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ABSTRACT

Centrographic analysis is a statistical technique that has been used for more than a century and that has experienced a rapid renewal over the last few years, in large part due to its integration in geographic information systems (GIS). Through the use of this centrographic technique, spatiotemporal analyses were performed in a GIS on the intra-urban migratory phenomenon in the Greater Moncton area. Greater Moncton, in the heart of the Maritimes in southeastern New Brunswick, Canada, is the only urban region in Canada with such a high degree of cohabitation between Acadians and Anglophones, who are in the majority. However, despite their minority status, over the years, Acadians have become more and more present in New Brunswick society through the creation of Acadian institutions in the fields of education and financial services. The aim of the current research is to study the various behaviours of Acadian and Anglophone inhabitants in their urban practices. Our analyses show that the more or less homogeneous distribution of Anglophones gradually occupied almost all the space in the Greater Moncton area between 1981 and 1996. Unlike this dynamic, the trend of the concentration of Acadians in the northwest and northeast, descending into the southeast, and in particular the migratory trend of Acadians toward the residential areas close to the Université de Moncton has become a remarkable phenomenon in the region being studied. Consequently, it reminds us of the vital role that the Université de Moncton, as an Acadian institution, has played in the growth of the Acadian milieu in the Moncton area over the course of the past decades.

1. INTRODUCTION

The development of a fully adequate theory of regional analysis by statistical means was one of the principal longstanding problems of geography. Neither maps nor statistics alone are enough; they must be brought together. Centrographical analysis is a perfect example of this combination. It is an aggregate of indicators that allows the description and measurement of the global characteristics of the distribution of spatial phenomena. This type of analysis provides the equivalent of statistical measures of central tendencies and dispersion, adapted for a two-dimensional geographical space (Capriolo, 1970). Jones (1980) presents centrographic measures as describing the three most important characteristics of a spatial phenomenon: its location, dispersion, and form. The idea of measuring the center of population distribution using centrography originated a century ago, as far as can be determined. Hilgard (1872) has been credited as the first person to compute a reliable census, when he attempted, in 1872, to trace the movement of the population of the United States as it expanded westward. Since that time, there have been many important developments in this field, and other closely related fields, for example, the creation of new methods, the correction of various errors and misconceptions, and the clarification of the interpretation of computed results. Over recent years, centrographic analysis has evolved quickly, in large part due to its integration in Geographic Information Systems (GIS). It is also being increasingly applied in different fields.

2. HISTORICAL CONTEXT

In the heart of Canada's Maritime provinces, we find a unique urban region: the Greater Moncton area, whose unique characteristic is the cohabitation of Acadians and Anglophones. This mostly bicultural region, which includes three communities, Moncton, Riverview and Dieppe, is located in southern New Brunswick on the Petitcodiac River, about 40 kilometres from the mouth of the Bay of Fundy. Over the years, this population cluster has made itself known across the country and even throughout international Francophone. The roots of the region are found in the city of Moncton, which grew from a small Acadian colony. Following the deportation of the Acadians in 1755, the area was abandoned until the arrival of Dutch and German immigrants in 1766. However, Moncton, which was named for Robert Moncton, a Lieutenant-Colonel in the English army, marked the beginning of English domination and, under him, became a center for the shipbuilding industry (Brun, 1999). In 1855, Moncton was incorporated as a town (Pelletier and Assenault, 1977), but its charter was only adopted in 1962. In around 1887, Moncton experienced a marked boom following the establishment of the corporate headquarters of the Intercolonial Railway, which later became Canadian National Railways or CN.

Due to its excellent geographic location, Moncton was the Maritimes' railway center for nearly a century before becoming, in the 1960s, a major distribution and services center. Today Moncton plays a key role in the development of the Maritimes as an important center for the high-tech and telecommunications sectors (Cormier, 1995). It is also the only Canadian region with such a high concentration of Acadians, who are still in the minority.

