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SYMBOLS USED ON ETHNIC MAPS IN THE EARLY DECADES OF THE 20TH CENTURY

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Abstract: While most maps are a representation of the surface of the earth at a reduced scale, some maps known as thematic maps are a representation of data distributed on the face of the earth. Within thematic maps, ethnic maps make up a special group since they have played a large role in defining state borders, especially during and after the First World War when territorial demands were made which were justified using ethnic maps. Many different mapping methods have been tried and while many can give a very accurate picture their interpretation is time-consuming hence they cannot be presented to decision-makers. This paper presents those mapping methods together with their scale which are ideal to be used for decisions on borders and analyzes their accuracy.

***Keywords**: ethnic maps, population mapping, qualitative data, quantitative data, mapping methods, objective depiction*

1. INTRODUCTION

A map is a representation of the surface of the earth or of data distributed on the surface using a predefined symbology at a constant scale. The amount of information a map can hold is limited (Klinghammer & Papp-Váry, 1983). While a topographic map is made with the purpose of representing the surface of the Earth, thematic maps are "not exclusively topographic, but represent on a topographic, hydrographic choreographic or geographic base localizable phenomena of any nature" (Cauvin et al, 2010a). Within the group of thematic maps the sub-group of ethnic maps show the ethnic affiliation (mother tongue) of the population. Generalization on any thematic map is challenging since it affects both the topographic data and the thematic data. Generalizing on ethnic maps is even more challenging due to the fact that to convey an accurate picture one does not only have to present qualitative data about the population (in this case ethnic affiliation) but also quantitative information (the number of inhabitants). Two maps using the same mapping method allows comparison of the statistics used to create the map while comparing maps made using the same statistical data allows analyses and comparisons to be performed on the mapping methods. One example is if the map shows the number of inhabitants one can get a more accurate picture of the ethnic

structure of the area than if it does not. In the first part of this study the reasons for and the consequences of showing or not showing the number of inhabitants is discussed. The use of different map symbols is also discussed as these are the basis of giving the map user an accurate picture. In the second part examples of maps are presented showing why these are important in practice. The maps used in the examples are maps used in the peace talks ending the Great War, where the time needed to interpret the maps was an important factor. Interpreting large scale maps (scale above 1:1 000 000 for the Carpathian Basin) is very time consuming making such maps unusable at the peace conference.

Maps can be seen as a form of graphical communication medium where the information communicated is not restricted to topographical information but can be anything having a special factor. Maps show a picture of reality that is reduced in size when compared to the earth's surface making generalization necessary which, under all circumstances, causes loss of information. The loss of information caused by generalization does not only happen with regards to topographic data but also with regards to the thematic data displayed on it. This data can be qualitative or quantitative, and while in both cases this can be a factor, the problem in general is much greater in the case of qualitative data.

Maps use symbols to depict geographic objects or, in the case of thematic maps, the geographical distribution of information in a certain data set. This can be anything from air pressure to temperature or any information gathered about the population be that quantitative (number of inhabitants, density of the population), or qualitative (ethnic affiliation, religion, age, ability to read and write, etc.). Symbols can be colored geometric shapes, pictograms, or simply just colored surfaces. The characteristics of the symbols can convey either qualitative or quantitative information to the reader. In order to convey both at least two characteristics need to be defined. Depending on the symbol these can be shape, size, color or shade (Klinghammer & Török, 1995). Ethnic maps usually use colored surfaces as symbols representing ethnic groups.

This study was done through analyzing maps that were used during the Paris Peace Conference in 1919 ending the First World War. This analysis could be done on any set of maps but due to the sensitivity of ethnic mapping and the availability of ethnic maps it is easier to show the differences between the different mapping methods. The maps selected all depict areas of the Carpathian Basin with some maps also depicting neighboring regions; however on these maps only the areas in the Carpathian Basin were considered. In the first part of the study the criteria for mapping ethnic groups in an objective manner are set. This was derived from the analysis of the maps which are presented in the second part of the study. The order of the two parts was selected to make the study easier to understand so that the reader understands the basic concepts before introducing results derived from the studied maps. The main source of information for this study are the maps cited in the study. In order to be able to analyze the maps it is important that we have an understanding about the basic concepts of ethnic cartography. It is important to understand what criteria the mapping methods used have to fulfill, what strengths and weaknesses a given mapping method has, and do certain

methods over- or under-represent minorities. One must also investigate if certain methods depict small minorities at all, and which ones over- or under-represent the minorities or the majorities (Jordan, 1999). The most important question is if the method used on a given map give an accurate picture of the full ethnic structure of the area.

The effects of using different colors are not discussed in this study. The sensitivity of the human eye to various colors is known (most sensitive to red, followed by green, yellow, blue and purple) but no data is available on the ranking of the aforementioned colors as to how they attract the eye when presented together (Robinson, 1967). However, the distinction the colors given to the different surfaces is much more important than to which extent they attract the eye. The mapping method used can distort the picture to a far greater extent than the colors used. By studying a given map for some time, the eye will get used to the composition and the possible distortion caused by the colors can be mitigated. If the mapping method however communicates false data, the distortion caused by the colors cannot be mitigated.

While it is important to note that ethnic maps are thematic maps and the same concepts should be applied to them as to other thematic maps so that the data is depicted in an objective manner; however when these maps were made the making of the maps had a political motive. At the end of the Great War these maps were intended to influence decision makers who were redrawing the borders within Europe. Every mapmaker chose mapping methods according to their own interest, often using mapping methods that could create a very distorted picture form even the most accurate data.

