Breeding value evaluation in Polish fur animals: Factors affecting pelt prices in the international trading system

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ABSTRACT: The aim of this study was to determine the contribution of pelt character traits to the price the skins could reach at an auction house. The paper also presents an analysis of trends showing the changes in the contribution of pelt character traits to the pelt price over 4 seasons. 10 177 records of arctic fox pelts sold at the Helsinki Auction House in the seasons 2000–2004 were analysed. The pelts were graded and sorted according to their character traits: size, quality, colour clarity and colour darkness. The significance of the pelt character traits and their effects on the pelt price were tested using the GLM procedure and two linear models (Model 1 – without interactions between main effects, Model 2 – with interactions between main effects). The total variation of the pelt price was partitioned into components connected with random effects included in the models using the REML and VARCOMP procedure. Then, based on the estimated variance components, the percent contribution of each component to the total variation of the pelt price was calculated. It was found that, depending on the model and season, the pelt price was mostly influenced by skin size and quality, whereas colour type and colour clarity had small effects on the pelt price. However, the effect of the skin size on the pelt price in the analysed seasons decreased, whereas the effects of the remaining three traits on the pelt price slightly increased.

Keywords: arctic fox; auction house; pelt character traits; pelt price

Fur farming is today a well-organized business providing incomes for many breeders. According to Furbusiness (www.furbusiness.com) fur production is mainly concentrated in Northern Europe (64%) and North America (11%). The most important species of fur-bearing animals are foxes and mink. Every year approximately 27 million pelts of these species are produced (80% of mink pelts and 20% of fox pelts).

The international trading system of pelts is based on auction houses which are located in countries producing large numbers of skins (Finland, Denmark, Canada, USA, Russia). Fur animal breeders sell skins at international auction houses either directly or through local collectors. At the auction house the pelts are graded and sorted according to their size, quality, colour clarity and colour darkness, and then they are offered in "lots" to buyers. The international market prefers pelts of high quality hair coat and large size, and only that sort of skins can reach high prices. Thus, from the breeder's point of view, it is crucial to know to what extent the pelt price is affected by each of the skin character traits. Knowing that, the farmers could quickly respond by putting selection pressure on the skin trait(s) that influence the auction price to the largest extent.

The objective of this study was to determine the contribution of pelt character traits to the price the skin could reach at an auction house. The paper also presents an analysis of trends showing the changes in the contribution of pelt character traits to the pelt price over the seasons 2000–2004.

MATERIAL AND METHODS

Data

10 177 records of arctic fox pelts sold at the Helsinki Auction House in the seasons 2000–2004 were analysed. Within each season a few auctions (2000/2001 – 5 auctions, 2001/2002 – 6 auctions,

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2002/2003 – 5 auctions, 2003/2004 – 4 auctions) offering the pelts were organized. The pelts were graded and sorted according to their character traits: (1) size – 00000 (largest), 0000, 000, 00, 0, 1, 2, 4 (smallest); (2) colour darkness – xxxD (darkest), xxD, xD, DK, MED, PAL, xP, xxP, xxxP, xxxxP (lightest); (3) colour clarity – R+ (best clarity), R, R–, OC, OC– (worst clarity); (4) quality – SR (best quality), S, 1, 1B, 2, 3, BR, BRL, 4 (worst quality). A short statistical summary of the seasons as well as of the characteristic of arctic fox pelts sold during the studied years is presented in Tables 1 and 2, respectively.

Statistical analyses

The significance of the pelt character traits and their effects on the pelt price were tested using the GLM (General Linear Models) procedure and two linear models (Model 1 without interactions between main effects, Model 2 – with interactions between main effects).

Although the skin character traits were assigned into classes using a discrete scale (a few categories within each class), their scores were normally distributed (skewness and kurtosis ranged from 0.05 and 0.13 for colour type to 0.24 and –0.17 for skin size, respectively) fulfilling the requirement of linear analysis [the analysed trait should be normally distributed, with $N(\mu, \sigma^2)$]. Furthermore, null covariances between random effects of the models were assumed.

