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The size and structure of Tarnobrzeg Lusatian culture population

Tarnobrzeg¹ Lusatian culture is a cultural unit distinguished in south-eastern Poland, spanning from the middle Bronze Age to the early Iron Age (and thus roughly from the 14th/13th to the 5th/4th century BC). One of its most characteristic features are large crematory cemeteries (the largest consisting of more than a thousand tombs), utilized for many centuries. For many of them, apart from standard archaeological information, we also possess anthropological analysis, perfect for demographic considerations. One can specify the size and structure of the population which used the cemetery, as well as study the dynamics of changes in the course of a long period of burying the dead in the same place. Such an analysis in the form of social microstructure research is the basis of inference at a higher level, including mesoregions settlement, characterized by a network of co-occurring cemeteries and accompanying settlements. The sum of these observations, in turn, allows us to estimate the number of people living in the territory assigned to Tarnobrzeg Lusatian culture. At each level of inference in terms of population size, a crucial role is played by possibly the most accurate and precise estimation of time of cemetery usage or the presence of settlements in the analyzed region.

KEY WORDS: Tarnobrzeg Lusatian culture, Bronze Age, Early Iron Age, anthropological analysis, microstructures, cemeteries, mesoregions settlement, paleodemography

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Tarnobrzeg Lusatian culture is a cultural unit distinguished in south-eastern Poland (Moskwa 1976) spanning from the middle Bronze Age (according to traditional Polish terminology) to the early Iron Age (and thus approximately from 14th/13th until at least 5th century BC). It is characterized by very good (though obviously not ideal) state of research. Previous research of Tarnobrzeg Lusatian culture communities in demographic context can be assessed from two separate source perspectives. The first relates to considerations in the field of settlement archaeology, including the implications of the organization and functioning of individual settlements. The second perspective is that of funeral archaeology, where material from graves and cemeteries becomes the basis for inference. Both approaches are inherently interdisciplinary due to the nature of their sources and research methodology. They can be seen as two paths leading to the same goal, i.e. recognition of prehistoric society in terms of its size, structure and organization. In this sense it can be assumed that well-conducted studies in these fields should complement and even correct each other. The condition, however, is an appropriately large source material, examined and interpreted. In examining the demographical issues of Tarnobrzeg Lusatian culture population we are

primarily concerned about the size and possible structure of the population utilizing the site.

Settlement archaeology has a fixed heritage in terms of Tarnobrzeg Lusatian culture, which focuses more on general issues related to meso- and macroscale. In several studies there occur comments about the size of groups living in a certain area, but they can be perceived only as very careful estimates, which result from the intensity of settlement processes. They have often been verified by calculations on productivity of zones in relation to projected population size (Rajpold 2014). Meanwhile, the micro-regions, identified as territories used by groups living in one or several interrelated settlements, should constitute the basis of inference. Suitable source basis has been provided by large-area research carried out in recent years. They enable us to determine or more accurately predict the size of settlements and their internal structure. In individual (one-period) settlement horizons it can constitute the basis for estimating or calculating the number of active farms. They, after adopting the assumption of the size of a basic group (e.g. family), can lead to the calculation of the number of population in the settlement.

Today we can identify at least a dozen settlements of Tarnobrzeg Lusatian culture studied on a relatively large area (up to several hundred hectares). Not all have been analysed to the degree allowing for detailed estimations in terms of their layout, size or time of operation. These three values are key concepts for considerations on the number of people living in these settlements. On the basis of several sites examined to date it can be said that the starting point should

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be a separation of the objects grouped in farms. If we assume a certain value of the size index of family (home group) living on the farm and multiply it by the number of separate units, the result would show us the estimate of the size of entire group of inhabitants. However, the condition of relative simultaneity of settlement facts in question must be met. Therefore, studies in the organization of the settlements should take into account the relative chronology of objects and utility phases. Due to the nature of settlement material from Tarnobrzeg Lusatian culture sites, such studies are very difficult and sometimes not even possible. Viewing all the discovered objects as simultaneous, with at the same time long (e.g. 200–300 year) period of settlement activity is at least a simplification, or a mistake from the point of view of conducting demographic estimates. Naturally, such procedure makes sense in relation to sites (settlements) studied in their entirety or on a sufficiently large area, which allows to determine the size of the original range of the whole or of particular settlement phases.

