BREEDING OBJECTIVES FOR SEASONAL PRODUCTION SYSTEMS: AN EXAMPLE FROM NEW ZEALAND VENISON SYSTEMS

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SUMMARY

Seasonal variation in prices received and input costs can have market effects on breeding objectives and farm system strategies. A breeding objective was developed for venison production systems in New Zealand, accounting for seasonal prices and feed costs. Two farm systems were compared, one with an early kill profile targeting premium prices in spring, and the other with a later kill profile which doesn't achieve spring price premiums. The impact of spring premiums on the value of additional growth was marked, but is somewhat negated by the additional feed costs incurred under an early kill system. The principles demonstrated in this example have application to other pastoral production systems.

INTRODUCTION

The value of genetic improvement in different traits can be strongly influenced by seasonal fluctuations in prices received and input costs such as feed under pastoral systems. In such systems, the commercial value of genetic improvement in different traits can vary depending on whether the farm management system targets seasonal premiums or not, and what the current success rate in achieving these premiums is.

The New Zealand venison industry has many similarities to other pastoral based meat production systems (e.g. lamb and beef), but a distinguishing feature of venison production systems is the very marked impact of seasonality. The venison industry operates under seasonal feed supply patterns (no different to many other pastoral systems), but also has strongly seasonal market demand and strong biological seasonal control over reproduction, feed intake and growth of deer. The biological and feed supply seasonality factors constrain supply of venison into periods of peak market demand.

The major markets for New Zealand venison are European, where a strong preference exists to consume venison during the northern hemisphere autumn, based on centuries of culinary tradition and hunting during "the rut". This means that chilled venison produced from July to November attracts premium prices. Venison produced during the remainder of the year is mainly exported as frozen product, generally attracting a lower price, and stored for consumption during the following European autumn. Despite attempts to market venison to European consumers "out of season", the fundamental consumer tradition and preference for venison consumption during autumn remains strong.

The schedule paid for venison carcasses to farmers reflects the seasonal demand for venison and the difficulty in producing venison of the desired carcase specification (55 to 70 kg carcase) from an animal less than 12 months old. Moreover, as the schedule declines during New Zealand's spring the value of a constant weight carcase declines at a rate which, depending on the absolute value of the schedule, often means that the additional carcase weight obtained by retaining growing animals for an additional week is not sufficient to compensate for the declining schedule leading to a loss of value. Thus venison production during this period is often driven by selling animals as soon as they reach a weight which will produce a carcase within specifications (around 55 kg carcase weight), and consequently the average weight of venison carcasses has not changed in many years, although the timing of the kill or the age of animals killed (rising one-year olds vs animals retained for an extra year) may have changed significantly.

The consequences of seasonal schedules on the economic value assigned to traits can be marked, and these are dependent upon the current level of performance of the farm system being considered. In this paper we constructed a breeding objective for New Zealand venison systems operating under a seasonal schedule, and compare the economic value for different traits under scenarios where farm strategy and performance differs. While the example is specific to venison production, the principles can be applied to other livestock production systems where seasonal payment schedules are a feature.

DEVELOPMENT OF THE BREEDING OBJECTIVE

A bio-economic model for a self-replacing deer herd focussed on venison production only was created using an excel spreadsheet. The production system was based on slaughter of animals aged from 9 months to 21 months of age (ie. yearling production system), typical of most venison production in New Zealand. Two different scenarios were modelled, based on variation in average slaughter date. In an early kill system, median slaughter date for stags was set to 6th October, with median slaughter date for hinds being 6th December. This farm system targets the period in which spring premium prices are available, and while a proportion of animals are killed during the premium period, genetic gain in traits which lead to heavier animals at a fixed time of year will result in a larger proportion of animals achieving spring premiums. A later kill system was also modelled, with median slaughter dates being 6th December and 6th February for stags and hinds respectively. In this system most animals are killed after the spring premium period has ended, and incremental gain in traits leading to earlier slaughter is not sufficient to make a large difference to the proportion of animals achieving premium prices. However, as with the early kill system some savings in feed costs are potentially available from the reduction in maintenance requirements arising from earlier slaughter. Figure 1 shows the assumptions for seasonal variation in feed costs and schedule price.

