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Dynamics of Breeding Native Breeds of Sheep in Poland in the Years 2008-2016

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The sheep genetic resources conservation programme is an important tool for preserving the biodiversity of the species. The year 2018 was another year of the implementation of the Agri-Environmental Programme for 2014–2020, Package 7, which supports animal genetic resources conservation programmes, also with reference to sheep. From the earliest days of the programme, the conserved population has been observed to increase steadily. Over the last 10 years, sheep numbers have tripled: from 22,275 ewes in 2008 to 66,735 this year, bred in the total of 884 flocks. Since the Polish Merino (old type) and Podhale Zackel were included in the programme, i.e., since 2008, a significant, nearly two-fold increase in the number of flocks has been reported, compared to numbers reported in the Programme for 2004-2006. In 2015 further two breeds were covered by the protection, namely, the Polish Pogórze Sheep and Black-Headed Sheep. Currently, there are 15 breeds of sheep covered by the sheep genetic resources conservation programme. These are, next to the two listed above, the Coloured Polish Mountain Sheep, Corriedale, Coloured Merino, Kamieniecka Sheep, Olkuska, Pomeranian, Uhruska, Świniarka and Wielkopolska Sheep, Polish Heath Sheep and, last but not least, Żelaźnieńska Sheep (Sikora et al., 2015).

Actions related to the implementation of conservation programmes have impact on sheep breeding in Poland. Availability of subsidies for animals covered by conservation programmes incentivises researchers to choose native sheep breeds, covered by subsidies, more eagerly than other breeds. In 2008, the ewes included in the genetic resources conservation programme constituted c.a. 33% of the total of ewes inserted in herdbooks, compared to nearly 78% in 2017. Over the last decade, increase in the number of flocks has been diversified and varied depending on the breed from c.a. 12% (Podhale Zackel) to 89% (Coloured Merino). The most dynamic growth in numbers, of more than 80%, was observed for the Coloured Polish Mountain Sheep, Coloured Merino, Corriedale, Świniarka and Kamieniecka Sheep. A decrease in the number of flocks has been observed only for Pomeranian and Heath Sheep, but without impact on the size of the population of these breeds, which has grown by 32 and 48% respectively over the years discussed (Sheep breeding..., 2009-2017).

A positive aspect of the activities conducted as part of the genetic resources conservation programme for sheep is the accompanying activity, based on the non-productive role of this species. The use of extensive grazing of sheep as a form of nature conservation serves to preserve environmentally valuable areas and reduce succession of forests and the culture of local communities associated with sheep Another positive aspect of conservation breeding is the development of activities related to the market of traditional and regional products, which are directly connected with the local breeds of sheep (Sikora et al., 2015).

The genetic resources conservation programme for sheep has been run in Poland since the 1970s. It started with a successful attempt to restore the Heath Sheep breed to sustainable numbers. Through the initiative of the Institute of Animal Production the breed, previously considered extinct, was reconstituted and restored to breeding in the 1970s. A similar trend was observed for the Świniarka and Olkuska breeds, where a group of enthusiasts associated in sheep breeding unions and agricul-

tural universities contributed to the success of restorative efforts. In the 1990s there was a dramatic decrease in the entire sheep population in Poland and many less productive breeds were at a substantive risk of being eliminated from breeding. The genetic resources conservation programme for sheep and the agri-environmental programmes implemented since 2004 have brought about new possibilities to protect breeds endangered with extinction (Sikora, 2006).

Currently the number of protected breeds oscillates around 700 (Coloured Merino) to 9,000 (Heath Sheep) sheep mothers. However, as the size of their population was considerably smaller at the beginning of the conservation programme, a number of genetic parameters may have changed, not necessarily for the better (Piwczyński et al., 2013). As this may have negative effects on the health and productivity of sheep covered by the conservation programme in the future, an attempt has been made to analyse traits of individual protected breeds to assess the effects of the conservation programme and trends in the shaping of selected characteristics. Breeding small populations carries a lot of risk of close genetic relations between individual specimens. If the animals are kept in closed groups, the risk of growing inbred effects becomes even higher with time, as new generations begin to emerge.

