

ANALYSIS OF SELECTED BIOMETRIC FEATURES AND POPULATION ATTRIBUTES OF WILD BOAR IN THE ZIELONKA GAME INVESTIGATION CENTRE

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Abstract. The authors analysed selected biometric features of the wild boars harvested in the Zielonka Game Investigation Centre in 2004-2007, including the carcass weight, body length and height at the withers, with regard to age and sex. Some population attributes were also analysed, including age, sex and social structure.

Key words: wild boar, population, biometrics, age structure, sex structure, social structure

INTRODUCTION

Wild boar (*Sus scrofa* L., 1758) is an even-toed ungulate (order *Artiodactyla*, suborder *Suiformes*, family *Suidae*, and genus *Sus*). Wild boar range coincides with the natural range of beech and oak whose nuts are wild boar's main food in winter. Apart from Europe, wild boar occurs in vast areas of Asia and North Africa [Nußlein 1995]. The number of wild boars in Poland did not change for a few years (1993/94-1997/98), but started to grow rapidly from about 80,000 to over 177,100 individuals in season 2006/2007 (an increase of 221%).

Wild boar density in Poland increased from 8.85 individuals per 1000 ha of forest in season 1993/94 to 19.81 in 2006/07. The density in the last 14 years (1993-2007) averaged 13.14 individuals per 1000 ha of forest across hunting grounds. The rate of wild boar harvest in Poland averages 10 individuals per 1000 ha of forest. and varies by region. The highest harvest rate is in western Poland, while the lowest one in southern Poland.

The research was carried out in the Zielonka Game Investigation Centre (Zielonka GIC), about 30 km north-east of Poznań. Located within Łopuchówko Forest District and Zielonka Experimental Forest District, Zielonka GIC is 13,000 ha in area, with 7,500 ha of forest. Zielonka GIC is located at the transition between the Atlantic and

continental climates. The dominant forest species is Scots pine (*Pinus sylvestris*), having 80.0% share and present at almost all sites. The main broadleaved species is oak (*Quercus* sp.), accounting for 9.0% of the overall species composition. Other species include: alder, birch, spruce, beech, and larch [Górecki and Kasprzak 2001]. Black cherry, hazel, blackthorn, mountain ash and some minor species form the undergrowth, while cowberry, raspberry, and blackberry are the most common ground cover species. The big game to be found in Zielonka GIC include red deer, fallow deer, roe-deer, and wild boar whose number is estimated at 120-160 individuals.

MATERIAL AND METHODS

During the research period (2004-2007) no factors occurred, such as natural disasters, harsh winters or epizootic diseases, that could dramatically affect the wild boar population in Zielonka GIC. Also, the hunting and wild boar population management complied with commonly observed breeding practices.

The individuals harvested or observed in the field were divided into three age classes:

- age class 1: piglets (wild boars in their first year of life),
- age class 2: yearlings (wild boars in their second year of life), and
- age class 3: mature wild boars (wild boars older than two years).

As biometric measurements were expected to vary within the same age class – depending on the killing date, especially with respect to younger individuals which grow faster – the hunting season was divided into three periods:

- period 1: from 1st April to 31st August,
- period 2: from 1st September to 30th November, and
- period 3: from 1st December to 28th February.

The biometric measurements were collected from the wild boars killed during the hunting season, i.e. from 1st April to the end of February (piglets were not harvested in period 1 due to low carcass weight). Some somatic features and the relation between the carcass size and weight with regard to sex and age were analysed. The independent variables included age, sex and the killing date, while the dependent ones were all the measurements and the weight of the carcass. As only few age class 3 individuals had been harvested, the carcass weight trend was shown only for piglets and yearlings.

The biometric measurements included:

A) head length, B) head width, C) body length, D) tail length, E) height at the withers, F) height at the rear of the body, G) front leg length, H) rear leg length, I) carcass weight.

The measurements were always collected in the same way, i.e. with the carcass lying on its side. A webbing tape accurate to 1 cm was used to measure the carcass, and its weight was recorded accurate to 1 kg. In total, 221 wild boars were measured, including 100 piglets, 91 yearlings and 30 mature wild boars. Also, 149 direct field observations were carried out, and 997 wild boars were observed.

