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STUDY ON SZTUMSKI MARES ENROLLED IN THE GENETIC RESOURCES CONSERVATION PROGRAMME IN 2008*

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Abstract

The aim of this study was to conduct genetic analysis of 219 cold-blooded Sztumski mares, which were enrolled in the genetic resources conservation programme in 2008. The inbreeding level in the mares, their average genetic relationship with the population, and the average coefficient of kinship were analysed, as well as the number and origin of common ancestors (founders of the population) were determined. The age structure and coat colour in the mares, as well as the size and geographical distribution of the herds were also determined. Over 97% of the mares enrolled in the conservation programme were inbred. The average inbreeding coefficient was 1.93% and ranged from 0% to 32.6%; the average relationship coefficient (2.38%) for the population was the highest in the group of mares aged 9 to 11 years (2.63%); the average kinship within the population was 2.89% and ranged from 5 to 5.99% in the case of five mares. The mares descended from 785 founders, including 561 mares (mainly cold-blooded Sztumski and Sokólski breeds) and 224 stallions (mainly Ardennes and Belgian breeds). Distribution of the herds does not fully reflect the historic region from which the breed originated, while the population itself is scattered and kept in many herds, most of which have 2 (occasionally up to 6) mares.

Key words: Sztumski horses, pedigree analysis, inbreeding, relationship, conservation programme

Cold-blooded horses first appeared on Polish lands as late as the second half of the 19th century. The population of cold-blooded horses was developed from native, small primitive horses known as the *mierzyn*, which derived from the Tarpan. In southern Poland, in the 16th century, the *mierzyns* were improved with the blood of oriental horses, thus giving rise to many local types of light work and saddle horses in this area. Cold-blooded horses, such as Ardennes, Breton and Belgian (less often Percheron) were imported into Poland much later, i.e. at the end of the 19th century. The creation of the local types of cold-blooded horses was associated with the development of agriculture, the demand for traction power in expanding urban centres, the

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regeneration of the army, and the needs of the rural population. In Pomerania, German colonizers contributed to the influx of heavy work horses, which were imported from Western Europe. In Pomerania, the horse population was more uniform than in other regions of Poland. In Warmia, where soils are heavy and fertile, the cold-blooded horse type was developed based on imported Rhenish-Belgian stallions (PZHK, 1964). After the Second World War, in 1955, a Sztumski horse breeding centre was organized, which covered the Sztum, Kwidzyń, Malbork and Elbląg districts, with 50% of the Sztumski horse population being found in Sztum centre. As of 1 January 1959, the Sztumski Horse Stud-Books contained 778 mares (Pruski, 1960).

In the second half of the 20th century, the local types of horses changed as a result of moving borders, migrations, economic transformations, and regionalization of breeding, changes in breeding goals (production of slaughter foals) and importation of stallions from abroad. Chachuła (1967) states that the exchange of material between breeding centres resulted in the gradual disappearance of differences between local types of horses, to the extent that in Volume Two of the Stud-Book (1972), information on imported horses, Sztumski, Sokólski, Lidzbarski, Mur Insulan and other breeds of horses was no longer published in separate sections. By the late 20th century most of the local types merged into the developing breed of Polish Cold-blooded horse. The most distinguished two types, Sztumski and Sokólski, became similar to each other due to the common use of the same foreign sires. According to Chrzanowski et al. (1989), the largest number of lines was established by Ardennes stallions imported from Sweden and France.

In 2008, on request of the Sztumski horse breeders the genetic resources conservation programme was initiated, with the goal to restore the breed. It was assumed that it should be about 400 mares of the Sztumski type meeting pedigree requirements (IZ-PIB, 2008). It was necessary for the mares to have at least three generations of ancestors born in Poland and to be entered in the Polish Cold-blooded Horse Stud-Book (with the provision that no Fjord and Mur Insulan must occur in the fourth generation). In the transition period, i.e. until 2011, the mares could have a female ancestor of unknown origin (NN) in the third generation. It has been necessary to keep at a farm at least two Sztumski mares to join the conservation programme.

