

## **ANALYSIS OF CONFORMATION TRAITS OF NEW ZEALAND WHITE RABBITS ON A BREEDING FARM**

Dorota Kołodziejczyk, Aldona Gontarz, Stanisław Socha

Siedlce University of Natural Sciences and Humanities, Poland

**Abstract.** The aim of the study was to analyze the conformation traits of rabbits in relation to the year of evaluation and sex of the animals. The analyzes involved a rabbit production farm located in south-eastern Poland. The farm is specialized in the following breeds: New Zealand White, Blanc de Termonde, Alaska, Californian White, Giant Chinchilla, and Popielno White. The study covered 858 New Zealand White rabbits (741 does and 117 bucks). The ANOVA results indicated statistically significant effect of sex on the quality of the coat, body frame and breed type. The year of evaluation statistically significantly influenced the body size, weight, hair coat quality, specific breed traits, body frame, breed type, and the total score attained by the rabbits. The interaction sex  $\times$  year of evaluation significantly influenced body weight only, whereas no significant effect can be found if we look at the remaining traits. The variation of the traits, as measured with the coefficient of variability, ranged from 1.05 to 9.19%. The correlations were quite varied, ranging from  $-0.7715$  (between the breed type and the year of evaluation) up to  $0.6017$  (between the body frame and the total score). The analyzed animals were characterized by very good body type and conformation parameters, which is demonstrated by a high score achieved for each trait.

**Key words:** breeding farm, conformation traits, phenotypic correlations, rabbits, statistical analysis, variability

### **INTRODUCTION**

Domestic rabbit originates from the wild Mediterranean rabbit, whose domestication occurred probably between the years 150 and 100 BC. The domestication resulted in a number of changes observable in both the anatomy and the

appearance of the body, color and length of hair, or in the behavior of rabbits. First crossing attempts, which can be dated back to the Middle Ages, were carried out in French monasteries. The monks were the first rabbit breeders to artificially cross individuals, which over time led to the emergence of various breeds and utility types [Barabasz, Bieniek 2003]. Currently, rabbits are farmed for pelts, angora wool, and – primarily – for the nutritious and dietetic meat.

The list of top rabbit producing countries includes France, Spain, Italy, China, Egypt, Brazil, and Argentina [Bielański 2004, Bielański, Kowalska 2008]. Important traits to be taken into account in the production of rabbit meat include the structure and the size of the body [Yakubu, Ayoade 2009, Egena *et al.* 2012]. As a result of the human impact and genetic improvement, the average body weight of rabbits increased dramatically. Currently, the domestic rabbit ranges between 1 and 9 kg in weight, whereas wild rabbits never reach more than 1.5–2 kg. Body weight is closely related to its length, in which the domestic rabbit can attain up to 75 cm, as compared to up to 40 cm attainable by the wild form [Niedźwiadek 1984]. Another trait is the color of the coat; the Agouti type of the wild rabbit has transformed into a wide range of color types seen in the today's domestic rabbit.

The aim of the study was to analyze the conformation traits of New Zealand White rabbits farmed at a breeding facility located in south-eastern Poland.

## MATERIAL AND METHODS

Data for the study were obtained from a rabbit breeding farm located in south-eastern Poland. The farm specializes in various breeds of rabbits, mostly New Zealand White and Blanc de Termonde. To a lesser extent, other breeds, such as Alaska, Californian White, Chinchilla Giant, and Popielno White, are managed on the farm, too. Animals are kept in a cage system and fed pelleted feed in accordance with the relevant rabbit nutrition standards [Barabasz *et al.* 1994]. The female-to-male ratio on the farm is 8:1, and 6 litters on average are obtained from one female per year. The analysis covered a period of ten years (1994 to 2003), and involved a total of 858 New Zealand White rabbits, including 117 males and 741 females. Evaluation covered animals aged minimum 6 months.