The age of an individual was assessed roughly – based on its morphological features (carcass weight) – and exactly – based on the development stage of the lower jaw teeth. The collected data were statistically analyzed. By examining wild boar carcass weights

and measurements, the following basic measures of location and variability were calculated with regard to each sex and in total: **arithmetic mean, standard deviation, classical coefficient of variation, minimum and maximum, median.**

Mean values of all the analysed wild boar features were calculated with a 95% confidence intervals which were determined separately for each sex and age class.

The researchers also attempted to determine the following basic population attributes: sex structure, age structure, and social structure. In order to describe the social structure of a wild boar population, the following group names were used: males older than two years (**O**), sows with piglets (**LW**), sows with yearlings (**LP**), sows with piglets and yearlings (**LWP**), piglets alone (**W**), yearlings alone (**P**), breeding packs (**H**), unspecified (**N**), other – falling into none of these categories (**I**).

RESULTS

Body measurements

The biometric measurements in the research period were collected from 221 wild boars. Following the analysis of the carcass weight, basic classical measures of location and variability were calculated separately for each sex. The changes in wild boar carcass weight were analysed according to the established method in each period of the hunting season (Table 1).

The carcass weight of piglets in period 2 averaged 20.9 kg, which was slightly less than 23.2 kg in period 3. In period 3 the mean carcass weight of piglets increased by 11% compared with period 2; the increase was higher in the case of males, averaging 2.5 kg compared with 2.1 kg in the case of females.

As for the yearlings, their mean carcass weight in all the periods was increasing. The mean carcass weight of the yearlings in period 2 (44.8 kg) was higher than in period 1 (30.8 kg). The gain in weight between these two periods was 45.5%, with yearling males gaining 31.3% more weight than yearling females. As with the piglets, period 3 saw an increase in the mean carcass weight of all the yearlings by 19.2% (to 53.4 kg) compared with period 1.

Similarly, as regards the mature wild boars, a continuous increase in the mean carcass weight was observed throughout all the three periods. The increase in the mean carcass weight was from 61.4 kg (period 1) to 74 kg (period 2), i.e. 20.5%. The increase between period 2 and 3 was only 5.5% (4.1 kg).

The changes in the mean carcass weight were tracked for piglets and yearlings, regardless of sex, in selected months: from August to February for piglets (harvested as their carcass weight was sufficient), and from April to February for yearlings.

The largest gain in the weight of piglet carcasses (5.8 kg) was between September and October. As piglets were becoming yearlings, i.e. between January and April, the increase in the mean carcass weight was 1.8 kg. The largest gain in the weight of yearling carcasses (9.8 kg) was between August and September, while the largest decrease between January and February (8.7 kg).

The effect of sex and age on the carcass size was examined with Student's t-test, by checking whether the mean differences in the features between males and females were statistically significant. The calculations were carried out separately for each age class.

Table 1. Basic measures of the carcass weight of the wild boars harvested in the three hunting seasons by sex and age class

Tabela 1. Podstawowe charakterystyki masy tuszy dzików w trzech okresach sezonu łowieckiego z uwzględnieniem płci i klasy wieku