The aim of this study was to conduct genetic analysis of the population of mares enrolled in the genetic resources conservation programme for cold-blooded Sztumski horses in 2008, and to analyse their distribution in Poland, as well as their age and coat colour.

Material and methods

Data on 219 mares enrolled in the genetic resources conservation programme for Sztumski horses in 2008 included: 1. mare's place of residence – province; 2. age and coat colour; and 3. pedigree data. All the information was sourced from the breeding documentation (horse passport and certificate of Polish Cold-blooded Horse Stud-Book entry) sent by breeders to the National Research Institute of

Animal Production. Pedigree information on ancestors up to the fourth generation came from horse passports, and further pedigree information was taken from Volumes One to Six of the Polish Cold-blooded Horse Stud-Books, as well as a database of the Polish Horse Breeders Association.

Genetic analysis was performed using complete available pedigrees that spanned 6 to 16 generations (11 generations on average). Horses of foreign breeds that have been imported to Poland and are found in the pedigrees of mares were regarded as founders, and their ancestors were not included into the database. Horses born in Poland that were of unknown origin were also considered as founder animals.

The inbreeding coefficient of individual mares, the coefficient of relationship between mares and their average relationship, the average coefficient of kinship, and the average percentage of founder genes in the analysed population were calculated using software by Wieczorek and Wieczorek (2009), available in the National Research Institute on Animal Production. A dedicated Microsoft Access database has been created for the purpose of this study.

Results

Distribution and structure of the population

Of the 219 mares enrolled in the genetic resources conservation programme for Sztumski horses in 2008, the largest number originated from northern and central Poland: 94 mares from the Pomorskie province (43%) and 55 mares from the Mazowieckie province (25%). Twenty-one mares (9.5%) were enrolled from the Łódzkie province and 15 mares (7%) from the Warmińsko-Mazurskie province. The other 34 mares (over 15% in total) were found in the Kujawsko-Pomorskie and Dolnośląskie (over 10 each) as well as in Śląskie, Wielkopolskie, Świętokrzyskie and Małopolskie provinces (a few each). The distribution of the mares is presented in Figure 1.

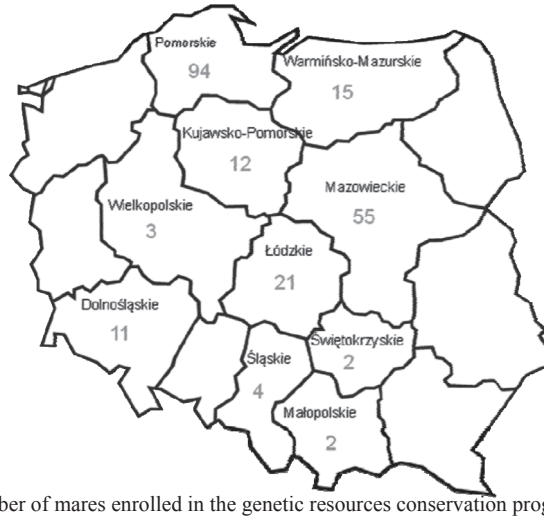

Figure 1. Number of mares enrolled in the genetic resources conservation programme for Sztumski horses in 2008 by province

Table 1. Size of herds of Sztumski mares enrolled in the conservation programme in 2008

Province	Number of mares per herd					Total number of herds
	2	3	4	5	6	
Pomorskie	15	7	4	3	2	31
Mazowieckie	18	3	1		1	23
Łódzkie	6	3				9
Warmińsko-Mazurskie	4	1	1			6
Kujawsko-Pomorskie	3	2				5
Dolnośląskie	1		1	1		3
Wielkopolskie		1				1
Świętokrzyskie	1					1
Śląskie			1			1
Małopolskie	1					1
Total herds	49	17	8	4	3	81

Mares were kept in 81 herds, most of which were located in the Pomorskie (38%) and Mazowieckie provinces (28%) (Table 1). Sztumski mares were raised mainly in small herds, consisting of 2 mares. The Pomorskie province had the largest proportion of herds with more than 2 mares (51.6%). In the same province, there were 2 out of 3 herds consisting of 6 mares, 3 out of 4 herds of 5 mares, and 4 out of 8 herds of 4 mares. With 23 herds, the Mazowieckie province ranked second for the number of herds. Small herds of 2 mares were the most numerous (18), with a total of 5 herds of 3, 4 and 6 mares. In the other provinces, there were 27 herds in total (33.3%).

