠ 0.81
5. Remer	"	13	52-55	2.18	3.38	≠ 1.20
6. Fobes	"	9	53-55	2.42	3.50	≠ 1.08
7. Baron	"	6	53-55	1.37	3.50	≠ 2.13
8. Veteran	"	5	54-55	2.70	3.75	≠ 1.05
9. Deacon	"	4	48-53	3.23	3.12	- 0.11
1. Mohican	Guern.	48	44-54	2.10	2.94	≠ 0.84
2. Ambassador	"	27	49-55	2.57	4.13	≠ 1.56
3. Fortune	"	13	44-51	1.72	2.43	≠ 0.71
4. Maxim	"	13	53-55	2.72	5.93	≠ 3.21
5. Improver	"	9	54-55	4.06	6.70	≠ 2.64
6. Invader	"	5	54-55	5.20	6.70	≠ 1.50
1. Hi Ho	Ayr.	43	49-55	2.59	3.17	≠ 0.58
2. Gentleman	"	27	51-55	2.82	3.06	≠ 0.24
3. Douglas	"	22	44-47	1.31	1.50	≠ 0.19
4. Novel	"	22	46-54	2.73	2.61	- 0.12
5. Echo	"	17	44-51	1.41	2.14	≠ 0.73
6. Star	"	8	54-55	3.75	3.65	- 0.10
7. High Noon	"	6	44-47	1.67	1.50	- 0.17
1. Draconis	Jer.	38	44-55	2.55	3.30	≠ 0.75
2. Advancing	"	37	44-55	3.54	3.30	- 0.24
3. Standard	"	16	47-55	2.84	3.31	≠ 0.47
4. Advancer	"	14	53-55	2.76	4.00	≠ 1.24
5. Sparkling	"	14	49-55	3.46	3.57	≠ 0.11
6. Volunteer	"	13	44-48	1.89	2.92	≠ 1.03
7. Aim	"	9	53-55	2.72	4.00	≠ 1.28
8. Nash	"	5	53-55	2.30	4.00	≠ 1.70

SUMMARY

The breeding records of the Oklahoma A. & M. College dairy herd were summarized to study those factors commonly associated with reproductive efficiency.

1. A large year effect for services per conception was found ($P < 0.01$).
2. The monthly average services per conception varied from a high of 3.53 in December to a low of 2.44 in October. These months were significantly different ($P < 0.05$). There was a tendency for the average services per conception to increase with the number of services per month.
3. Repeatability of reproductive performance over breeds, as measured by number of services per conception, was 0.0098.
4. The first gestation required more services per conception than did the second, third, fourth and fifth gestations, with a gradual decrease to the fifth gestation which had the lowest number of services per conception in these data.
5. The average length of 1780 estrous cycles following infertile service was 41.66 days, with a standard deviation of 33.1 days. The length of intervals ranged from 2 to 324 days.
6. Known abortions had a negligible effect on the reproductive efficiency of the herd during the period covered by this study.
7. A total of 74,149 days were lost during a five and one-half year period, due to decreased reproductive efficiency. This is equivalent to 203 cow years, or an average of 37 cows per year.

8. A total of 895 cows in 96 groups averaged 2.33 services per conception. Because of the large year effect and the variation in the number of cows per group, it was difficult to make comparisons of the groups. However, it was noted that the cow groups with large numbers tended to be near the breed average.
9. There were 30 sire groups which averaged 2.55 services per conception. A difference of more than one service per conception between sires within a breed was noted in the Holstein, Guernsey, and Jersey breeds.

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A P P E N D I X

APPENDIX

TABLE I

SUMMARY OF SERVICES, CONCEPTIONS, AND SERVICES PER CONCEPTION

GUERNSEY BREED

1st No. - No. of Services
2nd No. - No. of Conceptions
3rd No. - No. of Services per Conception

BULL	1944	1945	1946	1947	1948	1949	1950
Mohican	33/18/1.8	46/22/2.1	67/18/3.7	51/24/2.1	41/23/1.8	62/27/2.3	24/5/4.8
Crystal Arc	-	8/5/1.6	-	-	-	-	-
Ambassador	-	-	14/8/1.8	19/13/1.5	37/20/1.9	39/11/3.5	83/23/3.6
Financier	-	-	-	-	-	-	-
Vegor	-	-	-	-	-	-	-
Maxim	-	-	-	-	-	-	16/8/2.0
Allsquire	-	4/4/1.0	-	-	-	-	-
Knight	-	-	1/0/	-	-	-	-
Invader	-	-	-	-	-	-	-
Improver	-	-	-	-	-	-	-
Excel	-	-	-	-	-	-	-
Cornation Dick	-	-	-	-	-	-	-
Kings Lad	-	-	-	-	-	-	-
Imperial	-	-	-	-	-	-	-
Viking	-	-	-	-	-	-	-
Van Dyke	-	-	-	-	-	-	-
Ideals Pharoah	-	-	-	-	-	-	-
Harbor Bull	-	-	-	-	-	-	-
Efaws W. F.	-	-	-	-	-	-	-
Prediction	-	-	-	-	-	-	-
Ensign	-	-	-	-	-	-	-
Judy's Bull	-	-	-	-	-	-	-
Jeweler	-	-	-	-	-	-	-
Sherbert	-	-	-	-	-	-	-
Maggies Bull	-	-	-	-	-	-	-
Breeding/Year	33/18/1.8	58/31/1.9	82/26/3.2	70/37/1.9	78/43/1.8	101/38/2.7	123/36/3.4

Table I (Continued) - Guernsey Breed

BULL	1951	1952	1953	1954	1955	Totaled & Averaged over Years Total Ser.	Total Con.	Ser/Con.
Mohican	-	-	-	-	-	324	137	2.4
Crystal Arc	-	-	-	-	-	8	5	1.6
Ambassador	44/4/11.0	21/7/3.0	26/4/4.5	15/2/7.5	26/3/8.7	324	95	3.4
Financier	-	10/3/3.3	32/11/2.9	28/4/7.0	10/2/5.0	80	20	4.0
Vegor	-	8/7/1.1	-	-	-	8	7	1.1
Maxim	53/27/2.0	-	-	12/2/6.0	31/10/3.1	112	47	2.4
Allsquire	-	-	-	-	-	4	4	1.0
Knight	-	-	-	-	-	1		
Invader	18/9/2.0	35/17/2.1	5/1/5.0	-	-	58	27	2.2
Improver	11/6/1.8	43/18/2.4	62/11/5.6	-	-	116	35	3.3
Excel	-	-	-	-	18/1/18.0	18	1	18.0
Cornation Dick	-	-	25/8/3.1	49/10/4.9	21/3/7.0	95	21	4.5
Kings Lad	-	-	6/0/	16/0	1/0/	23		
Imperial	-	-	-	-	2/1/2.0	2	1	2.0
Viking	-	-	-	-	6/0	6		
Van Dyke	-	-	-	11/3/3.7	23/3/7.7	34	6	5.7
Ideals Pharoah	-	-	2/0/	4/0/	7/0/	13		
Harbor Bull	-	-	-	-	2/0/	2		
Efaws, W. F.	-	-	-	-	2/0/	2		
Prediction	-	-	-	1/0/	-	1		
Ensign	-	-	-	-	1/0/	1		
Judy's Bull	-	-	-	-	6-30/2/3-15	6-30*	2	3-15*
Jeweler	-	-	-	1/1/1.0	-	1	1	1.0
Sherbert	-	-	-	-	1/0/	1		
Maggies Bull	-	-	1/1/1.0	-	-	1	1	1.0
Breeding/Year	126/46/2.7	117/52/2.3	159/36/4.4	137/22/6.2	157/25/6.3		1241/410/3.0	

*Pasture breeding - Range of possible services

Table I (Continued)

HOLSTEIN BREED

1st No. - No. of Services
2nd No. - No. of Conceptions
3rd No. - No. of Services per Conception

