Assessing the Reliability of the 1760 British Geographical Survey of the St. Lawrence River Valley

by

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To my loving wife, Christina Copland

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Acknowledgements

Usually a Master's degree precedes the Doctorate—but in this case, the trajectory was the opposite. A dissertation on the history of cartography in North America sparked my interest in GIS as a handmaiden to historical scholarship. So, in the sixth year of my Ph.D., I began taking courses at USC's Spatial Sciences Institute where I was quite lucky to find strong mentorship coupled with a new and exciting way of thinking about my dissertation topic.

I am grateful to my Ph.D. advisor Peter Mancall for letting me pursue this whim and to my teachers at the Spatial Sciences Institute. Here Jordan Hastings and my advisor Karen Kemp deserve special thanks for designing challenging classes and providing so much thoughtful feedback. They are both committed teachers who care deeply about their students. Put simply, they made me think about the world differently—and I am deeply indebted to them for it.

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List of Abbreviations

ANOM	Archives Nationales d'Outre-Mer (Aix-en-Provence, France)
BNF	Bibliothèque Nationale de France (Paris, France)
BL	The British Library (London, UK)
CO	Colonial Office
DIV	Division
DFC	Dépôt des Fortifications des Colonies
FM	Fonds Ministériel
GIS	Geographic Information System
HGIS	Historical Geographic Information System
K.Top	King's Topographical Collection
LAC	Library and Archives of Canada, Ottawa, Canada
n.d.	not dated
P	Pièce
PF	Portfeuille
PRDH	Programme de recherche en démographie historique (Université de Montréal)
RAPQ	*Rapport de l'Archiviste de la Province de Québec* ([Québec] : Ls-A. Proulx, 1921-1961) 40 vols
SH	Service Hydrographique
SSI	Spatial Sciences Institute
TNA	The National Archives (Kew, UK)
USC	University of Southern California
WO	War Office

Abstract

This project employs a mix of archival and digital techniques to evaluate an extensive geographic survey of the St. Lawrence River valley, conducted under auspices of the Quebec Governor James Murray following the 1760 British conquest of Canada. I show how scholars have misread the historical evidence surrounding the production and dissemination of this survey by ignoring the patronage motives of those involved in its production. I also use archival evidence to examine contemporary practices and ideas surrounding maps and accuracy. I discuss how I built a Historical Geographic Information System by manually creating and spatially adjusting vector data from Murray's personal copy of the survey (which was composed of forty-four individual map sheets measuring forty-five by thirty-six feet when fully assembled). This dataset allowed me to establish that the survey demonstrated a high degree of spatial accuracy for the eighteenth century. Here I also discuss methods for retroactively creating administrative boundaries, which were undocumented in the period. This allowed me to create spatial interoperability with other contemporary quantitative records—historical censuses and parish registers, which recorded births, marriages, and deaths—to evaluate the reliability of these various administrative technologies of state during the early modern period. I conclude that while the historical censuses undercounted people, the survey and parish registers support each other's conclusions, which suggest their demographic accuracy. This work serves as a proof of concept for a much larger spatial humanities project that would employ these same techniques to digitally process the series of other geographic surveys conducted throughout British North America between 1765 and 1777 to capture a geographic snapshot of the late colonial period.

Chapter 1: Introduction

> . . . In that Empire, the Art of Cartography attained such Perfection that the map of a single Province occupied the entirety of a City, and the map of the Empire, the entirety of a Province. In time, those Unconscionable Maps no longer satisfied, and the Cartographers Guilds struck a Map of the Empire whose size was that of the Empire, and which coincided point for point with it. The following Generations, who were not so fond of the Study of Cartography as their Forebears had been, saw that that vast map was Useless, and not without some Pitilessness was it, that they delivered it up to the Inclemencies of Sun and Winters. In the Deserts of the West, still today, there are Tattered Ruins of that Map, inhabited by Animals and Beggars; in all the Land there is no other Relic of the Disciplines of Geography. Purportedly from Suárez Miranda, Travels of Prudent Men, Book Four, Ch. XLV, Lérida, 1658
>
> -Jorge Luis Borges, "On Exactitude in Science"[1]

Following the British conquest of Canada in 1760, General Jeffrey Amherst, the commander-in-chief of the British Army in North America, instructed James Murray, the military governor of Quebec,[2] to have a survey made of the newly conquered territory. Murray complied, sending seven teams of military engineers into the field. The surveying occurred through the early months of 1761. Then draftsmen visually translated the measurements of the surveyors into at least seven sets of maps, a process that continued until the end of 1762. Figure 1 shows how these mapmakers synthesized this geographic knowledge onto a single sheet of paper. The most elaborate copies measured forty-five by thirty-six feet when the forty-four individual sheets were

[1] In *Jorge Luis Borges: Collected Fictions*, translated by Andrew Hurley (New York, N.Y.: Penguin Books, 1998), 325.

[2] I have generally chosen to not include diacritical marks for Canadian place names in this thesis because in the main period of this study, the British did not generally use them. However, I do reproduce them for the names of people and organizations, the titles of scholarly publications, place names for scholarly publications (i.e. the place name as it is given by the publication), and when I am quoting original archival material.

assembled together. Figure 2 illustrates the forty-four sheets laid over the modern landscape as revealed by aerial photography.[3]

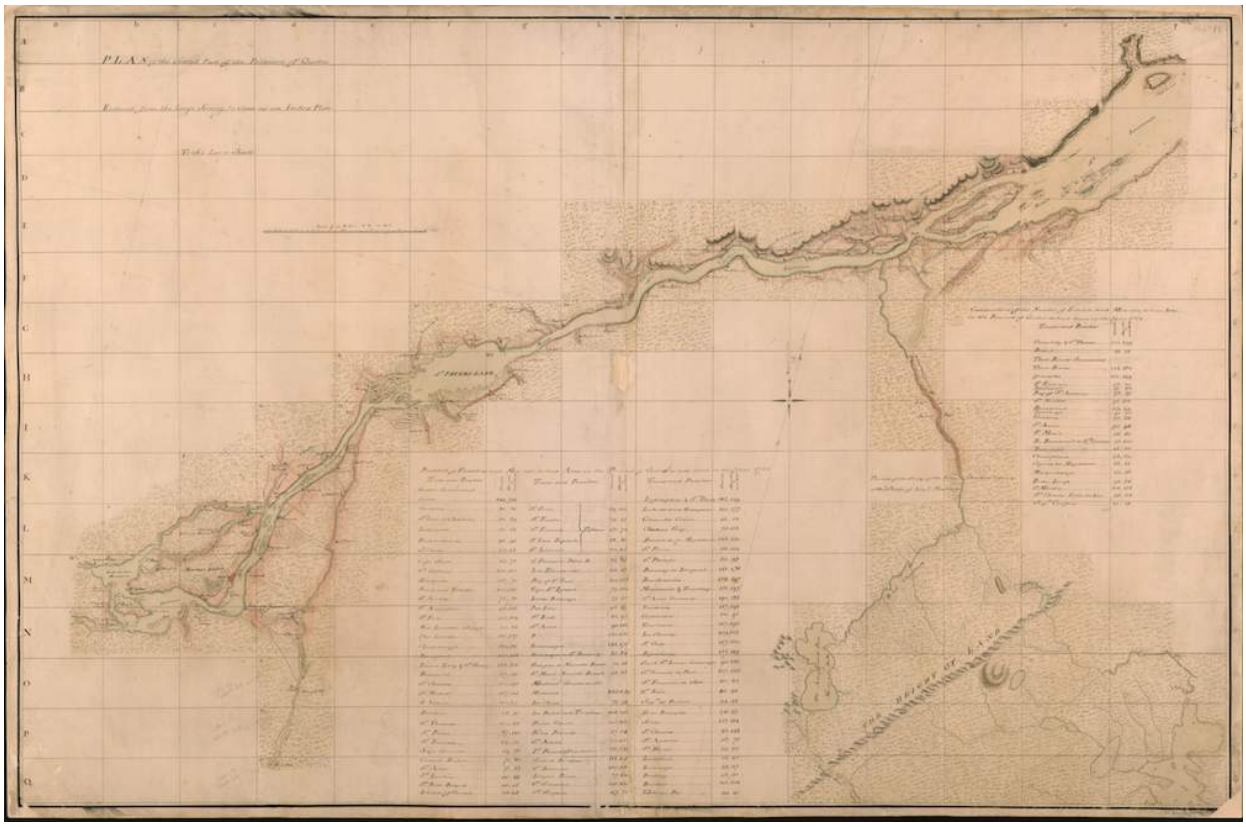

Figure 1: "PLAN of the Settled Part of the Province of Quebec Reduced from the large Survey to serve as an Index Plan To the Large Sheets" (c.1762), LAC, NMC135035, (henceforth referred to as the composite map)

[3] For the scholars discussing this geographical survey of the St. Lawrence River, see Nathaniel Shipton, "General James Murray's Map of the St Lawrence" *Cartographica* 4:2 (December 1967): 93–101; Douglas W. Marshall, "The British Military Engineers 1741-1783: A Study of Organization, Social Origin, and Cartography" Dissertation (University of Michigan, 1976); James Shields, "The Murray Map Cartographically Considered: A Study of General James Murray's Survey of the St. Lawrence River Valley in 1761" Dissertation (Queen's University, 1980); Stephen Hornsby, *Surveyors of Empire: Samuel Holland, J. W. F. Des Barres, and the Making of the Atlantic Neptune* (Montreal: Mcgill Queens University Press, 2011); Alexander James Cook Johnson, "Charting the Imperial Will Colonial Administration & the General Survey of British North America 1764-1775" (Dissertation: University of Exeter, 2011); S. Max Edelson, *The New Map of Empire: How Britain Imagined America Before Independence* (Cambridge, Massachusetts: Harvard University Press, 2017).

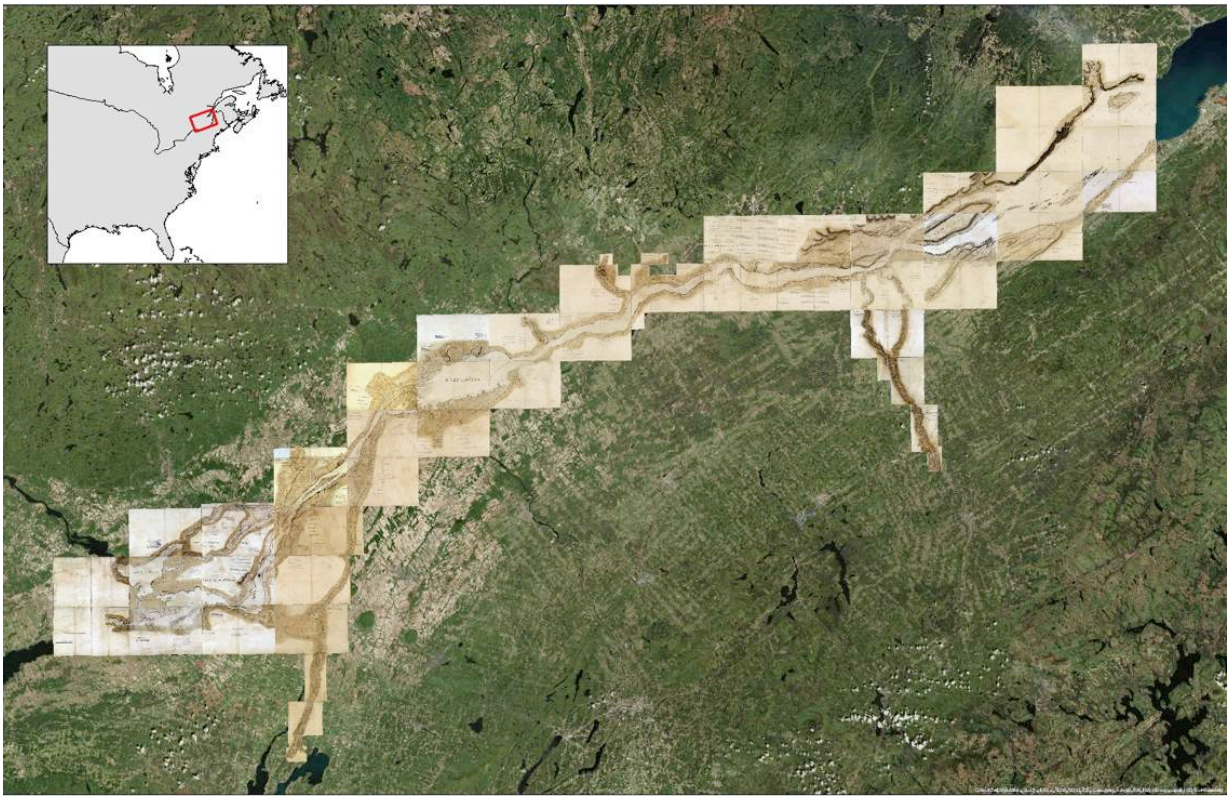

Figure 2: Study Area. St. Lawrence River Valley with the Superimposed Sheets of the Murray Atlas (c.1762), LAC, NMC13036-13078. Present-day aerial photography sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

In a nutshell, this was the most detailed and expansive survey of North America completed to that date. The most comprehensive versions of the atlas depicted roads, walls, dwellings, churches, mills, other buildings, place names (also known as toponyms), waterways, navigational information, the military positions of British and French armies during the 1759-60 campaigns, and terrain that included forest, meadow, cultivated agricultural land, marsh, swamp, and various combinations thereof. Additionally, the draftsmen recorded notes about each parish, usually a combination of history and geographic description with the results of a 1760 census (undertaken independently from the geographic survey). The level of detail and the scope of the project were at the same time grandiose and an overload of information. Indeed, this ambitious masterpiece, henceforth referred to as the Murray Atlas, could have inspired the absurdist short

story of Jorge Luis Borges "On Exactitude in Science" in which the tattered remains of map made at the scale of 1:1 offered refuge to "Animals and Beggars" in the deserts of a once geography-obsessed civilization.[4]

The advent of computing has rendered the absurdity of that short story somewhat moot. As hard drives and screens have replaced paper as the repository for geographic information, the scale of 1:1 no longer requires us to shroud the real territory with paper in the manner Borges described. Indeed, computing and a diverse array of analysis and visualization tools can also breathe new life into such obsessive data. These new tools can elucidate the patterns and trends that humans cannot grasp with the naked eye. In other words, while the act of zealously setting down details might have once obscured, now it adds evidentiary fuel for the analytical fire. Yet in thinking about the Murray Atlas, we might look to Borges (and a generation of historians of cartography) for a reminder that we should suspect the rhetorical exercise of "exactitude." And here in a nutshell is the point of this project. The Murray Atlas *appears* impressive but digital tools can now help us judge (and potentially improve) the quality of the data contained in the maps. And we can also use digital tools to analyze that data, i.e. to transform the tattered, weather-beaten, and "Useless" artifact of imperial obsession into something meaningful for understanding the past.

This thesis develops a conceptual and a methodological framework for translating early maps—by which I mean those predating aerial photography—into historical geospatial data that we can be confident are fit for use in undertaking historical geographical analysis. I begin with some of the vocabulary of Geographic Information Science concerning different elements of

[4] Scholars refer to the results of the survey as both the Murray Atlas and the Murray Map so that both titles show up in citations. Here, I stick to "Murray Atlas" for the sake of consistency.

spatial data quality, particularly completeness and positional accuracy.[5] Said differently, how well did the surveyors and draftsmen record the existence of (completeness) and spatial relationships between (positional accuracy) the geographic phenomena they depicted? And if we find error in either of these realms, can we reduce it enough in digitally processing the historical map to be confident in the quality of the historical geospatial data?

Crucial to this process was archival research. Here I studied the creation and dissemination of the Murray Atlas to understand what Geographic Information Science refers to as its spatial data lineage.[6] Questions I asked included: What motivated its production? How might those motivations have shaped the quality of the data? For what purposes did historical figures hope to use the map? Was the data quality, in their minds, fit for those uses? How did those surveying, drafting, or coordinating cartographic labor conceptualize accuracy?

Next, I digitally processed the Murray Atlas within a GIS, meaning that I manually created vector data on top of digital scans of the historical maps and then spatially adjusted that vector data to align with our present-day understanding of the terrain. I employed spatial and quantitative tools to evaluate the positional accuracy of the data represented within the original historical map. Then I worked with historical censuses and parish registers, two demographic sources that helped me to evaluate the completeness of dwellings—which are, from a historical geographic perspective, one of the most important features depicted in the Murray Atlas for their ability to tell us about human settlement patterns.

I organize this thesis into four parts. The next chapter reviews the relevant literature on the historical geography of Canada and digital approaches to the history of cartography. I explore the benefits of bringing these fields more closely together and explain the necessity of grounding

[5] For a full overview of these elements, see Pepijn van Oort, "Spatial Data Quality: From Description to Application" Dissertation (Wageningen Universiteit, 2006), 11-20.
[6] van Oort, "Spatial Data Quality," 14.

such endeavors in archival research. Next, in examining scholarship on the Murray Atlas itself, I argue earlier scholars have fundamentally misread the archival sources, failing to identify the primacy of patronage motives. In the third chapter, I reinterpret this archival record to show how these motives shaped the rhetoric of accuracy in discourses about the map. I also situate the Murray Atlas in a century-long, mutually constitutive relationship between cartography and human geography in Canada. In Chapter Four, I outline my methods for digitally processing the Murray Atlas. I discuss spatial distortion within the Murray Atlas, concluding that the surveyors did a good job given their goals and limitations. I also explain how I worked with the digitized Murray Atlas to spatially align it with other quantitative sources. In the final chapter, I discuss these other quantitative sources—five historical censuses taken between 1760 and 1765 by the British and parish registers of vital events (births, deaths, and marriages) stretching back to the colony's founding under the French. I conclude that the Murray Atlas and the parish registers support each other's demographic conclusions while the censuses appear to undercount people in erratic ways.

Chapter 2: Towards a Historiographical Synthesis of Archival and Digital Methods

In October 1690 a fleet of New England vessels sailed up the St. Lawrence River, bombarded the French city of Quebec, and ultimately retreated. Nearly two centuries later, the historian Francis Parkman devoted two chapters to this event in his *Count Frontenac and New France under Louis XIV* (1877), concluding with a curious footnote:

> "In the Bibliothèque Nationale is the original draft of a remarkable map, by the engineer [Robert de] Villeneuve, of which a fac-simile is before me. It represents in detail the town and fortifications of Quebec, the surrounding country, and the positions of the English fleet and land forces."[7]

Parkman relied on this "fac-simile" to describe Quebec's topography and the location of its palisades, batteries, and artillery—but he did not know the full story of the map: While Villeneuve did meticulously survey Quebec and its environs during the mid-1680s, he had departed the colony before the city was fortified or assaulted.[8] The siege map, which Villeneuve drafted with a great deal of imagination, was poor evidence for describing the military matchup in 1690.

This cartographic deception would not merit our attention except that Parkman bequeathed his facsimile to Harvard College whose librarians recently digitized it, making it freely available online. They also georeferenced it so that scholars working with a Geographic Information System (GIS) could import its data, described as "roads, drainage, selected buildings with names of landowners, fortification, English ships and lines-of-fire, ground cover, and more." The logic was that "Historic paper maps can provide an excellent view of the changes

[7] Parkman, *Count Frontenac and New France under Louis XIV* (Boston: Little, Brown, & Company, 1877), 285. For how Parkman acquired the map, see Parkman to Pierre Margry (Boston: 16 Oct 1875) in Wilbur R. Jacobs, ed., *Letters of Francis Parkman*, 2 vols (Norman: University of Oklahoma Press, 1960), II:85-87.
[8] Jean Bochart de Champigny to Jean-Baptiste Antoine Colbert, *Marquis de Seignelay* (16 Nov 1689) ANOM, FM, C11A, 10:244-250.

that have occurred in the cultural and physical landscape." Of course this only is true if we can trust the historic paper map and it is indeed the authentic original—neither condition being true in this case. The conundrum is that few historians have the deep technological knowledge necessary to create, manage, or analyze spatial data while few technicians have the archival skills to interrogate the originality, authenticity, or truthfulness of historical sources.[9]

2.1. The Underuse of Historical Maps in the Spatial Humanities

Within the past two decades a handful of humanists, most without formal geographic training, have begun integrating geospatial technology into their scholarship. This field of "spatial humanities" emerged out of many disparate, sometimes epistemologically irreconcilable intellectual trends. It draws inspiration from the circulation of people, goods, and ideas described by historical geographers. It engages the quantitative methods adopted and developed by social historians of the 1960s and 70s who believed that numbers could help give voice to historically disempowered peoples.[10] Yet it was also deeply influenced by poststructuralist theoreticians who had conceptualized the subjectivity of space while rejecting the positivist impulse undergirding quantitative social sciences.[11] Surprisingly, scholars working in the spatial humanities have not engaged deeply with the history of cartography, which emerged in the 1980s as historians, art

[9] Harvard College Library, "Quebec, Canada, ca. 1690 (Raster Image)" in the Harvard Map Collection Digital Maps (accessed 7 September 2014) available: http://vc.lib.harvard.edu/vc/deliver/~maps/G3454_Q4R4_1690_V5_1855.
[10] On quantitative history, see J. Dennis Willigan and Katherine A. Lynch, *Sources and Methods of Historical Demography* (New York, N.Y: Academic Press, 1982); and especially the historiographical overview in Pat Hudson, *History by Numbers an Introduction to Quantitative Approaches* (London: Arnold, 2000).
[11] On Poststructuralism, see Jurgen Habermas, *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society* Translated by Thomas Burger (Cambridge, MA: MIT Press, 1962); Yi-Fu Tuan, *Space and Place: The Perspective of Experience* (Minneapolis: University of Minnesota Press, 1977); Michel de Certeau, *The Practice of Everyday Life* (Berkeley, CA: University of California Press, 1988); Michel Foucault, *Discipline and Punish: The Birth of the Prison* 2nd Vintage Books ed. (New York: Vintage Books, 1995).

historians, literary scholars, and geographers collaborated to understand the significance of maps to historical development.[12]

Historical GIS (HGIS) projects have explored a variety of geographic scales ranging from analysis of global networks and the dissemination of print matter within Europe to the changing environments of cities and towns. The small-scale projects rarely rely directly on historical maps but work with digital gazetteers (which themselves may have been constructed with the aid of historical maps) providing the locations of non-extant toponyms.[13] The large-scale projects often use georeferenced historical maps to integrate quantitative and textual data derived from archival sources.[14] Usually this is done for aesthetic reasons rather than analytical ones. Rarely do these projects treat the historical maps as sources of valuable geospatial data in of themselves. Most of this work concerns the nineteenth and twentieth-centuries, which reflects the broader field of quantitative historical scholarship and limitations existing within the earlier documentary record. Moreover the small number of historically oriented geospatial datasets (especially before 1800) has limited the growth of this potentially dynamic field. Its development depends on scholars with dual areas of expertise who are able to both process and evaluate historical sources to create new datasets.[15]

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[12] For the most influential work on American Historical Geography, D.W. Meinig, *The Shaping of America: A Geographical Perspective on 500 Years of History* (New Haven: Yale University Press, 1986). For influential works on the history of cartography see J. B. Harley and David Woodward, eds., *The History of Cartography*. 6 vols (Chicago: University of Chicago Press, 1987); Harley, "Silences and Secrecy: The Hidden Agenda of Cartography in Early Modern Europe" *Imago Mundi* (January 1988), 40: 57–76.

[13] Fiona Black, Malcolm Black, and Bertrum MacDonald, "Geographic Information Systems: A New Research Method for Book History" *Book History* (1998), 1: 11–31; Franco Moretti, *Atlas of the European Novel, 1800-1900* (London: Verso, 1998) and *Graphs, Maps, Trees: Abstract Models for Literary History* (London: Verso, 2007); Ana Crespo Solana, ed., *Spatio-Temporal Narratives: Historical GIS and the Study of Global Trading Networks (1500-1800)* (Newcastle upon Tyne: Cambridge Scholars Publishing, 2014);

[14] Loren J. Siebert, "Using GIS to Document, Visualize, and Interpret Tokyo's Spatial History" *Social Science History* (2000), 24: 537–74; Brian Donahue, *The Great Meadow: Farmers and the Land in Colonial Concord* (New Haven: Yale University Press, 2004).

[15] For edited books that include projects at a mix of different scales see, Anne Kelly Knowles, ed., *Placing History: How Maps, Spatial Data, and GIS Are Changing Historical Scholarship* (Redlands, CA: ESRI Press, 2008); Jennifer Bonnel and Marcel Fortin, eds., *Historical GIS Research in Canada* (Calgary: University of Calgary Press,

This project, then, largely emerges from a belief that to date historical maps have been underutilized and misused as a source base for recreating and analyzing historical landscapes, especially early modern ones. Historians of cartography have been interested in positional accuracy for the past half-century, originally using it as a kind of barometer for the scientific progress of civilization.[16] In the 1980s, scholars in this field began distancing themselves from this notion as they embraced the poststructuralist argument that maps are subjective documents shaped by the worldviews of the society producing them. The question of accuracy has reappeared more recently as a handful of historians of the map have integrated geospatial tools into their analytical toolkit. They have analyzed positional accuracy to infer how mapmakers compiled and processed their information.[17] Yet the assumption of extreme cartographic subjectivity raises doubts about the completeness of what has been depicted and, therefore, undermines the premise of using historical maps for historical geography

This all begins to explain why historians of cartography have rarely attempted to bridge their work with that of the historical geographer. We might examine one prominent article that does do this work for more insight into its difficulty. In 2010, Levin, Kark, and Galilee used 375 historical maps to understand how nomadic peoples in Palestine's Negev Desert became sedentary across the nineteenth and early twentieth centuries.[18] For them working on a frequently mapped area, surveyed by many different regimes, and employing a mix of techniques including

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2014). For overview of the spatial humanities more generally, see Ian Gregory and Paul S Ell, *Historical GIS: Technologies, Methodologies, and Scholarship* (Cambridge: Cambridge University Press, 2007); David J, Bodenhamer, John Corrigan, and Trevor M Harris, *The Spatial Humanities: GIS and the Future of Humanities Scholarship* (Bloomington: Indiana University Press, 2010).

[16] W. R. Tobler, "Medieval Distortions: The Projections of Ancient Maps." *Annals of the Association of American Geographers* 56, no. 2 (June 1966): 351–60; Shields, "The Murray Map Cartographically Considered"

[17]Brooks Pearson, "Comparative Accuracy in Four Civil War Maps of the Shenandoah Valley: A GIS Analysis" *The Professional Geographer* 57, no. 3 (2005): 376–94; Richard J. A. Talbert and Tom Elliott, "New Windows on the Peutinger Map of the Roman World" in *Placing History*, ed. Knowles, 199-218; Christopher D. Lloyd and Keith D. Lilley, "Cartographic Veracity in Medieval Mapping: Analyzing Geographical Variation in the Gough Map of Great Britain" *Annals of the Association of American Geographers* 99:1 (January 2009): 27–48.

[18] Noam Levin, Ruth Kark, and Emir Galilee, "Maps and the Settlement of Southern Palestine, 1799-1948: An Historical/GIS Analysis" *Journal of Historical Geography* 36 (2010): 1–18.

aerial photography gave them a confidence in the completeness of geospatial data that they extracted. Their discussion encompassed more than the geographic phenomena depicted within the historical maps but also considered agency of those maps as objects (e.g. in shaping and legitimizing landscapes as opposed to simply "reflecting" them) along with the imperialism underlying their creation (which also exerted agency in shaping landscapes and legitimizing or delegitimizing through representation the people within those landscapes).

The time, energy, and expense involved (which they discuss) in producing such thorough, thoughtful scholarship probably explain why we don't see more. Their work points to a second dilemma, namely that the phenomena depicted within the historical maps shape, to some extent, the kinds of questions it is possible to ask within a GIS environment—which perhaps limits the possibility for a single research agenda or consistently replicable method of spatial analysis. Finally, their work points to a third difficulty for earlier maps—i.e. those before their study period—namely that without aerial photography it is difficult to assess completeness in an evaluation of accuracy.

Some historical geographers of Canada have used historical maps as evidence to grasp at some of the qualities shaping settlement patterns—but much of this work was done before the advent of GIS or statistical software. Courville who has authored the most recent and definitive account of the historical geography shaping the present-day region of Quebec mostly synthesized older scholarship (much of it his own) from the 1960s and 1970s. Courville and his contemporaries, for example, may have tallied the number of *seignieurial* grants to different classes of people (nobles, clergy, merchants, etc.) but did not have had the tools to push their inquiry much further. Did any kind of spatial logic govern the distribution of those grants? Did

merchants do a better job peopling their grants than clergy? Courville was silent on the Murray Atlas, surprising given his extensive use of earlier French and later British maps. [19]

2.2 Scholarship on the Murray Atlas

This chapter began with a quote from the Harvard Libraries explaining their rationale for digitizing and georeferencing historical maps. That rationale could apply to the Murray Atlas as well. Before digitally processing it, we must first do our due diligence so that we do not repeat their mistake. We must evaluate the reliability of the Murray Atlas. Have scholars raised any red flags? Or do we find records in the archives that undermine it?

Scholarship on the Murray Atlas, itself, has focused on the context of its production. This began in 1967 with Nathaniel Shipton's brief article inspired by the copy held by the William L. Clements Library where Shipton served as the Map and Print Librarian. After reviewing the chronology of the survey and drafting, Shipton hypothesized about whom had received which of the surviving copies (although he was stumped when it came to determining whom had originally possessed Clements Library's copy). Douglass Marshall followed a decade later with a dissertation on British military engineers in North America, devoting special attention to the Murray Atlas as the only one of "five military mapping projects . . . in North America between 1761 and 1775" that was sponsored exclusively by the army. Marshall fleshed out Shipton's timeline, the biographies of the military engineers and draftsmen involved, and situated the Canadian survey within the mapping practices that had originated from a 1740s survey of Scotland.[20]

[19] Serge Courville, *Quebec: A Historical Geography* translated by Richard Howard (Vancouver: UBC Press, 2008), originally *Le Territoire: Atlas Historique du Québec* (Quebec: Presses de l'Université Laval, 1997).

[20] Shipton, "General James Murray's Map"; Marshall "The British Military Engineers."

The fullest treatment of the Murray Atlas came in a 1980 geography dissertation by James Shields. Shields began with a wide-ranging literature review, which included historiographical discussion of the British occupation of Quebec and contemporary surveying techniques. His second chapter narrated the military conflict between the British and French in North America, through the British conquest of Canada. Next, Shields canvassed earlier mapping projects in the St. Lawrence River Valley, quickly moving through the French period and offering a more sustained examination of British reconnaissance mapping. This led into a sustained discussion of the Murray Atlas during chapter Four, mostly distinguished from the earlier scholarship by its greater depth rather than the novelty of its conclusions. Most significant, Shields located the intense intrapersonal conflict—noted but not explained by Shipton and Marshall—between the mapmakers under Murray in "the rivalry of engineers and battalion officers."[21]

Breaking the most new ground was chapter Five in which Shields offered his "cartographic assessment" of the Murray Atlas. First, Shields revisited Shipton's assessment of who received which copies. Next he performed a visual and stylistic analysis of those different copies, noting that "the presentation of landforms . . . lacks a consistency and a degree of accuracy."[22] Mostly, he attributed these inconsistencies to the stylistic tics of the draftsmen—and as such situates the Murray Atlas within the uneven process by which British military cartography was codified.

Shields took special issue with the "method of portraying farmland" for not bearing any "resemblance to the true nature of the landholdings in the St. Lawrence River valley; that of long

[21] Shields, "The Murray Map Cartographically Considered," 91.
[22] Shields, "The Murray Map Cartographically Considered," 124.

narrow lots stretching away from the river."[23] He also observed certain inconsistencies in the depictions of the three urban areas as compared against more detailed town plans, explaining that the very existence of those plans granted the surveyors some measure of cartographic license in depicting the towns at a smaller scale. He praised "the concentrated efforts of the surveyors" in the countryside.[24] In concluding this visual analysis, Shields argues that controlling the recently conquered population was the rationale of the mapping project. As he explains, the "hierarchy in their choice of features to be portrayed" reflected the "concern of the British for effective control of the community."[25]

Finally, Shields applied the—what was at the time "new"—practice of cartometry to quantify whether the Murray Atlas could "fulfill the basic requirement of portraying the landscape with an accuracy which could be depended upon for military purposes."[26] He accomplished this—without the assistance of computers—by selecting "a number of features . . . for locational comparison with identical points on modern maps . . . [in] the regions immediately surrounding Quebec City, Trois Rivieres and Montreal."[27]

This analysis should be useful for us in thinking about using the map for a spatial humanities project but it is undermined by a questionable methodology. Shields claims that for these physical and human features to have qualified as his control points, they had to have "existed in the same position since the eighteenth century."[28] A close examination of his control points, which can be seen in Figure 3, calls this assertion into question: It is in no way clear that the points he chose actually persisted on the landscape. We might take the Beauport area as one

[23] Shields, "The Murray Map Cartographically Considered," 129.
[24] Shields, "The Murray Map Cartographically Considered," 132.
[25] Shields, "The Murray Map Cartographically Considered," 134.
[26] Shields, "Murray Map Cartographically Considered," 135.
[27] Shields, "Murray Map Cartographically Considered," 137.
[28] Shields, "Murray Map Cartographically Considered," 138.

example, it being one of the places he identified as having the most linear error at 66.4%. The black circles represented the points he used in his nearest neighbor measure and seem to correspond to street intersection in the Murray Atlas—

Figure 4 provides the view from the Murray Atlas of the same area depicted in Figure 3. However, we do not know that there is indeed this kind of continuity in where roads lay or met. The Murray Atlas does not generally name streets (though there is in one case a somewhat ambiguous toponym that might refer either to a street or a parish) so these are unsubstantiated assumptions that Shields brings to his reading of the map.

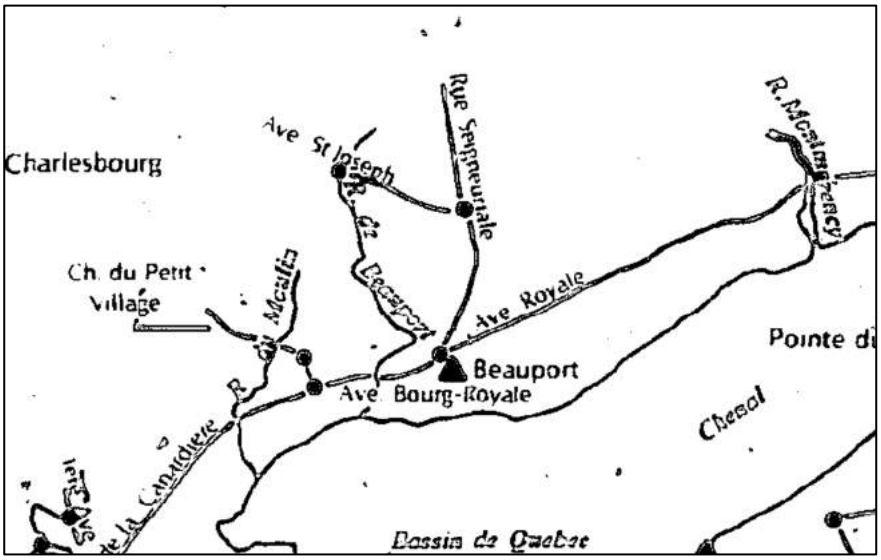

Figure 3: Detail of Beauport from Shields, "Cartometric Assessment of the Quebec City Region" in "Murray Map Cartographically Considered," 150.

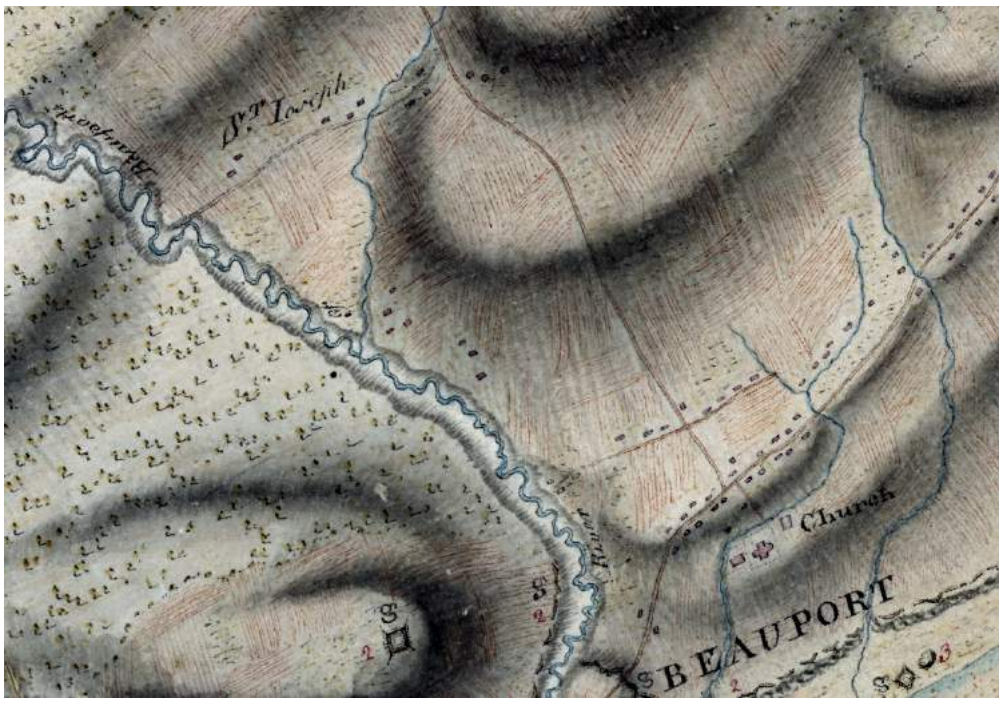

Figure 4: Detail of Beauport in the Murray Atlas. Are the roads depicted here the same ones as existed when Shields was writing in 1980? Given changes in most urban landscapes since 1760, it would be surprising if they were.

