

The contribution of English, Scottish and German settlers to the French-Canadian gene pool of the Quebec (Canada) population

The Quebec (Canada) population (approximately 8 million in 2013) descends in most part from French immigrants who settled in the St. Lawrence River valley during the seventeenth century (Charbonneau et al. 2000, Vezina et al. 2005). However, people from other European origins have also contributed to the early settlement of the Canadian province (Bergeron et al. 2008, Tremblay et al. 2009, Tremblay 2010). Following the British conquest of New-France in 1763, immigrants from England, Scotland and Germany came to Quebec (Beaujot and Kerr 2004, Campey 2006, Wilhelmy 2009). Although these immigrants were mostly Protestants, some of them were married to French-Canadians Catholics and thus had descendants who can be traced through genealogical records from the contemporary Quebec population. By means of genealogical data spanning more than three centuries, this study aimed to measure and compare the contributions of these immigrants of English, Scottish and German origins to the peopling of the Quebec regions.

DATA AND METHODS

Data for this study was retrieved from the BALSAC population database (Projet BALSAC 2013). This database contains demographic and genealogical data on the population of Quebec from the 17th to 20th century. Most of the information used to construct this database came from Catholic Church records (birth, marriage and death records). The richness of the database provides a mean genealogical depth rarely seen in other populations, which is a most valuable asset to better understand the origins of a population and the structure of the genealogical links between individuals.

A total of 5100 genealogies (300 per region) were reconstructed for this study. Subjects (the starting points of the genealogies) are individuals who were married between 1966 and 1985 in one of the seventeen Quebec regions (see Figure 1). The genealogies go back as far as the first immigrants who came to Quebec (defined as the founders). The origins of the founders correspond either to their place of birth, marriage or emigration. Immigrants of English, Scottish and German origins were identified and linked to all their descendants in the genealogical samples. All genealogies are linked, that is to say that all kinship links among all ancestors appearing in the genealogies have been established. This is important because the use of linked data allows for example to identify which subjects share the same ancestors and calculate kinship coefficients for each pair of individuals in the sample.

Several demogenetic measures were used to describe and analyze the genealogical data. These measures include the completeness of the genealogies per generation, which is the proportion of ancestors identified at each generational level (Jomphe et al. 2002), the mean genealogical depth, which corresponds to the average length of the genealogical branches (Cazes and Cazes 1996), the number and concentration of the ancestors, which depends on their number of occurrences in the genealogies, the kinship coefficients between all pairs of subjects (Thompson 1986, Hartl and Clark 2007), the distribution of the founders according to their places of origin and period of immigration, and their genetic contribution to the subjects (Heyer and Tremblay 1995). This measure of the genetic contribution takes into account both the number of occurrences of the founders in the genealogies and the distance, in number of generations, between the founders and the subjects.

RESULTS

Approximately 1 million mentions of ancestors were found in each genealogical sample (Table 1). However, since many of these ancestors appear several times in the genealogies, the number of distinct ancestors is much lower, varying between 36377 (region 11) and 75515 (region 13). On average, ancestors appear between 14 (regions 06 and 16) and 33 (region 02) times. Regions with the highest mean numbers of occurrences are often considered as genetically more homogeneous than other regions. The genealogies span more than ten generations on average, with a maximum depth of 16 to 18 generations. Regional completeness is at least 80 % up to the 7th generation (Figure 2). After the 9th generation, the completeness falls rapidly as the genealogical branches reach the first immigrants to Quebec.

English, Scottish and German founders appear in the genealogies of all seventeen Quebec regions, although in various proportions (Figure 3). Between 16 % and 72% of the regional genealogies contain at least one English founder, whereas Scottish founders appear in 5 % to 39 % of the genealogies and German founders in 15 % to 45 % of the genealogies. English founders appear more frequently in the western regions of the province (around Montreal), as expected according to historical data (Olson and Thornton 2001). The concentration of Scottish founders is higher in some eastern regions (01, 02 and 09), whereas German founders, somewhat like the English, appear more frequently in the western part of the province. Most of these founders appear in less than four different regions, but a few of them are found in the genealogies of the seventeen Quebec regions.