The research was carried out on 15 breeds of sheep covered by the genetic resources conservation programme, i.e. the Podhale Zackel, Kamieniecka Sheep, Corriedale, Coloured Merino, old type Polish Merino, Olkuska Sheep, Polish Coloured Mountain Sheep, Pomeranian, Świniarka, Uhruska and Wielkopolska breeds, Polish Heath Sheep, Żelaźnieńska Sheep, Polish Pogórze Sheep, Black-headed Sheep. Data concerning the last 10 years (2008-2018), obtained from the 'Bio-sheep' database of the National Research Institute of Animal Production, were compared. Two groups of traits were analysed. The first one was connected with reproductive indices such as the number of reared offspring and reproductive performance, and the other one with lamb rearing parameters such as body weight at the age of 56 days depending on sex and litter weight. As the information received was abundant, the data was presented at two-year intervals. The Polish Pogórze Sheep and Black-headed Sheep were not included in the study, as their participation in the genetic resources conservation programme has been short.

The most accurate method of reproductive performance (prolificacy and breeding performance) assessment in ewes is based on the number of lambs born or reared over several production seasons (Dankowski et al., 2002; Murawski, 2011). Additionally, the average number of lambs born or reared per litter is calculated on the basis of several seasons (Gruszecki and Lipecka, 2002; Niżnikowski et al., 2007; Piwczyński, 2009). Reproduction indices for the ewes subjected to analysis in individual breeds were close to those reported by other authors (Milewski, 2017). The breeds analysed were diversified in terms of prolificacy. The highest prolificacy was observed in Olkuska Sheep, in which high prolific values are conditioned genetically, and varied from 194.6 to 220.4% (Table 1). The lowest prolificacy was in turn reported in Wielkopolska Sheep (113% in 2016 to grow to c.a. 120% in subsequent years (121.5, 124.3, 117.4%) (Tab. 1). In other breeds subjected to analysis prolificacy varied from 116.4% for Corriedale in 2016 to 118-145% for other breeds. Within this group the most prolific was Coloured Merino (164% in 2008; 158.6-134.5% in subsequent years (Tab. 1).

Table 1. Prolificacy (%) of the studied sheep breeds in 2008–2016

***Prolificacy* (%)**					
	2008	**2010**	**2012**	**2014**	**2016**
Breed					
Wielkopolska Sheep	121.5	124.3	117.4	114.4	113.2
Corriedale	136.3	132.5	128.1	118.4	116.4
Pomeranian	129.6	128.0	122.3	118.5	118.5
Kamieniecka Sheep	118.8	118.8	121.3	124.3	116.7
Polish Heath Sheep	135.9	132.9	125.0	124.0	127.4
Świniarka Sheep	119.5	123.2	119.8	119.9	121.3
Coloured Polish Mountain Sheep	117.9	132.1	133.2	129.8	128.5
Olkuska Sheep	220.4	214.0	201.0	199.3	194.6
Coloured Polish Merino	164.0	158.6	145.2	134.5	145.9
Uhruska Sheep	130.5	122.1	119.9	115.7	118.8
Żelaźnieńska Sheep	157.4	142.7	131.7	130.7	125.0
Podhale Zackel	129.1	126.8	129.3	126.1	126.5

The analysis of prolificacy trends shows decrease in the majority of breeds, for example, in Wielkopolska Sheep, Corriedale, Pomeranian Sheep, Coloured Polish Mountain Sheep, Olkuska Sheep and Żelaźnieńska Sheep. The prolificacy rate for Kamieniecka Sheep grew between 2010 and 2014 (118.8–124.3%), only to drop drastically to 116.7% in 2016 (Table 1). In old type Polish Merino, Polish Heath Sheep and Świniarka Sheep the trait decreased gradually over the years to report a significant growth in 2016. The biggest growth in prolificacy was observed in Coloured Polish Merino (growth by 11.4% between 2014 and 2016). The most significant drop was in turn observed in Polish Heath Sheep and in Olkuska Sheep (7.9% and 13% respectively) (Tab. 1). Negative ewe prolificacy tendencies in old type Polish Merino, Pomeranian Sheep and Polish Heath Sheep were also reported by Piwczyński and Mroczkowski (2005). Similarly, Lipecka and Gruszecki (1991) pointed to the decreasing prolificacy of the Polish Lowland Sheep. This unfavourable trend may have both genetic and environmental roots. Milewski (2017) suggests that poor ewe prolificacy may be the effect (among others) of improper preparation of the ewes for breeding.