After identifying control points and measuring distances between them (translating them according the map scale), he compared the results from Murray's personal copy of the Murray Atlas and (what were then) present-day topographic maps to obtain the linear error. He did this across both longer and shorter distances, concluding that "the map, while reasonably accurate overall, had some areas of localized error far in excess of the mean."[29] He attributed this localized error to the mistakes of particular surveyors and the haste in which the survey was taken. In my fourth chapter (section 0) I will present a very different view of positional accuracy in the Murray Atlas. I would suggest now that his questionable choice of control points explains why Shields found such a high rate of localized error in the places he did.

[29] Shields, "Murray Map Cartographically Considered," 139.

Ultimately, Shields judges the Murray Atlas was "an improvement on earlier maps of the region, but that for reasons of time constraints and manpower problems, the attainment of high accuracy was unfulfilled."[30] Yet this hedge does not answer the original question, namely whether the survey was accurate enough to suit the military purposes for which it was intended. And this is indeed a question worth our revisiting—and more important, asking the inverse, i.e. What might the Murray Atlas' degree of accuracy tell us about why it was made?

Recent scholars have glossed over Shield's arguments about error in the Murray Atlas, instead recommending it as one of the most advanced, precise cartographic undertakings to that date. [31] They also focus on the Murray Atlas only briefly. This is more or less a narrative strategy on their parts, making the survey a prelude to a larger cartographic moment in the late eighteenth-century Atlantic World. This new scholarship, then, has mostly synthesized selective parts of the earlier work without revisiting the evidence or interpretations. The exception is Edelson who has consulted a report on the government of Quebec drafted by Murray, using it as the primary lens for understanding the mapping project. While this is a reasonable enough instinct, I show in the following chapter (section 0) that Murray did not intend text and map to work together in quite the way that Edelson assumes. Most problematic, this group of scholars has largely failed in doing their due diligence. They have largely ignored Shield's most important chapter "Cartographic Assessment of the Murray Map" and have instead readily accepted the eighteenth-century rhetoric of accuracy deployed in the map and the discourses that surrounded it. In the next chapter I dive into the archival sources to explain why this is so problematic.

[30] Shields, "Murray Map Cartographically Considered," 152.
[31] These include: Johnson, "Charting the Imperial Will"; Hornsby, *Surveyors of Empire*; Edelson, *The New Map of Empire*.

Chapter 3: Historical Overview of Cartography in Canada during the French Regime and through the British Conquest

This chapter recounts the history of cartography in Canada, showing how the aims of mapmakers and their ways of cartographic thinking helped to shape on-the-ground settlement patterns. Next, we consider the continuity of cartographic styles and practices across the French and British regimes. This helps us situate contemporary ideas and definitions of accuracy within the collection, representation, and use of what we today refer to as geospatial data. Finally, this chapter revisits the specific archival sources surrounding the creation and dissemination of the Murray Atlas.

3.1. The French Mapping of Canada and the Shaping of the Human Geography

The French mapping of America commenced in 1524 when King François I commissioned the Florentine navigator Giovanni da Verrazano to sail across the Atlantic. Most of the maps from this voyage, which ultimately took Verrazano and his crew along the American coast from Florida to Cape Breton, have been lost.[32] Other French expeditions in the sixteenth century had produced only simple coastal surveys. More significantly for the history of cartography, mapmakers and printers in France incorporated the textual accounts of these explorers into their work. The 1547 Vallard Atlas, for example, drew heavily upon the work of the explorer Jacques Cartier in its depiction of Canada. Maps drafted for royal eyes could be incredibly ornate, filled with notes and icons meant to pique royal interest in funding overseas

[32] One relatively simple sea chart by Verrazzano's brother survives at the Vatican Library where it is currently on display. For a reproduction, see Edward Luther Stevenson, *Maps Illustrating Early Discovery and Exploration in America, 1502-1530* (New Brunswick, NJ: 1906); William F. E. Morley, "Verrazzano, Giovanni da," in *Dictionary of Canadian Biography*, vol. 1 (1966, revised 1979).

ventures. Northeastern America did not figure prominently into these early fantasies, however, and initial expeditions to Canada resulted in little more than a French fishing outpost.[33]

Significant French interest in this region only developed around 1600 when felt tipped hats lined with the pelts from beavers, abundant in northeastern America, became fashionable in Europe. During the summer months French merchants sailed to the Canadian Maritimes to acquire pelts from Native trading partners. Initially pelts resold in Europe for roughly two hundred times their original cost but as more ships made the transatlantic voyage, discerning Natives raised their prices.[34] The French King Henry IV granted a trade monopoly to reduce competition, requiring the monopoly holder to establish a permanent settlement in Canada. The cartographer Samuel de Champlain participated in these early seventeenth-century corporate expeditions, producing maps created from his own observations as well as from Native knowledge meant to survey natural resources, facilitate subsequent navigation, locate ideal sites for a French settlement, establish French territorial claims, and attract settlers along with capital for the nascent French colony.[35]

When initial attempts to establish a colony along the Acadian coast failed, the geographically savvy Champlain recommended building a post where the north and south shores of St. Lawrence River began converging, just upstream of the Isle d'Orleans—a strategic node that (if properly defended) would control access to the northern continental interior. The colony

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[33] For an example of ornate French cartography based on the textual accounts of explorers, see Pierre Desceliers' considerably large (roughly 40 square feet) map of the world drawn on vellum in 1550 for either King Henri II of France or the Duc de Montmorency. At the British Library, Additional Manuscript 24065; Vallard Atlas, HM 29, [fol. 9] (Canada), Huntington Library; Frank Lestringant and Monique Pelletier, "Maps and Descriptions of the World in Sixteenth-Century France" in Harley and Woodward, *History of Cartography*, III:1463-1479; Peter C. Mancall, "The Raw and the Cold: Five English Sailors in Sixteenth-Century Nunavut" *The William and Mary Quarterly* 70:1 (January 1, 2013): 3–40, see 21-22 for discussion of the Vallard Atlas.

[34] J. F. Crean, "Hats and the Fur Trade" *The Canadian Journal of Economics and Political Science / Revue Canadienne d'Economique et de Science Politique* 28:3 (August, 1962): 373–86;

[35] W. J. Eccles, *The Canadian Frontier, 1534-1760* (New York: Holt, Rinehart and Winston, 1969), 12-34; Conrad E. Heidenreich, "The Mapping of Samuel de Champlain, 1603–1635" in Harley and Woodward, *History of Cartography*, III:1538-1549; David Hackett Fischer, *Champlain's Dream* (New York: Simon & Schuster, 2008).

during these early years consisted of a trade outpost around present-day Quebec City, destroyed by English privateers in 1629. Champlain drafted a map showing French claims for the negotiations in London. This non-extant manuscript map likely informed his 1632 engraved map (accompanying his pamphlet *Les voyages de la Novvelle France*) aimed at attracting people and capital to resettle Canada, portrayed a land of abundance filled with trees, agricultural land, botanical specimens, and animals with valuable pelts.[36]

In reestablishing the colony, the *Compagnie de la Nouvelle France* hoped to do a better job peopling and protecting it. To these ends, they sent the Jesuit-educated engineer and mapmaker Jean Bourdon to help reestablish the colony. One challenge was militaristic. During these years the fur trade had cemented alliances between the French and various Native groups, particularly the Hurons and Algonkins, but these alliances also drew the French into prolonged warfare with the Iroquois League.

As attacks intensified in the 1640s, Bourdon travelled to France in search of aid, furnishing two unembellished maps to secure goodwill. One of these can be seen below in Figure 5, which depicts Quebec City in the bottom left corner. Aspirational in the sense that they projected imaginary lines onto the landscape, Bourdon's maps revealed attempts to institute in Canada a seigniorial land tenure system in which the *Compagnie* granted large parcels of land to *seigneurs* who in turn were responsible for subdividing, "improving," and peopling those grants. When the colony faltered in 1660, Bourdon again journeyed to France. On this occasion he supplied a small-scale map of Quebec, which can be seen in Figure 6. Titled "True plan of high

[36] Samuel de Champlain, *Les voyages de la Novvelle France occidentale, dicte Canada* . . . (Paris: Clavde Collet, 1632); Heidenreich, "The Mapping of Samuel de Champlain"; Tim McNeese, *The St. Lawrence River* (Philadelphia: Chelsea House Publishers, 2005), 2-6; James H. Thorp, Gary A. Lamberti, and Andrew F. Casper, "St. Lawrence River Basin" in Arthur C. Benke and Colbert E. Cushing, eds., *Rivers of North America* (Boston: Academic Press, 2005), 983-1030; Raymonde Litalien, Denis Vaugeois, and Jean-François Palomino, *Mapping a Continent: Historical Atlas of North America, 1492-1814* (Québec: Les éditions du Septentrion, 2007), 83-88; Fischer, *Champlain's Dream*.

and low Quebec," this map similarly projected imaginary lines to plan city development. Mostly, however, the *Compagnie* did not invest much into realizing these plans, leaving the French settlers to their own devices.

Figure 5: Jean Bourdon "Carte depuis Kébec jusque au cap de Tourmente" (1641), BNF, GED-8070(RES).

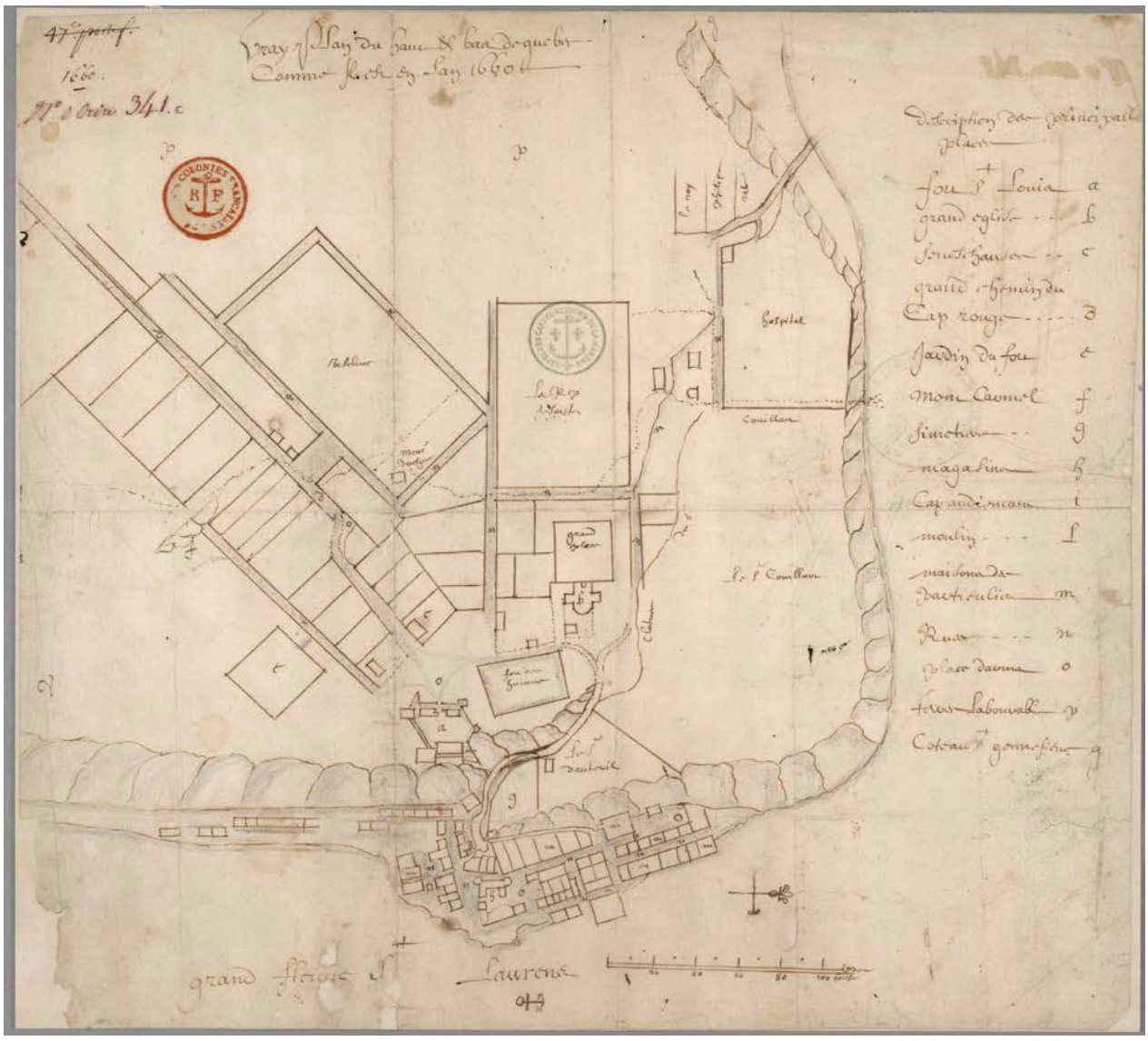

Figure 6: Jean Bourdon, "Vray Plan du haut & bas de quebec comme il est en l[']an 1660" (c.1660), ANOM, DFC 341C.

This began to change, however, once Louis XIV revoked the charter of the bankrupt *Compagnie de la Nouvelle France* in 1663, proclaiming Canada a royal colony. Throughout this decade, the French state sponsored a wave of male and female immigrants to Canada, hoping to create a demographically and economically self-sufficient colony that could contribute to state coffers rather than drain metropolitan resources. Population growth after this point (under French rule) hinged increasingly upon natural increase as the number of transatlantic immigrants

dwindled. Imperial reorganization coincided with the invigoration of state cartography, owing to Finance Minister Jean-Baptiste Colbert who upon his appointment in 1661 implemented domestically a state culture of intelligence gathering that privileged maps for reporting and integrating economic, legal, demographic, natural, ecclesiastical, and military information. In this context, governors and other Canadians began regularly sending maps (usually containing the decorative hallmarks of patronage objects) to Versailles to advance their personal agendas. In other words, maps in this transatlantic bureaucratic context served a blend of patronage and evidentiary purposes. The appearance of accuracy often mattered more than actual accuracy—who would know the difference, after all?[37]

By the 1680s, the French state began sending military engineers and other metropolitan mapmakers as part of an increasingly mercantilist colonial agenda. Two partial surveys of Canada were made under Louis XIV during 1685−6 and 1709. Examples from the earlier survey of Robert de Villeneuve can be seen in Figure 7 (Quebec City) and Figure 8 (the environs around Quebec City). The French governor sent these to demonstrate the success of the centralized state planning in shaping concentrated settlement patterns into the terrestrial interior. An example from the second survey, depicting the lots of land along St. Lawrence River can bee seen in Figure 9. Figure 10 shows a detail from Figure 9 of the city of Trois Rivieres with a better view of these lots and the textual descriptions naming the people to whom those lots belonged. The archival context of this survey is less clear but it would seem these maps were meant to demonstrate the success of the Seigniorial system of land settlement in which a Lord or other

[37] In 1663 Colbert requested that officials throughout France send "accurate and detailed maps of each province and généralité" and employed the geographer Nicolas Sanson to process the information. At the decade's end, Colbert hired the Italian mathematician Jean-Dominique Cassini to conduct a national survey of France. Konvitz, *Cartography in France*, 1-8, quote on 2; Jacob Soll, *The Information Master: Jean-Baptiste Colbert's Secret State Intelligence System* (Ann Arbor: University of Michigan Press, 2011), 70-6, 99; Brotton, *A History of the World in 12 Maps*, 294-336.

notable person was granted a large parcel of land and was responsible for subdividing it to attract settlers.[38]

Figure 7: Robert de Villeneuve, "Plan De La Ville Et Chateau de Quebec, Fait En 1685, Mezvrée Exactement" (1685), ANOM, DFC, 349B.

[38] Nicholas Gliserman, "Landscapes of Conflict: Cartography and Empire in Northeastern America, 1680-1713" (Dissertation, University of Southern California, 2016), 100-157.

Figure 8: Villeneuve, “CARTE DES-ENUIRONS DE QVEBEC EN LA NOUVELLE FRANCE Mezuré Sur le Lieu Tres-Exactement, En 1685, Et 86, PAR LE S[r] DEVILLENEVVE Injenieur du Roy” (1685-6), BNF,

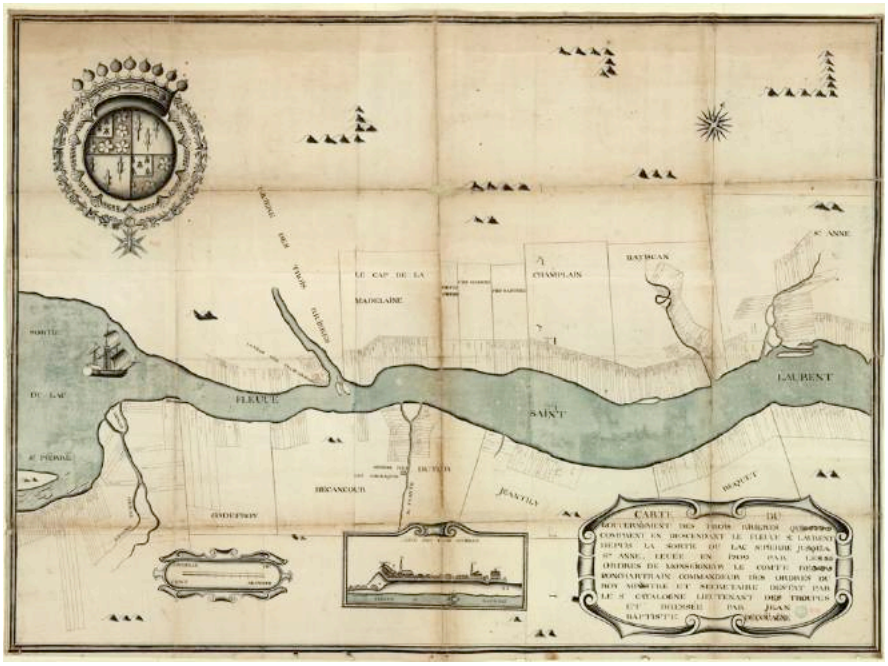

Figure 9: Gédéon de Catalogne and Jean Baptiste de Couagne, "Carte du gouvernement des trois rivieres" (1709) BNF, SH18, PF127, DIV2, P4

Figure 10: (Detail from Figure 9) The walled city of Trois Rivieres, surrounded by long, narrow lots.

These two partial surveys suggest the staying power of Bourdon's templates for peopling Canada Three major towns (Quebec, Montreal, and Trois Rivieres) closely resembled northwestern French ports divided between "a commercial lower town and an administrative and military upper town." Baroque architecture, geometric garden plots, and religious buildings framed the upper city while a denser matrix of commercial buildings and residences hugged the

river on the lower ground. Between the cities and villages farmers gradually peopled long, narrow plots fronting the St. Lawrence. Arriving from a variety of regions, these habitants blended together a variety of landscape vernaculars. Rapids just upstream of Montreal barred the entry of large sail-based European vessels and limited further settler colonialism. Beyond these natural limits, soldiers built sparse wooden fortifications to conduct and protect the fur trade, which dominated the colony's economy. French missionaries who travelled widely throughout Indian country lured Christian converts to settle communities in the shadow of French towns.[39]

After the death of Louis XIV, however, cartographic exchanges between metropole and colony changed. On the one hand, the French state invested more resources into building and planning elsewhere in French North America, sending cartographically talented engineers to Louisburg, Louisiana, and the Mississippi River. Canadians furnished no more ambitious surveys of the St. Lawrence River throughout the remainder of the French regime—although they did send fortification schematics and a few town plans. [40] Immigration declined after the state-sponsored wave of the 1660s and would not seriously pick up again until the Seven Years War, limiting the ability of overseas metropolitan officials to easily create enduring templates for settlement patterns in new places.[41] The village system championed by Colbert during the 1660s in the environs of Quebec remained in place, for example, but would not be established elsewhere in the colony.

[39] Cole Harris, "Retracing French Landscapes in North America" in Michael P. Conzen, ed., *The Making of the American Landscape*. 2nd ed. (New York: Routledge, 2010), 73-90, quote on 79; Serge Courville and Richard Howard, *Quebec: A Historical Geography* (Vancouver: University of British Columbia Press, 2008).
[40] Gliserman, "Landscapes of Conflict," 213-261, 416-427.
[41] Leslie Choquette, *Frenchmen into Peasants: Modernity and Tradition in the Peopling of French Canada* (Cambridge, Mass: Harvard University Press, 1997).

3.2. British Mapmaking and the Invasion of Canada during the Seven Years War

Civil War and Revolution in seventeenth-century England hindered the kind of French centralized cartographic bureaucracy from developing there—even as the late Stuart monarchs Charles II and James II were envious of and *tried* implementing it. Somewhat ironically in the eighteenth century, the state cartography of France originally developed under the auspices of Colbert and Louis XIV, continued to exert an outsize influence on British cartography: Droves of Huguenot engineers, trained under the influence of the master engineer of the French state, Sébastian le Prestre Vauban, defected to Britain. Printed maps similarly traversed the English Channel in these years. The cumulative result was a common cartographic language and aesthetic in the British and French empires.[42]

While the British military had institutionalized the training of engineers in the 1740s, surveying and map drafting did not initially figure much into this education. Instead, military engineers acquired these skills in the field so that throughout the eighteenth century, their knowledge circulated in more decentralized ways and catered to local rather than metropolitan agendas. Around the same time as the establishment of this engineering school, the military expanded the number of copyists working at the Tower of London. Only in 1752 did this "Drawing Room" become "a recognized department."[43] An 1841 fire makes it difficult to assess the significance of the Drawing Room as a cartographic storehouse during the Seven Years War. In any case, it seems that it sent few maps or draftsmen to North America during the Seven Years War. British officers frequently noted the difficulty in locating existing maps, as well as

[42] Peter Barber, "Necessary and Ornamental: Map Use in England Under the Later Stuarts, 1660-1714." *Eighteenth-Century Life* 14, no. 3 (1990): 1–28; Barber and A. Stuart Mason. "'Captain Thomas, the French Engineer': And the Teaching of Vauban to the English" *Proceedings of the Huguenot Society* 25 (Autumn 1991): 279–87; Mary Sponberg Pedley, *The Commerce of Cartography: Making and Marketing Maps in Eighteenth-Century France and England* (Chicago: University of Chicago Press, 2005).
[43] Marshall, "Military Maps of the Eighteenth-Century and the Tower of London Drawing Room" *Imago Mundi* 32 (January 1, 1980): 23.

copyists, surveyors, and cartographic draftsmen. Surveying equipment was often unavailable—frequently requested but rarely sent.[44]

The Seven Years War saw British mapmakers flood into North America. In 1756, before many of them had a chance to do much of anything, the famed English man of letters Samuel Johnson wryly commented on the rising number of engraved maps of North America: The war "has incited us to survey and delineate the immense wastes of the western continent by stronger motives than mere science or curiosity could ever have supplied."[45] John Campbell the 4th Earl of Loudoun was especially interested—during his brief tenure as the commander-in-chief of British forces in North America from 1756-7—in assembling cartographic knowledge as a broader set of military reforms. It seemed this was mostly to aid the planning and execution of military expeditions. Loudoun, for example, ordered engineers Samuel Holland, John Montresor, and Charles River to copy and synthesize maps of the Hudson River and Lake Champlain so as to show this overland route between British and French colonies.[46]

We must note a discrepancy between commanding officers and the actual producers of geographic knowledge in how they valued or thought about accuracy. As a general rule, officers cared more about aesthetics than accuracy. Engineers understood this and often complied with this demand for well-drafted maps that dressed up terrain in pleasing ways. As Marshall notes, many engineers and surveyors "were reluctant to submit work which was not an artistic rendering."[47]

These engineers and surveyors did not necessarily sacrifice accuracy, as they understood it, at the altar of aesthetics. Indeed, the few records that directly capture the voices of British

[44] Marshall, "The British Military Engineers."
[45] As quoted in Edelson, *New Map of Empire*, 65.
[46] G. D. Scull, ed., *The Montresor Journals* (New York: Printed for the New-York Historical Society, 1881); Johnson, *Charting the Imperial Will*.
[47] Marshall, "The British Military Engineers," quote on 213.

surveyors suggest accuracy was a preoccupation, at least in their criticism of maps made by others. Some cases reveal how closely they had studied particular maps coupled with their visible disappointment when those maps omitted or misrepresented. In his journals, for example, John Montresor commented to himself about the accuracy and completeness of existing maps as the British fleet sailed up the St. Lawrence River to siege Quebec. It bears noting that Montresor did not seem to intend these journals as public documents for he wrote many impolitic things that could have badly damaged his career. We can reasonably assume that his criticism was not part of some rhetorical strategy to bolster his authority at the expense of somebody else—but as close to an unfiltered, unmediated opinion as a primary source will ever yield.

In some cases, Montressor spoke of many maps: "The Island of St. Pauls in some Draughts is but just marked, in others not taken notice of, no further than a Dot and the writing signifying what it is, but 'tis very erroneous . . ."[48] And in other cases, he singled out specific maps: "There is a long ledge or Spit that runs S.S.W[.] from Hare Island four miles with some shrubs growing on it not inserted in Jeffries Chart of the river St Lawrence."[49] It also becomes clear reading Montresor's journal that just because British navigators possessed and studied a given map, did not mean they then followed its advice: "The winds very light and I could not find any one vessel Draughted nigh the Shore nothwithstanding the several Draughts or Charts of the River St Lawrence expressing that circumstance that it must require a leading Gale to pass through."[50]

Despite the challenges of navigating up the St. Lawrence River, the British fleet arrived at Quebec's doorstep in late June 1759. A siege lasting nearly three months ended with a British victory on the Plains of Abraham where the British were able to draw French troops out of the

[48] Scull, ed., *The Montresor Journals*, 197.
[49] Scull, ed., *The Montresor Journals*, 202,
[50] Scull, ed., *The Montresor Journals*, 205.

city. In the winter of 1759-60, Amherst planned what would become a successful three-pronged expedition Montreal (two armies leaving from Albany, one via Lake Champlain and the other Lake Ontario, and the third from Quebec). The French generals attempted but failed to retake Quebec during spring 1760 and then, recognizing the hopelessness of their situation, quickly surrendered in September when British forces met at Montreal. Crucially, for our story, Amherst agreed to the French governor's terms of surrender, which would guarantee rights for the French populace to remain in Canada with their property and their faith intact under the new British regime. Amherst divided Canada into three military governments (Montreal, Trois Rivieries, and Quebec), leaving an excessive seventeen battalions in case they were needed to subdue the French population. This availability of soldiers coupled with the British metropolitan desire to visually commemorate the victory and the strength of empire in North America probably helps to explain the genesis of the project to survey Canada.[51]

3.3. Surveying, Drafting, and Gifting The Murray Atlas

Few records survive that directly discuss the technical aspects of surveying and drafting the Murray Atlas; nothing that gives us much insight into the tools, record keeping, and symbological practices employed. So while archival investigation reveals no outright falsehoods, neither does it buttress the Murray Atlas's visual rhetoric of accuracy. What we can reconstruct comes from bureaucratic correspondence, mostly between Murray and his superiors: Jeffrey Amherst, commander-in-chief of the British Army in North America; William Pitt, the Secretary of State for the Southern Department; and the Board of Trade. These letters hint at three objectives behind the cartographic project. First, to aid a potential reinvasion of Canada should the colony be returned to the French during peace negotiations; second, to help govern a

[51] Fred Anderson, *Crucible of War: The Seven Years' War and the Fate of Empire in British North America, 1754-1766* (New York: Alfred A. Knopf, 2000).

potentially unruly conquered population; and finally, to help Murray and others in negotiating the patronage politics of advancement within the British military bureaucracy. I argue that historians have overestimated the significance of these first two points, failing to see how they were in many ways subjected to the third patronage rationale.

Two sources provide direct insight into the tools employed during the survey. First in a letter to Amherst in February 1761, Murray wrote that "We have prepar'd plain Tables and all requisites" for the survey.[52] The "requisites" here may have referred to an object such as a surveyor's compass or geometric quadrant, which mounted on the plain (later "plane") table could measure angular distance. Murray's comment ("We have prepar'd") suggests that the surveyors worked with makeshift tools, crafted locally. Second, one of the surveyors Samuel Holland recalled in 1768 that they had measured distances with chains.[53] The method was relatively simple and not new in 1760: Measure the distance between two points using a chain; from both of those points, measure the angle to a third point; finally, use trigonometry to determine the distances to that third point (this last step is not necessary to do in the field, which speeds the surveying). In the process of measuring distances and angles, the surveyors also "drew the visible features of the landscape" using paper mounted on the plain table.[54]

These instruments had their limitations. Chains expanded in heat and contracted in cold. Meanwhile, the tools to measure angular distances probably only subdivided to the degree. These issues would have detracted from the accuracy of the survey. Yet the simplicity of the tools "permitted relatively unskilled assistants to accomplish a fairly rapid survey."[55] The lack of an identified projection system suggests the surveyors had perhaps not squared their on-the-ground

[52] Murray to Amherst (22 Feb 1761), TNA, WO 34/1, 36.
[53] Marshall, "The British Military Engineers," 223-224.
[54] Edelson, *New Map of Empire*, 82.
[55] Shields, "Murray Map Cartographically Considered," 63-64.

measurements with established theories concerning projection of three-dimensional objects onto flat surfaces or more recent debates over the true shape of the Earth.[56] The result, in the estimation of Shields, was "an improvement in accuracy . . . from earlier maps [of the St. Lawrence]" but nevertheless "considerable localized error resulting from the inexperience of surveyors and draftsmen, not to mention the quality of instrumentation."[57] GIS-aided analysis of spatial distortion will allow us to sharpen these conclusions but we might add that the objectives of the survey may have mitigated the need for a high degree of spatial accuracy, as understood through a Cartesian grid.

Murray spoke to the survey's first objective—reinvading Canada should it be returned to France in peace negotiations—in a May 1761 letter to Secretary Pitt, assuring that this "copy of the survey of Canada" will mean that "happen what will[,] we never again can be at a loss how to attack and conquer this country in one campaign." Pitt's copy, which depicted the "RIVER St. LAURENCE from MONTREAL TO BERTHEIR," can be seen in Figure 11. Murray may have earnestly meant these words or he may have had his private doubts. Whatever the case, by promising Pitt a copy of the survey at the same time he explained its utility, Murray was framing himself as a diligent, dedicated, and forward thinking military officer. Months later, Murray revealed to Amherst that his brother at "court" was attempting to negotiate for Murray a commission in "an old Regiment." In this light, we might think of Murray as attempting to cultivate a patronage relationship with Pitt, using the map as both a gift to the Secretary (marked by traditional trappings of patronage as evidenced in Figure 12) and a demonstration of his efficiency.[58]

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[56] Jerry Brotton, *A History of the World in 12 Maps* (New York: Viking Adult, 2013), 294-336.
[57] Shields, "Murray Map Cartographically Considered," 151.
[58] Murray to Amherst (7 Feb 1762), TNA, WO 34/1, quote on 220; Reginald Henry Mahon, *Life of General the Hon. James Murray: A Builder of Canada* (London: John Murray, 1921), quote on 288.

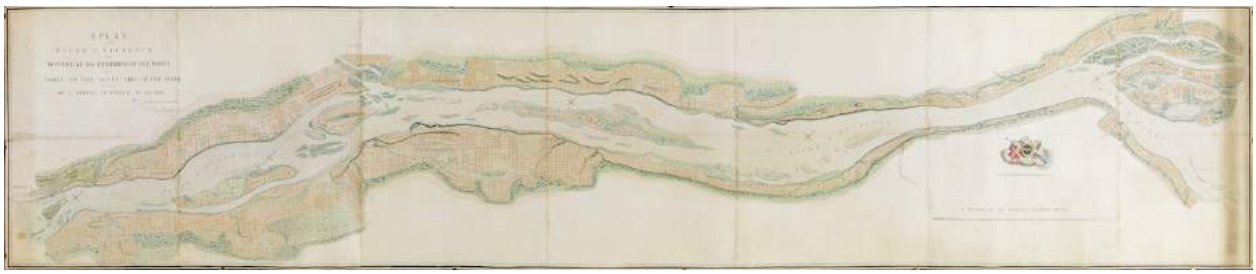

Figure 11: Samuel Holland and [John] Montresor, "A PLAN of the RIVER St. LAURENCE from MONTREAL TO BERTHEIR ON THE NORTH and to SOREL ON THE SOUTH SIDE OF THE RIVER being part OF A SURVEY INTENDED TO QUEBEC" (c.1761), BL, K.Top, 119:29

Figure 12: (Detail from Figure 11) Dedication and Coat of Arms in Pitt's copy of the Murray Atlas

Having established Murray's likely patronage goals, we can now proceed to assess the map's utility in light of the stated goal of reinvading Canada. Murray's emphasis on "how to attack" suggests he may have been most concerned with documenting terrain and elevation, conditions that would help officers decide where to place redoubts and soldiers. A cursory visual

examination of the atlas reveals a great deal of attention to the terrain—e.g. meadows carefully delineated from cultivated land; persistent shaded relief throughout.

Variation across different copies of the Murray Atlas however, suggests that we should be careful to not conflate attention to these kinds of details with accuracy. Figure 13 and Figure 14 show the same area around the Island of Bouchard as depicted in Pitt and Murray's copies, respectively. Figure 15 and Figure 16 zoom in even further to show the church of St. Sulpice and the surrounding terrain. Some differences may have emerged from resurveying after Murray sent Pitt's copy—but this explanation is unsatisfying because, of all the copies, Pitt's comes the closest in resembling the French land tenure system (visible in Figure 5, Figure 9, as well as present-day aerial photography, Figure 17) in how the parcels were oriented—although the lots should have been much thinner.

Figure 13: (Detail from Figure 11) Terrain North of the Island of Bouchard in Pitt's copy.

Figure 14: Same area as in Figure 13, depicted in Murray's personal copy of the Murray Atlas. Note the discrepancies in shaded relief and also the additional roads.

Figure 15: (Detail from Figure 11) cultivated land around St. Sulpice in Pitt's copy. Note the sharply delineated borders, the continuous depiction of cultivated land (i.e. no meadow interspersed)

Figure 16: Same area as in Figure 15, depicted in Murray's personal copy. Note the different geometrical patterns, the depiction of meadow interspersed with cultivated land, and the undefined borders between landholdings.

Figure 17: Present-day aerial photography of the same area in Figure 13 and Figure 14. Note the persistence of the older land tenure system (depicted in Figure 5 and Figure 9) into the present, i.e. thin lots fronting the St. Lawrence River. Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

We see more continuity between Pitt and Murray's copies when we focus on other elements of the terrain such as the forest line (although here too we can spot a few inconsistencies). At a certain level, then, these discrepancies call into question the survey's utility for informing terrain-based tactics. Most likely, in a reinvasion, the survey could have

served primarily logistical ends. Features such as roads, dwellings, and windmills—generally consistent across different copies--would have respectively helped move and feed troops.[59]

Route finding figured into Murray's ambitions as well in that he directed surveyors to examine lengthy tributaries of the St. Lawrence River and requested of Amherst copies of the recent survey of Lake Champlain. Indeed he joked in one letter to Amherst that he himself should "reconoiter the communications from the St. Lawrence to the River St. John and that River as farr as the fort built by General Monkton . . . Since you [Amherst] can give me no better employment." Murray explained, "this will at least amuse me and may perhaps be of some use hereafter."[60] Yet the atlas ultimately did not document the overland routes connecting the St. Lawrence to the Eastern seaboard, suggesting Murray prioritized finishing the map quickly. In this way, Murray would have probably agreed with Marshall writing two centuries later that the chief obstacle to British victory in the Seven Years War had been "the nature of geography" more than deficits in British knowledge of overland routes to Canada.[61] Having a detailed map of Canada would have certainly helped plan a second invasion but probably Murray knew he was overstating the case to Pitt in order to inflate the significance of his cartographic accomplishment.

The map also served administrative purposes—though ones largely misinterpreted by scholars. In June 1762, responding to orders by the Secretary of State Charles Wyndham, 2nd Earl of Egremont (who succeeded Pitt in 1761), Murray and his counterparts in Montreal and Trois Rivieres sent reports to the Board of Trade on their respective governments. We might note Murray's tone of frustration in this report when he lamented that it was "impossible . . . to

[59] J. B. Harley, "The Contemporary Mapping of the American Revolutionary War" in *Mapping the American Revolutionary War* ed. by Harley, Barbara Bartz Petchenik, and Lawrence W. Towner (Chicago: University of Chicago Press, 1978), 1-44, see especially 25-35.
[60] Murray to Amherst (18 June 1761), TNA, WO 34/1, 92.
[61] Marshall "The British Military Engineers," 199.

ascertain exactly, what part of North America, the French stiled Canada" because during the British conquest "no Chart or Map whatever having fallen into our hands . . . to shew what they understood by it."[62] The dearth of records, whether the result of poor French record keeping or wartime discontinuity, left unanswered geographic questions as basic as where did the colony begin and end.

It is quite reasonable to assume that Murray wanted the Atlas to answer some of these basic administrative questions. This would explain why he sent a copy of it with his 1762 report, which he noted doing in a September 1762 letter to Amherst, ("I have sent a Copy of this Survey to the Secretary of State to accompany the Report I have been ordered to make of my government to His Majesty." This likely referred to the copy seen in Figure 18—fully assembled but reduced in size—present in the Colonial Office (CO) 700 Series at the (British) National Archives (TNA), which was once the cartographic storehouse of the Board of Trade. Murray also noted to Amherst that he had "inserted Plans of the Battle & encampment and attacks." This most certainly refers to the next map in the CO 700/Canada series, which can be seen in Figure 19. It depicts the military operations of 1759 in the environs of Quebec.[63]

[62] Murray, "[Report on the Government of Quebec]" (5 June 1762), TNA, CO 323/15, 183.
[63] Murray to Amherst (9 Sept 1761), TNA, WO 34/2, quote on 86.