Traits under consideration were: body weight, frame, size, breed type, quality of fur, and specific breed traits. The specific breed traits include the color of down hairs, which must be snow-white, eye color (red), and claws (white or flesh-colored). This trait could score a maximum of 20 points. The same point scale was used for evaluation of body frame, breed type and quality of fur. For each of the remaining analyzed traits (size, coat color) the animals could attain a maximum of 10 points [Wzorzec 2000]. For each of the studied traits, the following statistical parameters were calculated: arithmetic means, standard deviations, and

coefficients of variation. Based on the mathematical model, two-way analysis of variance was performed, which included the year of assessment and the sex of animals.

## RESULTS AND DISCUSSION

The factors that highly significantly affected the body weight of rabbits were: sex and year of the evaluation. Figure 1 shows the mean body weight in relation to sex and year of evaluation.

The means shown in Figure 1 reveal that the highest body weight was achieved by females in the eighth year of the study (4404.62 g), while the lowest – by males in the fifth year of assessment (3721.88 g).

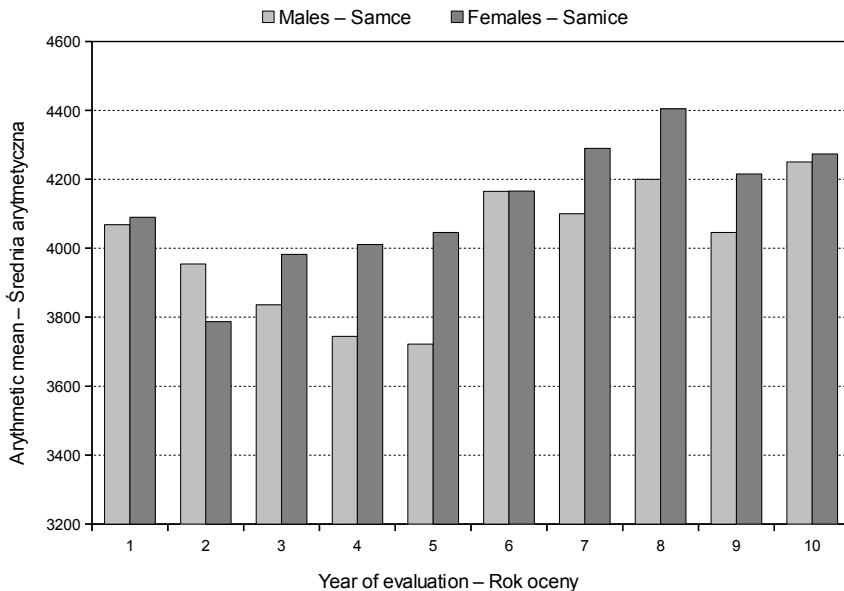


Fig. 1. Mean body weight of rabbits in grams in relation to sex and the year of evaluation

Rys. 1. Średnia masa ciała królików wyrażona w gramach w zależności od płci i roku oceny

Bearing in mind how the level of this trait developed over a number of years, it can be seen that in the second year of the study there was a significant decrease in the body weight of females compared to the other years. This could have been a result of some adverse environmental factors, such as, for example, difficult personnel situation at the farm and poor nutrition. For males, these means initially

decreased from the first to the fifth year of the study, both inclusive, then rose and declined alternately (Fig. 1).

The body weight is strictly related to the body size, which was expressed in points. Figure 2 presents the arithmetic means of body size of rabbits by gender and the year evaluation.

Figure 2 shows that the highest scores were achieved by females in the sixth and eighth year of the study, whereas males attained the highest number of points (10) at the sixth, seventh, eighth, and tenth year of evaluation.