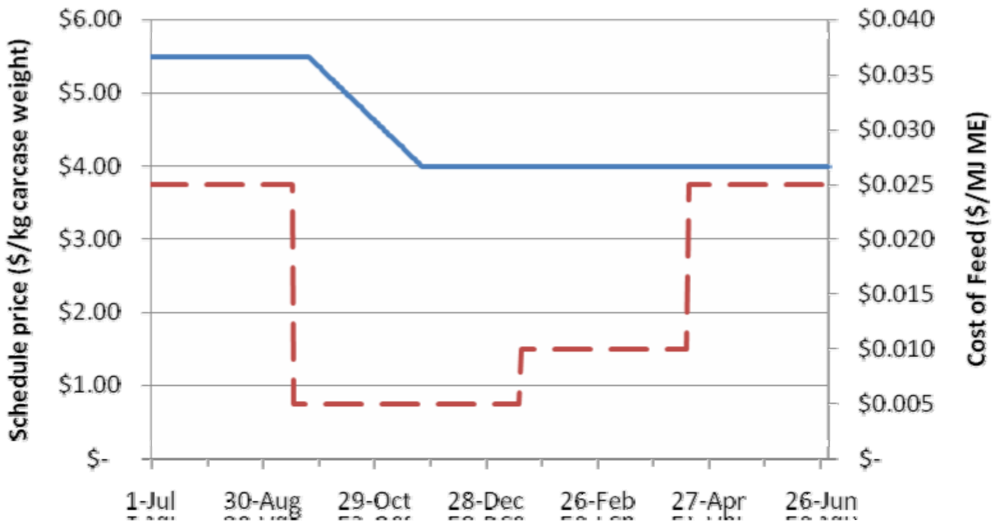

Figure 1. Assumptions used to describe seasonal changes in schedule price (solid line) and cost of feed (broken line).

The bio-economic model was constructed to reflect a system where animals are drafted weekly from 1st September, with all animals greater than 97 kg liveweight sold for slaughter. Feed costs for different classes of animals were calculated using assumptions for maintenance (0.7 for stags and 0.6 for hinds MJ ME per $kg^{0.75}$) and growth (37 MJ ME/kg liveweight gain). Feed costs were broken down into costs from birth to 3 months, 3 months to 6 months and 6 months to 12 months. Changes in weight at each age independent of the other ages were modelled to calculate an economic value, this approach leading to negative weights at earlier ages reflecting the slightly reduced maintenance requirements resulting from a growth path that is slow early on followed by rapid gains to reach slaughter weight. However, the economic weight for weight at 12 months is positive, reflecting the fact that a heavier weight at this age leads to earlier slaughter and consequently savings in maintenance requirements. Increases in hind mature weight resulted in increased annual maintenance requirements, increased feed costs to rear replacement hinds to a heavier weight, and increased cull value for hinds surviving to slaughter.

There are two potential pathways by which animals can be slaughtered earlier (but at a constant liveweight), namely improvement in growth rates or earlier calving. Reproduction in red deer is under strong seasonal control driven by photoperiod, but some genetic variation in conception date appears to exist both between breeds (Scott *et al.* 2006) and within breeds (Archer, unpublished data). The impact of seasonal changes in schedule price was calculated by deterministically simulating the drafting of animals at a fixed liveweight (97 kg), starting on 1st September. Economic values for carcase weight (at a constant age) were calculated based on the change in average price per kg resulting from earlier slaughter. During the finishing period, animals were assumed to grow at 0.3 and 0.25 kg/day for stags and hinds respectively. Standard deviations for liveweight at 12 months were 15 and 12 kg respectively. Economic values for calving date were calculated by shifting the mean calving date forward, and then calculating the change in average value per calf slaughtered and multiplying by the number of calves slaughtered per hind mated (0.59).

Carcass composition and reproductive traits were included in the index for future purposes, although little measurement of these traits currently occurs. Carcass composition was broken down into loin cuts and hind quarter cuts worth 4 times and 1.6 times the value of fore-quarter cuts respectively. These values were calculated at a constant slaughter weight, so that an increase in weight of one area displaces weight in other cuts. Economic values of reproductive success (pregnancy and calf survival) were calculated as the value of additional calves slaughtered minus feed costs.

The number of discounted genetic expressions for each trait type was calculated to account for differences in the frequency and timing of expressions (based on Amer 1999). A planning horizon of 25 years was taken with gene flows modelled through generations in the breeding herd. A discount rate of 0.07 was assumed.

