The 1st International Scientific Conference Biotechnology of Farm Animals
Slovak J. Anim. Sci., 46, 2013 (4): 131-136

ISSN 1337-9984

ANIMAL GENETIC RESOURCES IN LITHUANIA

R. ŠVEISTIENĖ*, V. RAZMAITĖ

Institute of Animal Science of Lithuanian University of Health Science, Baisogala, Lithuania

ABSTRACT

The objective of this study was to analyse data of farm animal monitoring and to estimate the status and effective population size of Lithuanian farm animal breeds. The principles of conservation of Lithuanian farm animal genetic resources and evaluation of Lithuanian breed status are based on the experience of animal breeding in small conserved herds and on the criteria of global strategy of FAO for the management of farm animal genetic resources. The minimal size of the conserved population was determined according to the breeding possibility of isolated animals without considerable inbreeding increase and regarding to the evaluation standards for breeding animals. The numbers of animals from native breeds were stabilized and even had increased for some breeds. After restoration and conservation of Lithuanian old native breeds' it seems that Lithuanian animal breeds could experience bottleneck effect. Effective population size for many Lithuanian breeds is below 50 till now, there is driftless reproduction and, therefore, the survival of the population is uncertain. The inbreeding can be minimized by having a larger effective population size (more than 50) and by using special mating schemes to maintain genealogical structure. The first decision in setting up conservation schemes was to carry forward the existing variability in the breeds. This is mainly concerned with the size of available resources, which could be adjusted by choosing individuals for conservation action from different lines and by carrying out planned mating between the chosen animals. Although the establishment of isolated herds with four non-related groups based on founders generation and implementation of special mating schemes had prevented the total disappearing of Lithuanian old animal breeds, the amounts of the compensatory payments are not sufficient for successful conservation of Lithuanian farm animal breeds. Despite the numbers of animals from rare Lithuanian breeds were stabilized and even have increased for some breeds, the numbers of sires should be increased and higher requirements for pure breeding and participation in the programme must also be considered.

Key words: effective population size; animal; breeds; genetic resources

INTRODUCTION

Animal genetic resources are those animal species that are used, or may be used, for food and agriculture and the populations should be conserved within those species as well as their stored genetic material. Animal genetic resources are among the most valuable and strategically important assets a country possesses. Animal genetic resource diversity may become even more important in the future as farmers and breeders face the challenge of adapting their animals to ever-changing socio-economic demands and environmental condition, including possible adaptation to climate change (FAO, 2009).

The globalization process should take into account the increasingly diversified social requirements which tend to safeguard the specific features of different communities and cultures linked to diverse traditions and history; these specificities have proved to be determining factors of sustainable development, going beyond environment-related and socio-economic aspects (Casabianca and Matassino, 2006). Local biological resources will constitute an element of increasing importance, especially as regards the necessity to restore the widest range of genetic differentiation of livestock species. Weitzman (1993) recognized that the issue of

***Correspondence:** E-mail: ruta@lgi.lt
Rūta Šveistienė, Institute of Animal Science
of Lithuanian University of Health Science,
R. Žebenkos 12, LT-82317 Baisogala, Radviliškis distr., Lithuania

Received: September 20, 2013
Accepted: October 7, 2013

biodiversity conservation is an inherently economic question, and provided a framework with the objective to distribute a limited budget among conservation efforts and so maximize the expected welfare from diversity and other conserved characteristics. The activities for conservation of Lithuanian breeds were launched respectively in 1994 and 1999 when minimal herds of Žemaitukai horses, ash-grey and white-backed cattle, indigenous wattle pigs, local coarse-woolen sheep and a flock of "Vištines" geese, and herd of old genotype of Lithuanian White pigs were formed at the Institute of Animal Science (LIAS), and thus their complete extinction has been prevented (Razmaitė and Šveistienė, 2003). In 1998-2002, National research programme "Investigations and conservation of genetic resources of cultivated plants and farm animals" was approved and implemented. Researchers of LIAS prepared the National Programme for the conservation of the native farm animal genetic resources adopted by the Ministry of Agriculture of Lithuania in 1996 and in 2008. The main purpose of this programme was collection, investigation and conservation of Lithuanian local breeds. In this programme we used FAO definition of local breeds: breeds that occur only in one country (FAO, 2007). The national Farm Animal Genetic Resources Coordinating Centre was established at the Institute of Animal Science at the end of 2008. The main activities of the Centre are coordination of animal genetic resources, identification, characterization and evaluation of animals, monitoring, and preparation of conservation programs, conservation *in-situ* and *ex-situ*.