Hunting season Okres sezonu łowieckiego	Age class Klasa wieku	Sex Płeć	Average carcass weight Średnia masa tuszy kg	Standard deviation Odchylenie standardowe	Coefficient of variation Współczynnik zmienności %	Confidence interval (95%) CI (95%)	Minimum	Maximum	Median Mediana
1. 1 April – 31 August 1. 1 IV – 31 VIII	piglets warchlaki	M							
		F							
	yearlings przelatki	M	30.8	9.1	29.72	26.9; 34.6	19	58	27
		F	30.8	8.8	28.63	26.5; 35.1	18	50	29
	aged > 2 starsze	M	67	10.8	16.1	54.8; 79.2	58	79	64
		F	53	9.9	18.7	39.3; 66.7	46	60	53
2. 1 September – 30 November 2. 1 IX – 30 XI	piglets warchlaki	M	22.7	1.5	6.8	20.9; 24.4	21	24	23
		F	20.5	6.0	29.3	16.9; 24.0	10	26	23
	yearlings przelatki	M	48.5	8.5	17.5	43.4; 53.5	36	60	52
		F	39	8.8	22.5	32.5; 45.5	26	50	39
	aged > 2 starsze	M	74	5.3	7.2	68.0; 77.9	70	80	72
		F							
3. 1 December – 28 February 3. 1 XII – 28 II	piglets warchlaki	M	25.2	4.9	19.5	23.7; 6.8	14	36	25
		F	22.6	5.8	25.5	20.6; 24.6	13	37	22
	yearlings przelatki	M	54.2	6.5	11.9	50.7; 57.8	42	66	55
		F	52.9	6.3	6.9	50.3; 55.6	35	60	52
	aged > 2 starsze	M	81.3	13.4	16.5	66.1; 96.5	66	91	87
		F	77.6	9.4	12.1	73.3; 81.9	65	95	78

The p-value obtained through the test of significance showed that the mean differences in the carcass sizes between males and females were statistically insignificant.

Average body measurements were determined with 95% confidence intervals, for each age class separately for males and females, for all the males and females regardless of the age class, and for all the age classes regardless of sex. Considering these intervals, the difference between the maximum and the minimum, and the median of carcass sizes in each age class regardless of sex, it was found that the older the age class, the smaller the difference between the maximum and the minimum. The smallest difference with regard to piglets concerned the head width (13 cm), while the biggest one the height at the rear of the body (41 cm). As with piglets, also with respect to yearlings the smallest difference concerned the head width (13 cm), and the biggest one the height at the withers (39 cm). Among the wild boars aged over two years, the smallest difference concerned the rear leg length and head width (6 cm), while the biggest one the body length (25 cm; Table 2).

Table 2. Basic body measurements of the harvested wild boars with regard to age class and sex
Tabela 2. Podstawowe charakterystyki wymiarów tuszy dzików z podziałem na klasy wieku i płeć

Measurement Cecha cm	Age class 1 Klasa wieku 1				Age class 2 Klasa wieku 2				Age class 3 Klasa wieku 3			
	males samce (n = 46)		females samice (n = 54)		males samce (n = 46)		females samice (n = 54)		males samce (n = 46)		females samice (n = 54)	
	χ	W %	χ	W %	χ	W %	χ	W %	χ	W %	χ	W %
Head length Długość głowy	31.1	10.4	30.2	13.3	35.8	12.7	37.4	10.4	41.6	3.0	41.2	5.3
Head width Szerokość głowy	9.3	12.5	9.2	24.9	10.3	20.1	10.4	20.1	10.8	8.5	12.1	13.0
Body length Długość korpusu	74.2	8.3	71.9	10.9	86.6	9.5	86.2	16.5	98.7	6.2	104.2	5.9
Tail length Długość ogona	20.9	16.8	19.5	19.2	23.4	25.6	26.2	30.8	34.8	12.8	34.1	16.9
Height at the withers Wysokość w kłębie	68.4	8.8	63.2	10.6	78.0	13.3	80.2	11.2	91.7	5.2	94.2	5.1
Height at the rear of the body Wysokość w tylnej części korpusu	68.6	8.4	65.4	10.9	79.8	12.6	81.2	11.5	93.2	6.8	93.6	4.4
Front leg length Długość odnóży przednich	34.3	8.8	32.8	9.9	40.4	9.1	39.9	10.7	45.5	3.8	44.3	5.2
Rear leg length Długość odnóży tylnych	25.7	8.3	24.8	9.2	29.8	17.6	29.7	17.6	32.7	2.1	31.9	4.3

χ – mean, W – coefficient of variation, %.
 χ – średnia, W – współczynnik zmienności, %.

As for the piglets, the mean values of all the analysed features were slightly higher with regard to males. The lowest variation characterised the body length and rear leg length of males (coefficient of variation – 8.3%). The most variable feature of males was the tail length (16.8%), and of females the head width (24.9%).