BULL	1944	1945	1946	1947	1948	1949	1950
Remer	-	-	-	-	24/13/1.8	34/8/4.3	34/10/3.4
Valiant	-	-	-	12/6/2.0	42/19/2.2	85/25/3.4	63/19/3.3
Skylark	66/26/2.5	26/6/4.3	-	-	-	-	-
Belmont	5/2/2.5	81/33/2.5	61/28/2.2	62/32/1.9	9/3/3.0	-	-
Deacon	-	-	20/8/2.5	-	-	-	-
Baron	-	-	-	-	-	-	11/5/2.2
Burke Fobes	-	-	-	-	-	-	20/2/10.0
Veteran	-	-	-	-	-	-	3/0
Valor	-	-	-	-	1/1/1.0	-	-
Pontiac	82/7/11.7	-	-	-	-	-	-
Flood	-	-	-	-	-	-	-
Lad	-	-	-	-	-	-	-
King	-	-	-	-	-	-	-
Unknown Services	-	-	3/2/1.5	1/1/1.0	2/2/1.0	-	-
H - 9	-	-	-	-	-	-	-
H - 10	-	-	-	-	-	-	-
H - 13	-	-	-	-	-	-	-
H - 14	-	-	-	-	-	-	-
H - 62	-	-	-	-	-	-	-
Breeding Year	153/35/4.4	107/39/2.7	84/38/2.2	75/39/1.9	78/38/2.1	119/33/3.6	131/36/3.6
NS Only	-	-	-	-	-	-	-

Table I (Continued) - Holstein Breed

BULL	1951	1952	1953	1954	1955	Totaled & Averaged over Years Total Ser.	TotalCon.	Ser/Con.
Remer	14/3/4.7	9/3/3.0	35/18/1.9	7/1/7.0	4/0/	161	56	2.9
Valiant	17/5/3.4	56/23/2.4	44/20/2.2	9/2/4.5	23/6/3.8	351	125	2.8
Skylark	-	-	-	-	-	92	32	2.9
Belmont	-	-	-	-	-	218	98	2.2
Deacon	-	-	-	-	-	20	8	2.5
Baron	15/41/3.8	6/5/1.2	-	-	-	32	14	2.3
Burke Fobes	47/14/3.4	9/2/4.5	7/1/7.0	9/2/4.5	-	92	21	4.4
Veteran	0/0/	59/13/4.5	11/1/11.0	-	-	73	14	5.2
Valor	11/3/3.7	-	-	-	-	12	4	3.0
Pontiac	-	-	-	-	-	82	7	11.7
Flood	-	-	16/9/1.8	67/29/2.3	74/13/5.7	157	51	3.1
Lad	-	-	10/5/2.0	52/30/1.7	50/14/3.6	112	49	2.3
King	-	-	-	-	11/0/	11	0	
Unknown Services	4/4/1.0	4/2/2.0	-	-	-	14	11	1.3
H - 9	-	-	14/1/14.0	-	-	14	1	14.0
H - 10	-	-	12/3/4.0	-	-	12	3	4.0
H - 13	-	-	14/2/7.5	-	-	14	2	7.0
H - 14	-	-	23/2/11.5	-	-	23	2	11.5
H - 62	-	-	-	-	8/0/	8	0	
Breeding Year	108/33/3.3	143/48/3.0	186/62/3.0	144/64/2.3	170/33/5.2		1496/497/3.0	
NS Only	-	-	123/54/2.3	-	151/33/416		1416/490/2.9	

Table I (Continued)

AYRSHIRE BREED

1st No. - No. of Services
2nd No. - No. of Conceptions
3rd No. - No. of Services per Conception

BULL	1944	1945	1946	1947	1948	1949	1950
Hi Ho	-	11/7/1.6	25/17/1.5	45/24/1.9	35/21/1.7	46/15/3.1	46/13/3.5
Novel	49/34/1.4	29/20/1.5	9/6/1.5	-	-	-	-
Gayboy	10/7/1.4	-	-	-	-	-	-
Gentleman	-	-	-	-	9/6/1.5	29/10/2.9	64/15/4.3
Star	-	-	-	-	-	-	-
Bingo	-	-	-	-	-	-	-
Prince	-	-	-	-	-	-	-
Echo	1/1/1.0	-	-	-	-	-	-
High Noon	2/2/1.0	-	-	-	-	-	-
Miscellaneous	1/0/	-	-	10/10/1.0	1/1/1.0	-	-
Fame	-	-	-	-	-	-	-
Princess Bull	-	-	-	-	-	-	-
Lippitt Gus A-9	-	-	-	-	-	-	-
A-8	-	-	-	-	-	-	-
A-6	-	-	-	-	-	-	-
A-5	-	-	-	-	-	-	-
A-3	-	-	-	-	-	-	-
Melody Master	-	-	-	-	-	-	-
Breeding Year	63/44/1.4	40/27/1.5	34/23/1.5	55/34/1.6	45/28/1.6	75/25/3.0	110/28/3.9

Table I (Continued) - Ayrshire Breed

BULL	1951	1952	1953	1954	1955	Totaled & Averaged over Years Total Ser.	Total Con.	Ser/Con.
Hi Ho	62/23/2.7	44/18/2.4	33/13/2.5	42/10/4.2	22/10/2.2	411	171	2.4
Novel	-	-	-	-	-	87	60	1.5
Gayboy	-	-	-	-	-	10	7	1.4
Gentleman	33/13/2.5	28/15/1.9	41/19/2.2	20/4/5.0	22/3/7.3	246	85	2.9
Star	16/7/2.3	23/7/3.3	3/1/3.0	76/19/4.0	68/23/3.0	186	57	3.3
Bingo	-	1/1/1.0	33/5/6.6	-	-	34	6	5.7
Prince	-	5/1/5.0	15/3/5.0	-	-	20	4	5.0
Echo	-	-	-	-	-	1	1	1.0
High Noon	-	-	-	-	-	2	2	1.0
Miscellaneous	-	-	-	-	-	12	11	1.1
Fame	-	-	14/8/1.8	8/4/2.0	-	22	12	1.8
Princess Bull	-	-	-	4/2/2.0	-	4	2	2.0
Lippitt Gus A-9	-	-	-	1/0/	6/2/3.0	7	2	3.5
A-8	-	-	-	2/0/	-	2		
A-6	-	-	3/0/	-	-	3		
A-5	-	-	5/1/5.0	-	-	5	1	5.0
A-3	-	-	-	-	6/0/	6		
Melody Master	-	-	-	-	23/5/4.6	23	5	4.6
Breeding Year	111/43/2.6	101/42/2.4	147/50/2.9	153/39/3.9	147/43/3.4		1081/426/2.54	

Table I (Continued)

JERSEY BREED

1st No. - No. of Services
2nd No. - No. of Conceptions
3rd No. - No. of Services per Conception

BULL	1944	1945	1946	1947	1948	1949	1950
Ronald	63/18/3.5	71/18/3.9	44/18/2.4	47/20/2.4	34/12/2.8	34/11/3.1	22/9/2.4
D.R. Standard	50/15/3.3	43/14/3.1	-	4/2/2.0	21/9/2.3	-	-
S. R. Royal	-	-	5/2/2.5	22/13/1.7	40/13/3.1	66/16/4.1	51/14/3.16
Dynamite	2/0/	-	-	-	-	-	-
S. D. Standard	-	30/8/3.8	61/20/3.1	17/13/1.3	6/1/6.0	19/6/3.2	7/3/2.3
Fortune	-	-	6/1/6.0	-	-	-	-
C. Advancer	-	-	-	-	-	-	4/3/1.3
S. A. Nash	-	-	-	-	-	-	31/8/3.9
Aim	-	-	-	-	-	-	-
Wrens Bull	-	-	-	-	-	-	-
Wonder	-	-	-	-	-	-	-
Worthy	-	-	-	-	-	-	-
Finella's Bull	-	-	-	-	-	-	-
Design's Bull	-	-	-	-	-	-	-
Miscellaneous	-	1/1/1.0	2/1/2.0	1/1/1.0	-	3/0/	2/1/2.0
J - 17	-	-	-	-	-	-	-
J - 19	-	-	-	-	-	-	-
J - 21	-	-	-	-	-	-	-
Breeding Year	115/33/3.5	145/41/3.5	118/42/2.8	91/49/1.9	101/35/2.9	122/33/3.7	117/38/3.1

