Morphometrical Analysis of Reproduction Traits for the Wild Boar (*Sus scrofa* L.) in Croatia

Nikica ŠPREM [1(✉)]
Marina PIRIA [1]
Tihomir FLORIJANČIĆ [2]
Boris ANTUNOVIĆ [2]
Tomislav DUMIĆ [2]
Hrvoje GUTZMIRTL [3]
Tomislav TREER [1]
Ino CURIK [4]

Summary

The wild boar (*Sus scrofa* L.) is native game in Croatia, whose population have tendency of increasing as well throughout the Europe. The wild boar is a natural inhabitant of Europe, Asia, and North Africa and is phylogenetically the ancestor of the domestic pig. Because of its phylogenetic and economic importance, this species is an interesting model for studying testis function. Therefore, the present study was performed to investigate the testis morphometry, and gonadosomatic index (GSI) for 77 individuals. The mean live body weight was 75.03 kg, testis weight was 0.355 kg and with a gonadosomatic index (GSI) of approximately 0.40%. The mean circumference for the left and right testes were not significant, but a significant and positive correlation was observed between testis weight and body weight ($r = 0.88$, $p<0.05$). A high reproductive contribution of juveniles is a likely consequence of a high hunting pressure rather than a species specific life history pattern characterizing wild boar. Generally, beside female seasonal reproductive activity knowledge of male reproduction cycle in wild boar is very important for established better management of free-ranging population.

Key words

Croatia, GSI, testis circumference, wild boar

[1] University of Zagreb, Faculty of Agriculture, Department of Fisheries, Beekeaping, Game Menagement and Special Zoology, Svetošimunska cesta 25, 10000 Zagreb, Croatia
✉ e-mail: nsprem@agr.hr
[2] University of J. J. Strossmayer in Osijek, Faculty of Agriculture, Chair for Wildlife, Fishery and Beekeeping, Trg Sv. Trojstva 3, 31000 Osijek, Croatia
[3] Center for Livestock Improvement, Kolođvar 1, 31216 Antunovac, Croatia
[4] University of Zagreb, Faculty of Agriculture, Department of Animal Science, Svetošimunska cesta 25, 10000 Zagreb, Croatia

Received: May 30, 2011 | Accepted: July 1, 2011

Aim

Knowledge of the reproductive biology of mammals remains extremely limited, especially with regards to the most basic reproductive parameters of wild animals (Wildt, 2005). The testis structure is very similar in mammals, each species may exhibit particular morphofunctional characteristics, such as those related to phylogenetic aspects and reproductive behavior (Costa et al., 2010). At the moment wild boar (*Sus scrofa*) is the most widely distributed ungulate and has by far the largest range of all suid species, and demonstrate a high ecological adaptability and a very high reproductive potential (Bywater et al., 2010). The wild boar is originating from Europe, Asia, and North Africa and is now found on all continents, whose population have tendency of increasing as well throughout the Europe. It's a seasonally breeding animal, the rutting time falling mainly in late autumn and early winter. This seasonality of reproduction is a common occurrence in wild mammal, it can be considered as an adaptive mechanism that serves to synchronize births with optimal conditions for the survival of the young (Mauget et al., 1981). Habitat quality, climatic conditions, photoperiodism, amount of natural and supplementary food, hunting pressure and the herd social structure are impacts of big influence on wild boar reproductive (Bieber and Ruf, 2005; Servanty et al., 2009). Although the wild boar represents an attractive model to study testis function in boars, there are few data regarding the male reproductive function (Kozdrowski and Dubiel, 2004). The main objective of the present study was to perform the reproduction traits of male wild boar in Croatia. The results will allow a comparison with the data already obtained among wild boar, feral and domestic pigs.

Material and methods

We analysed testis morphometry variations in free-range male wild boar output based on a 2-year study (2007-2009) during legal drive hunts. The main drive hunt season is during November, December and January when we collected all the samples, because of the highest reproductive activity. All animals presented phenotypic characteristics of the species. The age of the animals were estimated using patterns of tooth eruption and replacement according to Boitani and Mattei (1992). The animals were classified into three age classes (Pedone et al., 1991): juvenile (less than one year of age), yearling (between 1 and 2 years of age), and adult (older than two years of age). The testes were measured using a tape measure (±1 mm) and digital scale (± 5 g). The live body weight was measured using digital scale (± 0.5 kg). A total of 77 individuals were scored for the four morphometrycal measurements: circumference of left testis; circumference of right testis, testis weight and live body weight. The gonadosomatic index (GSI) was calculated with the formula by Barber and Blake (1991), GSI= testis weight/body weight x 100. The data were analysed with SPSS Statistics (IBM Corporation, 2010).

