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## DYNAMICS OF SETTLEMENTS WITHIN BALYHOROD COMMUNE THROUGH THE USE OF GIS TECHNIQUES

The main aim of this work is to analyze the dynamics of settlements from the 2<sup>nd</sup> half of the 18<sup>th</sup> century to 2<sup>nd</sup> half of 20<sup>th</sup> century in Balyhorod commune (in Polish “Baligród”), in Lesko district, Podkarpackie voivodeship in Eastern Poland. Balyhorod commune was analyzed in terms of the changes of settlements, applying maps together with published historical data for the analysis of changes in its structure. Firstly, the tactical map of «WIG-Military Institute of Geography» was applied. Secondly, maps from the «WMS-Web Map Service, Geoportal» were analyzed. Changes in the number of villages and households population dynamics for Greek Catholics, Latins and Jews for the year 1785 were evaluated applying ArcGIS 10.3 program. Ukrainian ones were evaluated using ArcGIS 10.3 program in comparison with the number of Poles and Jews for the year 1939. Ethnic and religious composition from the 2<sup>nd</sup> half of the 18<sup>th</sup> century to 2<sup>nd</sup> half of 20<sup>th</sup> century and the character of settlements distribution in Balyhorod commune was evaluated based on the study of spatial distribution of settlements with the use of Spatial Statistics (Spatial Autocorrelation Global Moran's test, Standard Deviational Ellipse and Mean Centre). In 1785 there were 74,01% of Greek Catholics and in 1939 there were 77,98% of Ukrainians in Balyhorod commune. There was confirmed a similar configuration of Standard Deviation Ellipse and Mean Center for Greek Catholics who were Ukrainians for the year 1785 and Ukrainians for the year 1939 in Balyhorod commune. The scale and results of such changes are essential for future research, mainly in terms of the change of traditional village system infrastructure and culture.

**Key words:** dynamics, village, GIS, Balyhorod commune.

### *Igor Kozak, Hanna Kozak. ДИНАМІКА ПОСЕЛЕНЬ ГМІНИ БАЛИГОРОД ІЗ ЗАСТОСУВАННЯМ ГІС*

У статті проаналізовано характер розміщення поселень, кількість сіл, чисельність господарств, релігійний та національний склад в актуальних межах гміни Балигород (Baligród) у Ліському повіті Підкарпатського воєводства у південно-східній Польщі. Застосування в аналізах техніки GIS підтвердило домінування греко-католиків у 1785 році та українців у 1939 році. Виявлено зміни традиційних сільських систем та культурних надбань у межах гміни Балигород. Показано подібну конфігурацію еліпсів стандартних відхилень і середніх центрів тяжіння для греко-католиків у 1785 році і українців у 1939 році в межах гміни Балигород. Масштаб і результати таких змін є важливими для подальших досліджень, особливо в аспекті зміни традиційних сільських систем, їх інфраструктури та культурних надбань.

**Ключові слова:** динаміка, поселення, ГІС, гміна Балигород.

### *Igor Kozak, Hanna Kozak. ДИНАМИКА СЕЛЕНИЙ ГМИНЫ БАЛИГОРОД С ИСПОЛЬЗОВАНИЕМ ГИС*

Представлена динамика селений, численность хозяйств, религиозный и национальный состав в актуальных пределах гмины Балигород (Baligród) Леского района в Подкарпатском воеводстве в юго-восточной Польше. Использование в анализе техники GIS подтвердило доминирование греко-католиков в 1785 году, а также украинцев в 1939 году. Выявлены изменения традиционных сельских систем и культурных наследий в пределах гмины Балигород. Показана подобная конфигурация эллипсов стандартных отклонений и средних центров тяжести для греко-католиков в 1785 году и украинцев в 1939 году в пределах гмины Балигород. Масштаб и результаты таких изменений являются важными для дальнейших исследований, особенно в аспекте изменений традиционных сельских систем, их инфраструктуры и культурных достижений.