The genetic contributions of the three groups of founders vary greatly according to the region (Figure 4). However, these variations differ from those in the previous figure. This means that the occurrences of the founders of each origin in the genealogies are not uniform across all regions. For instance, Scottish founders who were identified in the genealogies of region 02 have the second highest genetic contribution, whereas the proportion of genealogies in which they appear is much lower than most English founders. Another example is that of the German founders in the genealogies of region 11 (third highest genetic contribution). On the whole though, the genetic contributions of English founders are usually higher than those of Scottish and German founders. The highest value is that of the English founders in the genealogies of region 16, where almost 1% of the regional gene pool is explained by these founders.

Although the contributions of English, Scottish and German founders to the peopling of the Quebec regions remain relatively small in comparison with the French founders, results of this study show that many of these founders and/or their descendants were integrated into the predominant French Catholic Quebec population during the 18th and 19th centuries. Contemporary descendants of these late 18th and early 19th century immigrants can be found in all regions of Quebec.

REFERENCES

- Beaujot R, Kerr D, 2004: *Population Change in Canada* (Second edition). Don Mills, Oxford University Press.
- Bergeron J, Vézina H, Houde L, Tremblay M, 2008: La contribution des Acadiens au peuplement des régions du Québec. *Cahiers québécois de démographie*, 37-1:181-204.
- Campey LH, 2006: *Les Écossais: The Pioneer Scots of Lower Canada, 1763-1855*. Natural Heritage Books, Toronto.
- Cazes MH, Cazes P, 1996: Comment mesurer la profondeur généalogique d'une ascendance. *Population*, 51:117-140.

Charbonneau H, Desjardins B, Légaré J, Denis H, 2000: The population of the St-Lawrence Valley, 1608-1760. In Haines, MR, Steckel RH et al., *A Population History of North America*. Cambridge University Press, 99-142.

Hartl DL, Clark AG, 2007: *Principles of Population Genetics*, Fourth Edition. Sinauer Associates, Sunderland, MA.

Heyer É, Tremblay M, 1995: Variability of the genetic contribution of Quebec population founders associated to some deleterious genes. *The American Journal of Human Genetics*, 56:970-978.

Jomphe M, Tremblay M, Vézina H, 2002: *Analyses généalogiques à partir du fichier RETRO*. Document no I-C-215, Projet BALSAC, Chicoutimi.

Olson S, Thornton P, 2001: La croissance naturelle des Montréalais au XIXe siècle. *Cahiers québécois de démographie*, 30-2:191-230.

Projet BALSAC, 2013 : <http://balsac.uqac.ca/>

Thompson EA, 1986: *Pedigree analysis in human genetics*. Johns Hopkins University Press, Baltimore.

Tremblay M, 2010: La contribution des immigrants d'origine germanique au peuplement des régions de Lanaudière, de la Mauricie, de la Montérégie, de Chaudière-Appalaches et du Bas-Saint-Laurent. *Cahiers québécois de démographie*, 39-2:179-200.

Tremblay M, Letendre M, Houde L, Vézina H, 2009: The contribution of Irish immigrants to the Quebec (Canada) gene pool: an estimation using data from deep-rooted genealogies. *European Journal of Population / Revue européenne de démographie*, 25-2:215-233.

Vézina H, Tremblay M, Desjardins B, Houde L, 2005: Origines et contributions génétiques des fondatrices et des fondateurs de la population québécoise. *Cahiers québécois de démographie*, 34-2:235-258.

Wilhelmy JP, 1997: *Les mercenaires allemands au Québec, 1776-1783*. Les éditions du Septentrion, Sillery.