Table I (Continued) - Jersey Breed

BULL	1951	1952	1953	1954	1955	Totaled & Averaged over Years Total Ser.	Total Con.	Ser/Con.
Ronald	17/9/1.9	-	-	-	-	332	115	2.9
D. R. Standard	-	-	-	-	-	118	40	3.0
S. R. Royal	-	-	-	-	-	184	58	3.2
Dynamite	-	-	-	-	-	2		
S. D. Standard	1/0/	-	-	-	-	141	51	2.8
Fortune	-	-	-	-	-	6	1	6.0
C. Advancer	27/11/2.5	22/11/2.0	25/2/12.5	44/12/3.7	11/0/	133	39	3.4
S. A. Nash	74/12/6.2	31/4/7.8	54/3/18	20/2/8.5	8/2/4.0	218	31	6.9
Aim	18/7/2.6	43/15/2.9	26/9/2.9	14/5/2.8	-	101	36	2.8
Wrens Bull	-	4/3/1.3	15/5/3.0	-	-	19	8	2.4
Wonder	-	-	9/5/1.8	27/6/4.5	55/15/3.7	91	26	3.5
Worthy	-	-	10/5/2.0	-	8/0/	18	5	3.6
Finella's Bull	-	-	-	1/1/1.0	-	1	1	1.0
Design's Bull	-	-	4/3/1.3	1/0/	-	5	3	1.7
Miscellaneous	3/3/1.0	2/2/1.0	-	-	-	15	9	1.7
J - 17	-	-	18/3/6.0	-	-	18	3	6.0
J - 19	-	-	1/0/	-	-	1		
J - 21	-	-	19/3/6.3	16/3/5.3	3/1/3.0	38	7	5.4
Breeding Year	140/42/3.3	102/35/2.9	181/38/4.8	123/29/4.1	85/27/3.1		1440/432/3.3	

Table I (Continued)

ALL BREEDS (1944-1955 inclusive)

	1944	1945	1946	1947	1948	1949	1950
Holstein	153/35/4.4	107/39/2.7	84/38/2.2	75/39/1.9	78/38/2.1	119/33/3.6	131/36/3.6
Guernsey	33/18/1.8	58/31/1.9	82/26/3.2	70/37/1.9	78/43/1.8	101/38/2.7	123/36/3.4
Ayrshire	63/44/1.4	40/27/1.5	34/23/1.5	55/34/1.6	45/28/1.6	75/25/3.0	110/28/3.9
Jersey	115/33/3.5	145/41/3.5	118/42/2.8	91/49/1.9	101/35/2.9	122/33/3.7	117/38/3.1
Average	364/130/2.8	350/138/2.5	318/129/2.5	291/159/1.8	302/144/2.1	417/129/3.2	481/138/3.5

	1951	1952	1953	1954	1955	Total
Holstein	108/33/3.3	143/48/3.0	186/62/3.0	144/64/2.3	170/33/5.2	1496/497/3.0
Guernsey	126/46/2.7	117/52/2.3	159/36/4.4	137/22/6.2	181/25/7.2	1241/410/3.0
Ayrshire	111/43/2.6	101/42/2.4	148/50/3.0	153/39/3.9	147/43/3.4	1081/426/2.5
Jersey	140/42/3.3	102/35/2.9	181/38/4.8	123/29/4.1	85/27/3.1	1440/432/3.3
Average	485/164/3.0	463/177/2.6	684/186/3.7	557/154/3.6	583/128/4.6	5258/1765/3.0

TABLE II

BREEDINGS BY MONTHS - OVER YEARS (1944-55 INCLUSIVE) - HOLSTEIN

BULL	YEARS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1	48-55	15/4	15/3	19/8	16/5	9/1	8/3	9/2	9/3	12/6	22/11	13/7	14/3	161/56
2	47-55	32/8	37/12	26/10	24/9	35/17	22/8	19/6	28/11	21/8	40/16	24/10	43/10	351/125
3	44-45	16/6	8/2	9/2	13/2	12/4	9/3	7/5	6/3	6/2	3/1	1/1	2/1	92/32
4	44-48	30/13	33/18	22/11	18/9	13/5	11/6	12/5	15/2	16/6	17/9	9/3	22/11	218/98
5	1946	-	-	2/1	5/2	1/1	-	1/0	-	3/2	3/1	2/0	3/1	20/8
6	50-52	5/1	6/2	3/1	1/0	1/1	1/1	1/1	2/1	3/3	3/0	3/2	3/1	32/14
7	50-54	11/2	3/0	11/0	5/2	10/4	7/0	4/2	5/3	2/0	10/5	10/2	14/1	92/21
8	50-53	9/0	12/3	6/1	8/3	10/3	2/0	4/0	5/2	-	1/0	6/0	10/2	73/14
9	48,51	-	-	-	-	1/1	2/1	-	1/0	3/0	4/2	1/0	-	12/4
10	53-55	12/3	8/2	13/6	13/7	4/1	10/4	6/2	10/2	14/3	21/8	28/9	18/4	157/51
11	53-55	6/6	9/4	13/4	6/4	4/1	8/4	4/1	5/0	9/5	10/5	29/12	9/3	112/49
12	1955	-	-	-	-	-	-	-	-	-	-	3/0	8/0	11/0
13	1944	14/1	12/0	8/0	17/1	18/1	10/4	3/0	-	-	-	-	-	82/7
Miscellaneous		1/1	-	10/1	6/0	24/4	14/5	19/5	-	1/1	-	8/1	2/1	85/19
Totals		151/45	143/46	142/45	132/44	142/44	104/39	89/29	86/27	90/36	134/58	137/47	148/38	1496/497
Av. Ser/Con.		3.4	3.1	3.2	3.0	3.2	2.7	3.1	3.2	2.5	2.3	2.9	3.9	3.01
% Conception		29.80	32.17	31.69	33.59	30.99	36.89	32.58	31.40	40.00	43.28	34.31	25.68	33.22

1 - P. Remer P.
2 - S. P. Valiant
3 - S. B. Fobes
4 - P. S. B. Bess
5 - S. P. Deacon
6 - S. V. Baron
7 - S. B. B. Fobes
8 - S. B. Veteran
9 - S. R. Valor
10 - H. R. Flood
11 - H. R. Lad
12 - King
13 - S. H. Pontiac

Table II (Continued) - Guernsey

BULL	YEARS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1	44-50	38/12	31/12	24/11	29/15	29/18	15/1	22/8	24/12	32/11	26/15	23/9	31/13	324/137
2	1945	-	-	-	-	-	-	-	2/1	5/4	1/0	-	-	8/5
3	46-55	33/11	27/10	25/3	24/5	26/6	19/5	21/4	25/5	22/9	25/13	27/9	50/15	324/95
4	52-55	5/2	5/3	14/3	4/0	8/2	4/0	4/0	4/0	7/1	5/2	3/0	17/7	80/20
5	1952	5/4	3/3	-	-	-	-	-	-	-	-	-	-	8/7
6	50,51 54,55	17/6	11/3	16/9	15/7	10/7	3/1	2/0	2/0	3/1	10/4	12/5	11/4	112/47
7	1945	-	-	1/1	1/1	2/2	-	-	-	-	-	-	-	4/4
8	1946	-	1/0	-	-	-	-	-	-	-	-	-	-	1/0
9	51-53	5/2	6/3	5/1	5/3	5/3	3/1	3/2	6/2	3/1	6/5	5/0	6/4	58/27
10	51-53	3/0	8/3	12/1	19/7	20/5	10/3	7/3	10/5	5/1	8/4	5/2	9/1	116/35
11	1955	-	-	-	-	1/0	2/0	3/1	4/0	3/0	1/0	3/0	1/0	18/1
12	53-55	11/2	10/2	7/2	7/1	6/3	4/0	11/1	6/1	8/3	7/2	10/3	8/1	95/21
13	53-55	1/0	-	-	-	-	-	-	1/0	4/0	4/0	6/0	7/0	23/0
14	1955	-	-	-	-	2/1	-	-	-	-	-	-	-	2/1
15	54-55	2/0	2/2	3/1	10/1	7/2	1/0	-	-	-	-	4/0	5/0	34/6
16	1955	-	-	-	-	-	-	-	-	-	-	3/0	5/0	8/0
Miscellaneous	53-55	6/1	3/0	1/0	1/0	-	1/0	-	4/2	5/1	-	1/0	4/0	26/4
Totals		126/40	107/41	108/32	115/40	116/49	62/11	73/19	88/28	97/32	93/45	102/28	154/45	1241/410
Av. Ser/Con.		3.2	2.6	3.4	2.9	2.4	5.6	3.8	3.1	3.0	2.1	3.6	3.4	3.03
% Conception		31.75	38.32	29.63	34.78	42.24	17.74	26.02	31.82	32.99	48.39	27.45	29.22	33.04