The best examples to illustrate this issue are two sites – Rzeszów, site 117 (Czopek et al. 2014), and Jarosław, site 158 (Czopek 2014). For the former a dynamic model of area activity was proposed, with five utility (construction) phases, attributable to two chronological horizons (Table 1). In each there functioned from 3 to 5 farms, thus the estimated number of people living in the village is 24–40 people. Analysis of Jarosław site allowed to distinguish only 3 phases, but at the same time a higher number of farms was assigned to each of them. It stems from a wider range of field research, which enables us to recognize this site as almost entirely examined (with respect to Tarnobrzeg Lusatian culture). It is for this reason that these estimates take the overall merit of completeness. This cannot be said about Rzeszów 117 site, where continuation of construction must

be acknowledged. This explains the significantly lower estimates in each phase.

The presented model of inference is based on accurate planigraphic studies of settlements together with classic source studies in terms of chronology. However, it is not about basic determination of absolute chronology or applying the site to periodisational schemes of culture or era, which are based on relative chronology. What is important is “microtime” of each site and the possibility of distinguishing more accurate divisions of utility phases. The main burden of these calculations is an arbitrarily accepted indicator of the number of people identified with a single farm. The very fact of assuming identical values for each of them is an obvious oversimplification. The local (“village”) population viewed in this way represents only a certain prototypical situation. At this point one can ask a question: what if planigraphic studies (even in relation to the settlements examined to a large extent) do not produce satisfactory results? Are we then deprived of the possibility to estimate the number of their inhabitants? In this case we are deprived of the opportunity to observe the internal dynamics of the settlement with its organization and inhabitants. Only more general estimates are possible. The starting point can be either the area of the settlement or the number of discovered objects. Thanks to better analysed settlements we have such indicators at our disposal. For the settlement in Jarosław cited above it was calculated, for instance, that the parameter of space per capita is 1.96 are (S. Czopek 2014, 196), in other sites it reaches almost 3 ares (Czopek 2015). One can thus adopt the average value of 2.5 are. Therefore, if the area of the village is 2 ha, with this estimate we obtain the number of the population reaching around 80. We can thus use the following formula:

Table 1. Estimates of settlement population size in Jarosław 158 and Rzeszów 117 sites in particular phases of utility

Tabela 1. Szacunkowe wskaźniki wielkości populacji na przykładzie stanowisk osadowych Jarosław, stan. 158 i Rzeszów, stan. 117 w poszczególnych fazach użytkowania

Chronological horizon	Phase of utility	Number of farms	Average size of the farm	Number of settlement inhabitants
Rzeszów, site 117				
Older	1	4	6–10	24–40
	2	5	6–10	30–40
	3	3–4	6–10	18/24–30/40
Younger	4	4	6–10	24–40
	5	3	6–10	18–30
Average		4	6–10	24–40
Jarosław, site 158				
Older	1	7–8	6–10	42–80
	2	4–7	6–10	24–70
Younger	3	4	6–10	24–40
Average		6	6–10	36–60

$$P = W_0/k$$

where P is the maximum number of inhabitants; W_0 – size (settlement area), k – factor of the average amount of space per 1 inhabitant (calculated on the basis of data from better researched sites).

It is worth to pay attention to the other limitations of this method. The natural environment is important here together with the consequent specificity of settlement in at least two dissimilar zones within Tarnobrzeg Lusatian culture – in the zone of loess and in the highlands as well as in the lowland part of the Sandomierz Basin, where the locations on light sandy soils in the dunes are predominant.

Apart from these reservations, in order to obtain synthetic data one should try to estimate the number of inhabitants in selected settlements with the proposed method (Table 2).

