Poster

ECONOMIC WEIGHING OF TRAITS IN A PRELIMINARY SELECTION INDEX FOR OSTRICHES IN SOUTH AFRICA

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SUMMARY

A selection index to identify the best males and females from the Oudtshoorn research flock to supply the ostrich industry with performance-recorded breeding material was built using a cost approach. Traits of economic importance that were included were growth, adult weight, chick production and survival, feather weight and quality, nodule development and the presence of hair follicles. Economic values were weighted by discounted genetic expressions coefficients to determine economic weights for these traits and combined with genetic standard deviations to indicate the relative emphasis that is put on each trait in the resulting selection index.

INTRODUCTION

The South African ostrich industry has a lack of pedigreed flocks due to the wide use of large breeding colonies where individual reproduction cannot be recorded. The government owned Oudtshoorn Research Farm is one of the only institutions with a breeding structure (pair breeding) and recording system that can generate data suitable for genetic evaluation (Cloete *et al*. 2008b). Data on quantitative and qualitative production traits are also routinely recorded on the farm and can be used to estimate genetic parameters for traits of economic importance.

Quantification of the economic value of the relevant genetic traits is needed to optimise genetic selection strategies (Amer *et al.* 1999). The ostrich industry is basically a slaughter industry, with most income being derived from the products, namely meat, leather and feathers. Live weight or growth to slaughter would therefore be an important trait to consider, since live weight is highly correlated to both carcass weight and skin size (Engelbrecht *et al*. 2009; 2013). Survival and reproduction rate should also be considered in a breeding plan for the ostrich industry (Cloete *et al*. 2008b). Genetic and economic information for these traits can be combined into a multiple trait selection index, which gives proper weight to each trait to estimate genetic merit and ensure more efficient selection than when selecting for one trait at a time (Hazel 1943). Account must also be taken of the frequency of expression of each trait in an individual and its descendants, as well as discounting to account for time delays in the expression of some traits relative to others (McClintock & Cunningham 1974; Amer 1999).

This paper provides a description of simple economic weight calculations for the development of a maternal and a paternal index, which will allow identification of the best males and females from the progeny of Research Farm flock for replacement purposes, as well as for selling to commercial farmers.

MATERIALS AND METHODS

Traits of economic importance were identified by making use of a bio-economic model prepared by Van Zyl (2001), adapted according to current industry cost structures. Once traits of economic importance were decided upon, economic values for the various traits were calculated and economic weights were subsequently derived.

Input cost variables and revenue streams were computed to determine the economic value of each trait, following methods described by Byrne *et al.* (2016). The economic value of a trait was defined as the amount by which profit may be expected to change for each unit of improvement in the trait concerned (Hazel 1943). These economic values were transformed into economic weights by accounting for the different rates of transmission and timing of expression (Amer 1999).

"Days to slaughter" was one of the first traits of economic importance chosen to be used in the selection index. For skin quality, nodule size and the presence of hair follicles was chosen as the most important traits influencing skin income (see Engelbrecht 2013). Feather weight and feather quality was chosen as predictor traits of feather income. Other traits chosen for use in the selection index were the number of chicks per female per season and adult live weight.

Calculations of the economic values for these traits were based on various assumptions and industry averages (Table 1), as well as current industry price structures (April 2019).

Table 1. Base input parameters used for the calculation of economic values

Description	Value
Annual investment/cost of farm	5 000 000 ZAR
Cost of one labourer per annum	50 000 ZAR
Number of labourers	4
Number of birds slaughtered per year	1000
Interest / mortgage minus inflation	0.07%
Maintenance/depreciation	0.05%
Number of chicks per female	20
Survival to slaughter	60%
Mature breeder weight	130kg
Breeder feed intake per day	2.6kg
Juvenile bird (7-month-old) feed intake per day	1.9kg
Price/kg breeder diet	4.50 ZAR
Price/kg maintenance diet	3.50 ZAR
Price/kg grower diet	4.00 ZAR
Length of breeding season	224 days
Average live weight gain per day at slaughter age	300g/day
Maintenance requirements per day	116.5g/day

Economic value of chick production. The economic value of number of chicks per season was calculated based on increasing the average number of chicks per female per production year (20) by one. This translated to needing 4.76% (1-20/21) fewer breeder birds to produce the same number of chicks as before, which would represent a saving of 4.76% on the cost of breeder birds. The annual cost of a breeder pair was calculated to be 7807.80 ZAR, so this translates to an economic value of 371.80 ZAR.

Economic value of survival to 7 months of age. If one assumes that chicks die on average at 2.5 months of age, the costs incurred to rear a chick from hatch to 2.5 months of age need to be added to the value of a day-old chick to determine the economic value. This equates to 570.26 ZAR.

