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Sow removal in commercial herds: Patterns and animal level factors in Finland

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ABSTRACT

This observational retrospective cohort study provides benchmarking information on recent sow productivity development in Finnish herds. It focuses on parity cycle specific trends in sow removal patterns, and especially on the role of litter performance (size and piglet survival) in sow removal. In addition, the generated models offer a tool for calculating sow removal risks in any period, which could be used in economic and other simulation models. The data used in the study pool information of sows starting the same parity cycle (1 through 8) over the enrollment period of July 1st, 2013 through June 30th, 2014 and followed until the end of the study period (December 31st, 2014), and their performance histories across their entire previous productive life. Out of 71,512 individual sow parity cycle observations from the first to the eighth, 15,128 ended up in removal. Average litter sizes exceeded 13 piglets born in total in all of the most recent farrowings. Yet, even larger litter sizes were favored by the implemented culling policies, as sows having medium and large early life litters had lower risks of removal compared to those with the smallest litters, particularly in younger animals. With regard to piglets born just prior to removal, the smallest litter sizes were associated with the greatest culling risk for sows of that particular parity. In addition, having more than one stillborn piglet in the first and second litter put the sow at higher risk of being removed in all but the last (sixth through eighth) of the studied parity cycles. Investigation of removal patterns revealed a negative linear relationship between parity count and the mean days from farrowing to removal. More specifically, the median (mean) times to removal varied across the parity cycles from 62 (72) in the first to 34 days in both the seventh and eighth (47 and 42, respectively). Moreover, one in every six sows was removed within the first and second parity cycle. The findings especially in the earliest cycles may be a reflection of removal decisions not made according to any clear and pre-determined policy, or of biological issues that prevent farmers from firmly adhering to their policy. Quantitative performance should be linked to overall system functionality and profitability while taking animal welfare into consideration in identifying opportunities to improve herd parity structure and future farm success.

1. Introduction

In piglet production, replacing sows is a major cost of operation and one of the most important management decisions for a producer to make as it is interrelated with numerous other factors that ultimately impact the system cost-efficiency (Dhuyvetter, 2000). Traditionally, culling has been referred to as either voluntary (removal for economic reasons) or involuntary (biological or forced reasons that are beyond the farmer's control) (Fetrow et al., 2006). From an economic point of view, a particular sow should be kept in the herd as long as her expected profit for the next parity is higher than the per parity lifetime average return from a replacement gilt (Huirne et al., 1988; Dijkhuizen et al., 1989). Stalder et al. (2003) and Sasaki et al. (2012) suggested that a sow needs to produce three litters to reach a positive net present value, whereas it has also been estimated that for profitable overall herd performance sows should be culled within parity cycles five

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through nine (Gruhot et al., 2017a) or be kept up to the eighth or ninth parity (Dhuyvetter, 2000). In contrast to financial perspectives, society's growing awareness of production animal welfare has drawn attention to reduced longevity and forced culls as they raise concern about animal well-being and sustainability.

An optimal herd profile is determined by numerous interacting factors, which can potentially vary over time (Dhuyvetter, 2000; Zimmerman, 2012a; Gruhot et al., 2017b). The overall herd culling rate is an accumulation of culling rates of all parities, which determine the herd parity distribution (Houška, 2009). Both the quantity and the quality of piglets produced per year are influenced by the parity distribution. With increasing culling rates the percentage of mated gilts inevitably increases, resulting in a larger proportion of gilt progeny of inferior performance and survivability (Klobasa et al., 1986; Hinkle, 2012; Mabry, 2016). The overall financial efficiency in pig herds decreases with increasing culling rates; as the average sow lifespan decreases, the number of piglets weaned per sow per year drops and the share of a sow in the cost per piglet increases (Lucia et al., 1999).

At herd level sow removal depends on a variety of biological and environmental factors. Different characteristics of sows, such as productivity, age at first farrowing, and stage within productive life, as well as living conditions and management practices within the farms, impact longevity (Le Cozler et al., 1998; Serenius and Stalder, 2007; Hoge and Bates, 2011; Sasaki et al., 2011; Iida and Koketsu, 2015; Engblom et al., 2016; Magnabosco et al., 2016).

Comparison between sow longevity studies is problematic due to differences in the time periods of interest, study populations, and statistical analyses used. Selection for hyperprolific sows is ongoing with a simultaneous change towards larger and more intensively managed units. However, at some point it will be uneconomical and unethical to expect sows to continue performing based on predominantly quantitative key production indicators. The main objective of this study was to scrutinize recent sow productivity and removal patterns by dam parity using lifetime records of animals in production from July 1st, 2013 to December 31st, 2014 in Finland. An additional objective was to calculate actual sow removal risks for further use as input values in economic and other simulation models.

