

## COMPARISON OF THE QUALITY OF RED DEER (*CERVUS ELAPHUS* L.) FROM DIFFERENT HUNTING GROUNDS IN NORTH-EASTERN POLAND

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**Abstract.** The quality of red deer stags, hinds and calves living in the Forest Division of Mrągowo was determined based on carcass weight as well as the weight and type of antlers. The animals were also compared to red deer inhabiting north-eastern Poland and other regions of the country. It was found that in the red deer population analyzed in this study the average carcass weight of stags, hinds and calves was 121.77 kg, 81.30 kg and 47.96 kg respectively. Average antler weight reached 2.93 kg, and stags carrying antlers with sixteen and twelve points dominated in the population (accounting for 28% and 23% respectively). In comparison with red deer from other hunting grounds in NE Poland, the animals harvested in the Forest Division of Mrągowo were characterized by higher carcass weight and antler complexity.

**Key words:** red reed, carcass weight, antler weight, quality

### INTRODUCTION

The red deer (*Cervus elaphus*) inhabits most of Europe, Crimea, Caucasus, Iran, Central and Eastern Asia, northern China and India, as well as Algeria and Tunisia in Africa. In Europe, the red deer is completely absent only from Iceland, northern Scandinavia and most of Greece [Whitehead 1972].

Particular populations (ecotypes) of the red deer differ considerably with respect to body size, measurements and weight. In Europe, the smallest individuals can be found in Scotland, while the largest – in the Carpathians. Generally, the average adult red deer is 230 to 250 cm in length (from nose to tail), with height at withers ranging from 120 to 160 cm [Bobek et al. 1992]. In Poland, the average carcass weight of the stag (following evisceration) ranges from about 110-120 kg in the Karkonosze Mountains, through 160-180 (200) kg in the north-eastern region to 200-250 kg in the Bieszczady Mountains.

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The average carcass weight of the hind varies between 60 and 100 kg [Bobek et al. 1992, Dzięgielewski 1970].

The body weight of an animal is affected primarily by age. The rate of growth and development is species-related and dependent on numerous environmental factors, the most important being climate conditions and the availability of food resources. Body weight is also influenced by the ratio between population size and the biotic capacity of a hunting area. The abundance and variety of nourishment available in the summer have a significant effect on body weight, since the fastest rate of tissue growth and fat deposition is observed over this period. Another key factor affecting the body weight of red deer is natural and artificial selection. Hunting stags with underdeveloped antlers permits the elimination of weaker individuals from the population, thus increasing the prevalence of such desirable traits as higher body weight and antler complexity among offspring [Bobek et al. 1984].

The objective of this study was to determine the quality of red deer stags, hinds and calves hunter-harvested in the Forest Division of Mrągowo, based on carcass weight as well as the weight and type of antlers, and to compare them to other individuals inhabiting north-eastern Poland.

## MATERIALS AND METHODS

The study was carried out in the Forest Division of Mrągowo, located between 20°50'-21°25' east longitude and 53°35'-54°03' north latitude. The major stand-forming species in the investigated area are the pine (41%), birch (19%), spruce (16%) and oak (13%), and the dominant habitat types are fresh broadleaved forests and fresh mixed broadleaved forests (Table 1).

Table 1. Forest site types in the Forest District of Mrągowo, %  
Tabela 1. Udział siedlisk na terenie Nadleśnictwa Mrągowo, %

Type of habitat – Typ siedliska	Percentage – Udział procentowy
Fresh broadleaved forest – Las świeży	41
Fresh mixed broadleaved forest – Las mieszany świeży	21
Fresh coniferous forest – Bór mieszany świeży	7
Moist mixed coniferous forest – Bór mieszany wilgotny	5
Alder forest – Ols	4
Moist coniferous forest – Bór wilgotny	1
Marshy coniferous forest – Bór bagienny	1
Moist mixed deciduous forest – Las mieszany wilgotny	1
Moist broadleaved forest – Las wilgotny	1
Other – Inne	1

Numerical data, contained in annual hunting plans and harvest records kept by hunting associations, were collected over eight hunting seasons, from 1998/1999 to 2005/2006. Data on 301 animals, including 137 males (stags), 96 females (hinds) and 68 individuals aged up to 1 year (calves) were analyzed.