In the age class of yearlings the features varied less than in the case of piglets. Except for the tail length, height at the withers and height at the rear of the body, all mean values of the features were higher with regard to males. The least variable features of males were the front leg length (coefficient of variation – 9.1%) and body length (9.5%). The least variable features among females were the head length (10.4%) and, as with males, the front leg length (10.7%). The most variable feature of both male and female yearlings was the tail length (coefficients of variation – 25.6% and 30.8%, respectively).

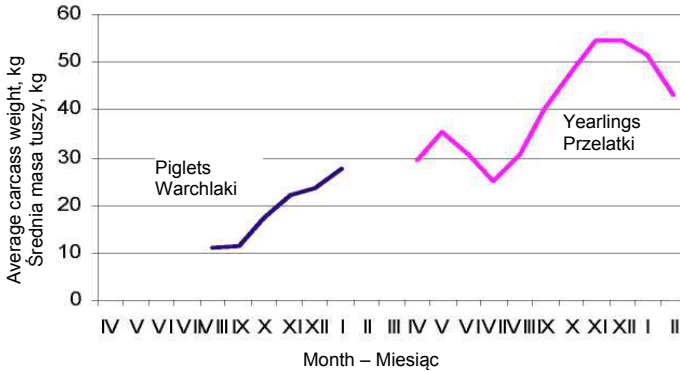


Fig. 1. Rate of changes in the average carcass weight of piglets and yearlings of both sexes in selected months of the hunting season

Rys. 1. Dynamika zmiany średniej masy tuszy warchlaków i przelatków bez podziału na płeć w wybranych miesiącach sezonu łowieckiego

In the group of mature wild boars the most variable male and female feature was the tail length (coefficient of variation – 12.8% and 16.9%, respectively). The least variable feature of both males and females was the rear leg length (2.1% and 4.3%, respectively). As for females, another least variable feature was the height at the rear of the body (4.4%). With respect to the wild boars of over two years of age, the following features had higher mean values regarding females: head width, body length, height at the withers and height at the rear of the body. The mean values of other features were higher with respect to males.

The analysis of the wild boar carcasses regardless of sex clearly showed that the mean values of all the features increased with age. The coefficient of variation of the head length decreased with age. The most variable feature in the age class of piglets was the head width (coefficient of variation – 19.6%), and among yearlings and wild boars aged over two years the tail length (27.9% and 15.5%, respectively). The least variable feature among piglets and wild boars aged over two years was the rear leg length (9.1% and 3.7%, respectively), and among yearlings the front leg length (9.7%).

Population attributes

Sex structure. In the research period, 221 harvested wild boars were examined, including 100 piglets (45.25%), 91 yearlings (41.18%) and 30 individuals of over two years of age (13.57%). Among the piglets (age class 1), females accounted for 54% and males for 46%. The sex structure was therefore expressed as a proportion of 1:1.17 in favour of females. Killing piglets with respect to their sex may be considered random, as assessing the age of a young wild boar before shooting is impracticable. Therefore, it is likely that in Zielonka GIC area the proportion of male and female piglets is approximately 1:1.17.

The distribution of sexes among the harvested yearlings and wild boars aged over two years was nearly uniform, i.e. 1:1. However, according to the observations, the distribution was expressed as 1:4.78, which indicated that females significantly outnumbered males.

Age structure. Two methods of determining the age structure of wild boar in Zielonka GIC were used. The first method consisted in assessing the age of the wild boars in the field by their carcass size, while the second one in examining the stage of teeth development of the individuals shot in the research period. In the regular field observations during the season (made by all Department's hunters and employees), the piglets were found to be the most numerous age class (487 individuals – 48.8%), followed by 348 yearlings (34.9%) and 162 mature individuals (16.3%).

Social structure. Apart from the number, age and sex of the wild boars, the field observations also focused on determining the social structure of each group. The most commonly observed groups comprised sows with piglets (24%) and yearlings alone (23.5%). The third most often found group comprised sows with piglets and yearlings (14.3%). Similar frequency characterised the groups referred to as 'other' (7.9%) and 'sows with yearlings' (7.1%), followed by 'single males' (4.5% of all the groups that were observed). Piglets alone and breeding packs were the least common groups to be observed (3.9% and 3.2%, respectively).