1 - M.L.K. Mohican
2 - S. C. Arc
3 - M. L. Ambassador
4 - B. Financier
5 - L. L. L. Vegor
6 - B. K. S. Maxim
7 - D. Allsquire
8 - S. Novel Knight
9 - Invader
10 - Improver
11 - Excel
12 - Cornation Dick
13 - Kings Lad
14 - Imperial
15 - Van Dyke
16 - Viking

Table II (Continued) - Ayrshire

BULL	YEARS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1	45-55	40/22	40/18	37/15	39/9	39/17	34/16	33/16	24/11	23/11	26/10	28/12	48/14	411/171
2	44-46	9/6	9/7	18/13	12/7	6/3	9/6	6/4	5/3	5/4	3/2	1/1	4/4	87/60
3	1944	10/7	-	-	-	-	-	-	-	-	-	-	-	10/7
4	48-55	21/3	22/8	18/7	22/4	26/11	26/11	24/11	13/4	20/8	14/7	13/4	27/7	246/85
5	51-55	23/6	25/8	19/5	16/6	14/8	10/3	8/4	11/3	7/2	14/3	22/6	17/3	186/57
6	52-53	2/1	3/0	4/1	-	2/0	-	2/0	2/0	5/1	5/2	5/0	4/1	34/6
7	52-53	7/2	2/0	2/0	4/1	-	-	-	-	-	-	-	5/1	20/4
8	1944	1/1	-	-	-	-	-	-	-	-	-	-	-	1/1
9	1944	2/2	-	-	-	-	-	-	-	-	-	-	-	2/2
10	53-54	2/0	2/2	4/2	-	-	-	-	-	1/1	-	3/1	10/6	22/12
11	1954	2/0	-	2/2	-	-	-	-	-	-	-	-	-	4/2
12	1955	-	-	-	-	-	-	-	1/1	1/0	5/2	11/2	5/0	23/5
Miscellaneous	44-55	5/0	4/1	6/3	1/1	1/1	1/1	1/1	1/1	1/1	1/1	3/1	10/2	35/14
Totals		124/50	107/44	110/48	94/28	88/40	80/37	74/36	57/23	63/28	68/27	86/27	130/38	1081/426
Av. Ser/Con.		2.4	2.4	2.3	3.4	2.2	2.2	2.1	2.5	2.3	2.5	3.2	3.4	2.54
% Conception		40.32	41.12	43.64	29.79	45.45	46.25	48.64	40.35	44.44	39.71	31.40	29.23	39.41

1 - D. C. Hi Ho
2 - S. A. C. Novel
3 - Gayboy
4 - D. C. C. Gentleman
5 - L. B. Star
6 - Bingo
7 - Pearl's Bull
8 - S. B. Echo
9 - S. High Noon
10 - Fame
11 - Princess Bull
12 - Melody Master

Table II (Continued) - Jersey

BULL	YEARS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
1	44-51	43/16	34/11	24/6	30/7	28/8	29/14	24/7	19/4	20/4	25/11	28/17	28/10	332/115
2	44-48	21/9	7/4	4/3	18/5	11/2	9/3	11/5	8/1	10/4	5/1	3/1	11/2	118/40
3	46-50	19/3	20/3	7/3	16/3	15/6	16/7	7/2	10/6	11/5	19/6	19/5	25/9	184/58
4	1944	-	1/0	1/0	-	-	-	-	-	-	-	-	-	2/0
5	45-51	14/5	15/6	10/5	8/3	7/3	18/4	16/2	3/1	9/3	19/9	9/3	13/7	141/51
6	1946	-	-	-	-	-	-	-	1/0	3/1	1/0	1/0	-	6/1
7	50-55	23/3	17/4	13/4	12/8	11/5	3/2	5/1	4/1	12/3	12/3	9/3	12/2	133/39
8	50-55	28/1	38/3	23/2	20/2	16/6	5/0	6/2	4/1	4/1	18/4	26/5	30/4	218/31
9	51-54	4/0	7/4	6/1	17/6	9/2	9/5	5/0	7/2	10/3	15/6	7/5	5/2	101/36
10	52-53	4/2	3/0	5/2	2/1	1/0	-	-	-	-	-	-	4/3	19/8
11	53-55	9/4	5/1	6/3	9/4	9/4	2/0	8/3	8/1	4/1	9/1	13/3	9/1	91/26
12	53-55	1/0	4/1	2/1	5/1	5/2	6/0	-	3/1	3/0	4/0	2/0	3/1	38/7
13	53,55	-	-	-	-	3/2	-	2/1	4/2	1/0	-	4/0	4/0	18/5
14	53,54	-	1/0	-	-	-	-	-	-	-	-	1/1	3/2	5/3
Miscellaneous	53,54	1/1	2/1	1/1	4/2	1/0	8/2	7/0	3/0	2/1	3/3	2/1	-	34/12
Totals		167/44	154/38	102/31	141/42	116/40	105/37	91/23	74/20	89/26	130/44	124/44	147/43	1440/432
Av. Ser/Con.		3.8	4.1	3.3	3.4	2.9	2.8	4.0	3.7	3.4	3.0	2.8	3.4	3.33
% Conception		26.35	24.68	30.39	29.79	34.48	35.24	25.27	27.03	29.21	33.85	35.48	29.25	30.00

1 - A. Ronald
2 - D. R. Standard
3 - S. R. Royal
4 - D. O. Dynamite
5 - S.D. Standard
6 - S. D. Fortune
7 - M. C. Advancer
8 - S. A. Nash
9 - P. R. B. Aim
10 - Wrens Bull
11 - Wonder
12 - True Lad J 21
13 - Worthy
14 - Design Bull

Table II (Continued) - Over Breeds - Over Years (1944-1955) - By Months

BREED	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTALS
1	151/45	143/46	142/45	131/44	142/44	103/38	89/29	86/27	90/36	134/58	137/47	148/38	1496/497 3.01 Sv/C 33.22%
2	126/40	107/41	108/32	115/40	116/49	62/11	73/19	88/28	97/32	93/45	102/28	154/45	1241/410 3.03 Sv/C 33.04%
3	124/50	107/44	110/48	94/28	88/40	80/37	74/36	57/23	63/28	68/27	86/27	130/38	1081/426 2.54 Sv/C 39.41%
4	167/44	154/38	102/31	141/42	116/40	105/37	91/23	74/20	89/26	130/44	124/44	147/43	1440/432 3.33 Sv/C 30.00%
Totals	568/179	511/169	462/156	481/154	462/173	350/123	327/107	305/98	339/122	425/174	449/146	579/164	5258/1765
Av. Ser/Con.	3.17	3.02	2.96	3.12	2.67	2.85	3.06	3.11	2.78	2.44	3.08	3.53	2.98
% Conception	31.51	33.07	33.77	32.02	37.45	35.14	32.72	32.13	35.99	40.94	32.52	28.32	33.57

1 - Holstein
2 - Guernsey
3 - Ayrshire
4 - Jersey

TABLE III

INTERVALS BETWEEN ESTRUAL PERIODS FOLLOWING INFERTILE SERVICES, BY COW
HOLSTEIN COWS - (ALL GESTATIONS)