**Ключевые слова:** динамика, селения, ГИС, гмина Балигород.

**Introduction.** Statistical data is not always objectively shown in terms of ethnic and religious composition of the whole Galicia population [13] and the study area of Balyhorod commune. Based on this situation, it may be considered that evaluation of national origins and religious data is quite significant for a research within Balyhorod commune. Abovementioned is also important in terms of rural cultural landscapes. Such cultural landscapes are usually associated with traditional village system (TVS) with centre-periphery zoning from houses, gardens, fields, mowed and grazed grasslands to forests [8]. The consequences of losing such a system require a more detailed study.

**Scientific background.** The dynamics of settlements in Balyhorod commune was not a subject to any research. There may be identified studies on specific religious and ethnic relations within the Polish-Slovak-Ukrainian borderlands [11], landscape change at high Beskid (Bieszczady) [20] and three-dimensional

reconstruction of already nonexisting churches [17]. The analysis of the literature on traditional village systems (TVS) shows how such systems contribute to characteristic natural and cultural heritage [3]. Cultural heritage of TVS has been recognized and promoted at a global level in a number of international agreements and programmes [5; 9; 18]. However, the traditional village system with its cultural landscape is often threatened by socio-economic and technological changes in agriculture, industrial forestry and by particular nature conservation strategies [3; 5]. The role of TVS in terms of Ukrainian Carpathians is evaluated in the context of sustainable forest management [8]. The analysis of the social and cultural aspects of TVS is a current issue and requires development of new approaches.

**Study goal and methods.** The aim of this work is a detailed study on settlement distribution within present borders of Balyhorod commune. Additionally, it is important to conduct the analysis of the loss of TVS and of evidence of the change in ethnic, religious and cultural components.

Settlements in the landscape within current borders of Balyhorod commune, in Lesko county, Podkarpatske voivodship (gmina Baligród, powiat Leski, województwo Podkarpackie) were objects of this study.

Historical material from 1785, archival materials, geo-statistical methods of research available in modern GIS packages were used. The study of the dynamics of settlements was performed by applying their location in the form of points and polygons on maps from 1785 and 1939. The corresponding layers in the ArcGIS 10.3 program [15; 18] were completed. The number of these householders [13] and the number of inhabitants based on religious and ethnic composition was added for each of these settlements, starting from 2<sup>nd</sup> half of the 18<sup>th</sup> century, especially from 1785 [7] and from 1939 [13]. Tactical map of «WIG- Military Institute of Geography» and maps from the «WMS-Web Map Service, Geoport» were applied. Changes in number of villages and households population dynamics for Greek Catholics, Latins and Jews for the year 1785 were evaluated applying ArcGIS 10.3 program. Ukrainian ones were evaluated using ArcGIS 10.3 program in comparison with the number of Poles and Jews for the year 1939. Ethnic and religious composition from the 2<sup>nd</sup> half of the 18<sup>th</sup> century to 2<sup>nd</sup> half of 20<sup>th</sup> century and the character of settlements distribution in Balyhorod commune was evaluated, based on the study of spatial distribution of settlements with the use of Spatial Statistics (Spatial Autocorrelation Global Moran's test, Standard Deviational Ellipse and Mean Centre) executed in ArcMap program [19].

**Main material.** Calculations in the present work, conducted on the basis of data published by Z. Budzynski [7], evidence that in the Balyhorod commune in 1785