Figure 1: The 17 Quebec regions

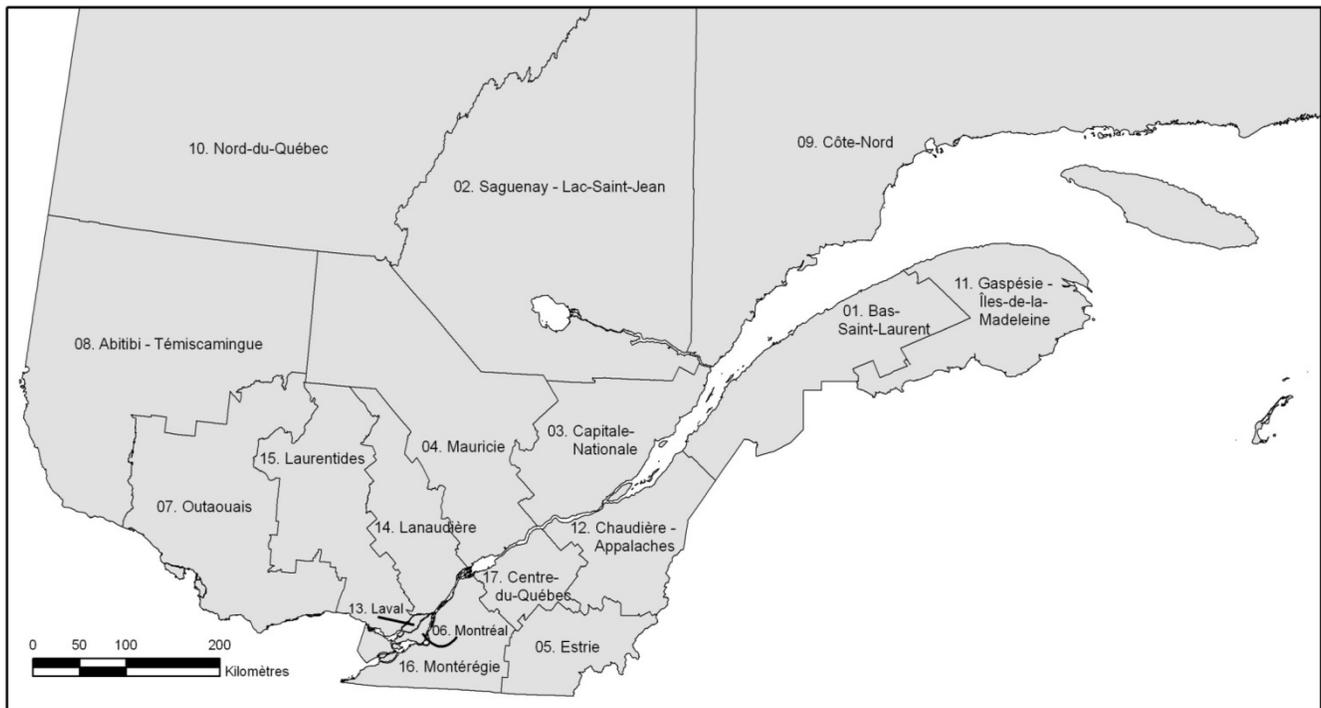
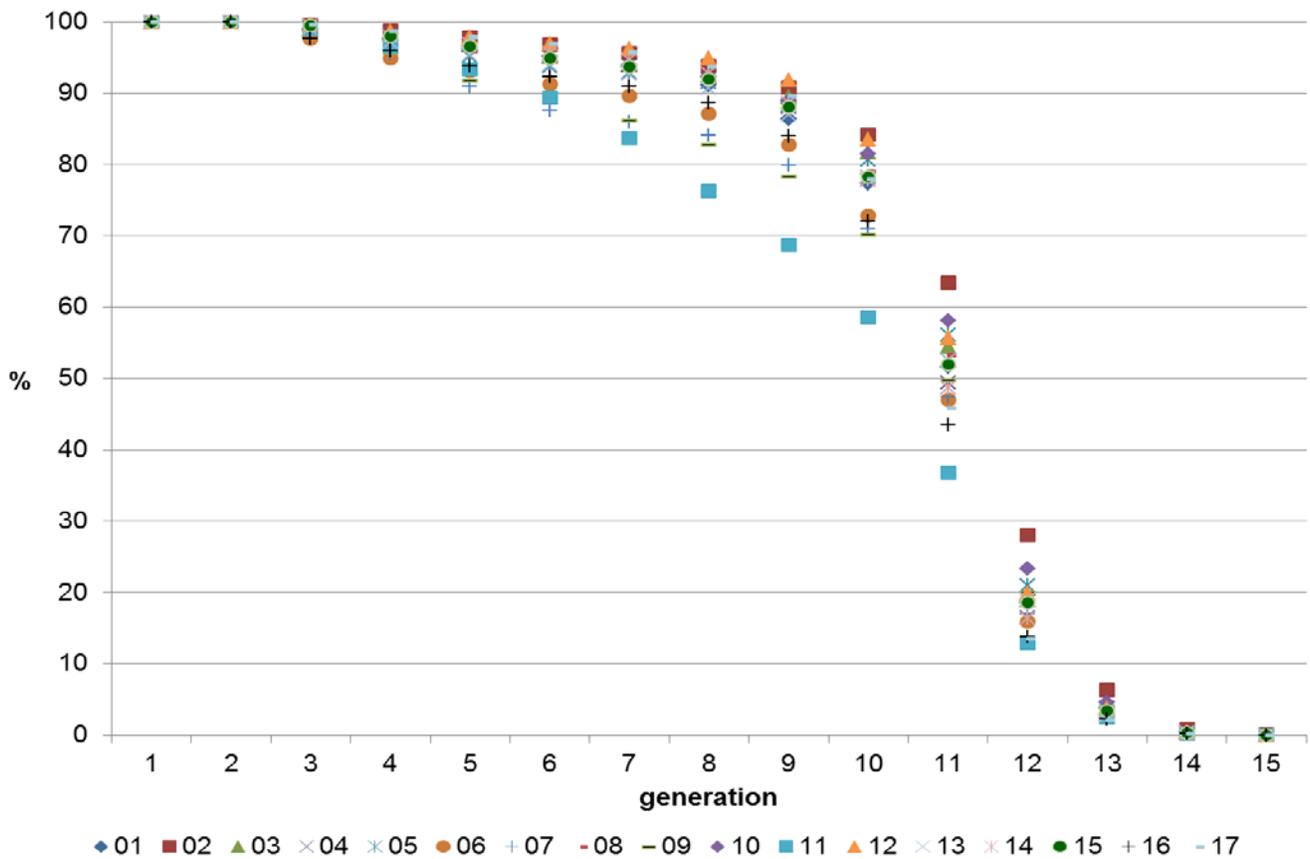