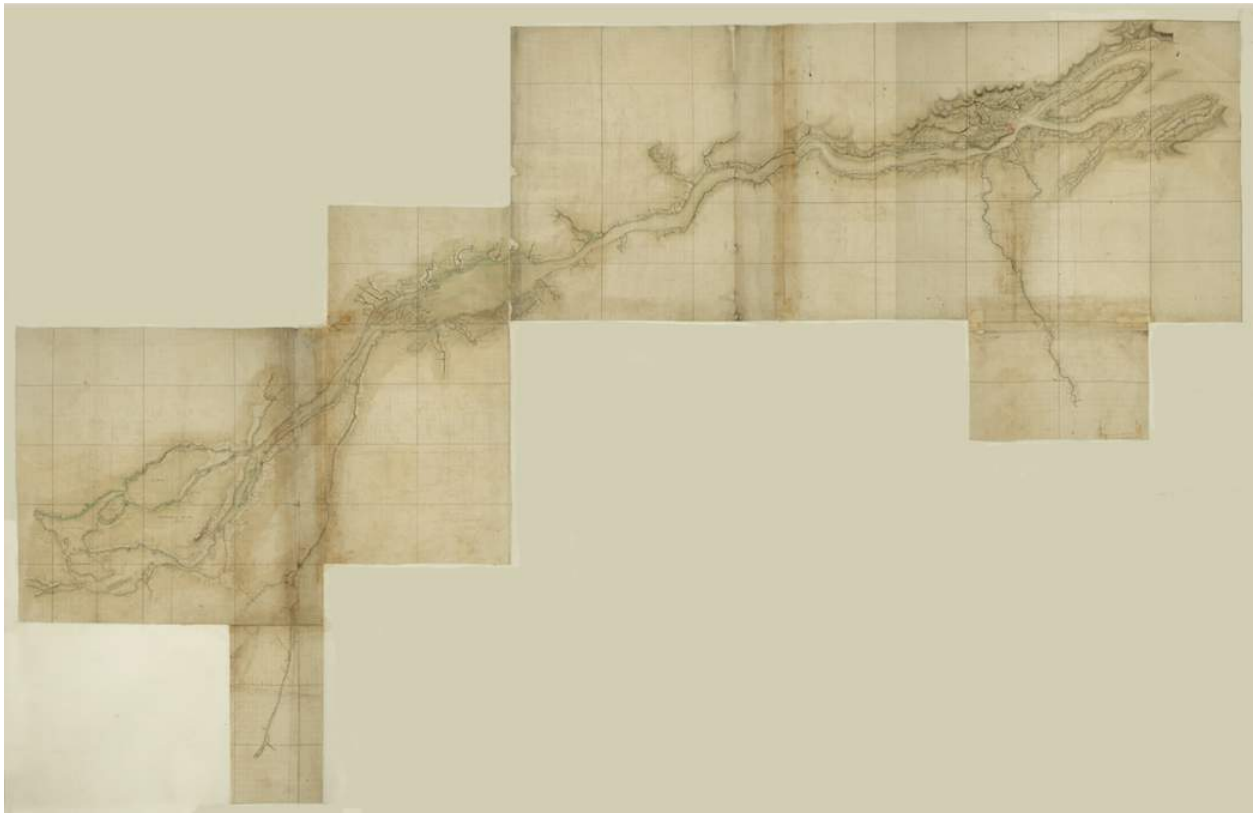

Figure 18: [Murray et al] "[Map in two sheets of the inhabited parts of Canada]" (c.1762) TNA, CO 700/Canada 18.

Figure 19: [Murray et al], "[Map of Quebec and the environs, with plan of military operations of 1759]" (c.1762), TNA, CO 700/Canada 19.

Murray referred extensively to this environs map (Figure 19) in the section of his report on fortifications, intending the maps to orient the reader in space rather than serve as visual evidence of the phenomenon he discussed. A wall in poor condition merited comment in the text of the report ("From K to L is a very bad stockade"[64]—see Figure 20 for this detail from Figure 19) but was drawn on the map in the same manner as all the others. Murray concluded this section of his report outlining remedies and sheepishly asking for money to implement them ("I am therefore of the opinion that if His Majesty shall think proper to be at the expense of strengthening Quebec, the most effectual method will be . . ."[65]). The map coupled with the report allowed Murray to depict himself as a competent administrator. It might have even facilitated administration by directing funds where (Murray believed) they needed to go. But the point here was not collapsing the vast distance across the Atlantic. Murray had not provided an unvarnished view so that metropolitan officials could make decisions remotely. Instead, he employed the environs map to buttress and even call attention to his judgment as somebody operating on the ground.

Figure 20: (Detail in Figure 19) City of Quebec with the letters Murray referenced ("From K to L is a very bad stockade") in the example above.

[64] Murray, "[Report on the Government of Quebec]," 149.
[65] Murray, "[Report on the Government of Quebec]," 151.

Curiously, Murray never directly cited or referenced the Survey of Canada in his report as he did with the environs map of Quebec. It seems, as he whizzed through place names, that he (again) intended the map to (*silently*) aid Egremont and the Board of Trade in following along. Less clear is that he intended the map itself to serve as visual evidence—as some scholars have assumed. For example, Edelson writes: "These maps made clear how little of the countryside along the river was occupied and how much flat, open land close to navigation might yet be cultivated."[66] In fact, the maps show no such thing—and this is a suspect reading of them. The extant copies of the survey, including the one held by the Board of Trade, depict dwellings and road clustered alongside the St. Lawrence River, with only a handful of places void of settlement, as seen in Figure 21. It does not stand to reason, therefore, that Murray sought to use the survey to buttress his report's commentary on the fertility of the landscape, the laziness of its inhabitants, or the economic schemes he proposed.

Figure 21: (Detail from Figure 18) The copy of the Murray Atlas given to the Secretary of State included the roads and dwellings (red dots) clustered along the St. Lawrence River that were also featured in the larger copies.

[66] Edelson, *New Map of Empire*, 83.

Another potential piece of evidence concerning the administrative utility of the survey are notes about each parish (the number of families and men able to bear arms) included on the version of the Atlas received by the King as well as Murray's personal copy. For an example of what these textual notes looked like, Figure 22. Surely this would be useful information for imperial administrators? Yet it was not included in the copy of the Murray Atlas received by the Secretary of State and held by the Board of Trade—the people who were drawing up new plans of government. To summarize, Murray treated the survey as having a limited number of functions for imperial administration, chief among them orienting overseas officials so that they could follow Murray's discussion of specifics. It seems unlikely that he intended the atlas to directly shape metropolitan ideas about how to structure colonial governance in Canada—only to bolster his authority on the subject. And for this purpose, the appearance of accuracy mattered much more than absolute accuracy.

Figure 22: An example of notes about parishes (in the King's copy): "THE PARISH of LONG POINT . . . This was a new Parish established in 1733 on account of the too great distance of Point aux Trembles from the Town of Montreal, it extends along the St. Lawrence about a League and a half upon the Depth of one . . . Families 77 Men able to bear Arms 100." From "PLAN of that part of CANADA and the RIVER St. LAWRENCE . . . Survey carried on under the Direction of the HONOURABLE BRIGADIER GENERAL MURRAY GOVERNOR OF QUEBEC &c."" (c. 1762), BL, K.Top 119:24.

Murray and the other people involved in the survey hoped it would help them negotiate the politics of patronage and reputation so crucial to career advancement in the military. We see this play out in ways both large and small. One especially telling moment concerns the production and reception of the aforementioned copy that Murray sent to William Pitt, which included the dedication to Pitt and his family's coat of arms. Though Murray sent it to Pitt during the winter of 1760-1, he mentioned it to Amherst only a year later when it provoked some embarrassment: "By a letter I had from Lord Egerton the plan must have been shewn to the King and much approven of but the unnecessary ornament [i.e. the coat of arms] was not liked." In explaining himself, Murray simultaneously embraced this gesture and distanced himself from it.

In one breath he wrote "I meant it for his [Pitt's] own use and I thought it a proper compliment from me" and with another, "I never assumed to myself any merit from the survey."[67]

Murray described a network of people around him who harbored ambitions for his elevation, ranging from the draftsman who had "officiously put Mr Pitts Arms upon it" to others who encouraged Murray to "ingratiate" himself "by means of this survey when it is finished." And as he usually did, Murray included Amherst in his web of patronage through flattery and deference. Referencing his friends who wanted him to use the survey to "ingratiate" himself, Murray assured Amherst that he would not have taken such a "step . . . without your consent, advice and approbation." In concluding the saga, Murray pointed to both the vertical (i.e. subservient) and horizontal (i.e. friendship) relations he shared with Amherst while asking forgiveness and advice: "I hope Dear Sir you will excuse this Detail & that your being my commander in cheif [sic] is no reason why I should not consult you as my friend as such I expect your advice and assistance."[68] In sum, Murray tiptoed around his ambitions lest he upset Amherst—but the subtext of his letter was that Murray did indeed have ambitions and believed the Atlas would help realize them.

Ironically, it seems that Pitt too believed in the power of maps for he did not merely *show* but actually *gave* his copy to the newly ascendant King—hence how it came to reside in the King's private map collection (now at the British Library, called the King's Topographical Collection). Relations between Pitt and George III were somewhat strained owing to Pitt's "difference of opinion with the King's other ministers as to the immediate necessity of a Spanish war." We might wonder if Pitt, before retiring "from business" hoped to remind the King of his successful management of the British war effort by giving him the visual proof of conquest

[67] Murray to Amherst (7 Feb 1762), TNA, WO 34/1, 219.
[68] Murray to Amherst (7 Feb 1762), TNA, WO 34/1, 220.

emblazoned with his seal. This subtle (and somewhat private) gesture that allowed Pitt, in Amherst's words, to go "out in good humour" enough so "to be handsomely rewarded" with a peerage for his wife and a "£3000 a year pension to himself and his son for both their lives."[69] Privately, as we have seen, the King grumbled about the "unnecessary ornament" and even had prepared a second, unsullied copy of the same map.[70]

Murray seems *not* to have quite understood the way Pitt yielded the map or the reasons for the King's comments. Instead he took away the lesson the cartophile George III preferred bare maps. And to this lesson Murray steadfastly adhered. Subsequent copies did not include the most obvious marks of patronage, sticking rigidly to the Enlightenment aesthetic of keeping that which was geographically unknown as uncluttered white space. Murray found ways around this limitation. He was sure to feature his name prominently where he could. The title for the King's copy, for example, described the "Survey carried on under the Direction of the HONOURABLE BRIGADIER GENERAL MURRAY GOVERNOR OF QUEBEC &c." The King's copy also depicted "General Murray's Encampment" (which can be seen in Figure 23) just outside Montreal, serving as a reminder of his military service. Perhaps a small detail but we might wonder if one source of Murray's anxiety over the copy for Pitt rested in the omission of Amherst's encampment (which would have been slightly beyond the map frame, as can be seen in Figure 24). It all went over the head of Amherst who seems to have not understood the cause of Murray's disquiet, namely that the *King* had taken offense at the map. Instead Amherst reassured Murray that "Mr. Pittman having Mr. Pitt's Arms on the Survey can be of no bad Consequences; Mr. Pitt could not take it any otherwise than a Compliment."[71]

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[69] Mahon, *Life of General the Hon. James Murray*, 288.
[70] "Plan of the River Saint Lawrence from Montreal to the Parish of Berthier on the North side of the River, and Sorel on the South" (n.d.), BL, K.Top 119:28.
[71] Amherst to Murray (28 March 1762), TNA, WO 34/3, 135.

Figure 23: Inset in the King's copy of the Murray Atlas. Note the reference to the encampments of Amherst and Murray.

Figure 24: Detail from Pitt's copy (Figure 11). Note that the "white" space of the map begins immediately after "Gen. Murray's Encampment" and the absence of "Amherst's Encampment" (which following the placement in the King's copy would rest just to the left of the map frame).

Patronage and reputation emerged again months later in another letter to Amherst, concerning this same c.1760 copy for William Pitt (Figure 11), but this time concerning two surveyors John Montresor and Samuel Holland. As Murray explained it, "Montresor says his Health makes it necessary for him to go to the southern Coloneys." Murray effectively wrote to warn Amherst of "a very wrong thing" Montresor had "been detected in doing." While boxing up the map to send to Pitt, Montresor "erazd [erased] Holands Name." Holland suspected as much for the next day, he "desired that the Box might be broke open and the Plan examined, which was accordingly done to Montresors disgrace."[72] When Montresor reached Amherst, the General (who was "Sorry to find Mr. Montresor . . . Guilty of [this] Ill Judged, wrong piece of Business") put him in charge of drafting sketches left by another engineer—perhaps as punishment.[73]

The episode, which appears to be true judging from an apparent erasure on Pitt's copy, reveals the desperate measures of people like Montresor in claiming full credit to impress a

[72] Murray to Amherst (26 Sept 1762), TNA, WO 34/2, 82.
[73] Amherst to Murray (28 Oct 1762), WO 34/3, 177.

potential patron. By the same token, Holland's (vindicated) suspicions illustrate that he too wanted his name to be seen by Pitt, fully aware of the cutthroat competition for advancement. Ultimately Holland prospered at this game, securing the allegiance of Murray who enthusiastically endorsed him to whoever would listen including Amherst, Egremont, and the Board of Trade.[74] This paid off when Holland received a lucrative commission to lead the northern survey of North America for the Board of Trade.[75] Montresor was left to write a bitter record about Holland's salary in this position ("2000 £ per annum *Sterling*") to himself in his diary after he felt his own career had stalled. He titled his list "*Mem[orandum]s of British Folly*, not having any good subjects of their own."[76]

Murray may have affected surprise to Amherst about Montresor's duplicity but he clearly understood the stakes in placing or omitting names on the final maps. And this wasn't the only instance where competition for recognition led to such backhanded tactics. In November 1761 Murray had complained to Amherst about Captain William Spry who had taken charge of "what he is pleased to call a drawing room" and was contriving "to dislodge Capt. Holland & indeed every body concern'd in this Affair."[77] As Shields has argued, much of the rivalry in this drawing room split along the lines of engineers vs. the battalion officers.[78] It seems possible that Murray himself fanned these competitive flames as one way to motivate his subordinates. As he later explained to Amherst:

> The Established Engineers and the other officers, who have assisted in taking the survey and drawing the Plans, have been very diligent, and deserve much praise, but I found it necessary, to excite emulation and to satisfy the Battalion Officers

[74] For example, see Murray to Amherst (9 Sept 1762), TNA, WO 34/1, 86.
[75] On Holland's career, see especially Johnson, *Charting the Imperial Will*.
[76] G. D. Scull, ed., *The Montresor Journals* (New York: Printed for the New-York Historical Society, 1881), 135. Scull, ed., *Montresor Journals*, 135.

[77] Murray to Amherst (15 Nov 1761), TNA, WO 34/1, 213-4.
[78] Shields, "The Murray Map Cartographically Considered," 91.

> that they are not to be rob[b]ed of the honor of their performances, to mark upon the face of the survey the particular labor of each individual.[79]

What does this all add up for us thinking about the value of these and other historical maps in the context of Geographical Information Science? Primarily, we should take little for granted in appropriating historical geospatial data from them. To recap this discussion so far, textual primary sources suggest the overriding rationale for creating and gifting maps in transatlantic political culture revolved around establishing patronage relationships and building one's reputation. This was the first lens through which the more utilitarian objectives of the mapping were refracted. A second lens, in this particular case, involved the makeshift tools, techniques, and labor practices that often left something to be desired by contemporary standards. So we must independently verify the phenomena represented within them as much as possible before trusting our dataset. This kind of painstaking work will help us understand what surveyors and draftsmen prioritized, what they fudged, and what they misrepresented. And in this way, we will begin to understand something about the spatial worldview of these people.

[79] Murray to Amherst (9 Sept 1762), TNA, WO 34/2, 86.

Chapter 4: Digitally Processing the Murray Atlas

This chapter outlines my methods for digitally processing the Murray Atlas into a GIS as well as my examination of spatial distortion within the Atlas. Finally, I discuss how I created spatial interoperability between my historical geodatabase and the demographic records discussed in the next chapter.

4.1. Creating a Basemap and Vector Data

Digitally processing the Murray Atlas began with the challenge of assembling the disparate sheets into a single basemap. Slight variations in size, discrepancies in the positions of geographic features, and warping of the paper over time impeded initial attempts to align neighboring sheets in Photoshop.[80] Instead, I proceeded by employing the composite map (Figure 1) as scaffolding for these individual maps—operating under the logic that by working with the mapmaker's synthesis of the disparate sheets, I preserved their intent, vision, and understanding of the geographic whole. In ArcGIS, I georeferenced this composite map with an affine transformation that maintained its original proportions but nevertheless allowed for easy comparisons to present-day maps when useful. Next I created vector polygons over the original grid (refer back to Figure 1), which dictated where each manuscript sheet was located. In most cases, I used this vector grid to georeference each of the individual manuscript maps, using the four corners as control points and then enacting a projective transformation. To see what this process looked like in ArcGIS, see Figure 25. The full results can be seen in chapter one, Figure 2.

[80] Paul, P. Bolstad, Gessler, and T. M. Lillesand. "Positional Uncertainty in Manually Digitized Map Data" *International Journal of Geographical Information Systems*, no. 4 (1990): 399–412.

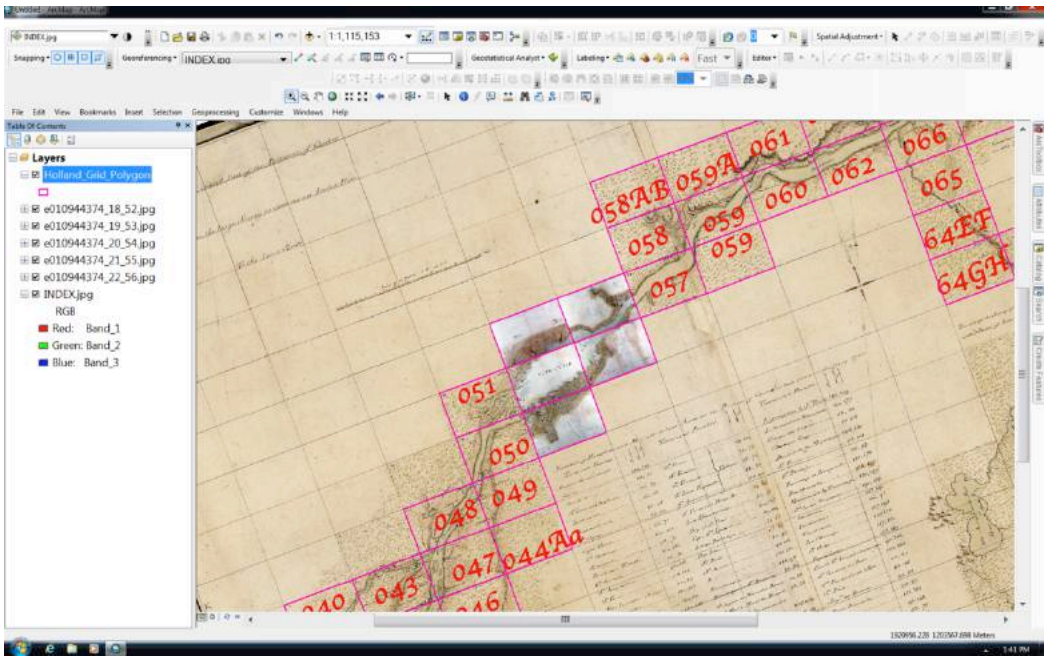


Figure 25: Assembling the Individual Maps on top of the Composite Map in ArcGIS. See Figure 2 for a view of all the individual sheets assembled together.

Certain sheets provided a special challenge. In some cases the draftsmen, to save space, included insets—made at the same scale as the main map—of other geographic areas that did not neatly paste onto the original grid. For an example of what these insets looked like, see Figure 26. In other cases, draftsmen depicted geographic space as spilling over neatlines, again to save them the task of drafting entirely sheets that would be mostly empty space. For an example of what this looked like see Figure 27.

Figure 26: Example of Insets in the Murray Atlas

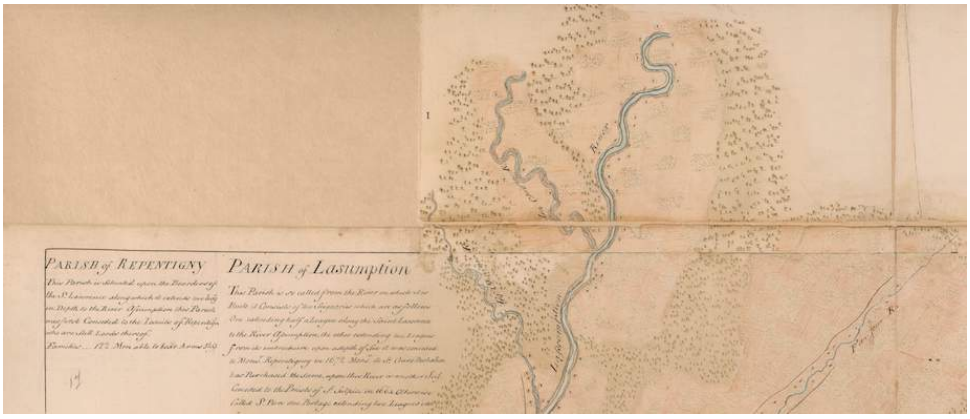


Figure 27: Example of Mapped Area Extending beyond Neatline

In the case of insets, I employed Adobe Photoshop to cut and paste the inset to the appropriate area, which was indicated through text in the inset. Figure 28 shows a screenshot from Photoshop with the insets being assembled. While not always an ideal solution, it preserved continuity of intent across different maps and usually aligned with the grid in ways that made sense as can be seen in Figure 29. Any major distortion that may have resulted in the inset area from not having additional control points anchored in the grid would later be corrected in the

spatial adjustment process. Moreover, in most cases these insets contained spatial data of limited significance to the primary purposes of this project because very rarely did they depict buildings, roads, or other elements of the human built landscape. Transgressed neatlines, while more likely to include more relevant geospatial data, required no additional editing from me. I anchored the map neatline within the grid, which allowed me to ensure that the overhang conformed to the logic of the grid as shown in Figure 30.

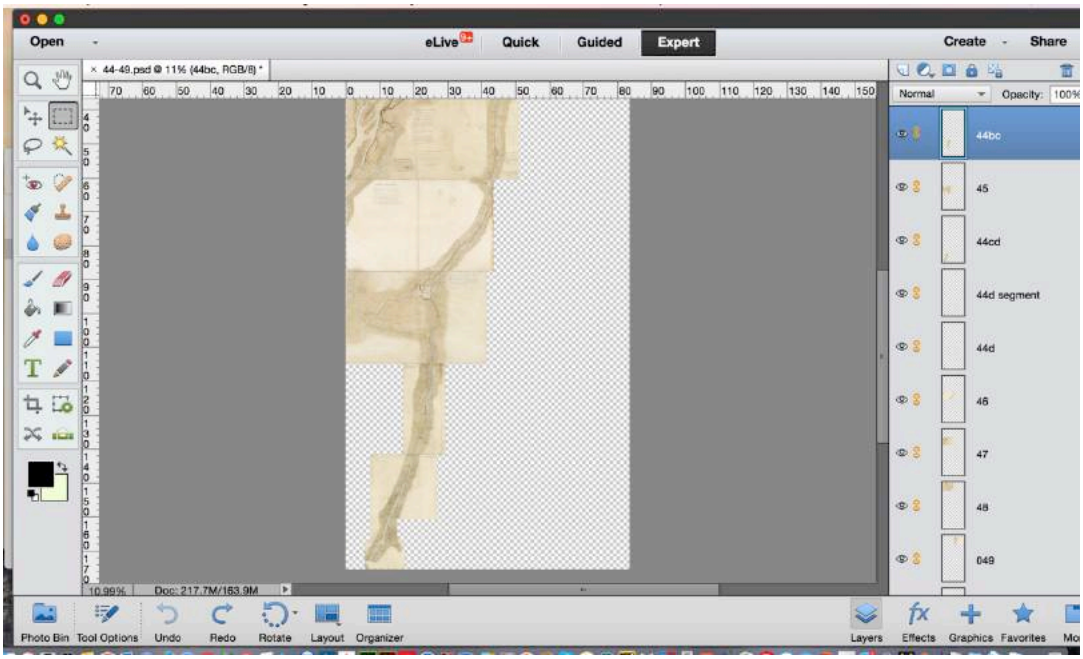


Figure 28: Assembling Insets in Photoshop

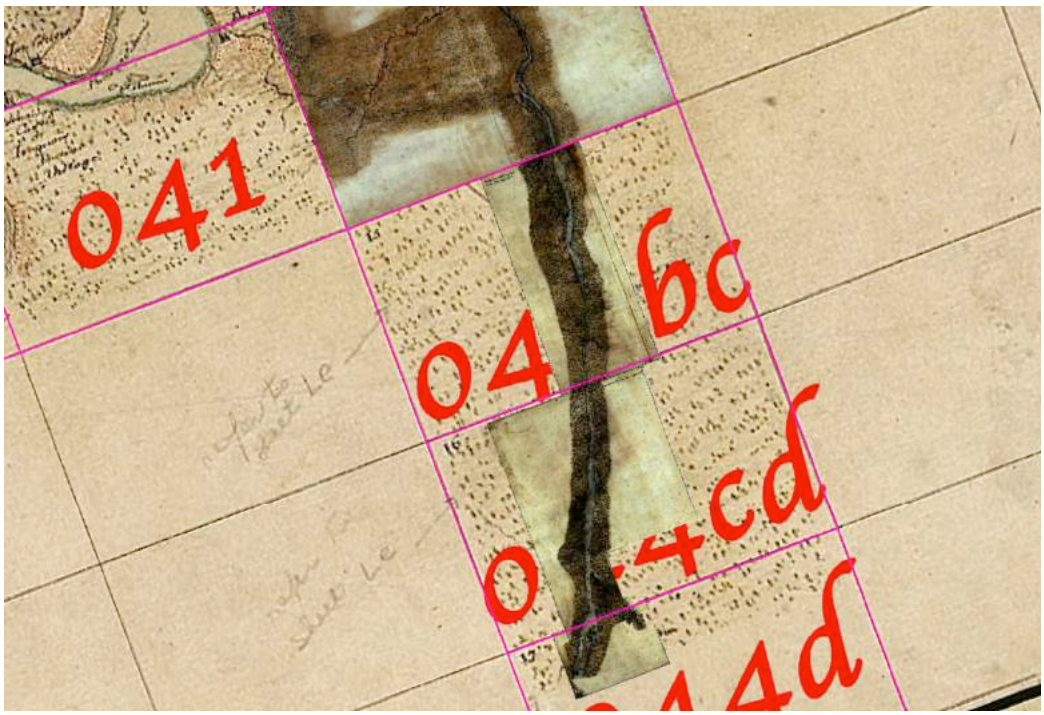


Figure 29: Inset Alignment with the Composite Map

Figure 30: Aligning the Neatline with the Grid in Case with Overhang

Having created the raster mosaic dataset, I proceeded to conceptualize the geographic universe being depicted in the Murray Atlas so that I could organize a geodatabase. Here I created an Entity-Relationship Diagram, which can be seen in Figure 31. My goal was, as much as possible, preserving the original intent of the cartographer—to see the geographic world in their terms rather than my own. In this way, creating an Entity-Relationship Diagram was an empathetic activity, helping me to chart the mapmaker's worldview.

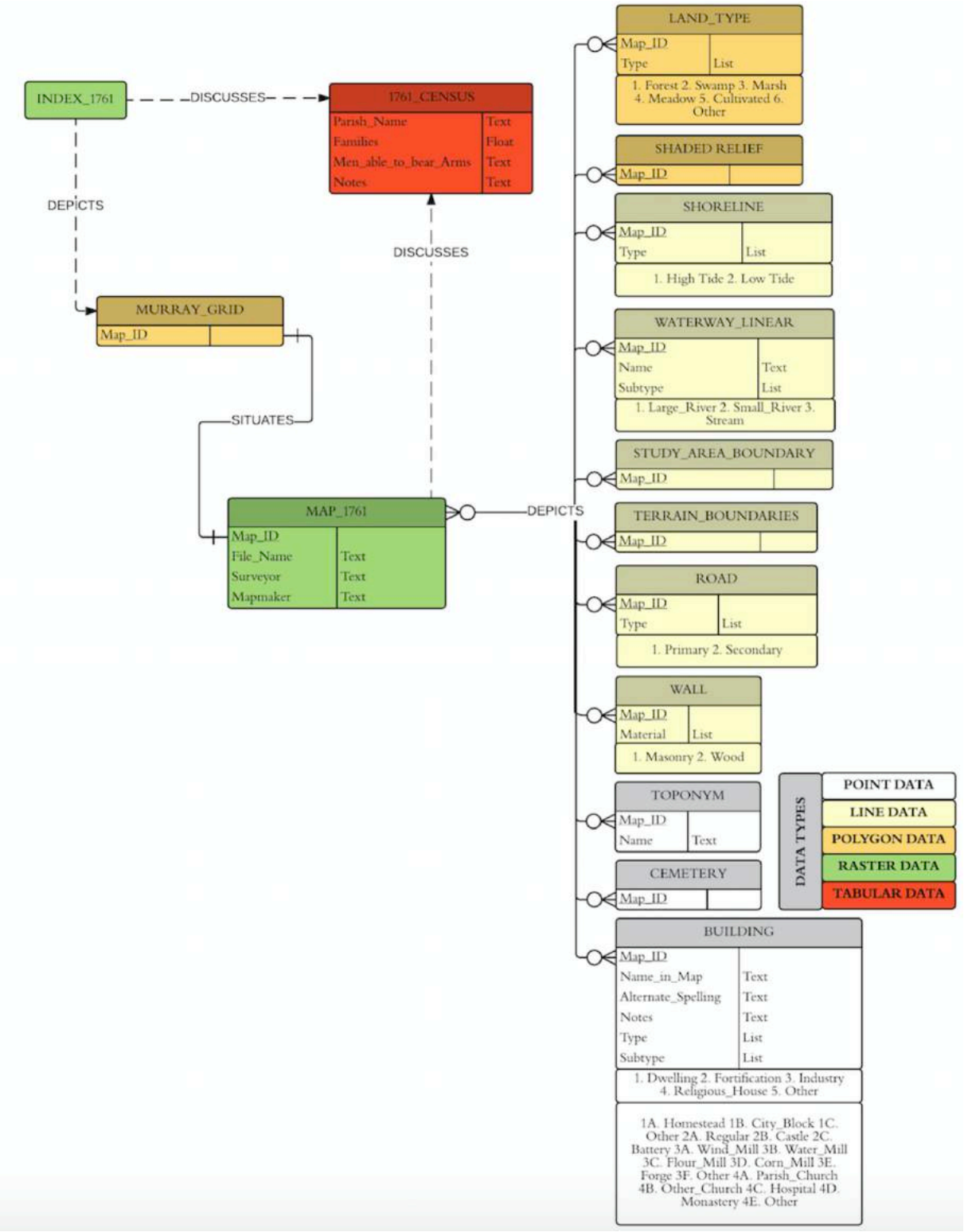


Figure 31: Murray Atlas Entity Relationship Diagram (ERD)

Advances in scanning and automation software mean that with relatively clear and legible paper maps, it is now sometimes possible to recognize certain kinds of geographic features embedded in the digital scans of those maps and then convert raster into vector data.[81] Unfortunately the Murray Atlas contains too much symbological and typographical variation for any kind of automated processing. This necessitated painstakingly manually creating vector data by hand, effectively tracing over the raster backdrop one vertex at a time—a sluggish process documented in Figure 32, which shows a screenshot in ArcGIS's data editing mode.

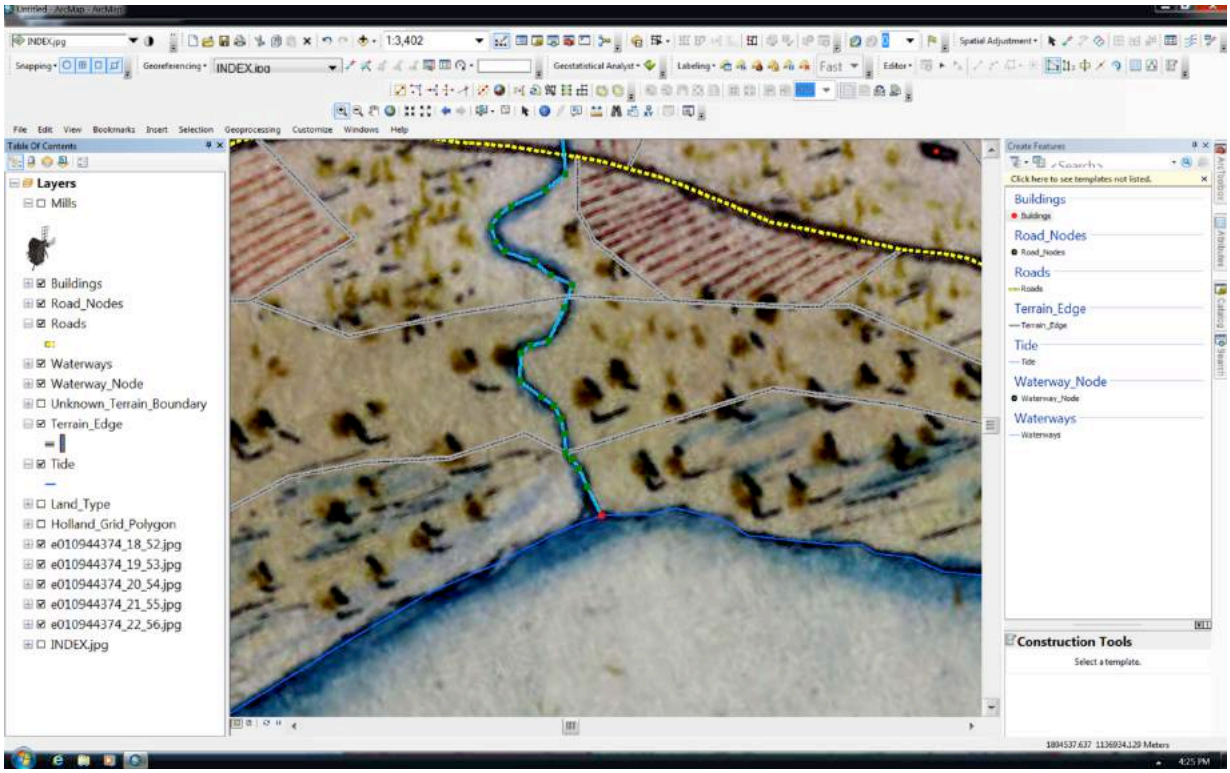


Figure 32: Creating Vector Data in ArcGIS by Tracing Over the Historical Map

There was one upside, however, to this manual processing. Carefully going over inch in the map facilitated close reading. I encountered details that I otherwise would have certainly

[81] Yao-Yi Chiang, Leyk Sefan, and Craig Knoblock, "A Survey of Digital Map Processing Techniques" *ACM Computig Surveys* 47:1 (April 2014), 1–44.

missed and, ultimately, I *really* knew what was and wasn't depicted in the map. Both of these facts aided my historical interpretation. As one example in the previous chapter (section 0), knowing the Murray Atlas so well helped me read Murray's report to the Board of Trade. I knew that Murray, in discussing the Canadian landscape, was not implicitly referencing any specific geographic features depicted in the Atlas other than toponyms. This in turn helped me identify the mistakes of an earlier scholar (Edelson) who believed Murray was using the Atlas to support an argument laid out in his report.

A key downside to manual vector creation is the potential for human error. To reduce this, I adopted strategies to ensure constantly rechecking of work and correction of mistakes. Rather than working on creating all the vector data in one historical map at a time, for example, I worked vector layer by vector layer across all historical maps. For example, I would process my "buildings" layer in all maps before moving onto roads or waterways. This also guaranteed that I employed consistent standards and definitions. If, for example, I had decided to process a certain visual symbol (a red cross) as a church, this practice ensured that I employed the same standard throughout. Processing new layers also required me to return to the same geographic areas, exposing earlier mistakes, omissions, and inconsistencies.

In certain cases, I encoded my uncertainty into the attributes of the vector data. Sometimes, I noted symbological ambiguities ("is that dot a dwelling or a smudge?"). In other instances, the uncertainty went deeper. Without the presence of any kind of key or legend, classifying certain kinds of terrain proved challenging. In these instances, it was often unclear how much to read into symbological differences. Did circles in what appeared to be marsh indicate rocks? Or did draftsmen simply render the same phenomenon in slightly different ways? Rather than answer that question directly, I created subclasses to preserve the symbological

distinctions while identifying what was commonplace. In some cases continued scrutiny of the map helped suggest what certain symbols represented; in other unresolved cases, other scholars accessing the dataset can choose for themselves if and how to interpret ambiguities.

4.2. Spatial Adjustment

After creating this vector data, I used spatial adjustment to ensure its alignment with our present-day understanding of the geography. I employed churches as my primary type of human-created control point, operating under the assumption that they offered the most continuity in the landscape between past and present. Moreover, judging by the high rank of churches in the symbological hierarchy, we can conclude that surveyors and draftsmen seem to have paid consistent attention to churches. In some cases, the churches standing today were built before 1760. In most cases, however, the churches were rebuilt in fairly proximate locations.