Greek Catholic (Ukrainians) population amounted to 74.01%, Latins to 18.27% and Jewish to 7.72% (Tab.). However, it should be noted that Z. Budzyński by the term Latins, except Poles, meant also Ukrainians, who spoke Ukrainian language, however in order to participate in mass service went to the church (kościół). As a result, the term “Latins” is incorrect. A correct manner is to identify two different terms: Roman Catholics (Poles) and Latins (Ukrainians), as it had been done before [13]. The previous is well illustrated on the example of such villages as: Tysovets, Rostoky Dolishni, Shernytsya Horishnya, Lubne. In 1785 in the village of Tysovets there lived 78 Greek Catholics and 12 Latins according to Z. Budzynski [7]. According to Kubiovych in 1939 there lived 245 Ukrainians, 15 Jews and no Poles [13]. In 1785 in the village of Rostoky Dolishni there lived: 86 Greek Catholics, 9 Latins and 9 Jews [7], while in 1939 there lived 270 Ukrainians, 20 Jews and no Poles [13]. In 1785 in the village of Shernytsya Horishnya there lived: 349 Greek Catholics, 50 Jews and 6 Latins [7], while in 1939 there lived 1155 Ukrainians, 15 Jews and no Poles [13]. In 1785 in the village of Lubne there lived: 25 Greek Catholics and 9 Latins [7], while in 1939 there lived 115 Ukrainians, 5 Jews and no Poles [13]. That lack of Poles in the statistics for the year of 1939 confirms the inaccuracy of data presented by Z. Budzynski. Consequently, Ukrainian dominance is quite clear, meaning the dominance of Greek Catholics and Ukrainians (Tab. 1) in Balyhorod commune is confirmed by the following data analysis from the year 1939, when 77,98% of commune's population were Ukrainians, 13,04% were Poles and 8,98% were Jews (percentage of Germans was lesser than 0 01% and therefore was not analyzed in the present publication).

Table 1

*Religious and national distribution of settlements in Balyhorod commune*

Nr	Name in English, Ukrainian, Polish	1785			1939		
		Greek Catholics	Latins	Jews	Ukrainians	Poles	Jews
1	Novosilky, Новосілки, Nowosiółki	230	13	15	690	40	30
2	Zahochevja, Захочев'я, Zahoczewie	244	60	8	715	85	40
3	Tysovets, Тисовець, Cisowiec	78	12	0	245	0	15
4	Mchava, Мхава, Mchawa	153	80	21	450	190	30
5	Kilchava, Кільчава, Kiełczawa	111	5	0	245	5	0
6	Rostoky Dolishni, Розтоки Долішні, Roztoki Dolne	86	9	9	270	0	20
7	Balyhorod, Балигород, Baligród,	134	190	148	480	830	650
8	Stezhnytsya, Стежниця, Stężnica	296	95	15	920	10	30
9	Huchvytsi, Гучвиці, Huczvice	56	4	0	200	10	0
10	Shernytsya Dolishnya, Шерниця Долішня, Żernica Niżna	155	45	13	460	10	30
11	Shernytsya Horishnya, Шерниця Горішня, Żernica Wyżna	349	50	6	1155	0	15
12	Zherdenka, Жерденка, Żerdenka	65	0	6	240	0	0
13	Bystre, Бистре, Bystre,	61	20	6	160	10	0
14	Lubne, Лубне, Łubne	25	9	0	115	0	5
15	Ryabe, Рябе, Rabe	168	20	15	735	15	20
16	Kolonytsi, Колонії, Kołonicze	140	5	6	280	70	10
17	Jablinky, Яблінки, Jabłonki	218	17	0	500	40	10
	Sum	2569	634	268	7860	1315	905