Economic value of weight at 7 months of age. It was assumed that farmers will slaughter animals earlier if they grow faster. Target slaughter weight was assumed to be 100kg. Due to the high genetic correlation between slaughter weight and weight at 7 months of age (Engelbrecht et al. 2011), and because preliminary selection decisions must be done before slaughter, it was decided to use a target weight of 70kg at 7 months of age as a selection trait instead. An increase of 1kg at 7 months, would translate to a 1.43kg heavier bird at slaughter age (100/70), which translates into a cost saving of 4.76 days (1.43kg/0.3kg average live weight gain/day) because the bird can be slaughtered earlier. The feed saving was calculated only for 3.33 days (4.76 x 0.7) though, since the birds were assumed to be a little heavier over their life. The saving on maintenance feed, labour, interest and depreciation amounted to an economic value of 35.77 ZAR per kg of 7 month weight.

Economic value of adult weight. If we assume that maintenance requirement equates to (live weight)$^{0.75}$, and average mature weight is 130kg, then increasing mature weight by 1kg will increase maintenance feed requirements by 0.57%, which translates to a negative economic value of 22.55 ZAR per adult bird per season.

Economic value of nodule size. Using the weighted average price of all skins and the distribution of nodule size scores across all skins, the economic value of an improvement of one unit in nodule size score was estimated at 137.31 ZAR.

Economic value of hair follicle prevalence. The economic value for hair follicles was calculated by considering the effect of improving hair follicle score (scored on a scale of 1 to 9) by one. Taking into account the distribution of hair follicle scores across all skins evaluated on the research farm, it was calculated that the number of skins being downgraded as a result of hair follicles would decrease by 12.9% as a result. Using the weighted average price difference between grades and the current distribution of grades, the economic value of an improvement in hair follicle score was estimated to be 104.67 ZAR.

Economic value of feather weight. The economic value of feather weight was calculated from an average price of 1562 ZAR for 1.17kg of slaughter feathers. The effect of an increase of 100g in total feather weight therefore equates to 133.50 ZAR.

Economic value of feather quality. The distribution of feather grades for white plumes and other wing feathers, the pricing for the different feather grades and the average feather weights for the different feather categories were used to derive an economic value based on the effect of an improvement of 1 grade in quality on the weighted average price. This amounted to an economic value of 162.54 ZAR for feather quality.

Accounting for number of expressions. Transmission factors (allowance of 0.5) for traits expressed by chicks instead of by the actual parent, were multiplied by the number of animals expressing each trait to convert units of economic values to a constant expression scale to give the final economic weights.

Percent emphasis of traits. Genetic parameters obtained from previous analysis of data from the pair-bred ostrich flock at the Oudtshoorn Research Farm (Cloete *et al.*, 2008a; Engelbrecht, 2013) were then used to compute percent emphasis for each trait. Estimates of the genetic standard deviation and variability for feather weight and quality were obtained by analysing weight and length records (as indicator of quality) for mature white wing feathers (n=3092).

RESULTS AND DISCUSSION

Table 2 describes the specific trait weights for a female line index. Traits with high positive economic weights were chick production, nodule size score and feather quality, while hair follicle score had a high negative economic weight.

The relative weights of the traits reflect the current industry situation, where feather prices are disproportionally elevated, while meat and skin prices are under pressure. It also reflects the increasing importance of hair follicles for determining skin quality. Similar to other livestock industries, reproduction (chick production) remains the most important trait of economic importance. For the male line index the corresponding relative trait emphasis were 17.36 for survival, 25.05 for 7-month weight, 3.49 for adult weight, 9.93 for nodule size score, 13.26 for hair follicle score, 13.09 for feather weight and 17.82 for feather quality.

Table 2. Economic values, economic weights, genetic standard deviations and the relative emphasis of different ostrich traits in a female line index per mating season

Trait	EV (ZAR)	Trans-mission	Number of times expressed / parent	Economic weight	Genetic s.d.	Relative emphasis
Chick production	371.80	1	1	371.80	6.52	32.26
Survival to 7 months	570.26	0.5	20	5702.63	0.15	11.76
7-month weight	35.77	0.5	12	214.62	5.94	16.97
Adult weight	22.31	1	1	-22.31	7.96	2.36
Nodule size score	137.31	0.5	12	823.87	0.61	6.72
Hair follicle score	104.67	0.5	12	-628.03	1.07	8.98
Feather weight	133.50	1	1	267.01	2.50	8.87
Feather quality	162.54	1	1	325.07	2.79	12.07

CONCLUSION

Economic weights were determined for a wide range of economically important ostrich traits to provide a basis from which a robust comparison of selection candidates can be made. However, according to Hazel (1943) an index constructed from data taken on a flock in one locality may not be widely applicable, due to differences in genetic constitution, environmental factors and management practices. Optimizing genetic improvement in the ostrich industry will therefore only be possible once commercial ostrich farms improve their breeding structures to allow access to data from different flocks and environments. Once an exhaustive set of genetic parameters are available for all the traits, these should also be factored into the selection index. Furthermore, 5-year averages for economic costings should potentially be used to account for the variability in market conditions applicable to the industry to increase the accuracy of the index over time.

ACKNOWLEDGEMENTS

The South African ostrich industry is thanked for providing information for calculating economic values. Financial support of the Western Cape Department of Agriculture and the Western Cape Agricultural Research Trust is also gratefully acknowledged.

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