SUMMARY OF RESULTS AND DISCUSSION

The mean carcass weight of the piglets in Zielonka GIC in the research period (males – 24.4 kg, females – 21.1 kg, 22.6 kg on average) was lower than that of the piglets in the former Poznań province (the administrative division of 1975-1998; males – 28.0 kg, females – 25.4 kg) [Fruziński 1993] and in Krucz Forest District (males – 27.1 kg, females – 24.5 kg, 25.6 kg on average) [Strawa 2007]. The piglets were also much lighter from those harvested in Lublin Highland and Roztocze (29.0 kg) [Drozd 1996] and in Berezyna Reserve in central Belarus (males 35.5 kg, females 36.0 kg) [Miłkowski and Wójcik 1984].

As with the piglets, the average weight of the yearlings harvested in Zielonka GIC (males – 41.6 kg, females – 42.9 kg, 42.3 kg on average) was much lower than that in the former Poznań province (males – 55.7 kg, females – 54.3) [Fruziński 1993].

The average carcass weight of yearling males was also higher in the macroregion of central-east Poland (48.9 kg) [Drozd 1996], and the highest one was found in the eastern part of Białowieża Forest (males 71.5 kg, females 64.1 kg). In comparison with the yearlings killed in Zielonka GIC, those in the western part of the Białowieża Forest were lighter (34-41 kg) [Miłkowski and Wójcik 1984].

The average weight of wild boars older than two years was 74.8 kg (males – 72.4 kg, females – 75.2 kg), which was less than the average weight of the wild boars harvested in the former Poznań province (males – 90.1 kg, females – 88.8) [Fruziński 1993] and more than the average weight of those from the Krucz Forest District (males – 72.6 kg, females – 64.8 kg, 69.6 kg on average) [Strawa 2007]. The average carcass weight of the yearlings and wild boars aged over two years in the Lublin Highland and Roztocze was higher (83.9 kg) than in the study area [Drozd 1996].

The body measurements as well as the carcass weight of wild boar depend on many factors, the most important being the sex and age of the animals. In the age class of piglets, the average body length of males was 74.2 cm, and of females 71.9 cm. These measurements are much smaller than those of piglets from the Krucz Forest District (males – 106.7 cm, females – 105.5 cm) [Strawa 2007]. The average body length of male piglets from the macroregion of central-east Poland was 106.6 cm [Drozd 1996], and from the eastern part of the Białowieża Forest 106.6 cm (females – 102.2 cm) [Kozło 1975].

In the age class of yearlings, the Zielonka GIC wild boars had the smallest average body length (males – 86.6 cm, females – 86.2 cm) as compared with the animals from all the regions mentioned, including those from Krucz Forest District (males – 124.0 cm, females – 122.2 cm) [Strawa 2007]. In the age class of wild boars aged over two years, the average body length of males in the study area was 98.7 cm, and of females 104.2 cm. As with the yearlings, the older wild boars had the smallest average body length as compared to the animals examined in all the regions referred to in this paper. The animals of over two years of age from the Krucz Forest District had smaller average body length (males – 140.1 cm, females – 141.7 cm) [Strawa 2007] as compared to males from the Lublin Highland and Roztocze (157.1 cm) [Drozd 1996]. In this age class, bigger average body length was recorded in the Belarusian part of the Białowieża Forest (males aged 3 – 146.1 cm, males aged 4 and over – 162.0 cm, females aged 3 – 137.0 cm, females aged 4 and over – 142.4 cm). The average height at the withers of male piglets in Zielonka GIC (68.4 cm) was bigger than that of males from the Berezyna Reserve (males – 66.5 cm), the Belarusian part of the Białowieża Forest (63.9 cm) and the Krucz Forest District (60.6 cm) [Strawa 2007]. The average height at the withers of the females in Zielonka GIC (63.2 cm) was smaller than that of the females from the Berezyna Reserve (67.1 cm), and bigger than that of the females from the Belarusian part of the Białowieża Forest (59.3 cm) [Kozło 1975] and the Krucz Forest District (60.3 cm) [Strawa 2007]. The population of yearlings in Zielonka GIC was characterised by a smaller average height at the withers (males – 78.0 cm, females – 80.2 cm) than that in Berezyna Reserve (males – 84.0 cm, females – 84.1 cm). In the Krucz Forest District, the average height at the withers of males was 75.6 cm, and of females 74.4 cm [Strawa 2007]. The average height at the withers with respect to the wild boars aged over two years which were harvested in Zielonka GIC was 91.7 cm for males and 94.2 cm for females. In the Krucz Forest District, the animals of the same age class had smaller average height at the withers (males – 88.4 cm, females – 82.8 cm). A bigger average height at the withers was recorded in the Berezyna Reserve (males aged 3 – 96.5 cm, males aged 4 and over – 102.4 cm, females aged 3 – 91.3 cm; females aged 4 and over – 95.2 cm).

