

# Identifying AI bulls associated with poor fertility and high rates of embryo loss

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**geno**

**nrf**  
Norwegian Red™

**TEAM SEMIN**

## Introduction

The relationship between fertility and semen quality is not always clear. Occasional AI bulls may show poor fertility even though semen passes quality testing. These bulls represent a potential loss for the dairy farmer, and may even possess undesirable genetic traits that could affect fertility in future generations. It is therefore important that these bulls are identified at an early stage in the breeding programme as soon as insemination data are available for analysis.

Norwegian Red (NRF) is the dominant dairy breed in Norway and semen is distributed by Geno, a farmer-owned cooperative. Close to 100% of inseminations are reported back to Geno and 95% of farmers also report data on calvings, stillbirths and culls through the Norwegian Dairy Herd Recording System. These data allow calculation of accurate non-return rates (NRR) and calving rates (CR) on sire basis. At present, progeny tested young bulls with NRR60 < 65% after 1000 first inseminations are routinely culled. However, this parameter alone may not be sufficient to identify animals with potential negative impacts on fertility traits. It was therefore investigated whether further analysis of sire fertility data would yield additional information.

## Materials and methods

The data set consisted of 479330 first inseminations on Norwegian Red (NRF) heifers and cows, with semen from 692 qualified NRF test and elite sires, performed between January 2000 and Oct 2007. The day of return-to-service was registered as a second insemination within 92 days after first insemination, and a minimum of 1000 first inseminations per bull was required to qualify for the study. The risk of return-to-service was modelled using a Cox proportional-hazard model, with day of return as outcome parameter, adjusted for covariates. Sires were classified as having either "poor" or "good" fertility if their NRR92 deviated from the mean by more than 3 standard deviations.

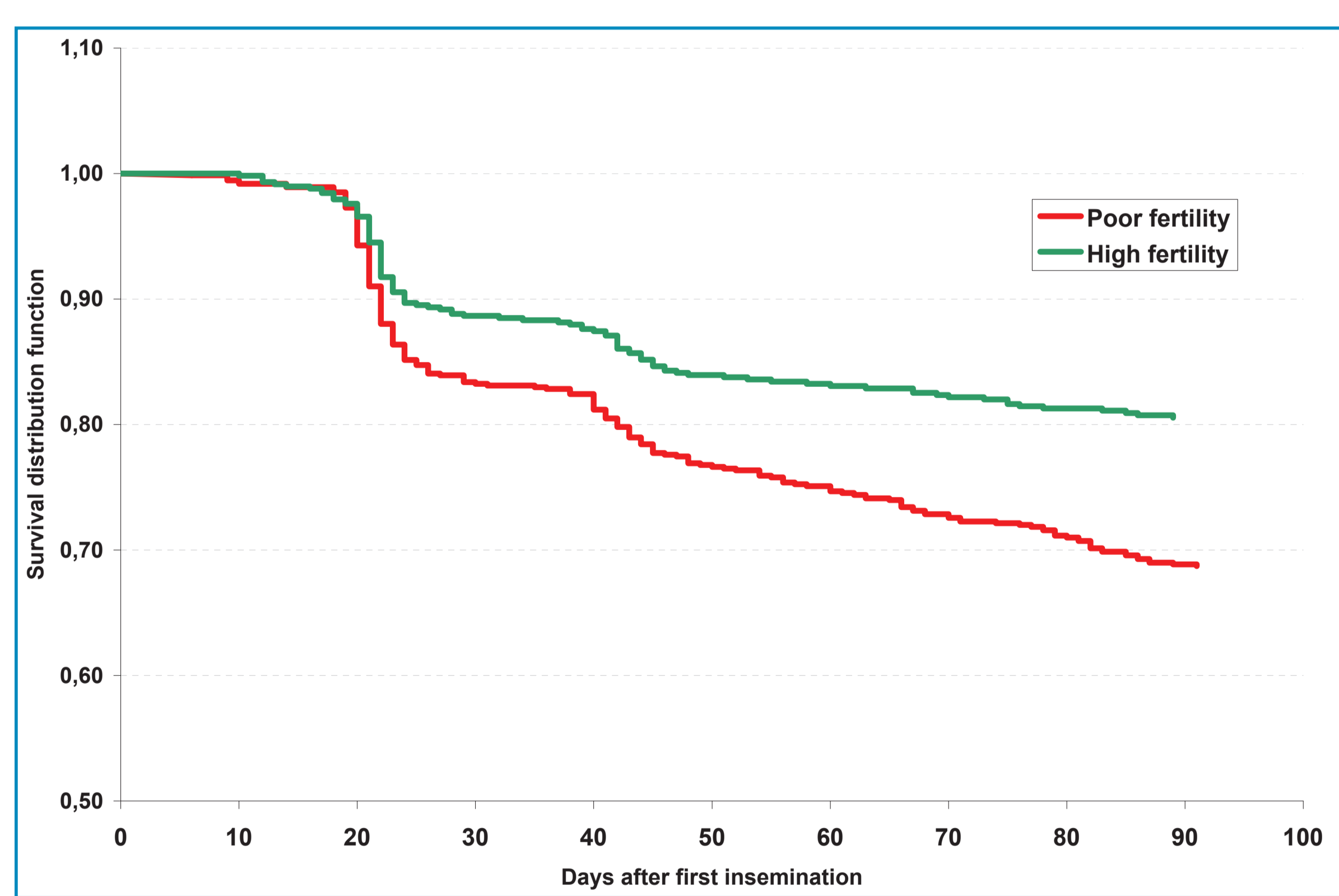


Figure 1. Kaplan-Meier plot of the two progeny test bulls with highest and lowest fertility. The bull with lowest fertility was culled due to poor NRR60.