The results clearly differ from the above calculations for the two analyzed settlements in Rzeszów and Jarosław, where the number of inhabitants in particular phases reached up to 60–80 people, probably even less. If calculations for these sites were carried out according to the proposed method, we would obtain the results of 46.8 (Rzeszów) and 76.8 (Jarosław), which would be close to the detailed estimates for particular phases. The differences observed in Table 2 may be caused by various reasons. Firstly, we do not have details concerning the size of the Tarnobrzeg Lusatian culture settlement, usually it is the only total area under study. These figures do not usually match. In the case of multicultural settlements it raises serious consequences in terms of the obtained results, since we use the artificially high value. We can thus conclude that in such general calculations we probably achieve only approximate range of the maximum number of population in the settlement. One has to also be aware of the fact that over a long – several centuries long – period of settlement activity, this number could be (and probably was) different.

Turning to the second group of problems associated with the graveyards, it should be noted that in comparison with settlements they are better known in terms Tarnobrzeg Lusatian culture. It can even be said that they are its most distinctive and easily recognizable feature. We are talking about large crematory graveyards (the largest of more than a thousand graves – cf. Table

3), used for many centuries. They are of great importance for understanding the various problems concerning this cultural unit. In addition to the standard information in the field of funeral archaeology, related to funeral rites, they provide source materials for chronological and periodisational studies and show the wealth of material culture. Location in the settlement area (micro- and macro-regional) of long-utilised cemeteries indicates their important role as stabilizers for the entire settlement network, and probably also places of special symbolic meaning, around which the local community concentrated and where a network of relationships identifying the entire community was created. What is significant in this context, is the number of known and researched necropolises, which has no comparison to the prehistoric realities of other eras in the south-eastern Poland. What is evidently linked to this, is the number of human remains, i.e. the size of the population at that time, which we can observe from different perspectives – territorial (micro-, meso- and macroscale), chronological, biological or social.

For many of the surveyed cemeteries, apart from the standard archaeological source information we also have anthropological analysis (Table 4). Thanks to it our sources are unique, especially in quantitative terms, as we are able to adequately use numerous sets of sources. But one has to acknowledge the fact that cremation of the dead, dominant in this era, deprives us of a large part of potential source information, and makes some of the information uncertain (ambiguity of anthropological diagnoses). It is a commonly known fact of source restrictions concerning burned human remains in urn graves. However, one can specify the size and structure of the population that uses the cemetery, as well as study the dynamics of changes in the course of a long period of burying the dead in the same place.

It should be noted that the previous methodological proposals focus on two research models. The first is *strictly anthropological*, based on the identification of gender and age of the dead, on the basis of which model tables of mortality are constructed – „real” (for the congestive population), one with additional estimation of the number of children and one with a margin for birthrate in a stable population (e.g. Wiśniewska, Szybowicz 1989; Szybowicz 1995). In this way we obtain the basic indicators of the biological condition of the

Table 2. Selected Tarnobrzeg Lusatian culture settlements with the calculation of the maximum number of their inhabitants

Tabela 2. Kalkulacja największej liczby mieszkańców na przykładzie wybranych osad tarnobrzezkiej kultury łużyckiej

No.	Site	The researched area (Ares)	Number of objects TLC	Index	Number of inhabitants	Chronology/duration of the settlement
1	Białobrzegi 2	232	231	2,5	92.8	Half 7th–4th/3rd century BC
2	Boratyn 17	195	528?	2,5	78	8th–6th century BC
3	Gorliczyna 19, 20	402	315	2,5	160.8	13th–10th/9th century BC half 7th–4th/3rd century BC
4	Terliczka 1	113	54	2,5	45.2	8th/7th–6th century BC
5	Terliczka 4, 5	300	192	2,5	120	8th/7th–6th century BC
6	Zabłotce 2	413	250	2,5	165.2	13th–10th/9th century BC 6th–4th century BC

Table 3. Overview of the largest Tarnobrzeg Lusatian culture cemeteries with an indication of the progress of anthropological analysis

Tabela 3. Przegląd największych cmentarzysk tarnobrzesckiej kultury łużyckiej z uwzględnieniem zakresu analiz antropologicznych

