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Litter size and health management as limiting factors of "*in situ*" conservation of Turopolje pig

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Abstract. Since 1996, the Turopolje pig is recognised as a Croatian autochthonous extensive pig breed and was include in program of "*in situ*" preservation. The purpose of this paper was to analyze the changes in breeding population of Turopolje pig in relation to reproductive traits and brucellosis outbreaks. 529 liters from 388 sows were analysed in the period from 2000 to 2009. In average 1.2 liters/sow/year were observed with 4.21 and 3.90 piglets born alive and weaned per litter, respectively. Mortality rate during the weaning period was close to 20%. In the period from 1996 to 2009 the size of breeding population was increased more than ten times in the number of sows and five times in the number of boars. In 2008, the numbers of sows and boars decreased about 21% in relation to 2007, primarily due to an outbreak of brucellosis. In average 44.2% and 30.1% of tested pigs during 2008 and 2009 were serologically positive to *Brucella suis* infection and were excluded from population. These results suggest requirements to increase the number of litters per year and survival of pigs born alive due to changes in Turopolje pig production system and development of a health monitoring program.

Keywords. Turopolje pig – Conservation *in situ* – Litter size – Brucellosis.

La taille des portées et la gestion de la santé comme facteurs limitants de la conservation "in situ" du porc Turopolje

Résumé. *Depuis 1996, le porc Turopolje, inclus dans un programme de préservation «in situ», est reconnu comme une race autochtone extensive en Croatie. Le présent travail a pour objectif d'analyser les variations de la population reproductrice de porc Turopolje en rapport avec les caractéristiques reproductives et l'épidémie de brucellose. On a analysé 529 portées de 388 truies dans une période comprise entre 2000 et 2009. On a observé 1,2 portée/truie/année en moyenne avec un résultat de 4,21 et 3,90 porcelets nés vivants et sevrés par portée. Le taux de mortalité au cours de la période de sevrage était de près de 10%. En ce qui concerne le nombre de truies, la population reproductrice s'est accrue plus de dix fois au cours de la période de 1996 à 2009, et cinq fois concernant le nombre de verrats. En 2008, le nombre de truies et de verrats a décru d'environ 21% par rapport à l'an 2000, en raison principalement d'une épidémie de brucellose. En moyenne, 44,2% et 30,1% des porcs analysés au cours des années 2008 et 2009 avaient été sérologiquement positifs à l'épreuve de l'infection à* Brucella suis*, et ont été exclus de la population. Ces résultats semblent indiquer l'exigence d'augmentation du nombre de portées par an et de survie des porcs nés vivants en raison des changements dans le système de production du porc Turopolje et du développement d'un programme de surveillance de la santé.*

Mots clés. *Porc Turopolje – Conservation* in situ *–Taille de la portée – Brucellose.*

I – Introduction

Turopolje pig is local pig breed well adapted to continental climate and extensive farming in periodically flooded forests of English oaks and marsh meadows of Turopolje region in central Croatia (Dikic *et al*., 2002; Dikic *et al*., 2006). Since 1996, it was included in a program of conservation in its natural habitat according to old traditional Croatian farming practices (Robic

et al., 1996). Typically, pigs are kept outdoor during all phases of production cycles with extensive using of woodland (>3 ha/pig). Housing is based on natural covering except during the farrowing and suckling period in which sows and piglets are kept in primitive woodenly buildings type “stanci” with restricted moving area in wood environment. Feeding is based on utilization of natural resources such as pasture, acorn and soil with addition of about 0.5 kg of corn seed per pig, especially in suckling and late fattening period as well in winter season with snow (Juric *et al*., 1997). Reproductive efficiency and growth performance could be highly influenced by weather conditions and control of diseases. In the past, outbreaks of some infectious diseases (swine fever, brucellosis, leptospirosis) were reported which strongly influenced the size of breeding population and production level (Cvetnic *et al*., 2002; Cvetnic *et al*., 2003; Roic *et al*., 2007). The aim of this paper was to analyze the reproductive characteristics of Turopolje pig and changes in breeding population in the period from 1996 to 2009 in relation to brucellosis outbreaks.