2. BASIC CONCEPTS OF ETHNIC MAPPING

Usually thematic maps present single characteristics of a certain data set (Muehrcke, 1972) which in the case of ethnic maps means that they show qualitative data – the ethnic affiliation of the population. In twentieth century, Europe the practice was to derive ethnic affiliation from the mother tongue of the population. This means that these maps are in actual fact not really ethnic maps, but maps showing mother tongue of the population. Today there would be much larger differences between the two types of data than there were back then. Usually the primary language spoken at home was considered the mother tongue of any given person (Kocsis, 1989). While depicting the population according to mother tongue seems straight forward one has to keep in mind that the geographical distribution of the population is not homogeneous and if one only shows the qualitative data on the map (ethnic affiliation or mother tongue of the population) then we will get a picture of the dominant language spoken in a given area, but we will not have an idea of the number of people living there. Since all areas, including uninhabited ones, belong to one or another municipality it may occur that the entire area of a municipality will seem to be inhabited by the majority ethnic group giving the impression that large uninhabited areas are in fact inhabited. This distorts the picture of the ethnic landscape of the depicted area since the map communicates a picture that would be true if the population would be homogeneous, and no uninhabited areas would exist. While this problem exists in all territories the inequality in the density of the population is far greater in mountainous areas. This means that while the ethnic affiliation of the population is qualitative

information, quantitative information needs to be displayed on the map in order to get an accurate picture of the ethnic landscape of the depicted area.

On maps showing the density of the population only quantitative information is shown. This can either be the number of inhabitants, or the map can also show the ratio of people per square kilometer in an area. However, since no qualitative information is shown, all characteristics of the symbols can be used to depict this information: color (or pattern), size, and/or shade. In theory is true the use of color is selective, separative, and associative thus it should only be used to depict qualitative information (Cauvin et al, 2010a). When used to depict population density the reader might assume qualitative data on the map while in actual fact it is not present and could be misled reading the map. This means that usually one would use a choropleth to depict data with value per unit area (Muehrcke, 1972) which is the type of data we have when depicting population density. In this case different shades of the same color can be used. In general, the more intense the color of the symbol the greater its value (Robinson, 1967). This in practice means that the darker the shade the greater the density of the population in the areas.

If qualitative information is shown (in this case the ethnic affiliation of the population) one of the symbol's characteristics must be used to depict this information. Since the size and shade of the symbol is more suited for depicting quantitative information the color or pattern of the symbol's surface needs to be used to depict qualitative information (ethnic affiliation). If the symbol uses colors, using patterns in general should be avoided unless two categories of information are closely related. In such cases using two different patterns of the same or similar color can help to group these categories. This does however have the effect that the map reader automatically groups these categories and if the color used by the two symbols is the same the map reader can even join these categories. Patterns should by no means be used for displaying any unrelated data if colors are used as this could make the map unreadable. Using colors or patterns for displaying quantitative data on maps where no other data is shown can make the map hard to read, but if qualitative data is also shown the map would become unreadable. This means that quantitative data should be shown by using shade or size. If the map uses colored symbols, then using more than two shades of a particular color will also make the map unreadable since someone who is not trained in this area cannot distinguish too many shades. This is reduced even further by variations in its surroundings making the connection between map legend and features on the map difficult or even impossible (Robinson, 1967). Furthermore, certain shades are often interpreted by humans as a different color. For example, a light shade of red is pink, a light shade of black is gray. These are often used on maps as another color, making this method unusable to show the density of the population on maps showing ethnic affiliation.

As a conclusion to the above one can state that if a map is made in such a way that both ethnic affiliation and population density is shown on a map it is best to depict the ethnic affiliation using the color or pattern of the symbol while the density of the population or number of inhabitants is to be shown by the size of the symbol. This might seem at first glance to have solved the problem, one must still make a

map that is easy to read by the map reader in practice. If symbols cover each other, which can easily happen, the map becomes unreadable. It is also very important that the map reader should see the picture in a spatial context, meaning that the frame given by the map projection should not be distorted beyond the point that the true geographical distribution of the population is not recognizable. This means that using traditional cartograms should be avoided since these tend to create such large distortions that in smaller regions the geographical area becomes unrecognizable in absence of major features (e.g. coastlines).

Another important question is the area represented by a given symbol. If the area is too large, the map becomes overgeneralized and this causes large data loss. When looking at the map the pattern that would otherwise appear, which in this case would show minorities, becomes smoothed due to the data loss. This procedure is very similar to smoothing of quantitative data which might not result in serious data loss if the general tendencies are visible on the map. When discrete values are smoothed the result becomes unscientific since the picture conveyed to the map reader will be a false one (Robinson, 1961). For this reason, population maps are usually not made using an isarithmic surface. In the case of qualitative data on ethnic maps (ethnic affiliation) the values are always discrete thus this kind of smoothing should be avoided. One very extreme example of when an area represented by a symbol is too large was the map made by the Romanian statistical bureau depicting the results of the 1930 census of Romania. The colored surface shows the majority population of the county. In Mureş county (Judeţs Mureş) the Romanians made up 45,8% of the population and Hungarians made up 42,6%. The rest of the population is represented by other ethnic groups. The whole county is colored purple showing that the majority of the population is Romanian and a yellow rhombus is placed in the map to show that the greatest minority are the Hungarians. This is severely misleading. The result is that it is incorrect for one symbol to represent such a large area unless the symbol reveals the true ethnic structure of the population which in this case it does not (Krallert, 1961). In fact, according to the publication made by the Institute of Political Sciences in Hungary (Államtudományi Intézet) if the Romanian author would have used a less distorted source for his statistics the whole county would have been colored Hungarian on that map (Staatwissenshcaftliches Institut, 1942). Another map is provided using pie charts and provides more accurate data, but pie charts are much more difficult to read than colored surfaces. If the area represented by the symbol is too small, it will not be visible on the map. The question of what is too large and what is too small is determined by the scale of the map, since the smaller the scale, the smaller the area on the map that represents a given area on the surface. This type of overgeneralization is very common on ethnic maps. In many cases this happens in such a way that the base map is far less generalized than the thematic contents. In thematic cartography a very basic concept is that the base map needs to be heavily generalized since its sole purpose is for the map reader to be able to place the data into a geographical context while being able to see the detailed thematic data without disturbance (Klinghammer & Papp-Váry, 1991). If the base map is not generalized to the extent of only having the minimal contents the map can become illegible. If