For the past thirty years, with the creation of Acadian institutions in the fields of education and financial services, such as the Université de Moncton, the Acadian cooperative society and Assumption Life, Acadians have become increasingly present in New Brunswick society, particularly in the Moncton area (Beaudin, 1993). The Acadians who are now living in urban regions in New Brunswick come from rural areas that are mostly Francophone. They have a high level of education and have moved to be closer to employment opportunities that offer more possibilities in terms of professional careers (Beaudin and Boudreau, 1994). In fact,
the entrepreneurial spirit that has inspired Moncton since the CN offices closed in the mid-1980s is partly due to the cohabitation of Anglophones and Acadians. The implementation of a strategic planning vision is seen as a way to connect two linguistic groups has enabled the Moncton area to take charge and find various alternatives to deal with the difficult situation that followed the closure of the CN facilities. Today, the Acadians living in the Greater Moncton area hold important positions in the business world, as well as in both the federal and provincial public service, and in the field of university teaching (Higgins and Breau, 1993).

This new reality is undoubtedly causing a major transformation in the region's socio-spatial structure (Cao, 2001). Over the past twenty years, transformations have occurred that have considerably modified the process of spatial distribution of Greater Moncton's Acadian and Anglophone inhabitants. Using a series of centrigraphic analyses in spatio-temporal dimensions, this study will attempt to show the aspects related to the articulation of the important actors, in particular the Acadians, in the intra-regional migratory phenomenon of the region being studied. The aim of this series of analyses is to develop a geographic information system (GIS) on the evolution of the Acadians, in order to reveal their urban behaviour practices as compared to those of the Anglophones, in particular their choice of residential area.

3. MIGRATORY PHENOMENON OF THE ACADIAN POPULATION

The triad of communities, Moncton, Dieppe and Riverview, that constitute the Greater Moncton area play a specific role in the process of spatial distribution of the Acadian and Anglophone residents. Dieppe and Riverview are traditional ethnolinguistic localities with a strong dichotomy in their linguistic composition. These two towns act almost as linguistic "ghettos." The inhabitants of Riverview are almost all Anglophone, while Moncton is predominantly Acadian. The town of Dieppe demonstrates relatively the same pattern of homogeneity, but in the opposite sense, attracting a principally Acadian population (See Table 1).

Moncton, however, presents a dynamic situation overall with regard to the mixed society of Acadians and Anglophones. Over the past few decades, the spatial and temporal diffusion of the spreading phenomena for both the Acadian and Anglophone populations was significantly accelerated, in particular due to a considerable increase in the number of newly arrived Acadians (Roy, 1990). In this sense, this diffusion corresponds with the transmission and gradual adoption of the majority Acadian population in this space. According to Bailly's study (Bailly et al., 1995), the few arrivals, minorities in particular, could choose to move to communities where they could find the milieu closest to their culture and their ethno-cultural group. People could also leave their neighbourhoods when different ethnic or cultural groups arrived and moved to similar urban or suburban zones. From this perspective, by reproducing spatial regularities, centriographic analyses help us to understand the major processes taking place in this transformation.

Given the preponderance of the Acadian-Anglophone dynamic in the Moncton area, the context's linguistic reality continues to play a vital role in the urban practices of the inhabitants. The series of centriographic analyses concerning the distribution of English- and French-speaking populations therefore shows a significant movement in the Greater Moncton area over the course of the last fifteen years. Figure 1 is composed of four schematic maps, each corresponding to a census, the first from 1981, the second from 1986, the third from 1991 and the fourth from 1996. These maps contain two series of ellipses each, three blue hierarchical ellipses representing the migratory phenomenon of the Acadian population and three red hierarchical ellipses representing that of the Anglophone population. Each map also includes five index points that are points of reference helping to visualize the different movements of the ellipses. On the map for 1981, Point A and Point B are therefore located in sector 0011.00 (northwest Moncton). Point C is located in sector 0003.01 (west Moncton), and, finally, Points D and E are located in sector 0014.00 (one in the southeast and the other more to the east). Each of the three hierarchical ellipses contains a central point, which is the center of gravity point (CG) point. There are two points per map, blue for the Acadian population and red for the Anglophone population. Figure 3 is the map that enables us to make a better comparison of the various movements, as this map only contains the four series of ellipses that represent the spatial distribution of the Acadians, one series for each of the censuses.