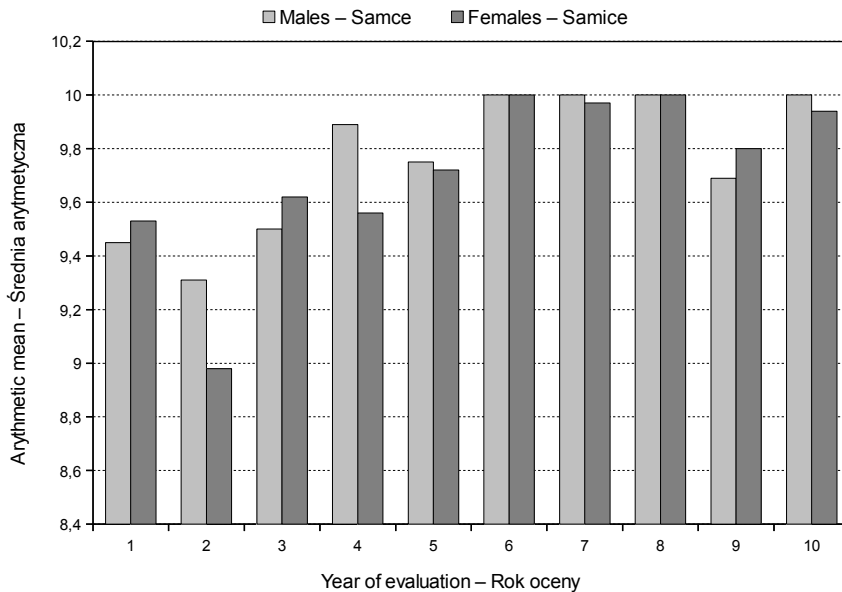


Fig. 2. Descriptive statistics of body size score of rabbits in relation to sex and the year of evaluation

Rys. 2. Charakterystyka statystyczna wielkości królików wyrażonej w punktach, w zależności od płci i roku licencji

Research on the influence of sex on the growth rate of rabbits have been carried out for a long time. Ristić [1988] and Staliński et al. [1989] demonstrated that the rate of growth of pure-bred animals is dependent on sex. Parigi-Bini et al. [1992], however, present the opinion that sex is important only in the final stage of fattening. Bieniek [1997] dealt with a related issue, however, and the author noticed differences between the sexes and daily gains in the period from 14 to 42 days of age. A similar view was represented by Zając [2002]. Castellini and Panella [1988], on the other hand, stated that a difference in body weight are seen when the rabbits reach full sexual maturity, i.e. at the age of 4–5 months.

The year of evaluation and sex highly significantly influenced the quality of fur, which is depicted in Figure 3.

Figure 3 indicates that, for both males and females, fur quality was at the highest level in the first year of evaluation. Later on the animals were characterized by a slightly lower quality of hair coat, with the lowest mean values found in males in the third, seventh and tenth year of the study (Fig. 3).

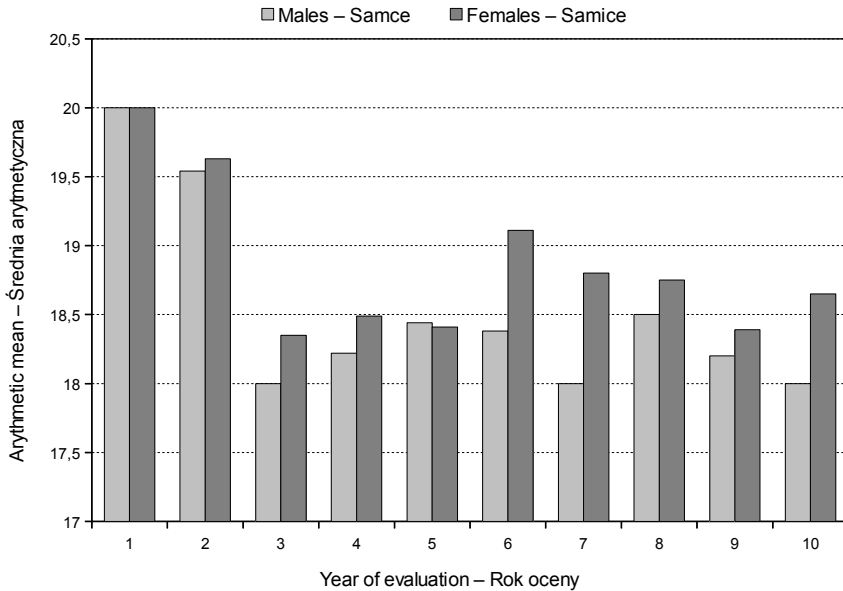


Fig. 3. The average quality of fur of rabbits in relation to sex and the year of evaluation