The distribution of sexes with respect to the wild boar population in Zielonka GIC was 1.17:1 in favour of females, while in the Krucz Forest District 1.28:1 in favour of females. The analysis of the sex structure in each age class showed that in Zielonka GIC the females dominated among piglets and wild boars aged over two years, while only in the age class of yearlings the males slightly outnumbered the females (1.02:1). Among the piglets harvested in the Krucz Forest District, the females were more numerous (0.75:1), while the males outnumbered females among yearlings and wild boars aged over two years (1.58:1 and 1.60:1, respectively) [Strawa 2007]. The proportion of males to females in the oldest age class in Białowieża Forest was 2.18:1 in favour of males. German researchers [Stubbe 2005 a] determined the proportions of the sexes as 0.91:1

for yearlings, 0.63:1 for wild boars aged 3-4 years and 0.37:1 for those older than 5 years in favour of the females.

The age structure of the wild boar population in Zielonka GIC as determined through direct observations was the following: the most numerous age class was the piglets (48.8%), followed by yearlings (34.9%) and mature wild boars (16.3%). In the Krucz Forest District, the most numerous age class was also the piglets (58.89%), followed by yearlings (24.32%) and mature wild boars (16.80%) [Strawa 2007].

Different results were published by Andrzejewski and Jezierski [1978] with respect to the Kampinos Forest (piglets – 53.74%, yearlings – 23.96%, older wild boars – 22.30%), and by Miłkowski and Wójcik [1984] with respect to the Białowieża Forest (56.7%, 19.4% and 23.9%, respectively). The age structure determined according to the observations in most cases varied from that of the harvested wild boars. In Zielonka GIC, the piglets accounted for 45.2%, yearlings for 41.2%, and mature wild boars for 13.6% of all the harvested animals. The piglets harvested in the Krucz Forest District accounted for only 27.45%, while yearlings to as much as 55.56%. The percentage of the older harvested wild boars was 16.99% [Strawa 2007]. The age structure determined in the Białowieża Forest according to the harvest data varied significantly from that of the Zielonka GIC population, as the piglets harvested in the Białowieża Forest accounted for 11.70%, yearlings for 37.50% and older wild boars for 50.80% [Miłkowski and Wójcik 1984].

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**ANALIZA POMIARÓW BIOMETRYCZNYCH
ORAZ WYBRANYCH PARAMETRÓW POPULACYJNYCH
U DZIKÓW BYTUJĄCYCH NA TERENIE OŚRODKA
HODOWLI ZWIERZYNY „ZIELONKA”**

Streszczenie. W pracy przeprowadzono analizę wybranych cech biometrycznych dzików pozyskanych w latach 2004-2007 na terenie OHZ Zielonka. Badano między innymi masę tuszy, długość ciała, wysokość w kłębie z podziałem na wiek i płeć odstrzelonych osobników. Poddano także analizie niektóre parametry populacyjne takie, jak struktura wieku i płci oraz struktura socjalna.

Słowa kluczowe: dzik, populacja, biometria, struktura wiekowa, struktura płciowa, struktura socjalna

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