As with the process of creating the vector data, I completed this process of locating these churches manually. On the one hand this reflected a dearth of existing geospatial data—I could find no dataset of churches providing locations and their building dates. On the other hand, even if such a dataset existed, it would still need to be carefully checked over to ensure rebuilt churches did not also relocate. As I had noted uncertainty while creating my vector data, I noted the evidence (positive and negative) that these historical churches occupied the same location since 1760. I acquired this evidence through parish websites and Google Maps. In the cases when a church had not made its architectural history available online, Google's street view enabled me to see dates etched in cornerstones, parish cemeteries, and other evidence that suggested continuity or discontinuity of location. In a handful other instances, I located other buildings such as fortifications depicted in the Murray Atlas where I could establish a lineage to

what stands in the present. Ultimately, I identified eighty-one of these control points. Figure 33 shows their distribution.

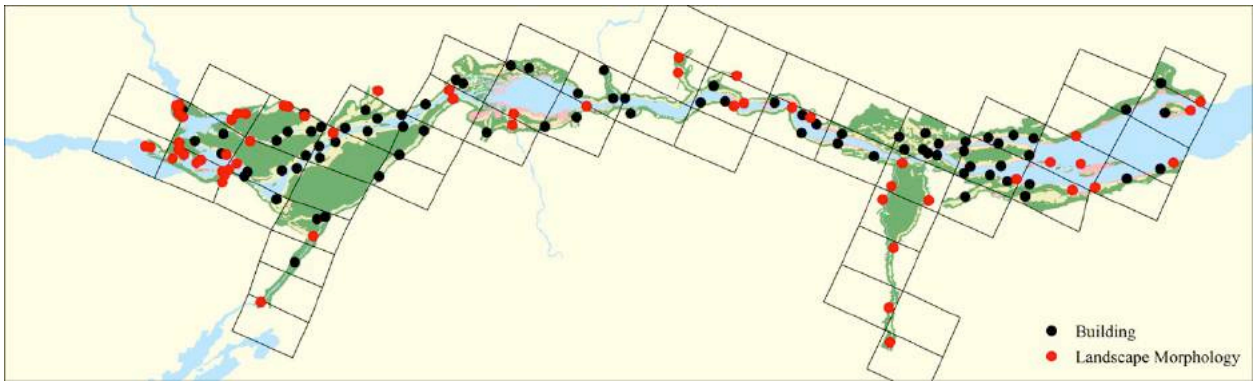


Figure 33: Distribution of Control Points for Spatial Adjustment

Yet these alone would not produce a satisfactory transformation owing to their uneven distribution. This uneven distribution was not especially surprising, having roots in historical development. Namely, long settled places in 1760 would logically have more buildings than recently settled places and therefore would be much more likely to have more buildings surviving into the present. To correct this, I identified an additional fifty-three control points (again, see Figure 33) rooted in durable qualities of the physical landscape represented in both the Murray Atlas and present-day aerial/satellite imagery such as islands with distinctive shapes or places in rivers with distinctive curvatures. Because the objective was to maximize the alignment between past and present, the adjustment method I employed to transform the vector data was rubbersheeting.

I had to repeat this process with the original data two or three times to get a satisfactory result. Here there were two issues. First, poor alignment in a handful of areas around selected church control points suggested that, perhaps, these particular churches had been relocated during rebuilding. Removing these control points solved this problem rather quickly. In other

cases, spaces between control points did not align well. Finding additional control points in the durable physical environment solved this problem. The overall result of this work can be seen in Figure 34 with details of Quebec and Montreal in Figure 35and Figure 36, respectively.

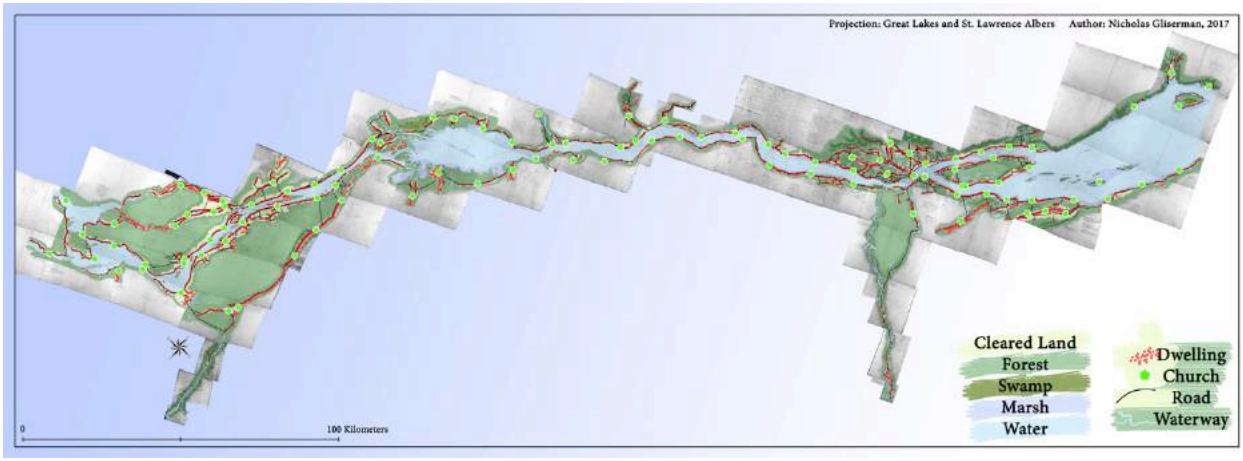


Figure 34: The Digitized Murray Atlas

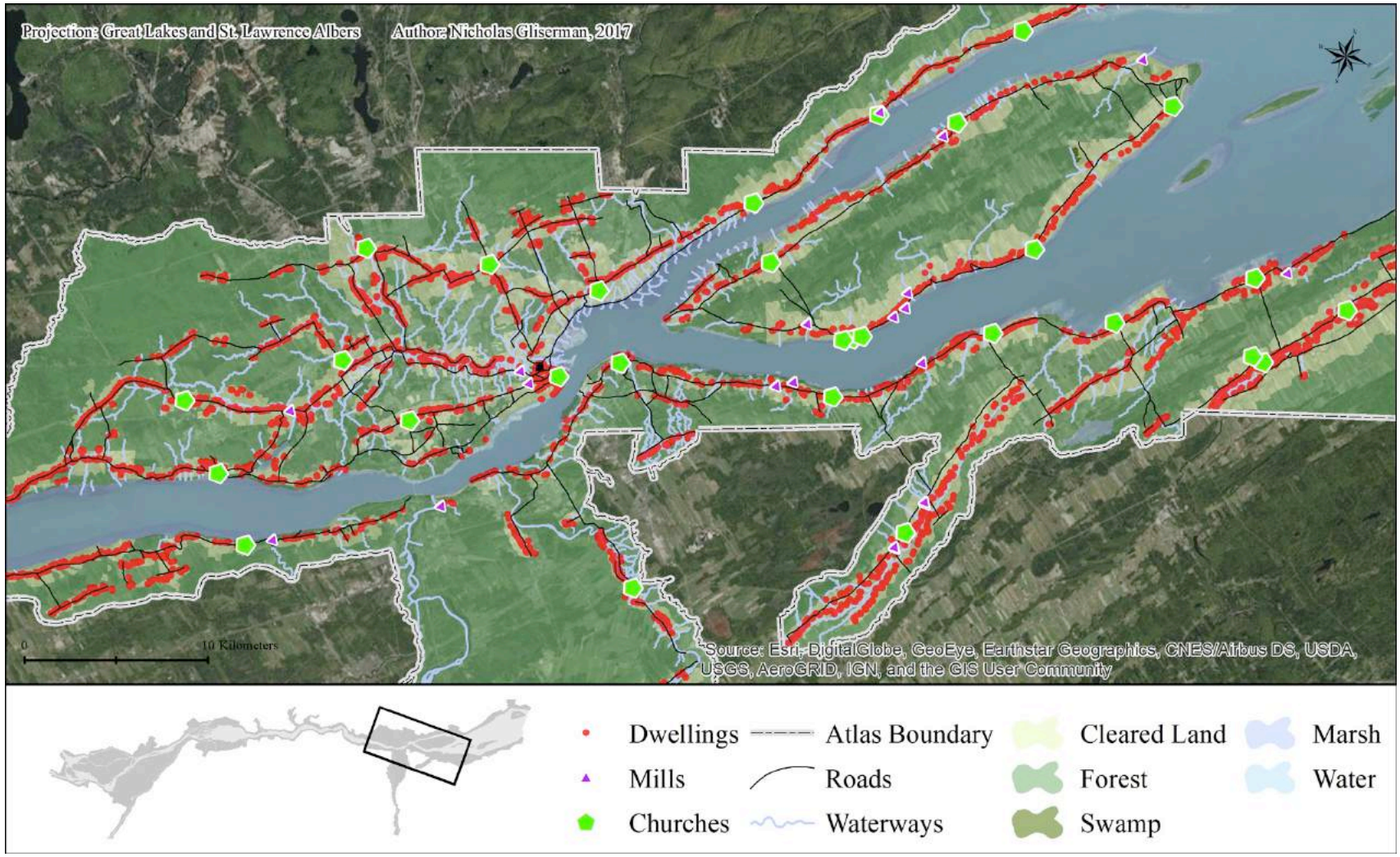


Figure 35: View of Quebec and Environs

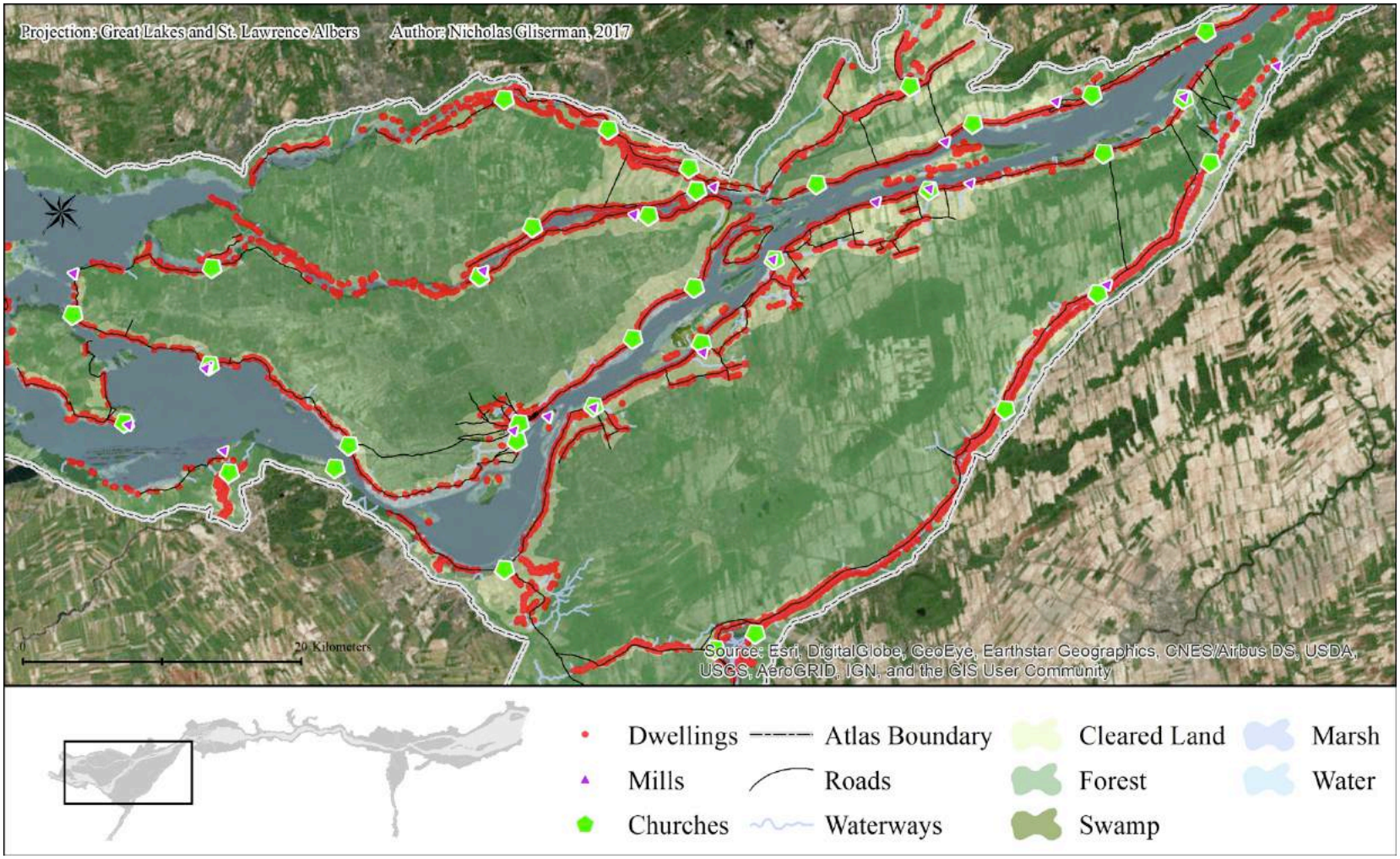


Figure 36: View of Montreal and Environs

4.3. Positional Accuracy and Spatial Distortion

With the historical geodatabase completed, the question now was: What kind of positional accuracy does the Murray Atlas offer? What is the level of error and how is that error distributed? To answer these questions, I created a fishnet composed of quadrats over the unadjusted data and then used the same control points to spatially adjust the fishnet. Next, I used GIS to measure the area of each quadrat and the length of each side. After factoring in the slight scale change, I was able to determine the linear distortion for each segment (and areal distortion for each quadrat). The average linear distortion was -2.06%. 91.2% of the map had less than 15% linear error while only 2.2% suffered from error greater than 25% (Table 1). The spatial distribution of that error can be seen in Figure 37 and Figure 38. Said differently, the vast majority of the map was not very distorted while only a tiny minority was extremely distorted. Overall, the low degree of spatial distortion outperforms our expectations given the particular historical context outlined in Chapter 3.

Table 1: Range of Error in Quadrat Lines

Linear Distortion	**Number**	**Percent**
Less than 5%	10065	50.6%
5- 15%	8011	40.2%
15%-25%	1395	7.0%
25%-35%	240	1.2%
Over 35%	197	1.0%

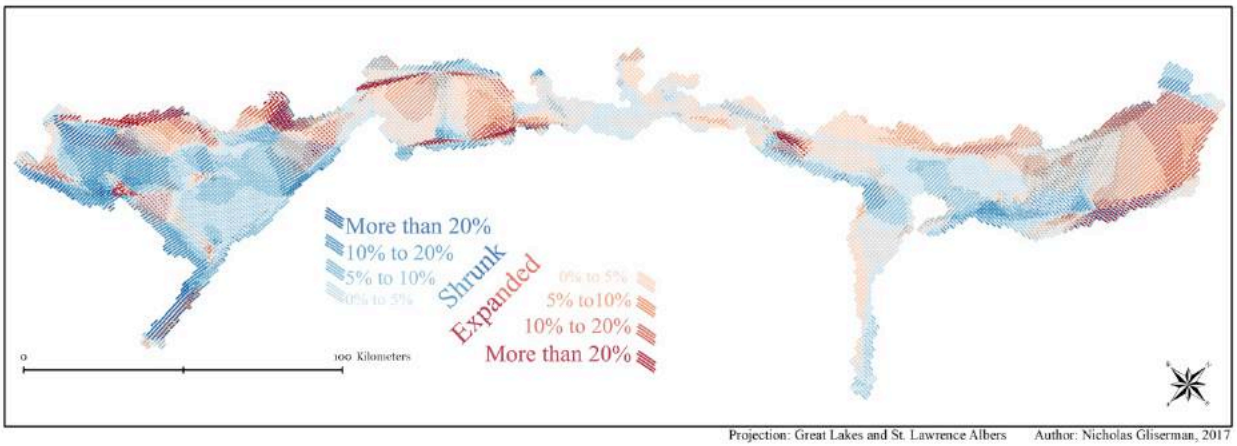


Figure 37: Linear Distortion in the Murray Atlas.

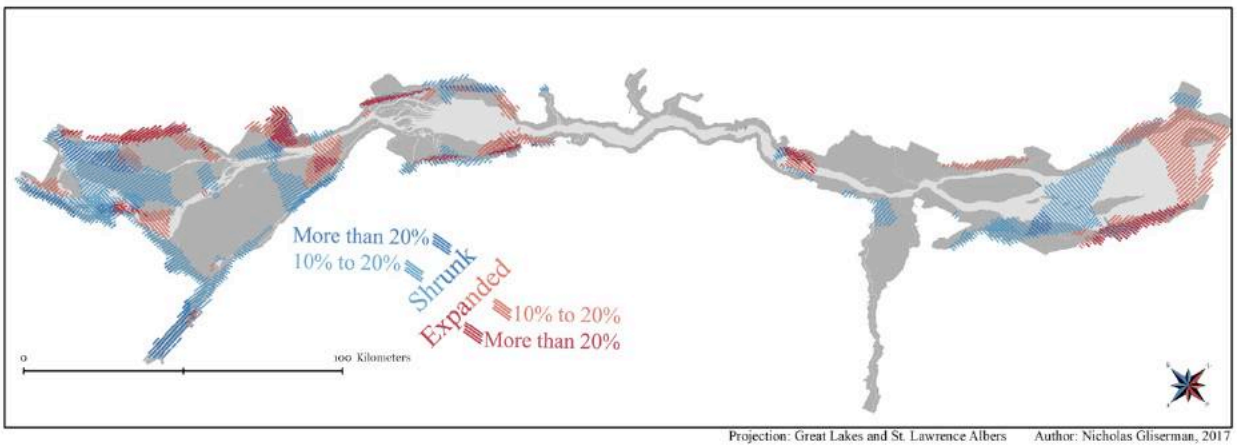


Figure 38: Linear Distortion Greater than 10% in the Murray Atlas

More *potentially* interesting for our purposes: What might the spatial distribution of that distortion tell us? Visually we can see both sides of the Atlas suffer from large swaths of distortion while the areas in-between have a few troublesome but confined spots. Some of this distortion probably emanates in part from the synthesis of the individual map sheets—for example, some low-grade distortion across downstream portions of the St. Lawrence River, which is visible in Figure 39. Here we note that the second to last column in the composite map was slightly wider (2.78 inches) than the others (~2.35 inches)—hence why we would see this

area shrink during the spatial adjustment. Figure 40 shows this disparity in column width on the composite map.

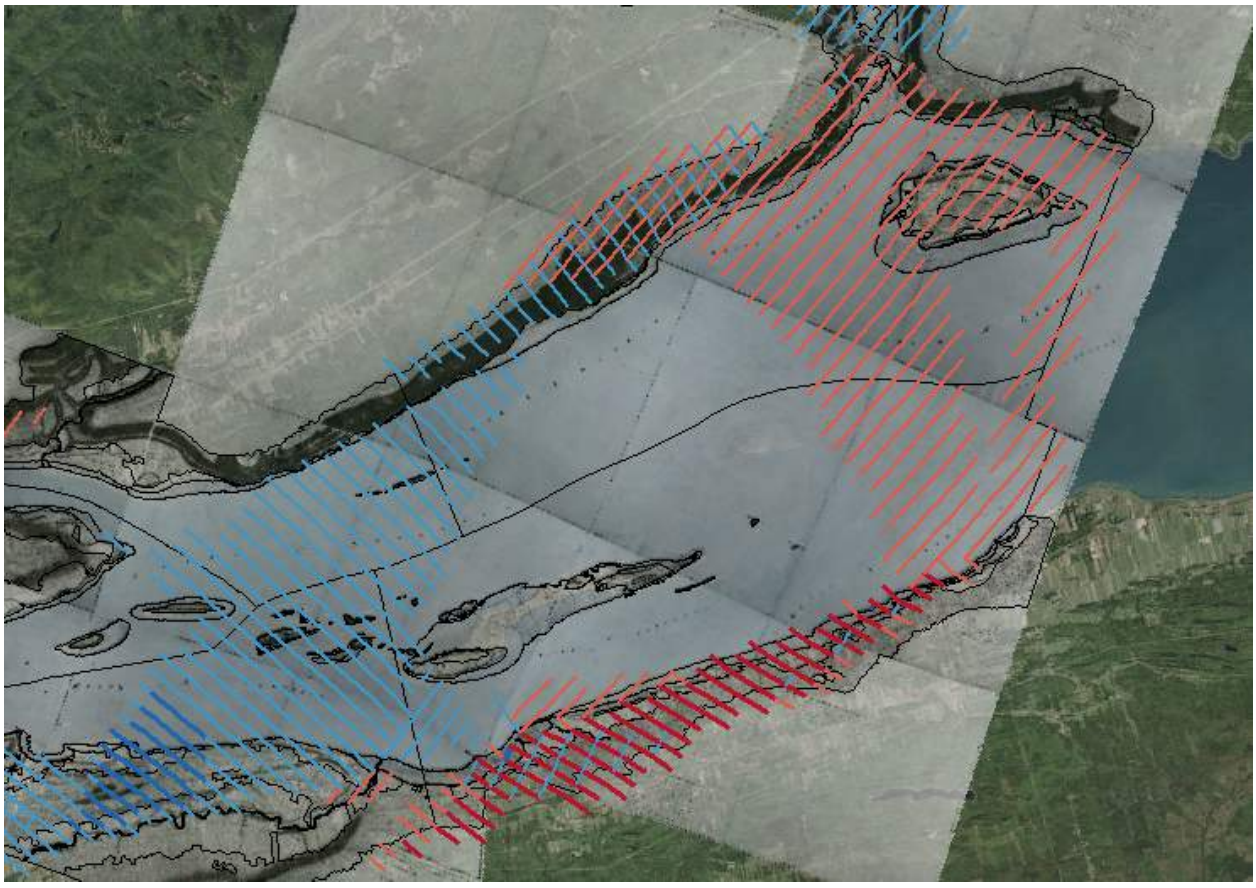


Figure 39: Linear Error (Greater than 10%) in the Eastern Portion of the Murray Atlas

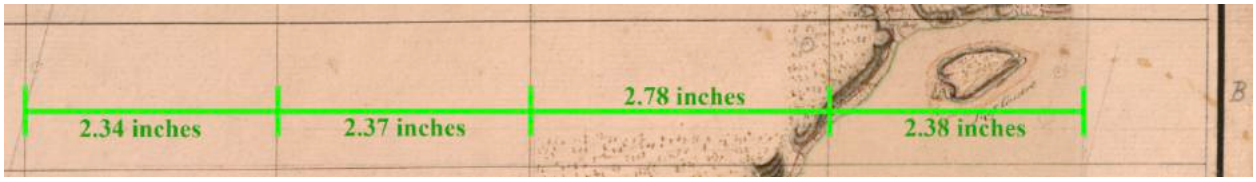


Figure 40: Row from the Rightmost Portion of the Composite Atlas (Figure 1). Note the slightly longer second-to-last column (compared with the others).

Another important note is that the territory in the government of Quebec was on average, less distorted (-0.88%) than that in Trois Rivieres (-3.41%) or Montreal (-3.02%) upstream. Indeed, the distribution of this error, which can be seen in Table 2, also favors Quebec. And from

a historical perspective, this all makes sense: The lengthy recon naissance and siege of Quebec in 1759 probably provided surveyors with preliminary data and greater familiarity with this terrain.

Table 2: Distribution of Error by Government

Error	**Montreal**		**Quebec**		**Trois Rivieres**	
	# Quadrat Segments	% Quadrat Segments	# Quadrat Segments	% Quadrat Segments	# Quadrat Segments	% Quadrat Segments
Less than 5%	2664	39.8%	5203	59.2%	1538	45.9%
5%-10%	2197	32.8%	2191	24.9%	1182	35.2%
10%-20%	1368	20.4%	1235	14.1%	458	13.7%
20-30%	324	4.8%	72	0.8%	139	4.1%
Higher than 30%	138	2.1%	82	0.9%	37	1.1%
TOTAL	6691		8783		3354	

How did surveyors contribute to the distribution of error? Here we might revisit Shields' conclusions. He discussed error and surveyors with a circular logic, essentially giving primacy to the archival evidence. In discussing the Isle d'Orleans where he found high error, he commented that it leads "one to believe that the survey was not taken in a competent manner." He continued: "Interestingly, the surveyor in question is none other than William Spry, who had so irritated Murray with his alleged ineptitude."[82] In contrast, Shields downplayed error when committed by those more favored by the historical record. For example, he wrote: "The Beauport region, surveyed by Holland, is the area of most serious localized error" which he explains with the hypothesis that "Holland may have trusted subordinates with the work."[83] My own results, which can be seen in Figure 41, tell us that error in both areas was under 10% in contrast with the

[82] Shields, "Murray Map Cartographically Considered," 141-142.
[83] Shields, "Murray Map Cartographically Considered,"142.

66.4% for Beauport and 35.9% for Île d'Orleans that Shields reported. But what about the general principle that some surveyors were more prone to significant error than others?

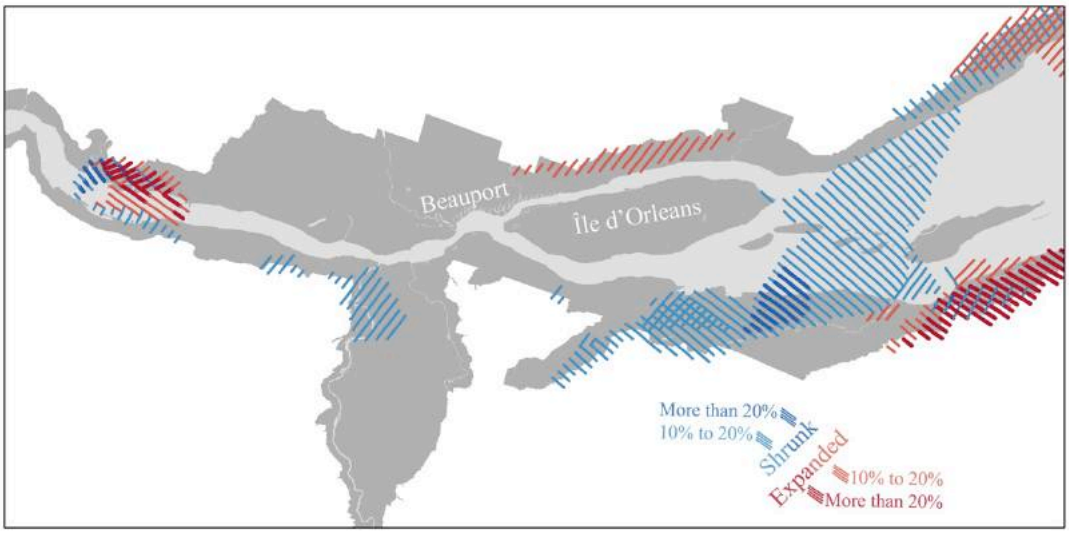


Figure 41: Absence of Linear Distortion Above 10% from Beauport and Île d'Orleans

In our small sample of surveyors, we find a moderate correlation (R^2=0.4592) between the average linear distortion and the amount of territory surveyed.

Table 3 lists the average linear error for as well as territory covered by each surveyor as Figure 42 charts this relationship. Figure 43 maps surveyor coverage while shading the places with more than 10% linear error. Said plainly, surveyors who did more mapping were somewhat more likely to make mistakes. Other factors such as skill must have also contributed. Samuel Holland, for example, who had surveyed the most territory and received generally glowing reviews from superiors had a lower average linear error rate than did three of his counterparts. John Montresor—the surveyor who attempted to erase Holland's name and bitterly complained his diary about the inaccuracy of other mapmakers—only surveyed slightly more than two others yet had an error rate second only to Fusier who mapped five times more territory. Limitations on mobility probably also posed problems for surveyors in certain terrain. We might hypothesize

that marshes and inland settlement patterns added to the high linear distortion around the peripheries of Lac-Saint-Pierre, which is shown in Figure 44.

Table 3: Surveyor Coverage and Error (Colors in the table match the key in Figure 43)

Surveyor	Area Surveyed (SqKm)	Average Linear Error (%)
William Spry	343	3.62
Frederick Haldimand Jr.	374	3.43
John Montresor	481	7.12
Joseph Peach	756	3.78
Philip Pittman	1032	6.72
Lewis Fusier	2703	8.75
Samuel Holland	**2780**	**6.46**

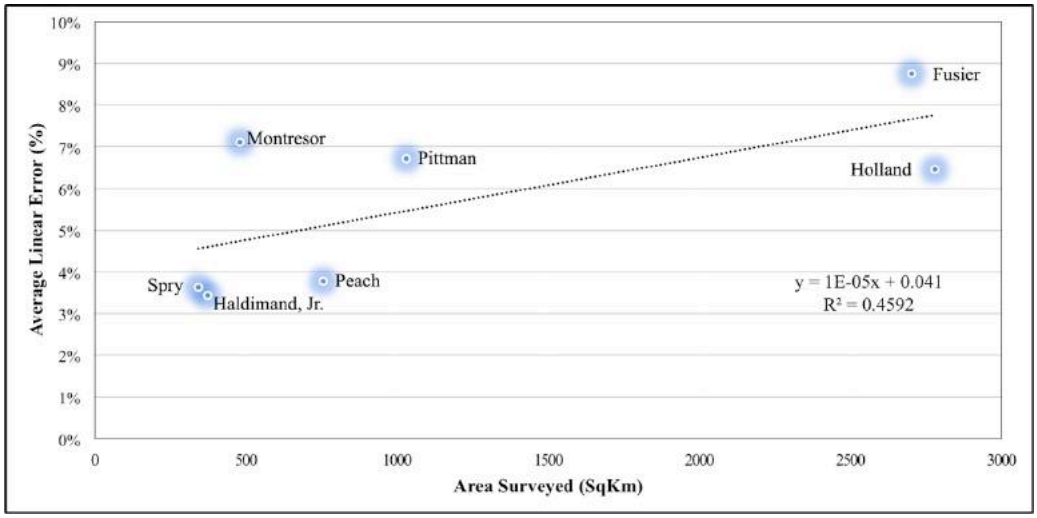


Figure 42: The Relationship between Surveyor Coverage and Distortion

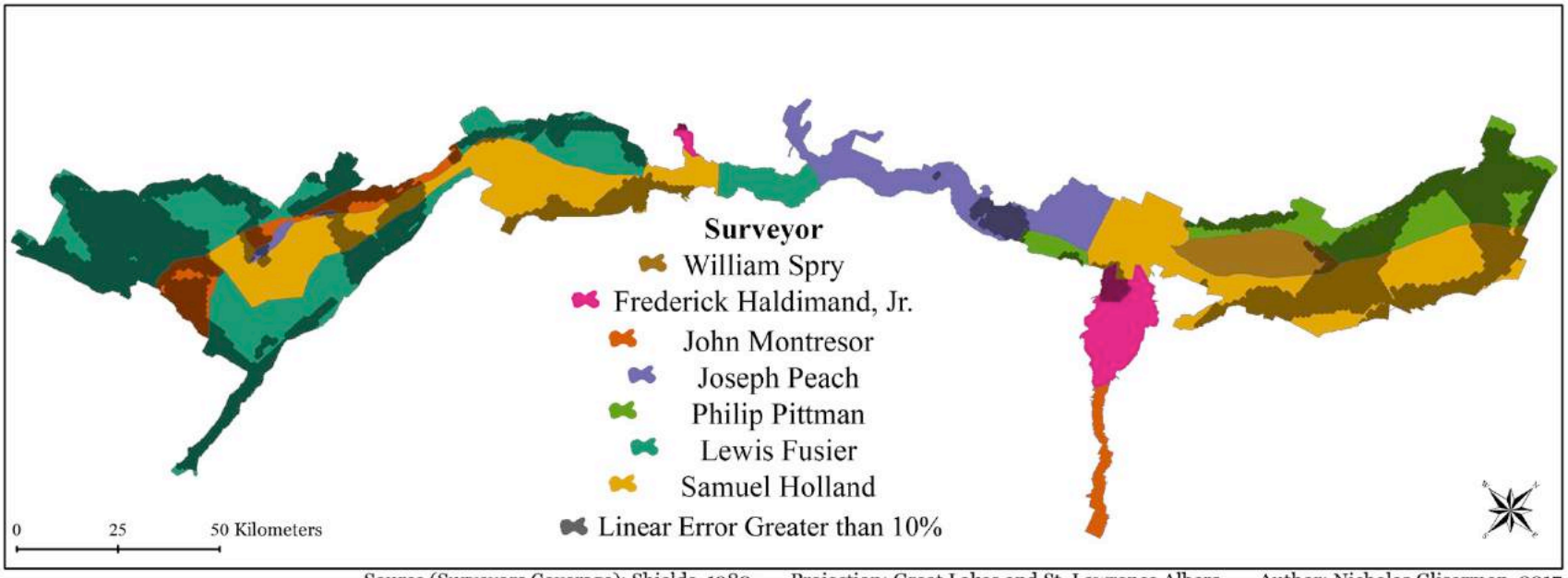


Figure 43: Surveyor Coverage and Error in the Murray Atlas

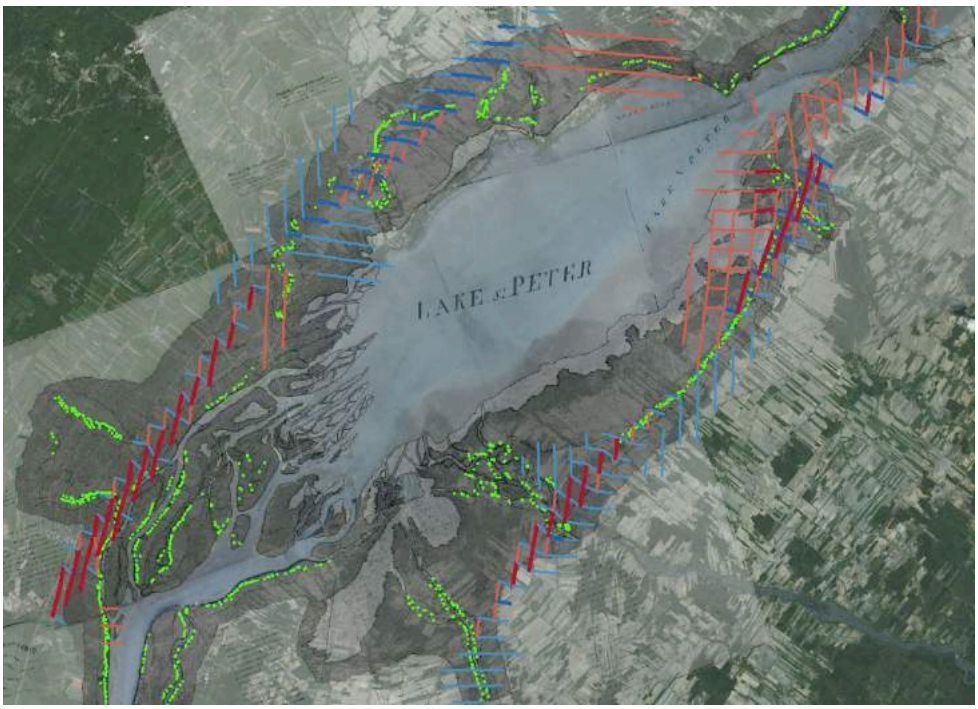


Figure 44: Error around Lake St. Peter with Dwellings in Green

We might investigate one last hypothesis concerning spatial distortion in the Murray Atlas. Did densely settled areas suffer from less distortion than places with little or no settlement (i.e. as depicted in the maps)? Visually it would seem so: Areas with highly clustered dwellings around Quebec and Montreal Cities look to suffer from low linear distortion. This might also help explain the high linear distortion upstream of Montreal and along the Richelieu River with fewer dwellings. I tested the proposition by creating points along the perimeters of the quadrats (as shown in Figure 45) and taking two pieces of data: First the linear distortion for the quadrat segment and second, to measure clustering, the sum of the inverted distances of dwellings (this weighs closer dwellings more than further ones) within a 5km radius (a distance that can be walked at a typical pace in an hour). Surprisingly, I found absolutely no correlation (R^2=0.0002) between the clustering of dwellings and distortion. See Figure 46 for a scatterplot showing the relationship between clustering and distortion. Measuring for density rather than clustering did not substantively change my results (R^2=0.00187) as shown in Figure 47. In other words,

surveyors did not make more effort to take good measurements because an area was well settled—this seems as good a clue as any that policing a conquered population was not the predominant concern of the surveyors.