Rys. 3. Średnia jakość okrywy włosowej królików w zależności od płci i roku oceny

Analyzing the breed type of the rabbits, it can be seen (Fig. 4) that the maximum number of points (20) received both males and females in the second year, and only males in the third year of the study. The lowest mean was found in males in the last year evaluation.

The specific traits of breed, i.e. color of down hair, eyes, and claws, like the breed type, were point-evaluated in the range of 0–20 points.

Figure 5 shows the mean number of points achieved by male and female New Zealand White rabbits for specific breed traits over the years of evaluation. Analysis of the results showed that the means remained at a similar level over nearly the entire period studied, reaching usually 20 points, or slightly fewer only in a few cases. The lowest score, 19.33 points, was attained by males in the last year of evaluation.

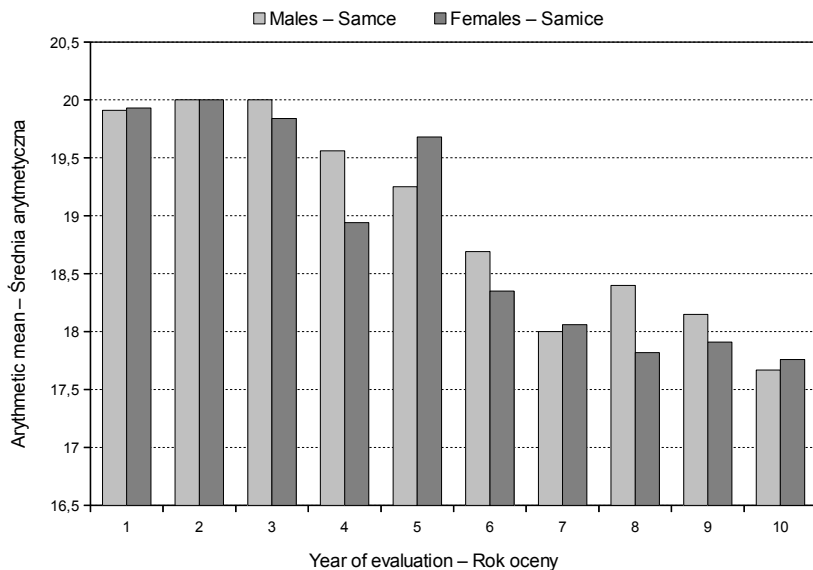


Fig. 4. Statistical characteristics of the breed type of rabbits in relation to sex and the year of evaluation

Rys. 4. Charakterystyka statystyczna typu rasowego królików w zależności od roku oceny i płci zwierząt