Results and discussion

To our knowledge, the present study is the first to report the results of a testis morphometry from Central Europe. Beside providing valuable data regarding the reproductive biology of this species, our results may allow important comparison between the well-investigated domestic pig and wild boar, which is phylogenetically the ancestor of the domestic pig. We obtained comprehensive data for 77 individuals: juvenile (27), yearling (19) and adults (31). The age distribution indicated a relatively older population: 40% of the examined animals were older than 24 months. Descriptive statistics of the analysed morphometrical measurements under three different age classes of the animals are presented in Table 1.

The mean live body weight was 75.03 kg, and for the three classes: juvenile (36.33 kg), yearling (77.95 kg) and adult (106.95 kg). Comparing with the other publish data of live body weight, our result is significantly higher (Herrero and Fernandez de Luco, 2003; Delgado et al., 2008). The mean testis weight was approximately 0.355 kg, with a gonadosomatic index (GSI) (testes weight divided by body weight) of approximately 0.40%. The value of GSI fluctuated during the season, with a tendency to increase in the rutting time from November to January (Almeida et al., 2006). The GSI obtained in two other studies on wild boar (Mauget and Boissin, 1987; Almeida et al., 2006) comparing with our study were lower. This may be explained by the fact that in our study we have larger number of samples and processed older individuals. A value of GSI for feral pigs was the smallest, only 0.21% (Costa et al., 2010). Another possible reason of higher value is because we calculated GSI in the winter (culmination of rutt), when is testis weight significantly higher than during the summer months (Mauget and Boissin, 1987). Comparing with domestic pig (Mauget and Boissin, 1987) breeds the GSI was approximately 20% lower in our study. This may be explained by the extensive selection for reproductive performance, to which the domestic pig breeds have been submitted. Total value of gonadosomatic index (GSI) in the wild boar for all three age classes was in relation to live body weight (Figure 1). The mean circumference for the left and right testes were not significant, but a significant and positive correlation was observed between testis weight and body weight ($r = 0.88$, $p<0.05$). The testis weight rises with tendency to increase with body weight, up to about three years. We noticed reproduction activity of boars in juvenile age class, with mean live body weight of 36.33 kg and mean testis

Table 1. Descriptive statistics of the analysed morphometrical measurements of wild boar

Age class	N	Live body weight		Testis weight		Left testis circumference		Right testis circumference	
		Mean±SD	Range	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range
Juvenile	27	36.33±9.69	24-64.5	71.11±57.55	0.025-0.28	6.46±2.25	2.1-13.3	6.73±2.42	2.5-13.7
Yearling	19	77.95±12.86	52.5-95.5	324.21±148.03	0.025-0.52	13.84±3.23	2.1-18	14.14±3.30	2.4-17.8
Adults	31	106.95±16.74	82.5-141.5	654.26±237.87	0.15-1.05	17.39±2.97	8.3-23.4	17.55±2.88	8.5-22.1

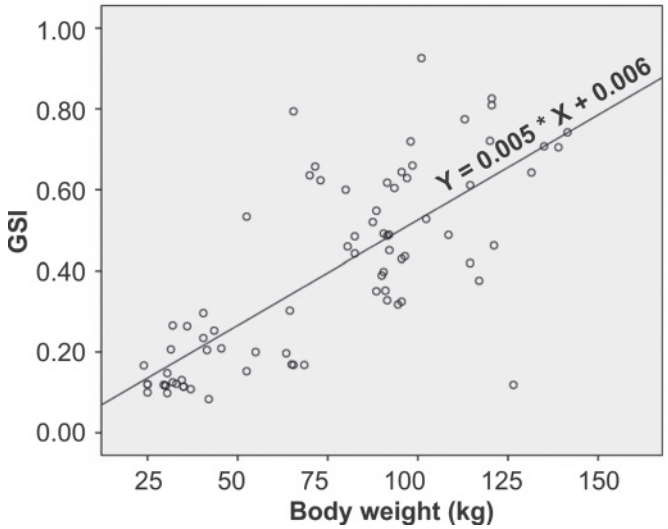

Figure 1. Characterization of gonadosomatic indeks (GSI) in the wild boar (R^2=0.576; F=102.044; $F_{1,75,0.05}$ = 3.968)

weight of 0.071 kg. Mauget and Boissin (1987) showed date for the presence of reproductive activities of boars aged 10 month, of body weight 30-35 kg and mean testis weight of 0.053 kg. We can conclude that in the same age class, body weights and testis weight in our study were higher, probably because male animals in Croatia enter earlier into reproductive.

We believe that reproduction activity begins in juvenile class at low weight because of habitat conditions, supplementary feeding by hunters and higher hunting pressure (Gethöffer et al., 2007). A high reproductive contribution of juveniles is a likely consequence of a high hunting pressure and supplementary feeding rather than a species specific life history pattern characterizing wild boar (Servanty et al., 2007; Servanty et al., 2009; Fonseca et al., 2011). As most individuals do not live more than tree-four breeding seasons, selective pressure should favor an increased reproductive effort early in life and so, juveniles should invent more in reproductive (Festa-Bianchet, 2003). The juvenile male individuals are little involved directly in rutting because of their inferiority compared to older and stronger individuals. However, further studies are needed in the wild boar to determine whether the seasonal changes in the testicular function are influenced by photoperiodism alone or in conjunction with other environmental factors such as temperature, food availability, hunting pressure and social factors.