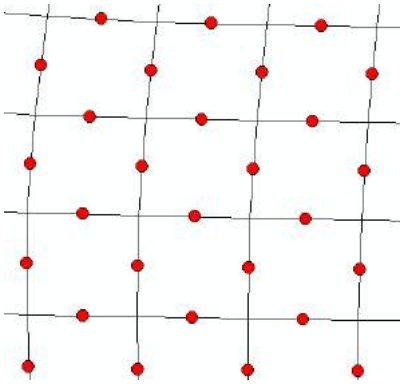


Figure 45: Points to Sample Linear Error and Clustering

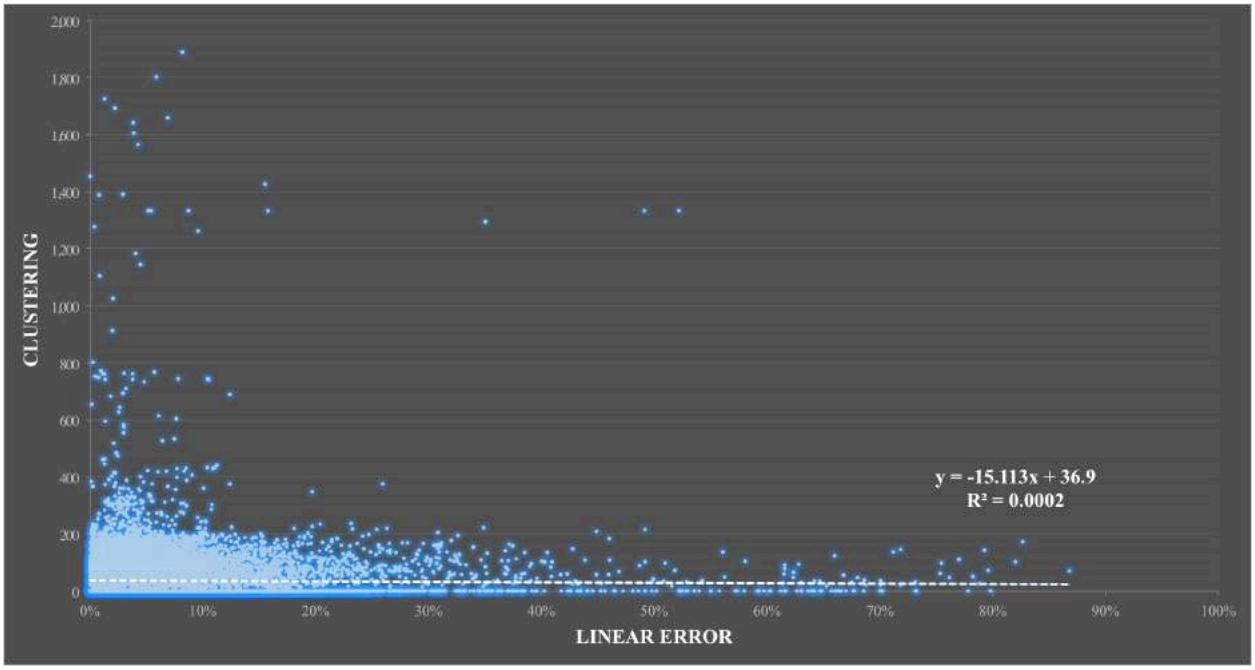


Figure 46: Scatterplot Showing Clustering (Sum of Inverted Distances to Dwellings within 5km) vs. Linear Error

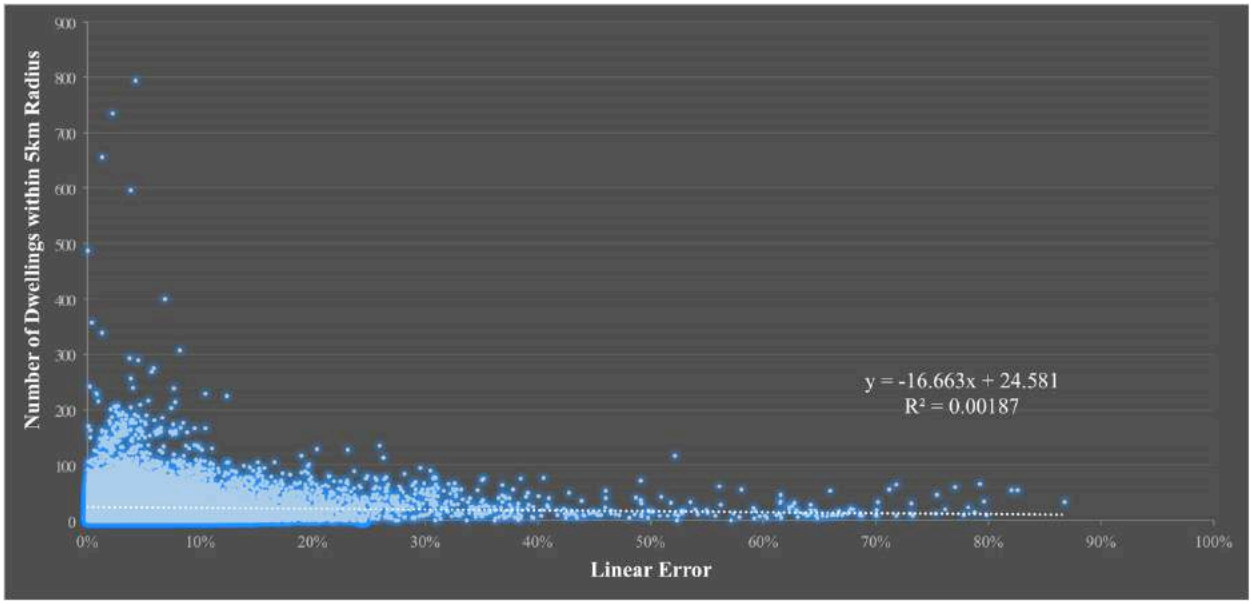


Figure 47: Scatterplot Showing Density (Number of Dwellings within 5km) vs. Linear Error

4.4. Boundaries of Enumeration

Having assessed the spatial accuracy of the Murray Atlas, we might begin to judge its broader reliability. Did the phenomena depicted within actually exist? Before we can address this question, we have a few more steps to follow. Specifically, we are testing whether the number and distribution of dwellings corresponds with other demographic records, namely the censuses and parish registers recording yearly vital events (births, deaths, and marriages). Before dealing with those sources, however, we need to ensure their spatial interoperability with our historical geodatabase. What does that mean, exactly? If the Murray Atlas depicts a dwelling in a particular location, we need to know the parish—the smallest geographic unit of enumeration for the census and parish register—to which that dwelling belongs. Otherwise, we could not compare our different source bases.

The first problem is that the location of administrative boundaries is unclear. The Murray Atlas does not actually depict them. Meanwhile, the other demographic sources provide very limited spatial information. When a parish register describes a vital event such as a birth or

death, we do not know the specific geographic coordinates at which the event occurred (nor does it provide an address, for example). When a census describes the population of a parish (the smallest geographic level of enumeration) we don't know the precise area where that population would be bounded in the Murray Atlas. Essentially we can only locate the parish through its name—so that like creating the vector data, this too is very much a manual process. Even here we run into some problems: parish churches are usually but *not always* depicted in the Murray Atlas; sometimes parishes have multiple names or very long names which are abbreviated in different ways in different sources; sometimes the parish church does not share the same name as the parish; and finally, we see parish names given in both French and English.

Fortunately—having anticipated this problem—I folded the work of locating the coordinates for the parish churches into my research for the spatial adjustment. However extrapolating parish boundaries from those coordinates proved an ultimately elusive goal. In some senses, such a task was always a bit of a fool's errand. From a historical perspective, we might take a *big hint* from the absence of depicted administrative boundaries in this, one of the most obsessive maps drafted before 1800. Here, we should heed the recent argument of Jordan Branch that the territorially sovereign state and its geographic administration operated much more in theory than in practice during this period.[84] So if we could create parish boundaries, we would have to conceptualize them as extremely fuzzy and fluid.

In addition to these theoretical challenges, there were also practical problems. While the Atlas did not depict administrative boundaries, it textually described the dimensions of many (but not all) parishes in the margins of the individual map sheets (See Figure 22 in chapter three for an example of this). These descriptions often noted a length and a width given in leagues.

[84] Jordan Branch, *The Cartographic State: Maps, Territory and the Origins of Sovereignty* (Cambridge: Cambridge University Press, 2015).

The descriptions, however, provided neither anchor points from which to measure these dimensions nor clarification as to the nature of these distances (e.g. as the crow flies vs. the contours of the St. Lawrence River shoreline). It is also unclear whether these are English or French leagues, which would make a difference in their length. Other methods for locating these parish boundaries yielded little in the way of clarity. I created Thiessen polygons[85] from the parish points, operating under the logic that people would belong to the most proximate parish church. I looked at present-day municipal boundaries along with the boundaries depicted in the surviving portions of the 1709 cadastral survey described earlier (see Figure 9 and Figure 10 in chapter two). But, as Figure 48 illustrates around the environs of Quebec, ultimately too much disagreement existed between all of these different sources in too many cases for it to be possible to create parish boundaries with any kind of confidence.

[85] Thiessen polygons partition space around a set of points in such a way as to indicate the closest of those points from any location.

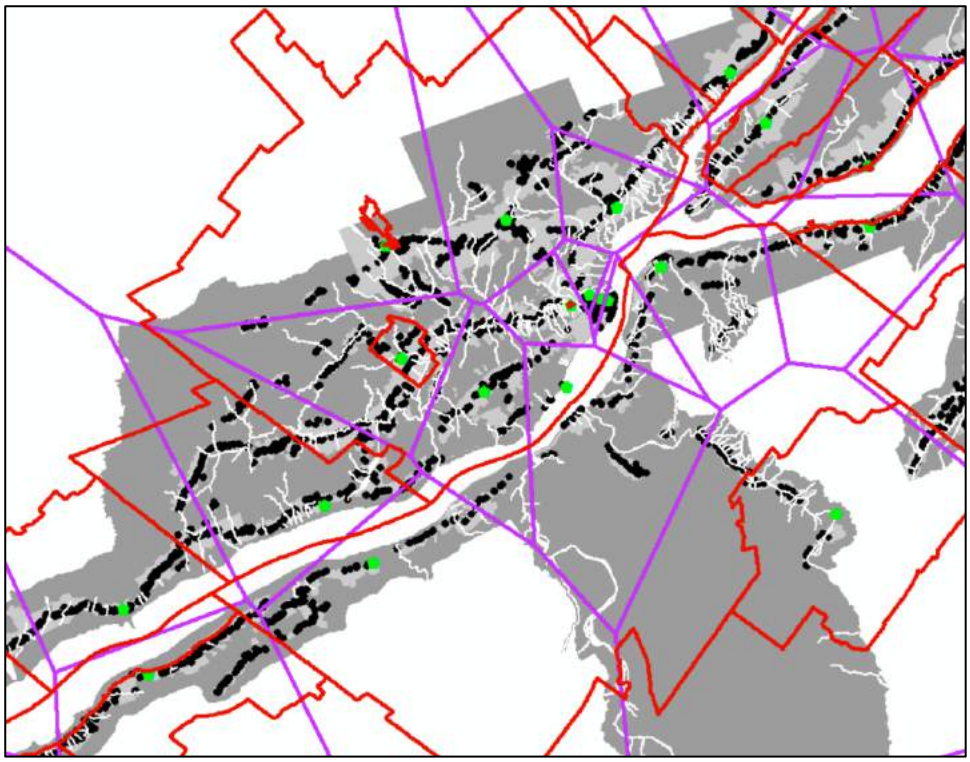


Figure 48: Some Boundary Options. Present-day municipal boundaries (red) and Thiessen polygons (purple) derived from parish churches (green). Both sets of boundaries often seem at odds with the human terrain (dwellings in black, cleared land in light gray) as depicted in the Murray Atlas.

Ultimately then, there was no one good metric of where one parish began and the next ended. Instead, I aggregated parishes together into larger units (which I call "regions") as the way to reconcile the Murray Atlas with parish registries and historical censuses. Here I took advantage of the fact that some parishes were clearly separated from their neighbors by discontinuities in settlement—and that in some of these cases, one or more of the sources described in the paragraph above suggested a boundary existed somewhere within that zone of discontinuity. See Figure 49 and Figure 50 along with their captions to see how I created region boundaries at the head of Lake St. Peter and around Montreal Island, respectively.

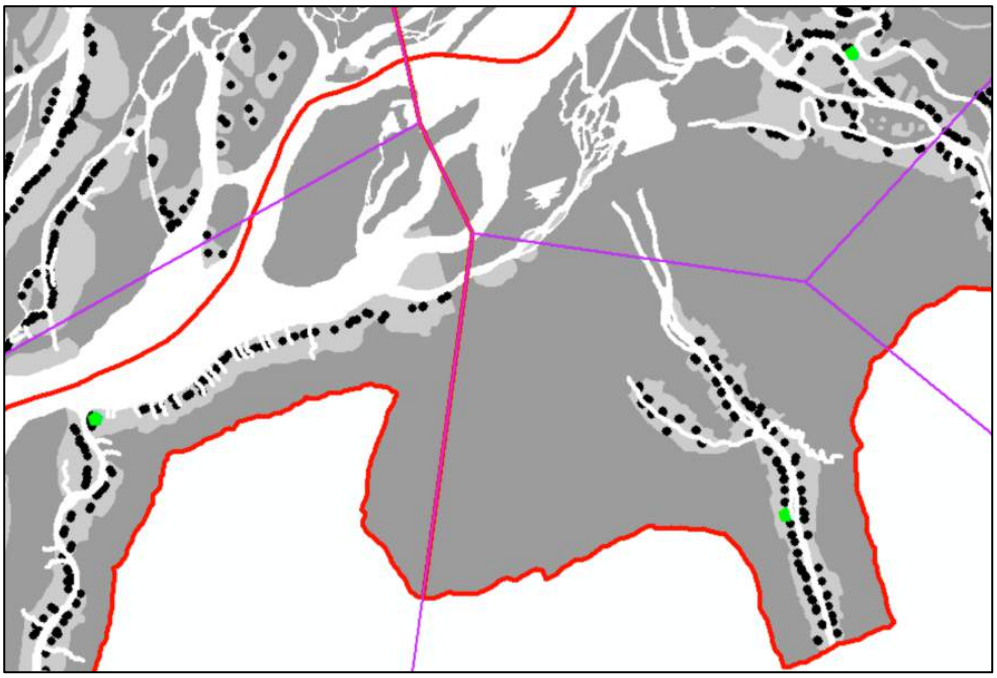


Figure 49: Creating Region Boundaries using Thiessen Polygons. In some cases, I drew the region boundaries (red) to coincide with Thiessen polygons (purple), such as here where the line lay between two regions of cleared land (light gray).

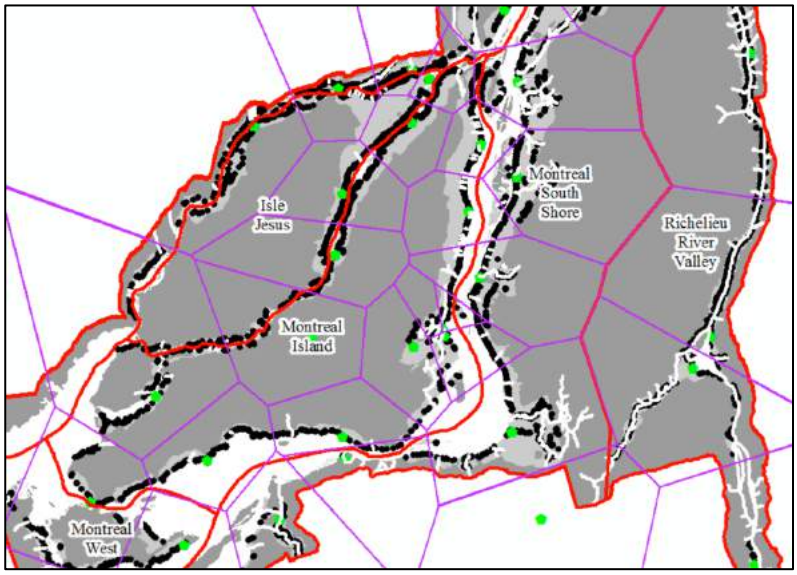
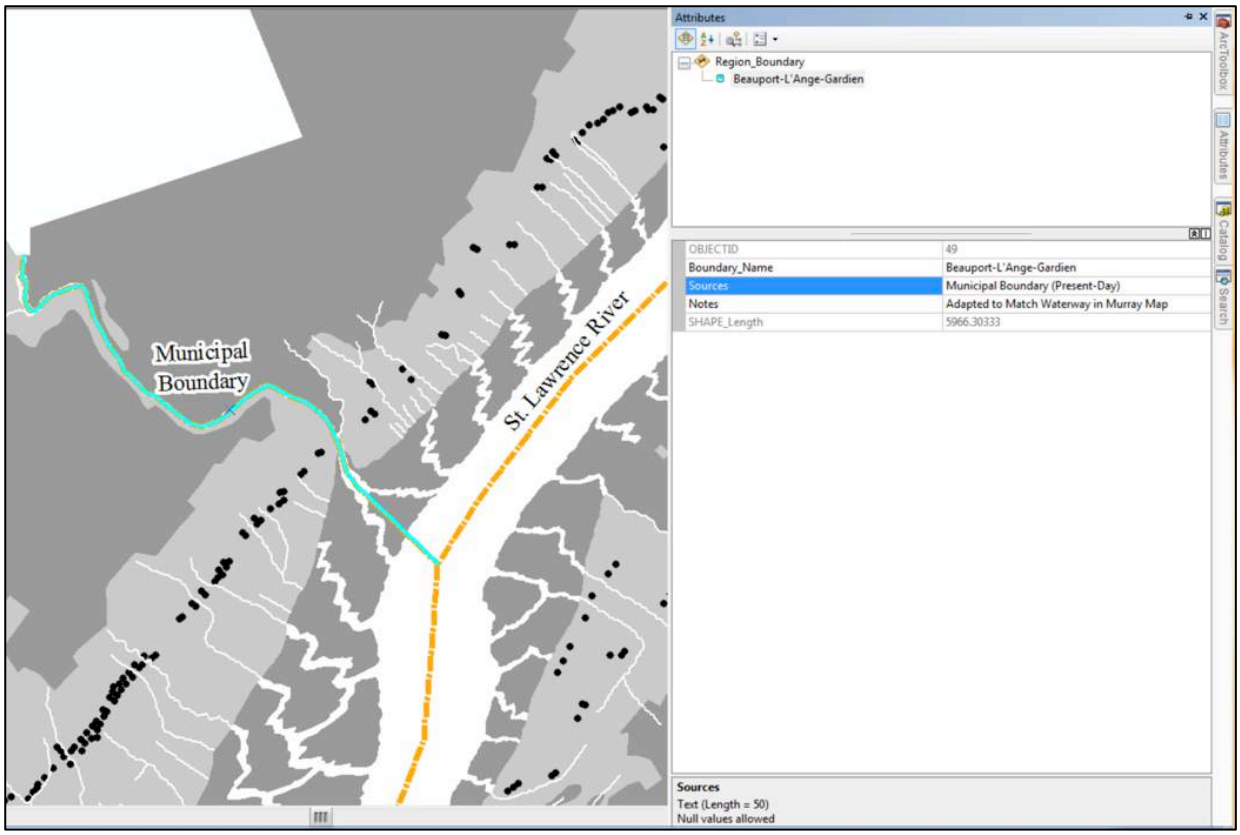


Figure 50: Creating Region Boundaries using Natural Barriers. In other cases, I used natural boundaries such as waterways to establish regions. Here for example, we see two regions (Isle Jesus and Montreal Island) derived from their status as islands.

This is not a perfect method. It relies on the assumption that the map accurately depicts settlement data. This is not the worst problem because we are testing how well the settlement data corresponds with other quantitative sources. If the map did a poor job in this regard, this method of spatial enumeration would create or aggravate inconsistencies between the map and the other demographic sources—and those inconsistencies would then be visible to us. In other words if the assumption is bad, then so is the underlying data.

Other problems with this method for creating regions involve a high level subjectivity that renders it difficult if not impossible to reproduce the same results, i.e. two researchers could very easily draw different sets of boundaries or group parishes together differently. This made it essential for me to document how I had reached my conclusions. First, I created a "boundaries" feature class (line) to document my rationale for each boundary segment that would supplement the final "regions" feature class (polygon). Figure 51 shows what this documentation process looked like in ArcGIS with an example of a region boundary within the government of Quebec. Additionally, I included the disparate data sources informing my decision-making in the final version of the geodatabase. My last step in the process of making the Murray Atlas spatially interoperable with the censuses and parish registers involved placing each region into an even larger unit of enumeration (a "government") to mirror the administrative division that existed during the period in which the Murray Atlas was created. The final result of this boundary-making can be seen in Figure 52.



OBJECTID	49
Boundary_Name	Beauport-L'Ange-Gardien
Sources	Municipal Boundary
Notes	Adapted to Match Waterway in Murray Map
SHAPE_Length	5966.30333

Figure 51: Documenting Sources and Rationales for Boundaries in the Geodatabase.

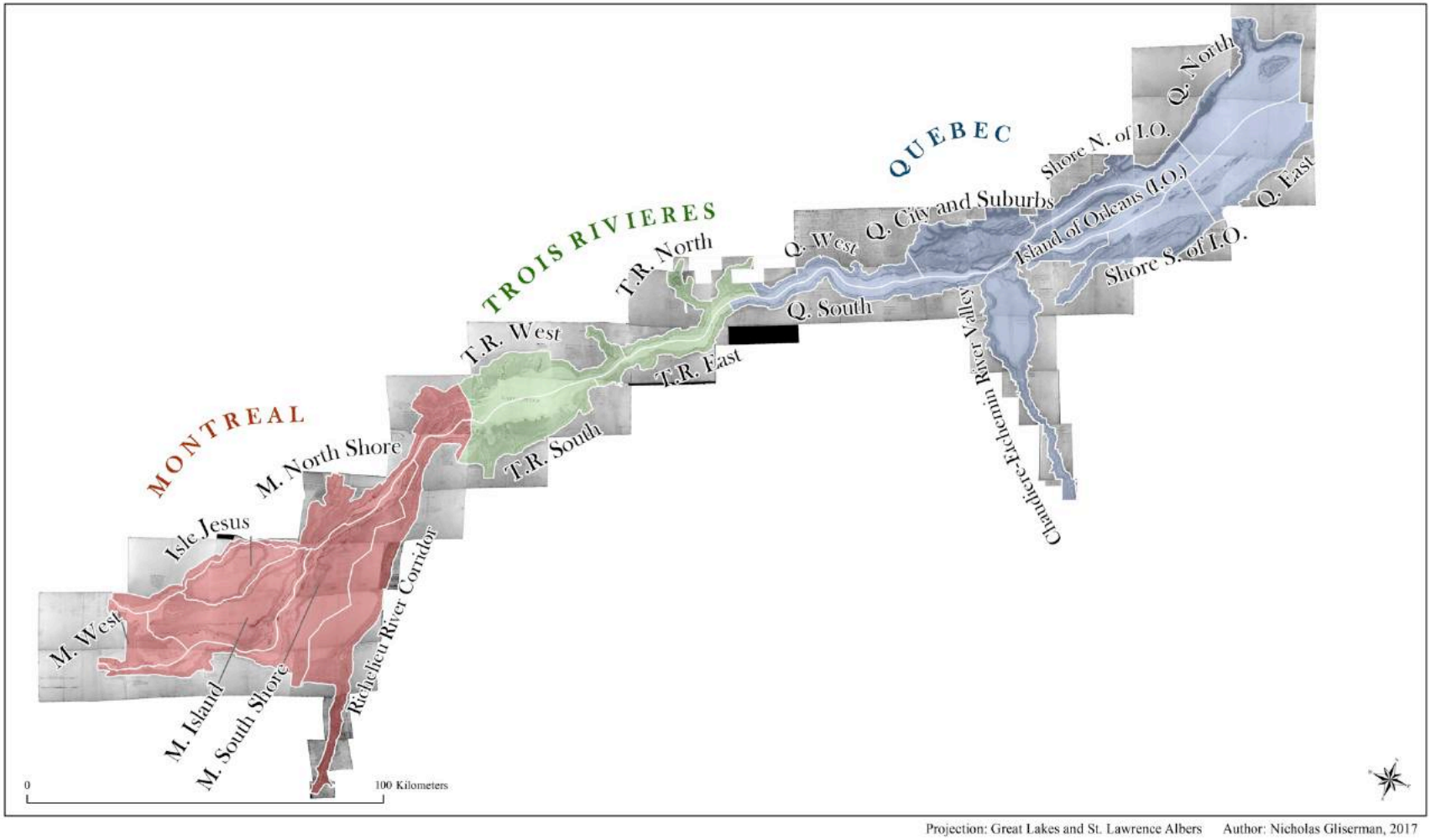


Figure 52: Governments and Regions of the St. Lawrence River Valley, c.1760-1765

Chapter 5: The Reliability of the Murray Atlas as a Demographic Source

In this chapter, I assess how completely the Murray Atlas recorded the presence and distribution of dwellings. In order to do this, I had to draw upon data sources that had independently recorded similar information. Ideally, this would be a source tallying the number of dwellings but no such evidence exists (rarely is available historical evidence ideal). Instead, I worked with sources that could speak to population, specifically censuses and parish registers. Censuses count the number of something (usually but not necessarily people) at a given moment in time while the parish registers recorded vital events (in this case births, deaths, and marriages) across time. In this chapter, I offer some brief context about these two source bases, which informed how I worked with them. After discussing my methods, I explain my results.

5.1. Historical Context of Early Canadian Demographic Sources

Only in the nineteenth century did the field of statistics begin to emerge as we think of it today, defined in theory though not always in practice by standardized techniques, methods, and procedures.[86] We must therefore appreciate the limitations and flaws of earlier demographic records, especially when specific documentation is thin or non-existent.

In Canada, French governors and religious leaders began informally counting the population of the colony from the time of settlement, providing overall head counts in occasional letters and reports. The small size of the population (under 250 according to counts in 1608, 1613, 1620, 1622, 1628, 1629, and 1641) facilitated this process. More formal censuses began in the 1660s when Canada transitioned from being a corporate colony to a royal one. These could be quite detailed, providing breakdowns by age, gender, occupation, and geographic location. Some also provided economic and environmental information concerning subjects such as

[86]On the emergence of this discipline, see Hudson, *History by Numbers*, 26-50.

livestock, land cultivated, or crops exported.[87] The complete lists (or rolls) of names survive for three of these censuses (1666, 1667, 1681) from which the briefer tables were derived. For an example of what a census roll looks like, see Figure 53, which shows a page from the 1666 census. For an example of what this looked like when compiled into a table, see from the 1685 census. We might guess that the process of data collection (i.e. gathering these names) was the primary source of error in census taking but one study notes serious discrepancies between these rolls and their returns. In other words, compiling data introduced further error.[88]

[87] See *Censuses of Canada, 1665 to 1871* (Ottawa: I. B. Taylor, 1876).
[88] Hubert Charbonneau and Jacques Légaré, "La Population Du Canada Aux Recensements de 1666 et 1667" *Population* 22:6 (1967), 1031–54.

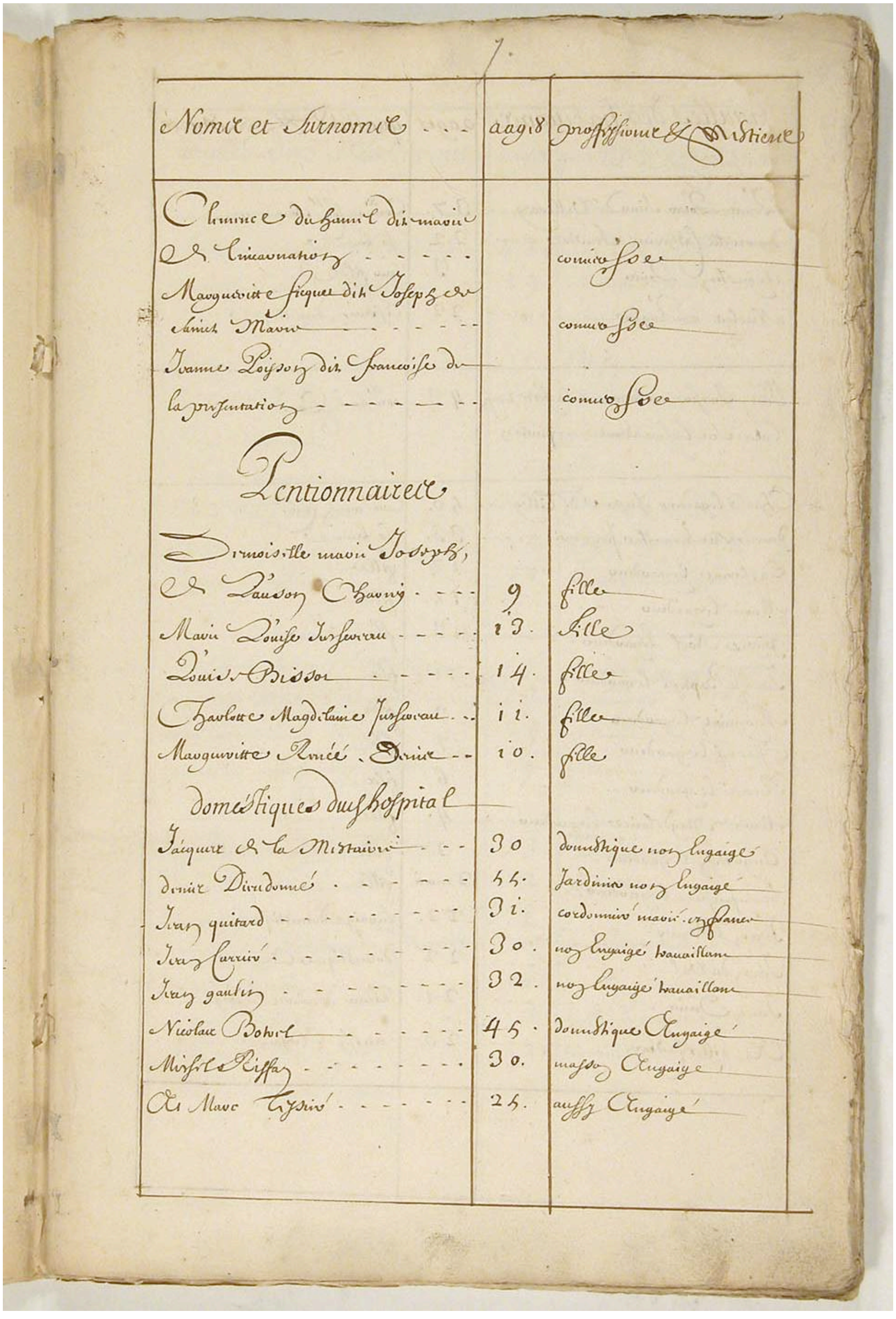
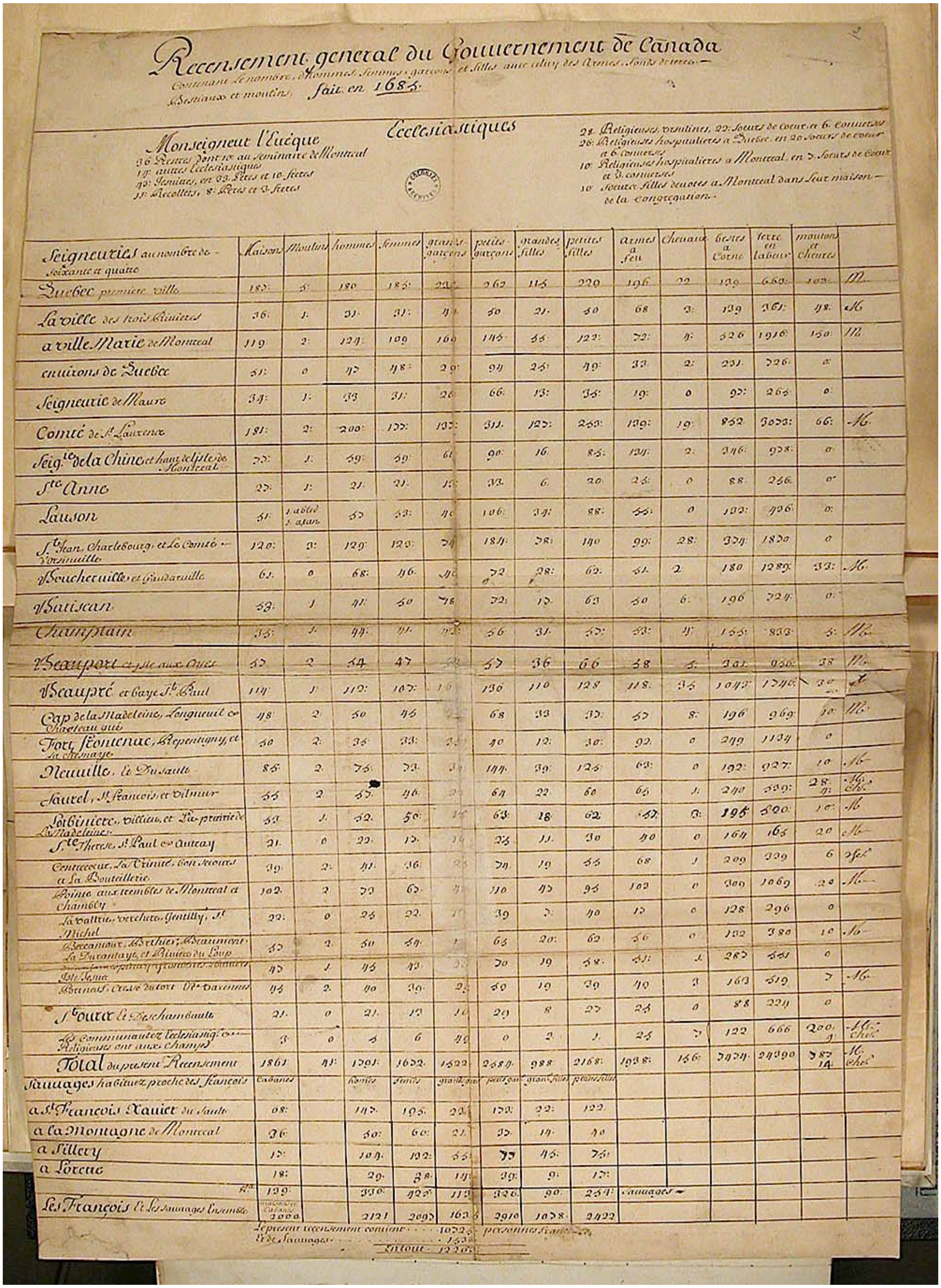


Figure 53: Page from Roll of Names for the Census of Canada (1666), ANOM, COL B1F109, 7. Digitized Version available at LAC (MIKAN no. 2318856).



Recensement general du Gouvernement de Canada
Contenant le nombre d'hommes, femmes, garcons et filles avec celuy des Armes, Sonds de terres, Bestiaux et moulins. fait en 1685

Ecclesiastiques

Monseigneur l'Euêque
36 Prestres dont 10 au seminaire de Montreal
14 autres Ecclesiastiques
43 Jesuites, en 33 Peres et 10 freres
11 Recollets, 8 Peres et 3 freres

28 Religieuses Ursulines, 22 Soeurs de coeur et 6 converses
26 Religieuses hospitalieres a Quebec, en 20 Soeurs de coeur et 6 converses
10 Religieuses hospitalieres a Montreal, en 7 Soeurs de coeur et 3 converses
10 Soeurs filles devotes a Montreal dans leur maison de la congregation.

Seigneuries au nombre de soixante et quatre	Maison	Moulins	hommes	femmes	grands garçons	petits garçons	grandes filles	petites filles	armes a feu	Chevaux	bestes a Corne	terre en labeur	moutons et Chevres	
Quebec premiere ville	183	5	180	185	232	262	115	229	196	22	139	660	102	M
La ville des trois Rivieres	36	1	31	31	41	50	21	50	68	3	139	361	48	M
a ville Marie de Montreal	119	2	124	109	160	145	55	122	72	4	526	1916	150	M
environs de Quebec	51	0	47	48	29	94	25	49	33	2	231	726	0	
Seigneurie de Maure	34	1	33	31	26	66	13	35	19	0	97	265	0	
Comté de St Laurent	181	2	200	177	137	311	127	253	139	19	852	3073	66	M
Seig.le de la Chine et haut de l'isle de Montreal	73	1	59	59	61	90	16	85	134	2	346	978	0	
Ste Anne	27	1	21	21	15	33	6	20	25	0	88	246	0	
Lauson	51	1 a bled 1 a [illegible]	57	53	40	106	34	88	55	0	133	406	0	
St Jean, Charlebourg, et le Comté d'Orsinville	120	3	129	123	74	184	78	140	99	28	334	1830	0	
Boucherville et Gaudarville	61	0	68	46	40	72	28	62	51	2	180	1289	33	M
Batiscan	53	1	41	50	48	72	17	63	50	6	196	724	0	
Champlain	35	1	44	41	42	56	31	57	53	4	155	833	5	M
Beauport et isle aux Oyes	57	2	54	47	[illegible]	57	36	66	58	5	301	950	38	M
Beaupré et baye St Paul	114	1	112	107	16	136	110	128	118	35	1043	1746	30	[illegible]
Cap de la Madeleine, Longueuil et Chasteau gué	48	2	50	45	[illegible]	68	33	37	57	8	196	969	10	M
Fort Frontenac, Repentigny, et la Chesnaye	50	2	35	33	[illegible]	40	12	30	92	0	249	1134	0	
Neuville, le Dusault	85	2	75	73	[illegible]	144	39	125	63	0	192	927	10	M
Saurel, St François, et Vilmur	55	2	57	46	[illegible]	64	22	60	65	1	240	559	28 / 9	M / Ch
Lotbiniere, Villieu, et la prairie de la Madeleine	53	1	52	50	[illegible]	63	18	62	57	3	195	500	10	M
Ste Therese, St Paul et Autray	21	0	22	17	[illegible]	25	11	30	40	0	164	165	20	M
Contrecoeur, la Trinité, bon secours et la Bouteillerie	39	2	41	36	[illegible]	74	19	55	68	1	209	339	6	[illegible]
Pointe aux trembles de Montreal et Chambly	102	2	73	67	[illegible]	110	47	95	103	0	300	1069	20	M
La Valtrie, Verchere, Gentilly, St Michel	22	0	25	22	[illegible]	39	7	40	17	0	128	296	0	
Becancour, Berthier, Beaumont, la Durantaye, et Riviere du Loup	57	2	50	54	[illegible]	65	20	62	56	0	132	380	10	M
[illegible] Isle Jesus	47	1	45	43	[illegible]	70	19	58	41	1	287	551	0	
[illegible]	45	2	40	39	[illegible]	50	19	39	40	3	163	519	7	M
St Ours et Deschambault	21	0	21	17	10	29	8	27	25	0	88	224	0	
Les Communautez Ecclesiastiq. et Religieuses ont aux champs	3	0	5	6	40	0	2	1	25	7	122	666	200 / 9	M / Ch
Total du present Recensement	1861	41	1791	1652	1522	2584	988	2168	1938	156	7474	24390	387 / 14	M / Ch
Sauvages habituez proche des François	Cabanes		hommes	femmes	grands garçons	petits garçons	grandes filles	petites filles						
a St François Xavier du Sault	68		147	195	23	139	22	122						
a la Montagne de Montreal	36		50	60	21	37	14	40						
a Sillery	17		104	132	55	77	45	75						
a Lorette	18		29	38	14	39	9	17						
	139		330	425	113	326	90	254	Sauvages					
Les François et les sauvages ensemble	maisons et cabanes 2000		2121	2093	1635	2910	1078	2422						

Le present recensement contient .... 1072[illegible] personnes François
Et de Sauvages ..... 153[illegible]
En tout 122[illegible]

Figure 54: "Recensement général du Canada" (1685), ANOM, FM, COL461, 3.