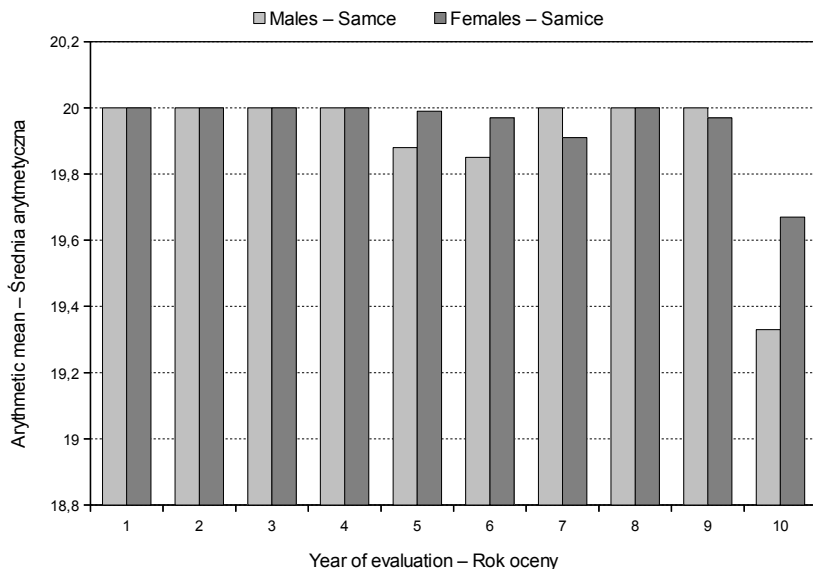


Fig. 5. Statistical characteristics of specific breed traits of rabbits in relation to sex and the year of evaluation

Rys. 5. Charakterystyka statystyczna specyficznych cech rasowych królików w zależności od roku oceny i płci zwierząt

Another trait significantly affected by sex was the body frame of the rabbits. It is evaluated in 10-point scale, and the evaluator takes into account the harmony in the body shape of the animal.

Analyzing the body frame of New Zealand White rabbits, it can be seen that the value of this trait ranged in the subsequent years of study from 17.98 to 19.43. The exception is the first year of assessment in which both males and females attained the lowest means for the frame of the body, respectively 19.43 and 16.6 (Fig. 6).

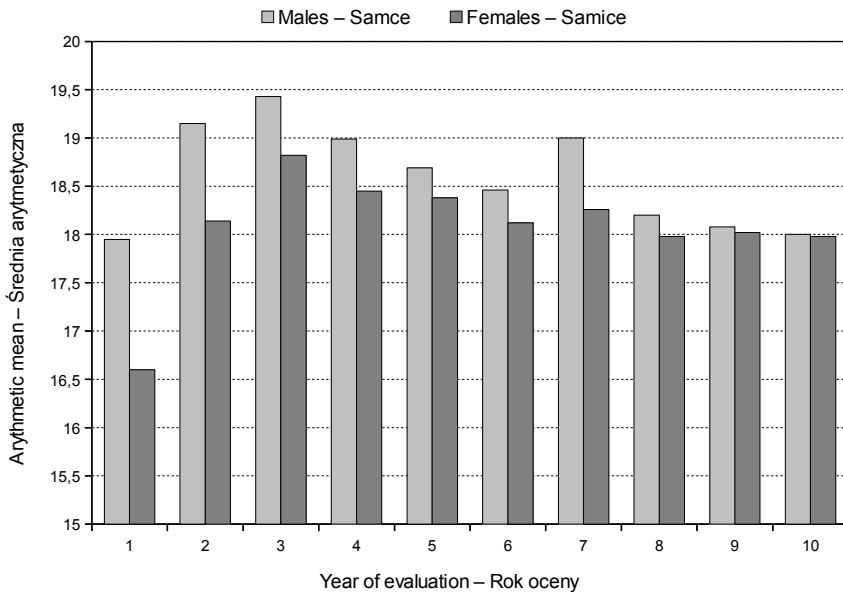


Fig. 6. Descriptive statistics of body frame of rabbits in relation to sex and the year of evaluation

Rys. 6. Charakterystyka statystyczna budowy ciała królików w zależności od płci i roku oceny

The results do not differ much from those presented Otulakowski [2011]. The author assessed the body frame of various breeds of rabbits, including the New Zealand White, and found that the average value of body frame assessment in all analyzed breeds was low over the years and never – except for one year – exceeded 19 points. The author also stated that there were very few rabbits which were given the model number of points, and the proportion of rabbits with normal body frame was satisfactory only in the case of the New Zealand White breed.

By adding up the points achieved for all the evaluated traits, we arrived at arithmetic means of the total score, as shown in Figure 7. Mean values of the general

evaluation of conformation fluctuated in the range 93.67 to 97.67 points, so were relatively high. This may prove a good performance and breeding value of the animals. In addition, it can be stated that this breed is one of the best breeds of rabbits reared on Polish farms. The results confirm the studies by Otulakowski [2011], in which the New Zealand White rabbits achieved the highest total conformation score in the group of medium-size breeds of broiler rabbits.