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S S Alta	51														
"	43														
"	20	41	20	78	28										
"	20														
S B Almeda	24														
"	22														
S S Carolyn	54														
S S India	48	31	247												
S D Kora	72														
"	20	20	98	25	24	21	32								
S S Hattie	116														
S P Paoli	(209*)														
"	45	62													
"	71														
"	21														
S B Cornelia	26	10													
S B Harriet	73														
"	23														
S B Inelda	45														
"	62														
S B Korina	60	62	43	21	83										
S B Koller	46	35	52												
"	41	19	21	62											
"	105														
S S Aileen	44	17	20												

*Known Abortions

Table III (Continued) - Holstein

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S S Surprise	85	43													
S S Ideal	66														
"	55	81	21	38	21	24	21	25	19	19	21	44			
S S Holly	93														
S S Holly	44	41													
S B Arlene	63	23	64												
S B Priscilla	20	23	25												
S S Klinger	61														
"	3														
"	37	121													
S S Koval	61	185													
S B Hannah	25	40	20	(164*)											
"	49	23	63												
S S Harmony	24														
"	70	44	24												
"	86														
"	25	42	49												
S B Carrie	(172*)														
"	63	192*													
"	40														
S B Pine	31	121	20												
"	84														
S B Altus	69														
S B Bebee	93														
"	40	23													
S B Varga	34	38													
"	82	52	50												
"	58	25	60	(208*)											
S B Konawa	16	42	30												
"	20	70	40												
"	63														

*Known Abortions

Table III (Continued) - Holstein

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S B Hester	39	22	44												
"	17	25	15												
S D Almira	21														
"	80	23	37	19	66	56	21	60							
S B Alfalfa	63	50													
S V Pristina	46	20													
"	43	24	48	21	49										
"	89	25													
S V Arleta	63	39													
"	41	92	6												
S B Suwanee	22	61	21	20											
"	16														
S V Holiday	46	21													
S R Kola	42	95													
"	41														
"	18	14													
S R Sweetheart	47	40													
"	23	47	20												
"	44														
S V Pin-up	34	64	65	110											
S V Korea	87	97	19												
"	58	22	24	19	21	21	21								
S R Hark	50	42	56	25	21										
S R Canary	189														
S R Careful	20	39	21	20	47	58									
"	24	22													
S R Formosa	201	35	98												
"	47	46	42	(169*)											

*Known Abortions

Table III (Continued) - Holstein

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S R Formosa	20	21	105												
"	109	20													
S V Koronet	19	21	28	30	19	70	20	42							
"	22														
"	23	30	104	41	20										
S V Korona	29	25	22	32											
"	31	43	80	77											
"	43														
S V Carlinda	41	24	33												
"	21														
S B Palm	57	18													
S V Hatpin	20	63													
"	41	117	21	37	13	26	40								
S F Sweetness	63	24	21												
"	40														
SKV Mistress Queen	23	23	54	24	22										
ORA Countess	22	38	23	23	22	47									
I Maudlene DeKol	26	30	22												
S B Ruby	23	29	27	18	33										
"	43														
B C Alcarta	22														
SKRA Lauxmaster	22	62	85	153											
"	48														
"	17	51	27												
USWB DGH Maid	26														
USWG Rose DHE M	102														
"	32	74													
S I Annabelle	21	44	22	24											
I C Inka Rock	27	20	58												
"	58														
"	20														

Table III (Continued) - Holstein

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S R Betty	44	21	21	21											
S F Pretty	19	85	Pasture Bred 101											Never Calved	
S B Carolyn	86														
S F Alma	66	29	61												
S V Alta	21	56	22	20	19	20	21	39							
S B Venus	20														
"	22	22													
"	22	49	69												
S R Honesty	71	65													
S V Klimer	20	146													
"	39														
"	19	89													
"	66	69													
"	42	24													
S B Pallas	22	53													
S V Kolor	53														
"	41														
"	25	13													
"	36	23													
"	21	21	24												
S F Prissy	47	38													
S F Honoree	47													Never Calved	
S O Buttergirl	84														
S B Polkadot	19														
"	31	41	25	37	24	40									
S V Kleen	40	22													
"	21														
D F S Maud	62														
S V Konnie	79	44													
"	62	53	62												
K Q Pride	25	22	43	44	21	24									

Table III (Continued) - Holstein

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S V Klip	30	19	28	48	39	46									
S V Kliming	19	23	20	19	39										
S V Inelda	21														
S Polka	25	67	40	22	20										
S V Allie	20														
S V Sussex	20	125													
S V Form	64	21	20												
S V Veneer	28	48	14												
S V Ida	42	20	38	20	19	20	20	19							
S V Alpha	36	56	29	26	26										
S B Variety	21														
S R Success	44														
S V Kove	84														
S V Mandy	103	57	21												
S V Rhoda	53	42													
S A Patience	18														
S T Castle	40	39													
S T Anita	31	21	24	24	45	22									
S R Helen	21														
S V Inca	19	23													
S V Carat	110	18	37												
S V Pineapple	27	54													
S V Ina	170	41	103	29	75										
"	25														
"	19	25													
S V Success	22	23	86	22											
"	24														
S V Patience	38	90	18	31	53										
S V Kling	39														
"	51	39	21												

Table III (Continued) - Holstein

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S V Kling	37	78	19	20											
"	25														
S V Koed	56	39	210	45	143	20									
"	44														
"	65	27	20	22	20										
S V Varuna	72														
"	42	78	(212*)												
"	40	21													
S R Koller	19														
S R Ione	46	21													
	8532	5192	3310	1407	1154	515	196	185	19	19	21	44			

TOTAL = 20,594 Days

*Known Abortions

Table III (Continued)

GUERNSEY COWS - (ALL GESTATIONS)

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
Unita of Primrose	68														
"	15	30	48	25	28										
Primrose O. Mary	45	27	45												
"	38	23	(113*)												
"	25	24													
Mary Anns Angie	23	57	24	22	64	259									
Sumarias Sunshine	35	25													
"	91	143	36	22	38	139	25	17	27	19					
S M Eagle	81														
SMA Sumatra	21	21													
"	19														
S A Curie	26														
S M Cecil	41	60	77												
"	(201*)														
S M Beda	22														
S M Ella	21														
"	36	21													
S M Whistle	52	27													
"	71	22													
S M Cedar	24														
"	31	22													
S M Rarity	49	21	51	20	20	42	22	49	21	20	43	25	21	20	67
S M Judy	24	44													
S M Wilhelmina	21	54													
"	59	21	61												
"	17														

*Known Abortions

Table III (Continued) - Guernsey

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S M Belva	30	101	76	23	25										
"	48														
S M Serene	19														
S A Jackie	21	27													
"	28	78													
"	11	11													
S A Jess	24														
"	82	84	21	22	83	24									
S A Earline	22	20	21												
S A Marquita	51														
"	69														
S M Uneda	29	90													
S A Early	103														
S A Beckie	20	21	24	65	20	19	20	32	20	21	45	20	66	20	22
S A Hostess	40	150													
"	86														
S M Bella	23	31													
S A Raven	25	21	28												
S A Mab	69														
S A Mab	23	47	21												
S M Marge	43	36	41												
"	22	23													
S A Wisteria	21	48	36	52	20	8	5	13	49						
"	20														
S M Follette	20	19													
"	19	19													
"	71														
B Q Judy	20														
"	21	20	20	20	44	20	39	21	44	21	25	131	20		

Table III (Continued) - Guernsey

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
B Q Maggie	26	19	22	29	69	26									
"	22														
B A Shirley	13	24													
"	41	27	44												
B B Charm	66														
B Q Patsy	27	28	21												
"	38	47													
B Q Sue	48	56	71	46											
"	21	26	146	24	48	51									
S M Hallie	67	22	25	42											
S A Certain	20														
S M Summary	82	42	66	43	21	41	42	41	97	104	53	23	68	48 (Never Calved)	
S M Hophia	19														
S A Joan	(158*)														
"	20	20	41												
S A Eager	62	43													
"	44	42	44	21	23	21	23								
S A Marquise	21														
S M Earmark	20														
"	25	35	64												
S A Mayfair	114														
"	71	41	41	23	42	20	55	21	21	21					
S A Rarebit	24	21	21	30											
"	46	21	25												
"	24	20	41	42	98	21									
P D Dean	24	21	(127*)												
"	18	21	41	42											
S A Hoper	20	21													