The objective of this study was to analyse data of farm animal monitoring and estimate the status and effective population size of Lithuanian farm animal breeds.

MATERIAL AND METHODS

Lithuanian farm animal genetic resources include old breeds (Žemaitukai, Ash-Grey and White-Backed cattle, Lithuanian Coarse-Woollen sheep, Vištinės geese) and breeds that were developed in the 20th century (Lithuanian Heavy Draught horse, Large type Žemaitukai horse, Lithuanian Black-and-White cattle (old genotype), Lithuanian Red cattle old genotype, Lithuanian White pigs old genotype, Lithuanian Blackface sheep). The principles of conservation of Lithuanian farm animal genetic resources and evaluation of Lithuanian breed status are based on the experience of animal breeding in small conserved herds and on the criteria of global strategy of FAO for the management of farm animal genetic resources (Bodo, 1999; FAO, 1999; Hammond, 1998; Marx, 1990). The minimal size of the conserved population was determined according to the breeding possibility of isolated animals without considerable inbreeding increase and regarding to the evaluation standards for breeding animals. The status of Lithuanian animal breeds was evaluated by their monitoring using the data of animals which are included in the breeding system of Lithuania. Period of our investigation was 1994-2012. The effective population size was expressed as $N_e = 4N_mN_f / (N_m + N_f)$, where: N_m – number of breeding males; N_f – number of breeding females (Maijala, 1999).

RESULTS AND DISCUSSION

The numbers of breeding animals in Lithuanian native breeds are presented in Table 1. The numbers of animals from native breeds were stabilized and even have increased for some breeds. The greatest proportion of Lithuanian White pigs shown in this table were pigs improved by immigration of lean foreign breeds. Only minor residual part of Lithuanian White pigs without any immigration after the breed recognition is bred as closed population. It is impossibility to increase the numbers of purebred pigs due to insufficient subsidies for pigs. The effective population size (N_e) for the original old genotype of Lithuanian White pigs without introgression of other pigs is only 38. *Ne* is important for understanding the effects of varying numbers of males and females on genetic drift variance and inbreeding. The levels of risk status based on N_e are: endangered, where $N_e < 50$, vulnerable, where $N_e < 100$ and care, where $N_e < 200$ (Maijala, 1999). Effective population size for many Lithuanian breeds is below 50 till now, there is driftless reproduction and, therefore, the survival of the population is uncertain (Table 1). The effective population size of most other Lithuanian farm animal breeds is low too and could be characterized as the critical and endangered (Table 1). Some native breeds have low N_e because there are critically low numbers of purebred breeding males like Lithuanian White boars or native bull sperm. The effective population size from 2004 only for such breeds as Lithuanian Heavy-Draught, Lithuanian Blackface sheep that were developed in the 20th have increased.

After restoration and conservation of Lithuanian old native breeds' it seems that Lithuanian animal breeds could experience bottleneck effect. For example the population of Žemaitukai horses in 1994 contained 30 purebred horses with recorded pedigree. Therefore, their genealogical structure is drastically narrow. Semen doses were collected and stored from 9 ash-grey and 7 white-backed heterogeneous bulls. Further, the number of bulls is decreasing. The conserved herd of Lithuanian indigenous wattle pigs had 19 founders of which five were non-related boars and fourteen sows - from five non-related groups. Nowadays there is just one herd of these pigs. The herd of Lithuanian native coarse-woollen

Table 1: Numbers of Lithuanian rare breed animals and their changes in 2004-2012 and the effective population size of Lithuanian native domestic animal breeds by N_e FAO (Maijala, 1999)