As shown by the research conducted, Olkuska Sheep ewes had the best prolificacy among all the breeds analysed. However, the high values of the parameter entailed considerable lamb losses in the rearing period. In Olkuska Sheep, in the period analysed the biggest losses were incurred in 2008 (27.3%, Tab. 2). Ewes of the Pomeranian Sheep, Polish Heath Sheep, Świniarka Sheep, Coloured Polish Merino Sheep and Uhruska Sheep reared their offspring much better, as c.a. 85-89.5% of lambs survived until weaning (Table 2). The highest lamb rearing ratio was obtained for Wielkopolska Sheep, Podhale Zackel and Polish Coloured Mountain Sheep and equalled 94.2 ,95.6 and 96.9% respectively (Tab. 2). The relatively high lamb rearing percentage for the above-mentioned breeds may be due to their good milkiness (mountain sheep breeds), protectiveness and a very good use of coarse fodder (Wielkopolska Sheep) The highest losses among the Olkuska Sheep and the Polish Heath Sheep offspring are probably rooted in the breeds' high prolificacy. As reported by Milewski (2017), lambs from numerous litters may be less developed and thus show poorer viability after birth.

Table 2. Lambs raised (%) in 2008–2016

***Lambs raised (%)* (%)**					
	2008	**2010**	**2012**	**2014**	**2016**
Breed					
Wielkopolska Sheep	86.9	90.3	92.8	92.1	94.2
Corriedale	93.0	92.3	90.4	91.7	91.8
Pomeranian	87.8	88.9	85.4	89.6	91.2
Kamieniecka Sheep	90.4	91.1	89.1	87.1	89.5
Polish Heath Sheep	88.0	88.0	84.7	86.1	88.4
Świniarka Sheep	96.0	90.3	92.1	91.5	86.0
Coloured Polish Mountain Sheep	94.2	96.9	93.9	93.0	93.1
Olkuska Sheep	72.7	76.8	73.6	74.2	77.4
Coloured Polish Merino	86.1	86.1	87.6	86.4	89.7
Uhruska Sheep	89.3	87.8	85.5	85.3	86.1
Żelaźnieńska Sheep	88.7	92.3	87.4	89.6	91.6
Podhale Zackel	95.1	95.6	93.7	92.3	93.0

Based on the analysis of collected data concerning lamb rearing, it can be concluded that within the last 10 years in all breeds the trait remained stable and showed no downward trend. Unfavourable lamb rearing trends were in turn reported by several authors for other native breeds (Szymanowska, 1998, Piwczyński and Mroczkowski, 2005).

Reproductive performance is a complex trait. It is calculated as the number of reared offspring from mated mothers in the flock and is the most important characteristic from the perspective of production efficiency. In the population analysed, the reproductive performance index varied from 94.2% (Uhruska Sheep in 2014) to 154.4% (Olkuska Sheep in 2010) and was the most diversified of all the traits examined (Tab. 3). The best reproductive performance throughout the period analysed was demonstrated by ewes of the Olkuska breed, followed by the Coloured Polish Mountain Sheep, Polish Coloured Merino and Podhale Zackel. It should be noted that in 2010, representatives of Żelaźnieńska Sheep achieved the reproductive performance index of 130% (Tab. 3). Between 2010 and 2016, unfavourable reproductive performance trends were observed among Corriedale, Pomeranian Sheep, Kamieniecka Sheep and Coloured Polish Mountain Sheep. Such remarkable reproductive performance differences between individual breeds may arise from the fact that some native sheep breeds (e.g. Olkuska Sheep) are well adapted to local environmental conditions and more resistant to diseases (Murawski, 2011).