The animals were assigned to particular groups based on:

1) carcass weight of hinds, calves (following evisceration) and stags (following evisceration and decapitation),

2) age of stags (based on the degree of wear of lateral teeth); in accordance with the current wildlife management regulations, the stags were divided into the following age group: I – stags aged 2 to 5 years, II – stags aged 6 to 10 years, III – stags aged 11 years and older.

3) weight and type of antlers.

Following the characterization of the red deer hunter-harvested in the Forest Division of Mrągowo, the animals were compared with the representatives of other sub-populations inhabiting the region of NE Poland, including the Białowieża Forest, the Pisz Forest, the Forest Division of Wipsowo and the Tabor Forest (referring to the results of previous studies conducted by the first author of this manuscript).

The collected numerical data were verified statistically using STATISTICA 5.0 PL software, and  $\bar{x}$ , Sd,  $x_{\min}$  and  $x_{\max}$  were calculated. The significance of differences between mean values, and the coefficients of correlation ( $r$ ) between carcass weight and antler weight were also determined [Bochno et al. 2001].

## RESULTS AND DISCUSSION

### Carcass weight of hinds and calves

The average carcass weight of hinds and calves harvested in the Forest Division of Mrągowo was 81.30 kg and 47.96 kg respectively, while the average carcass weight of stags reached 121.77 kg (Table 2).

Table 2. Average carcass weight of the red deer harvested in the hunting seasons 1998/99-2005/06

Tabela 2. Średnia masa tuszy jelenia w sezonach łowieckich 1998/99-2005/06

Group of animals Grupa zwierząt	n	$\bar{x}$	Sd	$x_{\min}$	$x_{\max}$
Stags – Byki	137	121.77	25.67	70.00	194.00
Hinds – Łanie	96	81.30	10.40	55.00	103.00
Calves – Cieleta	68	47.96	9.20	30.00	67.00

Hinds with the highest average carcass weight (86.5 kg) were harvested during the 1999/2000 season, while those with the lowest average carcass weight (72.6 kg) – over the 2002/2003 season (Table 3). The difference between the above values was found to be statistically significant.

Table 3. Average carcass weight of hinds, calves and stags in particular hunting seasons, kg  
 Tabela 3. Masa tuszy łań, cieląt i byków w poszczególnych sezonach łowieckich, kg

Statistical measure Miara statystyczna	Hunting season – Sezon łowiecki									Significance of differences Istotność różnic	
	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	Total Ogółem		
Hinds Łanie	n	12	16	11	12	11	12	10	12	96	99/00 > 02/03*
	$\bar{x}$	82.00	86.50	85.67	76.50	72.60	73.00	84.60	84.86	81.30	
	Sd	10.47	6.35	8.85	12.71	10.67	12.63	7.92	8.57	10.40	
	$x_{\min}$	67.00	77.00	74.00	61.00	58.00	55.00	76.00	70.00	55.00	
	$x_{\max}$	103.00	94.00	95.00	92.00	88.00	88.00	96.00	93.00	103.00	
Calves Cielęta	n	8	9	9	8	8	9	9	8	68	Not – Brak
	$\bar{x}$	55.00	44.00	47.50	48.75	41.33	44.00	52.00	49.67	47.96	
	Sd	13.64	9.62	3.54	4.99	5.13	8.21	16.97	7.77	9.20	
	$x_{\min}$	38.00	30.00	45.00	45.00	37.00	36.00	40.00	41.00	30.00	
	$x_{\max}$	67.00	55.00	50.00	56.00	47.00	55.00	64.00	56.00	67.00	
Stags Byki	n	21	22	22	18	19	9	12	14	137	Not – Brak
	$\bar{x}$	119.57	117.64	122.14	120.78	123.95	134.78	121.33	121.36	121.77	
	Sd	20.57	25.20	26.72	28.63	22.71	36.63	30.79	22.00	25.67	
	$x_{\min}$	89.00	76.00	77.00	76.00	74.00	77.00	70.00	92.00	70.00	
	$x_{\max}$	160.00	163.00	171.00	192.00	180.00	181.00	194.00	170.00	194.00	

\* P < 0.05.