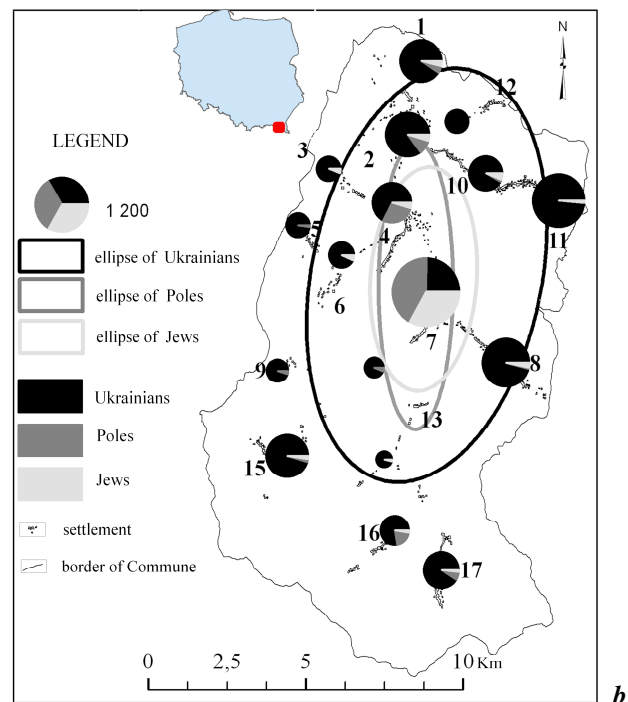
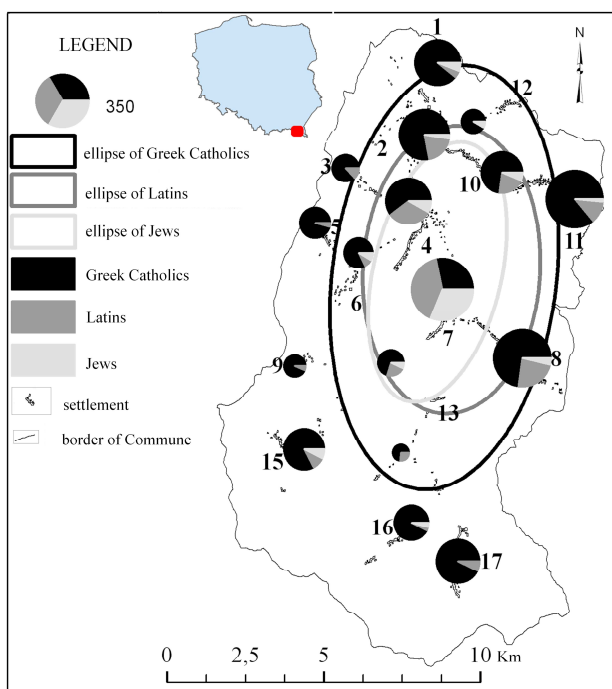
This situation demonstrates the dominance of Ukrainians before World War II. The placement ellipses analysis (Fig. 1a) showed that in 1785 ellipse for Greek Catholics (black) is broader and covers a larger area than one for Latins (dark gray). This indicates a natural and more equilibrated distribution of Greek Catholics within Balyhorod commune. The ellipse for Greek Catholics shows a more south (mountain) distribution comparing to the ellipse for Latins.

In the all Balyhorod settlements (numbers on the figures correspond to settlement number and settlement name in the table) Greek Catholics dominated in 1785. After the year 1785, the number of Greek Catholics increased [6]. In 1939 (Fig. 1b) distribution ellipse for Ukrainian (black) did not changed in comparison with ellipse for Greek Catholics in the year 1785. This tendency confirms the stability and durability of their set-

tlement on the territory of Balyhorod commune.

In 1939 ellipse for Poles (dark-gray) is smaller, elongated oval (Fig. 1b) and distributed more to the West, comparing to the ellipse for Ukrainians (black). Ellipse representing Jews (light-gray) moved to the Balyhorod city. The analysis of obtained results of Moran test leads to the conclusion that there was no clustering in the distribution of religious and ethnic composition of the population in the year 1785 and 1939.

All settlements within Balyhorod commune area were destroyed. Complete (100%) destruction of households occurred in such villages as: Ryabe, Bystre, Kolonytsi, Huchvytsi. In many others settlements, the level of destruction reached over 80%. It should be noted that the level of destruction that occurred in 1950's was the highest and contributed to the loss of traditional village system.



**Fig. 1. Settlement distribution of Balyhorod commune:**  
**a) religious structure in 1785; b) national structure in 1939**

The comparison of the data from the year 1939 and 1965 showed a sharp decrease in the number of households. Analysis of the number of households proved that in 1939 there were 1521 households on the Balyhorod commune territory. In 1965, the number of households fell sharply to 546 units.