one generalizes the thematic contents instead, then the contents the map needs to communicate to the user becomes extremely distorted usually in a way that it homogenizes the picture of the thematic contents, in this case the ethnic affiliation of the population. This is a huge error since the map reader gets a false picture of the ethnic structure of the population.

The last theoretical problem is defining the categories or classes of qualitative and quantitative data on the map. This form of generalizing is done by generalizing the thematic variable and not the geometry (Cauvin et al, 2010b). This at first seems straight forward since these categories are defined by the statistics provided. Since the cartographer's job is not to collect or analyze the statistics in detail but to depict them as objectively as possible one can say that this does not have any relevance. However, one can see from the above that the map reader cannot distinguish an infinite number of colors and thus it can be a problem if the statistics define too many categories in a small area. In actual fact we have more data than what we can depict on a map (Muehrcke, 1972). In this case categories need to be combined, but this must be limited. Firstly, when combining categories these must have very similar or shared characteristics. While we can combine two qualitative features into one class, for example common or similar language, we have to keep in mind that in the case of identity these can be much less similar than we think at first. Another aspect is that only one of the original categories that will be combined can be large enough to have a dominance in a certain area of the map. In other words, all but one category must be a very small local minority. A good example is the Bunjevci (an ethnic group living mostly in Serbia, Croatia and Hungary). If the map shows the area where they live in detail, they should not be combined with another category. If the title of the map contains any reference to them, then they should also not be combined. But if neither of these cases exist then they can be combined with one of the large south Slavic groups (Croats or Serbs) since their languages are similar. Due to their language, they often are declared as Serbs, while due to their religion they are declared as Croats in many cases. While this does cause a problem regarding identity it does not materially change the picture a map of, for example, the Carpathian Basin communicates to the map user since both the population and the area inhabited by the Bunjevci is very small, and they are in many ways similar to the other two ethnic groups. If one however looks at the Croats and the Serbs the criteria of not altering the picture does not stand. The foundation for a common Serbo-Croation language was created in Vienna in 1850 and was codified in 1954 after which this became the official language of Yugoslavia. In 1971 the Croats demanded that their language be accepted as one of the languages of Yugoslavia which in 1974 was acknowledged by the Yugoslav government (Jordan, 2002). This means that, while similar, one by no means can call the two languages the same. While the two ethnic groups speak similar languages and have both common features in their cultures and many differences, each ethnic group inhabits a large area in the Carpathian Basin so on a map showing the region the picture communicated to the map reader is severely distorted should these categories be combined. While attempts were made to combine these

categories it is clear that one cannot regard them as the same lingual, ethnic or cultural group (Krallert, 1961).

While combining categories on maps does happen creating new categories is under no circumstances the job of the cartographer. There have been maps where such categories have appeared and, in most cases, these cannot be proven by any available data from the time of the map's making.

The last important factor is the map's scale. This is something that appears on all maps and, in the case of topographic maps, there are certain practices that have standardized the scale. Since the base maps used on thematic maps are overgeneralized topographic maps the scale used has been standardized but one still needs to take the usual problems of the scale into account: the smaller the scale the less information can be shown on a map. The larger the scale the larger the map making it harder to have a general picture of a given area. If the map cannot be printed on one sheet reading the map becomes very complicated and time consuming which, again, makes it very difficult for the map reader to get an accurate picture of the ethnic structure of the depicted area even if the map itself is very accurate. On large scale maps the exact geographical location of the population can be depicted much more precisely.

3. DEPICTING ETHNIC GROUPS IN PRACTICE

While the concepts discussed above are great concepts in theory, it is often very difficult to apply them in practice. These concepts contradict each other to a certain degree thus applying all of them in full is impossible. Hence the question the mapmakers need to ask themselves is not if one is able to apply these concepts in full by checking if the map shows density of the population while depicting the given population in exactly the geographical area where they live all the while keeping the map legible. At the same time cartographers need to choose a mapping method that does show the statistical data provided to the extent possible in an objective manner (Krallert, 1961).

Analyzing this is the best when one uses historical examples. The largest number of ethnic maps using different mapping methods that both apply the above concepts and others that prove the negative effects of the lack of applying the above concepts were made at the end of the First World War of the Carpathian Basin. It is important when selecting the maps to be analyzed that both positive and negative examples should be available from the same era and the same area should be depicted on all maps. The examples, while there will be some from all parts of the Carpathian Basin, will focus on Transylvania since this is the area where (i) most different maps are available and (ii) the terrain makes applying these concepts even more important.