*Known Abortions

Table III (Continued) - Guernsey

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S M Curie	51														
"	23	19	66	129											
Arabella	45														
S M Nifty	21	56	23												
S M Essential	77	72													
S LP Chane	44	22													
S S Pattie	19	41	55	86	24	44	41	54	76						
S M Honey	86	85	48												
"	92	39													
S M Wishful	25	25	185												
S M Earring	69	43	34												
"	23														
S M Esther	23	22	23												
S M Whisper	25	20	70												
S M Julianna	42	11													
"	31	22													
S Max Joy	21														
S H Dot	64														
S I Marqurite	20	19	28												
"	24	19													
N M Ann	24	61	19	20	19	127									
S I Julip	42	93	51	96	39	20	20	22	21						
S H Sherbert	44	23	28	23											
S V Folly	37	43	20	21	24	19									
S I Willie	21	25	27	90	101										
S I Elberta	41	32	23	21											
S I Marion	25	20	26	41											
"	19														
S A Sunshine	21	48													
"	20														

Table III (Continued) - Guernsey

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S I Uneda	17	20	23	51											
S I Mary	55														
"	20	20													
S I Mazie	21	23	18	185											
S V Unita	29	13	79												
S A Whisper	234														
S I Cheer	21	23													
S I Sherry	42	36	40	61	63										
S V Honeydew	23	49													
S I Madge	72	21	22												
	4711	3150	2251	1437	913	901	292	270	376	206	166	199	175	88	89

TOTAL = 15,224 Days

Table III (Continued)

AYRSHIRE COWS - (ALL GESTATIONS)

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S D Ruth	19	46	22	45	42	107	47								
S E Fallacy	22														
"	79														
"	126	19													
"	39	20	19	19	42	19	67								
S E Nettie	83														
S N Karma	29	24													
"	7														
S S Kelly	20														
S N Charm	56	39	67	23	24										
S N Ruby	23														
S N Ramona	48														
S N Rubella	43	20	105	34											
"	67	20	46	40											
"	65	18													
S N Kelp	45														
"	(163*)														
"	20	42	22												
S N Chaffy	60														
S N Kitty	24	54	27												
"	20	22													
"	25	21	72	21	58	56									
S N Khila	21	67													
"	20	21	20	46	82										
S N Static	53	39													

*Known Abortions

Table III (Continued) - Ayrshire

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S N Susie	57														
"	25	68													
"	68														
S N Keen	9	12	17	10	16	15	39	55	65	95	40	20			
"	41	30	62												
S HH Geraldine	20														
"	21														
"	23														
"	44	21	21												
S HH Karline	22	22	20	22	21										
"	23	22	21	21											
S HH Stony	45	93													
S HH Stony	22	21	21												
"	22														
S HH Nerissa	113														
S HH Kildare	21														
S HH Becky	40	82	31	106	68	23									
"	235														
S HH Fearless	188	89	37												
S HH Burke	22	75													
"	20	28	23	23	31	24									
"	25														
S HH Charity	21	168	42	20											
S HH Faithful	24														
"	22														
D C Diane	74														
"	19														
D Sally Ann	21	20	20												
"	20														
"	19	22													

Table III (Continued) - Ayrshire

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S C Mission	22														
S G Kleta	20	30	22	61	66	48	43	212							
"	21	46													
S G Nesta	81	23	24	80	62										
S HH Bonnio	67														
S G Rubina	19	51													
"	17	47	91	24	11	52	36								
"	110	21	21	35	27	23	38	21	21						
S G Keda	61														
"	82														
"	61	88	26												
S HH Secure	33	59													
S HH Ramola	26	44	41	21	21										
"															
S HH Charming	105														
S HH Faultless	29	23	37												
S HH Statvia	22	34													
"	48	80													
"	38	13	18	17	43										
S G Karen	48	155													
"	51	44													
S HH Primrose	22														
S G Starlight	25	24	21	20	7	20									
S G Nerium	85	32													
"	2														
S G Barbara	22														
"	40	44	20												
"	64	108	15	19											
S G Kiltie	18	18	18	27	38										
W R Thrill	148														

Table III (Continued) - Ayrshire

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S Pearl	23	61													
S Rosie	32														
S June	39														
"	19	16	56	30											
W R Min	87														
S Claudia	44														
"	21														
"	22														
S HH Stareyes	21														
S HH Khedive	46	50													
S G Burma	48														
"	(245*)														
S S Minx	38	19	19	(250*)											
S HH Rubidium	26	108	44	43											
S G Ramee	21	52	90												
S HH Secret	24	24													
S HH Kitten	69	20													
S HH Diadem	36	40	41												
"	20														
S B Rilma	21	20													
S HH Khaki	26	45	49	139											
S B Chart	43	21	41	42	18	(183*)									
"	19	20													
S B Fable	41	62	17	83											
S HH Prime	52	112													
S B Starglow	24	29	41	33	125										
S HH Keenness	76	21													
"	75														

*Known Abortions

Table III (Continued) - Ayrshire

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S HH Claudette	21	22	28	63											
S G Karey	33	25	62												
"	40														
S HH Rubina	18														
S G Bonnie	19	19	20	20	104										
S G Charm	100	24	21												
S G Berlin	20	19	20	20	24										
T Donna Lee	33														
"	43	20	42												
G L Flora	24	37	88												
S G Ruby	40	20	22	19	20										
S G Belle	17	43	22	23	43										
S B Karet	27	19	20	19	37	24	16								
HH L Florence	42	18	20	20											
S P Netty	21	20	18	21	25	24	21								
S HH Sally	20	22	20	21	26										
S P Burl	19														
S G Kara	21														
S B Rural	39	20	20	21	41										
S P Kit	51	20	20	23											
S Joyce	8	40	22	111											
"	22														
"	20	21	20	21	44										
S G Kildee	22	21	34	20	20										
S G Katydid	26	21	24												
"	78	20	62												
S HH Diamond	155														
S Judy	102														
"	19														
"	40	40													

Table III (Continued) - Ayrshire

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S G Charitable	22	65													
S B Classy	21	63	20	35	83										
S G Starbright	19	24	27												
"	41	38	32												
S G Bertha	69	42	21	44											
S G Faith	63	51													
S G Kiss	21	30	20												
S G Chant	40	59													
S G Champagne	104														
"	47														
S G Rambler	21														
S HH Rubina	62														
W P Jolene	41	(210*)													
"	50	19	39	42	65										
"	21	20	21	23	18										
S HH Keno	20														
S B Statue	97	18	18												
"															
S B Russett	23	21	31												
S B Klipper	52	65													
"	17	20													
S HH Kathy	46	106	23												
S HH Secret	24	66	93	107											
S P Barbette	39	41	30	20											
G B Gaiety	24	22	24												
S HH Claudesta	22	23													
S B Charmer	20	19	42												
S F Cherry	42	22													
S F Starbright	40														
	6988	4294	2513	1797	1352	435	307	288	86	95	40	20			

TOTAL = 18,215 Days

*Known Abortions

Table III (Continued)

JERSEY COWS - (ALL GESTATIONS)

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S D Nantel	53	21	24												
"	46	21													
S V Norrelle	63														
S D Neon	22	46													
S A Panda	21	21													
"	25	43	41	34	20	23									
"	22	45	33	33	21	21	59	42	49	23	19				
S D Marigold	21	21	53	20	23										
"	54	40	23	41	20	22	49	10	20	98	22				
"	82	23	19	21	20	22	60								
S A Numa	20	20													
S D Lavender	21	51	21												
"	23	44													
N S Design	29														
"	20	21	45	68											
S D Finance	28														
"	25	62													
"	44														
S A Norma	63														
"	49	37	33	60	19										
S D Neossin	22	22													
Tiny Draconis	30	76													
"	23	23	21	23	25	38	46	22	51	56	39	23			
S A Fauvic	149														
S D Marble	20	41	19	41	20										
"	23														
S S Quaker	41	20	40	41	20										
S D Wren	21	19	41	7	12	43	29	108	63						
"	21	51	84	19	60	57	127	36	19						

