GENETIC RELATIONSHIP OF RAM LIBIDO SCORE WITH EWE REPRODUCTION OF FOUR SHEEP BREEDS

G.D. Snowder[1], J.N. Stellflug[1] and L.D. Van Vleck[2]

[1] USDA, ARS, U.S. Sheep Experiment Station, Dubois, ID 83423 USA
[2] USDA, ARS, Roman L. Hruska U.S. Meat Animal Research Center, Lincoln, NE 68583 USA

INTRODUCTION

Differences in sexual behavior among rams have been recognized for many years (Terrill, 1937). Sexual behavior in rams is measured by various procedures (Wiggins *et al*., 1983 ; Katz *et al*., 1988 ; Perkins and Fitzgerald, 1992). Rams with high scores for sexual performance or libido can improve flock fertility (Mattner *et al*., 1971 ; Kelly *et al*., 1975 ; Perkins *et al*., 1992). Ram libido is genetically influenced (Kilgour, 1985 ; Purvis, 1985 ; Snowder *et al*., 2002). It is not known if selection of rams for libido will have a correlated effect on ewe reproduction. Therefore, the objective of the current study was to determine if libido of rams and reproduction of ewes are genetically associated.

MATERIALS AND METHODS

From 1990 to 2000, rams were tested and scored for libido before public sale and breeding at the U.S. Sheep Experiment Station. Numbers of observations and unadjusted means are reported in table 1. Sexually naive yearling rams were scored in early August. Older rams (2 - 4 yr of age) previously exposed to ewes were also tested in August. The libido scoring performance test was conducted by exposing individual rams to three induced-estrual ewes for 30 min. Testing pens were outside, 17.5 m x 13.1 m large, and had solid wooden walls 4.4 m high. No feed or water was available in the pens. The ram and ewes roamed freely in the testing pen. Observers recording the data were seated outside the pen. Numbers of mounts and ejaculations were recorded and used to categorize the libido of the ram (Perkins, 1991). Scores ranged from 1 to 6 with scores increasing from sexually inactive to highly sexually active in the presence of estrous ewes. Overall average libido score was 3.5 ± 1.54.

Ewe reproduction was characterized by two prolificacy traits for each ewe : 1) number of lambs born per ewe exposed (NLB) and, 2) number of lambs weaned per ewe exposed (LSW). Ewe reproductive data was collected from 1990 to 2000. Ewes and lambs were managed in large flocks of approximately 1,000 ewes under herded management on open public range. Average weaning age was 112 days of age. Numbers of records and mean with its standard deviation for each trait are presented by breed in table 1.

Reproductive traits were measured on all ewes that included any female relatives of the rams on which libido scores were measured. Genetic correlations among traits were estimated from the relationships between the breeding values for ram libido with the breeding values for ewe reproductive traits. Ram libido and ewe reproduction were simultaneously analyzed in a multi-trait animal model that accounts for the genetic relationships between the rams and ewes of the population.

Genetic parameters from both single-trait and bivariate analyses for all traits were estimated with animal models for each breed. The model for libido scores of rams included fixed effects of selection line and year of record. A permanent environmental effect for ram was included to account for repeated measures. Age and weight at time of the libido test were linear covariates. Models for NLB and LSW included fixed effects of selection line, year of record, and age of ewe. A permanent environmental effect for ewe was included to account for the repeated lambing and weaning measures. Bivariate models were identical to the single trait models.

Table 1. Summary of number of records and mean ± sd for ram libido score and ewe reproductive traits

	Columbia		Polypay		Rambouillet		Targhee	
Trait	Records	Mean	Records	Mean	Records	Mean	Records	Mean
Libido	807	3.3 ± 1.55	1,668	3.6 ± 1.63	1,208	3.6 ± 1.50	1,002	3.4 ± 1.54
NLB	7,693	1.4 ± 0.88	9,229	1.8 ± 0.92	10,954	1.5 ± 0.83	7,278	1.4 ± 0.86
LSW	7,611	1.0 ± 0.79	9,106	1.2 ± 0.80	10,523	1.1 ± 0.78	6,895	1.0 ± 0.78

Estimates of variance components were accomplished using a derivative-free algorithm for REML. Convergence was considered to have been reached when the variance of the -2 log likelihood in the simplex was less than 1 x 10^{-6}. After initial convergence, four restarts were performed to ensure global convergence as determined when -2 log likelihood did not change to the second decimal. The standard errors of the heritability estimates were based on the average information matrix and the 'delta' method in the single trait models (e. g. Dodenhoff *et al*., 1998).