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It should be noted that in a study conducted by Janiszewski and Szczepański [2004] in the Forest Division of Wipsowo (approx. 40 km west of the Forest Division of Mrągowo) the average carcass weight of hinds was lower than in the present study, reaching only 76.6 kg. Janiszewski et al. [2007] reported even lower average carcass weight of hinds inhabiting the Pisz Forest (71.1 kg). Different results were obtained by Żurkowski et al. [2000]. According to those authors, the average carcass weight of hinds in the Pisz Forest was as low as 70.1 kg. The average carcass weight of hinds dwelling in the Białowieża Forest [Janiszewski et al. 2007] and of 96 hinds harvested in the Polish Lowland Dzieńciołowski [1969] was also lower than that reported in the current study, reaching 70.9 kg and 71.9 kg respectively. The results obtained by the above authors indicate that female red deer hunter-harvested in the Forest Division of Mrągowo are characterized by relatively high carcass weight, compared to both hinds inhabiting NE Poland and those dwelling in other regions of the country.

The average carcass weight of 68 calves harvested during eight hunting seasons in the Forest Division of Mrągowo was 47.96 kg (Table 2). The highest average carcass weight was reported for calves harvested during the 1998/1999 and 2004/2005 seasons (55.0 kg and 52.0 kg respectively), while the lowest – for those harvested over the 2002/2003 and 2003/2004 seasons (41.33 kg and 44 kg respectively; Table 3). Janiszewski and Szczepański [2004] found that red deer calves from the Forest Division of Wipsowo had lower average carcass weight, determined at 43.5 kg (difference of nearly 4.5 kg). The average carcass weight of calves harvested in the Pisz Forest [Janiszewski et al. 2007] and in the Białowieża Forest [Janiszewski et al. 2007] was even lower – 39.6 kg and 39.5 kg respectively. On the other hand, the average carcass weight of calves living in the south of Poland (Krynica Forest District) was substantially higher, reaching 55.8 kg [Tomek 2002]. A comparison of the above data shows that red deer calves hunter-harvested in the investigated area, similarly as hinds, are characterized by higher average carcass weight than the individuals inhabiting other regions of NE Poland. However, unlike hinds, they are lighter than red deer calves living in the mountains.

#### **Carcass weight of stags, antler weight and type**

The average carcass weight of all red deer stags investigated in the study was 121.77 kg (Table 2). Janiszewski and Szczepański [2004] reported that stags from hunting grounds located in the close vicinity of Mrągowo (Forest Division of Wipsowo) had lower average carcass weight (114.5 kg), while the average carcass weight of stags inhabiting the Krynica Forest was slightly higher (122.7 kg) [Tomek 2002]. No raising or falling tendency was observed with respect to the average carcass weight of stags, recorded during eight hunting seasons (Table 3). Differences in carcass weight, which ranged from 117.64 kg (maximum value) to 134.78 kg (minimum value), were found to be statistically non-significant. Differences in antler weight, which varied from 2.47 kg in the 1999/2000 season to 3.41 kg in the 2002/2003 season, were not confirmed by a statistical analysis, either (Table 4).

As shown in Table 5, carcass weight increased with age, reaching on average 107.96 kg, 137.86 kg and 160.67 kg in age groups I, II and III. Red deer stags harvested in the Pisz Forest had lower average carcass weight, i.e. 86.1 kg in group I, 130.3 kg in group II and 140.9 kg in group III [Janiszewski et al. 2007]. Lower carcass weight was also reported for stags inhabiting the Białowieża Forest, the respective values being 100.5 kg, 127.8 kg and 132.6 kg [Janiszewski et al. 2007].