Breeds	2004			2010			2012			Risk status
	No. animals	Breeding females	N_e	No. animals	Breeding females	N_e	No. animals	Breeding females	N_e	
					Horses					
Žemaitukai horse	191	70	55	421	170	110	564	206	120	Critical/endangered
Large type Žemaitukai horse	125	80	42	280	165	95	544	237	70	Critical/endangered
Lithuanian Heavy Draught horse	498	190	153	990	420	270	1174	566	205	Vulnerable
					Cattle					
Lithuanian White-Backed cattle	322	174***	20	820	420***	20	1011	502***	12	Critical
Lithuanian Ash-grey cattle	375	210***	40	961	482***	28	1291	634***	28	Critical
Lithuanian Black-and-White cattle (old genotype)	-	-	-	1108	520	33	1290	685	28	Critical
Lithuanian Red cattle (old genotype)	100	100	23	126	60	23	30	20	16	Critical
					Pigs					
Lithuanian White pigs (old genotype)	1164**	160***	20	1160**	46***	27	121***	74***	38	Critical-maintained
Lithuanian indigenous (Wattle) pigs	62	40	33	122	42	32	90	45	30	Critical-maintained
					Sheep					
Lithuanian Coarse-Woollen sheep	99	32	50	122	65	50	220	93	49	Critical-endangered
Lithuanian Blackface sheep	1587	666	225	2398	1615	225	4226	2109	157	Critical-maintained
					Geese					
„Vištinės“ geese	360	180	-	104	72	-	489	310	-	Critical-maintained

* In 2010 the number of Vištinės geese decreased to 70 birds (42 females)
** - Lithuanian White pigs, including improved pigs of open population
*** - pure breed breeding females

sheep had 6 founders and the population of Lithuanian "Vištinės" geese was restored from 100 eggs in 1996. Their effective population size (N_e) is less than 50.

The inbreeding can be minimized by having a larger $N_e > 50$ and by using special mating schemes to maintain genealogical structure. The first decision in setting up conservation schemes was to carry forward the existing variability in the breeds. This is mainly concerned with the size of available resources, which could be adjusted by choosing individuals for conservation action from different lines and by carrying out planned mating between the chosen animals. The variability in the conserved populations should be maximized and the target should be to minimize the overall kinship (Šveistys, 1982; Oldenbroek, 1999). This could be most efficiently achieved if the pedigree information was available in the population. In the case of old Lithuanian animal breeds, except horses, there were no pedigree records available, and we had to use other possible information, such as geographical accounts, to avoid redundant use of individuals, unnecessarily increasing average kinship. In order to meet these requirements the founders were divided into at least four disconnected pedigree animal groups and developed mating plans on the basis of experience in the pig breeding system, prepared by Šveistys (1967; 1982). The progeny of the founder generation in one group are mated with the progeny of the founder generation in another non-related group. After the progeny of the generation is available, their mating with the progeny of the first generation is the third group, and is carried out in order to obtain the second generation, etc. (Table 2).

Table 2: Circular breeding scheme for small populations (Razmaitė and Šveistienė, 2003)

Generation	Disconnected pedigree animal groups							
	1		2		3		4	
	Female	Male	Female	Male	Female	Male	Female	Male
Founder generation, parents	A x B		C x D		E x F		G x H	
Daughters, sons	A1	B1	C1	D1	E1	F1	G1	H1
1st generation, parents	A1 x H1		C1 x B1		E1 x D1		G1 x F1	
Daughters, sons	A2	H2	C2	B2	E2	D2	G2	F2
2nd generation, parents	A2 x F2		C2 x H2		E2 x B2		G2 x D2	
Daughters, sons	A3	F3	C3	H3	E3	B3	G3	D3
3rd generation, parents	A3 x D3		C3 x F3		E3 x H3		G3 x B3	
Daughters, sons	A4	D4	C4	F4	E4	H4	G4	B4
4th generation, parents	A4 x B4		C4 x D4		E4 x F4		G4 x H4	
Daughters, sons	A5	B5	C5	D5	E5	F5	G5	H5

Application of such circular mating schemes with 4 disconnected pedigree animal groups allows minimizing inbreeding. The coefficient of inbreeding (by Wright) amounted to only 6.2 % after four generations. On application of similar mating schemes with 8 disconnected pedigree animal groups, the coefficient of inbreeding should amount to only 3.12 % after eight generations (Šveistys, 1982). It was a great achievement to form four non-related groups (genealogical lines and families) of Lithuanian old critical indigenous breeds.