RESULTS AND DISCUSSION

Heritability estimates. Estimates of direct heritability from the single trait model for libido score and NLB and LSW for all four breeds are reported in table 2. Estimates of direct heritability for ram libido varied among breeds. Heritability estimates are larger for Columbia and Polypay breeds (0.31 and 0.30, respectively) compared to Rambouillet (0.14) and Targhee (0.17). The average of these estimates (0.23) is similar that reported for multiple breeds (0.22) by Snowder *et al*. (2002). The rate of selection response for libido score of rams in the Columbia and Polypay breed should be about double of that in the Rambouillet and Targhee breeds.

Heritability estimates for prolificacy traits, NLB and LSW, are low and ranged from 0.02 to 0.11. The lower heritability estimates are for LSW (0.02 to 0.04). These estimates are in agreement with those by Bromley *et al*. (2000) and Hanford (2001) for NLB and LSW. Burfening *et al*. (1993) reported similar estimates for heritability of NLB of 0.12 and 0.11, respectively.

Table 2. Heritability estimates (± se) for ram libido score and ewe reproductive traits

Trait	Columbia	Polypay	Rambouillet	Targhee
Libido score	0.31 ± 0.09	0.30 ± 0.08	0.14 ± 0.07	0.17 ± 0.08
Number born	0.07 ± 0.01	0.08 ± 0.01	0.11 ± 0.01	0.05 ± 0.01
Number weaned	0.03 ± 0.01	0.02 ± 0.01	0.04 ± 0.01	0.04 ± 0.01

Genetic correlation estimates. Estimates of genetic correlations of ram libido score with NLB and LSW varied across breeds (table 3). The estimate of the genetic correlation between ram libido and NLB is small and positive in the Columbia breed (0.24). This estimate is near zero for the other breeds and ranged from – 0.09 to 0.02. The estimate of the genetic correlation between ram libido and LSW is small and positive for the Columbia and Targhee breeds (0.28 and 0.32, respectively) and nil for the Polypay breed. However, for the Targhee breed the estimate is small and negative (- 0.17).

Table 3. Estimates of genetic correlations from bivariate analyses of ram libido score and ewe reproductive traits

Trait	Columbia	Polypay	Rambouillet	Targhee
Number born	0.24	0.01	0.02	-0.09
Number weaned	0.28	0.00	-0.17	0.32

The small estimates of genetic correlation between libido of rams and NLB in three breeds suggests that ram libido is not genetically linked to ewe reproductive rate as measured by NLB. However, LSW is a composite trait influenced by NLB, maternal ability, and lamb survival. Maternal ability includes maternal behavior to care for and protect a lamb(s) to weaning. Positive correlations between ram libido and LSW in the Columbia and Targhee breeds suggest a small genetic relationship between libido of rams for breeding and litter size at weaning which reflects both reproduction and maternal ability of the ewe.

CONCLUSIONS

Although selection for ram libido score may enhance flock fertility, the small or nil estimates of genetic correlations of ram libido score with NLB or LSW suggest that little or no correlated genetic improvement in number of lambs born or weaned will occur.

REFERENCES

Burfening, P.J., Kachman, S.D., Hanford, K.J. and Rossi, D. (1993) *Small Rumin. Res.* **10** : 317-330.

Bromley, C.M., Van Vleck, L.D. and Snowder, G.D. (2000) *J. Anim. Sci.* **78** : 846-858.

Dodenhoff, J., Van Vleck, L.D., Kachman, S.D. and Koch, R.M. (1998) *J. Anim. Sci.* **76** : 2521-2527.

Hanford, K.J. (2001) PhD Thesis. University of Nebraska, Lincoln, Nebraska.

Kelly, R.W., Allison, A.J. and Shackell, G.H. (1975) *Proc. N. Z. Soc. Anim. Prod.* **35** : 204-211.
Katz, L.S., Price, E.O., Wallach, S.J.R. and Zenchak, J.J. (1988) *J. Anim. Sci.* **66** : 1166-1173.
Kilgour, R.J. (1985) *Aust. J. Exp. Agric.* **25** : 298-302.
Mattner, P.E., Braden, A.W.H. and George, J.M. (1971) *Aust. J. Exp. Agr. Anim. Husb.* **11** : 473-477.
Perkins, A. (1991) PhD Thesis. University of California, Davis, CA.
Perkins, A. and Fitzgerald, J.A. (1992) *J. Anim. Sci.* **70** : 1787-1794.
Perkins, A., Fitzgerald, J.A. and Price, E.O. (1992) *J. Anim. Sci.* **70** : 2722-2725.
Purvis, I.W. (1985) PhD Thesis, University of New England, Armidale, Australia.
Snowder, G.D., Stellflug, J.N. and Van Vleck, L.D. (2002) *J. Anim. Sci.* **80** : (in press).
Terrill, C.E. (1937) *Proc. Am. Soc. Anim. Prod*. 311-312.
Wiggins, E.L., Terrill, C.E. and Emik, L.O. (1983) *J. Anim. Sci.* **12** : 684-694.