Table 4. Average antler weight of stags in particular hunting seasons  
 Tabela 4. Średnia masa poroża jeleni byków w poszczególnych sezonach łowieckich

Statistical measure Miara statystyczna		Hunting season – Sezon łowiecki								Total Ogółem	Significance of differences Istotność różnic
		1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06		
Antler weight Masa poroża kg	n	21	22	22	18	19	9	12	14	137	Not – Brak
	$\bar{x}$	3.00	2.47	3.26	2.73	3.41	2.99	3.12	2.49	2.93	
	Sd	1.89	1.34	1.78	1.47	1.33	1.25	1.46	0.84	1.50	
	$x_{\min}$	0.51	0.57	0.89	0.91	1.12	1.46	0.81	1.50	0.51	
	$x_{\max}$	7.00	4.97	6.88	7.28	6.04	5.10	5.49	4.02	7.28	

Table 5. Carcass and antler weight of red deer stags in particular age groups  
 Tabela 5. Masa tuszy i poroża byków w poszczególnych klasach wiekowych

Trait Cecha	Statistical measure Miara statystyczna	Age group – Klasa wiekowa			Total Ogółem
		I	II	III	
Carcass weight Masa tuszy kg	n	76	58	3	137
	$\bar{x}$	107.96	137.86	160.67	121.77
	Sd	16.96	24.23	16.17	25.67
	$x_{\min}$	70.00	80.00	142.00	70.00
	$x_{\max}$	145.00	194.00	170.00	194.00
Antler weight Masa poroża kg	n	76	58	3	137
	$\bar{x}$	1.99	3.97	6.85	2.93
	Sd	0.78	1.21	0.45	1.50
	$x_{\min}$	0.51	1.66	6.38	0.51
	$x_{\max}$	3.92	7.00	7.28	7.28

The carcass weight of male deer in age class I, harvested in central and eastern Poland, ranged from 81.1 kg for two-year-old stags, through 110.26 kg for four-year-old stags to 119.79 kg for five-year-old stags [Drozd et al. 2000]. The above data indicate that the carcass weight of red deer inhabiting Poland varies within a wide range, and that it is dependent on habitat. According to Bobek et al. [1992], the above differences are related to climate conditions and to the availability of food resources.

The average antler weight of all analysed stags, harvested in the Forest Division of Mrągowo, was 2.93 kg, reaching 1.99 kg in age group I, 3.97 kg in group II and 6.85 kg in group III (Table 4). The data presented in Table 4 show no statistically significant differences between particular hunting seasons with regard to antler weight. Żurkowski et al. [2000] demonstrated that the antler weight of stags harvested in the Pisz Forest was comparable to that determined in the present study – 2.7 kg. However, a study conducted by Janiszewski et al. [2007] in the same area, which involved a larger sample size, revealed that the average antler weight of stags was higher – 4 kg. Brewczyński [2002] recorded similar antler weight, i.e. 4.03 kg, in a population of red deer dwelling in the Carpathians. The antler weight of young stags harvested in the Białowieża Forest was also higher, compared to the current results, reaching 2.2 kg and 4.6 kg in age class I and II respectively [Janiszewski et al. 2007]. The oldest stags of the above population were characterized by lower antler weight (5.7 kg) than those harvested in the Forest Division of Mrągowo.

The relationship between the carcass weight and antler weight of stags harvested in the investigated area is presented graphically in Figure 1. A comparison of the values obtained for both those traits suggests that they changed according to a similar pattern in particular hunting seasons. The coefficient of correlation between carcass weight and antler weight was high – 0.68\*\* (Table 6). In a study performed by Żurkowski et al. [2000] on a red deer population in the Pisz Forest, the above coefficient was slightly higher ( $r = 0.74$ ). The coefficient of correlation between the carcass weight and antler