II – Materials and methods

1. The size of breeding population

The size of breeding population (number of sows and boars, gilts and young boars) and number of farms were analyzed in period between 1996 and 2009 using a data of “Annual reports - Pig breeding” of Croatian Livestock Center (CLC, 1997 to 2010). The effective size of population (Ne) was calculated according to formula by Falconer and Mc Key (1996):

$$Ne = 4\ x\ \frac{Nm\ x\ Nf}{Nm + Nf},$$

where Nm is number of male (boars) individuals and Nf is number of female (sows) individuals

2. Reproductive traits

Data were collected in the period from 2000 to 2009, in several farms, representing two main farming areas of Turopolje pig: "Turopolje field" – woodland area near the capital Zagreb and “Natural Park - Lonjsko Polje”. The data from 529 litters and 388 sows registered in Herdbook of Turopolje pig breed were collected. At all farms sows were kept under similar conditions in outdoor production system with extensive using of woodland and pasture. Data collected include: farowing index, number of piglets (total born, born alive and weaned piglets) per litter and per sows.

3. Blood sampling and serological tests

Blood samples were collected by venipuncture from vena cava cranialis, vena jugularis or the ear vein. During the year 2008 and 2009 blood samples from 385 and 83 animals were collected, respectively and were serologically tested to *Brucella suis* infection. The Rose Bengal Test (RBT) were used as a screening method and the Complement Fixation Test (CFT) and the indirect Enzyme-Linked Immunosorbent Assay (ELISA) as a "second line" test to confirm the swine brucelossis. All serologicall tests were performed occording to World Orgnisation for Animal Health standard procedures (OIE, 2004). The results of the each tests were interpreted according to producer‘s recommendations. Individual results were considered positive when a positive RBT was confirmed either by a positive iELISA or CFT result. A positive result in the RBT, associated with doubtful reactions in either iELISA or CFT was considered as "suspect".

III – Results and discussion

The program of *in situ* conservation of Turopolje pig breed was started in 1996 by opening of the herdbook at Croatian Livestock Center (CLC) by the public association "Universitas Commnitas Nobilium Campi Turopolia" (UCNCT, land community established in 13th century). At the beginning only 12 sows and 3 boars were registered in the herdbook. In the next three years (Table 1) population was increased and number of breeding animals was consolidated at 36 sows and 6 boars in 1999, what could be used as a basic year for the considerable increase in number of breeding population. In the period from 1999 to 2008 the size of breeding population was increased near the 5 times in number of sows and 6 times in number of boars registered in the herdbook. The increase in number of boars and sows resulted in the increase size of effective population, from 20.6 to 98.6 in 1999 and 2007, respectively. According to the FAO criteria for determining breeds at risk (Loftus and Scherf, 1993), Turopolje pig was in critical status from 1996 to 2003 and in the status of endangerment from 2003 to 2008. But in 2008 the numbers of sows and boars was decreased about 21% in relation to 2007 and did not significantly change during the year 2009.

Table 1. The size of breeding population of Turopolje pig in Croatia†

Year	Sows	Boars	Ne††	Gilts	Young boars	Farms
1996	12	3	9.6	-	-	-
1997	17	8	21.8	-	-	-
1998	13	6	16.4	-	-	-
1999	36	6	20.6	13	6	5
2000	40	5	18.8	37	1	5
2001	45	5	18.0	90	1	4
2002	70	4	15.1	53	3	3
2003	99	6	22.6	76	3	2
2004	116	9	33.4	78	8	2
2005	129	14	50.5	107	-	3
2006	137	13	47.5	8	3	4
2007	164	29	98.6	2	2	4
2008	130	15	53.8	21	7	5
2009	138	18	63.7	83	-	5

†Source: Annual report – pig breeding, HPA (1997 - 2009). ††Ne – effective size of population.

Slow increase of breeding population could be explained due to low reproduction efficiency (low farrowing index, litter size), high mortality during suckling period, appearance of some diseases and low interest of family farms (low daily gain, low meatiness) as well as the lack of pastures and forests areas for pig keeping which are required for *in situ* conservation (Dikic *et al*., 2008).

As shown in Table 2, low farrowing index (in average 1.19) and high variability in number of total born piglets per litter and sow (3.21 to 5.68 and 3.21 to 7.40 piglets per litter and sow, respectively) were observed. In the same time more than 90% of total born piglets were born alive, while mortality during suckling period varied between 2% and 35%. Similar mortality rate was founded by Đikic *et al*. (2008) in semi-controlled conditions up to 21st day (8.8%) and 42nd day (26.5%) of piglets age. The exception was year 2004, when was observed 2.0 litters per sow, but only 3.29 total born piglets/litter and 80% of mortality during suckling period. These results suggest that *in situ* conservation of Turopolje pig in outdoor extensive production system is more dependent on environmental conditions (weather conditions, keeping area and availability of natural feed resources –growing plants, forest fruits, and soil animals– and that

one farrowing per year in warm season with abundance of vegetation is sufficient. On the contrary, if the practice of two farrowing per year is used, one of these comes in the cold and humid season, what could have a strong influence on survival of young piglets.