No.	Cemetery	Number of graves	Anthropological analysis	Dating – chronolog. phases.	References
1	Bachórz-Chodorówka	802	yes	I–II	Gedl 1994; Szybowicz 1995
2	Chodaczów	115	yes	I–III	Czopek 1996b
3	Furmany	348	yes	I–III	Ormian 1998; Ormian, Brylska, Guściora 2001
4	Gorzyce	148	no	II–III	Moskwa 1958
5	Grodzisko Dolne 1	144	yes	I–II (?)	Czopek 1996
6	Grodzisko Dolne 2	179	no	III	Moskwa 1962
7	Grzęska	74*	no	III	Moskwa 1976; Czopek, Pawelec 2008; Czopek, Ligoda, Podgórska-Czopek 2009
8	Knapy	231	yes	III	Czopek 2004
9	Kłyżów	209	yes	III	Szarek-Waszkowska 1975a; 1975b; Czopek 1996; Trybała-Zawiślak 2005; 2012; 2015
9	Kosin II**	385	no	II–III	Miśkiewicz, Węgrzynowicz 1974
10	Krzemienica	163	no	III	Szarek-Waszkowska 1975c
11	Lipnik	349	yes	I–III (?)	Blajer 1999; 2000; 2001; 2002; 2004; 2005; 2006; 2007; 2009
12	Manasterz	125	no	I–III	Godlewski 2001; Czopek, Siek, Trybała, 2005; Trybała-Zawiślak 2006, 2007
13	Mokrzyszów 1	68	yes	II–III	Moskwa 1964
14	Mokrzyszów 2	173	yes	III	Trybała 2004a; 2012
15	Paluchy	1664	no	I–III	Kostek 2002
16	Pysznicza	773	yes	II–III	Czopek 2001
17	Trójczyce	130	no	III	Poradyło 2001
18	Tryńcza	62	no	III	Karnas 2004
19	Trzęsówka	336	yes	III	Moskwa 1971
20	Wietlin	68	no	I–III	Kostek 1991
21	Zbydniów	239	yes	II	Moskwa 1979

population. The second model can be called **anthropological and archaeological**, or (as we shall see) only **archaeological**. It is used for a crucial determination of the parameter of size of the group utilizing the cemetery. For this purpose, Polish archaeology adopted a method (formula) developed by Hunagrian anthropologists (Acsádi, Nemeskéri 1970):

$$P \cdot k + \frac{Dxe_0}{t}$$

or in Polish literature in the form of:

$$P \cdot \frac{Dxe_0}{t} \cdot xk \text{ or } P \cdot \frac{Dxe_0}{t} \cdot x_{1,1}$$

where P – the group utilizing the cemetery, D – the number of dead at time t, e_0 – life expectancy at birth, k – factor increasing value by 10%.

Obviously, it does not change the result, because the value of adding a fraction of 1/10 and the product of 1.1 are exactly the same. A modification with no correction factor is taken into account by E. Neustupný (Neustupný 1983, 37–38). Other methods

proposed by anthropologists were not successful, for example Gejvall method (Henneberg et al. 1975, 199) and Piasecki (1988; 1990). The output data, however, operate on the same or similar values (the number of dead, the expectation of further life expectancy, mortality rate) derived from anthropological analyses. What is also very important is the value indicating the lifetime of the necropolis (or part thereof) which is determined on the basis of archaeological data. Conducted comparative analyses (Czopek 2010, 101–102) have clearly shown that it is precisely this parameter which is influencing the final result. This shows that in the demographic studies a lot depends on archaeologists, their accuracy and chronological terms. It can also be said that all of the aforementioned methods (except Piasecki's proposal, impossible to use in archaeology), if we assume the same output values, give comparable final results. The ca. 10% lower value in Neustupný proposal is obvious (no correcting parameter), while according to Gejvall the results are, on average, higher by 20–30%. However, for small, several dozen people populations they do not cause a glaring difference, maintaining the final result in a similar, estimated size.

