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New Brunswick Institute for Research, Data and Training

THE USE OF PUBLIC LIBRARIES IN NEW BRUNSWICK, 2010 TO 2018

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PROJECT TITLE

The use of public libraries in New Brunswick, 2010 to 2018

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ABSTRACT

This report describes trends in borrower activity in New Brunswick's public libraries and investigates the impact of disruptions and improvements to library services, including access to library facilities and collections. We find positive trends in the south of the province, which are largely driven by population growth. Meanwhile, the rates of active borrowers[2] and physical circulations in the north are surprisingly resilient against population decline, with the rate of active borrowers higher outside the largest Census Areas. No disruptions and/or improvements to library services decreased the number of active borrowers in New Brunswick, and renovations and expansions significantly attracted thousands of active borrowers to each region. Overall, we find remarkable stability and growth in the use of library services in New Brunswick despite the context of an aging population, economic stagnation, slow population growth, and technological and social changes. We attribute these trends to policy decisions and innovations regarding library access and services.

[1] The map of New Brunswick Public Library service points is taken from New Brunswick Public Library Service (2015).

[2] The term "active borrower" refers to the number of library cards showing activity – or use – within a specified year. That activity could be borrowing an item from a physical collection, accessing online resources via the library website, or updating a patron account.

EXECUTIVE SUMMARY

This report describes trends in borrower activity in New Brunswick's public libraries and investigates the impact of disruptions and improvements to library services, including access to library facilities and collections. We use data compiled by the Government of New Brunswick for 63 public libraries in New Brunswick and analyze annual counts of active borrowers[3] from 2010 to 2018, as well as monthly counts of the physical circulation of public library items from January 2010 to December 2018.

We find the demand for public library services in the province remained steady between 2010 and 2018, based on the number of active borrowers and the total volume of circulations the province saw. We also find that New Brunswickers have augmented traditional physical borrowings with electronic library materials, though these still represent only a small percentage of overall circulations. Since 2015, the number of active borrowers and the physical circulation of library materials have been increasing in the south of the province, particularly in the three largest Census Areas (the Moncton and Saint John CMAs and the Fredericton CA). The rest of the province experienced declines over the same period; however, the rate of active borrowers per thousand local residents is still highest outside the three largest Census Areas.

The post-2015 trend of growth in the south could be due to the recent policy instituting Saturday access for all public libraries and Sunday access for five public libraries,[4] as well as the introduction of limited circulation cards and the elimination of overdue fines for children aged 12 and under. No disruptions and/or improvements to library services were found to have decreased the number of active borrowers, and renovations and expansions significantly attracted thousands of active borrowers to each region.

We find that the positive trends in the south are largely driven by population growth, while the rates of active borrowers and physical circulations in the north are surprisingly resilient against population decline. Overall, we find remarkable stability and growth in the use of library services in New Brunswick, despite the context of an aging population, economic stagnation, slow population growth, and technological and social changes. We attribute these trends to policy decisions and innovations regarding library access and services.

[3] The term "active borrower" refers to the number of library cards showing activity – or use – within a specified year. That activity could be borrowing an item from a physical collection, accessing online resources via the library website, or updating a patron account.

[4] The five NB public libraries participating in this pilot policy are the Moncton Public Library, Campbellton Centennial Library, Saint John Free Public Library - Central Branch, Mgr. W.J. Conway Public Library (Edmundston), and Fredericton Public Library.

INTRODUCTION

The status of public libraries in Canada is complicated, to say the least. Canadians appear to genuinely value their libraries. The Online Computer Library Center (OCLC) shows that, in 2011, Canadians visited their public libraries nearly as often as they went to the movies and 20 times more often than they attended NHL games. Also, nearly two-thirds of Canadians have a library card – a proportion almost equal to the number of Canadians that have passports (OCLC, 2011).

Besides traditional book borrowings, other library services are frequently used by Canadians as well. Library meeting rooms are used by over 28,000 people, and technology training classes are attended by nearly 16,000 people every month. Internet workstations are used over 18 million times a year, and libraries with free Wi-Fi support 3.2 million connections annually (OCLC, 2011). The province of New Brunswick (NB) has even publicly acknowledged the valuable role of libraries as "indispensable community hubs" by establishing October as New Brunswick Public Libraries Month (GNB, 2016, para. 3).

