THE ANALYSIS OF CZECH GENETIC RESOURCES OF NUTRIAS (*MYOCASTOR COYPUS*)*

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The aim of this study is to evaluate the effective population size and fertility in the Czech Genetic Resources of nutrias during the last ten years. This study includes three Czech colour types of nutrias: Czech Type of Standard (ST), Moravian Silver (MS), and Prestice Multicolour (PM). The effective population size of ST shows that this colour type is endangered, while MS and PM are critical. The average number of pregnancy was the highest ($P \leq 0.004$) in ST (1.7 pregnancy) and the lowest in PM (1.3 pregnancy). ST and MS nutrias had the significantly biggest litter size ($P \leq 0.004$). For the number of kits born per female in a year ($P < 0.001$) the significantly lowest value was in PM (5.1 kits). For weaned kits the highest value ($P \leq 0.006$) was in ST (4.8 kits). The results showed that the population size of MS and PM is low and there is a risk of biodiversity loss in these colour types.

nutria, colour type, effective population size, fertility

DE GRUYTER OPEN

doi: 10.2478/sab-2018-0014
Received for publication on January 11, 2017
Accepted for publication on October 1, 2017

INTRODUCTION

Genetic diversity provides the raw material for breed improvement and for the adaptation of livestock populations to changing environments and changing demands (Ajmone-Marsan et al., 2010; Felius et al., 2014). During the history the main evolutionary forces included mutation, selective breeding, adaptation, isolation, and genetic drift. These factors have created an enormous diversity of local populations. In the last centuries, these efforts have culminated in the formation of many well defined breeds used for a variety of purposes with differing level of performance. The result was that the highly productive genotypes have replaced the local population across the world. These changes have led to growing concerns about the loss of biodiversity (Food and Agriculture Organization of the United Nations, FAO 2007a). As the genetic diversity of low-production breeds is likely to contribute to current or future traits of interest, they are considered essential for maintaining future breeding options (Bruford et al., 2003; Toro et al., 2009). According to the FAO, 20% of the ca. 7600 breeds belonging to 19 mammalian species and 17 avian species are at risk, and 62 breeds became extinct within the first 6 years of the century (FAO, 2007b).

Nutrias come from South America, where they are used for the production of meat and fur. In the twenties of the 20th century nutrias were imported to Europe. Nutrias were originally bred to produce high-quality fur and meat was a by-product. However, the market situation has changed and meat is now the main product. In the Czech Republic, during the 90-year history of breeding, three colour types were created: Czech Type of Standard (ST), Moravian Silver (MS), and Prestice Multicolour (PM), and have been considered as Genetic Resources since 1997. In Poland nutrias are included in the Genetic Resources, too (Filistowicz, Martyniuk, 2013). There are seven colour types (Standard, Black Dominant nu-

* Supported by the Internal Grant Agency of the Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, Project No. SV16-53-21320.

tria, White Non-albino, Amber Gold, Sable, Pastel, Pearl) included into the Polish Genetic Resources (Barabasz et al., 2007).

Effective management of farm animal Genetic Resources requires comprehensive knowledge of the breeds' characteristics, including data on the structure of populations and population size. Effective population size is a factor which reflects the increase of inbreeding and determining allele frequency changes in natural and experimental populations (Duchev et al., 2006). Effective population size determines the level of random changes in allele frequencies (Wright, 1931). According to Meuwissen (2009) it is very difficult to determine the minimal effective population size to maintain viable populations. There are many different studies, most of which agree that 50–100 is the optimum size (Meuwissen, Woolliams, 1994). Data on nutrias population size are limited.

Beutling, Cholewa (2010) published the number of nutria females of seven colour types in Polish Genetic Resources within 2000–2008. In 2000, 1623 nutrias were registered. The smallest populations were in 2000 in four colour types (Pearl, Sable, Gold, and Pastel). The largest population size was in the year 2001 (1728 females). In 2008, there were 269 females of Standard, 187 females of Grönland, and 172 females of other colour types (22 Pearl, 57 Black, 39 Pastel, and 54 Gold nutrias). The first data of nutrias Genetic Resources in the Czech Republic were published by Kaplanova et al. (2012) who stated that in 2000, there were only 262 animals in the programme, which included 117 Czech Type of Standard nutrias (ST), 73 Moravian Silver (MS) nutrias, and 72 Prestice Multicolour (PM) nutrias. Their results also indicated that PM nutrias had the highest level of genetic diversity, while ST have already been suffering from the lack of heterozygosity and showed the highest level of inbreeding of these three studied colour forms. Since that time, the data on the Czech Genetic Resources of nutrias has not been published.