Table 4. Overview of Tarnobrzeg Lusatian culture cemeteries with the results of their anthropological analyses
Tabela 4. Cmentarzyska tarnobrzeskiej kultury łużyckiej z uwzględnieniem wyników analiz antropologicznych

No.	Cemetery	The number of graves	The number of graves with anthropological analyses		Number of individuals		Number of adults		The number of juveniles (Iuvenis)		Number of children (Infans I, Infans II)		The number of individuals of indeterminate age	
			N	%	N	%	N	%	N	%	N	%	N	%
1	Bachórz- Chodorówka	786	563	71,6	623	316	50,7	24	3,9	136	21,8	147	23,6	
2	Pysznica	772	595	77,1	726	391	53,9	44	6,1	224	30,8	67	9,2	
3	Furmany	348	301	86,5	372	211	56,7	0	0,0	123	33,1	38	10,2	
4	Trzęsówka	336	99	29,5	99	45	45,5	4	4,0	47	47,5	3	3,0	
5	Knapy	231	221	95,6	253	156	61,7	9	3,5	67	26,5	21	8,3	
6	Zbydniów	223	207	92,8	237	119	50,2	3	1,3	60	25,3	55	23,2	
7	Kłyżów	209	209	100	254	160	63,0	12	4,7	82	32,3	0	0,0	
8	Mokrzyszów 2	173	161	93,1	176	88	50,0	7	4,0	46	26,1	35	19,9	
9	Grodzisko Dolne 1	144	90	64,3	110	63	57,2	6	5,5	32	29,1	9	8,2	
10	Chodaczów	115	96	93,4	98	51	52,0	1	1,0	14	14,3	32	32,7	
11	Mokrzyszów 1	68	50	73,5	51	35	68,6	5	9,8	11	21,5	0	0,0	
	Total	3 422	2 595	---	2 999	1 635	---	115	---	842	---	407	---	

Obviously, in order to use the presented methods we have to possess anthropological analyses. And what if we do not have them? Are archaeologists completely helpless, at the mercy of speculation? In the literature there is a method proposed more than half a century ago by Kazimierz Godłowski (1960), who calculated the size of the group using the cemetery as the quotient of the sum of the registered burials and the number of generations during the activity of the cemetery. He assumed that one generation lasts for 25–30 years, and thus that the size of the population in each generation is the same. This is of course nothing else but a stagnant population within the meaning of anthropology. On the basis of comparisons and specific calculations for many Tarnobrzeg Lusatian culture cemeteries (Czopek 2010) another way of calculating the size of the group using the cemetery without anthropological data was proposed. It was observed that the rate of life expectancy for the studied Tarnobrzeg Lusatian populations oscillates around 20 years, and it depends on whether anthropologists use only the so-called original material or estimate the missing number of deceased children, not all of whom were buried at cemeteries, which is proven by the statistics. The second element is the number of the dead. This is not a simple correlation: urn grave = deceased individual, because in many cases we note the presence of remains of two or more individuals in one urn. One can, however, determine the average on quite a large series of anthropologically researched cemeteries, which equals 1.6. Hence a different model was proposed, which allows to estimate the size of the group using the cemetery without anthropological data:

$$P = \frac{Nx1,6}{T} \times \frac{100}{Wu} \text{ or in the form } P = \frac{Nx1,6}{T} \times 25$$

where P is the size of the population using the cemetery; N – the number of discovered graves, T – time of activity of the necropolis, Wu – mortality rate (if, according to the findings of anthropologists, we adopt its average value of 4%, we get a second version of the formula).

Let us now compare the calculations (Table 5) for the chosen cemeteries with the use of the method proposed here. They are mostly used with anthropological data.

Comparison of the results demonstrates that we still have estimates of a similar level, and the assumptions and simplifications adopted in the archaeological method do not differ from similar anthropological procedures (stagnant nature of the population, extra estimation of the number of children, etc.). One can allow for such procedure in a situation where one does not have anthropological analyses or they are for some reason unattainable.

