

ANALYSIS OF THE STATE OF BREEDING AND SELECTED PERFORMANCE TRAITS OF MOUNTAIN SHEEP OVER THE LAST DECADE*

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The aim of the study was to analyse the state of breeding and performance traits of mountain sheep in the years 2008–2017. The experiment used data from annual reports published by the Polish Sheep Breeders Association as well as data obtained from “Lambing Reports” for some flocks of three mountain breeds: Podhale Zackel, Polish Mountain Sheep, and Coloured Mountain Sheep. In the discussed period, the number of mountain sheep registered in flock books increased by more than 3,000. The changes over the last decade mainly concerned the mountain sheep population structure. The Polish Mountain Sheep breed constituted almost 60% of the population in 2008, but it began to decline since 2010. Currently 72% of the mountain sheep population is made up by Podhale Zackel, 18% by Coloured Mountain Sheep, and the remaining 10% by Polish Mountain Sheep. In the discussed period, higher reproductive indicators (prolificacy, lambs reared, reproductive performance) were found in Coloured Mountain Sheep and Podhale Zackel. No differences were observed in fertility of the ewes and in body weight of the lambs at 30 days of age. In the flocks chosen for the study, lifetime prolificacy averaged 1.33 for the ewes of all the breeds under discussion.

Key words: mountain sheep, breeding, performance traits

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Mountain sheep have become a permanent feature of the Carpathian Mountains landscape in Poland, and traditional pastoral farming, which had once been a source of livelihood for local communities, continues to be an integral part of highlander folklore. Mountain sheep are practically the only sheep raised for milk production in Poland, and the way their milk is obtained and used has remained unchanged for centuries, in keeping with the pastoral tradition. During a lactation of around 150 days, mountain sheep provide approximately 60–70 litres of milk, which is used to make traditional cheeses (Kawęcka and Krupiński, 2014). The extensive grazing of mountain sheep serves to preserve environmentally valuable areas. Development of the sheep products market, traditional handicraft and tourism encourage local businesses. Thus, mountain sheep farming is an example of multifunctional agriculture, which is optimal for mountain and submontane areas, is characterized by low capital intensity, and offers many market and public goods while caring for the environment (Klepacka-Kołodziejaska, 2009). Mountain sheep have been an integral part of this branch of economy, and today they are represented by three breeds: Podhale Zackel, Polish Mountain Sheep, and Coloured Mountain Sheep. The sheep of these breeds form 18% of all the ewes registered in flock books. Coloured Mountain Sheep and Podhale Zackel are among 15 breeds included in the genetic resources conservation programme.

The efforts to establish the Polish Mountain Sheep started after the Second World War at the Experimental Station of the National Research Institute of Animal Production in Grodziec Śląski. The purpose of breeding work was to improve the native Zackel breed, which resulted in heavier sheep with higher milk yield and altered nature of the coat. This improvement process, which first involved the Podhale Zackel and later the Polish Mountain Sheep, and was aimed to improve the productive value of mountain sheep, caused that the Zackel is no longer considered a separate breed and has been named Polish Mountain Sheep together with the improved sheep. Flock books for Coloured Mountain Sheep have been run since the year 2000 (Kawęcka and Krupiński, 2014). In 2007, work began on the genetic resources conservation programme for the Podhale Zackel (Kawęcka, 2007). Around 2700 sheep have complied with the requirements. Subsidies on the native breeds contribute to a rapid increase in their population, which translated into sheep breeding structure in Poland. These changes have also affected the mountain sheep.

The aim of the study was to analyse the state of breeding and selected performance traits of mountain sheep in the years 2008–2017.

Material i metody

The experiment used breeding data for three breeds of mountain sheep: Podhale Zackel, Polish Mountain Sheep and Coloured Mountain Sheep. Data on the population size and performance were sourced from annual reports published by the Polish Sheep Breeders Association (PZO, 2009–2018) for the years 2008–2017. Reproductive traits of the ewes, such as fertility, prolificacy, lambs reared and reproductive performance were analysed. Based on the data collected for selected flocks of mountain sheep in the form of Lambing Reports for 2017, analysis was made of parameters such as length of productive life, number of lambings, number of lambs born, and lifetime prolificacy of the ewe. In total, 650 ewes of three breeds

in six flocks were evaluated (two flocks per breed).

