Calculation Of The Economic Value Of Footrot For The Irish Sheep Industry

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Introduction

The long-term sustainability of many livestock sectors will depend upon having animals resistant to certain infectious diseases (Bishop and MacKenzie 2003), and selective breeding of domestic livestock for enhanced disease resistance is becoming more common throughout the world (Stear *et al*. 2001). Generally, disease costs vary widely depending on the prevalence of the disease and on the availability, effectiveness and sustainability of alternative control measures (Woolaston and Baker 1996) but costs of treatment and control are relatively simple to estimate for a given situation. The epidemic severity and disease incidence in any population is determined by the effect of transmission coefficient, latent period, recovery period, mortality rate, and the period of loss of immunity (Nath *et al*. 2004), and hence is complicated. In addition it is seldom possible to ascertain commercial flocks where the true prevalence of the disease trait has not been heavily influenced by treatment measures, and this therefore makes estimation of economic values for disease traits difficult. Foot health-related conditions including abscesses, scald, and footrot, requiring prevention and treatment measures represent a major welfare problem in sheep (Bishop and Morris 2007) and a significant cost to commercial sheep farmers in temperate environments (Nieuwhof and Bishop 2005). There is genetic variation in the performance of animals in relation to foot health (Nieuwhof *et al*. 2008) and therefore potential to improve performance through selection. Conington (2008) has evaluated alternative methods of scoring footrot for the purposes of a genetic improvement program run by commercial farmers. In breeding programs historically, much selection emphasis has been placed on improving productivity, and this is particularly so for sheep in Ireland (Byrne *et al*. 2009). The degree to which selection emphasis should be shifted towards reduced footrot incidence will be influenced by the economic values of breeding goal traits. This paper outlines a framework for computing an economic value for footrot for sheep in Ireland.

Materials and methods

Trait definition. Footrot was treated as a binomial trait as described by Conington (2008), in which the scoring methodology was developed to categorise foot lesions according to increasing severity, on a scale from 0 (normal hoof) to 5 (severe inter-digital dermatitis and under-running of the horn towards the walls of the hoof). In this study economic values were calculated for two separate traits; ewe footrot and lamb footrot. Economic values were calculated from a commercial farm perspective.

Rational for computing economic values. The units of the economic value give the farm profit impact per unit change in the footrot incidence trait per ewe or per lamb, per year. The calculations excluded any likely cost of reduced production (e.g. live weight, wool weight,

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and lambing percentage). Instead, the focus was on treatment and prevention costs including both chemicals purchased and labour.

The methodologies and control strategies for treating and preventing footrot employed in Ireland are likely to be wide and varied (McHugh 2009). In order to model the economic value of genetic improvement in resistance to footrot and foot health-related problems, two hypothetical farms of differing levels of prevalence were considered; a' low' prevalence and a 'high' prevalence farm. The costs differences associated with the required level of prevention measures and treatment protocols at each farm provided the basis for the calculation of the economic value.

Significant assumptions were required regarding the level of genetic difference between the hypothetical farms, and the associated levels of treatment required. It was assumed that the 'low' prevalence farm has 5% of ewes with any foot score >0, while the 'high' prevalence farm has 25% of ewes with any foot score >0. These same differences in prevalence levels were also applied when deriving the lamb trait economic value. Conington (2008) found average prevalence levels (score >0) to be 15% when considering 1600 hoof lesion scores on 100 mixed age ewes. This therefore represented the midpoint between the 'low' and 'high' prevalence farms modelled here.

Farm data. Data from the Teagasc Knockbeg Sheep Unit (Flannagan and Kelly 2009) provided the best practice protocol for the seasonal control of footrot in Ireland. Further to this, Nolan (2001) reported on the prevalence levels and prevention and treatment practices (foot paring, foot bathing, and topical and antibiotic treatment) on 17 sheep farms in Ireland. From this study, the 3 farms with the lowest average number of treatments (foot paring, foot bathing, and topical and antibiotic treatment) were modelled as the 'low' prevalence farm, and the 3 farms with the highest average number of treatments were modelled as the 'high' prevalence farm. The variation in control strategies undertaken by these groups of farms was assumed to occur as a direct result of the requirement to manage the condition and therefore directly linked to underlying genetic merit between our high and low farms.

Foot paring. It was assumed that 70% of ewes need foot paring at each of the foot paring events throughout the year, and that 3 minutes was required per ewe for capture, assessment and paring. It was assumed that lambs were not foot pared.

Foot bathing. All ewes and lambs were foot bathed at each respective foot bathing event throughout the year. This practice was assumed to take 1 hour per bathing (McHugh 2009). Data from Nolan (2001) provided the estimates of the proportion of foot bathing events utilising the various chemicals. The average cost per foot bath, including labour, was €0.07 per ewe and €0.056 per lamb.

Topical spray treatment and antibiotic treatment. The cost per treatment was assumed to be €0.35 and €0.90 for topical spray and long acting injection, respectively (McHugh 2009). Each topical or antibiotic treatment was assumed to take 1 minute. No lambs received antibiotic treatment.

Results and discussion

Annual ewe foot paring events totalled to 0.33 and 5.67, at a cost of €0.20 and €3.37 per flock ewe, for the 'low' and 'high' prevalence farms, respectively.