Table 3. Reproductive performance of sheep (%) of the analysed breeds in 2008–2016

***Reproductive performance* (%)**					
	2008	**2010**	**2012**	**2014**	**2016**
Breed					
Wielkopolska Sheep	98.6	106.3	105.0	102.1	103.8
Corriedale	113.6	119.6	115.0	107.0	105.3
Pomeranian	108.7	108.0	99.4	101.6	102.9
Kamieniecka Sheep	102.8	105.5	105.0	103.6	101.7
Polish Heath Sheep	116.0	114.9	103.3	103.5	111.1
Świniarka Sheep	107.7	103.6	102.1	103.5	98.5
Coloured Polish Mountain Sheep	111.0	128.0	124.8	119.3	118.5
Olkuska Sheep	151.4	154.4	142.5	142.2	147.1
Coloured Polish Merino	126.8	126.4	116.3	109.2	120.2
Uhruska Sheep	114.8	103.1	99.2	94.2	96.6
Żelaźnieńska Sheep	129.4	130.4	111.4	114.5	112.9
Podhale Zackel	122.7	120.7	120.0	115.5	117.3

To conclude the research conducted it can be stated that between 2010 and 2016 the number of ewes included in the genetic resources conservation programme grew, yet in some cases the breeding value of individual traits such as prolificacy or reproductive performance deteriorated. The negative trend for both traits was observed for the majority of breeds. The reproduction indices for the breeds analysed, deteriorating over subsequent years, may have negative impact on the condition of the animals. As a consequence, some specimens may cease to satisfy the conditions set in the breed standard and be removed from the genetic resources conservation programme.

An attempt was made to analyse the data collected in terms of the shaping of values denoting traits connected with meat performance of lambs, such as: body weight at the age of 56 or 30* days (separately for ewes and ram lambs) and litter weight at the age of 56/30 days (for Podhale Zackel and Coloured Polish Mountain Sheep lambs).

It can be assumed from the evidence available that the lambs' meat traits were highly dependent of sex (Kożańska-Małkiewicz et al., 2015). Ewes of the Pomeranian and Kamieniecka breeds and of the old-type Polish Merino were characterised by a rather similar body weight, ranging from 18.0 to 18.9 kg (Tab. 4). Body weight of the majority of ewes representing the Wielkopolska Sheep and Corriedale in subsequent years exceeded 19 kg. Lambs of the primitive Polish Heath Sheep and Świniarka Sheep were characterised by low body weight at the age of 56 days for ewes: 9.1–9.3 kg for the Polish Heath Sheep and 8.5–9.5 kg for Świniarka Sheep, and by slightly higher body weight for ram lambs: 9.4–9.7 kg or Polish Heath Sheep, up to 10 kg for Świniarka Sheep (Tab. 4). Lambs of mountain sheep (rams and ewes) weighed at the age of 30 days, had a similar body weight, i.e. from 9.7 kg (ewes) to 10.2 kg (ram lambs) for Podhale Zackel. Rams of the Wielkopolska breed (22.9 kg), Corriedale (20.7 kg) and Uhruska breed (20.7 kg) were the heaviest (Tab. 4).

The livestock production efficiency ratio, including reproductive performance and lamb growth rate, is in turn measured based on litter weight (Milewski, 2017). Only on the basis of parameters at 56 days of age can it be concluded that out of the 13 sheep breeds included in the genetic resources conservation programme, higher values were reported for the Olkuska Sheep (27.3 kg), Coloured Polish Merino (25.2 kg) and Żelaźnieńska Sheep (24.8 kg) (Tab. 5). The analysis of trends shows an insignificant weight loss at 56 days of age in the period analysed in the Coloured Polish Mountain Sheep, Wielkopolska Sheep, Corriedale and Żelaźnieńska Sheep.