Age structure

The population of mares participating in the conservation programme consisted of animals between 6 and 23 years of age. Most mares were young, between 6 and 8 years old (32.8%) and slightly older, between 9 and 11 years of age (28.3%). There were only 1.4% of mares older than 20 years. Mares aged between 6 and 14 years accounted for 86.7% of the entire population (Fig. 2).

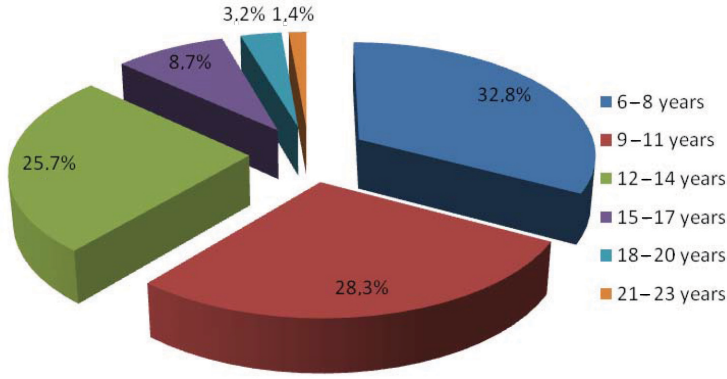

Figure 2. Age of mares enrolled in the conservation programme in 2008

Coat colours

The analysed population comprised mares of three different colours: chestnut, bay and black. The dominant colours were chestnut (or its shades), which was found in 133 mares (61%), and bay (74 mares, 34%). Black colour was rare and occurred in 12 mares (5%) only.

Genetic analysis

Inbreeding of the mares included in the programme

The inbreeding of mares ranged from 0% to 32.6%. Over 97% of animals were inbred, and the average coefficient of inbreeding for the entire population was 1.93%, while 1.99% for inbred mares only. The inbreeding coefficient equalled 0 for 6 mares and did not exceed 0.1% for 8 mares (Fig. 3).

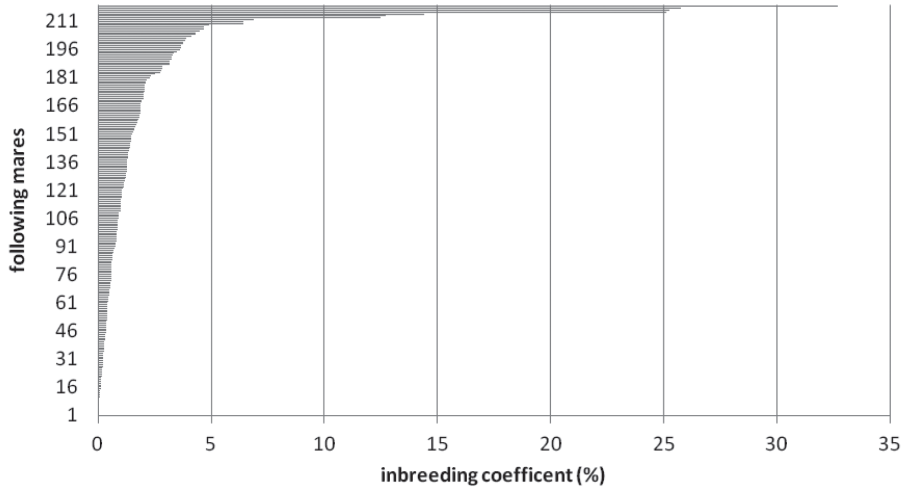

Figure 3. Distribution of inbreeding coefficient in Sztumski mares enrolled in the conservation programme in 2008

The largest group was made up by mares whose inbreeding did not exceed 2%. There were 163 (80%) such mares. For 212 mares (96.8% of the population), inbreeding did not exceed 6%. Inbreeding over 12% was only observed in seven mares (3.2%). No animals were found with inbreeding between 6 and 12%.