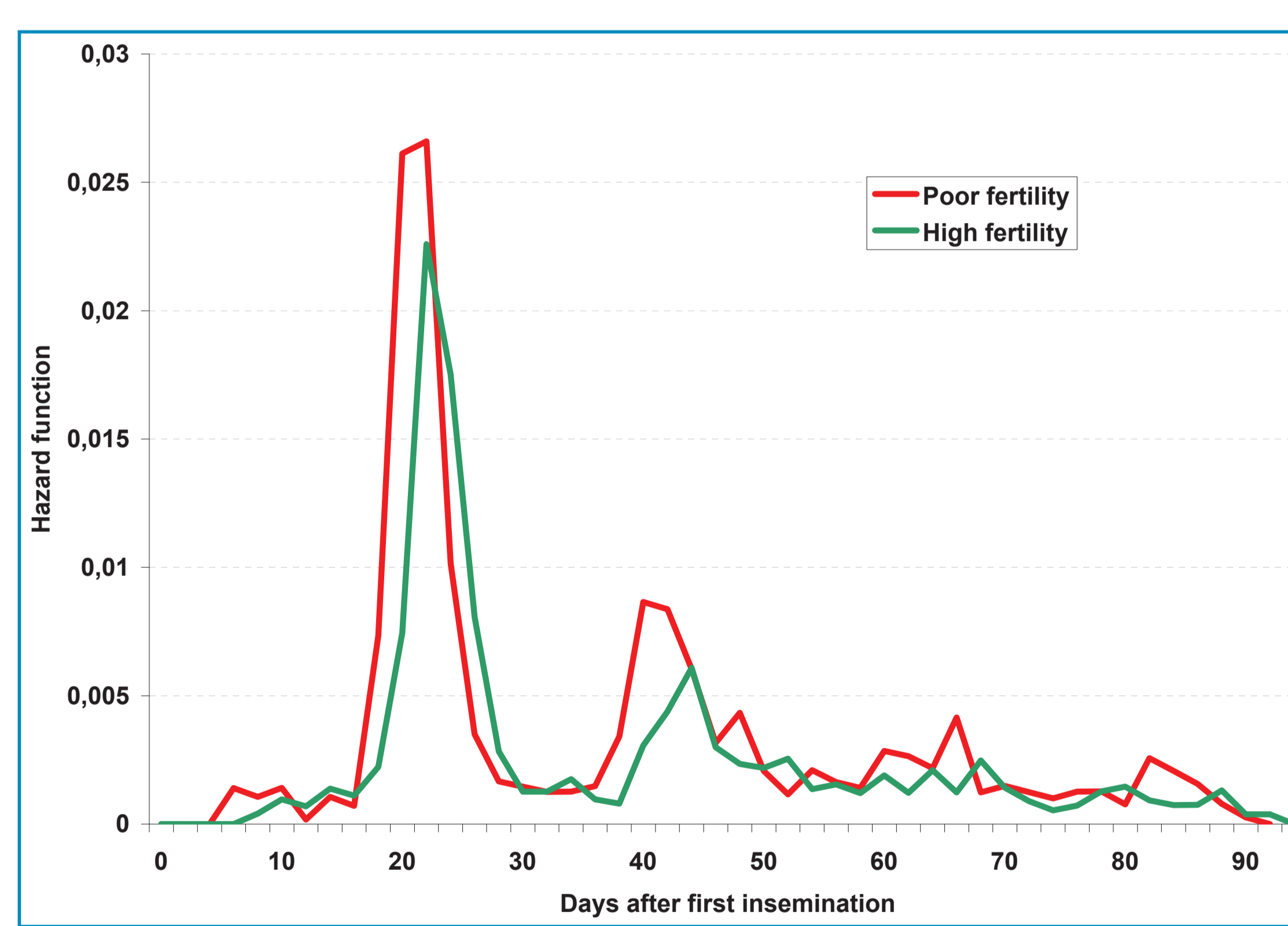


Figure 2. Risk of return-to-service as function of days post-first insemination. The hazard function shows a periodicity equivalent to the oestral cycle length

## Results and discussion

Compared to high fertility sires, poor fertility sires showed a more abrupt fall in NRR from 21 days onwards, suggesting a lower rate of fertilisation and/or higher incidence of early embryo death (before maternal recognition). Most interestingly, these sires also displayed a higher number of returns-to-service outside of the expected oestral cycle length. This suggests delayed oestrus indicative of late embryo death (after maternal recognition on day 17). Poor fertility sires may thus possess a combination of sperm-specific factors negatively affecting fertilisation as well as genetic mutations detrimental to embryo development. This analysis is carried out in parallel with flow cytometric studies of sperm from the same bulls.

## Goals of project

- Improved survival models including pedigree data and time-dependant covariates modelled as competing Wiener processes
- Identification of predictive fertility markers in sperm from test and qualified elite bulls
- Being able to identify poor fertility sires at an early stage in the breeding programme with high accuracy, using a combination of statistical and biochemical analyses