

Is Sexual Dimorphism a Practical Selection Objective in Sheep?

Boyd Walter Gudex

Master of Science (Hons.) Lincoln University, Canterbury, New Zealand

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Dedication

To all those who have come before me and whose teachings continue to guide me

In particular, I would like to pay tribute to:



Margaret Frances Gudex (24/2/45 - 22/1/2007)

I could fill a thesis with all the ways you helped me, but it is easier just to say you were my
mother



William (Bill) Robert Thayer (13/5/1919 - 22/11/2007)

A good friend to three generations of my family and ultimately the person responsible for
my interest in livestock genetics.

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Finally I would like to finish the acknowledgements off with a quote that I wish I had followed. This was written by a famous Kiwi and the "father" of nuclear physics, Ernest Rutherford:

"If your result needs a statistician then you should design a better experiment".

Abstract

Although for most traits, there is a difference between phenotypic expression in ewes versus rams, they have been traditionally treated equally in breeding programs. This thesis has investigated whether there is any variation between them in how they inherit growth and whether there are any benefits to be gained from divergent selection objectives. A bio-economic model was used to show that divergent selection for growth in ewes and rams could increase the feed efficiency and profitability of a self-replacing production system. The magnitude of the increase was found to be influenced by the age structure of the flock, fertility, base weight (average of both sexes) and the annual feed availability and price cycles.

To test whether divergent selection for growth is possible, sex-specific genetic parameters and genetic correlations between ewes and rams were estimated. Accordingly, a series of univariate, multivariate and random regression models using combinations of direct additive genetic, maternal additive genetic, maternal permanent environmental and direct permanent environmental effects were fitted. The results from these analyses revealed that ewes have larger heritability and smaller phenotypic variances than rams and that the intersex genetic correlations were less than unity and decreased with age (range 0.59 to 0.97). Furthermore, the phenotypic and BLUP selection responses predicted using these parameters revealed that rams had higher selection responses than ewes. The results for fat depth (corrected for live weight) were the sole exception to these results. Fat in ewes was deeper and had a lower heritability and higher phenotypic variances than rams. Little variation in sexual dimorphism was observed between the breeds used in this study despite variation in selection history/objectives and founder effects in each breed.

In conclusion, these results reveal that it is useful to select for divergent weight, fat and eye muscle depth objectives in ewes and rams and that sexual dimorphism can have a positive effect on the feed efficiency and profitability of a self-replacing flock. Other potential uses of sexual dimorphism in livestock breeding including in species other than sheep, single sex production systems (using sexed semen), reducing product diversity (equal ewes and rams) and the influence of recording/selecting a single sex were also discussed.

Declaration

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help in preparing this thesis, and all sources used, have been acknowledged in this thesis.



Signature

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