The model adequacy was determined by calculating the coefficient of determination – R^2. The total variation of the pelt price (σ_t^2) was partitioned into components connected with random effects included in the models (σ_s^2 – pelt size variance component, σ_q^2 – pelt quality variance component, σ_{cd}^2 – pelt colour darkness variance component, σ_{cc}^2 – pelt colour clarity variance component, σ_e^2 – error variance, σ_{int}^2 – interaction variance component calculated as the sum of variances of each interaction between the main effects of the linear model) using the REML (Restricted Maximum Likelihood) and VARCOMP procedure. Then, based on the estimated variance components, the percentage contribution of each component to the total variation of pelt price was calculated. The analyses were carried out in the whole data set and in the subsequent seasons. The GLM and REML procedures were run under the SAS system (2000).

The following linear models were used:

$$X_{ijklmo} = \mu + Y_i + A_{ij} + S_k + CD_l + C_m + Q_n + e_{ijklmno} \quad (1)$$

$$X_{ijklmo} = \mu + Y_i + A_{ij} + S_k + CD_l + C_m + Q_n + (SxCD)_{kl} + (SxC)_{km} + (SxQ)_{kn} + (CDxC)_{lm} + (CDxQ)_{ln} + (CxQ)_{mn} + (SxCDxC)_{klm} + (SxCxQ)_{kmn} + (CDxCxQ)_{lmn} + (SxCDxCxQ)_{klmn} + e_{ijklmno} \quad (2)$$

where: μ = overall mean

Y_i = the fixed effect of i-th year (i = 1,..., 4)

A_{ij} = the fixed effect of j-th auction within the i-th year (j = 1,..., 5)

S_k, CD_l, C_m, Q_n = random effects of skin size, colour darkness, colour clarity and skin quality, resp.

$(SxCD)_{kl}$, $(SxC)_{km}$, $(SxQ)_{kn}$, $(CDxC)_{lm}$, $(CDxQ)_{ln}$, $(CxQ)_{mn}$, $(SxCDxC)_{klm}$, $(SxCxQ)_{kmn}$, $(CDxCxQ)_{lmn}$, $(SxCDxCxQ)_{klmn}$ = interactions between respective main effects

$e_{ijklmno}$ = random error

In order to analyse the changes (trends) in the contribution of pelt character traits to the total variation of pelt price across the studied seasons, regression analysis was carried out. The average annual trend was estimated as the regression of the contribution of pelt character traits to the total variation of pelt price in time. Furthermore, Pearson's correlation coefficients between the pelt character traits were calculated.

RESULTS AND DISCUSSION

In the analysed seasons the number of arctic fox pelts sold by Polish breeders at the Helsinki Auction House substantially increased (Table 1). In the season 2000/2001 Polish breeders sold 22 813 pelts, whereas two seasons later this number doubled. However, at the same time the average pelt price dropped by a half. Although the number of pelts increased, it was not accompanied by clearly seen improvement of the pelt character traits (Table 2). The largest part of the pelts offered by Polish breeders were those of medium sizes (000 or 00; depending on the season from 20% to 40%), lower quality (1 or 2; depending on the season from 32% to 51%), and colour clarity departing from the required standard (R– or OC; depending on the season from 22% to 69%). The most valuable pelts of large sizes (00000 or 0000) and high quality (SR or S) constituted only from 1% to 11% (size), or from 0% to 2% (quality). Most Polish arctic fox pelts were pale or extra pale

Table 1. Number of sold pelts, their average price and the money earned by Polish breeders in the subsequent seasons of the analysis

Colour type	Season	Number of pelts sold	Average price(€)	Money earned(€) – total
Blue	2000/2001	22 813	76	1 743 092
	2001/2002	32 865	63	2 082 775
	2002/2003	45 905	33	1 498 717
	2003/2004*	2 986	41	121 132
Shadow	2000/2001	4 366	82	356 400
	2001/2002	6 231	74	463 561
	2002/2003	8 390	40	338 066
	2003/2004*	412	54	22 147

*by the end of January 2004

(PAL or xP; depending on the season from 22% to 30%) fulfilling the requirements of the skin market which prefers skins of light hair coat. The season 2003/2004 was not discussed because the data summarized only the beginning of that season.

