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Description of removal patterns in a selected sample of sow herds

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Background

Sow mortality on U.S. farms has been reported to be increasing in the last decade (Deen and Xue, 1999). High sow mortality increases economic loss that includes replacement and opportunity costs, estimated to be around $400 and $500 per sow (Deen and Xue, 1999).

Different ways to describe removals at herd level have been used. In the case of mortality, it has been described using the annual and/or specific mortality rate (Koketsu, 2000). Recently, Deen and Anil (2003) reported the use of the number culled in the parity as the numerator and the average herd population as the denominator. This takes into account the inventory in that parity and the culling rate and the outcome, which is the culling rate per parity cycle, as opposed to an annual rate.

Survival analysis has been applied when characterizing the magnitude of culling and in testing for differences in culling among dairy herds (Karuppanan et al., 1997).

The objective of this study is to describe the herd profiles of removals in sow herds of two commercial systems in the U.S.

Materials and methods

Two commercial systems, with 3 farms each, were analyzed. The following methods of examining removal were analyzed:

- Death and cull rate for each parity were extracted from the parity distribution report form PigCHAMP for the year 2002. Death and cull rate were calculated as the number of cases divided by average female inventory for each parity × 100.
- Probability of removal from the herd by parity was calculated as number of culled and dead females for each parity divided by herd average female inventory.
- Survival analysis was performed on sow data extracted from PigCHAMP using database applications with the date of entry being before 31 December 2002. The proportion of females reaching each parity was considered as survival time. Females that were culled, died or destroyed were coded as complete observations. Females alive or still present in the herd were coded as censored data. The cumulative proportion of sows of parities 2 and 5 remaining in the herd reflects the proportion of females that were not culled, died, or were euthanized. Cumulative proportion of females remaining in the herd and the respective 95% confidence intervals (cumulative proportion surviving—2 × standard error of the cumulative proportion surviving—were estimated for each herd).
- Reasons for culling and mortality were summarized for both systems. Reasons were extracted from PigCHAMP using database applications and imported into Excel for collation and charting.

Results and discussion

Death and cull rate by parity

The specific death rates by parity (%) for the two systems show that, overall, mortality rate increased with parity (Figure 1). System B, with the corresponding farms 4, 5 and 6, had higher death rates for the first two farms (4 and 5). Values for death rates for farm 4 ranged from 3.4% for P0 to 22.2% for P7+, with the highest values corresponding to P4 and P5, with around 25% of mortality for both. A substantial increase is also seen in the death rate from P0 (3.4%) to P1 (18%). A similar trend is observed among the other farms compared, with system A presenting less variability of mortality within parities.

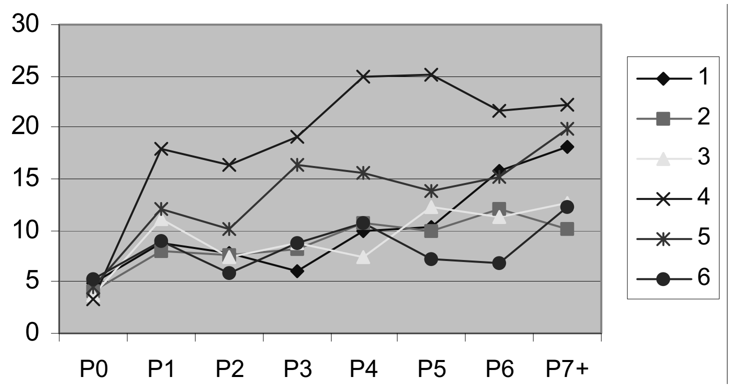
With respect to culling rates (%) (Figure 2), the highest values corresponded to farms belonging to system A, mainly for farms 1 and 2. Culling rates increased as sows got older.

Probability of removal

A disadvantage of describing removal rates as previously shown is that the proportion of females removed with respect to the herd inventory is not considered.