Mares with the highest inbreeding (32.67%) were TOLKA 4145 GGd derived from an incestuous mating between daughter and sire; for the same reason, high inbreeding was also observed in another two mares: PRYMUSKA 3190 GGd and LINIOWA 1708 GKo. In other cases, high inbreeding (12–14%) was due to half-sib mating. Inbred mares most often came from the Pomorskie and Mazowieckie provinces.

Average coefficient of relationship for the population

The average relationship of individual mares with all the other mares in the population was 2.38%, ranging from 0.15% to 5.30%. The highest relatedness was in the

group of mares aged 15–17 and 9–11 years (2.63% and 2.51%, respectively), and the lowest (1.48%) in mares aged between 21 and 23 years (Fig. 4).

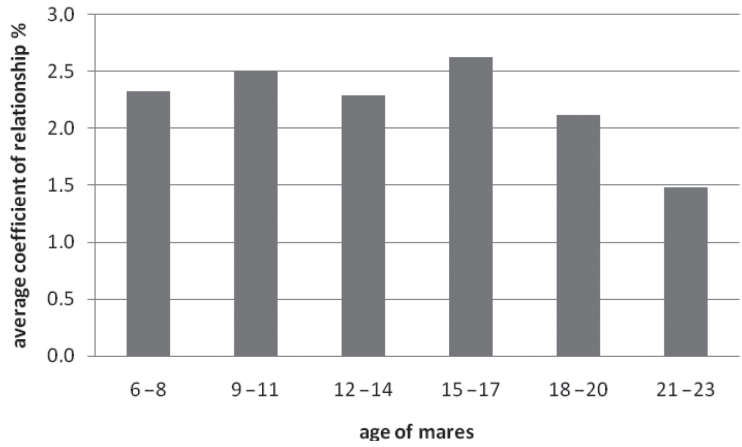

Figure 4. Average coefficient of relationship in different age groups of Sztumski mares enrolled in the conservation programme in 2008

Table 2. Relationship of Sztumski mares with >10% inbreeding, enrolled in the conservation programme in 2008

Mares	TOLKA	TOLA	PRYMUSKA	LINIOWA	ELEGANCJA	KAMA	BARBARIA
TOLKA	32.67%	72.94%	0.04%	0%	2.19%	0.49%	9.33%
TOLA		14.41%	0.05%	0%	2.38%	0.39%	10.04%
PRYMUSKA			25.78%	0.82%	0.24%	0.06%	0.57%
LINIOWA				25.10%	0.12%	0.01%	0.17%
ELEGANCJA					12.71%	0.39%	1.44%
KAMA						12.50%	0.10%
BARBARIA							25.26%

Inbreeding coefficient of each mare on diagonal.

Most mares with a high level of inbreeding were not highly related except the mares TOLA 3075 GGd and TOLKA 4145 GGd, for which the relatedness was 72.94%. These two mares also showed a high degree of relatedness with the mare BARBARIA 4319 GGd (10.04% and 9.33%, respectively). In other mares, the relationship coefficient ranged from 0% to 2.38%. Table 2 presents the relationship of mares with inbreeding in excess of 10%.

Average coefficient of kinship

The coefficient of kinship in the analysed population ranged from 0.61 to 5.89%, averaging 2.89% (Fig. 5). Over 86% of the mares had an average kinship below 4%. Average kinship ranged from 3 to 3.99% in the largest group of 69 mares, from 2 to

2.99% for 66 mares, and from 1 to 1.99% for 52 mares. The highest values of the average coefficient of kinship, from 5 to 5.99%, were found in 5 mares.