Table III (Continued) - Jersey

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S A Dream	22	23	67	23	22	24	23	22	24						
S D Flavia	20														
"	56														
S S Fraulein	22														
S S Frolic	21	20	46	21	43	22	21	19	21						
"	19														
S A Neva	43	22	47												
"	48	24	24												
S S Flute	90	18	106	177	40	19	40	37							
S S Carol	23	26	73	73											
S D Nordica	21	20	21												
S A Dragon Fly	21	61	21	20											
S S Financial	114	73	30	21											
S S North	23														
S A Dinah	40	168	34												
"	21	27	19												
S S Norine	43														
"	41	34	22												
"	45	22	48												
S A LaBlanche	41														
"	20	68													
S A Maria	80	41	(180*)												
"	62	19	22	18	40										
"	18	22	20	34	20	21									
"	27														
D C Beauty	45	20	20	115	30	22									
"	27	31	37	21											
S A Tiptoe	214	64	324	62	(82*)										
S S Carmen	(194*)														

*Known Abortions

Table III (Continued) - Jersey

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S S Diana	25	27													
S S Fanetta	21	23	44	42	21										
S S Delores	122	20	20	21	120	20	254	20	58	21	21	60	Never Calved		
S A Nechia	25														
"	26	45	83	18	18	20	18	19							
"	21	21	24	23	23										
S A Quail	15														
"	16	17	25	70	19	61	39	51	(196*)						
"	38	20	26	46											
S S Nola	30	40	61												
S S Fondness	21														
"	45	22	31	22											
S S Paxie	22														
"	22	23	65												
S A Firefly	25	25	71												
S A Notable	57														
S S Finella	44	25	147												
"	67	24	43												
"	25	35													
"	98														
S D Desire	22	77													
S A Laverna	21	80	38	137	39										
"	20														
"	50														
S A Neoma	21														
S A Neodora	67	64	21	21	24	99									
S D Normandy	24														
"	42														

*Known Abortions

Table III (Continued) - Jersey

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services													
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S D Normandy	22	22	20	22											
"	25														
S S Marcia	112														
"	21	43	181												
S S Pandora	19	20													
"	21	19	60												
S S Destiny	78														
S S Quality	19	41													
S A Fidelis	22	19	21	21	28	82	44	46	23	28	79				
S S Marbella	(228*)														
X F Kate	22														
"	23	23	23	155	46										
"	22	22													
S S Fine	159														
"	45	137	6	14	20	23									
S S Pandella	20	42													
S N Frisky	20	20													
S A Quantity	70														
S S Nell	41	65													
S A Constance	38	9	33	133	138	11									
S A Fruitfly	174	67													
"	69														
S A Fonda	132	53	22												
"	63														
S A Pagent	49	78	74	84	112	25	26								
S N Lavender	81	27	31	25											
"	23	19	22												
S A Nada	65	33	19	14											

*Known Abortions

Table III (Continued) - Jersey

Cow Names	Days Interval Between Successive Estrual Periods Following Infertile Services														
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16
S A Necessary	23	24	28	40	65										
S F Kate	38	41	19												
S A Marigold	136	25	94	55	36	13	82								
S A Quick	20	21													
S N Fawn	21	20	22												
"	45														
S N Beautiful	25	235													
"	22														
S A Qualified	19	20													
S N Caroline	87														
S A Dragonfly	43														
S A Wanda	47	195	9												
S A Frosty	176	108	15	87											
S A Nora	28														
S A Fontain	244	94	24												
S A Quality	43	72	250												
S A Nancy	88	28	14												
S A Norway	25	22	24	138											
S A Neva	21	44	15	17	17	18	43								
S B L Marble	21	40	19	39	20	20									
S A Destination	39	20	43	39											
D Elnor	19	22	16												
S D Erma	67														
S W Frisky	47	32	17												
S A Nice	35	41	23	19											
S W Maple	89														
S A Nan	20	19													
TOTAL	6323	4041	3321	2295	1201	726	960	432	328	226	180	83			
TOTAL = 20,116 Days															
ALL BREEDS	26554	16677	11395	6936	4620	2577	1755	1175	809	546	407	346	175	88	89
ALL BREEDS TOTAL 74,149 DAYS															

TABLE IV

LENGTH OF ESTRUSES FOLLOWING INFERTILE SERVICE

Days in Length	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8 15-16	No. of Estruses Total
2	1	-	-	-	-	-	-	1
3	1	-	-	-	-	-	-	1
4	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	1	1
6	-	-	2	-	-	-	-	2
7	1	-	-	1	1	-	-	3
8	1	-	-	-	-	1	-	2
9	1	1	1	-	-	-	-	3
10	-	1	-	1	-	-	1	3
11	1	2	-	-	1	1	-	5
12	-	1	-	-	1	-	-	2
13	1	3	-	-	1	1	1	7
14	-	1	2	2	-	-	-	5
15	2	-	4	-	-	1	-	7
16	3	1	1	-	1	-	1	7
17	7	2	3	2	1	-	1	16
18	6	7	6	3	3	1	1	27
19	29	21	11	9	6	4	8	88
20	48	40	29	17	16	10	13	173
21	60	38	28	20	10	6	21	183
22	42	29	17	9	3	5	6	111
23	25	24	10	12	3	4	6	84
24	20	14	14	5	7	7	1	68
25	26	12	5	4	3	1	4	55
26	10	2	3	1	2	2	1	21
27	6	8	5	1	1	-	1	22
28	4	3	7	-	3	-	1	18
29	6	3	1	2	-	-	1	13
30	4	6	3	3	1	-	-	17
31	6	3	4	1	1	-	-	15
32	2	3	1	1	-	-	2	9
33	3	1	4	2	1	-	-	11
34	2	2	3	3	-	-	-	10
35	2	4	-	2	-	-	-	8
36	4	2	2	-	1	-	2	11
37	3	3	5	2	1	-	1	15
38	8	4	2	1	2	1	1	19
39	8	8	1	2	4	-	5	28
40	14	8	4	3	2	1	3	35
41	17	12	11	5	1	1	2	49
42	10	9	4	6	3	1	3	36
43	12	8	4	2	3	1	3	33
44	13	9	5	2	2	1	3	35
45	11	3	2	2	1	-	1	20
46	8	4	2	3	1	1	2	21

table IV (Continued)

Days in Length	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8 15-16	No. of Estruses Total
47	7	4	1	-	1	1	1	15
48	9	3	4	1	1	1	1	20
49	4	2	2	-	1	-	4	13
50	3	2	1	-	-	-	-	6
51	6	5	2	1	-	1	2	17
52	3	2	1	1	-	1	-	8
53	4	3	1	-	1	-	1	10
54	2	3	1	-	-	-	1	7
55	2	-	1	1	-	-	2	6
56	3	4	2	-	-	2	1	12
57	3	2	-	-	-	1	-	6
58	3	-	1	-	1	1	1	7
59	1	2	-	-	-	-	1	4
60	2	1	2	1	1	-	3	10
61	4	4	3	2	-	1	-	14
62	6	5	4	2	1	-	-	18
63	10	2	1	1	1	-	1	16
64	3	3	2	-	1	-	-	9
65	3	4	2	1	2	-	1	13
66	4	1	2	-	2	-	1	10
67	6	3	2	-	-	-	2	13
68	2	2	-	1	1	-	1	7
69	7	1	1	-	1	-	-	10
70	2	1	1	1	-	1	-	6
71	5	-	2	-	-	-	-	7
72	3	2	1	-	-	-	-	6
73	1	1	1	1	-	-	-	4
74	1	1	1	-	-	-	-	3
75	1	1	-	-	1	-	-	3
76	1	1	1	-	-	-	1	4
77	1	1	1	1	-	-	-	4
78	2	4	-	1	-	-	-	7
79	2	-	1	-	-	-	1	4
80	2	2	1	1	-	-	-	6
81	3	1	-	-	-	-	-	4
82	5	1	-	-	1	1	1	9
83	1	-	1	1	3	-	-	6
84	3	1	1	1	-	-	-	6
85	2	2	1	-	-	-	-	5
86	4	-	1	1	-	-	-	6
87	3	-	-	1	-	-	-	4
88	1	1	1	-	-	-	-	3
89	2	2	-	-	-	-	-	4
90	1	2	1	1	-	-	-	5
91	1	-	1	-	-	-	-	2
92	1	1	-	-	-	-	-	2
93	2	2	1	-	-	-	-	5
94	-	1	1	-	-	-	-	2

table IV (Continued)