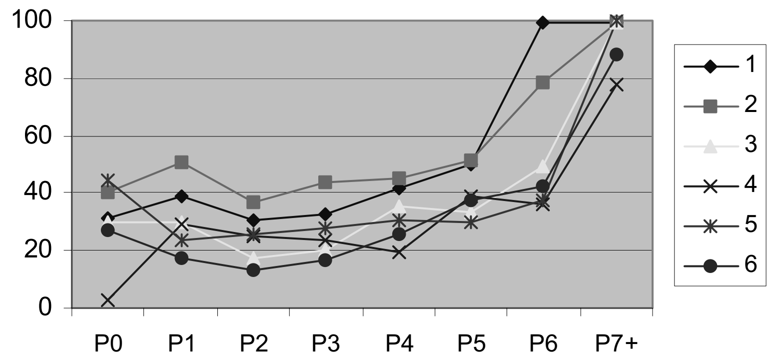
When we considered the removals by inventory for each parity (Figure 3), we can see that although higher removals occur in older parities, a high proportion of females are removed at younger parities, especially at parities 0 and 1. Comparing the systems, farm 1 and 2 of system A had the highest removal rates at P0 and P1. Herd 4 had an

Figure 1: Death rate (%) by parity for the two systems corresponding to the year 2002.



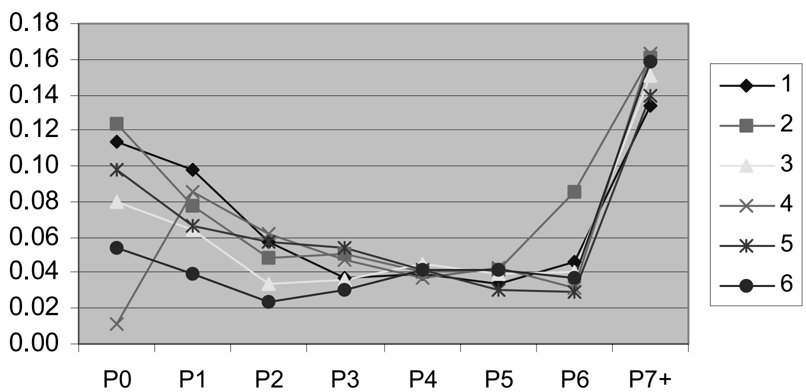
Farms 1, 2, and 3: System A
Farms 4, 5, and 6: System B

Figure 2: Culling rate (%) by parity for the two systems corresponding to the year 2002.



Farms 1, 2, and 3: System A
Farms 4, 5, and 6: System B

Figure 3: Proportion of herd removed by parity (culling plus deaths).



Farms 1, 2, and 3: System A
Farms 4, 5, and 6: System B

Production

unusually low removal rate for P0 which needs to be validated.

Probability of removal was described by Deen and Matzat (2003) as a control point in sow longevity. The most important sow characteristic is its age or parity, and decisions of culling or retaining a sow must be focused on the relative value of differing parities. To decrease replacement rates the overall aim is to decrease the culling of low parity sows. Also the average parity of removed sows is a controllable factor at employee level (Deen et al., 2002). By maintaining a sow up to 5 or 6 parities, the farm has been successful in reducing the demand for gilts (Deen and Anil, 2003).

Survival analysis

This technique is commonly used in human medicine to describe and compare survival ages. We can use it to describe survival in a sow herd with parity as the outcome. However, although parity is a reasonable reflection of economic contribution, it is a rather inexact measure of time. A high percentile parity indicates that retention is high relative to other herds. For example, 50% of herd 1 have been removed by parity 4 whereas 50% have been removed by parity 3 for herd 2. For the 75th percentile, it took 8 parities to have removed 75% of the sows for herd 6 (table 1).

The lowest median survival time was to parity 3 for farms 2 and 3 of system A and farm 5 of system B, and the highest values correspond to farms 1, 4, and 6.