We can now compare the earlier calculation obtained from the settlements with those of cemeteries. They are surprisingly convergent – average for settlements is in the range 24–60, so all the results for cemeteries are also included there (23–38), rather in its lower range. This kind of mutual verification can be considered a test of correctness, but at the same time an indication that the most probable settlement model is a large settlement (space-wise) with a corresponding cemetery with numerous graves.

The only researched, complete micro-region, for which the settlement and cemetery operating at the same time and used by the same group of people can be analysed, is the micro-region of Grodzisko Dolne from the early Iron Age. Thorough demographic studies that were conducted have been published elsewhere (Czopek 2015). Here we mention only the most important conclusions. Probable activity time of the group is ca. 200 years, during which 34 basic units (generations) marked their presence at the cemetery, burying their dead in 10 separate clusters. When we multiply the size of the largest of them (8) by the length of a generation (25 years), it determines the relative time of the activity of the necropolis (8×25=200). The size of the group using the cemetery was not constant and during that time it ranged from 6–8 to 48–64 people, with an average of 25–33. In relation to the settlement, which, contrary to the cemetery, has not been researched as a whole, but to a large extent, we can conclude that such estimates are probable. At the same time the comparison clearly indicates that in the settlement we can expect up to 34 farms (amount equal to the total of generations from the cemetery), assuming that each of them left its own trace in the form of objects forming groups of this type. During the research 9–11 farms were distinguished in the examined area.

Table 5. Comparison of calculations of population size using cemeteries obtained by different methods

Tabela 5. Porównanie wyników obliczeń wielkości populacji użytkującej cmentarzyska z uwzględnieniem różnych metod

Cemetery	Output data				Acsádi, Nemeskèri	Gejvall	Archeological method
	T	N	D	e ⁰ ₀			
Bachórz -Chodorówka 1	600	786	932	19,5	33,3	39,8	38,8
Grodzisko Dolne 1	300	144	273	19,8	19,8	23,0	22,8
Knapy 1	300	231	358	20,6	27,0	29,0	29,9
Mokrzyszów 2	200	173	268	20,2	29,7	33,2	33,5
Zbydniów 1	250	223	332	20,5	29,9	32,4	33,2

Similar considerations (though not in terms of full micro-regional structures, but relating only to the cemetery, without data from settlements, which constitute an important factor in the comparative analyses) was carried out for the largest published to date Tarnobrzeg Lusatian culture cemetery in Bachórz-Chodorówka. A fairly precise estimation of the chronology of source materials and a substantial series of anthropological analyses allowed us to calculate the size of the group utilizing this necropolis in each of the three phases of its use. In the oldest phase the group was the largest and consisted of about 118 individuals, in the middle phase – 47, and in the youngest – an average of 45 individuals. If these estimates were translated into the number of smaller social groups functioning in every phase, then we would get 21 families in the first phase, about 9 in the second phase, and about 8 in the third, respectively. Therefore, automatically – with the overall size of the population using the cemetery – there is a decrease in the number of individuals of reproductive age (parents), the youngest individuals (children), as well as elderly, post-reproductive individuals (Szybowicz 1995, 39–40).

The above considerations were related to the elementary stage of paleodemographic study, i.e. settlement microstructures (social – cf. Ostoja-Zagórski 1989). They may have another, more precise dimension (Czopek 2015). At some cemeteries with the so-called cluster layout (Trybała-Zawiślak 2015) a separation of zones, or even the assignment of graves to successive generations within the same social structure (e.g. family) is possible. In turn, in the settlement, as we noted earlier, we can talk about a single farm. In terms of interpretation (comparison) these would constitute complementary relationship: settlement house – a cluster at the cemetery, and in the broader context: settlement – necropolis (Tabaczyński 2012, 758).