The breeding of animal from native breeds and income from their production is not competitive compared with industrial breeds and does not correspond to farmers' and market´s demands.

The total numbers of some protected breeds are decreasing, and separate breeds have grown only due to the 5 year obligation to increase herds by participating in the Rural Development Programme. From 2005 animals of critical and endangered Lithuanian native breeds are receiving the subsidies from Rural Development Programme (Table 3). After the end of 2004-2009 programme for rare animal breeds, some farmers have stopped participating in the programme (for example "Vištinės" geese) due to insufficient support level. Consequently, the numbers of animals from Lithuanian native breeds are decreasing. Despite the numbers of animals from some rare Lithuanian breeds were stabilized, the numbers of sires in all breeds should be increased and higher requirements for pure breeding and participation in the programme must also be considered.

Moreover, some farmers already have started crossing native breeds with superior foreign breeds. Small payments for critical animal breeds did not promote keeping native animal breeds.

When animals are located only in one herd, there is a risk that accidents, disease outbreaks, disposal of the herd for economic, health, age or other unforeseen reasons and circumstances could increase the danger of breed disappearing. Currently, some breeds are conserved just at the Lithuanian Centre of Farm Animal Genetic Resources Coordination of the Institute of Animal Science (Table 4) where nucleus is maintaining. There are only one isolated herd of Lithuanian indigenous wattle pigs and Lithuanian White pigs of the old genotype without introgression of foreign breeds and also one breeding flock of Vištinės geese.

The Lithuanian Heavy-Draught horses and Lithuanian Blackface sheep are still popular among breeders and have the effective population size of vulnerable risk status (Table 4).

The breeding of animals from native breeds (genetic pool) and income from their production is not competitive compared with industrial breeds. The production of native breed animals is lower and in the majority of cases their market quality (especially meat animal) is lower and it is difficult to sell them in the market. It could be defined that nowadays native breed animals are kept not for commercial purposes but for breed restoration and herd stability maintenance by preserving biodiversity for future generations.

Therefore, compensatory payments have helped to conserve the genetic resources and stabilize the numbers of some Lithuanian farm animal breeds by

Table 3: The level of subsidies (€) for animals participating in Rural Development Programme from Lithuanian breeds

Breeds	Subsidies in € for animals, including males and females	Started in year	2005		2011	
			No. stakeholders	No. animals	No. stakeholders	No. animals
Horses						
Žemaitukai horse	198		8	80	54	255
Large-type Žemaitukai horse	198	2005	7	103	28	420
Lithuanian Heavy Draught horse	191	2005	25	290	115	731
Cattle						
Lithuanian Ash-grey cattle	180	2005	36	71	136	486
Lithuanian White-Backed cattle	180	2005	37	62	140	436
Lithuanian Black-and-White cattle (old genotype)	180	2005	35	165	122	878
Lithuanian Red cattle (old genotype)	180	2005	1	100	1	10
Sheep						
Lithuanian Coarse-Woollen sheep	28	2005	2	27	6	166
Lithuanian Blackface sheep	28	2005	11	938	51	2440
Pigs						
Lithuanian indigenou (Wattle) pigs	65	2005	0	0	3	49
Lithuanian White pigs (old genotype)	65	2005	3	184	4	72
Geese						
„Vištinės“ geese	3	2005 2011	1	45	1	100

reproducing new herds or animals following special mating rules and schemes in order to minimize inbreeding increase and prevent single individuals from getting extreme levels of inbreeding. However, low effective population sizes of some breeds or their genotypes show that the amounts of the compensatory payments are not sufficient and do not promote the increase in numbers of purebred pigs and geese. The amounts of the compensatory payments should be increased in taking into account of very small animal populations in Lithuania.