Before World War II the area of Balyhorod commune was densely populated. In 1785 density level reached 21,95 persons for 1 km<sup>2</sup>. In 1939 density level reached 63,76 person for 1 km<sup>2</sup>. According to the Central Statistical Office of Poland, in the year 2011 density level decreased to 20,41 persons for 1 km<sup>2</sup> [15]. In 1875 in Balyhorod commune there lived 3471 people. The majority of them, therefore 2569 out of 3471, were Ukrainian Greek Catholics. In 1939 there lived 10080 people in the commune, including 7860 of Ukrainian nationality. In the year 1965 the population of commune

amounted to 1000 people with no Ukrainians among them. Analyzing this situation, it is clear that without Ukrainians Balyhorod commune has lost the traditional village system, rich in cultural, social and economic traditions.

Before World War II the character of traditional land use practices (two field rotating system, a combination of tillage and livestock products in one sector, crops rotation, mechanical devices for cultivation and weed control, protection of soil from erosion using special methods of plowing) was completely dependent on the availability of local natural sources and kept in a sustainable and balanced relationship with the environment and with minimal use of resources and energy of the region [1]. Rural settlement livelihoods reflect spatial-temporal form of organization of life. These settlements were inherent with traditional way of building for villages, fea-

tures of wooden architecture, location and structure of agricultural land. Rural life was the basis of Ukrainian ethnographic identity.

After World War II the Balyhorod commune was depopulated. The area of buildings, arable land, pastures and grasslands decreased. The structure of the land and forests has changed dramatically. The private forests and lands were transferred to the state property. Since 1951 attempts have been made to settle these territories by seasonal workers or even people who had problems with the law [14]. Economic activities carried after 1950's were not always consistent with traditional systems management. Seasonal work caused an influx of people from different parts of Poland to Beskid (Bieszczady), nonetheless they usually left that area after the work season.

These changes reduced the variety of structural elements such as hedges and gardens, individual trees in various areas of traditional village system. People that moved into the commune from low-lying areas, till these days do not feel the spirit of that place (*genius loci*), spirit of this mountainous area. The local use of natural resources should be considered as a weakness. There are no satisfying practices of traditional land use. As it was shown by SWOT (strengths, weaknesses, opportunities and threats) analysis for Balyhorod commune unfavorable conditions for its development are: a little access to historical documentation, no traditions and therefore connection with its origins, no indigenous population, lack of access to religious sites (other than Roman Catholic), inconvenient architectural forms as to the landscape conditions.

Names of villages that originally came from Ukrainian etymology were changed into Polish: Baligród appeared instead of the name Voronkiv, Nowosiółki instead of Novosilky, Zahoczewie instead of Zahochevya (from the name of the river Hochivka), Cisowiec instead of Tysovets, Stężnica instead of Stezhnytsya (from the name of the trail), Rabe instead of Ryabe, Żernica Niżna instead of Shernytsya Dolishnya. It is estimated that in Beskydy (Bieszczady) around 60 names of villages were changed in that manner [14].

At present time, on the territory of Balyhorod commune there isn't any link between generations. Villages that had been the core of Ukrainian traditional village systems (TVS), together with churches and chapels in the center of village, roadside crosses, traditional farms and households were lost. The Boyko Ukrainian church, that dominated on the area of the commune, are considered as sacred and unique monuments of national wooden architecture, preserved in the center of old Rutenian traditions and became an element of Ukrainian and European cultural and religious foundation. Ukrainians have always preserved their cultural values (in every church, except religious icons, there were also icons of Prince Volodymyr and Princess Olga, to whom Ukrainians prayed and with whom they linked their confidence and hope). Church, due to its form and building material, perfectly inscribed into the landscape and complemented it.