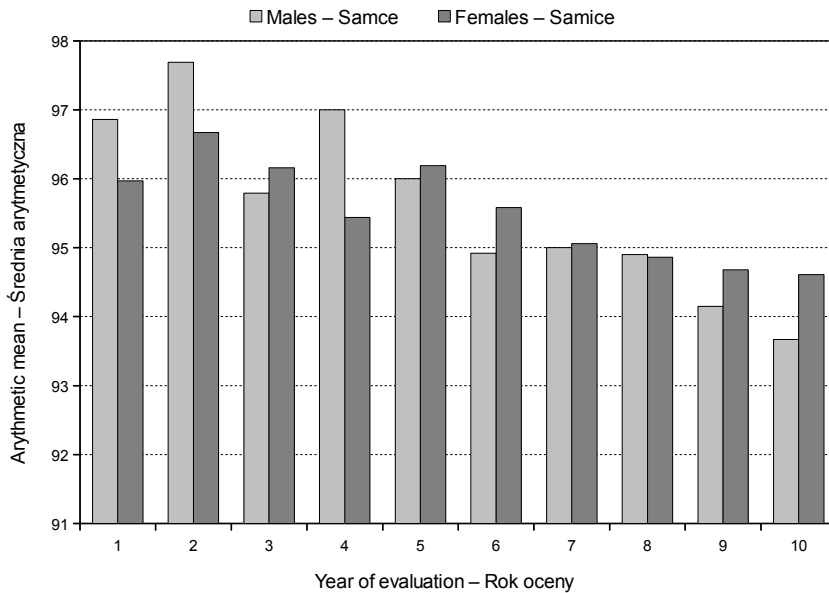


Fig. 7. Descriptive statistics of the total score in relation to sex and year of evaluation

Rys. 7. Charakterystyka statystyczna łącznej sumy punktów królików w zależności od płci i roku oceny

The variability of the studied traits, as measured with the coefficient of variation (Table 1), ranged from 1.05 to 9.19%, depending on the trait. The lowest coefficient of variation was observed for specific breed traits, while the highest for body weight (in kg).

The total score was characterized by relatively low variability. This may mean that the animals which were very good in some traits were also slightly inferior in terms of the others, which resulted in equalization of the total score value.

Table 2 shows the correlations between the phenotypic characteristics of the examined rabbits. The data reveals that the estimated correlation were quite varied, and ranged from  $-0.7715$  to  $0.6017$ . The lowest correlations were observed between the type of breed and the year of evaluation, the highest ones – between



Table 1. Coefficients of variability for the analyzed traits

Tabela 1. Współczynniki zmienności analizowanych cech

Trait Cecha	Size Wielkość	Body frame Budowa ciała	Breed type Typ rasowy	Hair coat quality Jakość okrywy włosowej	Specific breed traits Specyficzne cechy rasowe	Body weight, kg Masa ciała, kg	Total score Suma punktów
Males Samce	5.68	7.23	4.79	5.12	1.46	8.67	2.23
Females Samice	5.97	7.19	5.33	4.62	1.05	9.19	1.73
Total Ogółem	5.88	7.28	5.27	4.67	1.10	9.18	1.80

Table 2. Phenotypic correlations between the analyzed traits in the population of rabbits

Tabela 2. Korelacje fenotypowe pomiędzy analizowanymi cechami w populacji królików