3.1. Choosing an ideal projection and scale

Before a map can be made in any way a scale and projection must be chosen and all information depicted on the map must be depicted at the chosen scale. As far as the projection is concerned an equal area projection should be used when depicting pop-

ulation since the goal of the map is to present data about the population in geographical space. This means that the mapmaker wants to communicate information about the territory inhabited by a certain group of people. The choice of ideal projection in practice depends on the depicted territory. In the temperate climatic zones, one would generally choose a conic projection while in the tropics, due to its closer proximity to the equator, one would choose a cylindrical projection (Cauvin et al, 2010a). At the poles a plane projection would be the best, but this is not a question that would arise in practice since those regions a very sparsely inhabited. In the case of the Carpathian Basin (or parts of it) one can say that in general an equal area conic projection is what one should use. It is however important that the central meridian and the central parallel should be visible on the map since these define the starting point of the projection, which also define the distortion free area on the map. The further a given point on the map is from the distortion free area the greater the distortion on the map.

In practice the maps showing population are often based on an existing map. Before computers became widely available in the 1990s the calculation of projections was a strenuous task. Today the method that Muehrcke was expecting is available in all commercial and open-source GIS software. However, that when automation is used the concepts developed before automation still need to be applied.

The original topographic map was usually heavily generalized and the projection was very rarely recalculated. The intense generalization is necessary in order to avoid overloading the map and making it cluttered (Frenzel, 1967). While it is true that usually equal area conic projections were used, especially on Romanian maps that depicted only the eastern parts of the Carpathian Basin, the starting point of the projection is not on the map. While this should be avoided on all maps it can be said that this had less effect on how the ethnic structure of the area communicated by the map to its user than other factors discussed in this study.

When choosing the scale one must keep in mind the size of the depicted area. The smaller the scale the more heavily the map must be generalized. The choice of the scale on maps generally depends on the size of the smallest object. Unless the symbol depicting the object is enlarged on the map (for example roads that become too narrow to depict at the given scale), it will have to be removed from the map. The smallest depictable object on a map is 0.25mm (Cauvin et al, 2010a). This applies not only to topographic data on the base map but also to the thematic data on the map. Depicting thematic data does have its similarities to depicting topographic data. If the area of the sampled data or its geographical neighborhood are smaller than the mesh size on the map the information will be lost (Muehrcke, 1972). Enlarging symbols showing population will distort the picture as will removing it. This needs to be compensated using the correct set of symbols. All types of thematic maps have their own set of rules, so one should not try to apply rules developed for topographic maps (Cauvin et al, 2010a). Using different mapping methods can mitigate this loss to a certain extent but in general the basic concept that larger scale maps can hold more information also stands in the case of ethnic maps. This means that the mapping method used on the map depends on the scale of the map.

While large scale maps can hold large amount of information two further aspects have to be considered. Firstly, one must have an understanding as to how much information someone can interpret from the picture and how long this will take. While some people will analyze the map for long periods of time most people need a fast oversight of the map to get an objective picture. Secondly, the larger the scale of the map the larger the map sheet of a given area will be. If the sheet would become too large the map has to be printed onto multiple sheets. This makes a complete oversight of the area very difficult. Initially this was not considered by Hungarian cartographers resulting in a map printed on 54 sheets at a scale of 1:200 000. The map made by Zsigmond Bátky and Károly Kogutowicz showed the number of inhabitants and their ethnic affiliation but would have been so large if the sheets were fitted that most rooms would not have been large enough to accommodate for this (Bátky & Kogutowicz, 1918). But even if this would have been possible no map reader would have had any oversight of the area. Studying the sheets individually and putting the picture together in a person's head is very time consuming and only very experienced map users can do this and get an accurate picture of the ethnic structure of the area. The map is a dot map where a small half circle shows 50 inhabitants, a small circle shows 100 inhabitants, a large half circle shows 500 inhabitants, and a large circle shows 1000 inhabitants (Kocsis, 2007). The circles are grouped in such a way that all inhabitants represented by a given dot like symbol belong to the same ethnic group. The color of the symbol presents the ethnic group. Dot maps such as this one are the best in showing the exact topographic location (Jordan, 1999) and the exact number of the different ethnic groups (Jordan, 1999).

After this very accurate map was made, they did realize that while very accurate and precise the scale of the map made it just about impossible to read. After this the scale was reduced and the map was republished at a scale of 1:300 000 on 12 sheets (Bátky & Kogutowicz, 1919). While this did reduce its size without severely affecting its contents the problem that the map was on multiple sheets was not solved. The scale was reduced again to 1:900 000 by Jenő Dörre and Ernő Lux (Kocsis, 2007). Loss of data did occur in this case since the first two maps used symbols showing 50 inhabitants, and the 1:900 000 map used only symbols showing 1000 inhabitants (Lux & Dörre, 1919). This generalization had to be done since when reducing the scale one cannot have symbols covering each other, otherwise the map will not convey an objective picture of the data shown (Arnberger, 1966), in this case the ethnic affiliation of the population. While the problem of the scale was solved and one could conclude that a map of a scale around 1:1 000 000 is ideal for depicting the Carpathian Basin the mapping method still had several shortcomings. It was however clear that the ideal scale of the map was found and that this map could be printed on one sheet that any map user could handle.

3.2. Mitigating data loss

One can see in the above that while a larger scale does give more opportunities to depict the density of the population on a map that shows ethnic affiliation of the population an ethnic map of the Carpathian Basin that has a scale larger then 1:1 000

000 is hard to read and hard to handle. This means that a good, easy to use map of the Carpathian Basin cannot have a scale that is larger than 1:1 000 000. A mapping method had to be created that showed the density of the population in such a way that minimizes the data loss at the prescribed scale, does not clutter the map, and lets the user have a fast oversight of the ethnic structure of the area. When choosing map symbols for such a map one has to choose symbols that are simple to read. One has to take care of the symbols such that after being tested for convenience and simplicity they still have to function as expected when brought together on a map (Muehrcke, 1972).