We can examine the issue of the so-called cluster cemeteries more closely on the basis of necropolis in Kłyżów. It is a graveyard examined almost in its entirety. Grave inventories were distributed within narrower horizons of activity of the cemetery, and additionally we have full anthropological analyses there (all the graves were diagnosed and for all individuals their age at death was estimated). In the context of demographical studies such factors are of great importance. Even after a very cursory overview of ages and sexes of individuals buried in the cemetery, one can notice that particular clusters most likely correspond to small social groups such as family or kin group. This fact can be proven by tracing the average age in each of the clusters, which oscillates around a very similar range of figures. In order to do these calculations, average values for each of the age categories were adopted, i.e. if *Infans I* refers to the age of 0 to 7 years, an average value of 3.5 was adopted. If *Adultus* refers to the age of 20 to 30 years, the average of 25 years was adopted for calculations. What is problematic here is the age category of *Senilis* denoting age from 50 to x years, where the average of 60 years was assumed. In the case of category without a specified age of 20-x years, which simply means that the individual died at the age of 20 or more, the lower age limit, i.e. 20 years was adopted. Obviously, when we use the average data (somewhat „artificially” adopted), one may be wondering about the correctness of the results. In this case, however, it is more important to illustrate the situation with

which we are dealing at the cemetery in Kłyżów (as well as in other necropolises of Tarnobrzeg Lusatian culture), where after a cursory review of anthropological data and distribution of some of the features within the burial area, one can already clearly see that there is no relationship between the sex or age of the deceased and the place of his or her burial in the cemetery. The obtained results of average age of individuals at death, buried within particular clusters, are in the range of 38.4 years to 11.4 years. This last example is quite unique in the context of the whole cemetery, as for 10 individuals buried in this cluster, in as many as 7 cases we are dealing with children, mainly aged *Infans I*. In the case of the Kłyżów necropolis, the activity of the cemetery can be specified by one of the largest clusters. Assuming that in a single generation, within each family, there are at least four deaths (Czopek 2010, 114), taking into account that 32 individuals were buried in the cluster and using a suitable formula ($32 \div 4 = 8$), we obtain evidence that the duration of the cemetery would correspond to 8 generations, that is, the period of approx. 200–240 years ($8 \times 25/30 = 200/240$). On the other hand, observations on the distribution of anthropological data in different clusters lead to a somewhat different conclusion. It seems that taking into account the anthropological information and assuming that the activity of the necropolis in Kłyżów may be even shorter than 200 years (which results from the analysis of inventories) we would have to correct the number of generations using the cemetery to ca. 6 (maximum 7). Then, the analysis would imply that the cemetery functioned for roughly 150–180 years (assuming that we have 6 generations, each of which lasts about 25–30 years, for $6 \times 25/30 = 150/180$). In this way we get the so-called dynamic image (cf. Czopek 2010a, 120) of the functioning of the Kłyżów necropolis. Smaller clusters, comprising a dozen burials could have been used during 3–4 generations, and the smallest were used during two or even one generation. This hypothesis can be additionally confirmed by the distribution of particular inventories within periodisational phases distinguished for the cemetery – it very clearly shows that clusters lasting the shortest time are mostly confined to the last (III) phase of cemetery use. Alternatively, there are few items that could be associated with phase II or vice versa – the functioning of the cluster was initiated in phase II, but the materials associated with the phase III are already scarce. In the smallest groups of clusters only the youngest materials are distinguishable, assigned to periodisational phase III. In addition, no situation was noted in which some cluster was founded in the early stage of use of the necropolis and was soon abandoned (Trybała-Zawiślak 2012; 2015). Groupings of burials where the oldest source materials are found are often used almost until the end of the activity of the cemetery (which confirms the presence of materials recognized as the youngest).

The classical approach to paleodemographic problems, i.e. developing general characteristics based on tables with mortality rates seems to be ineffective, because it concerns the whole material and does not reflect the specificity of the cemeteries such as the necropolis in Kłyżów described above. With such a short time of use of the cemetery and relatively small number of buried individuals ($N = 254$), the figures obtained can only characterize the population as a whole, but they do not reflect the dynamics of functioning of the necropolis or, more importantly, individual clusters of graves.

As it has been attempted to demonstrate, it seems that the studies in paleodemography are most effective in relation to the settlement and social microstructures. They remain close to specific sources, making all the calculations (estimates) burdened with the smallest error. At the same time they point to the most significant component, *i.e.* time. This is a factor which in the most direct and fundamental way applies to the classical archaeological inference. The possibility of a dynamic understanding of settlement processes and funeral behavior exists *de facto* only in the microstructures. One has to realize that the calculations for the meso- and macroregions, and even more for the whole cultural units, use a very far-reaching generalizations, especially chronological ones. They allow us to perceive demographics only as a static image.