A better way to compare different herds is to look at the cumulative proportion of gilts and sows surviving to a certain parity; for example parity 2 and parity 5. Farms 1 and 2 of system A, and farm 6 of system B had the highest survival (Table 2). The cumulative proportion does not necessarily coincide with the median survival time because survival rates may vary in subsequent parities. The advantage of survival analysis is that in addition to being able to compare culling or mortality among herds, a survivorship approach provides an estimate of the rate of removal that is not biased by age (Karuppanan et al., 1997).

Reasons for culling and mortality

Considering reasons for culling, no heat and lameness were the primary for both systems (Figure 4). These reasons represent approximately 30% for parities 0 and 1, decreasing in following parities.

Looking at reasons for culling by farm, we see that the major percentage is due again to no heat, however there is a considerable difference between both systems. System A (Farms 1, 2, and 3) has a much higher proportion of culling due to this cause, reaching around 40%, while in System B the values range from 9–19%. Culling due

Table 1: Percentiles of the survival function.

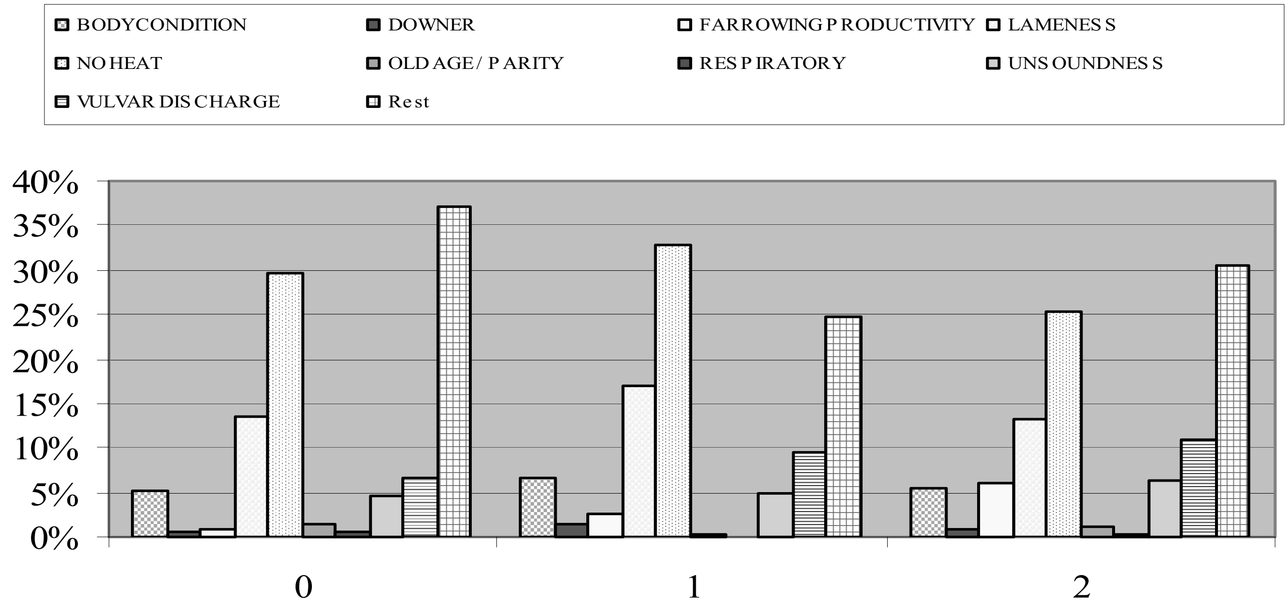
System	Farm ID	50th percentile	25th percentile	75th percentile
A	1	4	1	6
A	2	3	1	7
A	3	3	1	6
B	4	5	3	8
B	5	3	1	7
B	6	5	3	8

Table 2: Cumulative proportion of females remaining and 95% confidence intervals (C.I.) in the respective farm for parities 2 and 5.