The results were statistically analysed with STATISTICA ver. 10 (StatSoft Inc., 2011) using one-way analysis of variance. Duncan's multiple range test was used if a factor was found to have a significant effect on a trait ($P \leq 0.05$ and $P \leq 0.01$).

Results

The number of mountain sheep recorded in the flock books changed during the discussed period. There were 9896 ewes in 2008 and 3000 more in 2017 (Fig. 1). When the genetic resources conservation programme for the Podhale Zackel was launched in 2008, the number of ewes recorded in the flock books was 3577, and over 10 years the size of this breed increased three-fold (Fig. 2). The Polish Mountain Sheep breed numbered 5835 ewes in 2008, but the population started to decline in 2010, and today the flock books include less than 1300 ewes (PZO, 2018). The number of Coloured Mountain Sheep has steadily increased and now 1970 ewes in 34 flocks are included in the conservation programme. In general, the flocks of mountain sheep have more than 50 ewes (Fig. 3). Flocks with up to 100 ewes dominate in the case of Polish Mountain Sheep, while the highest variation in flock size occurred for Coloured Mountain Sheep: flocks with up to 100 ewes accounted for 50%, those with more than 100 ewes for 30%, and the rest had more than 150 ewes.

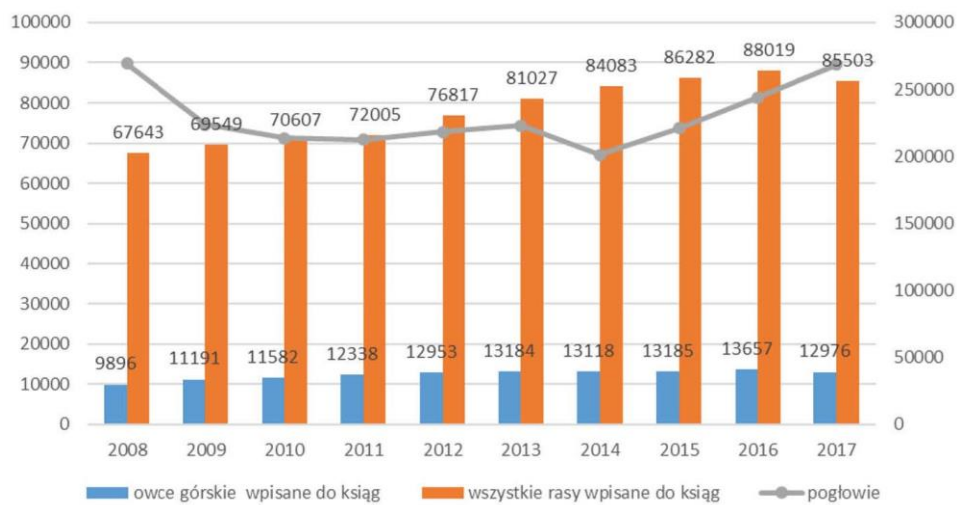


Fig. 1. Sheep population in Poland in 2008–2017 and number of ewes registered in flock books

The mean reproductive parameters of the analysed population of Mountain Sheep are presented in Table 1. The mean fertility for all the groups was 99.3%. In the case of prolificacy, higher values were observed for the conserved sheep (127.5–129.1%) than for the Polish Mountain Sheep (123.6%) and the difference was statistically significant. In the Polish Mountain Sheep, rearing performance (number of lambs born to lambs weaned) was 92.4% and it was significantly lower than that found for the other breeds (94.3%). The mean reproductive performance for the Zackel was 119.4% and for the Coloured Mountain Sheep it was 120.1%, and these values were higher than the values noted for the Polish Mountain Sheep (113.7%). The present analysis revealed no differences between the breeds

in body weight of the lambs. Ram lambs weighed 10.0–102 kg, and ewe lambs 9.8–9.9 kg.