As with mapping, formal census taking in the St. Lawrence River Valley declined in the eighteenth century. Only one census (1739) was conducted at the parish level. A handful of others (1719, 1720, 1721, 1734, 1754) provided information for the entire colony. It bears noting that scholars have not assessed the quality of these censuses taken during the French era. Moreover, only the tabular results for these censuses survive and not the more comprehensive rolls so that we have no way of ascertaining or eliminating the compilation error discussed in the paragraph above.[89]

Generally, the British state lagged behind the French one in developing an information apparatus. That was true of the census too—with the 1086 AD exception of William I's Domesday book. In the 1750s intellectuals in the Royal Society were discussing the idea of a national census but for half a century, popular opposition—rooted in fears over taxation and an intrusive government—sunk Parliamentary bills to count the population.[90] That did not stop censuses in the British colonies, however, carried out by governors responding to requests for information from the Board of Trade. It is more than possible, then, that officials conducting censuses in Canada had previous experience doing so—or could access people with knowledge of the process.[91]

Immediately after conquest, the British conducted five independent censuses in Canada within the five-year period of time from 1760 to 1765. The first one came immediately after military victory during a broader process of securing allegiance from the conquered population. Here General Amherst instructed various subordinates to go to particular parishes where they would "not only . . . tender the Oath of Allegiance to the New Subjects, but also to disarm them."

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[89] *Censuses of Canada, 1665 to 1871*.
[90] D. V. Glass, *Numbering the People: The Eighteenth-Century Population Controversy and the Development of Census and Vital Statistics in Britain* (Farnborough: D. C. Heath, 1973).
[91] Robert Wells, *Population of the British Colonies in America Before 1776* (Princeton: Princeton University Press, 1975), especially 16.

Furthermore they would demand from the "Captain or Commanding Officer of the Militia . . . a List of the Officers & Men of the militia under his Command & of the number of arms they are possessed of; Likewise a List of the names of the Inhabitants of said Village or Parish."[92] The results of this census were reported in the Murray Atlas, which counted the number of families and the number of men able to bear arms.

The second round of censuses came in 1761-2 as the Board of Trade was deciding how to form the new government of the colony. The Board requested reports and censuses from the three military governors of Quebec, Trois Rivieres, and Montreal, who each sent a census to the Board in 1762.[93] The rolls for Quebec survive and have been published—though nobody has yet checked the consistency between them and the returns sent to the Board of Trade.[94] The final census (1765) was the most comprehensive in terms of the information it sought—but there is little in the way of archival context explaining how or why it was taken.[95]

Parish registers form a second crucial source for reconstructing the demographic history of Canada. Unlike censuses, which sought to capture the full extent of the population at one moment in time, the parishes recorded vital events—in Canada these were baptisms, marriages, and burials—as they happened. These were textual documents that recounted not just the event but also the particulars surrounding it. A baptismal record, for example, could include details such as parents; a marriage record might note the person's place of birth; a burial record would perhaps name the deceased's children. The Canadian baptismal and burial records noted not just

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[92] "[Amherst's Orders to Capt McIntosh, Capt Steiner, and Lieut Sturling]" (15 Sept 1760), TNA, WO 34/85, 103-107.
[93] James Murray, "[Report on the Government of Quebec]" (5 June 1762), TNA, CO 323, 15, ff. 136-186; Ralph Burton, "[Report on the State of the Government of Trois Rivieres]" (April 1762), TNA, CO 323/16, 1-14; Thomas Gage, "[Report on the State of Government of Montreal]" (March 20, 1762), TNA, CO 323/16, 32-51.
[94] *RAPQ*, V:1-143.
[95] For the returns of this census, see *Censuses of Canada, 1665 to 1871*. For the rolls of Trois Rivieres and Montreal, see *RAPQ*, XVI:1-121. For the a partial list of names from Quebec, see LAC, RG4-A1, volume 11, pages 4496-4500.

the date of the event but also of the birth and death date (respectively). For a sense of what these records looked like, see Figure 55, which documents the baptism of one François Plouf in the parish of Contrecoeur.

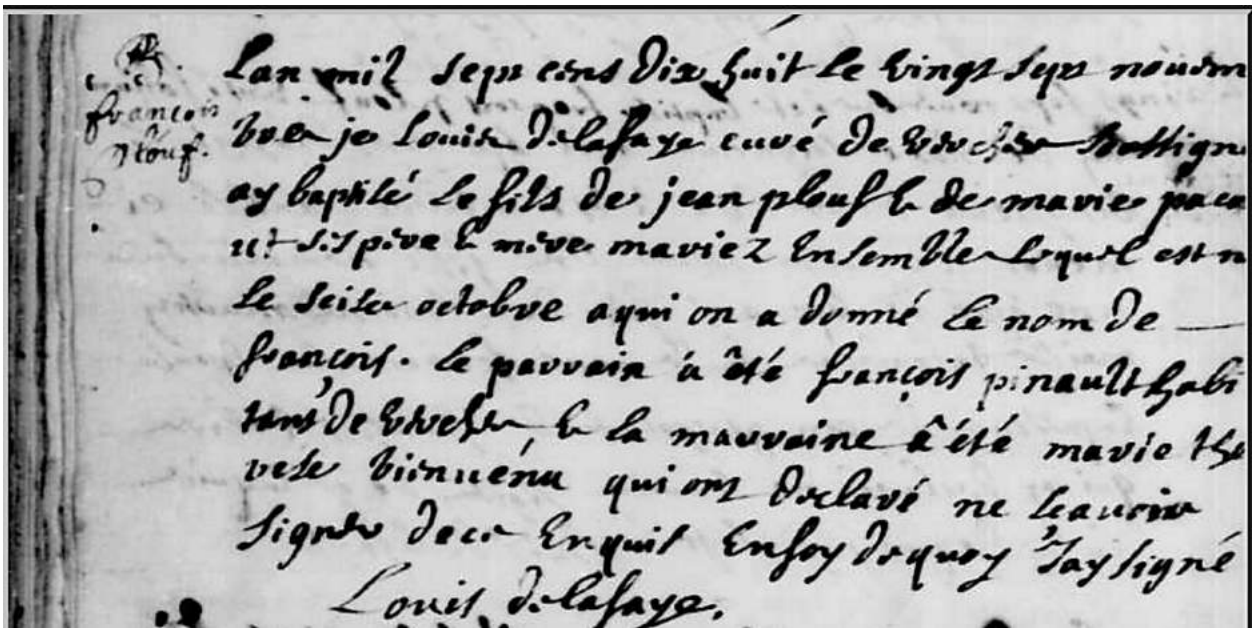


Figure 55: François Plouf's baptism record from the Contrecoeur parish register (Accessed 28 Nov 2017: https://www.genealogie.umontreal.ca/en/exemple/reconstructions-familiales)

It bears noting that across the early modern period parish registers did not necessarily record everybody who theoretically fell within their geographic reach. As studious readers above may have guessed, infants who died before receiving baptism may not have been recorded. Also, parish registers generally recorded only the life events of people of the church's faith—so that (self-acknowledged) Protestants might theoretically not be included in the register of a Catholic church. Most evidence suggests that Canada was religiously homogenous during the French era—but it is possible religious dissidents existed but were not recorded as such. The crucial

point here is that this is a source base more likely to undercount people rather than over count them.[96]

A second difference between parish registers and the census concerns their location. The registers were decentralized as a matter of necessity, each one stored at a different church. This can make it difficult for historians to work with—unless somebody else has expended the time and energy to gather, compile, and process them in some way. In our (fortunate) case, the Programme de recherche en démographie historique (PRDH) at the Université de Montréal began this work compiling parish registers in 1966.[97] They have made some of the results of their dataset publicly available, namely the tallies of baptisms, burials, and marriages in each parish for each year when records survive. I did not have access to their propriety database for this project but it bears noting that their labors resulted in more than the transcription of these records. They created "individual files" for everybody mentioned in the parish registers, thereby linking together disparate life events. Figure 56 offers the PRDH's visualization of an "individual file" with the different types of information included. It bears noting that while dozens of books and articles have emerged from this dataset, scholars have not yet applied a geographic lens to it.[98]

[96] Hudson, *History by Numbers*, 14
[97] For a brief history of the PRDH, see "About the PRDH" (2017). Accessed 30 Nov 2017: https://www.genealogie.umontreal.ca/en/le-prdh. For an early statement of the scope of their project, see Jacques Légaré, "A Population Register for Canada under the French Regime: Context, Scope, Content and Applications" *Canadian Studies in Population* 15:1 (1988): 1–16.
[98] For the full bibliography as compiled by the PRDH, see "Bibliography of the PRDH" (2017). Accessed 30 Nov 2017: https://www.genealogie.umontreal.ca/en/bibliographie

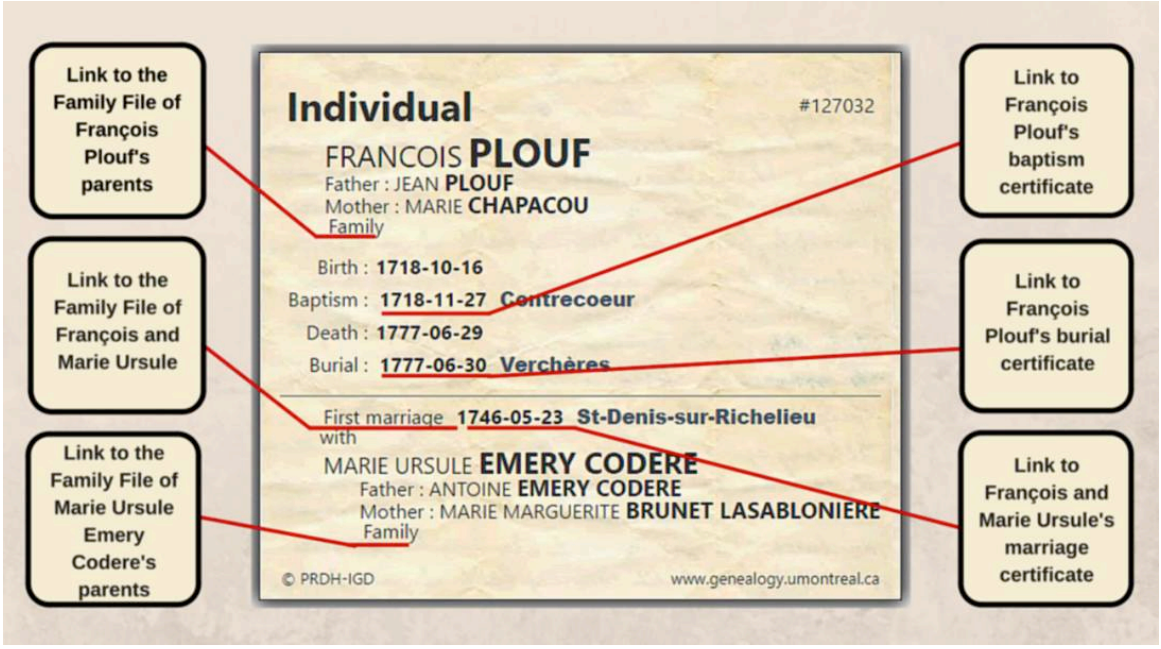


Figure 56: PRDH's "Individual File." This ties together entries in the parish registers through the same individual (in this case François Plouf mentioned in Figure 55). Accessed 28 Nov 2017: https://www.genealogie.umontreal.ca/en/exemple/reconstructions-familiales

5.2. Potential Pitfalls in Working with the Census and Parish Registers

In examining these demographic source bases (and cross-referencing them with the Murray Atlas), we run into five potential problems that merit discussion. These problems lessen our ability to precisely judge the quality of the Murray Atlas as a demographic record but they do not necessarily render it an impossible task. In other words, we will not be able to identify the exact error rate in one source base as we could do with spatial distortion in the previous chapter. But we will get a sense of whether the error rate is unacceptably high.

The first problem is that—as with the Murray Atlas—we do not necessarily know that censuses and parish registers did a good job acquiring the information they sought. The answer lies in cross-referencing the different quantitative sources. If the data collection methods of at least two of these various source bases were good enough to adequately capture the underlying data, we should find they reinforce each other in some key way. It bears noting that cross-

referencing different quantitative sources in this way does not always yield ready answers. If census, parish registry, and map all disagree, that tells us that at least two of these sources are faulty in some way but it is still possible that one is good. This method will not tell us which source might be good though we can still resort to logic and interrogate the internal coherence of the three separate source bases. For example, because we have access to five censuses taken within a five-year period of time, we can compare the censuses with each other. Finally, it bears noting that there are some labor-intensive methods by which one could evaluate error rate in the census and the parish registers. I outline this future work in my conclusion.

Second, as we attempt to reconcile the map with these sources, the interchangeability of people, families, and dwellings is unclear; we neither know the average ratios of these different measures in 1760 nor the degree to which those averages varied across space. This problem requires us to think about a range of acceptable outcomes rather than a single answer that would vindicate the two sources being cross-referenced. For example, we might be content, if looking at the Murray Atlas and the censuses, we find that the average ratio of people per dwellings ranged from five to ten across our different regions. If, however, we find that one region has twenty people per dwelling and a neighboring region has half a person per dwelling, then we might suspect one or both sources to be faulty. In other words, we are looking for disqualifying or suspect results.

Our third and fourth problems are somewhat related: Missing records and inconsistencies in those that survive. We will begin discussing these problems as they pertain to the census. In the above section (0) I noted how information gathered under the French Regime (i.e. rolls of names) did not always make it into the census returns. This was probably an issue with the five

censuses in this study. Additionally, the 1765 census did not include information for Montreal or Quebec Cities.

More problematic than missing information was inconsistency. These five censuses sought different information, defined categories differently, and did not always operate at the same geographic level. They usually broke population numbers down by age and gender—but usually in erratic ways. For example, one census might break the female population down into girls and women but with no clear age boundary distinguishing the former from the latter. Another might include a group of people such as strangers or slaves whose gender is not noted. Some censuses did record specific age boundaries but then the age boundary in one might be totally different from another. Figure 57, which shows a page from the 1762 Montreal census, offers one striking case (within the same census!) in which the age boundary distinguishing boys from men (age 16) was different than the one for girls from women (age 12). For a sense of the inconsistency between censuses, compare this with Figure 58, which comes from the 1762 census of the government of Quebec.

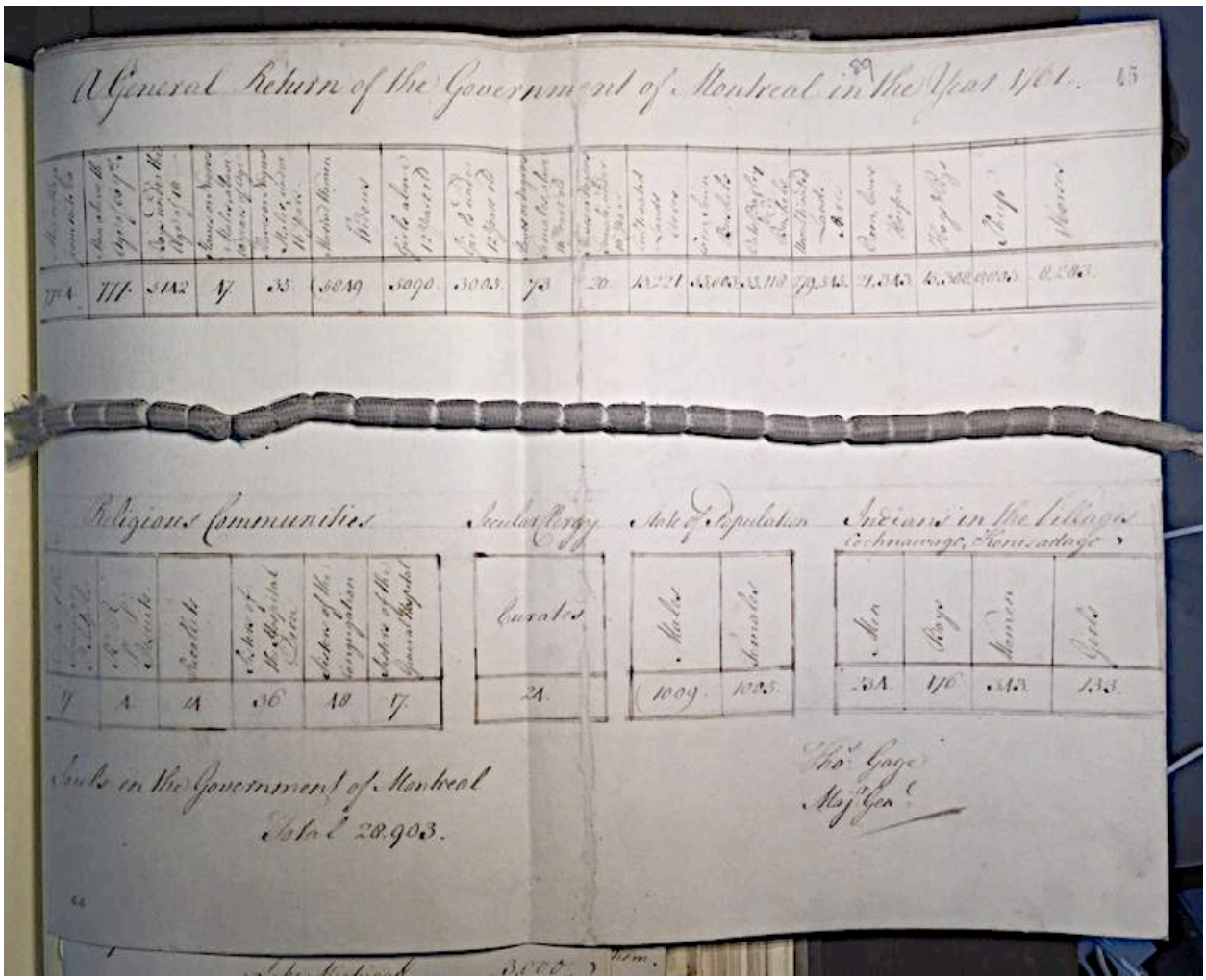
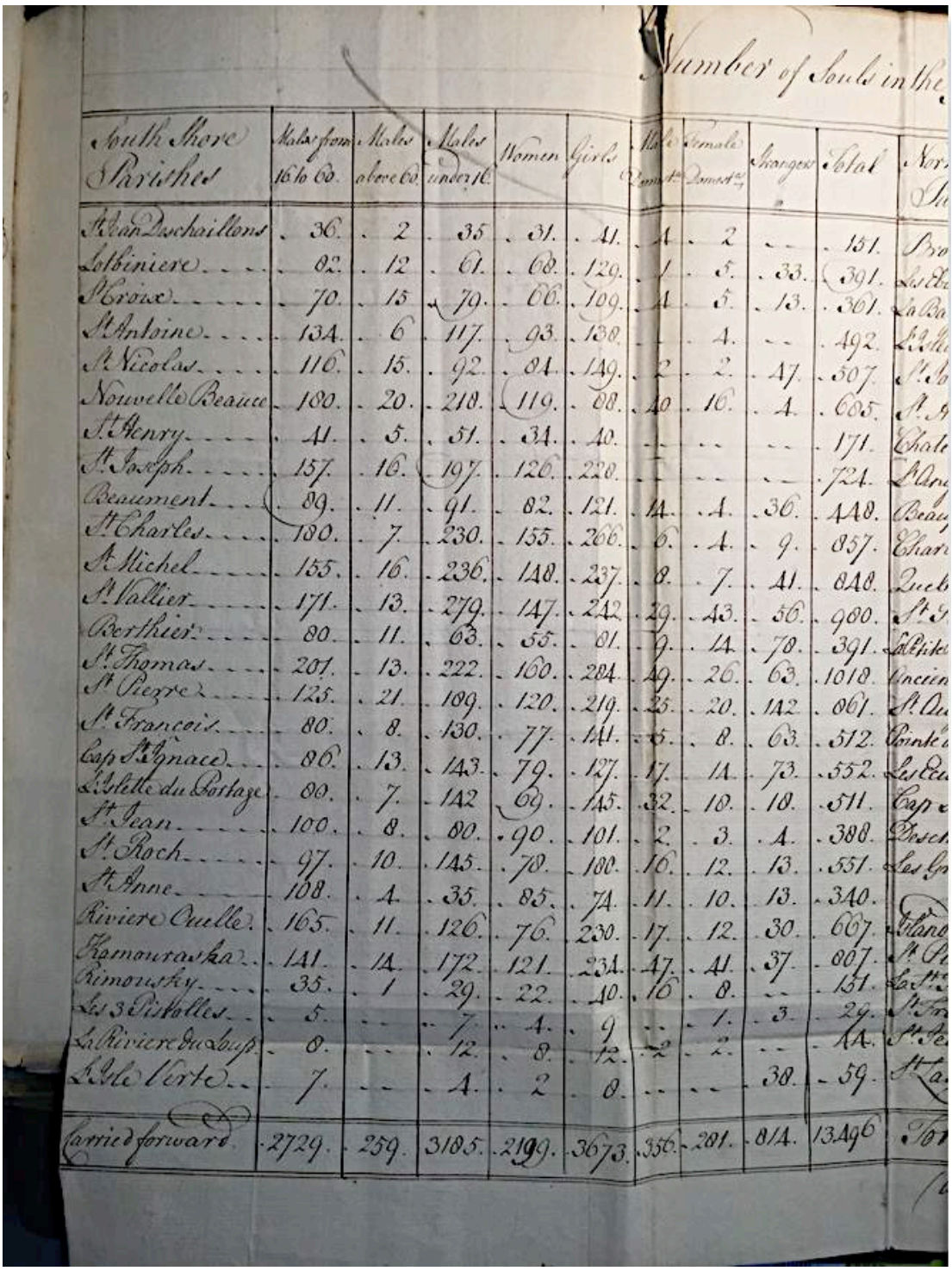


Figure 57: "A General Return for the Government of Montreal" in Thomas Gage, "[State of Government of Montreal]" (March 20, 1762), TNA, CO 323/16, ff.32-51. Note that this census only provides population data for the entire government of Montreal. Also note the inconsistency of categories: It distinguishes boys from men at age 16 but girls from women at age 12.



Number of Souls in the

South Shore Parishes	Males from 16 to 60	Males above 60	Males under 16	Women	Girls	Male Domestics	Female Domestics	Strangers	Total	North Shore
St Jean Deschaillons	36.	2	35	31.	41.	4	2	--	151.	Pro
Lotbiniere	82.	12	61.	68.	129.	1	5.	33.	391.	Les Ec
Croix	70.	15	70.	66.	109.	4	5.	13.	361.	La Ba
St Antoine	134.	6	117.	93.	138.	--	4.	--	492.	La Ri
St Nicolas	116.	15.	92.	84.	149.	2	2.	17.	507.	St Ni
Nouvelle Beauce	180.	20.	218.	119.	98.	10	10.	4.	685.	St J
St Henry	41.	5.	51.	34.	40.	--	--	--	171.	Chal
St Joseph	157.	16.	197.	126.	228.	--	--	--	724.	L'Ass
Beaumont	89.	11.	91.	82.	121.	14.	4.	36.	448.	Beau
St Charles	180.	7.	230.	155.	266.	6.	4.	9.	857.	Char
St Michel	155.	16.	236.	148.	237.	8.	7.	41.	848.	Que
St Vallier	171.	13.	279.	147.	242.	29.	43.	56.	980.	St J
Berthier	80.	11.	63.	55.	81.	9.	14.	78.	391.	L'Ass
St Thomas	201.	13.	222.	160.	284.	49.	26.	63.	1018.	Ancien
St Pierre	125.	21.	189.	120.	219.	25.	20.	142.	861.	St Au
St Francois	80.	8.	130.	77.	141.	6.	8.	63.	512.	Pointe
Cap St Ignace	86.	13.	143.	79.	127.	17.	14.	73.	552.	Les Ec
L'Islette du Portage	80.	7.	142	69.	145.	32.	18.	18.	511.	Cap
St Jean	100.	8.	80.	90.	101.	2.	3.	4.	388.	Orsc
St Roch	97.	10.	145.	78.	180.	16.	12.	13.	551.	Les Gr
St Anne	108.	4.	35.	85.	74.	11.	10.	13.	340.	
Riviere Ouelle	165.	11.	126.	76.	230.	17.	12.	30.	667.	Islano
Kamouraska	141.	14.	172.	121.	231.	47.	41.	37.	807.	St Pa
Rimouski	35.	1	29.	22.	40.	16	8.	--	151.	La St
Les 3 Pistolles	5.	--	7.	4.	9	--	1.	3.	29.	St Fr
La Riviere du Loup	8.	--	12.	8.	12.	2	2.	--	44.	St Pa
L'Isle Verte	7.	--	4.	2	0.	--	--	38.	59.	St La
Carried forward	2729.	259.	3185.	2199.	3673.	356.	281.	814.	13496	To

Figure 58: "Number of Souls in the Government of Quebec" in "[Report on the Government of Quebec]" (5 June 1762), TNA, CO 323, 15, ff. 136-186. Unlike the (above) Montreal census, the Quebec census provides a population breakdown by parish. Also note some of the internal discrepancies in the categories here. For example, we have three clearly defined age categories for males ("Males from 16 to 69" "Males above 60" and "Males under 16") in contrast with just two semi-defined ones for females ("Women" and "girls").

These inconsistencies in categorization and missing data limit our ability to fully compare these three different moments (1760, 1762, and 1765). Only the 1760 and 1765 censuses count the number of families. Because of the missing data in the 1765 census, it is not possible to draw comparisons at the colony-wide level (we run into the same exact problem comparing the raw number of people between the three 1762 censuses and the 1765 one). The governors employed different metrics in 1762—so for example, we cannot compare directly categories like age between them and the 1765 census (where they drew the line between child and adult varied). Also in 1762, the Montreal governor didn't bother to break down his data by parish so we only have numbers at the government level. For us, this jumble of early modern record keeping limits what we can compare. Usually it means that—until we have a better sense of the census quality—we must work with raw population totals and be flexible about which pieces of the censuses we compare.

In the case of the Canadian parish registries, the largest frustration grows out of missing records (i.e. whatever inconsistencies exist in the original textual source do not bear upon the basic fact of the particular event having occurred). Of the 120 Canadian parishes active before 1760, only 29 have complete records from their date they were established. While the remaining parishes may have lost an odd year of records here or there, what we see most commonly are missing records in the earliest years of a parish, i.e. immediately after it was first established. Therefore the percentage of surviving data usually declines in periods during which large numbers of new parishes were established. Not surprisingly this effect diminishes as the total number of parishes increases.

We see the most erratic movement in the percentage of surviving parish data in the seventeenth century. This is shown in Figure 59, which plots the raw numbers of operational

parishes and surviving records from the colony's founding to 1765. Figure 60 shows the percentage of records that survive across the same time period. The survival rate begins at 0% but jumps erratically back and forth to 100% during the years when only one parish (Notre-Dame-de-Quebec) existed. With a few more parishes established, the rate rises to about 80% in the 1640s but then hovers just above 50% throughout the rest of the century as state sponsored immigration contributed to the steady opening of new parishes. Then the number slowly climbs throughout the eighteenth century, reaching to 90% and higher in the last three decades of the study period. Overall, this missing data amounts to 20% of all records from 1616-1765, including from parishes outside the territory depicted in the Murray Atlas (the overall survival rate is slightly lower for just these parish registers at 78%). For a regional breakdown of parish register survival, see Figure 61. Our silver lining here is that 98% of parish records survive for the year 1760. In other words, we have a relatively complete record for the year that matters most to us. Moreover, the parish record survival stays above 95% through 1765 so that we have relatively complete data for evaluating the 1762 and 1765 censuses.

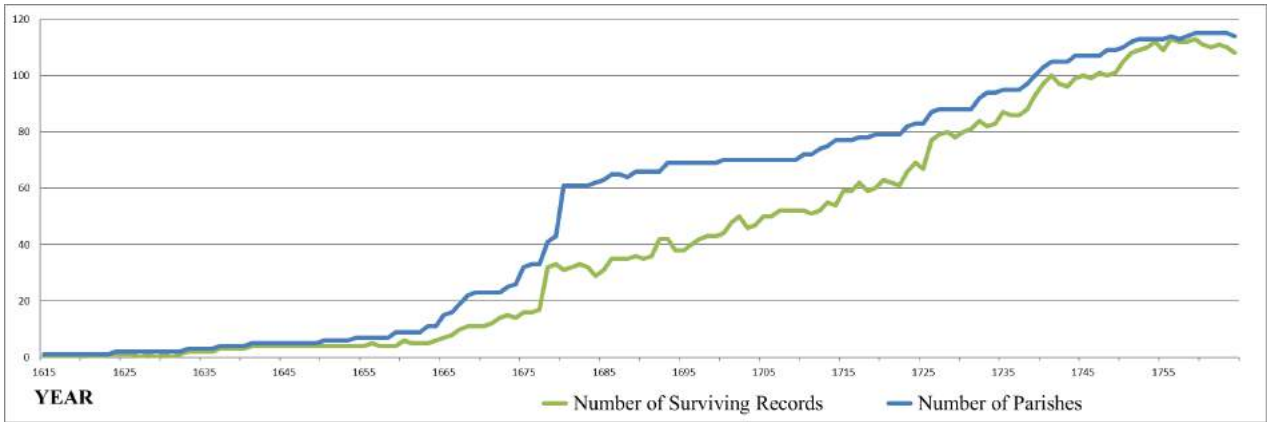


Figure 59: Number of Parishes vs. Surviving Parish Records, 1615-1765

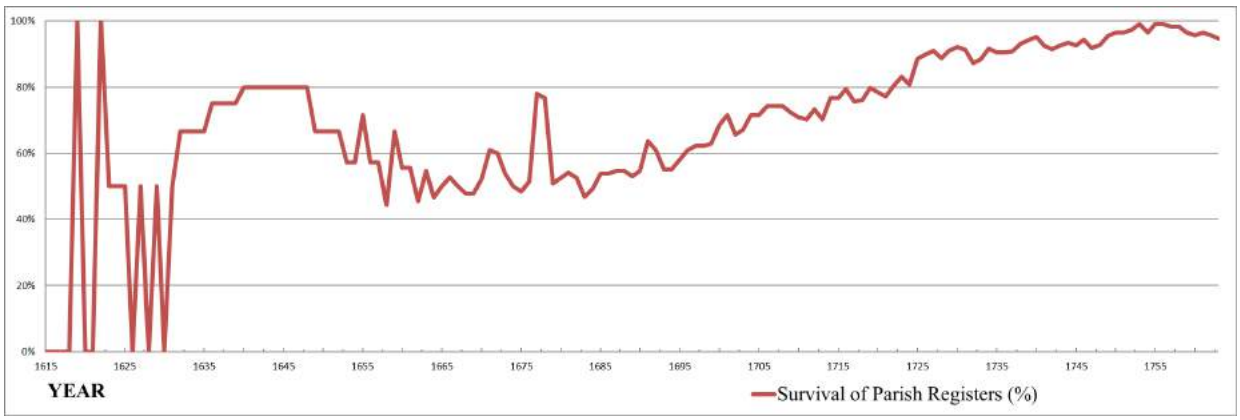


Figure 60: Percentage of Surviving Parish Records, 1615-1765.

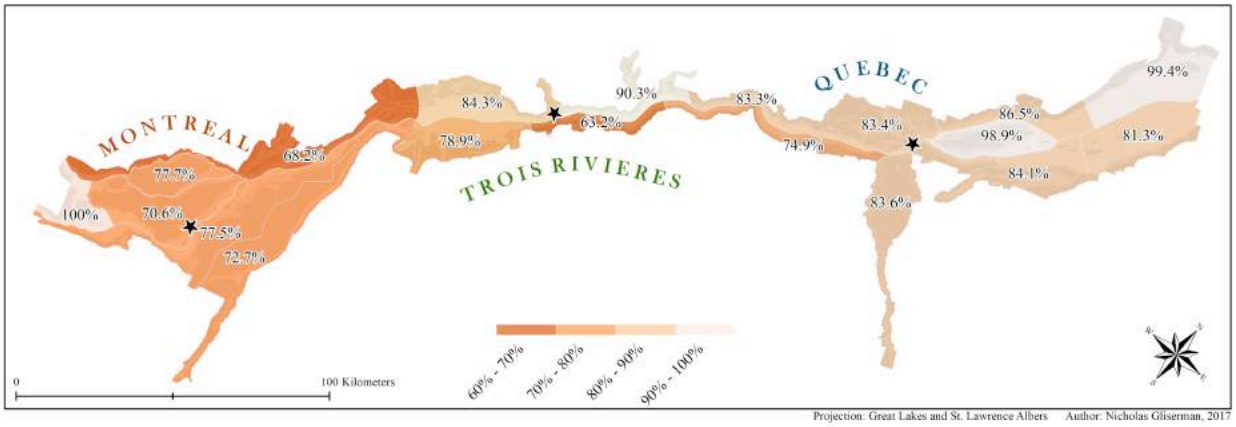


Figure 61: Survival of Parish Registers by Region

The final problem concerns the alignment of map, census, and parish register. In chapter four, I discussed the spatial dimension of this problem vis-à-vis the boundaries of enumeration. In an ideal world, we would also be able to create a perfect temporal alignment—meaning we could translate the vital events in the parish records into a series of temporal snapshots showing the distribution of population at discreet moments. Yet this problem does not prevent us from using the parish registers: The strong survival rate of parish records in the years concerning our study means that we can use the raw number of births as our demographic indicator with which to check the accuracy of the censuses and the Murray Atlas.

Having explained these two specific problems with the parish registers (missing records, temporal misalignment), I should now add that I have created models to fill in the values of these missing records—but have saved my discussion of them for the appendices. The first model estimates the values of births and natural growth (i.e. births minus deaths) for the missing years in the parish registers (Appendix A). The second model estimates yearly population values for the entire colony (Appendix B). As I discuss in those appendices, I have some doubts about my results although I think they deepen how we think about the registers that survive. I discuss the results of these models a handful of times within the body of this thesis—but explicitly identify them as such. Otherwise, I stick with the values derived from the surviving registers alone.

5.3. Assessing the Quality of the Censuses

As noted before, we can compare the censuses not just with other demographic sources but also with each other. However, inconsistencies and some missing data mean that we can only selectively compare portions of them. We begin by comparing the growing or shrinking number of families in the 1760 and 1765 censuses across the different regions. Figure 62 maps out this change and a more detailed table can be found in Appendix C. Our first observation here must be the remarkable degree of variation from one region to another. For a relatively short period of time, we see quite large changes. Of the 22 regions, fourteen (nearly two thirds) apparently grew or shrunk by more than 10%. Table 4 shows the distribution of this change in the number of families according to the census.

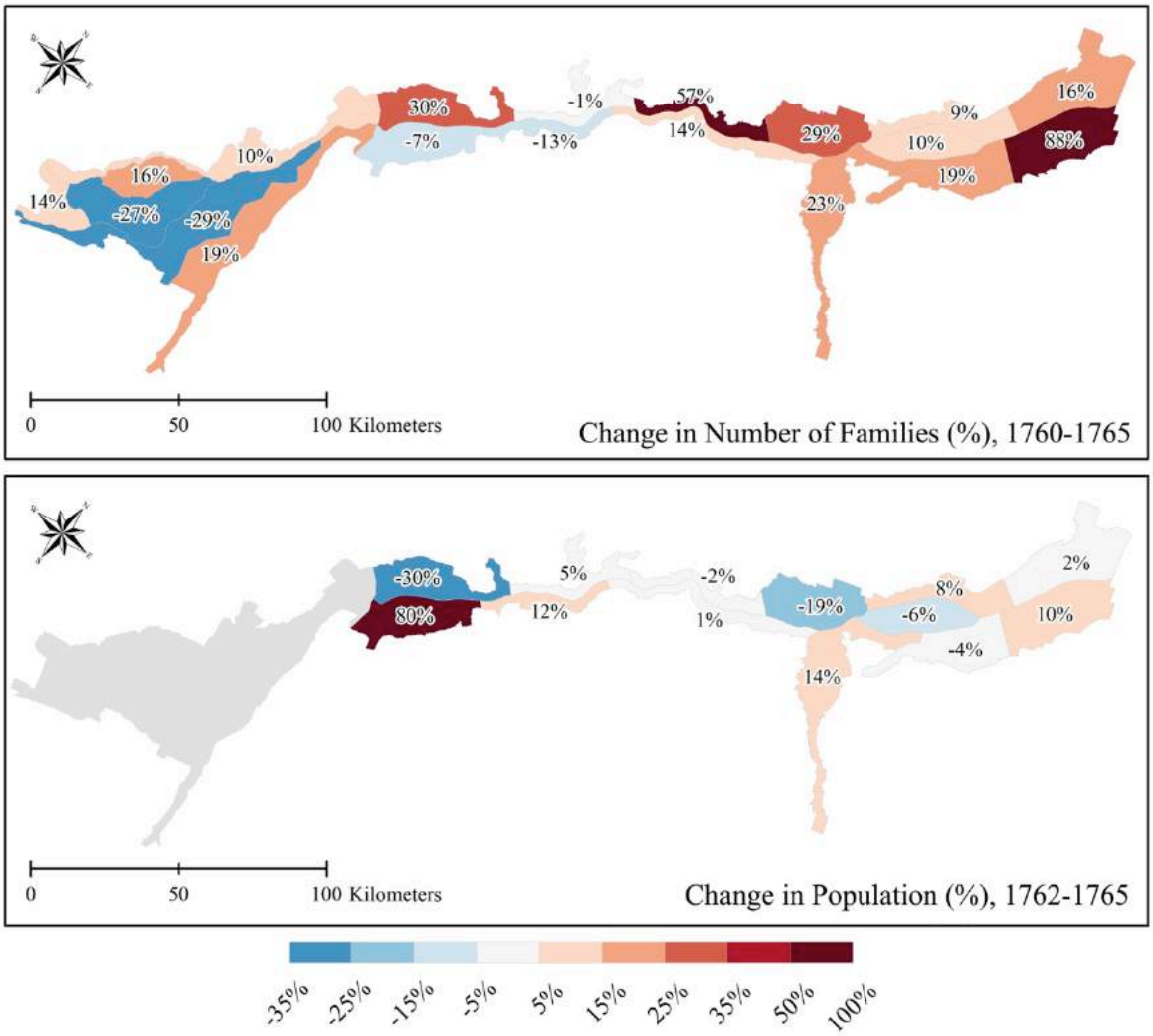


Figure 62: Demographic Change According to the 1760, 1762, and 1765 Censuses

Table 4: Distribution of Recorded Changes in Number of Families between 1760 and 1765 Censuses.