Table 4. Body weight of lambs (kg) with regard to sex at 30/56 days of age (2010–2016)*

*Body weight at 30 */56 days of age (kg) [ewes/ram lambs]*				
	2010	**2012**	**2014**	**2016**
Breed				
Wielkopolska Sheep	19.8/22.7	20.1/22.9	19.7/21.9	19.4/21.7
Corriedale	19.5/19.6	20.4/20.7	19.9/19.8	20.1/20.1
Pomeranian	18.1/19.0	18.4/19.1	18.4/19.1	18.1/18.7
Kamieniecka Sheep	18.1/18.4	18.3/18.7	18.5/18.7	18.0/18.3
Polish Heath Sheep	9.1/9.4	9.2/9.6	9.3/9.7	9.1/9.4
Świniarka Sheep	8.5/8.9	9.7/9.9	8.9/9.6	9.5/10.0
Coloured Polish Mountain Sheep	10.0/10.3	9.8/10.1	9.7/10.0	9.7/9.9
Olkuska Sheep	15.5/16.1	15.7/16.4	15.9/16.2	15.6/16.1
Coloured Polish Merino	18.7/19.8	17.0/17.9	16.9/17.6	17.8/18.2
Uhruska Sheep	19.9/20.7	19.6/19.9	19.7/19.8	19.7/20.6
Żelaźnieńska Sheep	18.1/18.5	20.3/20.4	19.5/19.7	19.7/19.6
Podhale Zackel	10.1/10.2	10.0/10.2	10.0/10.1	10.0/10.2

Table 5. Litter weight at 56 days of age (kg) in 2010–2016

Litter weight at 56 days of age **(kg)**				
	2010	**2012**	**2014**	**2016**
Breed				
Wielkopolska Sheep	22.7	22.9	21.9	21.7
Corriedale	19.6	20.7	19.8	20.1
Pomeranian	21.9	21.8	21.6	21.4
Kamieniecka Sheep	20.8	21.0	21.0	20.3
Polish Heath Sheep	10.6	10.5	10.5	10.9
Świniarka Sheep	11.5	11.6	10.8	10.9
Coloured Polish Mountain Sheep	12.9	12.8	12.1	11.8
Olkuska Sheep	26.1	25.8	26.0	27.3
Coloured Polish Merino	24.7	24.4	22.6	25.2
Uhruska Sheep	22.7	22.3	21.7	22.4
Żelaźnieńska Sheep	24.8	24.7	23.4	23.1
Podhale Zackel	12.3	12.5	11.9	12.1

Conclusions

The analysis of sheep populations included in the genetic resources conservation programme in the years 2008-2008 shows that:

- in the period analysed, the prolificacy rate was moving downwards for a number of breeds;
- lamb rearing ratio, expressed as the ratio of the number of reared lambs to born lambs was rather stable over the last 10 years and showed no downward trend;
- as the reproductive performance of the breeds assessed varied considerably, for the majority of them it was impossible to trace the tendencies (only three breeds showed decreasing trends);

- the average body weight of lambs weighed at the age of 30 or 56 days varied depending on the breed;
- in some of the breeds analysed a decreasing trend was observed in terms of litter weight at the age of 56 days;
- due to the alarmingly decreasing values of some traits (prolificacy, litter weight at 56 days of age), the population should continue to be monitored, and efforts must be taken to reverse the negative breeding trends.

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DYNAMICS OF BREEDING NATIVE BREEDS OF SHEEP IN THE YEARS 2008–2016

Summary

The sheep genetic resources conservation programme is an important tool for preserving the biodiversity of this species. The year 2018 is another year of the implementation of the Agri-Environmental Programme for 2014–2020, including Package 7, which supports the animal genetic resources conservation programme, including sheep. From the beginning of the implementation, the conserved population has been observed to increase steadily. During the last 10 years of the programme, sheep numbers have tripled. Analysis of the collected lamb rearing data revealed that in all the breeds, this trait was rather stable over the last 10 years and showed no downward trend. Due to the alarmingly decreasing values of some traits (prolificacy, litter weight at 56 days of age), the population should continue to be monitored, and efforts must be taken to reverse the negative breeding trends.

Key words: sheep, population, genetic resources, conservation programme