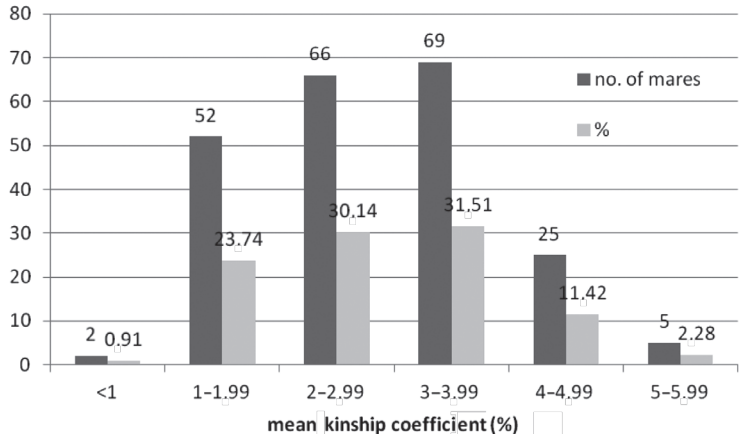

Figure 5. Distribution of the average coefficient of kinship (%) among Sztumski mares enrolled in the conservation programme in 2008

The highest coefficient of kinship (5.10 to 5.89%) was found in five mares (MALINA 3356 GGd, MONTANA 3336 GGd, MACZUGA 1257 GOl, GIZA 4435 GGd and JUNA 3642 GGd). Four of them came from the same district of the Pomorskie province, and three of them had the same sire (MACIUŚ 1066 Gel).

Share of founder genes

The analysed mare population had 785 founders, including 224 sires. Most founders were Ardennes and Belgian horses, especially such stallions as GRILLPARZER 1271 (appearing in the pedigrees of 199 mares), GUSTAW 2807 (pedigrees of 195 mares) JEAN DE BLANCHAMPAGNE 3971 (pedigrees of 193 mares) and LIPPE 557 (pedigrees of 181 mares) (Table 3). Stallions that appeared in the pedigrees of at least 100 mares formed a group of 21 animals, including 10 Ardennes and 8 Belgian or Rhenish-Belgian horses. The others were registered in the stud-books as Polish Cold-blooded or German Cold-blooded.

The average contribution of genes of individual founder stallions in the analysed mare population had a different rank order than the frequency of these stallions in the mare pedigrees. The stallions with the greatest genetic effect on the mare population analysed were the Ardennes stallions JEAN DE BLANCHAMPAGNE, MOLBER and GEBER, which contributed 5.40%, 3.96% and 3.63% genes to the population, respectively.

In the case of five stallions, the average share of their genes in the analysed population of mares exceeded 2% (Table 4). In the majority of mares the share of genotype of a given founder most often ranged from 0.1% to 5% (JEAN DE BLANCHAMPAGNE, MOLBER, GUSTAW and LIPPE). Only the effect of the stallion GEBER was different; it had no effect on the genotype of 81 mares, and in the case

of 72 mares, the contribution of his genes ranged from 5.1 to 10%. The proportion of the genotype of most common founders exceeded 15% in 12 mares and 20% in 4 mares.

Table 3. Most frequent founder stallions in the pedigrees of Sztumski mares enrolled in the conservation programme in 2008

Stallion	Average % of genes in the mare population	Breed	No. of mares	Share in the population (%)
GRILLPARZER 1271		Rhenish-Belgian	199	90.87
GUSTAW 2807	2.74	Ardennes	195	89.04
JEAN DE B. 3971	5.40	Ardennes	193	79.45
LIPPE 557	2.37	Ardennes	181	82.65
ADVOKAT VON S. 2930	1.43	German Cold-blooded	179	81.73
ELLOR 3632	1.25	Ardennes	174	79.45
BELGRAD		Belgian	169	77.17
GNEISENAU 1281		Rhenish-Belgian	169	77.17
MOLBER 4821	3.96	Ardennes	166	75.8
PANDOR 3998	1.15	Ardennes	164	74.88
AMANT 1956	1.67	Belgian	158	72.15
ETER 457		Polish Cold-blooded	149	68.04
DOBOSZ 2442		Belgian	145	66.21
GEBER 5789	3.63	Ardennes	138	63.01
ELIA ZOULOU 1933		Belgian	132	60.27
PERCE TRIBUN 2133		Polish Cold-blooded	121	55.25
ESTVANG 3995		Ardennes	119	54.34
HELLAS 8666		Ardennes	119	54.34
MARTINI 1213		Belgian	110	50.23
SAMSON 1746		Belgian	110	50.23
JUMAN 5786		Ardennes	104	47.48