However, the future of public libraries across the country remains unclear, as Canadian public libraries are increasingly faced with financial and staffing difficulties and threats of consolidation or closure. While New Brunswick celebrated Public Libraries Month, the province of Newfoundland and Labrador announced it would be closing 54 public libraries due to budget cuts – leaving only 41 libraries open in the province ("Public," 2016). Although this plan was suspended due to widespread public opposition ("Good," 2018; Roberts & Ensing, 2016), and the government of Newfoundland and Labrador allocated $11.3 million to library budgets for 2017, the province's Library Association notes that libraries are still being underfunded ("Good," 2018).

The existing literature identifies some primary challenges threatening the support of public libraries. These include the widespread prevalence of the Internet, the recent economic downturn, budget cutbacks and reduced funding, population shrinkage, attempts to increase value for taxpayers, demands to see return on investment, lack of personnel and up-to-date technology, competition from other free services, and general perceptions that people no longer use libraries (Berthiaume, 2017; Chen & Ke, 2017; DeYoung, 2015; Fischer, 2015; Galloway, 2018; Gustina, 2018; Holt, 2009b; Johnson, 2010; Sawyer, 1996; Smith, 2014; Taylor et al,. 2012).

As a result of these difficulties, public libraries are "forced to demonstrate their value to the public to earn . . . financial and intellectual support" (Chen & Ke, 2017, p. 45). However, relatively little research to date has attempted to prove this value in an empirical manner (Holt, 2009b; Vårheim, 2008). It is therefore important that more studies explore this concept, especially in reference to small and rural communities, where the futures of public libraries are particularly volatile due to declining populations and shrinking tax bases (Gustina, 2018) and where internet access is not as good, or at least not as affordable.

We are interested in describing trends in the use of public libraries in NB, and we aim to show whether disruptions to library services – such as changes in hours of access or closures for renovations – significantly affect library use. First, our report presents descriptive statistics on trends in public library usage in New Brunswick between 2010 and 2018. Second, this report analyzes the impacts of occurred disruptions, changes in access, and improvements on the use of 63[5] public libraries in NB between 2010 and 2018, using regression analysis. For the descriptive statistics and regression models, we use a dataset consisting of annual counts of active borrowers from 2010 to 2018. The term "active borrower" refers to the number of library cards showing activity – or use – within a specified year. That activity could be borrowing an item from

[5] In November 2018, the New Brunswick Library of Craft and Design opened in Fredericton, bringing the number of public libraries in the province up to 64. Although we obtained data for physical circulations in this library, we do not include it in our analysis due to too few observations.

a physical collection, accessing online resources via the library website, or updating a patron account. We also use a dataset of monthly counts of physical circulation of public library items from January 2010 to December 2018. Both datasets are provided by the Government of New Brunswick. Additionally, we use 2011 and 2016 data from Statistics Canada's Census of Population.

We compare active borrowers and physical circulations by Census area (Moncton CMA, Saint John CMA, and Fredericton CA versus the rest of the province), by region (York, Fundy, Albert-Westmorland-Kent, Haut-Saint-Jean, and Chaleur), and by division of the province into North and South.

We find that demand for public library services in the province remained steady between 2010 and 2018, based on the number of active borrowers and the total volume of circulations the province saw. We also find that New Brunswickers have started augmenting traditional physical borrowings by using electronic libraries for materials, though these still represent only a small percentage of overall circulations.

Since 2015, the number of active borrowers and the physical circulation of library materials have been increasing in the south of the province, particularly in the three largest Census Areas (the Moncton and Saint John CMAs and the Fredericton CA). Meanwhile, the rest of the province experienced declines. The post-2015 trend of growth in the south could be due to the recent policy instituting year-round Saturday access for all public libraries and Sunday access for five public libraries, as well as the introduction of limited circulation cards and the elimination of overdue fines for children aged 12 and under.

The disruptors that occurred to public libraries in NB between 2010 and 2018 did not significantly influence measures of active borrowers on the individual library level. On the regional level, the open-7-days pilot, renovations, and expansions significantly attracted thousands of active borrowers for each region, while no events were found to decrease active borrowers. The open-7-days pilot has proven to be a good policy that significantly increased the volume of physical circulations on individual library and regional levels.