Fertility is an important factor in breeding and is the main criterion for new farm animals selection. There is limited information about fertility in nutrias. Nutrias usually have two litters per year and 4–6 animals in the litter (Mertin et al., 2005). In the study of Mertin et al. (2002a) the number of animals in the first kindling was 3.8–5.3 and in the following kindling it increased from 4.4 to 4.8 animals. Another study with Grönland, Standard, Silver nutrias and crossbreds of Gold male and Standard female reported litter size of 3.3–5.6 animals in the first kindling. The authors also determined the effect of colour type on litter size; the biggest litter size was in the Grönland nutrias and Silver nutrias had the lowest average litter size (3.9 animals) (Mertin et al., 2002b).

The aim of this study is to evaluate the effective population size and fertility in the Czech Genetic Resources of nutrias during the last 10 years.

MATERIAL AND METHODS

Material description, population size, and effective population size

The data for the study on the population size and reproduction of three colour types of nutrias were obtained from the Central Herd Book of nutria kept by the Czech Association of Breeders and from the National Registry administrated by the Institute of Animal Science, Prague. The Czech Genetic Resources of nutrias include three colour types – ST, MS, and PM. ST nutria has a long body. This colour type is characteristic by black or brown down, orange guard hair with black top and black guide hair on the back. On the flanks and belly there is orange guard hair and guide hair with black top. The back is darker than the belly. The down is dense. MS nutrias have a long body, too. This genotype has silvery-bluish or bluish-grey colour of guard hair with pigmented hairless parts. On the back the half to two thirds of guard hair is intensively silvered with black top. Other guard hair is black. On the flanks almost 100% of guard hair is silvered with black top and on the belly the guard hair is white without black top. The down is short. The last nutria colour type in the Genetic Resources is PM. It shows typically white colour of guard hair with black, brown, grey or yellow guard hair and colour of down the same as that of guard hair. These nutrias have short and sparse undercoat and low density of guard hairs on the belly (Chodova et al., 2014).

The data evaluating the population size and the effective population size (N_c) were obtained from the years 2006–2015. In total 3279 litters of three colour types were included in the study of population size. Effective population size was evaluated on a number of nutrias in each breed according to the formula of Wright (1931):

$$N_c = 4\,(N_m \times N_f)/(N_m + N_f)$$

where:

N_m = number of males

N_f = number of females

Fertility

In this part of the study, reproduction was evaluated on the basis of the number of litters, litter size, number of born kits per female, number of weaned kits, and number of weaned kits per female. In total 3279 litters, 15 300 born nutrias, and 14 114 weaned animals were observed.

The data on reproduction were processed by the SAS software (Statistic Analysis Software, version 9.1.3., 2003) by one-way ANOVA using the GLM procedure. The significance of differences between the colour types was tested by the Scheffé's test on the level of significance $P \leq 0.05$.

Table 1. Nutrias population size (PS) and number of breeders (NB) in the Czech Republic

Year			Colour type					
			ST		MS		PM	
2006	PS		124		71		61	
	females	males	105	19	61	10	50	11
	NB		8		4		2	
2007	PS		129		71		65	
	females	males	110	19	61	10	54	9
	NB		8		4		2	
2008	PS		120		74		69	
	females	males	98	22	62	12	56	13
	NB		7		4		2	
2009	PS		132		67		38	
	females	males	109	23	54	13	32	6
	NB		7		4		2	
2010	PS		134		79		78	
	females	males	112	22	64	15	60	18
	NB		9		5		4	
2011	PS		149		73		84	
	females	males	123	26	59	14	64	20
	NB		9		5		4	
2012	PS		98		55		71	
	females	males	80	18	44	11	55	16
	NB		7		4		4	
2013	PS		85		40		76	
	females	males	70	15	33	7	59	17
	NB		7		4		4	
2014	PS		97		43		49	
	females	males	78	19	37	6	39	10
	NB		8		6		3	
2015	PS		107		42		65	
	females	males	95	12	35	7	56	9
	NB		8		6		4	

PS = Population, NB = Number of breeders, ST = Czech Type of Standard, MS = Moravian Silver, PM = Prestice Multicolour

RESULTS

This study presents the first detailed report on the situation in the population of Czech Genetic Resources of nutria. Information about the population size and number of breeders of each colour type is given in Table 1. The highest nutrias population size in the Czech Genetic Resources was registered in 2006 with 256 animals and the lowest in 2014 with 189 nutrias. From all colour types, the largest population is in ST. For this colour type, the highest population size was in 2011 and the lowest in 2013. Since this year, the population of this colour type has been slightly increasing. In MS the highest population size was in 2010 and the lowest in 2013. Similar trends were found in PM with the highest number of nutrias in 2011 and the lowest in 2014. The number of animals in populations decreased from 2006 to 2015 by about 13.7% in ST, 40.8% in MS, and 8.2% in PM.