Table 4. Number of mares with given percentage of genes of the major founder stallions in the population of Sztumski mares enrolled in the conservation programme in 2008

Stallion	Breed	0	0.1–5	5.1–10	10.1–15	15.1–20	>20.1
JEAN DE B. 3971	Ard	26	91	68	27	5	2
MOLBER4821	Ard	53	95	53	14	2	2
GEBER 5789	Ard	81	53	72	12	1	0
GUSTAW 2807	Ard	24	157	37	1	0	0
LIPPE 557	Ard	38	165	15	1	0	0

Among the 561 mares determined as founders of the analysed population, the most frequent mares in the pedigrees were BERTA 2033 (172) and KRYCHNA 2977 (155). Apart from them, there were 9 founder mares, which appeared in the pedigrees of over 100 mares. They most often represented the Cold-blooded and Sztumski breeds or their pedigree was not specified in the stud-book.

The average proportion of genes of the four major founders in the analysed mare population ranged from 0.60% to 1.37%. The highest proportion concerned the mare BRUDNA 1972, which occurred in the pedigrees of 132 mares and the largest number of mares had the proportion of her genes ranging from 0.1 to 5%. The share of genes of these four founder mares in the genotypes of individual mares participating in the conservation programme did not exceed 10%.

Proportion of breeds

In the analysed population of Sztumski mares enrolled in the conservation programme in 2008, the 785 founders (561 mares and 224 stallions) represented 23 breeds, 19 in the case of stallions and 13 in the case of mares (Table 5). A large group of founders (282) were of unknown origin (NN) in the stud-books.

Table 5. Founder breeds occurring in the pedigrees of Sztumski mares enrolled in the conservation programme in 2008

Breed	Mares	Stallions	Total
NN	222	60	282
Ardennnes	2	52	54
Swedish Ardennes	5	9	14
Belgian	1	8	9
Breton	0	5	5
Døle	0	11	11
Fjord	0	1	1
Frederiksborg	0	1	1
Haflinger	0	3	3
Polish Konik	1	0	1
Lidzbarski	0	3	3
Mur Island	4	1	5
North Swedish	0	2	2
Rhenish-Belgian	0	5	5
Sokólski	13	4	17
Sztumski	21	0	21
Heavy type horse	4	0	4
Improved horse	1	0	1
x Trakehner	0	2	2
x East Prussian	2	1	3
Anglo-Arabian	3	2	5
Thoroughbred	0	3	3
Polish Cold-blooded	281	47	328
German Cold-blooded	1	4	5
Total	561	224	785

Most founder mares were either Cold-blooded animals (281 or 50%) or mares of unknown origin (NN) (222, or 39.6% of the entire group). The group of Sztumski founders was much smaller (21 or 3.7%). Founder stallions consisted predominantly of Ardennes, including Swedish Ardennes (27%), Polish Cold-blooded (21%) and

stallions of unknown origin (26.8%). The Døle breed was relatively common (about 5%) among the founder stallions. Individual founders represented Warm-blooded breeds (such as Thoroughbred, Anglo-Arabian, Trakehner, East Prussian) and small breeds (Fjord, Haflinger, Polish Konik and Mur Island).

Discussion

The number of Sztumski mares enrolled in the genetic resources conservation programme in its first year, 2008, was similar to the number of mares of other breeds enrolled in the programme: 230 mares of the Polish Konik breed (year 2000) (Tomczyk-Wrona, 2011 a), 210 mares of the Hucul breed (2000), and 209 mares of the Silesian breed (2005). Slightly more mares were first enrolled in the programme for the Małopolski breed (347 in 2005) (Konowalczyk, 2006), and the fewest mares for the Wielkopolski breed (144 in 2008) (Tomczyk-Wrona, 2011 b).