Mindful of these limitations, we should try to make more general estimates, relating to larger territorial units. The minimum value resulting from microregional calculations for the aforementioned settlements and cemeteries is 30 (with an average of 30–50). Let us adopt it as a basis for further calculations. For mesoregion of the lower Wisłok and San 10–13 microregions in the early phase and 21 in the late phase can be isolated (Czopek 1996). Population size would amount to 300/390–500/650 and 630–1050 people respectively. These values, divided by the size of the intensively utilized area (about 200 km²) show the estimated population density at the level of 1.5 / 1.95–2.5 / 3.25 and 3.15–5.25 persons per km². These values are comparable (and they even exceed them for maximum values, because of the narrowed concept of the

area under human activity) to calculations for other provinces of Lusatian cultural circle (Ostoja-Zagórski 1989, 122; Bukowski, Dąbrowski 1982, 266). Tarnobrzeg Lusatian culture settlement is concentrated in certain regions, not evenly reaching the whole area of its ecumene. The calculated values are adequate for such densely populated areas. If larger territories, areas bordering the proper settlement zone (in the case of Wisłok-San region – 1048 km²) were taken into consideration, the average population density would significantly decrease to 0.3–1.0 persons per km². The factor calculated in this way allows in turn for the estimated calculation of the total Tarnobrzeg Lusatian culture population, whose ecumene can be estimated for 17 000–19 000 km². Multiplying this value by the overall average (0.3–1.0) we get range from 5100/5700 to 17 000/19 000 people. We no longer have any doubt that this is a very general estimate.

To conclude, it has to be noted that a well recognized Tarnobrzeg Lusatian culture is suitable to conduct paleodemographic studies. Its value that is difficult to overestimate is the possibility of comparing the calculations carried out for settlements and cemeteries. The level of reliability of the studies depends on the accuracy of archaeological analyses, among which the most important is to accurately determine the chronology, especially the relative „time layer” (Koselleck 2012), concerning the site under analysis. The accuracy of such studies is possible only in the field of microstructural studies. The reliability of demographic estimates and calculations significantly decreases together with the enlargement of the area under study.

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Liczebność i struktura populacji tarnobrzeskiej kultury łużyckiej

Streszczenie

Tarnobrzeska kultura łużycka jest jednostką kulturową wyodrębnioną w południowo-wschodniej Polsce, charakterystyczną dla okresu obejmującego okres od środkowej epoki brązu do wczesnej epoki żelaza (w przybliżeniu od XIV/XIII do V/IV w. p.n.e.). Jedną z jej najbardziej charakterystycznych cech są duże cmentarzyska ciałopalne (największe z nich liczą ponad tysiąc grobów), użytkowane przez wiele stuleci. Dla wielu z nich oprócz standardowych informacji archeologicznych dysponujemy również analizami antropologicznymi, które doskonale nadają się do rozważań demograficznych. Dzięki nim można określić liczebność i strukturę populacji użytkującej cmentarzysko, a także zbadać dynamikę zmian w ciągu

długiego czasu grzebania zmarłych w tym samym miejscu. Taka analiza w postaci badań mikrostruktury społecznej może być następnie podstawą wnioskowania na wyższym poziomie, między innymi na temat osadnictwa mezoregionów, charakteryzujących się siecią współwystępujących cmentarzysk i towarzyszących im osad. Suma tych obserwacji pozwala z kolei oszacować liczbę ludności zamieszkującej tereny przypisane do tarnobrzeskiej kultury łużyckiej. Na każdym poziomie wnioskowania dotyczącego liczebności populacji, kluczową rolę odgrywa możliwość jak najdokładniejszego i najbardziej precyzyjnego oszacowania czasu użytkowania cmentarzyska lub obecności osadnictwa na analizowanym terenie.