Trait Cecha	Body size Wielkość zwierząt	Body frame Budowa ciała	Breed type Typ rasowy	Hair coat quality Jakość okrywy włosowej	Specific breed traits Specyficzne cechy rasowe	Total score Suma punktów	Year of evaluation Rok licencji
Body weight Masa ciała	**0.5198	*0.1299	**−0.3389	0.0050	−0.0399	*0.1239	** 0.2881
Body size Wielkość zwierząt		*0.1392	**−0.3167	**−0.1419	−0.0715	**0.1894	** 0.3326
Body frame Budowa ciała			−0.0391	**−0.2082	0.0099	**0.6017	0.0850
Breed type Typ rasowy				*0.1563	*0.1413	**0.4038	**−0.7715
Hair coat quality Jakość okrywy włosowej					*0.1097	** 0.3295	**−0.3705
Specific breed traits Specyficzne cechy rasowe						*0.1228	**−0.2261
Total score Suma punktów							**−0.3481

\* – differences significant for  $P \leq 0.05$ ; \*\* – differences significant for  $P \leq 0.01$ .\* – różnice istotne dla  $P \leq 0,05$ ; \*\* – różnice wysoce istotne dla  $P \leq 0,01$ .

body frame and the total score attained. Both correlations proved highly significant.

Correlation is an important measure for the breeder, as it indicates the existence of a relationship between various traits in the same subject. The correlation coefficient, ranging from  $-1$  to  $+1$ , is a measure of this relationship between traits. As long as the coefficient remains within the range  $-1$  to  $0$ , the correlation is negative, which means that an improvement in one trait will result in deterioration of another. If the coefficient ranges from  $0$  to  $+1$ , the correlation is positive, indicating an improvement in both traits [Barabasz, Bieniek 2003].

Positive correlations between the analyzed traits and the year of evaluation, obtained in this study, indicate an increase in the value of a given trait over the study period, whereas negative correlations indicate a decline in the value of the trait over the 10-year period of observations.

## CONCLUSIONS

1. Rabbits are animals that are bred and evaluated in a different way than in the case of other fur-bearing animals. One of the main differences is the 100-point model for conformation assessment, which includes the 6 traits.
2. The evaluated rabbits attained a high score for individual traits, which leads to a conclusion that the animals were characterized by very good parameters of shape and conformation. The New Zealand White rabbit is one of the most popular rabbit breeds, farmed also in Poland, and – at the same time – a breed most suitable for intensive farming.
3. The animals were of good quality both in terms of performance and breeding value. The positive correlations found in this study between the evaluated traits (body weight, size in points and body frame) and the year of evaluation indicate a growth in this trait over the studied period, whereas negative correlations between the remaining traits (breed type, hair coat quality, specific breed traits, and total score attained) and the year of evaluation indicate a slight decline in the value of the traits over the studied decade.

## REFERENCES

- Barabasz B., Bielański P., Jarosz S., Sławoń J., 1994. Normy żywienia mięsożernych i roślinożernych zwierząt futerkowych [Nutrition standards for carnivorous and herbivorous fur animals]. Instytut Fizjologii i Żywienia Zwierząt PAN [in Polish].
- Barabasz B., Bieniek J., 2003. Króliki. Towarowa produkcja mięsna [Rabbits. Commodity meat production]. PWRiL Warszawa [in Polish].