Effective population size is an important parameter for evaluating a population. It has a direct relationship with the rate of inbreeding and the amount of genetic variation. Table 2 gives data on effective population size and the level of population threat. Effective population sizes of the three colour types have copied the data of population sizes, with the highest effective population size of ST and PM in 2011. In MS, the highest value was reached in 2010.

Table 2. Effective population size

Year	Colour type		
	ST	MS	PM
2006	64.4	34.4	36.1
2007	64.8	34.4	30.9
2008	71.9	40.2	42.2
2009	76.0	41.9	20.2
2010	73.6	48.6	55.4
2011	85.9	45.3	61.0
2012	58.8	35.2	49.6
2013	49.4	23.1	52.8
2014	61.1	20.7	31.8
2015	42.6	23.3	31.0
2006–2015 (mean)	64.8	34.7	41.1
Classification of EAAP	endangered	critical	critical

ST = Czech Type of Standard, MS = Moravian Silver, PM = Prestice Multicolour

Table 3. Results of fertility of ST, MS and PM nutrias

Parameter	Colour type			RMSE	Significance
	ST	MS	PM		
Average number of pregnancy	1.7^{a}	1.6^{ab}	1.3^{b}	0.542	0.004
Litter size	5.1^{a}	5.0^{a}	3.9^{b}	1.686	0.004
Number of born kits per female per year	8.4^{a}	7.3^{a}	5.1^{b}	2.640	< 0.001
Number of weaned kits	4.8^{a}	4.6^{ab}	3.7^{b}	1.654	0.006
Number of weaned kits per female per year	7.9^{a}	6.6^{b}	4.8^{c}	2.495	< 0.001

ST = Czech Type of Standard, MS = Moravian Silver, PM = Prestice Multicolour, RMSE = root mean square error

$^{a–c}P \leq 0.05$

Table 3 presents fertility parameters. The number of kindling ranged from 1.3 to 1.7 litters per female. In our study, this characteristic was affected by genotype. The significantly highest number of kindling was in ST and the lowest in PM, whereas MS did not differ from both colour types in this parameter. In our study the litter size was affected by colour type and the highest value was in ST. A significant effect of colour type was also observed in the number of weaned kits in litter. These parameters were lower in PM. If we compare the results of weaned kits in litter and the number of weaned kits per female in a year, it is clear that MS nutrias had higher mortality of kits during weaning period from kindling to weaning.

DISCUSSION

Results of the population size show that compared with data of K a p l a n o v a et al. (2012) from year 2000, the ST nutrias population had increased until 2011 and then decreased to 107 animals in 2015. Compared to Polish Genetic Resources (B e u t l i n g , C h o l e w a , 2010), the population of the Czech ST is only 25%. The population size of MS and PM nutrias was lower in the current study than in the study of K a p l a n o v a et al. (2012). Data on the nutrias effective population size cannot be compared with those from literature because in the literature this information about nutrias is missing. According to the European Association for Animal Production (EAAP) the population size indicates that the population of ST is endangered and MS and PM populations are critical. Based on the results there is a risk of biodiversity loss, deterioration of vitality and reproductive characteristics in several generations in the populations of MS and PM. We assume that the Czech Genetic Resources of nutrias need more effective support to increase the population size. Low effective population size could affect the inbreeding increase and fixation of deleterious mutations. If there is no increase of the population size of nutria in the Czech Genetic Resources, there is a risk of losing the unique characteristics obtained over years. Our results on fertility are worse in comparison

with literature. Mertin et al. (2005) presented two kindling per female in one year. On the other hand, there is no data in literature about the effect of colour type on the number of pregnancy. In agreement with Mertin et al. (2002b), litter size was affected by the colour type of nutrias. Litter size corresponds with the number of born kits per female and weaned kits in a year. These results of weaned kits in litter and the number of weaned kits per female in a year are not comparable with literature because of the lack of data.

CONCLUSION

This study shows the first data on nutrias in the Czech Genetic Resources. The population size of each colour type decreased during the evaluated period. All fertility characteristics were significantly affected by the colour type.

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