% Difference in # of Families	0-5%	5-10%	10-15%	15-20%	20-30%	30-40%	50-60%	80-90%
Number of Regions	2	6	3	4	4	1	1	1

We might attribute some of this to internal migration (i.e. families moving from shrinking regions to growing ones), natural population growth, the potential for statistical misinterpretation (e.g. an influx of families to a relatively unpopulated region creating having an outsize effect),

and the possibility that young people had been putting off marriage during wartime. Looking at the overall increase in the number of families (around 5%) in this period, however, suggests this last explanation was not an especially serious factor. The transition from wartime into peacetime does potentially explain why there might have been a larger degree of internal migration than normal. Here we run into the Modifiable Areal Unit Problem (MAUP)—probably much of any hypothetical internal migration occurred within regional boundaries as between them. But why would we see so much internal migration spread throughout the colony when war did not affect every region in the colony? Sure, for the sieged Quebec region we might expect to see people going to the city for protection from British soldiers roaming the countryside and then returning afterwards. This doesn't explain the variation in the regions under the governments of Montreal and Trois Rivieres. Did French colonists really flee so far afield? It seems unlikely.

We readily spot some inconsistencies as we zoom in to particular regions. For example, we might look to the region of Quebec East where the number of families may have, according to this census data, nearly doubled in five years from 155 to 291. Yet in comparing the population difference from 1762 and 1765 censuses for the same region, we only note a shift from 1451 to 1590 people (a 9.6% increase). Perhaps the remainder of the increase in the number of families occurred from 1760 to 1762? Whatever explanations we can concoct, the 88% increase in the number of families still seems beyond likely.

If we turn to the parish registers, here, we do find that the number of births jumps somewhat dramatically from 68 (1760) to 87 (1761) and eventually reaches 96 (1765)—an 41.2% increase in a five-year period or half the increase we might expect based on the increase in families. Table 1 provides the full range of data for this decade while Figure 63 plots it on a graph. We might exercise additional caution, however, in assuming that increases or decreases in

births tells us much about population in these years. Here we might note that in the Quebec East region the raw number of births had been hovering in the low 80s and upper 70s throughout most of the 1750s so that it had dipped significantly in 1760. In fact this trend mirrors a quite uncharacteristic drop in births occurring across the government of Quebec in 1758-1760 (which we can almost certainly attribute to the war and the siege in particular) and then increase after 1761. So the sudden rise of births probably speaks less to a burst of growth but a return to the status quo and then some modest growth. Most likely, the 87% increase in families resulted from an error in data acquisition for one or both censuses.

Table 5: Raw number of births in Quebec, 1755-1765, according to surviving Parish Registers.

	Year										
Region	**1755**	**1756**	**1757**	**1758**	**1759**	**1760**	**1761**	**1762**	**1763**	**1764**	**1765**
Quebec East	79	61	81	73	64	68	87	85	89	89	96
Government of Quebec Overall	1770	1626	1824	1615	1411	1311	1517	1701	1794	1912	2022

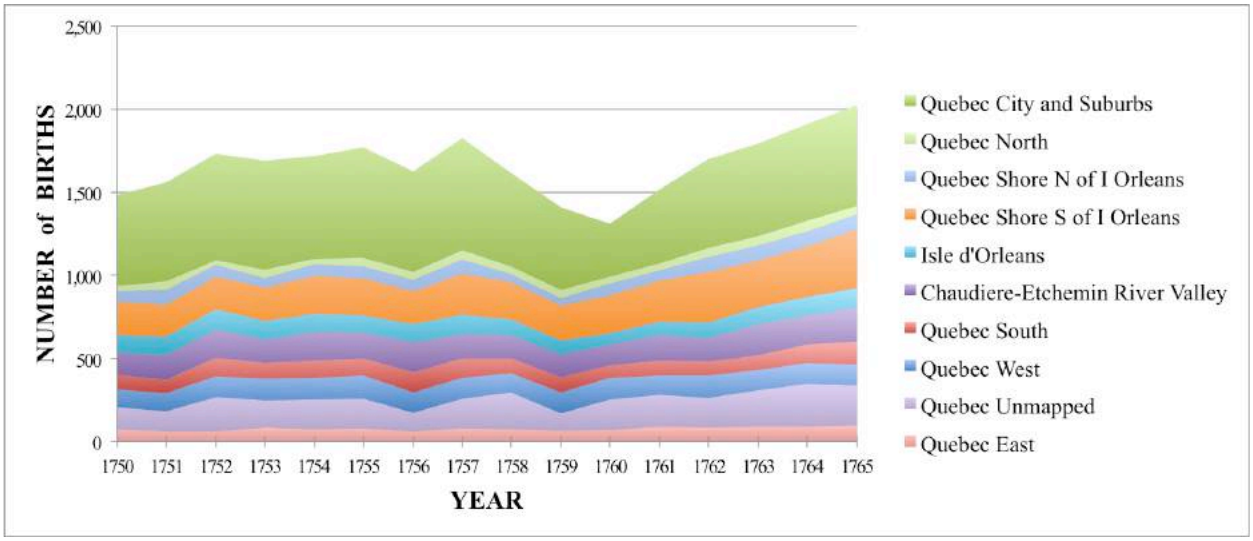


Figure 63: Raw Number Births in the Government of Quebec, 1750-1765, According to the Parish Registers. Note the significant dip in 1759 for all regions and the continuation of this dip for Quebec City and Suburbs in 1760. This was almost certainly the result of the British siege and conquest in 1759.

Does our impression of the census change as we look directly at population (rather than families) by comparing the 1762 and 1765 censuses? Not really. The distribution of regional change can be seen in Figure 62 above and Table 6 below (for the full table, see Appendix D). First, we must qualify our source. We cannot include Montreal in our analysis at all because the 1762 census does not give us a parish breakdown of population while the 1765 does not have data for Montreal City. In other words, we can neither compare individual regions nor the entire government. In looking to Trois Rivieres and Quebec, the variation is less extreme than when we measured the family data (which makes some sense because the time frame is briefer). Eight out of the fourteen regions (57%) grew or shrunk by less than 10% and there is only one (7%) outlier beyond 30%. But some of this variation is nevertheless perplexing. One region, for example, apparently grew by about 80% in a three-year period.

Table 6: Distribution of Recorded Changes in Population between 1762 and 1765 Censuses

Percent Difference in Population	0-5%	5-10%	10-15%	15-20%	20-30%	80-90%
Number of Regions	5	3	2	1	2	1

In fact of the thirteen regions for which population data is available in both the 1762 and 1765 censuses, we might note that fully nine (69%) of them tell us the exact opposite as the families data about whether the region is growing or shrinking in this five year period of time. In some cases, the difference is not especially large such as in Trois Rivieres North—the number of families apparently declined by 1% while the population increased by 5%. In other cases, we see baffling differences: Trois Riveres West (30% vs. -30%), Trois Rivieres South (-7% vs. 80%), Quebec West (-2% vs. 57%), Quebec City and Environs (29% vs. -19%; note that parish data for Quebec City is missing for 1765 so was not factored into the 1762 regional data either)—to note four of the most serious cases. In other cases we find a dramatic difference though not a dispute

of the direction of growth or decline. Apparently families in Quebec West grew at a rate of 88% over five years while population grew only at 10% in three years. The numbers simply do not add up. The censuses do not support each other or allow us to construct coherent narratives about demographic change.

That the censuses do not agree with each other does not conclusively prove they are bad. For this, we might test them according to their Crude Birth Rate (CBR). CBR is a measure for the number of births per thousand people (calculated by dividing the number of births by the population and multiplying by 1000). For each region and for the colony as a whole, we will couple the census data with the number of births according to the surviving parish registers. We will then ask if these CBRs look plausible or unrealistic. Here we begin by asking: what is a reasonable ceiling for a CBR?

In a dataset compiled by the World Bank comparing national CBRs from 1960 to 2015, more than 50% of all countries had a CBR above 40 from 1960 to 1967 (it subsequently declined to below 50%). Throughout the 1960s, more than 5% of countries (almost entirely in Africa) had CBRs above 50. The highest CBR in any country between 1960 and 2015 was 58.228—specifically in Niger in 1962. In the most recent year available in this dataset (2015), Niger still held the world's highest CBR at 48.438 while only 3.2% of all countries had CBRs above 40. The point I am making is that over the past six decades the metrics surrounding international CBRs have uniformly followed a downward trajectory—owing largely to the greater availability of effective contraception, rising divorce rates, and the fact that in economically "developed" countries children carry more financial costs than benefits. If this dataset extended further into the past, it is theoretically possible that we might find a CBR greater than 58. But other datasets

with non-comprehensive pre-1960 records such as Max Roser's "Our World in Data" do not document CBRs that are any higher.[99]

In this light, a CBR of 58.54 (1762 Census) seems at the limit of what is possible—though not necessarily likely. A CBR of 78.60 (1765 Census[100]) seems absolutely implausible—both as an unrealistically high number and for the magnitude of the jump from three years earlier. We only have two real explanations here: The censuses were undercounting people or the parish registers were over counting births. Let's think through the question. Logically, it is usually much easier to undercount than over count—and we can follow a well-documented paper trail for the parish registers. The only ways that our parish data would be over counting births is if priests (or the people compiling the PRDH database centuries later) were fabricating baptisms. But what would motivate such a widespread deception? Also, given that we are only working with surviving parish records, we should expect that the number of births (and therefore, the CBR) should be slightly higher for both years if we incorporated data for the missing parishes. Therefore, we must conclude that the censuses, particular the 1765 census, were vastly undercounting people.

The 1760 census counted families rather than people, rendering it slightly more difficult to test this census using the measure of CBR. But what happens if, as a hypothetical exercise, we test what the CBR would be if we use different average family sizes? Table 7 shows the abbreviated results while Appendix E offers a breakdown by region. We find that the average family size would need to be somewhere around seven to provide a barely possible CBR (60.27).

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[99] Dirk J. va de Kaa, "Europe's Second Demographic Transition" *Population Bulletin* 42:1 (1987), 1-59; Rowland, *Demographic Methods and Concepts*, 220-261; The World Bank, "Birth rate, crude (per 1,000 people)" (2017), Published online at www.worldbank.org. Retrieved from: https://data.worldbank.org/indicator/SP.DYN.CBRT.IN [Online Resource]; Max Roser, "Fertility" (2017), *Published online at OurWorldInData.org.* Retrieved from: https://ourworldindata.org/fertility/ [Online Resource]

[100] Because the 1765 census does not record Quebec or Montreal cities, this calculation of CBR excludes the births recorded (681) from parishes.

Only when family size reaches an average of eight does our CBR (52.74) begin to look somewhat likely if still a little high.

Table 7: Summary of Hypothetical Colony-Wide CBRs for 1760 Census based on Average Family Size[101]

# of Births	# of Families	CBR based on Average Family Size of:				
		4	5	6	7	8
4659	11043	105.47	84.38	70.32	60.27	52.74

Is an average family size of eight plausible in Canada? The 1765 Canadian census (55,100 people in 10,660 families) would suggest an average family size of about 5.17—though we have already noted problems with that census. We can also look at the first federal census of the United States (1790), which provides an average *family* size for some counties in some states (Connecticut, Maryland, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island, South Carolina, and Vermont), depending upon whether the original rolls survive or are missing. Across these counties we find the lowest average to be 4.3 and the highest to be 24.3 in Dorchester County, MD. However, counties in southern states had much larger numbers, owing to the aggregation of slaves into the (white) families being counted. The highest rate in the North was in Kings County (8.3 people/family), which encompassed New York City, and was also inflated by the incorporation of slaves into white households.[102] If we look ahead to Appendix B, we find a population estimate from 93,929 to 97,571 by this date. This *would* suggest a large average family size of 8.51-8.84. Either the 1760 census takers had a somewhat looser definition of family than other censuses or they undercounted the number of families. Historical context—a

[101] For breakdown by region, see the full table in Appendix E

[102] Steven Manson, Jonathan Schroeder, David Van Riper, and Steven Ruggles. *IPUMS National Historical Geographic Information System: Version 12.0* [Database] (Minneapolis: University of Minnesota. 2017).

military quickly administering the census while taking oaths of loyalty and securing firearms to a recently conquered population—favors the latter interpretation.

All in all, we should be somewhat wary of trusting census data. Future work might involve checking the surviving census rolls against their returns to see what error, if any, was introduced in originally compiling this demographic data. Scholars may also wish to cross reference the people in the census rolls with those in the parish registers. This would more precisely illuminate the limitations of either source base and how much one or both were under or over counting. Another question to ask: Do the PRDH's family reconstructions match the household structure we see in the portions of the censuses for which the rolls survive? This would be an easy enough question to answer through limited sampling.

5.4. The Parish Data and Murray Atlas as Demographic Sources that Reinforce Each Other

GIS lets us easily count the number of dwellings in each region as well as the total number (12,911) across the whole map. Here we must note that the mapmakers did not depict any dwellings within the walls of Montreal City so this number is a little low. As with the question of "average" family size in the previous section, we must ask what was the average number of people per house? Demographers of early North America often use a multiplier of seven.[103] Indeed, if we look ahead to Appendix B for our overall population numbers (93,929 from just surviving parish registers or 97,571 with estimates for missing registers), we find an average between 7.28 and 7.56 people per dwelling. This ratio is a little artificially high given Montreal's missing dwellings and because these population numbers stretch into unmapped areas (with more dwellings, presumably). In this light, seven seems a reasonable ratio. Would the

[103] Evarts Greene and Virginia Harrington, *American Population Before the Federal Census of 1790* (Baltimore: Genealogical Publishing Co., Inc., 1993), xxiii.

distribution of population derived from multiplying the houses in each region by seven produce a reasonable range of CBRs?

Before answering this question, we must discuss two problematic regions. First, we run into problems with Montreal Island because the undercounting of houses in Montreal City raises the ratio of people per house. Montreal West is also problematic though for different reasons. It contains only one, recently established parish—in other words, a small and unusual sample. It is likely that, at that point in time, many people here were linked to parishes in other regions, especially Montreal Island, and therefore registering their births there.

Here if we aggregate Montreal Island with Montreal West, then add a hypothetical 570 dwellings (the number within the walls of Quebec City) to fill in the cartographic omission, we find a CBR of 57.5—high but certainly not implausible. Another region, Quebec East, has a slightly higher CBR (60.6). In both cases it is easy enough to explain these numbers. Perhaps these regions had a slightly higher average people/dwelling ratio (which would lower the CBR). Or perhaps a ceiling of 58 is high for a country but not necessarily for a smaller geographic unit of enumeration.

Otherwise, all of the other regions lie within a reasonable range of CBRs as discussed in the above section (0) on the census. Moreover, the map of CBR rates, shown in Figure 64, appears to show signs of clustering. We see higher values in the government of Montreal, the lowest numbers in the government of Trois Rivieres, and a mixture in the government of Quebec but with generally well-matched neighbors. Unfortunately, it is difficult to test this hypothesis in a statistically meaningful way given the linear geometry of the map and the inadequate number of regions.

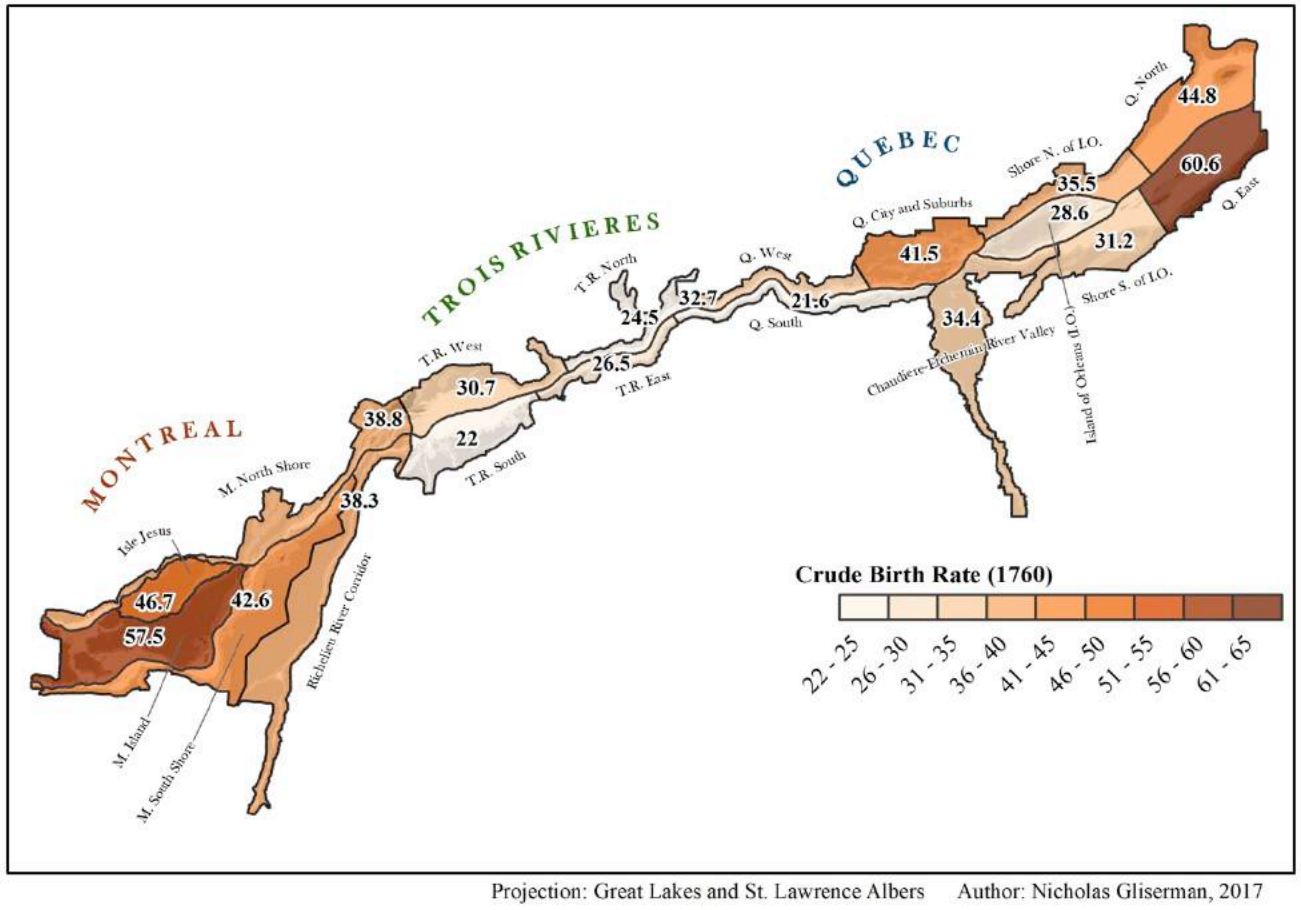

Figure 64: CBR According to A) Population Projections from Dwellings in the Murray Atlas and B) 1760 Parish Registers

What happens when we examine migration using these two sources together? Again, we find that a cohesive narrative emerges. We can calculate net migration between different regions by comparing natural growth from 1616-1760 with our population numbers derived from dwellings in the Murray Atlas. If, for example, we look at a region like Quebec City and Environs where this cartographic method would suggest a population of 13,526 inhabitants vs. the 9,809 people we would expect to find from natural growth, we can calculate the net migration to the region (from beyond the colony or other regions) is 3,717 people.

Here we see a narrative about migration that makes intuitive sense. Cursory visual analysis, offered in Figure 65, shows that the eastern-most regions experienced outmigration while others absorbed migrants. When we incorporate the numbers from the unmapped parishes in the Murray Atlas, which largely lay further downstream (easterly) on the St. Lawrence River, we find a similar exodus (-61.8%).[104]

The directional flow of migration is only one part of this story. Time appears to be another. Figure 66 plots out relationship between the percentage of pre-1700 parishes in a given region and the net migration to or from that region by 1760. Regions with a larger percent of parishes established after 1700 were moderately more likely (R^2=0.4318) to receive a greater share of migrants than those with more pre-1700 parishes. This is what we would logically expect to find—i.e. at a certain point older parishes stop expanding geographically and must either become denser or lose whatever surplus population they might be generating.

[104] This data is a little messy. Most but not all of these parishes lie to the east of the mapped territory but we can only estimate population for them as a whole. We are not deriving this estimate from the houses in these places but rather by subtracting our population estimate for the mapped areas (95715) from our overall population (97577) estimate. We don't know precisely how this unmapped population was actually distributed. We also know that slight changes to our ratio (people/dwellings) to determine population within the map will significantly change our estimate for this unmapped population much more than for other regions. For example, changing the ratio from 7.1 to 7.0 people/dwelling, would yield a net migration rate of -34.4% instead of -61.8%.

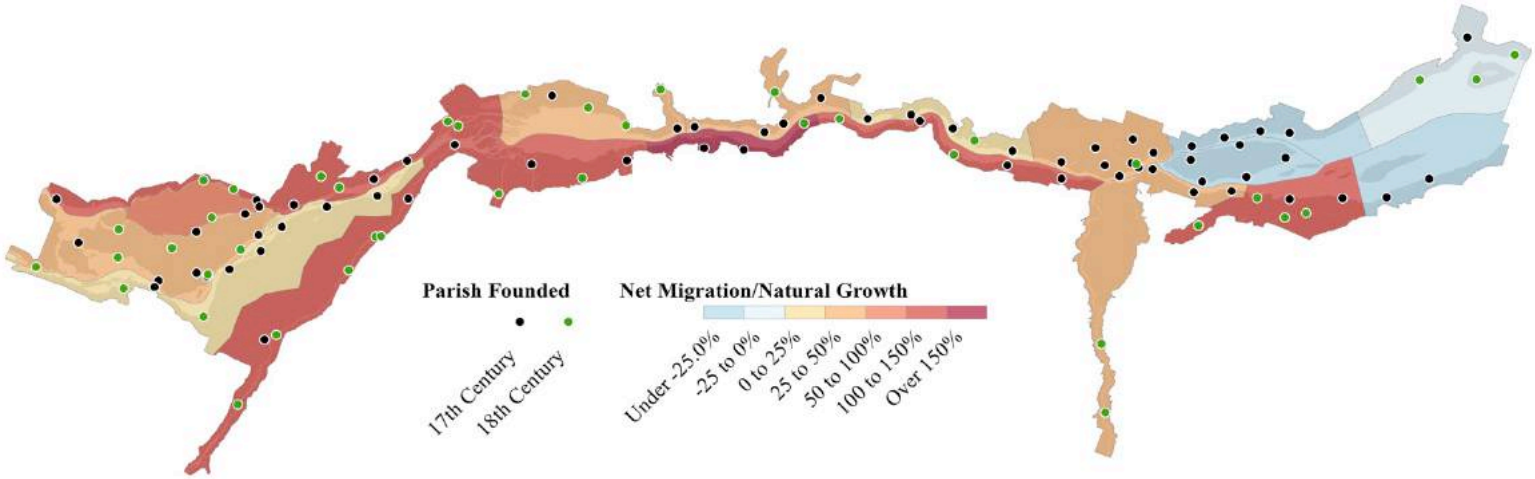

Figure 65: Migration as a Percent of Natural Growth

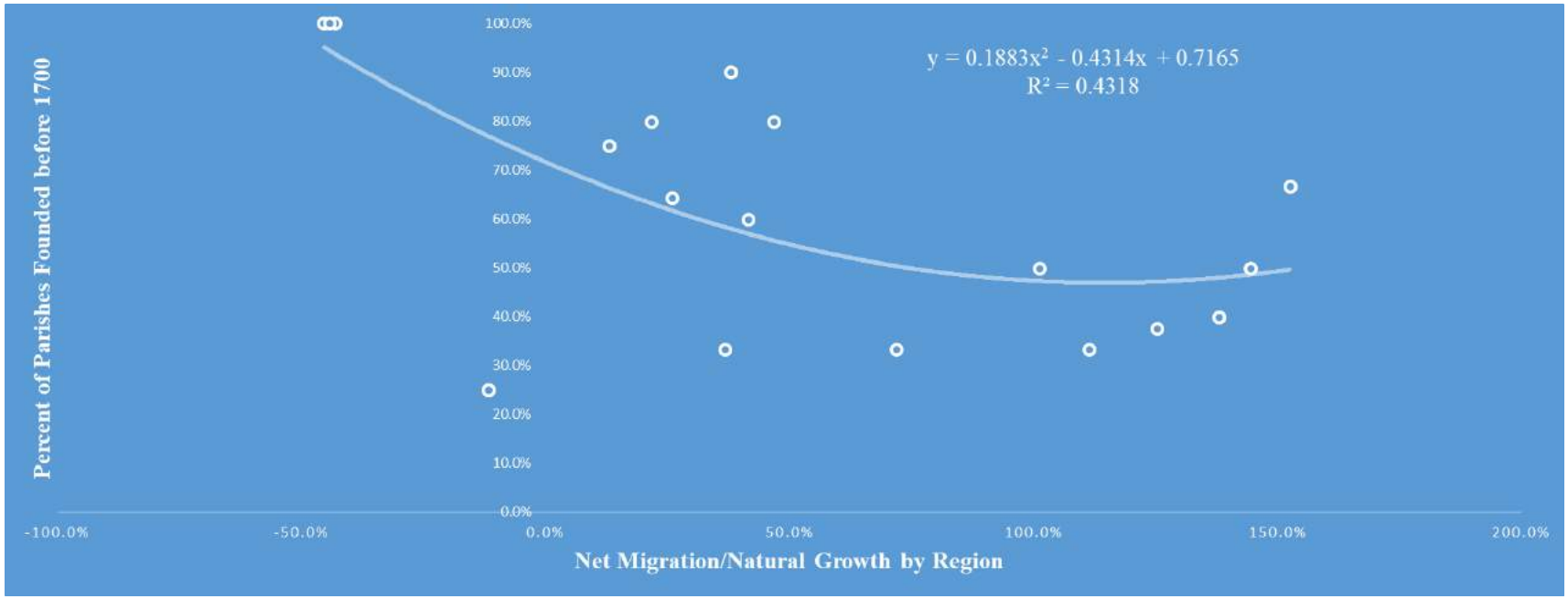

Figure 66: Relationship between Time (Percentage of parishes founded before 1700) and Net Migration (Divided by the Region's Natural Growth)

This preliminary inquiry suggests that the parish registers and the Murray Atlas support each other's demographic accuracy. We have found no obvious contradictions as we did analyzing the census. Moreover, in conversation these sources suggest a sensible narrative of internal migration within the colony. Deeper analysis of the people in the parish registries and census rolls would probably help us solidify this conclusion by elucidating how migration worked within the colony—which regions produced or absorbed surplus population and *when*—and providing us a snapshot of population distribution in 1760 that we could use to compare with the map. Such future research might tell us even more about how we can use historical maps as demographic sources.

Chapter 6: Conclusions

I began by suggesting that the spatial humanities would benefit from a closer integration of digital and archival methods, which I have modeled throughout this thesis. Thinking about accuracy in an expansive undertaking such as the Murray Atlas benefits from pairing historical context with computational tools. In reviewing the existing literature on the Murray Atlas, I argued that earlier scholars have misinterpreted the archival sources. In reviewing that archival evidence myself, I have told stories about maps shaping human geography, the utility of maps within patronage networks, and the conflicts involving and limitations placed upon mapmakers in conducting the 1760 survey of the St. Lawrence River Valley. But in many ways, these are by themselves not complete stories. Digital approaches helped us fill in the archival silences.

Close visual analysis, encouraged by digital processing, helped me to identify inconsistencies across different copies mainly to do with terrain. This in turn helped me to think about what geographic features—roads, the forest line, dwellings, churches, mills—surveyors and draftsmen depicted consistently and, perhaps we can say, valued most. Spatial analysis conducted in chapter four revealed a low rate of linear error and suggested that temporal limitations shaped error in two key ways. First, covering a greater amount of territory in roughly the same time allotted to other surveyors increased the likelihood of error. Second, having greater familiarity and more time to survey the territory within the government of Quebec improved the spatial accuracy of the Murray Atlas there as compared with Trois Rivieres and Montreal. Quantitative analysis of demographic sources in chapter five revealed fatal problems with the British censuses taken between 1760 and 1765. Yet it also suggested that the parish registers and the Murray Atlas reinforce each other as records of population. As if recording the

results of the 1760 census wasn't enough of a clue, we can deduce that Amherst, Murray, and the surveyors working under them were concerned with recording the distribution of people.

The Murray Atlas was by no means perfect—what map is? But—given the personality disputes, the limitations of time and tools, the extent of the territory surveyed, and the primacy of patronage goals in guiding the map's creation and execution—it is surprisingly accurate in two critical measures. Does this knowledge cause us to revisit our conclusions from chapter three? Certainly it does. It appears that those who surveyed the landscape did so well and to the best of their ability. We know from Montresor's attempt to erase Holland's name from one copy that these surveyors—mostly voiceless in the archival record—cared about publicizing their work to potential patrons. But it seems they also cared about the accurate execution of their fieldwork. Perhaps they wanted to impress their supervisor Murray who himself knew the terrain as one of the architects of the invasion of 1759-60 and was perhaps in an unusually strong position to judge their work.

Combining digital and archival methods provides more insight into how and why the map was produced than would either approach alone. The resultant geodatabase also provides us with insight into the landscape it depicted. What new things might this geodatabase potentially tell us about the historical geography of Canada? I do not mean to constrain the direction of future research, of course, but I would simply offer a few preliminary thoughts. First, this historical spatial data help us confirm what we think we already know. Looking at individual map sheets, for example, it looks like most buildings lie close to larger waterways—the St. Lawrence River or its major tributaries. Indeed, we can now say that of the 12,911 dwellings in the Murray Atlas, 10438 (or 80.8%) are within 1km—roughly a 10 to 15 minute walk—of a major waterway. In other words, people valued proximity to the riverfront. This is undoubtedly a story of rivers

offering mobility, transportation, irrigation, soil fertility, and a visible landmark by which people could orient themselves.

The historical geodatabase not only confirms our suspicions but also deepens the kinds of questions we can ask. Where, for example, are these outlier dwellings, situated more than 1km away from what is depicted as a major waterway? In looking at Figure 67, we find most of them in six primary locations, with a range of different explanation why. The environs of Quebec (#4 in Figure 67) boast the most dwellings (909), reflecting the much earlier efforts of imperial officials from roughly 1660 to 1690 to create a densely populated area around the capital. Across the St. Lawrence (#4) and much further downstream (#5), we see another two clusters. These dwellings happen to hug what the mapmakers depicted as slightly smaller rivers. The distance from major waterways in other areas such as around Lac St. Pierre (#2) or near Trois Rivieres (#3) suggest that for these French people, environmental barriers (swampy or marshy land) to establishing such close proximity to a major waterway did not outweigh the value of having a continuity of settlement. Perhaps being able to geographically web the familial relationships established in the PRDH database will help us explain why.

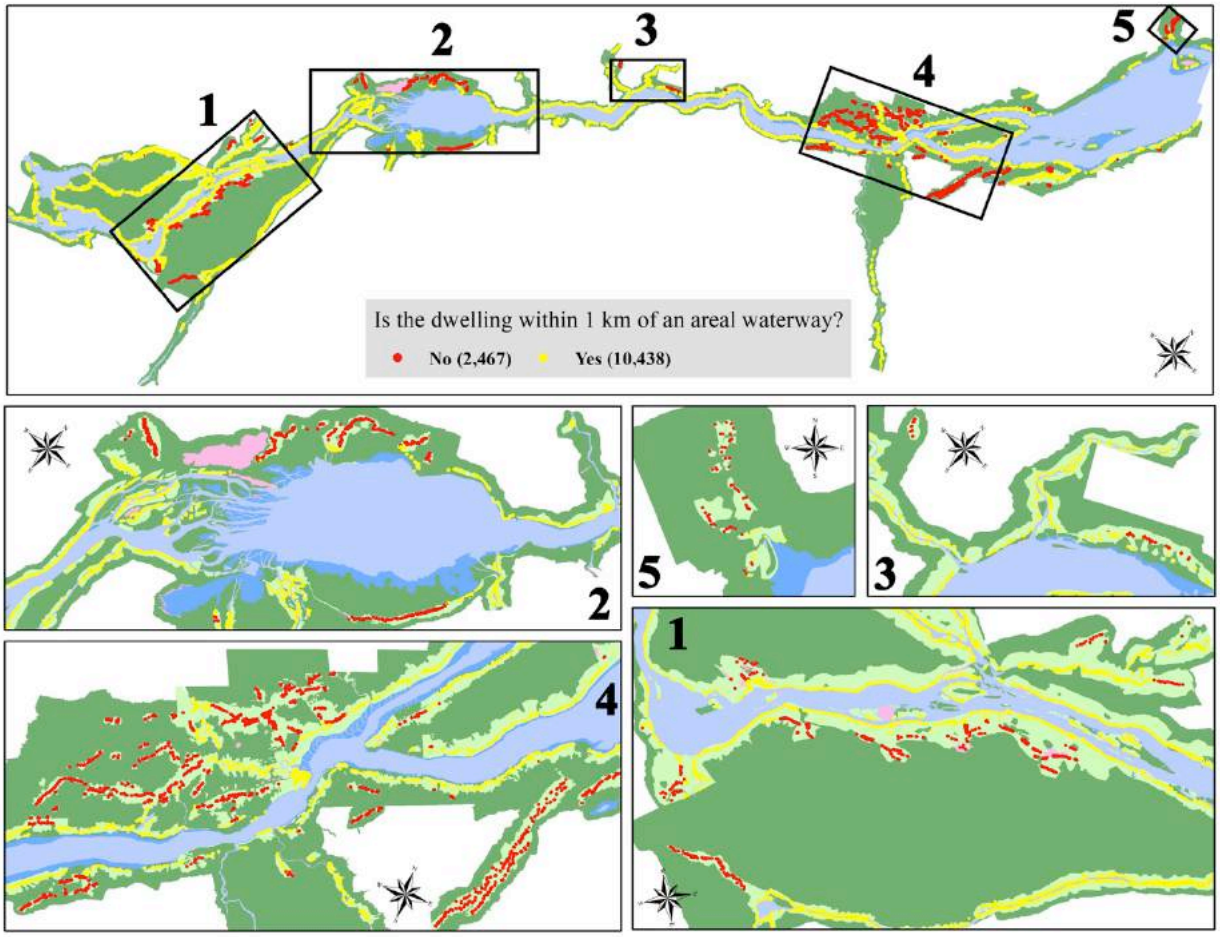

Figure 67: Dwellings within and beyond 1 Kilometer of a Major Waterway

Finally, on the shore opposite Montreal City (#1) we find a second line of dwellings forming behind those lining the shore of the St. Lawrence. Why here, particularly? A kernel density analysis, visible in Figure 68 and Figure 69, helps elucidate the reasons. First, we might expect Montreal City as a dense urban area to lie at the center of this hotspot but it actually lies at the edge of it. The explanation for why rests largely in the environment; the width of St. Lawrence River narrows here slightly compared with areas further downstream while the narrow wedges of two larger islands converge here. We know from Figure 70 that for the decades preceding 1760 this region (Montreal South Shore) yielded a high and consistent natural population growth. Figure 65 suggests the broader region in general absorbed slightly more

people than it exported but this number encompasses the entire history of the colony and includes immigrants to Canada as well as within it. In other words, it seems that this area was producing “surplus” population. Had that surplus population wanted, it could have relocated just ten kilometers upstream of Montreal City where it appears there still existed a significant amount of forested and unsettled riverfront. Instead, it seems these people chose to settle inwards, i.e. density was building upon itself. Again, the PRDH database might elucidate this story more by giving us an understanding of the geographic orientation of kinship networks.