In Balyhorod commune there were 16 churches, located in the following villages: Balyhorod – church of Uspynnya Presvyata Bohorodytsya (1639); Mchava –

church of St. Archangel Myhayila from 1534; Rostoky Dolishni – church of Archangel Myhayila from 1700; the church of Archangel Myhayila Shernytsya Dolishnya (1700); Shernytsya Horishnya – church of St. Vasylija Velykoho (1750); Zahochevja – church of Archangel Myhayila from 1463, the church of St. Mykolaya Chudotvortsya in Stezhnytsya (1510); the church of Archangel Mychajila in Kolonytsi (1615); the church of Pokrov Presvyata Bohorodytsya in Jablinky (1700); the church of Uspynnya Presvyata Diva Mariya from in Ryabe (1800); the church of Rizdvo Bohorodytsya in Bystre (1800); the church of Uspynnya Presvyata Bohorodytsya in Tysovets (1700); the church of St. Myhayila in Kilchava (1837); Huchvytsi – church of Blahovishchennya Presvyata Bohorodytsya (1700); – chapel of Apost. Petro and Pavlo in Novosilky (1830); the chapel of Pokrov Presvyata Bohorodytsya in Zherdenka (1773).

After deportation of Ukrainians, there remained only one out of 16 churches in Balyhorod commune, that currently is subject to renovation process [12]. Four churches in villages of Ryabe, Zherdenka, Huchvytsi and Bystre were destroyed during or immediately after the deportation of Ukrainians in the years 1945-1947. Seven churches in villages of Shernytsya Dolishnya, Shernytsya Horishnya, Zahochevja, Stezhnytsya, Kolonytsi, Jablinky, Kilchava were demolished in the postwar period – during 1950's. In the place of four demolished churches, in Mchava, Rostoky Dolishni, Novosilky and Tysovets, Roman Catholic churches were built.

Churches, as spiritual centers, were located mainly on hills (the highest part) in the central area of the settlements. Settlements were one street structured, in chained form, where buildings were built with one roof, therefore reflecting the ethnographic peculiarities of Ukrainian settlement and their life [1].

After deportation of Ukrainians it is difficult to consider settlements as those that perform traditional role of rural systems. In fact, destroyed TVS had the traditional spatial structure, satisfying different needs of people. Research shows that lack of such system negatively affects the social and cultural aspects of sustainable management of the studied region. After World War II, there has been noticed in the region an increase in forestation and decrease in land use (due to decrease in number of population within that area). Eventually, natural succession process took advantage over the lack of human activity and land use practices [4]. Objective historical information on loss of traditional village system (TVS) is also important for touristic purposes. Analyzing the value of the landscape after the deportation of Ukrainians on the example of former Ruthenian (Ukrainian) Boryslavka village (currently nonexistent) in Sanotsko-Turchansky mountains (Podkarpackie voivodeship, Przemyśl county, Fredropol commune), A. Affek [2] confirmed the sudden and radical changes in the characteristics of most landscape: the loss of its identity, the loss of spirit of the place (*genius loci*) of mountain terrain [2].

According to the European Landscape Convention [9] – it is a loss of social and cultural values on local and regional level. The Convention defines landscape as zone or area in the perception of local residents or visitors, where visual signs and symbols of the landscape are

a result of natural and cultural factors, historical stratifications for a long time. The most important – its identity, tradition and material culture in the human landscape [9]. Those elements were lost in the Balyhorod commune. The abovementioned conducts to the degradation of the landscape, which in our opinion, constitutes a coherent entity, where natural and cultural components are closely interrelated.

**Conclusions.** Analysis of changes of settlement structure in Balyhorod commune confirms the dominance of Greek Catholics (74.01% in 1785) and Ukrainians (77.98% in 1939). Analysis of ellipses and mean centers for Greek Catholics in 1785 and Ukrainians in 1939 presents steady and identical settlements within

Balyhorod commune.

In summary, it is worth noting that after 1947 the number of households has decreased. The structures of the landscape, nature of traditional farming, TVS, which have been formed for centuries, have changed. Signs of Ukrainian identity, such as churches, considered as spiritual center of Ukrainians in Balyhorod commune completely disappeared.

The changes analyzed on the example of Balyhorod commune are typical for all Polish-Ukrainian borders. The scale and consequences of such changes require further research, especially in terms of the traditional village system and its cultural heritage.

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