- Bieleński P., 2004. Wpływ rasy i systemów utrzymania na cechy produkcyjne brojlerów króliczych [Effect of breed and housing systems on production traits of broiler rabbits]. Instytut Zootechniki Kraków, 282. [in Polish].
- Bieleński P., Kowalska D., 2008. Królik – nieznan czy znany? Cz. I. Polska [Rabbit – known or rather unknown? Part I, Poland] *Mag. Weter.* [in Polish].
- Bieniek J., 1997. Wpływ czynników genetycznych i środowiskowych na użytkowość mięsną królików w warunkach chowu tradycyjnego [Effect of genetic and environmental factors on rabbit slaughter value under traditional farming conditions]. *Zesz. Nauk. AR, Kraków.* [in Polish].
- Castellini C., Panella F., 1988. Heritability of pre- and post-weaning weights in rabbits. *Proc. 4th World Rabbit Congress, Budapest, Hungary, 2, 112–119.*
- Egena S.S.A., Akpa G.N., Aremu A., Alemode I.C., 2012. Predicting body weight of Rabbit from linear body measurements at various ages by genetic group, parity and sex. *10th World Rabbit Congress, September 3–6, Egypt, 19–23.*
- Niedźwiadek S., 1984. Zasady hodowli królików [The Principles of Rabbit Breeding]. PWRiL Warszawa. [in Polish].
- Otulakowski G., 2011. Analiza genetyczna i fenotypowa cech pokroju i wskaźników rozrodu wybranych ras królików. Rozprawa doktorska [Genetic and phenotypic analysis of conformation traits and reproduction parameters of selected rabbit breeds. PhD Dissertation]. UP Wrocław. [in Polish].
- Parigi-Bini R., Xiccato G., Cinetto M., Zotte A.D., Converso R., 1992. Effect of age, slaughter weight and sex on carcass and meat quality. *Zootech. Nutr. Anim.*, 18, 3–4, 157–172.
- Ristić M., 1988. Einfluss von Geschlecht und Mastengewicht auf den Schlachtkörperwert von Jungmastkaninchen. *Proc. From the 6th Symposium on Housing and Diseases of Rabbits, Furbearing Animals and Pet Animals, Celle, Germany, 81–88.*
- Staliński Z., Bieniek J., Drożyńska D., Ptak E., Stobiecka D., 1989. Wpływ rasy, płci, oraz systemu żywienia na wzrost i niektóre cechy użytkowości mięsnej królików [Effect of breed, sex, and feeding system on the growth and selected slaughter value traits of rabbits]. *Pr. Mat. Zootech.* 39, 57–72. [in Polish].
- Wzorzec królików [Rabbit Model]. CSHZ, Warszawa 2000. [in Polish].
- Yakubu A., Ayoade J.A., 2009. Application of Principal Component Factor Analysis in Quantifying Size and Morphological Indices of Domestic Rabbits. *Int. J. Morphol.*, 27 (4), 1013–1017.

## ANALIZA CECH POKROJU KRÓLIKÓW RASY NOWOZELANDZKI BIAŁY W FERMIE HODOWLANEJ

**Streszczenie.** Celem pracy była analiza cech pokroju królików w zależności od roku oceny oraz płci zwierząt. Analizą objęto hodowlaną fermę królików znajdującą się w południowo-wschodniej Polsce. Ferma ta specjalizuje się w hodowli królików ras: nowozelandzki biały, termondzki biały, alaska, biały kalifornijski, szynszyl wielki i biały popielniański. Obserwacji poddano 858 zwierząt (741 samic i 117 samców) rasy nowozelandzki biały. Przeprowadzone analizy wariancji wykazały statystycznie wysoko istotny wpływ płci na jakość okrywy włosowej, budowę ciała i typ rasowy. Rok licencji statystycznie wysoko istotnie wpłynął na wielkość królików, masę ciała, jakość okrywy włosowej, specyficzne cechy rasowe, budowę ciała, typ rasowy oraz łączną sumę punktów, jaką uzyskały króliki. Interakcja płci z rokiem oceny wysoko istotnie wpłynęła jedynie na masę ciała, natomiast dla pozostałych analizowanych cech nie stwierdzono statystycznie istotnego wpływu. Zmienność cech mierzona współczynnikiem zmienności osiągnęła wartości od 1,05 do 9,19%. Oszacowane korelacje były dość zróżnicowane, wahały się w przedziale od  $-0,7715$  (między typem rasowym a rokiem licencji) do  $0,6017$  (pomiędzy budową ciała, a łączną sumą punktów). Zwierzęta poddane analizie charakteryzowały się bardzo dobrymi parametrami budowy i pokroju, o czym świadczy wysoka liczba punktów uzyskanych podczas oceny za poszczególne cechy.

**Słowa kluczowe:** analiza statystyczna, cechy pokroju, ferma zarodowa, korelacje fenotypowe, króliki, zmienność

Accepted for print – Zaakceptowano do druku: 22.11.2013