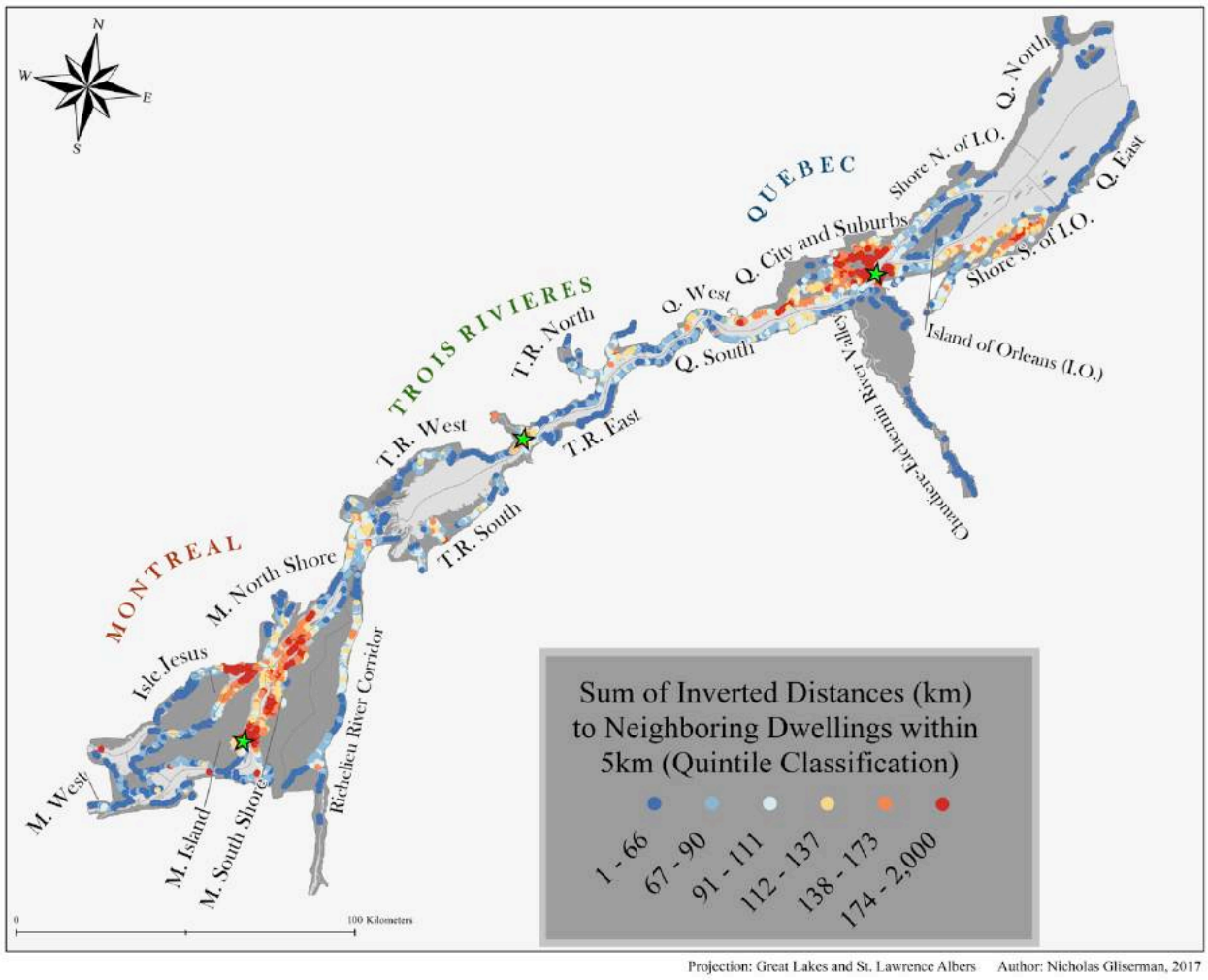

Figure 68: Kernel Density Analysis of Dwellings. This method adds together the inverted distances to neighboring dwellings (this weights closer neighbors more heavily than distant ones) within a 5km radius (the distance that most healthy people can walk in about an hour).

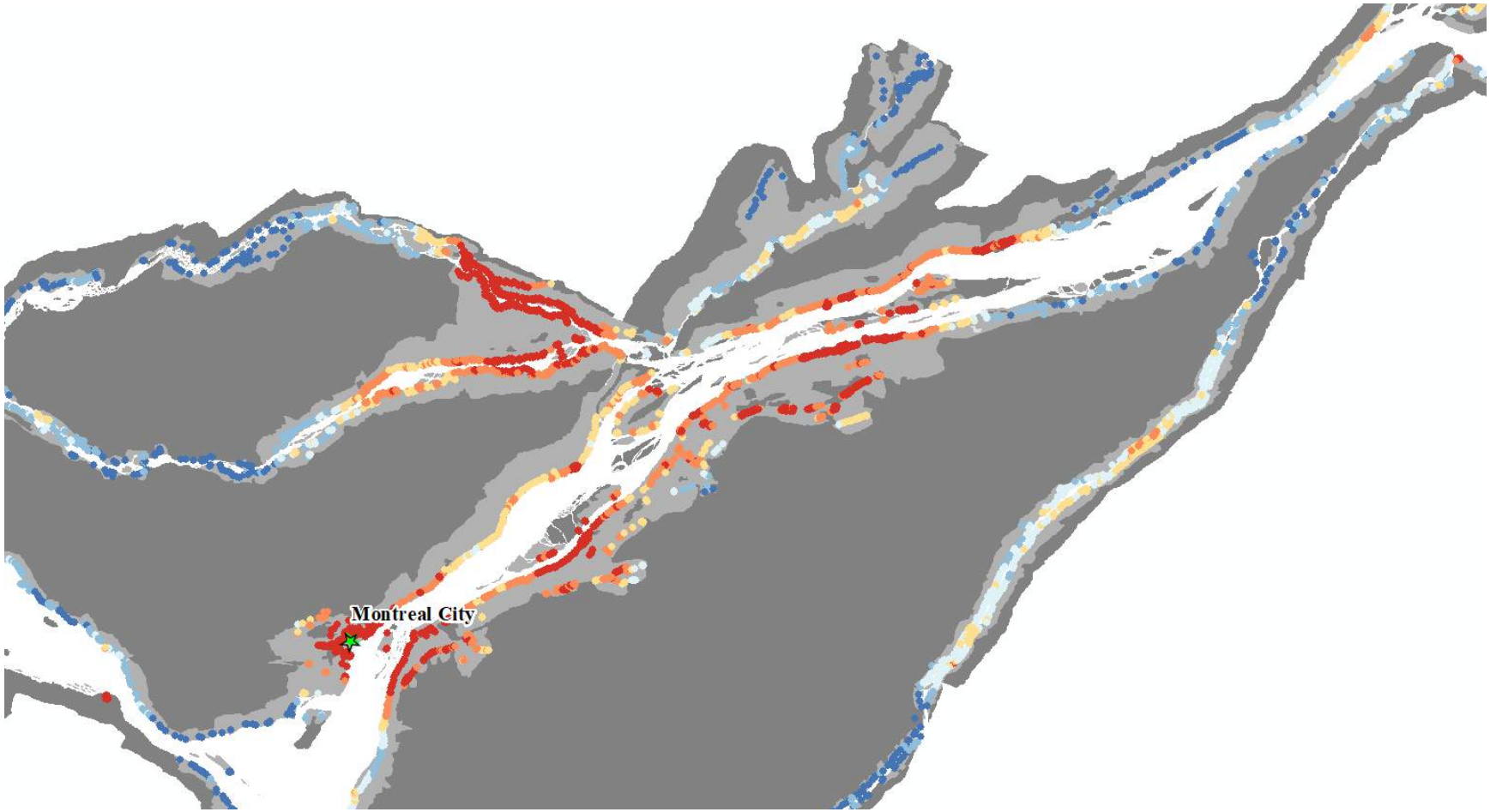

Figure 69: Kernel Density Analysis of Dwellings in Montreal. Light grey indicates cleared land, dark grey forest or swamp.

So while one major pole of the colony's population around Quebec City and environs was rooted in a seventeenth-century imperial political agenda, the other in the government of Montreal emerged in the eighteenth century more organically out of the particularities of environment there. Even as these outlier dwellings in Montreal were situated distant from major waterways, they were attracted to the social density made possible by the convergence of those waterways.

This analysis is, again, preliminary and suggestive. It could be repeated to think about other kinds of proximity—to churches, mills, or roads as a few examples. And we might draw in other sources bases such as the PRDH or other historical maps. This could have a chronological orientation—i.e. looking at earlier or later historical maps depicting the same terrain to ask questions about change. Here the 1685—6 and 1709 surveys offer tantalizing possibilities because they both record people's names.

We might also think about broadening our geographic frame. The Murray Atlas's enthusiastic reception in the halls of power helped launch many more geographic surveys throughout British North America over the next two decades.[105] These later cartographic projects were better documented and executed with better tools—which likely means they had better positional accuracy than the Murray Atlas. Subjecting the Murray Atlas to additional tests of completeness may suggest that it will be worthwhile to digitally process these other snapshots of British North America in the era of imperial crisis and colonial revolt.

Such a dataset stretched across colonies along the eastern seaboard should illustrate some of the typical spatial models by which Europeans colonized North America while helping us determine what made the outliers, outliers. In other colonies, for example, do we also find that Europeans stay quite so close to waterways? Or do we find that different environments, climates,

[105] Hornsby, *Surveyors of Empire*; Jones, "Charting the Imperial Will."

economic systems, legal practices, political structures, ethnic and racial compositions, gender ratios, and/or religious sects created entirely different settlement patterns? Such a project will also allow us to revise demographic estimates that have to date been based in what were likely flawed censuses.

Whatever questions scholars might want to ask, they now have a historical geodatabase to help them. They also have a greater sense of the reliability or unreliability of three important pre-1800 quantitative source bases (maps, parish registers, and censuses). Most important, however, this project has developed and documented a robust methodology for using historical maps to create spatial data and then evaluating that spatial data. This process involves conceptual labor in conjunction with historiographical and historical research. It should be rooted in the archives but not limited by them. Researchers must prepared to expand time and energy to create the vector data and then, to spatially adjust them. They should look to create spatial and temporal alignment with other records. And they should be comfortable with and able to document their uncertainty. The result of this methodology yields geospatial data, yes. But it also provides a deeper appreciation of the historical map and the geography it represents.

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Appendix A: Models for Reconstructing Missing Parish Records

Reconstructing Canadian population using the parish registers depends upon successfully estimating the number of births and deaths for the years and parishes with missing records. I embarked on this task with multiple models. To gage their reliability, I first used them to estimate values I already knew—in other words to gauge whether they predicted those values with any precision.

This approach hinges upon the assumption that the missing data and the surviving data are similar to each other. This assumption is partially flawed. Some data are missing for what appear to be random reasons. But poor record keeping during the earliest years of a parish was a recurring pattern, suggesting a potential correlation between the cause of the absent data and the value of that data. Because we only have a handful of parishes with complete records in their early years, we have less insight into the overall nature of this kind of data. I summarize my models in Table 8 and explain them in more detail throughout the next few paragraphs. Following this discussion, I present the error for each of these models in

Table 9. I have cartographically visualized the reconstructed natural population growth in Figure 70. Finally, the population model I constructed for the entire colony with this reconstructed data follows in Appendix B.

The first two models (Model 1 and 2) averaged together adjacent years. Model 1 averaged the year directly before and following; Model 2 drew upon the three years directly before and following. Missing records were not included in the average. For example, if we were trying to estimate the value for one year and the previous year was missing, then Model 1 would replicate the value of the following year. These models preclude the possibility of a number above or below the range of adjacent years, thereby eliminating the possibility of outliers. In

other words, they weed out unusual numbers that don't fit within the range of the parish but are slightly problematic for years where war, disease, famine, or unusual bounty.

Table 8: Description of Models to Estimate Missing Parish Values

Model	Description
1	Averages the values for the previous and subsequent year
2	Averages the values for the previous and subsequent three years
3	Multiplies value for previous year by the average growth rate for the year (based on sum of all parishes with complete records)
4	Divides value for next year by the average growth rate for the year (based on sum of all parishes with complete records)
5	Multiplies value for previous year by the average growth rate in the region for the year (based on sum of all parishes with complete records)
6	Divides value for next year by the average growth rate in the region for the year (based on sum of all parishes with complete records)
3F	Method 3, Excludes Values that Fall Beyond the Range of Known Values for the Parish during its Lifetime
4F	Method 4, Excludes Values that Fall Beyond the Range of Known Values for the Parish during its Lifetime
5F	Method 5, Excludes Values that Fall Beyond the Range of Known Values for the Parish during its Lifetime
6F	Method 6, Excludes Values that Fall Beyond the Range of Known Values for the Parish during its Lifetime
A(verage)	Average of Methods 1, 2, 3F, 4F, 5F, 6F (When values available). If the value falls below 0 (i.e. for births), given default value of 0.
7	Uses Ratio of Known Data from the Parish for the same Years for the Region, Extrapolates data for missing years
8	Starts Parishes with Complete Records at the Same Time, Averaging Together Values for Y1, Y2, Y3, etc.

Models 3, 4, 5, and 6 employed growth rates to calculate either forward from the year preceding (Models 3 and 5) or backwards from the year following (Models 4 and 6). I derived these growth rates from parishes with complete records during the relevant two-year period both throughout the colony (Models 3 and 4) and region (Models 5 and 6). In other words, if was trying to determine growth rate to use to calculate forward from 1750 or backward from 1751, I would only include parishes for which I had records for both years (1750 and 1751).

Certain problems presented themselves for Models 3 to 6. First, they could produce results that fell beyond the range of recorded values for the parish. While it is certainly possible that the missing parish registers included outliers, I wanted to see what the results looked like without them as well. A second problem arose: A large rate of change (in the region or throughout the colony) in a given year could create negative results in the cases of births or deaths. This is not necessarily a problem for predicting natural growth, which is negative when deaths outweigh births. But for this study, I have decided to filter out the unborn and undead. These two layers of filtering (denoted in the model name with an "F" following the number) yielded only marginally lower overall rates of error but they improved the distribution of that error—so, for example, we saw fewer individual cases of error greater than 100%.

At a certain level, Models 3 through 6 add a certain kind of nuance to Models 1 and 2 but none will help us find the value of missing data if we don't have records for adjacent years. Said differently, however well these models worked for estimating randomly missing records, they did much less to establish the values for records missing in the early years of a parish—especially when the run of missing years lasted for a decade or longer. In these cases, I developed an additional two methods for estimating values. Model 7 determined the ratio of values between parish and region for the years in which parish data is known, using that ratio to extrapolate the data for missing years. Model 8 drew upon the parishes with complete records to create average values for the first, second, third, etc. years.

The problems with these models should be somewhat obvious. Model 7 does not factor in other missing parish registers in calculating its ratio or extrapolating backwards from it. Nor does it give us the values for the first years of the first parish operating in a region (if the parish register is missing, without a second parish, there is no value for the region). Therefore this

model will work best during the later years when more parishes populate a region—precisely when we need it least. Model 8 assumes that all parishes are essentially alike—this seems quite dubious. Not surprisingly, the error rate was high for both models (e.g. these methods underestimated births by 55% and 35% respectively), reflecting highly flawed assumptions. Probably the error was actually much higher for Model 8 because it drew upon biased aggregate data. Said differently, the only way we would know the error rate for a given parish was if that parish had data that survived—and if it had data that survived, it was guiding our estimate in the first place. The best we can say here is, first, that something might be slightly better than nothing. Second, it seems that these methods undercount rather than over count so that we find an answer slightly closer to the truth but without overshooting. Third, we can interrogate our results using CBR, which we do in the next appendix.

The final model, which I have named with the letter "A" for average, averaged together Models 1, 2, 3F, 4F, 5F, and 6F. If a particular model did not generate an estimate for a given parish in a given year (e.g. if Model 1 had no data from the adjacent year before and after) it was not included in the average. I experimented with a few other averages but found this one yielded the most impressive results: A low overall (and generally well-distributed) rate of error. As measured against known data, Model A over counted natural growth (births minus deaths) by 0.29% and undercounted births by 0.87%. See

Table 9 below for the error rates of all the different models.

Table 9: Model Error for Estimating the Values of Missing Parish Registers

	Percent Error Estimating:	
Model	**Births**	**Natural Population Growth**
1	1.18%	1.95%
2	0.45%	0.94%
3	1.46%	7.07%
4	-3.23%	1.91%
5	3.34%	2.52%
6	8.80%	9.11%
3F	0.83%	6.51%
4F	-1.41%	4.80%
5F	4.70%	5.00%
6F	0.27%	8.96%
A(verage)	-0.87%	0.29%
7	-55.09%	-8.28%
8	-35.66%	41.14%

After testing the error rate of these models, I followed a hierarchy in actually estimating the missing values. First, I filled in the missing records with results from Model A. For years where this did not yield an estimate, I used the results from Model 7 (even though this had a higher rate of error than Model 8, at least I knew I could trust the estimate of error). Only for the values that were still missing at this point did I use Model 8. For a cartographic visualization of these results see Figure 70. One final note is that we should be able to improve upon these results in the future with access to the full PRDH database: Because vital records often reference earlier life events (for which the records might not survive), we should be able to fill in more missing data (e.g. marriage certificates discussing when and where the husband and wife were born).

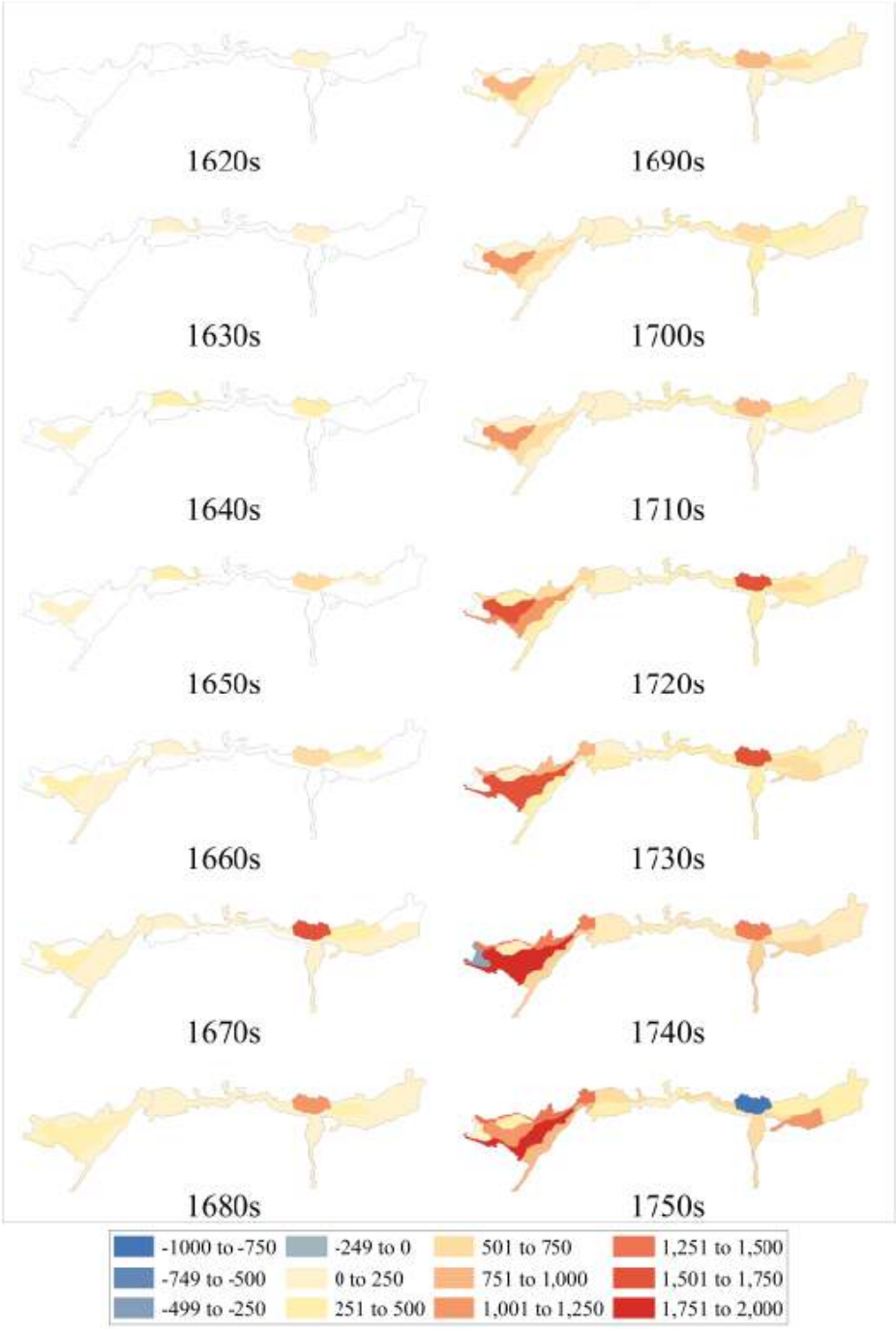

Figure 70: Regional Distribution of Projected Natural Population Growth (Raw Numbers) by Decade (1620-1760). White coloring indicates no parishes yet established in the region.

Appendix B: Modeling Population in Canada with Parish Registers

Having created estimates for the value of missing data (Appendix A), my next objective was creating population estimates for the colony as a whole from its founding (1616) to the date of the last census considered for this study (1765). Doing this for the whole colony is straightforward enough: For a given year, we add A) natural growth (births minus deaths), B) net immigration to the colony, and C) the population from the previous year. Fortunately, Leslie Choquette has reconstructed the numbers for net migration to Canada.[106] For natural growth, I used two sets of numbers: The first as recorded *only* in the parish registers that survive; and the second including the estimates for missing records. This illustrates the estimated effect of the missing data. The results are below in

Table 10, Figure 71, and Figure 72.

Table 10: Population Estimates and Source Comparisons

Year	Population from Source					
	Net Migration to Canada	**Surviving registers**	**Registers with estimates for missing data**	**Census (# of People)**	**Census (# of Families)**	**Map/Census (# of Dwellings)**
1620	22	22	36	N/A		
1640	958	1,325	1,470			
1660	4,983	7,097	7,340			
1680	9,591	17,350	18,308			
1700	11,500	27,226	29,343			
1720	12,530	39,985	42,768			
1740	15,126	63,653	66,931			
1760	23,546	93,929	97,571		11,043	12,911 (Map)
1762	23,666	98,111	101,782	66,068	N/A	N/A
1765	23,846	105,145	108,950	55,100	10,660	9,930 (Census)

[106] Choquette, *Frenchmen into Peasants*, 162.

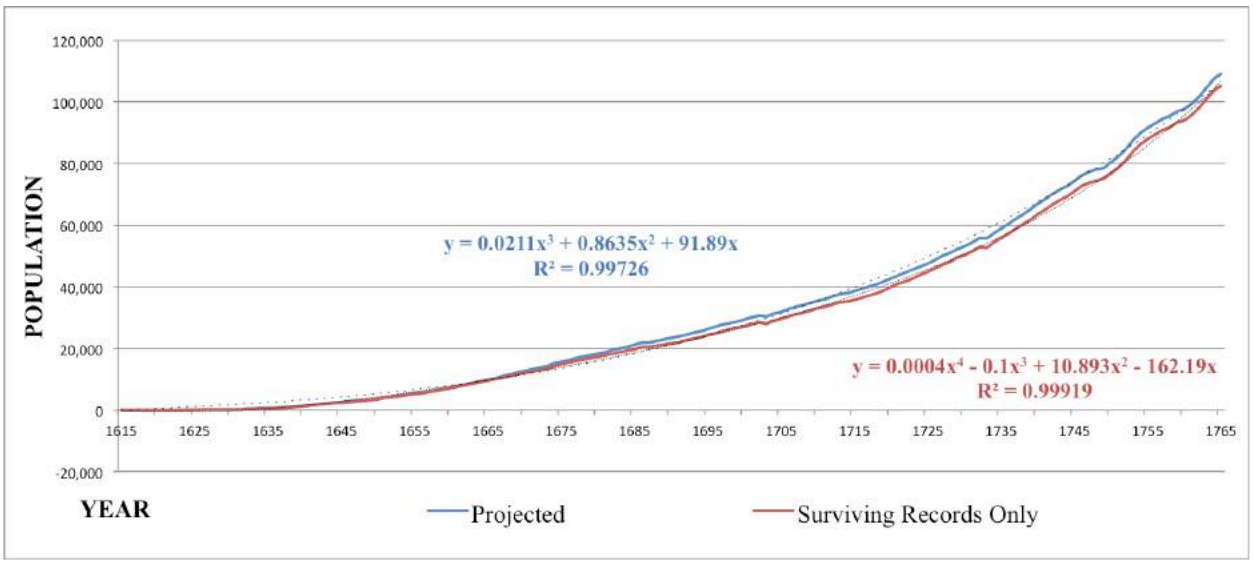

Figure 71: Canadian Population, 1615-1765

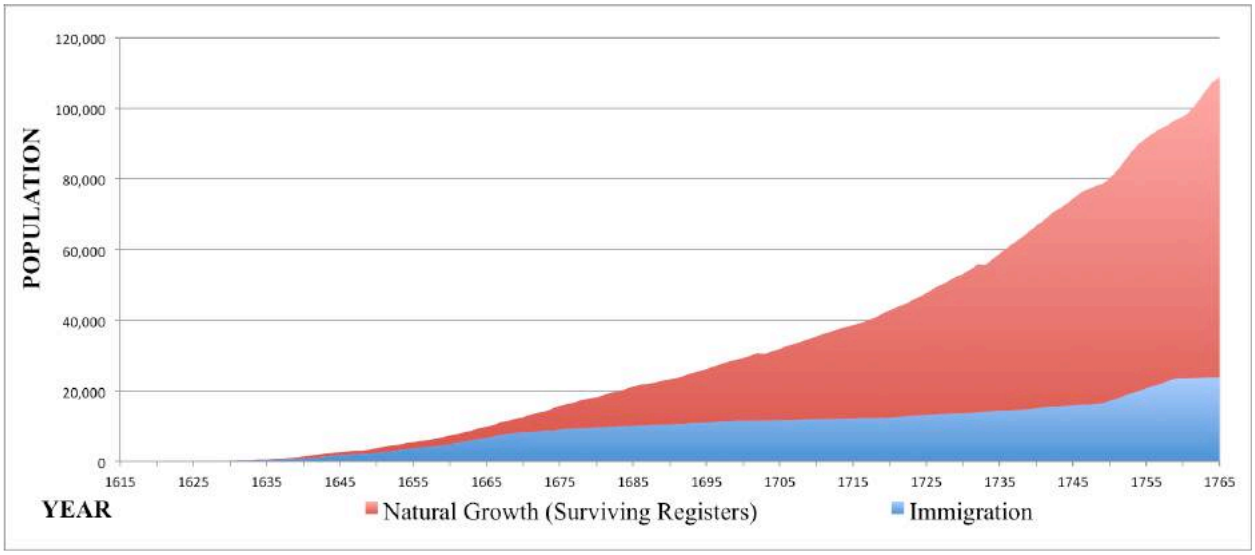

Figure 72: Share of Canadian Population from Natural Growth and Immigration, 1615-1765

What happens if we subject these estimates to the same CBR test that we employed to the census and Murray Atlas? In the earliest years of the colony (roughly to 1640), the CBR looks erratic and at times impossibly high. The gender ratio of the early colony skewed heavily male, so we should expect a very low CBR. Yet the model estimating values for missing parish data does a poor job in these early years (Figure 73)—whether because it underestimates overall

population or overestimates the number of births—providing a CBR in 1626 that almost reaches 250. This is not entirely surprising because these estimates come from what was the least reliable model, as discussed in Appendix A. The small number of operational parishes during this period would, moreover, weight these bad estimates more heavily. The numbers for only the surviving registers also look unusual, jumping back and forth to and from zero, peaking above one hundred in the late 1630s. In some sense, the poor results here are not too surprising. Everything here is complicated by large gaps in record keeping and the erratic nature of a small early colonial population.

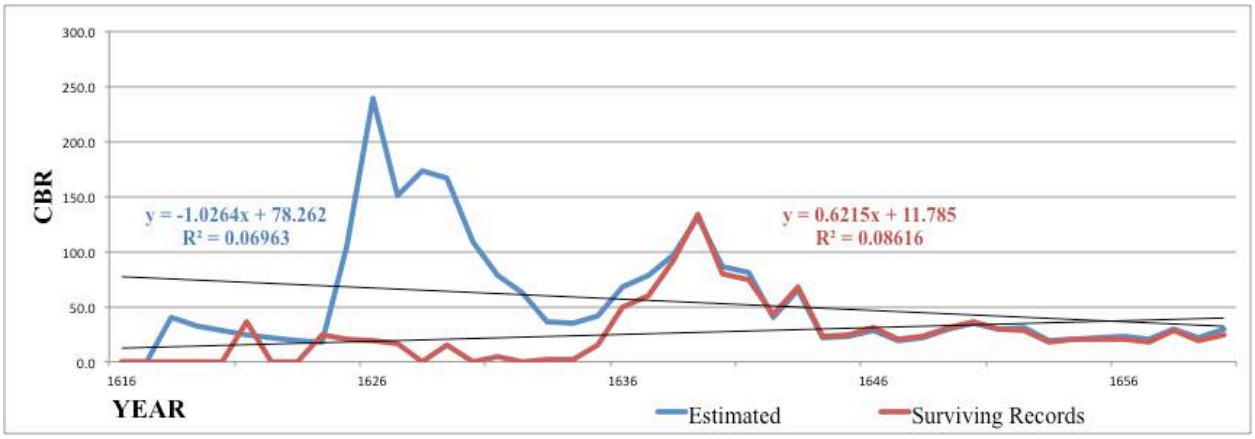

Figure 73: CBR Calculated from Only Surviving Registers vs. Surviving Registers with Estimated Values for Non-Surviving Registers, 1616-1651.

What we can say about this population projection is that after about the year 1645, it provides a CBR within reasonable bounds that broadly conforms to what we might expect. We see, for example, a low CBR in the 1650s that increases slowly in the 1660s and then more dramatically in the 1670s, reflecting the state-sponsored migration of young (unmarried) women to the colony in the 1660s to balance the heavily male gender ratio. The CBR calculated from surviving registers generates a trendline with a higher R^2 value (0.71299) than does the one using our estimated values (R^2=0.56874). We might not necessarily read too much into this, as it might

mean that including estimates merely exaggerates the seventeenth-century volatility we already see in the records. Whichever population estimate derived from PRDH data we use, we can see that it points to a much larger population than either 1762 or 1765 census (

Table 10). That the natural growth alone is greater than the census estimates gives us a strong clue as to how much the censuses were undercounting people.

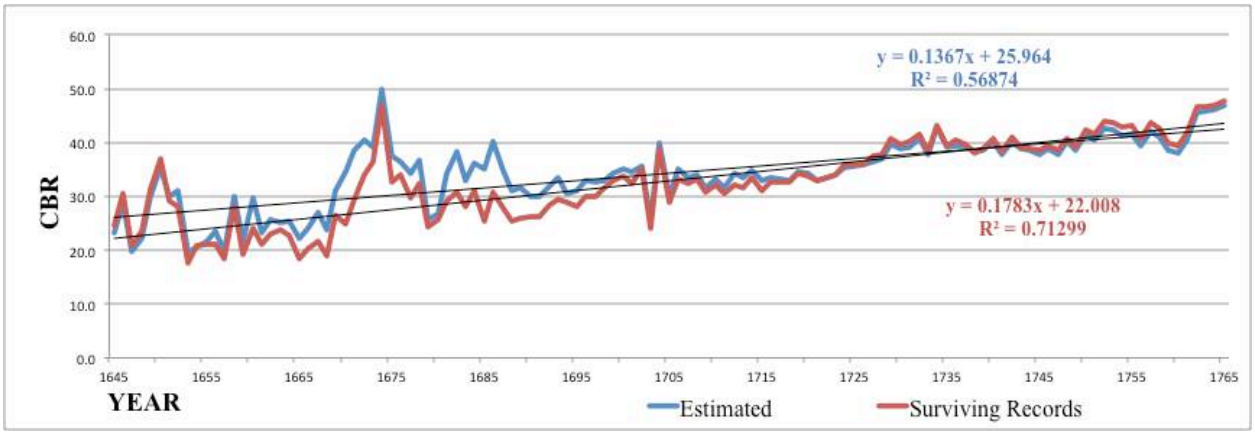

Figure 74: CBR Calculated from Surviving Registers Only vs. Surviving Registers and Estimated Values for Non-Surviving Registers, 1645-1765.

Appendix C: Comparing 1760 and 1765 Censuses by Region

Region	Families 1760	Families 1765	Difference (%)
Quebec West	297	465	56.6%
Quebec South	333	381	14.4%
Quebec City and Suburbs*	665*	858	29.0%
Chaudiere-Etchemin River Valley	524	647	23.5%
Isle d'Orleans	383	420	9.7%
Quebec Shore S of I Orleans	689	820	19.0%
Quebec Shore N of I Orleans	286	313	9.4%
Quebec East	155	291	87.7%
Quebec North	161	186	15.5%
Quebec (Unmapped)	556	599	7.7%
TOTAL QUEBEC	**4049**	**4980**	**23.0%**
Trois Rivieres South	415	387	-6.7%
Trois Rivieres West	326	424	30.1%
Trois Rivieres East	164	142	-13.4%
Trois Rivieres North	310	307	-1.0%
Trois Rivieres (Unmapped)	66	0	N/A
TOTAL TROIS RIVIERIES	**1281**	**1260**	**-1.6%**
Montreal West	102	116	13.7%
Isle Jesus	402	467	16.2%
Montreal Island*	1285*	937	-27.1%
Montreal South Shore	1198	851	-29.0%
Richelieu River Corridor	676	803	18.8%
Montreal North Shore	957	1050	9.7%
Montreal (Unmapped)	194	196	1.0%
TOTAL (MONTREAL)	**4814**	**4420**	**-8.2%**
TOTAL (ALL)	**10144**	**10660**	**5.1%**

Asterisk (*) indicates data has been subtracted to facilitate comparison (i.e. for the parishes with missing data in the 1765 census, the 1761 parish data has not been incorporated into the number of families by region to create parity in the comparison. Of course, these comparisons might still be problematic, if the census takers defined the parish boundaries differently).

Appendix D: Changes in Population According to 1762 and 1765 Censuses

Region	1762 Census [107]	1765 Census [108]	Difference (%)
Quebec West	2538	2496	-1.7%
Quebec South	1902	1923	1.1%
Quebec City and Suburbs	5602*	4531*	-19.1%
Chaudiere-Etchemin River Valley	2876	3282	14.1%
Isle d'Orleans	2458	2303	-6.3%
Quebec Shore S of I Orleans	4619	4443	-3.8%
Quebec Shore N of I Orleans	1635	1762	7.8%
Quebec East	1451	1590	9.6%
Quebec North	1032	1054	2.1%
Quebec (Unmapped)	2648	3339	26.1%
TOTAL QUEBEC*	**21159**	**22192**	**4.9%**
Trois Rivieres South	1065	1918	80.1%
Trois Rivieres West	2974	2088	-29.8%
Trois Rivieres East	646	724	12.1%
Trois Rivieres North	1524	1597	4.8%
Trois Rivieres (Unmapped)	283		
TOTAL TROIS RIVIERIES	**6972**	**6327**	**-9.3%**
TOTAL (QUEBEC AND TROIS RIVIERES*)	**28131**	**28519**	**1.4%**

Asterisks (*) indicate the total without data for Quebec City.

[107] [Report on the Government of Quebec] (June 5 1762), CO 323/15, TNA; [Report on the Government of Trois Rivieres] (April 1762), CO 323/16, TNA.
[108] *Censuses of Canada, 1665 to 1871* (Ottawa: I. B. Taylor, 1876), 62-68.

Appendix E: Hypothetical Colony-Wide CBRs for 1760 Census based on Average Family Size

Region Name	Births	Families	CBR if Family Size =				
			4	5	6	7	8
Montreal West	34	102	83.33	66.67	55.56	47.62	41.67
Trois Rivieres South	114	415	68.67	54.94	45.78	39.24	34.34
Quebec West	127	297	106.90	85.52	71.27	61.09	53.45
Trois Rivieres West	165	326	126.53	101.23	84.36	72.30	63.27
Isle Jesus	174	402	108.21	86.57	72.14	61.83	54.10
Montreal Island	816	2117	96.36	77.09	64.24	55.06	48.18
Montreal South Shore	485	1198	101.21	80.97	67.47	57.83	50.61
Richelieu River Corridor	317	676	117.23	93.79	78.16	66.99	58.62
Montreal North Shore	587	957	153.34	122.68	102.23	87.63	76.67
Trois Rivieres East	54	164	82.32	65.85	54.88	47.04	41.16
Quebec South	136	333	102.10	81.68	68.07	58.34	51.05
Quebec City and Suburbs	601	1548	97.06	77.65	64.71	55.46	48.53
Chaudiere-Etchemin River Valley	202	524	96.37	77.10	64.25	55.07	48.19
Isle d'Orleans	121	383	78.98	63.19	52.65	45.13	39.49
Quebec Shore S of I Orleans	354	689	128.45	102.76	85.63	73.40	64.22
Quebec Shore N of I Orleans	88	286	76.92	61.54	51.28	43.96	38.46
Quebec East	96	155	154.84	123.87	103.23	88.48	77.42
Quebec North	55	161	85.40	68.32	56.94	48.80	42.70
Trois Rivieres North	133	310	107.26	85.81	71.51	61.29	53.63
TOTAL	**4659**	**11043**	**105.47**	**84.38**	**70.32**	**60.27**	**52.74**

Appendix F: Regional Distribution of Dwellings in Murray Atlas (with Extrapolated Population and CBR) by Region

Region	Dwellings (#)	Estimated Population (7 People per Dwelling)	CBR
Montreal West	259	1838.9	12.5
Trois Rivieres South	480	3408	22.0
Quebec West	573	4068.3	32.7
Trois Rivieres West	587	4167.7	30.7
Isle Jesus	416	2953.6	46.7
Montreal Island	1066	7568.6	99.2
Montreal South Shore	1420	10082	42.6
Richelieu River Corridor	915	6496.5	38.3
Montreal North Shore	1427	10131.7	38.8
Trois Rivieres East	186	1320.6	26.5
Quebec South	611	4338.1	21.6
Quebec City and Suburbs	1905	13525.5	41.5
Chaudiere-Etchemin River Valley	540	3834	34.4
Isle d'Orleans	330	2343	28.6
Quebec Shore S of I Orleans	1028	7298.8	31.2
Quebec Shore N of I Orleans	286	2030.6	35.5
Quebec East	158	1121.8	60.6
Quebec North	132	937.2	44.8
Trois Rivieres North	592	4203.2	24.5