Sławoń (1994, 1995), who analysed the situation on the international market for the seasons 1993/1994 and 1994/1995, found that Polish skins of large sizes (skins marked 000 were largest at that time) constituted only 1.5% of the total, whereas the large skins offered by the Finnish breeders constituted 33.5%. The highest number of skins offered by Polish breeders was of medium size (42% of total). According to Sławoń (1994) the quality of Polish pelts as compared to Finnish ones was more than one class lower. In consequence the prices paid for Polish pelts were by 30% lower than those paid for Finnish pelts. Polish pelts were comparable to Finnish ones only as far as the colour darkness was concerned. However, this trait did not significantly influence the auction price of skins (Filistowicz and Żuk, 1995; Filistowicz et al., 1999).

The study carried out on one of the best Polish fox farms (Wierzbicki, 1999) revealed that only 0.2% and 13.4% of pelts produced there were of large size and high quality, respectively. Most of the skins were of medium size (65.3%) and lower quality (46.5%). This situation reflected the level of fox skin production in the mid 90s, and the distance between Polish fur animal farming and Scandinavian fur production, which was considered the best in the world.

The GLM procedure revealed that pelt character traits (size, quality, colour darkness, colour clarity) and interactions between them had a highly significant effect on pelt price ($P \leq 0.0001$ or $P \leq 0.001$). Only the interaction $CD \times C \times Q$ had no significant effect on skin price ($P \leq 0.224$). The coefficient of determination (R^2, Tables 3 and 4) indicates that depending on the model (Model 1 or Model 2) and season (2000/2001, 2001/2002, 2002/2003, and 2003/2004), the effects included in the models explained from 80% to 96% of the total variation of pelt price.

The analysis carried out in the whole data set (Table 3) showed that skin size (from 60.2% to 60.8%) followed by quality (from 20.5% to 27.9%) showed the largest contribution to the total variation of pelt price. This means that the pelt price is mostly affected by these two traits, and when selecting foxes the selection pressure should mainly be put on these traits. The contribution of colour clarity and colour darkness to the total variation of pelt price was low, ranging between 0.2–0.5% and 0.5–0.9%, respectively. Interactions between the pelt traits constituted 8% of the total variation of price (the most important was the interaction $C \times Q$ constituting 2.5% of the total variation of price).

The study carried out by Filistowicz and Żuk (1995) revealed that in the season 1994/1995, 59% of the pelt price was determined by skin size, while quality determined 27% of the total variation of price. The results are comparable with those presented in this study. However, the authors did not study the contribution of colour clarity to the total price variation (this effect was not included in the linear model). Two seasons later Żuk and Filistowicz (1998) found that 85–87% of the total

Table 2. Characteristics of Polish arctic fox pelts sold at the Helsinki auction house in the seasons 2000–2004

Pelt character trait	Class	Distribution (%) in seasons			
		2000/2001	2001/2002	2002/2003	2003/2004*
Size	00000	1	1	2	4
	0000	10	11	11	22
	000	20	31	31	40
	00	38	36	37	28
	0	18	18	17	6
	1	3	3	2	–
	2	–	–	–	–
	4	–	–	–	–
Colour darkness	xxxD	–	–	–	–
	xxD	–	1	1	–
	xD	1	5	3	1
	DK	3	8	8	9
	MED	14	25	18	14
	PAL	22	24	29	27
	xP	30	24	24	25
	xxP	12	8	8	15
	xxxP	16	5	9	9
	xxxxP	2	–	–	–
Colour clarity	R+	–	–	–	–
	R	9	8	12	13
	R–	27	22	55	58
	OC	64	69	33	29
	OC–	–	1	–	–
Quality	SR	–	–	–	–
	S	2	2	2	2
	1	43	36	32	47
	1B	–	–	–	–
	2	36	40	43	51
	3	19	22	22	–
	BR	–	–	–	–
	BRL	–	–	1	–
	4	–	–	–	–