Table 1: Characteristics of the genealogical samples

no.	Region	Total number of ancestors (1)	Number of distinct ancestors (2)	Mean number of occurrences per ancestor (1)/(2)	Mean genealogical depth (generations)	Maximal genealogical depth (generations)
01	Bas-St-Laurent	1170672	41802	28.0	11.1	16
02	Saguenay-Lac-St-Jean	1475684	44155	33.4	11.6	16
03	Capitale-Nationale	1200370	61463	19.5	11.2	16
04	Mauricie	1106340	57748	19.2	11.1	16
05	Estrie	1244788	64718	19.2	11.2	16
06	Montréal	1051480	73991	14.2	10.8	16
07	Outaouais	1057718	58073	18.2	10.6	16
08	Abitibi-Témiscamingue	1204688	68917	17.5	11.2	17
09	Côte-Nord	1145444	48519	23.6	10.7	17
10	Nord-du-Québec	1314000	65186	20.2	11.3	16
11	Gaspésie-Îles-de-la-Madeleine	871542	36377	24.0	10.2	18
12	Chaudière-Appalaches	1243326	48945	25.4	11.4	16
13	Laval	1172862	75515	15.5	11.1	16
14	Lanaudière	1105112	64721	17.1	11.1	16
15	Laurentides	1167890	66782	17.5	11.2	17
16	Montérégie	992916	70094	14.2	10.7	16
17	Centre-du-Québec	1030730	54742	18.2	11.1	16

