



Analysis of Frieswal cattle for survival pattern, herd structure and expected herd life

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ABSTRACT

Records of 1 024 Frieswal cows maintained at Military Dairy Farm, Meerut, during 1987–2007 were used to study the lactation specific survival pattern, herd structure, expected herd life and overall life time statistics. Study revealed that 76% of the total cows at first lactation were survived for next lactation and vis-à-vis 24% cows left the herd after completion of first lactation. The probability of a cow to survive in the herd decreased along with the lactation number. Herd structure showed that about 37% of the herd comprised first calvers and about 80% of the total females present in the herd belonged to first 3 lactations only. The expected herd life at first lactation was 2.05 lactations more and follows a decreasing trend along with the increase in lactation. Average net reproductive rate was 0.86, which indicated that each cow produced less than one female calf. It was observed that the proportion of cows being lost from the herd was 0.24 in first lactation. This is the equilibrium replacement rate required to maintain the herd size.

Key words: Cattle, Disposal, Expected life, Frieswal, Reproductive rate, Survival rate

Herd size of the milking animals and its maintenance in subsequent lactation is one of the most important factors which depend directly on the survival pattern among the lactating animals and herd structure of the cows being present in different lactations. The lactation specific survival/disposal pattern, herd structure, expected herd life and overall life time statistics in a herd of Frieswal cattle are important, as these are required to formulate, operate and evaluate a breeding program for genetic improvement, developing models to optimize culling and replacement rates and to have a check on management practices for better production and reproduction of animals. Therefore, an investigation was carried out to study these characteristics of newly developed strain (Frieswal) at Military Farms.

MATERIALS AND METHODS

Present study was carried out on 1024 Frieswal cows maintained at Military Dairy Farm, Meerut, over a period of 21 years (1987 to 2007). The life history data of these cows comprised the information on calving, mortality and culling of adult cows. Collected information was used to estimate the lactation-wise demographic characters like survival rate

(P_x), loss rate (Q_x), stayability (L_x), herd structure, expected herd life and net reproductive rate (V_x). These were calculated as per Schons *et al.* (1985) and have been detailed by Tomar *et al.* (1996).

Loss rate (Q_x): It is the probability, assuming survival to lactation x , of dying or culling before lactation $x+1$. Thus, $Q_x = d_x/n_x$ where d_x is the number of animals died and culled during lactation x . n_x is the number of animals present in the herd at the beginning of lactation x .

Survival rate (P_x): This is the complement of Q . It is the probability, assuming survival to lactation x , of surviving to lactation $x+1$ and estimated as $P_x = L_{x+1}/L_x = 1-Q_x$. Thus it is the probability of an animal being present at lactation x in the herd to the next lactation of $x+1$.

Stayability or survivorship (L_x): This is the probability at first lactation of a cow present in the herd to lactation x and estimated as number present at lactation x divided by the number alive at first lactation. The survivorship at first lactation was taken as unity and hence $L_x = 1.0$. It is estimated as $L_x = n_x/n_0$. This can also be estimated as $L_x = P_x L_{x-1}$, where, n_x = number surviving at lactation x . n_0 = number of cows at first lactation.

Expected herd life (E_x): This is the number of additional years that an animal of lactation x is expected to remain in the herd E_x more years and it was estimated as the sum of probability of an animal of a given lactation remaining in the herd (P_x) through each succeeding lactation up to the

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last lactation. Thus,

$$E_x^n = P_x + P_x P_{x+1} + P_x P_{x+1} P_{x+2} + \dots + P_x P_{x+1} P_{x+n} \quad (\text{Ahmed et al. 1992})$$

$$= [EL_{x+1}]/L_x + 0.5$$

Herd structure: Greer *et al.* (1980) proposed the procedure for lactation specific loss which is the probability of cows being lost that are of each lactation ($q_x = Q_x/L_x$ such that $\sum q_x = 1.0$). They also proposed the formula for lactation distribution of cows present in the herd ($P_x = L_x/\sum L_x$).

RESULTS AND DISCUSSION

Survival and disposal pattern

The survival rate was 76.1% in first lactation. The loss rate was minimum in the first lactation (23.9%) and hence the probability of survival rate was maximum at the first lactation as these 2 parameters are complementary to each other (Table 1). The survival rate decreased along increase in lactation number. Lower survival rate than the present estimate was reported by Singh *et al.* (2005) for Karan Fries (72%) whereas higher estimates of survival rate were reported by Arun *et al.* (2010) for Haryana (79%) and Abbas *et al.* (2010) for Sahiwal cattle (82%) in the first lactation. The differences in different herd could be due to the differences in death and culling rates at different farms because of differences in management. Probability of an animal to survive or stay in the herd decreased with the increase in lactation number. It was 0.342 at fourth lactation, 0.116 at sixth lactation and 0.01 at tenth lactation. Thus only 34.2, 11.6 and 1.0% of the female which completed first lactation, survived or stayed in the herd at 4th, 6th and 10th lactation. These findings were in conformity with the reports of Singh (2001), Abbas *et al.* (2010) and Arun *et al.* (2010).

Herd structure

The probability of cows being lost from the herd due to their death and culling was found to be 0.239 at first lactation,

which means about one-fourth of the total cows could be leaving the herd by the end of first lactation. This is the equilibrium replacement rate which can be used to estimate the number of replacement heifers required to maintain a constant herd size. Proportion of female being lost from the herd was found to be 0.2168 in second lactation and 0.2028 in third lactation and decreased as the parity order increased and was lowest (0.09%) in 12th lactation. Results indicated that, more than half of the total females of first lactation left the herd till they completed third lactation. The reason could be the culling of old/low producing animals due to higher availability of young heifers. Mukherjee and Tomar (1997) reported that 22.3% losses occurred during the first year of age, 6.1% in second year of age and 18.0% each year during 4 and 5 years of age. Lathwal *et al.* (1995) reported the proportion of Red Sindhi cows being lost in first, second and third lactation as 0.29, 0.22 and 0.12, respectively. Proportion of cows present in the herd revealed that more than one-third (36.9%) of the total herd comprised the first calvers. It was observed that 77.8% of total female present in the herd belonged to first three lactations and only less than 3 pre-cent females belonged to 7 and above lactations, which indicated that this herd of Frieswal cattle mostly comprised younger females.