If one analyses the maps made by Zsigmond Bátky and Károly Kogutowicz one can see that while the mapping method is very precise it is hard to read. This is not only due to the scale since the map uses a dot symbol method that only creates very small areas that are colored in a certain color that represent a given ethnic group. Dots are discrete so they will lead the eye to see them as discrete while surfaces give the impression of continuity (Cauvin et al, 2010a). While the map does show the uninhabited areas the colored surface of one specific symbol is rather small. Due to this any given color does not even dominate the area of the map inhabited by the given population and the map reader does not have a picture on which areas of a specific color exist, rather spots of that color. Due to this the user cannot see the larger areas dominated by a specific ethnic group. This information can be gathered from the map but is time consuming. Furthermore, when the scale is reduced to 1:900 000 the loss of information is too large to create an accurate picture of the ethnic structure of the area. This meant that a mapping method had to be created which could depict the ethnic structure and density of the population of the Carpathian Basin without extensive loss of data.

The fact that data is lost is a feature of mapping. One however had to set a limit as to how much data loss could be tolerated. To get an accurate picture this limit had to be set to a point where the local minorities had to be visible. A problem that arises from generalization is that when the thematic content is generalized the local small minorities start disappearing. This cannot be completely avoided, but when the picture of an area gets homogenized to an extent that creates the impression that only one ethnic group resides in an area while a significant number of inhabitants live there who are members of another ethnic group or groups the map communicates a false picture. This meant that a mapping method had to be developed that could meet these criteria at a scale of around 1:1 000 000.

3.3. Showing the ratio of ethnic groups

When a symbol shows the ethnic group that makes up the majority in the area represented by the symbol the minorities cannot be seen. Reducing the area the symbol represents mitigates this problem, however the smaller the scale, the less this method can be applied. Since it is clear from the above that the scale cannot be larger than 1:1 000 000 the method had to be adapted to this scale. Using surface symbols to show the majority would, at this scale, not show the ethnically mixed areas and the minorities in detail thus another method had to be constructed.

In 1918 the Hungarian government was developing such methods for the map to be used at the peace talks existing methods were analyzed and some even adopted. One of these methods was developed by Jenő Cholnoky in 1906 (Figure 1). When Cholnoky had to flee Kolozsvár in 1918 he fled to Budapest and assisted the work of the Hungarian peace delegation, thus it was rather evident to try and use his method.

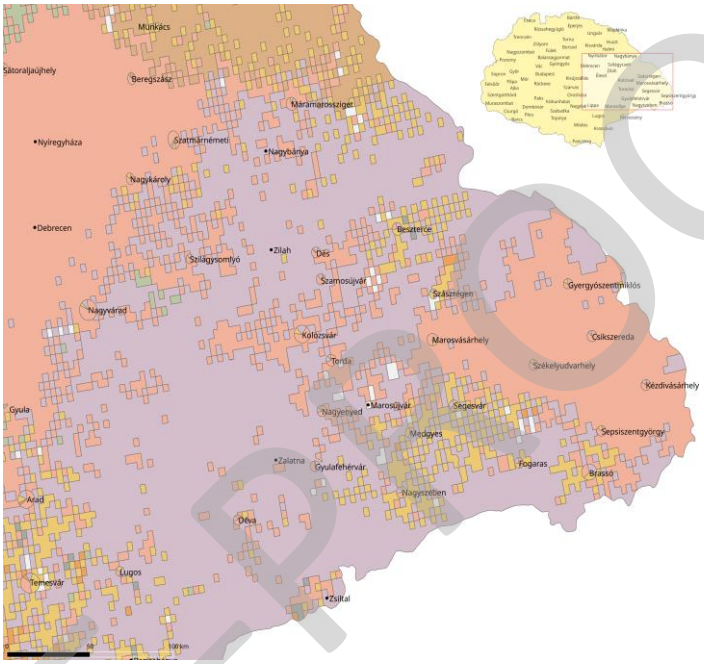

Figure 1

Eastern Transylvania on a reconstruction of the map made in 1918 using Cholnoky's method. The Hungarians are shown in red, the Romanian in purple, the Germans and Ruthenians in yellow, and other in white. The ethnically mixed areas can be seen well (reconstruction made by János Jeney)

Cholnoky's method used ratios instead of showing the majority. He used districts as reference areas for his symbols. The area of the Carpathian Basin was dived into small rectangles. Each district was made up of a certain number of rectangles and the number depended on the size of the district (Cholnoky, 1906). The percentage of rectangles colored in a certain color was the same as the percentage of the population of the district made up by a particular ethnic group. This means that each symbol represents a district and the symbols show the ratio of ethnic groups in the given district (Kocsis, 2007).

This method has its advantages and shortcomings. It fits into the scale of 1:1 000 000, but it can also be used effectively at smaller scales. The colored surfaces are large enough for the map reader to have an actual picture of the ethnic structure of the Carpathian Basin in a short time. The minorities can be clearly seen on the map,

since the map does not homogenize the areas that have an ethnically heterogeneous population. The areas with ethnically mixed population can be seen very well. However the map does not show the density of the population or any uninhabited areas. For this reason, the 1918 publication of the map is based on the 1910 census data and had an inset that showed the density (the real number and territorial distribution) of the population. The problem with this is that while the requested data is available it is shown on two maps. It is very difficult for the map reader to combine this into one picture, especially in a very limited amount of time. This meant that the density of the population had to be shown on one map for the map user to get an accurate picture.