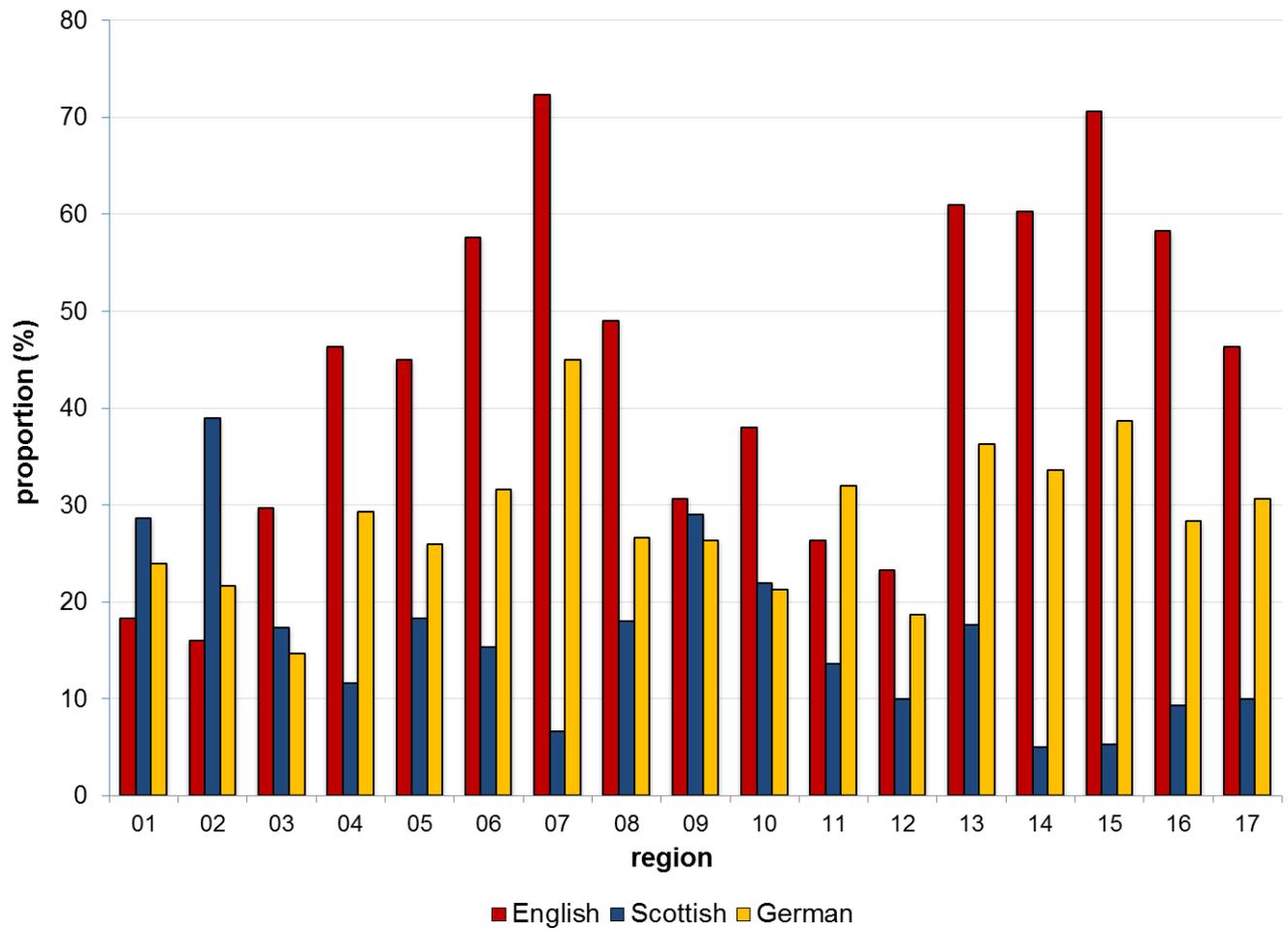
Figure 2 : Completeness (%) of the 17 genealogical samples, up to the 15th generation of ancestors



Regions : Bas-Saint-Laurent (01), Saguenay–Lac-Saint-Jean (02), Capitale-Nationale (03), Mauricie (04), Estrie (05), Montréal (06), Outaouais (07), Abitibi-Témiscamingue (08), Côte-Nord (09), Nord-du-Québec (10), Gaspésie-Iles-de-la-Madeleine (11), Chaudière-Appalaches (12), Laval (13), Lanaudière (14), Laurentides (15), Montréal (16), Centre-du-Québec (17).