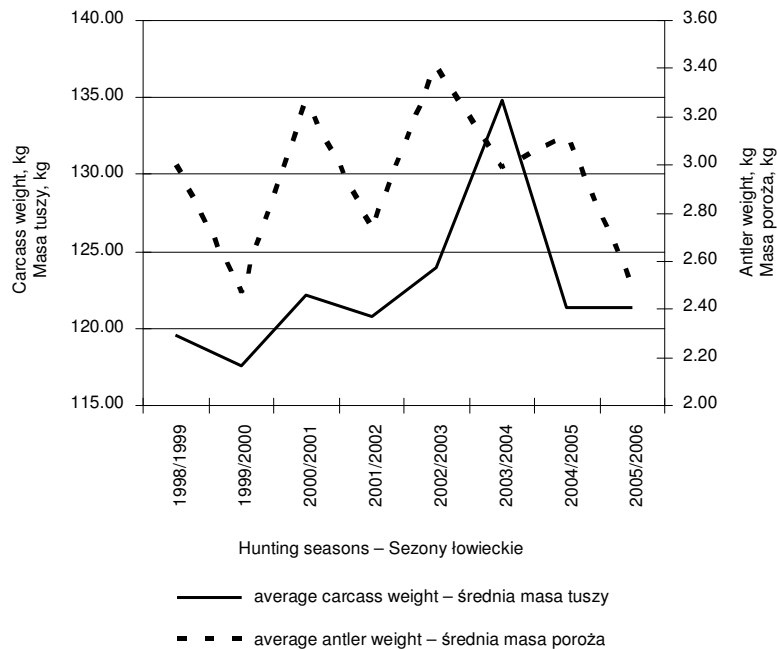


Fig. 1. Average carcass weight and antler weight of red deer stags in particular hunting seasons

Rys. 1. Średnia masa tuszy i poroża byków jelenia w poszczególnych sezonach

weight of stags harvested in the Białowieża Forest [Janiszewski et al. 2007] was comparable to that reported in the present study ( $r = 0.66$ ), while that determined for stags inhabiting the Tabor Forest [Janiszewski and Kolasa 2006] was higher ( $r = 0.86$ ). Therefore, it seems that the values of the coefficient of correlation between carcass weight and antler weight remain high, regardless of local variations within those traits observed in different red deer subpopulations in Poland.

Table 6. Coefficient of correlation between the carcass and antler weight of red deer stags  
Tabela 6. Współczynnik korelacji pomiędzy masą tuszy i masą poroża jeleni byków

Age group – Klasa wieku	n	r
I	76	0.61**
II	58	0.30*
III	3	0.90
Total – Ogółem	137	0.68**

\* $P < 0.05$ , \*\* $P < 0.01$ .

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Figure 2 illustrates changes in the carcass weight and antler weight of stags at a different age. It shows that carcass weight increased at a faster rate in younger stags. The difference in carcass weight between age class I and II was almost 30 kg, while between class II and III – less than 23 kg. The opposite tendency was observed with respect to the rate of antler growth, since the difference in antler weight between age class I and II reached 1.92 kg, and between class II and III – 2.88 kg.

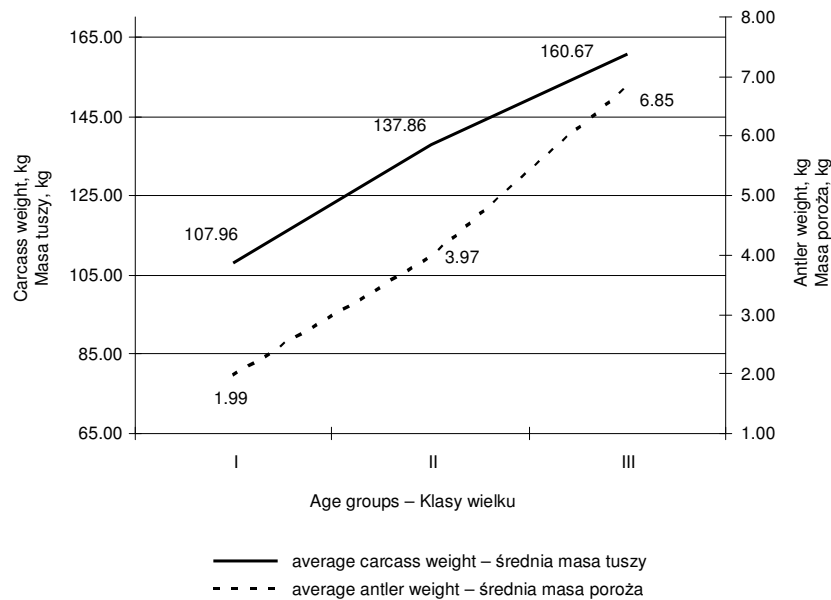


Fig. 2. Average carcass weight and antler weight of red deer stags in particular age classes

Rys. 2. Średnia masa tuszy i poroża byków jelenia w poszczególnych klasach wiekowych

Stags carrying antlers with sixteen and twelve points dominated in the tested population (accounting for 28% and 23% respectively). In the Białowieża Forest and in the Pisz Forest, ten-pointers and twelve-pointers, respectively, were encountered most frequently [Janiszewski et al. 2007]. The high percentage of sixteen-pointers in the investigated area testifies to their very good quality. A study conducted on a population of 622 red deer stags harvested in forests surrounding the town of Krosno showed that 32.31% of them carried eight-point antlers, whereas the proportion of ten-pointers, six-pointers, spickers and twelve-pointers was 26.36%, 15.27%, 8.03% and 6.91% respectively [Brewczyński 2002].