Expected herd life (E_x)

This is the number of additional lactations that an animal of lactation x is expected to remain in the herd E_x more lactations. It was observed that a cow belonging to first lactation was expected to remain in the herd for about 2 more lactations and follow a decreasing trend along with the increase in lactation. Average expected herd life of cows at 3 to 5 lactations was almost constant (1.3) and it was less than 1 lactation for the cows belonging to eighth and above lactations. Lower expected herd life than the present study was reported by Lathwal *et al.* (1995), Tomar *et al.* (1996)

Table 1. Lactation specific survival and disposal rate, herd structure and expected herd life in Frieswal herd

Lactation	Total cows	Survival rate (P_x)	Disposal/loss rate (Q_x)	Stayability (L_x)	Herd structure		Expected herd life (lact.)
					Died and culled (q_x)	Present in the herd (p_x)	
1	1024	0.761	0.239 (245)	1.00	0.2393	0.3691	2.05
2	779	0.715	0.285 (222)	0.761	0.2168	0.2639	1.67
3	557	0.627	0.373 (208)	0.544	0.2028	0.1658	1.37
4	350	0.614	0.386 (135)	0.342	0.1318	0.1018	1.32
5	215	0.554	0.446 (96)	0.210	0.0936	0.0563	1.31
6	119	0.428	0.572 (68)	0.116	0.0640	0.0241	1.22
7	51	0.393	0.607 (31)	0.049	0.0301	0.0094	1.00
8	20	0.599	0.401 (8)	0.019	0.0078	0.0056	0.78
9	12	0.417	0.583 (7)	0.012	0.0067	0.0023	0.67
10	5	0.399	0.601 (3)	0.005	0.0029	0.0009	0.60
11	2	0.499	0.501 (1)	0.002	0.0009	0.0004	0.50
12	1	0.000	1.000 (1)	0.000	0.0009	0.0000	0.00

and Mukherjee and Tomar (1997), with a declining trend along the lactation. Contrary to the present findings Schons *et al.* (1985), Abbas *et al.* (2010) and Arun *et al.* (2010) reported higher expected herd. Comparatively lower expected herd life for the present herd may be due to the higher availability of replacement heifers for culling the older cows.

Overall life time statistic

Study revealed that the cows present in the herd had completed on an average 2.21 lactations. Present estimate was lower than those reported by Lathwal *et al.* (1995), Tomar *et al.* (1996), Singh (2001) and Arun *et al.* (2010). The lower values obtained might be due to the availability of higher replacement rate. It was also observed that the cows lost from the herd completed on an average of 3.1 lactations. This average was very close to that reported by Lathwal *et al.* (1995), whereas it was lower than those observed by Tomar *et al.* (1996), and Arun *et al.* (2010). The average probability of a cow being lost from the herd was observed to be 0.48 per cow per lactation. This average loss per cow per lactation was higher than those reported by Tomar *et al.* (1996), Singh (2001) and Arun *et al.* (2010). Result revealed that the cows were being culled at higher rate to maintain the constant herd size as the sufficient numbers of heifers were available. The average life expectancy of a cow at first lactation was found to be 1.56 lactations. Average net reproductive rate in this herd was observed as 0.86, which means that each cow produced less than one female calf during her life and this revealed that all cows did not replace themselves. The higher values of net reproductive rate than the present study were

observed by Tomar *et al.* (1994), Lathwal *et al.* (1995), Tomar *et al.* (1996) and Singh (2001).

REFERENCES

- Abbas M, Gowane G R and Chandran PC. 2010. Lactation specific demographic analysis in Sahiwal cows. *Indian Veterinary Journal* **87**: 798–800.
- Ahmed Z, Berger P J and Healey M H. 1992. Estimated culling probabilities, age distribution and expected herd Life in Nilli Ravi Buffalo. *Journal of Dairy Science* **75**: 1707 – 14.
- Arun K, Singh U, Khanna A S and Singh R. 2010. Disposal pattern and herd structure of Haryana Cow. *Indian Veterinary Journal* **64**:1283–90.
- Greer R C, Whitman R W and Woodward R R. 1980. Estimation of probability of beef cows being culled and calculation of expected herd life. *Journal of Animal Science* **51**:10–19.
- Lathwal S S, Tomar S S and Sachdeva G K. 1995. Herd structure and expected herd life of Red Sindhi Cattle. *Indian Journal of Dairy Science* **48**:447–49.
- Mukherjee K and Tomar S S 1997. Age specific fertility parameters in a herd of Brown Swiss crossbred cows. *Indian Journal of Animal Research* **31**:11–14.
- Schons D, Hohenboken W D and Hall J. 1985. Population analysis of a commercial beef herd. *Journal of Animal Science* **61**:44–54.
- Singh L. 2001. 'Genetics of replacement rate in Fries cattle.' Ph.D. Thesis, NDRI, Deemed University Karnal.
- Tomar S S, Rawal S C, and Sachdeva G K. 1994. Expected herd life and herd structure of cattle. *Indian Journal of Animal Sciences* **64**:1283–90.
- Tomar S S, Rawal S C and Singh R B. 1996. Population analysis for certain demographic parameters in Tharparkar herd. *Indian Journal of Dairy Science* **49**:562–66.