4. TRACKING THE MOVEMENT OF THE ELLIPSES' CENTERS OF GRAVITY

The center of gravity (CG) of an ellipse in centriographic analyses is the relative center of the region being studied, according to the weight of each of its geographical units. When studying the spatial distribution of a phenomenon, if this phenomenon is distributed unevenly between geographical units, it is interesting to take into consideration the weight of each geographical unit and to assign this weight to each point. The calculation of the coordinates of the center of gravity is then based on these data and the weights of the geographical units in the region. It is, in fact, a useful reference for comparing several geographical units (i.e., containing different geographical regions) or for comparing the position of one geographical unit over time (Pumain and Saint-Julien, 1997, p.54).

We determined the weights of centers of gravity for the spatial distribution of both the English- and French-speaking populations for the four censuses, i.e. 1981, 1986, 1991, and 1996, and presented them in Figure 1. In 1981, the center of gravity representing the spatial distribution of the Francophone population was located in sector 0006.00 (near the center of Greater Moncton); but touched sectors 0012.00 and 0013.00, which are closer to the east, compared to in 1981, when the CG was located at the east of sector 0006.00 without touching the others. The CG has therefore moved slightly the north and also slightly to the east. As of the most recent census, in 1996, the CG only touches sectors 0122.00 and 0133.00; as we know that it was no longer touching sector 0006.00 in 1991, it has only continued its trajectory toward the northeast. The movement or even attraction of the center of gravity seems to be due to the existence of the town of Dieppe, which still has a high number of Acadians, and therefore must be drawing the center of gravity to the east and to the north because of the presence of the Université de Moncton. The university promotes the development of the surrounding sectors, particularly those to the northeast.

However, the center of gravity representing the spatial distribution of the English-speaking population has experienced much more limited movement. The center of gravity for the Anglophones, which was located in sector 0005.00 in 1981, has moved to the east over time, but at a much slower rate than that of the Acadians; it has never left

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3 Statistics Canada only began including the language usage variable in the 1991 Moncton census agglomeration as of 1981.
4 The sector numbers are presented in Figure 2.
5 In this research, the geographical unit is the census tract (CT). A CT is a small geographical unit representing urban or rural communities created in census metropolitan areas and census agglomerations in Canada, in which the city core has 50,000 inhabitants or more according to the previous census (Callon and Arseneault, 1999).
In two series of ellipses representing the Acadian population and three of the Anglophones, the points that are points of contact of movements of the two populations A and Point B are (northwest Moncton, west Moncton, and sector 0014.00 (one in the east)). Each of these points is a center of movement and identifies a region that enables us to identify its movements, as this region represents the gravity center for each series of the ellipses.

5. EVOLUTION OF THE FORMS OF THE ELLIPSES AND CHANGES IN THEIR MAJOR AND MINOR AXES

The evolution of the forms of the ellipses and the changes in their major and minor axes in cartographic analysis express the dispersion of the phenomenon under study in relation to the two spatial dimensions. In order to report better the spatial distribution of the overall phenomenon being studied, the ellipse can be oriented according to the direction with the most variation (Collet, 1992, p. 132).

Let us now look at the ellipses in Figure 1, which surround the index points. The exterior ellipse representing the Francophones, which is the ellipse the furthest away from the center of gravity, in 1986, touches Points B, C, D and E as in 1981, except that it is getting closer and closer to Point A, due to the rotation of the series of ellipses. In 1991, this ellipse was touching the bottom of Point A, but still touched the other points. Finally, in 1996, the same evolution continues, however now the ellipse touches Point A; also, Point B moved higher and Point D moved lower.

The rotation of these ellipses is still related to the increasing weight of the Acadian population in the geographical units in the region to the north and to the east of the Uniak Centre in Moncton and the town of Dieppe. This shows that the distribution of the French-speaking population is concentrated in the northern part of the region descending into the southeast. One can then see that the region under study can be divided, starting in the northwest and coming down diagonally toward the southeast. The northeastern part of the diagonal would be the part preferred by the Acadians. Statistics confirm that the area of the ellipse grew between 1981 and 1996 toward the northeast and southwest due to the expansion of the Acadians. The area went from 171.75 km² in 1981 to 184.49 km² in 1996, an increase of around 13 km² (See Table 2).

The Anglophones present ellipses that are increasingly round. This demonstrates the homogeneous distribution of Anglophones throughout the years, come to occupy almost all the space in the region under study. In fact, the area of the ellipse grew by only 8 km², a smaller increase than that of the Acadians.