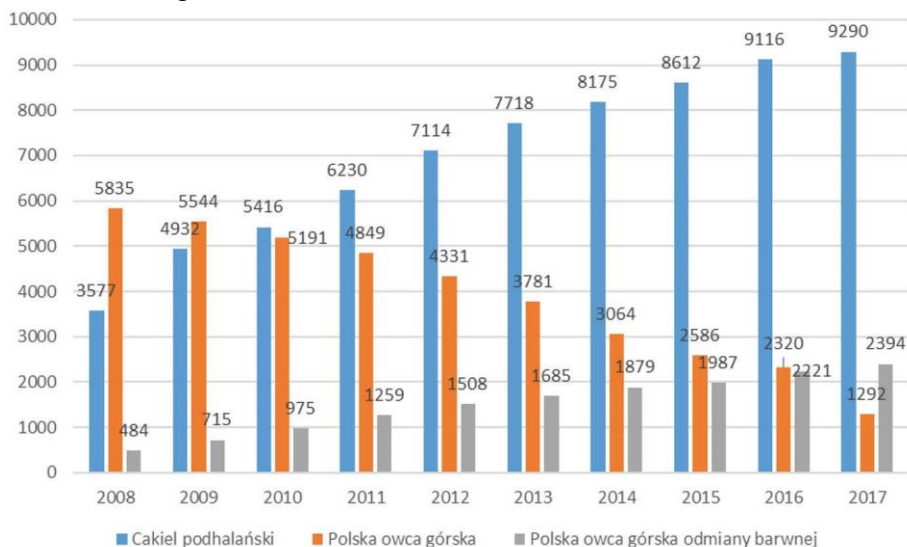


Fig. 2. Changes in numbers of mountain sheep registered in flock books in 2008–2017

In the flocks chosen for the study, the mean productive life of the ewes was over 4 years (Tab. 2), and the oldest ewes were 10 years old. More lambs per ewe were born in the flocks of Zackel and Coloured Sheep, and also in these flocks the number of lambs reared was higher than in the flocks of Polish Mountain Sheep. No differences were found in the lifetime prolificacy of the ewes between breeds; it averaged 1.33 per ewe for all the breeds under discussion.

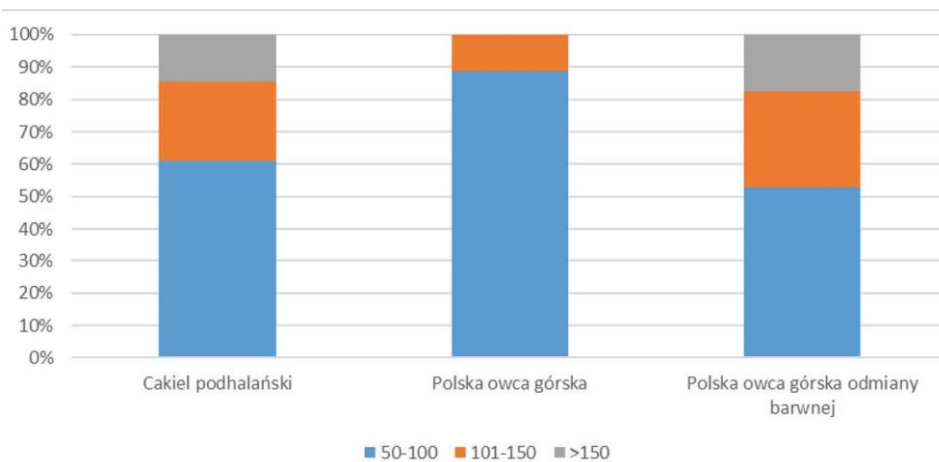


Fig. 3. Flock size structure (%)

Table 1. Reproductive parameters of Mountain sheep in the years 2008–2017

Item	Podhale Zackel		Polish Mountain Sheep		Coloured Mountain Sheep	
	x	SD	x	SD	x	SD
Fertility (%)						
Prolificacy (%)						
Lambs raised (%)						
Reproductive performance (%)						
Body weight of ram lambs on day 30 (kg)						
Body weight of ewe lambs on day 30 (kg)						
	99.5	0.3	99.5	0.4	99.2	0.6
	127.5A	1.9	123.6B	2.7	129.1A	4.2
	94.1A	1.6	92.4B	2.0	94.4A	1.3
	119.4A	3.2	113.7B	1.7	120.1A	4.6
	10.2	0.1	10.2	0.1	10.0	0.2
	9.9	0.1	9.9	0.2	9.8	0.2

Explanatory notes:

x – mean value; SD – standard deviation. a, b, c – $P \leq 0.05$; A, B, C – $P \leq 0.01$ – means in rows with different letters differ statistically significantly.