3.4. Showing ethnic data based on the density of the population

Not showing the density of the population severely distorts the picture of the ethnic structure of the depicted area. The extent of this distortion depends on how much the density of the population differs in space: the larger these differences are in the depicted area the larger the distortion. In practice this means that in the Carpathian Basin mountainous areas not showing the density of the population results in much larger distortion than on flat plains. In other words, using colored surface symbols on maps to show very sparsely populated areas without showing the density of the population in any way severely distorts the picture of the ethnic structure and can be regarded as extremely manipulative (Jordan, 1999). The Romanians very often used colored surfaces to depict the ethnic groups. Using such a method would make the Romanian rural population (50 thousand) around Kolozsvár (Romanian: Cluj/Cluj-Napoca) seem eight times as large as the Hungarian population living inside the city (50 thousand) when in reality they were roughly equal (Kocsis, 2002).

It is important however that the criteria discussed above must be applied to such a map as well. This means that a map had to be created where the size of the population, the minorities, and ethnically mixed areas can be seen at a scale of maximum 1:1 000 000. It was also of concern that the map reader must get an accurate picture in a very short amount of time, meaning that the interpretation of the symbology cannot be overly complicated.

This was first achieved by Count Paul Teleki who created a map (actually a cartogram, a value-area map) in 1919 based on the census of 1910. All criteria discussed above were achieved. The cartogram[1] was made at a scale of 1:1 000 000. Every square millimeter on the map represented 100 inhabitants, and its color showed the ethnic affiliation of the depicted population (Figure 2). If any inhabitants lived in an area where the population was less than 100 this population was added to the nearest inhabited area, meaning that every inhabitant was represented on the map. This led

[1] The work is commonly known as a map since the base map actually does have a projection and is indeed a map. The thematic data however is presented in such a way that it resembles a cartogram, hence in this study it will be referred to as a cartogram since the study deals with the thematic data

to the fact that while there was a minor error in the geographical area of some inhabitants, the general picture the map communicated of the ethnic composition of the Carpathian Basin is very accurate (Kocsis & Tátrai, 2006). Uninhabited and sparsely populated areas can be seen while the population numbers are also clearly visible (Teleki, 1919). If one looks at the method used for showing the thematic content on the map, one can say that the method resembles an anamorphic cartogram (Kocsis, 2007). Not all studies of this map interpreted its methodology correctly. When one looks at the map the white areas are often interpreted as uninhabited areas while in actual fact the legend states that they are uninhabited and sparsely populated areas. Often no mention of the fact is made that the areas where the population was less than 100 inhabitants these are added to the nearest populated area as it was the case in the publication of Wilfried Krallert in 1961 in the International Yearbook of Cartography (Krallert, 1961). At the same time, it is said the Bátky and Kogutowicz maps are very objective but no research is done into the interpretation of their mapping methods (Krallert, 1961). While the maps not showing the density of the population over represent the rural population this map shows the exact ratios.

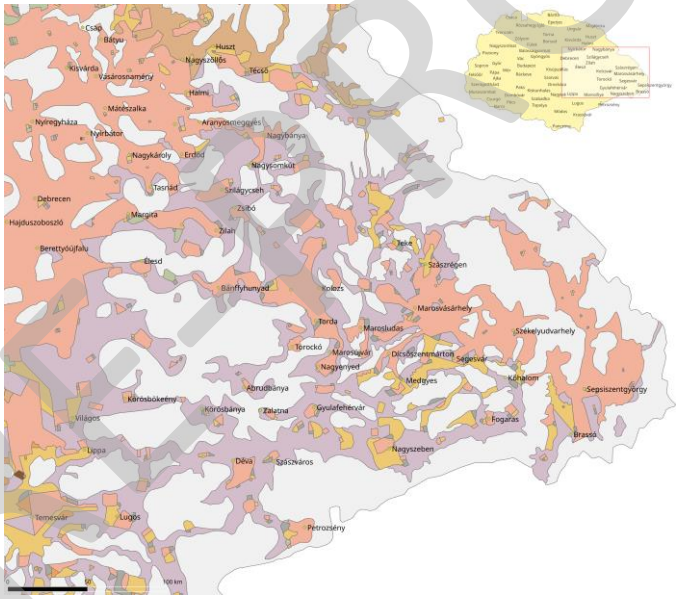

Figure 2

Transylvania based on the Teleki cartogram. Purple shows the Romanians, yellow the Germans, pink the Hungarians and gray the uninhabited and sparsely populated areas. One can see that on this value-area thematic map Romanians create a visual impression corresponding to their proportion within the contemporary population (1910: 55%). (reconstruction made by János Jeney)

Looking at it from the point of view of the ethnic composition one can see that in Transylvania the ratio of Romanians against the total population is much less than what it seems on maps not showing the density of the population. At the same time

in the Banat the general picture is very similar to that conveyed by the map designed by Cholnoky since both show the mixture of the population. The method employed on the map lets the map reader get an accurate picture in a very short time since colored surfaces and not colored spots are easily distinguished.

3.5. Maps with new categories

In the first part of this study, it was discussed that a mapmaker in some cases must combine categories if it is not possible to create the number of symbols needed to depict all categories on the map. A mapmaker cannot however create new categories since cartography is about depicting the data not about creating statistics. The map also must give reference to the source of the data otherwise it cannot be determined of the data is accurate or not.