*by the end of January 2004

Table 3. Variance components and their contribution (%) to the total variation of pelt price

Linear model	R^2	σ^2_s	σ^2_q	σ^2_{cd}	σ^2_{cc}	σ^2_{int}	σ^2_e	σ^2_t
Model 1 n = 10 177	0.85	551.39 (60.8)	252.75 (27.9)	4.46 (0.5)	2.00 (0.2)	–	96.54 (10.6)	907.14 (100%)
Model 2 n = 10 177	0.89	484.78 (60.2)	165.15 (20.5)	7.39 (0.9	3.90 (0.5)	64.28 (8.0)	79.60 (9.9)	805.1 (100%)

Table 4. Variance components and their contribution (%) to the total variation of pelt price in the subsequent seasons of the analysis

Season	Linear model	R^2	σ^2_s	σ^2_q	σ^2_{cd}	σ^2_{cc}	σ^2_{int}	σ^2_e	σ^2_t
2000/2001 n = 2 169	Model 1	0.80	989.08 (74.6)	215.55 (16.2)	12.33 (0.9)	5.31 (0.4)	–	104.84 (7.9)	1327.11 (100%)
	Model 2	0.89	1014.5 (73.7)	150.05 (10.9)	19.78 (1.4)	13.65 (1.0)	104.22 (7.6)	74.86 (5.4)	1377.06 (100%)
2001/2002 n = 2 486	Model 1	0.93	510.96 (75.2)	111.59 (16.4)	16.81 (2.5)	5.02 (0.7)	–	35.09 (5.2)	679.47 (100%)
	Model 2	0.96	366.02 (70.5)	65.36 (12.5)	10.53 (1.9)	4.81 (0.9)	46.80 (9.3)	25.52 (4.9)	519.04 (100%)
2002/2003 n = 2 826	Model 1	0.88	107.58 (70.0)	25.51 (16.6)	6.11 (4.0)	2.04 (1.3)	–	12.41 (8.1)	153.65 (100%)
	Model 2	0.93	125.91 (71.1)	27.89 (15.8)	4.80 (2.6)	1.63 (0.9)	7.02 (4.1)	9.75 (5.5)	177.00 (100%)
2003/2004 n = 2 696	Model 1	0.91	250.23 (75.4)	61.88 (18.7)	2.79 (0.8)	3.24 (1.0)	–	13.53 (4.1)	331.67 (100%)
	Model 2	0.94	264.27 (76.2)	60.74 (17.6)	1.06 (0.3)	2.55 (0.7)	7.60 (2.2)	10.68 (3.0)	346.90 (100%)

variation of pelt price was determined by skin size, whereas pelt quality determined only 11% of the total variation of price.

Table 4 presents changes in the contribution of pelt character traits to the total price variation over the studied seasons. The pelt price was mostly affected by skin size and quality which constituted 70.0–76.2% and 10.9–18.7% of the total price variation, respectively. The remaining two traits had a small effect on pelt price, constituting from 0.3% to 4.0% of the total price variation. The effect of interactions between the skin character traits on pelt price, estimated using Model 2, was rather small, except for the season 2001/2002 when the contribution of this effect to the total variation of price reached 9.3%.

Filistowicz et al. (1999) studied factors affecting Polish pelts prices at the Helsinki Auction House in the seasons 1996 and 1998. They found a smaller effect of skin size on the pelt price (skin size constituted 58.1–63.1% of the total variation of price), and higher effect of skin quality (from 29.4–34.5%). The contribution of colour darkness and interactions between pelt traits to the total variation of price was low, ranging from 1.4–2.7% to 3.9–4.4%, respectively.

Peura et al. (2004) carried out a study in the Finnish blue fox population in order to calculate the economic weights for the skin character traits. They excluded colour darkness from the study, stating that this trait had no significant effect on skin price. They revealed the highest relative economic weight in the skin size (0.37), followed by the skin quality (0.26) and the skin clarity (0.06). These results reflecting the economic importance of skin character traits are in agreement with the results of the present study. In both studies skin size and skin quality were the most important economic factors, whereas the two other skin character traits had no significant effect on economic success in fur production.