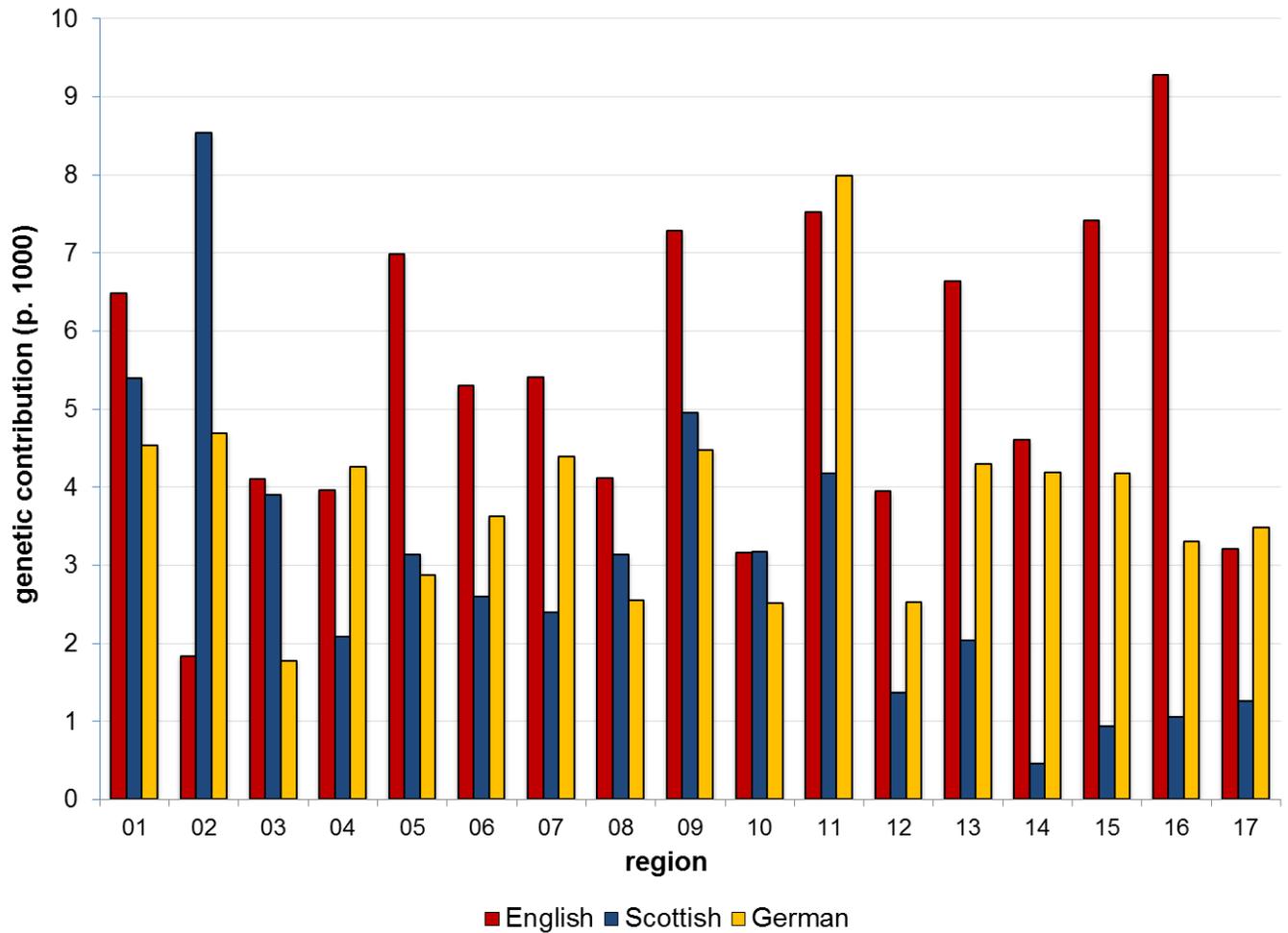
Note : The genealogical completeness is the proportion of ancestors identified in the genealogies at each generation, based on a maximum value of 2^n ancestors ($n = \text{generation level}$). Generation 1 is that of the subjects' parents, generation 2 is that of the subjects' grandparents, etc.

Figure 3 : Proportion of genealogies containing at least one founder of English, Scottish or German origin, in each Quebec region



Regions : Bas-Saint-Laurent (01), Saguenay–Lac-Saint-Jean (02), Capitale-Nationale (03), Mauricie (04), Estrie (05), Montréal (06), Outaouais (07), Abitibi-Témiscamingue (08), Côte-Nord (09), Nord-du-Québec (10), Gaspésie-Iles-de-la-Madeleine (11), Chaudière-Appalaches (12), Laval (13), Lanaudière (14), Laurentides (15), Montérégie (16), Centre-du-Québec (17).

Figure 4 : Genetic contributions (%) of English, Scottish and German founders, in each Quebec region



Regions : Bas-Saint-Laurent (01), Saguenay–Lac-Saint-Jean (02), Capitale-Nationale (03), Mauricie (04), Estrie (05), Montréal (06), Outaouais (07), Abitibi-Témiscamingue (08), Côte-Nord (09), Nord-du-Québec (10), Gaspésie-Iles-de-la-Madeleine (11), Chaudière-Appalaches (12), Laval (13), Lanaudière (14), Laurentides (15), Montérégie (16), Centre-du-Québec (17).