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Identification of breeding objectives using a bioeconomic model for a beef cattle production system in Uruguay

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ABSTRACT

The aims of this study were to establish the breeding objective for a typical Uruguayan beef cattle production system, identifying the main economically relevant traits, estimating their economic values (EVs) and relative importance in the breeding objective. The bioeconomic model included performance (weights, daily gains, mortality, pregnancy and replacement rates), and economic (sale, feed and health prices) parameters. The herd was a cow–calf operation of 100 Hereford cows with a finishing component, which annually sells steers, non-pregnant cows and surplus replacement heifers. Feed requirements were calculated for pasture grazing animals based on the factorial approach to calculate energy requirements for maintenance and growth for young animals, and maintenance, gestation and lactation for cows. Increases in requirements caused by changes in the system were supplied through purchased feed. Economic profit was simulated as total revenues less total costs. Biological traits affecting profit were identified as economically relevant trait. The EV of a trait was calculated by simulation as difference in farm profits at the average trait level and after incrementing the trait level by one unit keeping other evaluated traits constant. EVs are expressed per 100 meted cows, and were adjusted using the discounted gene flow method, to account for frequency and timing of trait expressions. Calving rate had an EV of US$96.0, followed by Carcass Weight ($21.4 for heifers and $2.5 for cows), Calving Ease (US$ 20.4), Dry Matter intake (−$0.7 for steers, −0.5 for heifers and −0.7 for cows), Weaning Weight direct (−$1.1) and Weaning Weight maternal (−$3.8). EV was expressed as the income obtained in this production system per 100 mated cows. When EVs were expressed per additive genetic standard deviation, reproductive traits were three times more important than growth and feed intake traits. Some of the most important traits do not currently have an Expected Progeny Differences, to allow selection, so efforts should be placed to generate that information.

1. Introduction

Definition of the breeding objective is a crucial step in the development of genetic improvement programmes. A profit-based breeding objective comprises economically important traits weighted according to their importance in a given production system. Decisions about which traits should be included should be based purely on economic relevance, and not on whether the traits are difficult or easy to measure or to change by selection (Ponzoni and Newman, 1989). In Uruguay, the main beef cattle breeds are Hereford and Angus, and each breed association

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produces an annual genetic evaluation (i.e. estimation of Expected Progenies Differences, EPD), for routinely recorded traits (growth, carcass and reproduction). Some of those traits are economically relevant (ERT) but most of them are indicator traits. ERTs affect profitability by being associated with a specific production cost or income stream, whereas indicator traits are not directly related to profit but are correlated with ERT. Genetic trends for beef cattle in Uruguay show that selection has been for heavier post-natal live weights, with less attention to reproductive traits measured as scrotal circumference (Ravagnolo et al., 2011). Selection has been based on individual perceptions since formal breeding objectives have not been formally adopted by Uruguayan breeders or breeding societies, despite published scientific studies in this area (Urioste et al., 1998).

The aim of this study was to identify the main ERT to be included in a breeding objective for a typical Uruguayan beef cattle system, to estimate their economic values (EVs) and their relative importance in the breeding objective.

2. Materials and methods

The four steps suggested by Ponzoni and Newman (1989) were followed to identify the breeding objective: (i) specification of the breeding, production and marketing system, (ii) identification of sources of income and expense; (iii) determination of biological traits influencing income and expense; (iv) derivation of economic value of each trait.

2.1. Specification of the breeding, production and marketing system

The production system was defined as an integrated system with two components (subsystems): a cow–calf operation of 100 Hereford cows and a finishing component, which annually sells steers at a standard fixed age, non-pregnant and cull-for-age cows and surplus replacement heifers. Feeding was based on unimproved native pastures for cows, improved pastures for heifers and steers, with steers fed 90 days of sorghum concentrate as a finishing ration prior to their harvest. A fixed number of mated cows and variable feed was assumed; consequently, feed requirements typically change as a result of any change in the production system.

The assumed age structure for the breeding herd includes seven categories (Table 1). Age at first mating occurs when heifers are two years old. Herd size (number of mated cows) remains constant over the years through the introduction of replacement heifers born in the system (at a rate of 20.5%) and culling of empty and old cows.

Average calving rate in the system is 77.8%; calves are born in spring and are weaned at 205 days. Males are kept

Table 1
Age structure at calving.

	Age at calving							
	3	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
Number of cows per category	20.5	19.7	19.1	14.6	11.1	8.5	6.5	100
Calved cows per category	17.7	14.3	14.6	11.1	8.5	6.5	5.0	77.8
Discarded cows at pregnancy diagnosis			4.1	3.1	2.4	1.8	1.4	12.9
Empty heifers retained	2	4.8						6.8
Dead cows	0.82	0.59	0.38	0.29	0.22	0.17	0.13	2.6
Calving percentage (%)	90	75	78	78	78	78	78	
Mortality rate (%)	4	3	2	2	2	2	2	

Table 2
Assumed weights at different ages from animals calved from heifers and mature cows.

	Progeny from adults cow				Progeny from heifers			
	Males		Females		Males		Females	
	Wt. (kg.)	Daily gain (kg/d)[a]	Wt. (kg.)	Daily gain (kg/d)[a]	Wt. (kg.)	Daily gain (kg/d)[a]	Wt. (kg.)	Daily gain (kg/d)[a]
Birth wt.	36		35		34		33	
Weaning wt.	185	0.72	176	0.69	169	0.60	162	0.63
Yearling wt.	266	0.51	250	0.46	253	0.52	235	0.45
15th month wt.	315	0.54	284	0.38	306	0.58	274	0.43
18th month wt.	386	0.76	348	0.68	362	0.60	338	0.69
24th month wt.	495	0.60	390	0.23	457	0.53	380	0.23
26th month wt.(steers)					480	0.38		
36th month wt.(females)			455	0.18			445	0.18
Mature cow wt.			485	0.1			485	0.13

[a] daily gains were calculated between the previous and current weight.