Trends showing the contribution of skin character traits to the total variation of skin price over the studied seasons are presented in Figure 1. Although the skin price in the seasons 2000–2004 was influenced by the decreasing effect of skin size (–0.28), and the increasing effects of skin quality (0.77), colour clarity (0.24) and colour darkness (0.12), the contribution

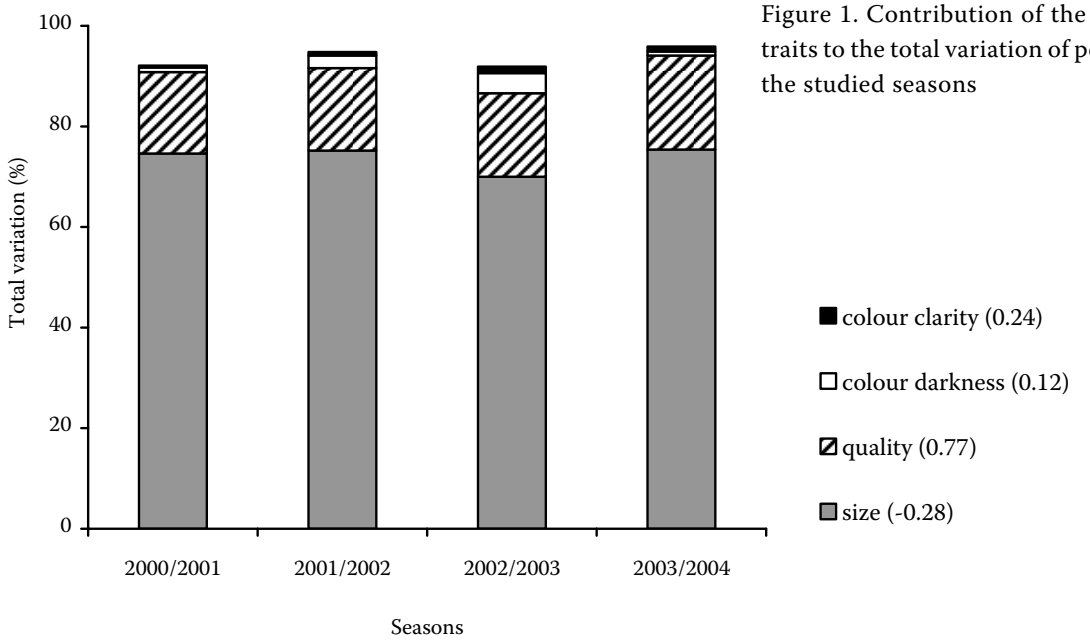

Figure 1. Contribution of the pelt character traits to the total variation of pelt price across the studied seasons

of skin character traits to the total variation of skin price across the studied years was quite stable. The information about the stability of market preferences is important for fur breeders in a long-term decision making since the results of auction sales are taken into account when preparing the ranking of fur farms (Kenttämies and Vilva, 1988; CSHZ, 1995).

Pearson's correlations indicate negligible relations between the majority of skin character traits evaluated at the auction house (Table 5). Only was the correlation coefficient between skin quality and colour clarity found to be moderate (0.240).

Table 5. Pearson's correlation coefficients (*r*) between the pelt character traits

Traits	*r*
Size – Quality	0.083
Size – Colour darkness	–0.017
Size – Colour clarity	0.045
Quality – Colour darkness	0.059
Quality – Colour clarity	0.240
Colour darkness – Colour clarity	0.043

CONCLUSIONS

The results of the study show that skin size and skin quality mostly contribute to the total variation of price in the international system of selling pelts. The two other skin character traits (colour clarity and colour darkness) and interactions between the traits have small or negligible effects on pelt prices. Furthermore, the contribution of skin character traits to the total variation of pelt prices over seasons seems quite stable. Thus, the fur breeders should concentrate on genetic improvement of skin size and skin quality, the traits of high economic importance.

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