In 2008, a total of 320 mares of the Sokólski breed were also enrolled for the first time in the horse genetic resources conservation programme (Polak, 2010). Because cold-blooded horses were still commonly used as working horses in small farms in the second half of the 20th century, the population of cold-blooded horses in Poland was fragmented. In the population of Sztumski mares in 2008, most herds (49 out of 81) had only two mares. This was due to the fact that in this region of Poland, farms are much larger than, for example, in southern Poland, and the presence of fertile and heavy soils required stronger horse teams. Another reason why most herds enrolled in the programme had a minimal number of mares was the difficulty in selecting proper breeding stock, especially with regard to the pedigree.

The distribution of the mares enrolled in the genetic resources conservation programme in 2008 did not coincide with the original distribution area of the type, i.e. Pomerania, in particular its south-eastern part in the area of Sztum and Sztumska Wieś, Warmia and Powiśle (IZ-PIB, 2008, 2010). Only less than 50% of the analysed population were found in this area. This number is small, especially when compared with the total number of 7812 cold-blood mares entered in the Polish Cold-blooded Horse Stud-Book in the same year (www.pzhk.pl). In the conservation programme it has been anticipated that the maximum number of mares enrolled in the programme, as part of the Rural Development Programme 2007–2013, would be 2 000 (PROW 2007–2013). However, this number is difficult to achieve because of the small number of eligible mares, the long generation interval, and the extremely low reproductive potential of this species. Selecting mares with typical Sztumski pedigrees meets particular problems (Polak et al., 2011).

The enhancement of the population size is also impeded by the conformation criteria specified in the conservation programme. On the other hand, the number of breeders applying for the conservation programme steadily increases because of the subsidies that can be obtained as part of the Rural Development Programme 2007–2013. The high subsidies available to the breeders and the relatively low costs and labour inputs are the reason why both Sokólski and Sztumski mares are sought after and reach high prices across Poland.

Age and colour

The largest group in the population studied were mares between 6 and 8 years of age. This could be due to the predominant use of the horses for slaughter in recent decades, because after rearing a small number of foals, the mares were culled for slaughter to avoid the risk of keeping older mares that are of lower market value and are harder to get in foal.

When comparing the colours of Sztumski horses entered in Volume One of the Cold-blooded and Heavy Horse Stud-Book, it is evident that the proportion of bay horses decreased 3% in favour of chestnut horses which raised by 5%, despite the fact that chestnut colour is recessive compared to all the other main colours. This is indicative of the increased frequency of alleles that determine this colour, which is probably due to the importation of Swedish Ardennes horses, which are typically of chestnut colour. There were only 9 black horses, as well as 1 dun and 2 grey mares, which are no longer acceptable in the conservation programmes.

Inbreeding and relationship between mares, proportion of founder genes

In the analysed population of Sztumski mares, there were 785 founders that represented as many as 23 breeds, including warm-blooded and small horses. Compared to the Sztumski type, the number of Sokólski founders was slightly smaller (718), with a larger group of mares (320) enrolled in the Sokólski horse genetic resources conservation programme in 2008 (Królak, 2012). Even fewer founders (110) were found among the Hucul horses born in Poland in 1999–2003, which are bred based on 7 male lines and 14 female lines (Kwiecińska, 2007). With respect to the Silesian breed, the horses born in Poland in 1976–1998 were descended from only 6 Silesian lines and 4 German lines (Walkowicz, 2009).

Comparison of these breeds shows that Sztumski horses have a very large number of founders. This situation results from the fact that the mares enrolled in the conservation programme showed large initial diversity. As mentioned in the introduction, both the Sztumski and Sokólski types are restored based on selection of horses currently entered in the Polish Cold-blooded Horse Stud-Book. This breed resulted from the crossing of both local Polish types and foreign breeds. The restoration of Sztumski type is based on selection of animals that meet the conformation standard and have more ancestors originating from the historic region of Sztumski horse breeding in their pedigrees. It is difficult to determine exact area of origin of the breed because of the population dynamics, both when the breed was developed and later on, when the regionalization of the breeds was first introduced and then abolished (Chrzanowski et al., 1989), and due to the changing breed standard and the development of the "economical" horses in the 1950s and 1960s. Today, Sztumski horses are thought to originate from the Pomerania and Kujawsko-Pomorskie provinces, and from the western part of the Warmińsko-Mazurskie province, i.e. the area of stud-book entry of horses with the symbols of district horse breeders associations ("G Gd", "G El", "G By" and "G Ol"); as well as horses without these symbols, which were born in state studs in the provinces mentioned above (e.g. the Nowe Jankowice Stud).