Overall, we find remarkable stability and growth in the use of library services in New Brunswick despite the context of an aging population, economic stagnation, slow population growth, and technological and social changes. We attribute these trends to policy decisions and innovations regarding library access and services.

LITERATURE REVIEW

Libraries are potential contributors to a community's "social capital." In the literature reviewed below, levels of activity and use of libraries are considered proxy measures of the size of the contribution of libraries to social capital. Measuring the socio-economic value of libraries can be a challenge, as the benefits associated with public libraries are not monetized through market transactions. Identifying willingness to pay for library services is also complicated by the "public goods" aspects of libraries: Library facilities and collections are non-rivalrous in consumption, and access is typically not excludable for members of the community. In situations like this, private markets will tend to under-provide public goods, meaning that public funding – along with nominal user fees and philanthropy – has been the dominant way to fund library services.

A number of articles have been produced on the economic value of libraries (Bishop et al., 2016; Field & Tran, 2018; Fitch & Warner, 1998; Hancks, 2012; Holt & Elliott, 2003; Leavitt et al., 2010; Sawyer, 1996; Taylor et al., 2012). However, a much greater proportion of the existing literature deals with libraries in terms of social, rather than merely economic, value by analyzing the relationship between public libraries and social capital (Bourke, 2005; Chen & Ke, 2017; Ferguson, 2012; Goulding, 2004; Griffis & Johnson, 2014; Hillenbrand, 2005a; Hillenbrand, 2005b; Johnson, 2010; Johnson, 2012; Johnson & Griffis, 2014; Khoir et al., 2017; Vårheim, 2007; Vårheim, 2008; Vårheim, 2009; Vårheim, 2014; Vårheim, 2017; Vårheim et al., 2008).

The term social capital can be traced back to political economy theorists of the Scottish Enlightenment and the classical sociological tradition of the nineteenth century (Hillenbrand, 2005b). However, the first official documentation of the term occurred in an article by L. J. Hanifan (1916), who defines social capital as

> "*those tangible substances [that] count for most in the daily lives of people: namely good will, fellowship, sympathy, and social intercourse among the individuals and families who make up a social unit… The individual is helpless socially, if left to himself… If he comes into contact with his neighbor, and they with other neighbors, there will be an accumulation of social capital, which may immediately satisfy his social needs and which may bear a social potentiality sufficient to the substantial improvement of living conditions in the whole community.*" (as cited in Hillenbrand, 2005b, p. 4)

A much more contemporary explanation can be found in the OECD (2001), which describes social capital as "*networks together with shared norms, values and understandings that facilitate co-operation within or among groups.*" Definitions of social capital do vary (Hillenbrand, 2005a; Johnson, 2010; Johnson & Griffis, 2014), but the majority of researchers approach social capital as the value of social relations (Vårheim, 2014).

Currently, the most commonly used definition is that of Putnam (2007), who defines social capital as "social networks and the associated norms of reciprocity and trustworthiness" (as cited in Vårheim, 2008, p. 2). Above all, however, it is through the development of trust that social capital is often measured (Johnson, 2010). Though "less concerned with economic output and more with civic society and networks in the family and community" (Ferguson, 2012, p. 24), social capital and social trust are nonetheless associated with increases in other forms of capital (Elbeshausen & Skov, 2004; Ferguson, 2012) and with economic development and improvements in democracy, schooling, individual health, civic participation, and overall social intercourse, to name only a few identified benefits (Chen & Ke, 2017; Goulding, 2004; Vårheim, 2007; Vårheim, 2017; Vårheim et al., 2008).

Hillenbrand (2005a) points out that "the argument for the assessing of social impact is based on the perceived need to *demonstrate* rather than assume the value and significance of the public

library" (p. 6). Although research on social capital has been flourishing more recently, literature on the role of public libraries in building social capital remained scant until the early 2000s, when Hillenbrand (2005b) argued that public libraries have been forgotten by most analysts as a potential source of social capital.

Following Hillenbrand's research, Vårheim (2011) noticed that many library mission statements include phrases such as "building strong communities" or "contributing to the well-being of communities" among their major goals, and Wilkinson (2018) – the CEO of The Reading Agency UK – reported that 75% of people believe that libraries supply an essential service to local communities. Libraries are seen as safe and trusted spaces that not only provide books, information, experiences, and ideas, but also contribute to education, community cohesion, wellbeing, and even health; therefore, arguably, libraries should be available to everyone (Wilkinson, 2018).