RESULTS AND DISCUSSION

The economic values calculated for traits in the index under the early kill and late kill systems are given in Table 1. The early kill system differs from the late kill system by having higher feed costs per MJ of ME supplied, a greater opportunity to exploit early season premiums in a significant proportion of calves slaughtered, and slightly higher hind mature weights. The economic values for liveweight traits in the late kill system reflect the cheaper cost of feed, with a lower penalty on mature weight and a greater economic value on 12-month liveweight. The benefit from achieving greater spring premiums in the early kill system is seen in the economic weights for carcase weight and calving date. Under the scenario modelled higher BVs for carcase weight translate into earlier slaughter (due to killing at a fixed liveweight), while earlier calving (ie. negative BV for calving date) leads to heavier animals at a given time of year and hence earlier slaughter at a fixed liveweight. Consequently, the index for the early kill system places considerably more emphasis on these two traits compared to the index for the late kill system. However, if carcase weight is considered to be directly related to 12 month weight by a factor of 0.55 (to account for dressing percent), then the total weighting on 12-month weight is 0.9015 for early kill and 0.8105 for late kill. Thus while additional growth is still more important in early kill systems, the advantage is somewhat diminished by the higher average cost of feed in this system. Economic weights for carcase composition traits are similar between the two systems, while traits describing reproductive success receive greater emphasis in the late kill system.

Table 1. Economic values for indices formulated for early and late kill systems.

Goal trait	Early Kill System			Late Kill System		
	EV[1]	DGE	EW	EV	DGE	EW
Growth rate						
Weight – 3 months kg	0.06	0.85	0.05	-0.33	0.85	-0.28
Weight – 6 months kg	-0.30	0.85	-0.25	-0.08	0.85	-0.06
Weight – 12 months kg	0.07	0.77	0.06	0.40	0.77	0.31
Hind mature weight kg			-0.45			-0.37
Replacement kg hind feed kg	-0.26	0.24		-0.22	0.24	
Annual hind feed kg	-0.69	0.95		-0.61	0.95	
Cull hind value	1.65	0.16		1.65	0.16	
Carcass Weight kg	2.81	0.54	1.53	1.67	0.54	0.91
Carcass yield (age constant BVs)						
Loin cuts kg	11.40	0.54	6.15	11.85	0.54	6.40
Hindquarter cuts kg	1.66	0.54	0.89	1.72	0.54	0.93
Forequarter cuts kg	-0.45	0.54	-0.24	-0.47	0.54	-0.25
Maternal						
Scanned pregnant – 2 yr old	113.54	0.24	27.14	129.04	0.24	30.84
Scanned pregnant – mixed age	113.54	0.76	87.69	129.04	0.76	98.65
Calf survival – 2 yr old	113.54	0.19	21.55	129.04	0.19	24.50
Calf survival – mixed age	113.54	0.76	87.69	129.04	0.76	98.65
Calving Date	-0.40	0.95	-0.39	-0.17	0.95	-0.16

[1]EV = Economic value ($) DGE = Discounted Genetic Expressions EW = Economic weight

These results highlight the impact of both seasonal premiums and seasonal feed costs on the composition of the index, and show that current farm system performance has a significant influence on the index and the farming strategy taken. Where a moderate change in genetic performance has a significant impact on the number of animals killed on premium schedules, it is worth putting significant emphasis on traits which will assist in targeting earlier kill. However, in situations where a large improvement in performance is required to meet premium schedules with earlier kill, a better strategy is to concentrate on reproductive performance and carcass yield, and to utilise the benefits of a lower cost of feed. Deer farmers make these decisions largely intuitively, but modelling approaches such as the one described here are useful to more objectively describe the trade-offs and determine the optimal direction to take in breeding programmes.

In practice the strategies used by many New Zealand deer farmers reflect this finding. With changing land use, the breeding herd has largely shifted to hill and high country where the cost of feed is lower, and the environment is conducive to better reproductive performance as calves tend to survive better in extensive areas. One of the industry issues currently being debated is the impact of high growth genetics on reproductive performance, with concerns that larger hinds will lead to poorer reproductive performance. The evidence to support this view is anecdotal rather than experimental, but nevertheless it is consistent with experiences in other pastoral meat production systems.

To our knowledge there are few reports in the literature where seasonal premiums are explicitly accounted for when valuing genetic gain and developing breeding objectives. Jones et al (2004) used a model of fat and lean growth in lambs together with a seasonal change in schedule prices to model a drafting strategy and calculate economic values for component traits. Their study also valued differences in feed costs throughout the year, and they suggested that this was particularly important when concentrate supplements were used along with grazing to feed animals. Certainly the issues of seasonal feed prices are common across most livestock industries, and seasonal premiums often reflect the impact of seasonal feed prices on supply. The venison example described here has additional seasonal drivers as schedule prices are a result of seasonal consumer demand and biological seasonality of deer in addition to seasonal feed prices, but the principles have application in other livestock systems.

ACKNOWLEDGEMENTS

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