**Application**

Growth curve parameters are important indicators of animal performance and can be used to compare the growth rate of different animals. They can be helpful in developing the best management, breeding and feeding plans.

**Introduction**

Growth functions can condense longitudinal body weight data into parameters with biological significance (Lupi et al., 2015), which are important for comparing the growth rate of different animals. Individual animal model parameter values can be useful for farmers to help make informed decisions regarding the management and nutrition of animals, thereby optimising production efficiency. The selection of an appropriate function to model the growth profiles of animals mainly depends on the structure of the data (Sharif et al., 2021) but also on how well the function fits the data as well as the potential application of the function. Several different growth functions exist each with their only merits and shortcomings. This study aimed to evaluate different growth functions with two, three or four parameters to model the growth of female lowland sheep.

**Materials and Methods**

A total of 990,306 body weight records from 228,390 female lowland sheep born during the years 2010 to 2020 were available from the Sheep Ireland national database. Records were discarded if the number of animals per flock per year was <20. Outliers per day of age were identified as weight records heavier than the third or lighter than the first quartile by more than two times the interquartile range. Subsequent to this, any weight exceeding the mean weight per day by three standard deviations was discarded. After these edits, only sheep with a minimum 1 weight measurement in the first week of life, 2 measurements during 8 to 180 days, 2 measurements between 181 and 999 days of age and 1 measurement after 999 days of age were retained. The number of animals for the final analysis was 13,090 with 158,463 body weight records.

Six nonlinear functions (Brody, Gompertz, Logistic, Negative exponential, Richards and von Bertalanffy) were fitted to the longitudinal body weight data of individual animals using the NLIN procedure of SAS 9.4 (SAS Institute Inc.) and the parameter values for the parameters A (asymptotic weight), B (integrated constant) and K (maturity rate) for each animal estimated. Outliers for each parameter of each function were identified based on the interquartile range method and were not included in calculating the summary statistics of each parameter. The fit of each function was evaluated based on the root mean square error (RMSE) and coefficient of determination (R2) per animal as well as the ease of convergence and the estimation of biologically plausible parameter values.

**Results**

The Logistic and Negative exponential functions achieved convergence for all animals, while only 82.39% of animals converged for the Richards functions. Hence, the Richards function was not considered useful. All the other studied functions achieved convergence for ≥99.91% of animals. Individual animal parameter values were most sensible for both the Gompertz and von Bertalanffy functions. The Brody function yielded the greatest mean R2 (0.96) and the smallest mean RMSE (3.98 kg), while the Logistic function provided the smallest mean R2 (0.94) and the greatest mean RMSE (5.25 kg) across the population. The mean R2 value for all the remaining functions was 0.95. The modelled body weights by the studied functions are shown in Fig. 1.

**Fig. 1.** Observed and modelled longitudinal body weights of female lowland sheep across five growth functions.

The mean value for the A parameter estimated by the different functions ranged from 67.42 kg (Logistic) to 69.80 kg (Brody). The mean value for the B parameter also varied between the functions with the Logistic function being the highest (5.76) and the von Bertalanffy function the lowest (0.50). The range of the K parameter was between 0.0046 kg/day per kg mature weight (Brody) and 0.0135 kg/day per kg mature weight (Logistic). The A parameter within all the functions was negatively correlated with both the B (r = -0.23 to -0.13) and K parameters (r = -0.55 to -0.41), while the B parameter within all the functions was strongly positively correlated (r = 0.56 to 0.79) to the K parameter.

**Conclusions**

The results suggested that the Richards function cannot be used to model growth curves of female lowland sheep due to its difficulty in achieving convergence for a large proportion of the animals. All the other studied functions were capable of describing the growth profiles of animals. The Gompertz and von Bertalanffy were identified as being the best functions based on their ease in convergence and yielding the greatest number of animals with biologically sensible parameter estimates.

**References**

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