Annual ewe foot bath events totalled to 1.67 and 9, at a cost of €0.26 and €1.39 per flock ewe, for the 'low' and 'high' prevalence farms, respectively. Annual lamb foot bath events totalled to 1 and 3, at a cost of €0.11 and €0.34 per flock lamb, for the 'low' and 'high' prevalence farms, respectively.

Annual ewe spray treatments totalled to 5% and 10% of the ewe flock, at a cost of €0.06 and €0.127 per flock ewe, for the 'low' and 'high' prevalence farms, respectively. Annual lamb spray treatments totalled to 5% and 10% of the lamb flock, at a cost of €0.03 and €0.06 per flock lamb, for the 'low' and 'high' prevalence farms, respectively.

Annual ewe antibiotic treatments totalled to 3% and 6% of the ewe flock, at a cost of €0.032 and €0.071 per flock ewe, for the 'low' and 'high' prevalence farms, respectively.

Total annual per flock ewe and per flock lamb costs of prevention and treatment practices for the 'low' (5%) and 'high' (25%) prevalence farms are presented in Table 1 below.

Table 1: Total annual per flock ewe costs of footrot control strategies for 'low' and 'high' prevalence farms

	Prevalence	Total cost per flock ewe		Total cost per flock lamb	
Low prevalence	5%	€	0.55	€	0.14
High prevalence	25%	€	4.96	€	0.40

The model predicted a change in annual per ewe costs of **€0.221** per percent increase in ewes with a foot score >0. A 1% increase in lambs with a foot score >0 resulted in a change in annual per lamb costs of **€0.013**.

The levels of prevalence allocated to the 'low' and 'high' farms were based on intuition, primarily because very little data is available on prevalence differences, and the associated costs of treating flocks, with differing genetic performance for resistance to footrot. More detailed recording of prevalence and treatment regimes on farms in Ireland is required to refine these assumptions. The development of breeding schemes presented by Byrne (2009) provides the opportunity to more accurately assess the true genetic merit of alternative flocks, and the associated treatment measures required. The feasibility of genetic improvement for disease traits appears to be high with the heritability of a range disease traits being similar to that of a number of production traits (Stear *et al*. 2001). However modelling the economic implications of differences in the true genetic performance of flocks for disease traits and selecting for resistance to disease traits, such as footrot, remains difficult. The risk in selecting for production traits only is that this will lead to deterioration of traits negatively correlated with the production traits (Heringstad *et al*. 2007) and these are often traits linked with immunological responses (Rauw *et al.* 1998). While large assumptions were required to calculate an economic value for footrot, errors in single economic weights in the area of ±50% have been shown to reduce the relative efficiency of index selection by less than 1% for all traits considered (Vandepitte and Hazel 1977). There is the possibility that the economic impacts of footrot prevalence have been over-estimated in this study, however Amer (1994) suggested that over emphasis on the trait, for which the economic value is questionable, is optimal when maximising expected response is the objective.

Conclusion

An economic value has been developed for footrot for sheep in Ireland. Data was available on the costs of treatment and prevention practices, however significant assumptions were required regarding the level of prevalence (and therefore genetic merit for resistance) associated with a prescribed level of treatment. While these assumptions are likely to be reviewed with development of breeding schemes to capture relevant data, the work reported in this paper provides a basis for inclusion of disease traits in the breeding objective for sheep in Ireland.

References

Amer, P.R., Hofer, A. (1994). *J. Anim. Breed. Genet.,* 111:89-101.
Bishop, S.C., MacKenzie, K.A. (2003). *Genet. Sel. Evol.,* 35:S3-S17.
Bishop, S.C., Morris, C.A. (2007). *Small Ruminant Res,.* 70:48-59.
Byrne, T.J., Amer, P.R., Fennessy, P.F. *et al.* (2009). *Proc. Assoc. Advmt. Breed. Genet.,* 18:434-437.
Conington, J., Hosie, B., Nieuwhof, G. *et al.* (2008). *Vet. Res. Commun.,* 32:583-589.
Flannagan, S., Kelly, W. (2009). Teagasc, Carlow, p. 4.
Heringstad, B., Klemetsdal, G., Steine, T. (2007). *J. Dairy Sci.,* 90:2419-2426.
McHugh, M.P. (2009). Galway.
Nath, M., Woolliams, J.A., Bishop, S.C. (2004). *J. Anim. Sci.,* 82:384-396.
Nieuwhof, G.J., Bishop, S.C. (2005). *Anim. Sci.,* 81:23-29.
Nieuwhof, G.J., Conington, J., Bünger, L. *et al.* (2008). *Anim.* 2:1289-1296.
Nolan, T., Clarke, P., Flanagan, J. P. *et al.* (2001). Teagasc, Galway.
Rauw, W.M., Kanis, E., Noordhuizen-Stassen, E.N. *et al.* (1998). *Livest. Prod. Sci.*, 56:15-33.
Stear, M.J., Bishop, S.C., Mallard, B.A. *et al.* (2001). *Res. Vet. Sci.,* 71:1-7.
Vandepitte, W.M., Hazel, L.N. (1977). *Annals Genetique Selection Animalia,* 9:87-103.
Woolaston, R.R., Baker, R.L. (1996). *Int. J. Parasitol.,* 26:845-855.