Conclusions

This study allow the conclusion that male wild boar in Croatia enter relatively earlier in reproduction, because of higher live body and testis weight. Gonadosomatic index (GSI) was high, much closer to the value of domestic pig breeds than other publishes data of wild boar. A high reproductive contribution of juveniles is a likely consequence of a high hunting pressure, supplementary feeding and habitat conditions.

References

Almeida F. F. L., Leal M. C., Franca L. R. (2006). Testis morphometry, duration of spermatogenesis, and spermatogenic efficiency in the wild boar (*Sus scrofa scrofa*). Biol Reprod 75: 792-799.

Barber B. J., Blake N. J. (1991). Reproductive physiology. In: Shunway, S (Ed.), Scallops: Biology, Ecology and Aquaculture, vol 21. Elsevier, Amsterdam, pp 377-409.

Bieber C., Ruf T. (2005). Population dynamics in wild boar *Sus scrofa* ecology, elasticity of growth rate and implications for the management of pulsed resource consumer. J Appl Ecol 42: 1203-1213.

Boitani L., Mattei L. (1992). Aging wild boar (*Sus scrofa*) by tooth eruption. In: "Ongules/Ungulates 91". F. Spitz, G. Janeau, G. Gonzales & S. Aulagnier (eds), SFEPMIRGM, Paris-Toulouse, 419-421.

Bywater K. A., Apollonio M., Cappai N. Stephens Philip A. (2010). Litter size and latitude in a large mammal: the wild boar *Sus scrofa*. Mammal Rev 40: 212–220.

Costa G. M. ., Leal M. C., Silva J. V., Ferreira A. C. S., Guimaraes D. A., Franca L. R. (2010). Spermatogenic cycle length and sperm production in a feral pig species (Collared Peccary, *Tayassu tajacu*). J Androl 31: 221-230.

Delgado R., Fernández-Llario P., Azevedo M., Beja-Pereira A., Santos P. (2008). Paternity assessment in free-ranging wild boar (*Sus scrofa*)-Are littermates full-sibs? Mamm biol 73: 169-176.

Festa-Bianchet M. (2003). Exploitative wildlife management as a selective pressure for the life-history evolution of large mammals. Animal Behavior and Wildlife Conservation (M Festa-Bianchet, M Apollonio, eds), Island Press, Washington DC, 191-207.

Fonseca C., Alves da Silva A., Alves J., Vingada J., Soares A.M.V.M. (2011). Reproductive performance of wild boar females in Portugal. Eur J Wildl Res 57: 363-371.

Gethöffer F., Sodeikat G., Pohlmeyer K. (2007). Reproductive parameters of wild boar (*Sus scrofa*) in three different parts of Germany. Eur J Wildl Res 53: 287-297.

Herrero J., Fernandez de Luco D. (2003). Wild boars (*Sus scrofa* L.) in Uruguay: scavengers or predators? Mammalia 67: 485-491.

IBM Corporation (2010). SPSS Statistics, version 17.0. www.spss.com.

Kozdrowski R., Dubiel A. (2004). The effect of season on the properties of wild boar (*Sus scrofa*) semen. Anim Reprod Sci 80: 281-289.

Mauget R., Boissin-Agasse L., Boissin J. (1981). Ecorégulation du cycle de la function de reproduction chez les Mammiferes sauvages. Bull Soc Zool 106: 431-443.

Mauget R., Boissin J. (1987). Seasonal changes in testis weight and testosterone concentration in the European wild boar (*Sus scrofa*). Anim Reprod Sci 13: 67-74.

Pedone P., Mattioli L., Mattioli S., Siemoni N., Lovari C., Mazzarone V. (1991). Body growth and fertility in wild boars of Tuscany, Central Italy. In: Csanyi S, Ernhaft J, editors. Transaction of XXth Congress of the International Union of Game Biologists, Aug 21-23, Godollo, Hungary, pp 604-609.

Servanty S., Gaillard J. M., Allainé D., Brandt S., Baubet E. (2007). Litter size and fetal sex ratio adjustment in a highly polytocous species; the wild boar. Behav Ecol 10: 1093-1099.

Servanty S., Gaillard J. M., Toïgo C., Brandt S., Baubet E. (2009). Pulsed resources and climate-induced variation in the reproductive traits of wild boar under high hunting pressure. J Anim Ecol 78: 1278–1290.

Wildt D.E. (2005). Lions, tigers and pandas, oh my. J Androl 26: 452-445.

acs76_49