System	Farm	P2 Cum. Prop. Surv.	95% CI	P5 Cum. Prop. Surv.	95% CI
A	1	0.719	0.729, 0.710	0.410	0.422, 0.398
A	2	0.681	0.691, 0.670	0.396	0.408, 0.383
A	3	0.584	0.594, 0.574	0.334	0.345, 0.324
B	4	0.584	0.595, 0.574	0.105	0.111, 0.098
B	5	0.529	0.540, 0.518	0.242	0.249, 0.235
B	6	0.727	0.737, 0.716	0.303	0.309, 0.296

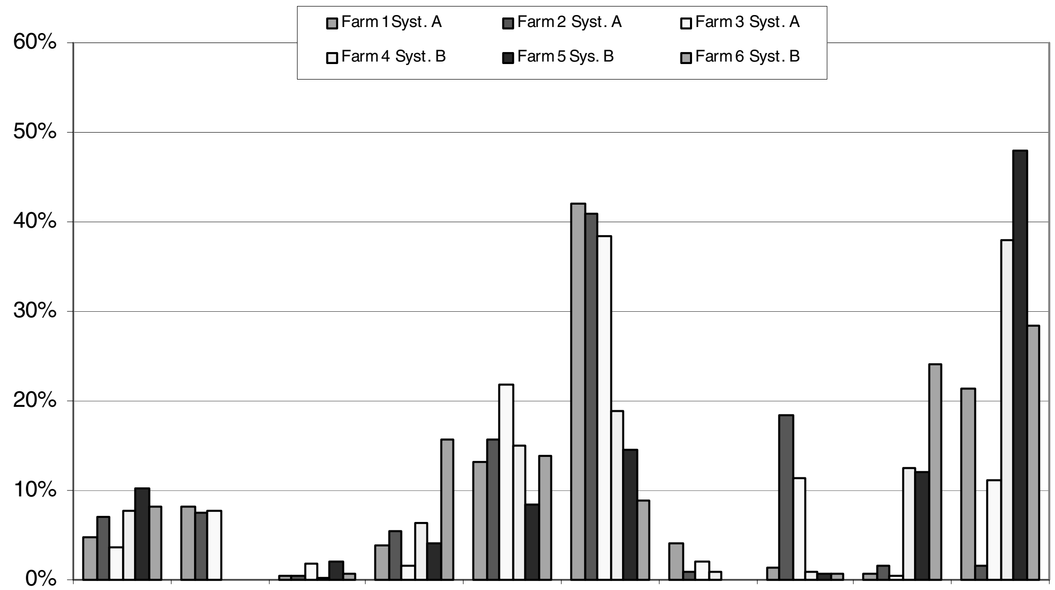
Production

Figure 4: Average (%) of major reasons for culling for parities 0, 1, and 2 in both systems.



"Rest" includes other reasons for culling and/or no registered reasons.

Figure 5: Reasons for culling (%) for all farms.



Production

to lameness is almost equal for both systems, while in System B there is a higher percentage of culling because of vulvar discharge, representing around 12–24% compared to 0.5–1.7% for System A (Figure 5).

Major causes of death were due to downer sows (16–49% for System A, and 13–17% for System B). This represents the majority of losses for parities 0 through 4, in the order of 18•25% of all deaths. A higher percentage of deaths due to ulcers were seen in farms belonging to System A and in parities 0 and 1 (12% and 16.62%, respectively) while for parities 2, 3, and 4 the values were 4.29%, 2.40%, and 0%, respectively. Still, the majority of causes of death were not recorded or registered.

Conclusion

In conclusion, describing removals as cull or death rate by parity is not very informative. It includes only the cases that occurred while not evaluating the population at risk. The probability of removal (or retentions) is better in that it is simple to calculate and gives us a cross-sectional picture of the herd and shows the importance of retention of younger females.

Survival analysis allows us to follow specific groups or multiple cohorts in a longitudinal way from a starting point in time. In this case the comparison of median parity for herds includes all the females that entered the herd for the past 5 years, since short-term descriptions can't be performed with this method because of a high degree of censored data.

Charting reasons for culling and death loss is useful for quickly capturing the major causes. It is important to remember that the use of the chart is only as good as the judgement that went into allocating a reason to each cull or death event.

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