Table 2. Reproduction traits of Turopolje pig breed

Year	Number of litters	Farrowing index	Number of piglets					
			Average per sow			Average per litter		
			Total born	Born alive	Weaned	Total born	Born alive	Weaned
2000	37	1.12	6.24	6.15	4.85	5.57	5.49	4.32
2001	23	1.10	6.14	5.95	3.90	5.61	5.43	3.57
2002	11	1.00	-	-	4.55	-	-	4.09
2003	36	1.00	4.78	3.33	2.83	4.78	3.33	2.83
2004	120	2.00	6.57	6.57	1.32	3.29	3.28	0.66
2005	39	1.00	3.21	3.13	3.08	3.21	3.13	3.08
2006	20	1.33	7.40	7.40	7.13	5.55	5.55	5.35
2007	34	1.17	6.66	6.48	6.41	5.68	5.53	5.47
2008	29	1.16	5.96	5.88	5.32	5.14	5.07	4.59
2009	60	1.02	5.64	5.34	5.15	5.55	5.25	5.07
Total	**529**	**1.19**	**5.26**	**5.02**	**4.45**	**4.44**	**4.21**	**3.90**

The breeding population of Turopolje pig is owned by two public organizations (UCNCT and Lonjsko Polje Nature Park) with more than 50 reproducers each and several small family farms with 3 to 10 animals each in relatively closed breeding area. Such farm structure and production system contributes to high exposure of Turopolje pig population to appearance of infection diseases. In the past, the contagious diseases like leptospirosis, swine fever and brucellosis were reported in pigs and/or in wild animals in the breeding area of Turopolje pig (Cvetnic *et al*., 2002; Roic *et al*., 2007), what emphasize problems in control of infectious diseases in outdoor kept Turopolje pig. Recently, the most important problem are brucellosis outbreaks in several herds of Turopolje pig.

As shown in Table 3, in the years 2008 and 2009, about 44% and 30% of tested blood samples of Turopolje pigs were serologically positive to *B. suis* infection, respectively.

Table 3. Seroprevalence of brucellosis in Turopolje pig breed in year 2008 and 2009

Year	Total number of blood samples	Serological positive blood samples	
		Total	%
2008	385	170	44.16
2009	83	25	30.12
Total	468	195	41.67

Swine brucellosis is a contagious disease in pigs caused by the bacteria *Brucella suis* that could be transmitted to humans. Infection occur primary in domestic and feral pigs, while wild pig (*Sus scrofa*) and/or European hare (*Lepus europeus*) could be assumed as a natural reservoir of *B. suis*. The most common symptoms of brucellosis include non-specific reproductive disorders such as infertility, abortion at any stage of gestation, stillbirth, weak pigs and orhitis in boars. The disease spreads by semen during coitus and by ingestion or inhalation of bacteria in

reproductive fluids, placenta, aborted fetuses, urine or milk. Pigs kept in extensive outdoor production systems such as Turopolje pigs are highly exposed to B. suis infection. Pigs often graze together with other species of domestic animals and mate naturally. All of this increases the possibility of direct contact among pigs from different owners as well as with wild boar (Cvetnic *et al*., 2003). In addition, an earlier study (Cvetnic *et al*., 2009) suggests that brucellosis is enzootic in Croatian populations of wild pigs, especially in the breeding area of Turopolje pig. Thus, the presence of *B. suis* in pigs environment and the extensive production system could explain the occurrence and high prevalence of brucellosis in Turopolje pig population.

According to Croatian legislation, all serologically positive animals to *B. suis* infections must be excluded from population. As a result, a lot of animals were excluded from breeding population what could explain the decrease in number of breeding animals in the Herdbook in 2008 without significant changes in number of breeding animals in 2009.

IV – Conclusions

In situ conservation of Turopolje pig breed is based on outdoor keeping according to a traditional production system in which large areas of pasture and woodland are used (more than 3 ha/pig) with low investment in housing and feeding. The main limiting factors for any considerable increase in size of breeding population in last 10 years were: reproduction efficiency (low farowing index, small litter size, high mortality of piglets in suckling period and consequently low number of weaned piglets per sow per year), the size and number of breeding farms and the outbreaks of infections diseases (brucellosis, swine fever, leptospirosis). In order to change the present state the urgent development and implementation of herd health management program and improvements in production system (housing and feed supplementation in suckling period) are needed.

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