Over 97% of the Sztumski mares enrolled in the conservation programme were inbred, and the average inbreeding for the entire group was 1.93%. Compared to

the population of Sokólski horses, for which inbreeding averaged 1.48% in 2008 (Królak, 2012), the inbreeding of Sztumski horses, which is a smaller population, is slightly higher.

Only 54% of the Silesian horses enrolled in the conservation programme were inbred, with the average inbreeding of 1.26% ranging from 0 to 18.3% (Walkowicz, 2009). Walkowicz (2009) explained that this is because breeders tended to avoid inbreeding. Among Hucul foals born in 2004, inbreeding was 5.70% and ranged from 0.88% to 11.28% (Kwiecińska, 2007).

Inbreeding was only found in 33.4% of Małopolski mares enrolled in the genetic resources conservation programme in 2005. Average inbreeding was 0.43% for the entire population and 1.27% for the inbred group, ranging from 0.02% to 7.23% (Konowalczyk, 2006). Inbreeding in the herds of Małopolski horses was low, and the population was characterized by large genetic variation resulting from the presence of many founders representing different breeds (Konowalczyk, 2006).

In the population of Sztumski horses, the cases of high inbreeding were sporadic but they may suggest the low level of awareness among breeders who mated a daughter to sire or full sibs, ignoring the risk of inbreeding depression. The level of inbreeding in the analysed population and the high proportion of mares in which inbreeding did not exceed 2% (77.1%), indicate that this is mainly due to the intensive use of a small group of stallions in the past. This is confirmed by the presence of stallions such as GRILLPARZER and GUSTAW in the pedigrees of almost all mares (199 and 195, respectively). The mares with high inbreeding were mostly not closely related.

Conclusions

1. In the analysed population of Sztumski mares enrolled in the conservation programme in 2008, despite the large number of founders and their breeds, inbreeding was found in almost all mares and its level was similar to that in the breeds with a smaller number of founders. For this reason, it is necessary to choose stallions more carefully, especially with respect to stallions whose ancestors were imported.

2. Work is needed to enhance uniformity of Sztumski type, to undertake selection of most valuable lines (both male and female), and to strictly follow the breed standard laid out in the conservation programme

3. As Polish breeds and types of horses are regional in nature, it seems inappropriate to enrol horses raised in the whole country in the conservation programme for a given breed due to the different environmental conditions which have a definite effect on both horses' phenotype and genotype.

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Badania nad klaczami sztumskimi przyjętymi do programu ochrony zasobów genetycznych w roku 2008

STRESZCZENIE

Przeprowadzono analizę genetyczną 219 klaczy zimnokrwistych w typie sztumskim zakwalifikowanych do programu ochrony zasobów genetycznych w 2008 roku. Określono także strukturę wiekową i umaszczenie klaczy oraz wielkość i rozmieszczenie stad. Stwierdzono, że 97% klaczy przyjętych do programu ochrony była zinbredowana. Współczynnik inbredu mieścił się w przedziale od 0% do 32,6% i wyniósł średnio 1,93%. Średni współczynnik pokrewieństwa dla populacji wyniósł 2,38% i był najwyższy w grupie klaczy w wieku 9–11 lat (2,63%); średni współczynnik kinship w populacji wynosił 2,89%, a w przypadku pięciu klaczy jego średnia wartość mieściła się w przedziale od 5 do 5,99%.

Wykazano, że klacze pochodzą po 785 przodkach założycielach, w tym od 561 klaczy (głównie rasy zimnokrwistej, sztumskiej i sokólskiej) oraz po 224 ogierach (rasy ardeńskiej i belgijskiej oraz NN). Rozmieszczenie stad nie odpowiada w pełni historycznemu rejonowi wytworzenia rasy, a sama populacja jest rozproszona, utrzymywana w wielu stadach złożonych głównie z 2, a sporadycznie do 6 klaczy.