An analysis of data collected in selected hunting areas within the Forest Division of Mrągowo, during the hunting seasons 1998/99-2005/06, provided a basis for the following conclusions:

- In the red deer population tested in this study, the average carcass weight of stags, hinds and calves was 121.77 kg, 81.30 kg and 47.96 kg respectively.

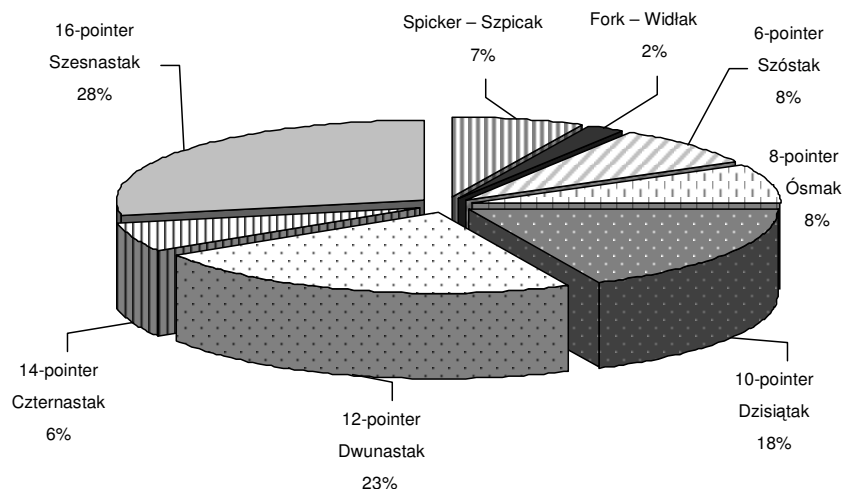


Fig. 3. Percentage of particular antler types among red deer stags harvested in the investigated area

Rys. 3. Procentowy udział poszczególnych form poroża byków pozyskanych na analizowanym terenie

- Carcass weight determined for particular sex and age groups of red deer varied over hunting seasons, but significant differences were reported only for hinds.
- The average antler weight of the investigated stags was 2.93 kg, ranging from 1.99 kg in age group I, through 3.97 kg in group II to 6.85 kg in group III.
- Sixteen- and twelve-pointers dominated in the tested population (accounting for 28% and 23% respectively), which testifies to the good quality of male red deer harvested in the Forest Division of Mrągowo.
- The Forest Division of Mrągowo provides suitable habitat for the red deer, since the values of such traits as average body weight or antler complexity were found to be higher than those determined in other deer subpopulations in NE Poland.

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## PORÓWNANIE JAKOŚCI JELENIA SZLACHETNEGO (*CERVUS ELAPHUS* L.) Z ŁOWISK POLSKI PÓŁNOCNO-WSCHODNIEJ

**Streszczenie.** Przeprowadzono charakterystyki jakości byków łań i cieląt jelenia szlachetnego bytującego w łowiskach Nadleśnictwa Mrągowo. Stwierdzono, że średnia masa tuszy byków jelenia szlachetnego wyniosła 121,77 kg, a łań i cieląt odpowiednio: 81,30 kg i 47,96 kg. Średnia masa poroża u analizowanych byków osiągała 2,93 kg, a najczęściej występującą formą trofeum byków był szesnastak (28%) i dwunastak (23%). Wykazano, że w porównaniu z osobnikami jelenia szlachetnego z innych analizowanych łowisk północno-wschodniej Polski osobniki z Nadleśnictwa Mrągowo charakteryzują się większą masą tuszy i bardziej rozbudowaną formą nakładanego poroża.

**Słowa kluczowe:** jelen szlachetny, masa tuszy, masa poroża, jakość osobnicza

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