Moreover, the major axis of the ellipse representing the Acadians, which is the horizontal length of the interior ellipse, experienced more change than the minor axis, which is the vertical length of the interior ellipse. These changes include a rotation toward the north and an increase in length. This must be due to the dispersion of the Acadians in the region, as mentioned previously. The major axis measured 7544 meters in 1981 and was 78.51 degrees north, while in 1996, the major axis measured 8050 meters and its angle was 71.85 degrees north (See Table 2). The difference is therefore around 500 meters for the major axis and only 22 meters for the minor axis, with a rotation of almost 7 degrees to the north.

In effect, these results partly demonstrate the dynamic of the Acadian population's migratory phenomenon.

There have been a fair number of changes during this relatively short period of time. If we compare the changes for the Acadians to those for the Anglophones, we can see that the distribution of the Anglophones has experienced a completely different evolution, the angles of their major axes have changed by 18 degrees to the north, a much greater variation than that of the Acadians. The major axis measured 6438 meters in 1981 and, fifteen years later in 1996, it measured 4924 meters, a decrease of 1514 meters. On the other hand, the minor axis, which measured 4924 meters in 1981, grew to 5518 meters by 1996, an increase of almost 600 meters. This explains why the ellipses became rounder during this period.

Over time, the Anglophones have subtly become increasingly homogeneous throughout the region.

6. DYNAMIC OF THE ACADIAN POPULATION

Figure 3 enables us to confirm what we observed above of the urban practices of the Acadians, in particular their choice of residential area, as this figure shows only the Acadian population over the course of the four censuses. First, we looked at the ellipse’s major axis in 1996, which showed a significant rotation to the north, as the ellipse was tilted toward the northeast along the major axis and the southeast along the minor axis; this phenomenon was probably due to the increase in the demographic weight of the Anglophone in the center of the region and other neighboring sectors. They exerted a strong force on the town of Dieppe to the east of the region being studied, and seemed to draw the center of gravity toward them. Secondly, it is important to note that the ellipse’s center of gravity moved around 600 meters to the northeast from 1981 to 1996, which demonstrates in part the importance of the presence of the Université de Moncton to the increase in the number of Acadians in the sectors close to the university, in particular those to the northeast. These changes in the ellipses also prove that the Acadian population in Greater Moncton is constantly evolving.

7. CONCLUSION AND DISCUSSION

Thanks to cartographic analyses on the study of the process of spatial distribution of Acadian inhabitants as compared to Anglophones, there has been a large reduction in the amount of information necessary for a specific series of exact measures allowing us to set out the global pattern of evolution in a mixed Moncton society over the last few decades. The various phases of socio-spatial evolution of the Acadian people have illustrated the basic outlines of this conclusion. The analyses show above all that the dynamic of the spatial distribution of the Acadian residents in the various sectors seems to reinforce a concentration of Acadians in certain Francophone linguistic "ghettos," notably in the northeast and northwest of the Moncton area, descending into the southeast. In addition, as opposed to the urban practices of the Anglophones in that sector, the Acadians seem mostly to choose a priori to move to the area the closest to their culture and ethnic group. Finally, the migratory tendency of Acadians toward the residential areas close to the Université de Moncton is becoming an important new characteristic of the region under study. This study shows that, over the course of the last few decades, the Université de Moncton, as an Acadian institution, has played a major role in the growth of the Acadian milieu in the Moncton area.

The advantages of cartographic analysis in a geographic information system are obvious in this study. However, in order to correctly assess the scope of our results, it is important to emphasize certain limits to the kind of analysis performed here. The data used is aggregated and only allows the identification of global trends. Our cartographic analysis has certainly proved to be an effective way to set out the major characteristics of the intra-urban migratory phenomenon in the Greater Moncton area. It does not, however, truly take into account the choice of residential area, as this choice is a complex process, affected by various factors. In that sense, it would be worthwhile to do a survey of the individuals involved in order to have a better understanding of the process.

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Produced by Huihua Cao, Cartography Laboratory, Université de Moncton, Canada, March 2001.
Figure 2. Census Tract Numbering, Greater Moncton, Canada, 1996

Figure 3. Evolution of the Migratory Phenomenon of the French-speaking population, Greater Moncton, Canada, 1981-1996