It has been hypothesized that libraries build social capital by bringing people together. Bundy (2003) even goes so far as to refer to public libraries as "social capital" itself (as cited in Ferguson, 2012, p. 23). As Johnson (2010) points out, "Libraries are open to people regardless of age, sex, income, race, or political or religious point of view" (p. 147). This universality of access makes libraries an ideal place for people to encounter one another and engage with people of different backgrounds and beliefs in a non-contentious environment (Johnson, 2010). Other studies have similar insights, suggesting that interactions between library users promote tolerance, respect, and social cohesion (Chen & Ke, 2017; Goulding, 2004; Griffis & Johnson, 2013; Hillenbrand, 2005b; Johnson, 2012; Vårheim 2007; Vårheim et al., 2008).

Social capital is said to result from many factors, including the information and emotional resources that library staff offer their patrons (Griffis & Johnson, 2012; Johnson, 2012; Vårheim et al., 2008); library involvement with voluntary associations and community activities (Griffis & Johnson, 2013; Hillenbrand, 2005b; Vårheim, 2007); and the information, technology, and classes that libraries offer to the public (Goulding, 2004; Hillenbrand, 2005b; Johnson, 2012; Vårheim, 2014). Finally, the very presence of the physical building allegedly builds social capital by generating "feelings of pride in the neighborhood" and inspiring "hope that local conditions can change for the better" (Johnson, 2012, pp. 59-60). As Oliphant (2014) argues, "No one wants to live in a community without a library, regardless of whether they are a library user" (p. 359).

The majority of literature to date on the correlation between public libraries and social capital has been speculative and assumptive, though optimistic. In recent years, however, some quantitative empirical studies have emerged on the correlation between access to public libraries and the generation of social capital in Canada (Griffis & Johnson, 2012; Johnson & Griffis, 2014), the United States (Johnson, 2010; Johnson, 2012; Vårheim, 2014; Vårheim et al., 2008), South Australia (Hillenbrand, 2005b) and Taiwan (Chen & Ke, 2017). All of these studies measure social capital through specially designed interviews and questionnaires.

The pioneering study conducted by Hillenbrand (2005b) undertakes a social capital audit of Mount Barker Community Library in South Australia from April to November 2004. Hillenbrand (2005b) relied on quantitative and qualitative methodologies to gather data, including administering a questionnaire survey to library users, interviewing stakeholders, holding informal discussions with library members and staff, and analyzing policy reports, previous user surveys, census data, and other communications. Hillenbrand's study (2005b) shows that the Mount Barker Community Library "contributes significantly" to the social capital of the community (p. 41).

Following Hillenbrand (2005b), Vårheim et al. (2008) analyze macro-level data on generalized trust from the third wave of the World Values Survey (2006) to determine whether public library expenditure could explain patterns of social trust in OECD countries. The combination of data

analysis and interviews with public library administrators regarding library plans and budgets brings them to conclude that public libraries seem to be the most important factor in creating generalized trust in OECD countries – even more than efficient/impartial public institutions such as hospitals. However, although Vårheim et al. demonstrate a high correlation between social trust and per capita spending on libraries, they acknowledge that the direction of causation is unclear, and it is possible that countries with high levels of trust prioritize public libraries anyway.

Johnson's 2010 study of the relationship between public libraries and indicators of social capital uses data from a questionnaire survey administered to library patrons in three public libraries in a large American Midwestern city. Using correlation analysis and the Lin position generator to develop levels of individual social capital, Johnson (2010) finds that the level of social capital of library users is significantly higher in terms of community involvement and trust than that of a random sample of city residents. However, frequency of library use is only significantly associated with community involvement, not trust. Nonetheless, the study shows evidence that a strong relationship exists between library use and social capital, though without proving whether this is a causal relationship.

In subsequent studies, both Vårheim (2014) and Johnson (2012) interview different groups for quantitative studies and once again confirm that libraries are public places where social value and social capital are created, and the use of libraries can serve as a proxy measure of social capital. However, there are some limitations to these findings, as generalized trust between library users may not extend to trust in strangers outside the library context (Vårheim, 2014).