Despite this a map has been made where very strange categories have been created that cannot be proven by any available census data. Aurelian Florinescu made a map where a new manipulative category was introduced by the name of "Hungarianized Romanians" (Florinescu, 1914). It is not clear what data source the mapmaker used for this category. While this type of category-creating is incorrect and fortunately uncommon it does happen from time to time. Similar issues arose on the ethnic map of the Balkans made by Jovan Cvijić of the Balkans where he added the category of "Albanized Serbs" on his map of Macedonia in 1909 (Wilkinson, 1951).

The symbology of the map is also of great interest. The symbol for the category of "Hungarianized Romanians" uses a symbol that is the same color as that used to depict Romanians. This causes the two symbols to be seen nearly as one by the map user. In fact, if the time available to interpret the map is very short the two symbols are seen as one. Since the symbols in theory depict very similar categories this would be a logical choice of symbology, but it is not clear how this category was created. This means that since there is no explanation for the source of this category on the map sheet the data represented by this symbol cannot be considered accurate.

Another interesting category on the map is the category of German and Romanian mixed areas. Since the map is severely overgeneralized, this could have been avoided by choosing a smaller reference area of the symbols. The symbol uses a pattern that also has the same color as used for the Romanian areas. The creation of this symbol can theoretically be justified by the cartographer since this was created by combing two existing categories but no criteria that is to be used for such combinations was followed. The categories of Germans and Romanians are not similar: both ethnic groups are present in large numbers in the depicted area and separate categories for Germans and for Romanians do exist on the same map. The map is overgeneralized to the extent that the German and Hungarian minorities in southern and western Transylvania are not visible. It is interesting however, that the Seklers in eastern Transylvania are shown as Hungarians and not "Hungarianized Romanians". This is correct, since the Seklers do consider themselves ethnic Hungarians and this is the data that is given by the census from that time (Florinescu, 1914).

Since the map is overgeneralized, it communicates a picture that shows a much larger percentage of Romanians in Transylvania than that shown by the maps made

by both Teleki and Cholnoky. This is because the map is overgeneralized, and the minorities and ethnically mixed areas cannot be seen. The fact that the map does not show the number of inhabitants further distorts this picture when compared to the Teleki cartogram (Teleki, 1919). The fact that the map contains an otherwise unknown category from an unknown data source further distorts this picture. It is safe to say that the map communicates a false picture of the ethnic structure of Transylvania.

3.6. Maps with inconsistent symbology

When creating a map the symbols used in the legend must be applied in all areas of the map. This means that if, for example, the legend has a symbol for uninhabited areas the map must show all uninhabited areas. One can see from the above examples that the depiction of uninhabited areas on ethnic maps is very important for the map to be able to communicate an accurate picture of the ethnic structure of a given area.

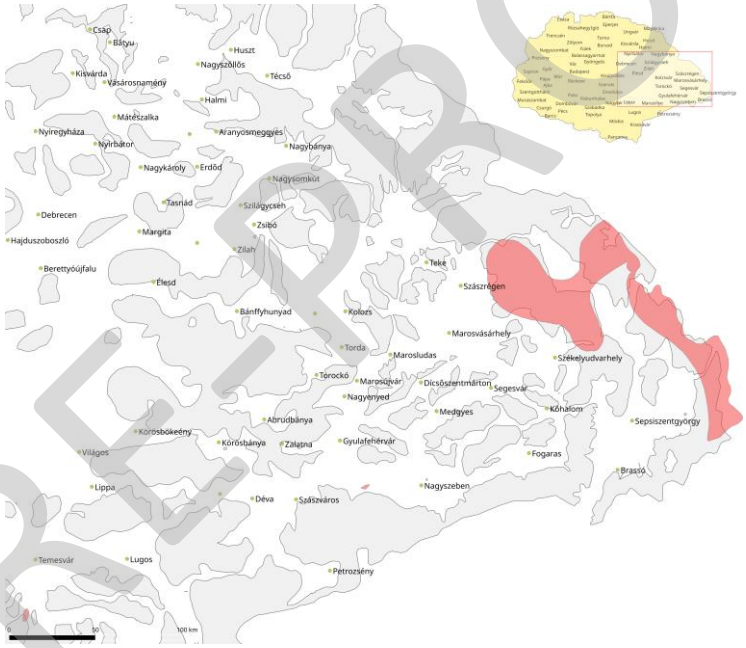

Figure 3

Uninhabited areas shown on the Teleki map (gray) and uninhabited areas show on the Popa & Istrate map (red). One can see the gray areas under the red areas, but other uninhabited areas seen on the Teleki map cannot be seen on the Popa & Istrate map. (reconstruction made by János Jeney)

On a map made by Val. Popa and N. Istrate a category of uninhabited areas is shown in the legend. This does appear on the map in the middle of Seklerland which is inhabited dominantly by Hungarians. While the area shown by this symbol is largely uninhabited the fact that no other uninhabited areas are shown makes this a

very serious mistake (Popa & Istrate, 1916). Having such a symbol on the map creates the impression that all uninhabited areas are shown on the map. While ethnic maps generally do not show relief since this would make reading the map very difficult, it is rather clear that high mountains in general are usually uninhabited with the population living in valleys. The edge of this uninhabited area is on a ridge on the top of the Carpathian Mountains which is unrealistic. Furthermore, other uninhabited areas are not shown on the map (Figure 3). Since the other uninhabited areas not shown are in the proximity of Romanian-inhabited areas and are shown as Romanian areas, the uninhabited areas shown are in the proximity of areas inhabited by Hungarians should also have been shown as Hungarian areas Using this symbol in the way it was used distorts the picture even more than if no uninhabited areas were shown. The map is overgeneralized, thus the minorities are invisible which distorts the picture even more creating the impression of an even larger Romanian dominance in Transylvania.