Table 2. Reproductive parameters of ewes from selected flocks of Mountain sheep

Item	Podhale Zackel		Polish Mountain Sheep		Coloured Mountain Sheep	
	x	SD	x	SD	x	SD
Years of productive life	4.7	2.5	4.2	1.8	4.9	2.8
Number of lambings	4.6A	2.4	3.7B	1.8	4.8A	2.8
Number of lambs born	6.0A	3.4	4.7B	2.8	6.5A	3.9
Number of lambs reared	5.5A	3.2	4.4B	2.5	5.8A	3.4
Prolificacy	1.34	0.3	1.31	0.5	1.35	0.4

Explanatory notes as in Table 1.

Discussion

According to the December 2017 census, sheep population in Poland was estimated to be 268 541 animals (PZO, 2018), practically returning to 2007 levels. As reported by Rokicki (2009), changes in the numbers of sheep raised in Poland have always been positively correlated to sheep farm support. In the years 1997–2006, farmers received subsidies from the Biological Progress Fund, and in the following years they received weight payments from the funds transferred by the Polish Sheep Breeders Association. Today, sheep breeding in Poland is influenced by the pace of implementation of the conservation programmes. In view of the possibility of receiving support for farming native breeds, breeders were more eager to keep these breeds (Sikora et al., 2015). The analyses performed by Borecka et al. (2016) demonstrated that in native sheep farms, this support helped to increase the operating income by 128% on average. When examining the size of the conserved population over the years, the number of flocks and ewes participating in the programme was observed to increase steadily. The implementation of the programme started with 145 flocks of sheep representing 11 native breeds. These flocks kept 8000 ewes. The genetic resources conservation programme for sheep was implemented concurrently with successive agri-environmental programmes: Rural RDP (Rural Development Programme) 2004–2006, RDP 2007–2013 and the current RDP 2014–2020. Each successive part of the programme covered the next breeds of sheep threatened with extinction. Over the last 10 years of the programme, sheep numbers increased three-fold, and in 2019 a total of 66 735 ewes were kept in 884 flocks. Since the inclusion of old-type Polish Merino and Podhale Zackel in the conservation programme in 2008, the number of flocks increased almost two-fold in relation to the number in the RDP 2004–2006. In 2015 the conservation programme included the next two sheep breeds: Polish Pogórze sheep and Black-headed sheep. In 2008, the ewes included in the genetic resources conservation programme accounted for around 33% of the total ewe population registered in flock books, and in 2017 this figure was 78%. The highest increase in number (over 80%) was observed for the Coloured Mountain Sheep, Coloured Merino, Corriedale, Świniarka and Kamieniecka breeds. Positive growth trends for native breeds, based on the example of Pomeranian and Wrzosówka sheep, were reported by Piwczyński and Mroczkowski (2011), which allows a conclusion that conservation programmes have a positive incentive to breeders to use these breeds. Also for the mountain sheep, the number ewes of recorded in flock books showed variation in the discussed period. In 2008, mountain sheep constituted 14.6% of all flock book ewes, and in 2017 this number increased by 3000, which caused these breeds to account for 18% of the analysed national population. However, the changes taking place during the last decade mainly concerned the population of mountain sheep registered in flock books. In 2008, the Polish Mountain Sheep breed had 5835 ewes, which formed almost 60% of the mountain sheep population. The number of Coloured Mountain Sheep increased steadily. When the conservation programme was launched in 2005, the

programme included four breeders and their flocks with a total of 142 ewes and 6 flock rams. Currently, 72% of the mountain sheep population is formed by Podhale Zackel, 18% by Coloured Mountain Sheep, and 10% by Polish Mountain Sheep.

In general, mountain sheep flocks have more than 50 ewes. In the case of Polish Mountain Sheep, 90% of the flocks keep up to 100 ewes per flock. The differences in flock size were greatest for Coloured Mountain Sheep: 50% were flocks with less than 100 ewes, 30% with more than 100 ewes, and 20% with over 150 ewes. Compared to the national population of native breeds (Sikora et al., 2015), in which large flocks (70–120 sheep) form less than 20%, mountain sheep farming is characterized by large flocks.