Days in Length	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8 15-16	No. of Estruses Total
95	-	1	-	-	-	-	1	2
96	-	-	-	1	-	-	-	1
97	1	1	-	-	-	-	1	3
98	1	-	2	-	1	-	1	5
99	1	2	1	1	-	-	-	5
100	1	-	-	-	-	-	-	1
101	-	1	-	-	2	-	-	3
102	2	-	-	-	-	-	-	2
103	2	-	1	-	-	-	-	3
104	1	-	1	-	1	-	1	4
105	2	-	2	-	-	-	-	4
106	-	1	1	1	-	-	-	3
107	-	-	-	1	-	1	-	2
108	-	3	-	-	-	-	1	4
109	1	-	-	-	-	-	-	1
110	2	-	-	1	-	-	-	3
111	-	-	-	1	-	-	-	1
112	1	1	-	-	1	-	-	3
113	1	-	-	-	-	-	-	1
114	2	-	-	-	-	-	-	2
115	-	-	-	1	-	-	-	1
116	1	-	-	-	-	-	-	1
117	-	1	-	-	-	-	-	1
118	-	-	-	-	-	-	-	-
119	-	-	-	-	-	-	-	-
120	-	-	-	-	1	-	-	1
121	-	2	-	-	-	-	-	2
122	1	-	-	-	-	-	-	1
123	-	-	-	-	-	-	-	-
124	-	-	-	-	-	-	-	-
125	-	1	-	-	1	-	-	2
126	1	-	-	-	-	-	-	1
127	-	-	-	-	-	1	1	2
128	-	-	-	-	-	-	-	-
129	-	-	-	1	-	-	-	1
130	-	-	-	-	-	-	-	-
131	-	-	-	-	-	-	1	1
132	1	-	-	-	-	-	-	1
133	-	-	-	1	-	-	-	1
134	-	-	-	-	-	-	-	-
135	-	-	-	-	-	-	-	-
136	1	-	-	-	-	-	-	1
137	-	1	-	1	-	-	-	2
138	-	-	-	1	1	-	-	2
139	-	-	-	1	-	1	-	2
140	-	-	-	-	-	-	-	-
141	-	-	-	-	-	-	-	-
142	-	-	-	-	-	-	-	-

table IV (Continued)

Days in Length	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8 15-16	No. of Estruses Total
143	-	1	-	-	1	-	-	2
144	-	-	-	-	-	-	-	-
145	-	-	-	-	-	-	-	-
146	-	1	1	-	-	-	-	2
147	-	-	1	-	-	-	-	1
148	1	-	-	-	-	-	-	1
149	1	-	-	-	-	-	-	1
150	-	1	-	-	-	-	-	1
151	-	-	-	-	-	-	-	-
152	-	-	-	-	-	-	-	-
153	-	-	-	1	-	-	-	1
154	-	-	-	-	-	-	-	-
155	1	1	-	1	-	-	-	3
156	-	-	-	-	-	-	-	-
157	-	-	-	-	-	-	-	-
158	-	-	-	-	-	-	-	-
159	1	-	-	-	-	-	-	1
160	-	-	-	-	-	-	-	-
161	-	-	-	-	-	-	-	-
162	-	-	-	-	-	-	-	-
163	-	-	-	-	-	-	-	-
164	-	-	-	-	-	-	-	-
165	-	-	-	-	-	-	-	-
166	-	-	-	-	-	-	-	-
167	-	-	-	-	-	-	-	-
168	-	2	-	-	-	-	-	2
169	-	-	-	-	-	-	-	-
170	1	-	-	-	-	-	-	1
171	-	-	-	-	-	-	-	-
172	-	-	-	-	-	-	-	-
173	-	-	-	-	-	-	-	-
174	1	-	-	-	-	-	-	1
175	-	-	-	-	-	-	-	-
176	-	-	-	-	-	-	-	-
177	-	-	-	1	-	-	-	1
178	-	-	-	-	-	-	-	-
179	-	-	-	-	-	-	-	-
180	-	-	-	-	-	-	-	-
181	-	-	1	-	-	-	-	1
182	-	-	-	-	-	-	-	-
183	-	-	-	-	-	-	-	-
184	-	-	-	-	-	-	-	-
185	-	1	1	1	-	-	-	3
186	-	-	-	-	-	-	-	-
187	-	-	-	-	-	-	-	-
188	1	-	-	-	-	-	-	1
189	1	-	-	-	-	-	-	1
190	-	-	-	-	-	-	-	-

table IV (Continued)

Days in Length	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8 15-16	No. of Estruses Total
191	-	-	-	-	-	-	-	-
192	-	-	-	-	-	-	-	-
193	-	-	-	-	-	-	-	-
194	-	-	-	-	-	-	-	-
195	-	1	-	-	-	-	-	1
196	-	-	-	-	-	-	-	-
197	-	-	-	-	-	-	-	-
198	-	-	-	-	-	-	-	-
199	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-
201	1	-	-	-	-	-	-	1
202	-	-	-	-	-	-	-	-
203	-	-	-	-	-	-	-	-
204	-	-	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-
206	-	-	-	-	-	-	-	-
207	-	-	-	-	-	-	-	-
208	-	-	-	-	-	-	-	-
209	-	-	-	-	-	-	-	-
210	-	-	1	-	-	-	-	1
211	-	-	-	-	-	-	-	-
212	-	-	-	-	-	-	1	1
213	-	-	-	-	-	-	-	-
214	1	-	-	-	-	-	-	1
215	-	-	-	-	-	-	-	-
216	-	-	-	-	-	-	-	-
217	-	-	-	-	-	-	-	-
218	-	-	-	-	-	-	-	-
219	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-
221	-	-	-	-	-	-	-	-
222	-	-	-	-	-	-	-	-
223	-	-	-	-	-	-	-	-
224	-	-	-	-	-	-	-	-
225	-	-	-	-	-	-	-	-
226	-	-	-	-	-	-	-	-
227	-	-	-	-	-	-	-	-
228	-	-	-	-	-	-	-	-
229	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-
231	-	-	-	-	-	-	-	-
232	-	-	-	-	-	-	-	-
233	-	-	-	-	-	-	-	-
234	1	-	-	-	-	-	-	1
235	1	1	-	-	-	-	-	2
236	-	-	-	-	-	-	-	-
237	-	-	-	-	-	-	-	-
238	-	-	-	-	-	-	-	-
239	-	-	-	-	-	-	-	-

table IV (Continued)

Days in Length	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	7 - 8 15-16	No. of Estruses Total
240	-	-	-	-	-	-	-	-
241	-	-	-	-	-	-	-	-
242	-	-	-	-	-	-	-	-
243	-	-	-	-	-	-	-	-
244	1	-	-	-	-	-	-	1
245	-	-	-	-	-	-	-	-
246	-	-	-	-	-	-	-	-
247	-	-	1	-	-	-	-	1
248	-	-	-	-	-	-	-	-
249	-	-	-	-	-	-	-	-
250	-	-	1	-	-	-	-	1
251	-	-	-	-	-	-	-	-
252	-	-	-	-	-	-	-	-
253	-	-	-	-	-	-	-	-
254	-	-	-	-	-	-	1	1
255	-	-	-	-	-	-	-	-
256	1	-	-	-	-	-	-	1
257	-	-	-	-	-	-	-	-
258	-	-	-	-	-	-	-	-
259	-	-	-	-	-	1	-	1
324	-	-	1	-	-	-	-	1
								1780

VITA

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