3.7. Showing ethnically mixed areas using one symbol

As it can be seen from the previous examples a reference area of a symbol has to be as small as possible. If this is not the case the map either homogenizes the picture of the ethnic landscape or new symbols are created which cause confusion.

British cartographer B. C. Wallis used a method in which symbols used different shades of a color to represent the percentage of a given group living in a certain area. A light shade of a certain color showed that a certain ethnic group made up 25% of the population, a somewhat darker shade of the same color showed that the given ethnic group made up over 50% of the population and an even darker shade showed that the ethnic group made up over 90% of the total population (Wallis, 1918). In ethnically mixed areas this made the map cluttered and no information could be read from the map. This in general could have been avoided if the mapmaker would have used symbols with a much smaller reference area. After having made this map Wallis decided to publish another version where the category showing the population between 25% and 50% was scrapped. This resulted in a map that was not cluttered, but the loss of information was extremely large. Large areas are shown where the ethnic group shown only makes up 50%-90% of the population, and no information is provided as to which other ethnic group or groups live in the area. The map reader does not even know how many other ethnic groups live in the given area and where in the area they live. Areas where no ethnic group makes up 50% of the population are left white. A white symbol is created in the legend to depict mixed areas creating further information loss, since the map has large areas where no information is available about the ethnic composition other than the fact that they are mixed. Through this symbology even extent to which these areas are ethnically mixed is not communicated very well since all the map reader sees is one large homogeneous area. This heavily overgeneralizes the map, and severely distorts the picture the map communicates to the map reader. In the Banat for example large white areas are seen where no information is communicated about the area represented by the given symbol other than that no ethnic group makes up 50% of the population in that area.

3.8. Showing uninhabited areas using the same symbol as another category

In the previous examples it can be clearly seen that depicting uninhabited areas is crucial to communicate an accurate picture. If these are not shown the area has to be colored in such a way that represents the inhabited areas around it in order to preserve the ratios of ethnic groups on the map as much as possible.

On a map made by Prof. Demetresco this is not adhered to. All uninhabited areas regardless of where they were found were shown as if they were inhabited by Romanians (Figure 4). Many of these areas are not just uninhabited but also uninhabitable since these are in high mountains. The uninhabited areas in Seklerland are shown as areas inhabited by Romanians. While the fact that no uninhabited areas are shown on the map distorts the picture the map communicates of the ethnic landscape, but showing uninhabited areas in the proximity of areas inhabited by Hungarians as if they were inhabited by Romanians distorts the picture to an even greater extent. By doing this the map would need to have a data source according to which the areas concerned are inhabited by Romanians. No data source is shown on the map, which discredits the information shown on the map (Demetresco, 1919).

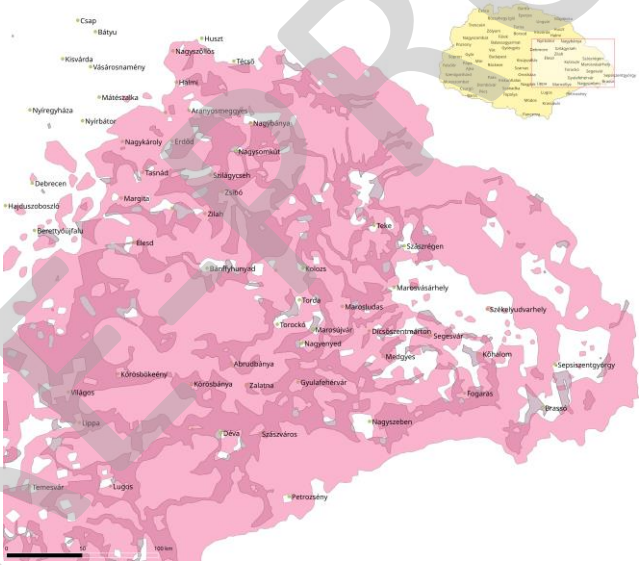

Figure 4

Romanians show on the Demetresco map (pink) and Romanians shown on the Teleki map (purple and dark pink). It can be clearly seen that by showing uninhabited areas as if they were inhabited by Romanians changes the picture of the dominance of Romanians in the area. (reconstruction made by János Jeney)

4. CONCLUSION

The mapping method used on a map heavily affects how information is conveyed by the map to the user. While using a larger scale can help to convey more information

to the user increasing the scale increases the size of the map. If the map is too large reading the map becomes very difficult and creating a picture of the ethnic landscape of the depicted area becomes impossible. One must find the maximum scale that can be used to depict the area and then find or develop a mapping method that can depict the population in such a way that gives an accurate picture of the ethnic landscape of the mapped area. Two very important aspects when choosing the mapping method is that the minorities should be visible and that the density of the population should also be visible on the map especially when the density of the population is very heterogeneous in the mapped area.

While it can be seen from the examples how to improve the quality of the map to convey an accurate picture of the ethnic structure of the mapped area other examples show what happens if very basic cartographic principles are adhered to. In these cases, the picture of the mapped area is severely distorted especially when the symbols in the legend are not applied consecutively or the thematic content, in this case the ethnic affiliation of the population, is overgeneralized.

While it is clear from the above that some methods show a more accurate picture than others, inaccurate methods were used by some mapmakers (especially Romanian mapmakers). This happened even though by then it was clear that these methods were inaccurate. When one simply handles these maps as simple thematic maps this seems irrational. The only rational explanation is that ethnic maps were always made using political motives since one of their primary functions was to influence decision makers redrawing borders.

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