Peter et al. (2017), who analysed reproductive parameters in mixed wool sheep in Poland in the years 2005–2015, concluded that the increase in the population of ewes of four native breeds (Wrzosówka, Świniarka, Coloured Mountain Sheep and Podhale Zackel) was accompanied by negative trends for most of the parameters. According to Milewski (2017), fertility rate is considered good if it exceeds 95%, and very good if it approaches 100%. The author found this parameter to be high in mountain sheep, when compared to both the native breeds raised in Poland and the domestic sheep population (Milewski, 2010, 2017). Analogous fertility values (99.3%) for these breeds were reported by Peter et al. (2017).

Prolificacy is the number of lambs born in relation to all ewes in a flock. Prolificacy depends largely on the breed, which gave rise to large differences in this parameter. According to the Polish Sheep Breeders Association data, among the native breeds the highest prolificacy (192%) is characteristic of Olkuska Sheep, followed by Coloured Merino ewes (144%) (PZO, 2018). The lowest prolificacy among the conserved native breeds was shown by Wielkopolska sheep (115%). The mean prolificacy was 133.3% for the national sheep population and 140.8% when estimated for the native breeds only (Milewski, 2010, 2017). In our analysis, prolificacy of the conserved Podhale Zackel and Coloured Mountain Sheep averaged 128.3% and was higher than for the Polish Mountain Sheep.

Rearing losses of lambs have an effect on sheep production profitability as they ultimately determine the number of slaughter lambs and those intended for further rearing. Rearing rate is expressed as the percentage of lambs born to lambs weaned at a given age. This age was defined as 30 days for mountain sheep and 56 days for the other breeds. Rearing losses should not exceed 5%. The average rearing performance of the lambs for Polish Mountain Sheep was significantly lower than for the other breeds (92.4% vs. 94.3%), but in general this indicator should be regarded as satisfactory when compared to the national sheep population figure, which was reported by Milewski (2017) to be 88%.

Fertility, prolificacy and rearing of lambs are reflected in reproductive performance, which stands for the number of lambs reared per 100 ewes in the flock. This trait has the largest effect on production profitability (Piwczyński and Mroczkowski, 2011). Despite the high fertility of mountain sheep, the other parameters under analysis were not very high. Lambing percentage of the conserved sheep fluctuated around 120% and was higher than that found for the Polish Mountain Sheep (113.7%). Similarly low (113%) lambing percentage was established for the national population (Milewski, 2017).

Live lamb production efficiency is determined not only by reproductive performance, but also by the rate of growth. Normal development of an animal is measured by the achievement of proper body weight at a given age. In Poland, breeders use the measurement of lamb body weight at birth and several weeks after birth. Meat breeds and varieties of sheep are weighed according to the French system at 10, 30 and 56 days of age and their weight gains are calculated in specific ranges. For maternal breeds, lamb weight at 56 days of age is determined. Body weight at 30 days of age is the standard for mountain breeds. The average body weight of the three mountain breeds was 10.1 kg for ram lambs and 9.7 kg for ewe lambs.

The present study does not address the milk production parameters of the mountain sheep, despite the fact that this direction of use holds an important position in these breeds, but this was due to the small amount of data for analysing the 10-year period under discussion. For many years, the milk yield of Polish Mountain Sheep was subjected to simplified assessment based on the milk yield index proposed by Ciuruś and Rzepecki (1985). This index method was used in 2002–2009 to evaluate milk production in Polish Mountain Sheep, and in 2008–2009 primiparous ewes of the Podhale Zackel and Coloured Mountain Sheep were also evaluated (Kawęcka, 2013). In the years that followed, the evaluation of sheep milk production in Poland was abandoned.

It is concluded that during the 10-year period covered by this study, the number of mountain sheep registered in flock books increased by more than 3000. Changes over the last decade concerned mainly the population structure of mountain sheep. The number of Polish Mountain Sheep ewes decreased and the population of the ewes included in the conservation programmes increased. In 2008, Polish Mountain Sheep accounted for almost 60% of the mountain sheep population. Currently 72% of the population is formed by Podhale Zackel, 18% by Coloured Mountain Sheep, and 10% by Polish Mountain Sheep. During the period under discussion, higher reproductive parameters (prolificacy, number of lambs reared, reproductive performance) were observed in Coloured Mountain Sheep and Podhale Zackel. There were no statistically significant differences in fertility and body weight of the lambs aged 30 days. In the flocks chosen for the study, no differences were found between the breeds in lifetime prolificacy of the ewes.

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