2. Materials and methods

2.1. Herds

The present study was a part of a larger project, where Finnish sow longevity was investigated in commercial herds (Niemi et al., 2017; Heinonen et al., 2018; Norring et al., 2018). Out of the 220 piglet producing farms of two major slaughterhouses in Finland a total of 46 farmers permitted the use of their farm data on breeding, productivity and longevity both at the animal and herd level for the project. After an extensive publicity campaign and being contacted in person, an additional 44 agreed to participate. The only inclusion criterion, in addition to the willingness of the farm manager to participate, was the use of WinPig herd management monitoring software (©2013 AgroSoft, Hietamaki, Finland). Based on the standardized performance summary statistics of WinPig from the participating farms the average herd size in 2014 was 342 sows (median 124, range 26–2726).

2.2. Data

Individual herd data files were exported as csv-files from WinPig.Net Agrosoft® and imported into the pen source statistical software R-studio (Team, 2016). Records across the entire productive life of females in production between 1 July 2013 and 31 December 2014 (study period) were extracted. In principle, complete information for each animal included birth information, breeding, farrowing and weaning events and removal data, but there was marked variation between farms in the number of stored values. Generally, no recordings were registered on estrual events or pregnancy status, nor were reliable records on breed available.

Crude data quality checks were done for each herd dataset separately, which were thereafter merged to yield a dataset with 65,313 females. In total, 9559 animals (14.7%) had not farrowed for the first time so they were excluded. Likewise, 1601 sows (2.9%) with incomplete parity cycle records were excluded from the study. Also, 2005 (3.6%) sows were excluded because of likely errors in dates of birth and first parturition (i.e. age at first farrowing less than 276 days or more than 555 days). Moreover, 92 (0.2%) records of sows were excluded if the total number of piglets born in a litter exceeded 26. The quality of the final dataset of 52,056 sows was assessed through preliminary descriptive analyses of the variables.

2.3. Cohort definition

Basically, we used the term parity to describe a sow by the number of completed farrowings as extrapolated to veterinary medicine from the Oxford medical dictionary (9th edition). In this study, our additional aim was to describe inter-parity removal characteristics. Thus, we supplemented the term parity with the term cycle (i.e. parity cycle) to refer both to the functional cyclicity of a sow's productive life, and to the number of days that pass after farrowing.

In order to document parity cycle specific productivity and the most recent patterns of removal, we included the maximum feasible number of parity cycles. Therefore, each cycle that had a record of a farrowing event between 1st July 2013 and 30th June 2014 (enrollment period) was included in the data set. To yield comparable follow up times, they were thereafter followed until 31st December 2014 (end of the study period). To further differentiate the cycles, enable comparison between them and understand dynamics of sow removal according to parity number, cohorts 1 through 8 were formed based on the number of farrowings as opposed to age cohorts: All members of a parity number cohort shared a significant experience, namely started the same parity cycle, over the same period of time (Fig. 1). Therefore, they all became at risk of progressing to their next farrowing, and subsequent parity cycle or removal, at the same point in time and production stage. For example, sows in cohort 5 all began their fifth parity cycle during the enrollment period, and if not removed, some of these sows also went on to start a further, the sixth, parity cycle (inclusion criteria for cohort 6).

After the actual start, i.e. farrowing, onwards cohort members were followed over time until the end date: a) the subsequent parturition, b) 180 days postpartum or c) removal, whichever occurred first. The choice of 180 day follow up was selected based on the observed data cycle length (95 percent quantile = 180 days). Baseline data on the relevant early life characteristics hypothesized to have effects on the individuals throughout their life course, i.e. considered as primary risk factors in our statistical analyses, were collected from existing records across the entire previous performance, linked with cohort follow up and outcome of interest, removal, and pooled together. In total, 17,379 eligible first farrowings, 13,605 second, 11,547 third, 9,783 fourth, 7,637 fifth, 5,700 sixth, 3,795 seventh, and 2,066 eighth farrowings occurred during the enrollment period. Furthermore, 1467 of 9th or higher farrowings were omitted from the analysis due to low numbers of records. Altogether, 71,512 parity cycles were included. The distribution of the cohorts is illustrated in Fig. 2.

Further, to be able to take the time postpartum into account, the follow up time for each cohort member was divided into time intervals. The onset was set at farrowing (day 0) and the length of each interval was in total 20 (1–20 days). The removal indicator equaled 1 if the sow experienced the event (i.e. was removed from the herd) within the given time interval and 0 otherwise. The length of the period was chosen based on the phases of a sow parity cycle and to ensure convergence of statistical models.