Implications

Although the establishment of isolated herds with four non-related groups based on founder generation and implementation of special mating schemes had prevented the total disappearance of Lithuanian old animal breeds, the amounts of the compensatory payments are not sufficient for successful conservation of Lithuanian farm animal breeds.

Despite the numbers of animals from rare Lithuanian breeds were stabilized and even have increased for some breeds, the numbers of sires should be increased and higher requirements for pure breeding and participation in the programme must also be considered.

ACKNOWLEDGEMENT

This research work was funded by the grant No. 8P-13-084 from the Lithuanian Ministry of Agriculture.

Table 4: Distribution of animals from critical and endangered breeds at farms of different stakeholders (% of total population)

Breeds	Distribution of National nucleus		Private farmers
	National stud and sheep farm of special purpose	Lithuanian Centre of Farm Animal Genetic Resource Coordination	
	Horses		
Žemaitukai horse	19.4	7.2	73.3
Large type Žemaitukai horse	34.8	0.0	65.2
Lithuanian Heavy Draught horse	1.6	0.0	98.4
	Cattle		
Lithuanian White-Backed cattle	0.0	2.5	97.5
Lithuanian Ash-grey cattle	0.0	2.0	98.0
Lithuanian Black-and-White cattle (old genotype)	0.0	0.0	100.0
Lithuanian Red cattle (old genotype)	0.0	41.0	59.0
	Pigs		
Lithuanian White pigs (old genotype)	0.0	69.9	30.1
Lithuanian indigenous (Wattle) pigs	0.0	88.4	11.6
	Sheep		
Lithuanian Coarse-Woollen sheep	0.0	50.6	49.4
Lithuanian Blackface sheep	31.3	0.0	68.7
	Geese		
„Vištinės“ geese	0.0	48.7	51.3

REFERENCES

BODO, I. 1999. The minimum number of preserved populations. *FAO Animal Production and Health Paper*, 1999, no. 104, p. 91-105.

CASABIANCA, F. – MATASSINO, D. 2006. Local resources and typical animal products. *Livestock farming systems*. Wageningen Academic Publishers, 2006, p. 9-26.

FAO. 1999. The Global Strategy for the Management of Farm Animal Genetic Resources. Executive Brief. 1999, 43 p.

FAO. 2007. The state of the world's Animal Genetic Resources for food and Agriculture, ed. Barbara Rischkowsky and Dafydd Pilling. Rome. 2007.

FAO. 2009. Preparation of national strategies and action plans for animal genetic resources. *FAO Anim.Prod. and Health Guidelines*. no. 2. Rome. 2009, p. 3.

HAMMOND, K. 1998. Development of the global strategy for the management of farm animal genetic resources. *Proc. of 6 WCGALP/FAO Symposium Animal Genetic Resources and Sustainable Development*, 1998, no. 28, p. 43-58.

MAIJALA, K. 1999. Monitoring Animal Genetic resources and criteria for priorization of breeds. *FAO Animal Production and Health Paper*, 1999, no. 104, p. 73-85.

MARX, A. 1990. Das Wollhaarige Weidesschwein in der Schweiz. Diplomarbeit Zollikofen. 1990, 38 p.

OLDENBROEK, J. K. (ed.) 1999. Genebanks and the conservation of farm animal genetic resources. DLO Institute for Animal Science and Health. Lelystad, the Netherlands. 1999, 119 p.

RAZMAITĖ, V. – ŠVEISTIENĖ, R. 2003. Minimal and effective population size of conserved Lithuanian farm animals. *Ekologija*, 2003, no. 1, 34-37.

ŠVEISTYS, J. 1967. Kiaulių tobulinimas uždara populiacija. *Žemės ūkis*, 1967, no. 5, p. 24-25.

ŠVEISTYS, J. 1982. Populiacinio metodo panaudojimas Lietuvos baltųjų kiaulių tipams ir linijoms sukurti. *LGMTI mokslo darbai*, 1982, no. 19, p. 46-59.

WEITZMAN, M. L. 1993. What to preserve? An application of diversity theory to crane conservation. *Quarterly J. Economics*, 1993, no. 108, p. 157-183.