Chen and Ke (2017) distributed survey questionnaires to users of the Singang Library in Taiwan and analyzed valid responses through descriptive statistics, factor analysis, and logistic regression analysis by SPSS 22.0. Their research shows a positive correlation between library use frequency, perceived outcomes, the library as a meeting place, and social capital.

Johnson and Griffis (2014) determine the relationship between library use and social capital in small towns in Ontario, Canada, by correlating frequency of library visits with measures of community- and individual-level social capital. They gathered data by recruiting participants for a questionnaire from library and non-library sites and used Lin's position generator to calculate levels of social capital. They find that "participants from small towns had higher levels of social capital than the urban participants" (p. 179). However, library use was not significantly associated with levels of social capital for small town participants, which suggests that libraries in small towns cater mainly to "middle-class residents who maintain their high level of social capital through participation in a variety of community activities and organizations" (Johnson & Griffis, 2014, p. 179). The study further explains that because people in small communities are more likely to already know one another, going to the library typically does not improve their chances of meeting new people and thus contribute to levels of trust.

These findings echo those of an earlier study by Griffis and Johnson (2013). The authors collected quantitative data at five rural libraries in Southwestern Ontario over three years to establish whether library use is related to levels of social capital. They administered surveys, interviewed library staff and users, collected organizational documents, and made field observations on site. They find that "while rural libraries have high potential to create social capital, the overlap of social networks in rural communities renders the library's influence redundant" (p. 96). It is more likely that their findings of overlap between library influence and social networks as influences of social capital mean that it is not possible to statistically identify the independent effect of libraries.

Following Vårheim (2014) and Johnson (2013), we measure the use of NB public libraries by frequencies. More specifically, our study relies on two measures of frequencies provided by the Government of New Brunswick: annual counts of active borrowers and monthly counts of physical circulations of library materials.

Limitations

Of course, not all studies approach social capital as the best means of measuring the value of libraries. According to Portes and Landolt (1996), social capital, or "the ability to form strong community ties and the economic benefits that result from those ties" (para. 1), has negative consequences for outsiders to a community. Additionally, they argue, "For social capital to mean something, the ability to command resources through social networks must be separate from the level or the quality of such resources. When social capital and the benefits derived from it are confused, the term merely says that the successful succeed" (para. 7).

On a similar note, Caidi and Allard (2005), Griffis and Johnson (2013) and Vårheim (2008) all demonstrate that individuals who suffer from social exclusion may lack access to the sources of information available through the library, as well as associated levels of social capital. Libraries can be potentially exclusionary forces – even if unintentionally. For instance, in the rural libraries of Griffis and Johnson's (2013) study, the clientele were predominantly White and Anglo-Saxon; visible minorities and the economically disadvantaged were "conspicuously absent" (p. 106); and many interviewees voiced the concept of the "outsider" as someone "not from here" (p. 107).

Beyond this issue and the difficulties of determining causal direction, much of the existing literature also faces limitations of context and scope. For instance, the method of administering questionnaire surveys raises the possibility of response bias. As Oliphant (2014) points out, "It is important to recognize that people are poor predictors of what they think they will do in a given situation and what they actually do" (p. 350). Not only are people unreliable judges of themselves, but they may also make incorrect assumptions about others, as could be the case in Johnson's (2012) survey of library staff.

Finally, there is a dire lack of empirical research on the subject at hand (Vårheim 2009; Vårheim et al., 2008), resulting in little proof that libraries do in fact create social capital and trust in people (Vårheim 2009). Vårheim (2014), for one, argues that concluding that library use creates social trust requires a collection of panel data, rather than the cross-sectional studies that currently exist.

It is also important to recognize that the relationship between public libraries and social capital likely differs according to context (Chen & Ke, 2017) – for example, Johnson's 2012 study requires expansion into wealthy neighborhoods if it is to provide a clearer picture of this correlation (or lack thereof). Moreover, as DeYoung (2014) suggests, it is important that the scope of the research being done extend to analyze library services for First Nations, Inuit, and Métis communities, which are often absent from these studies.

DATA

For the descriptive statistics and regression models, we use a dataset consisting of annual counts of active borrowers from 2010 to 2018, as well as a dataset of monthly counts of physical circulations of public library items from January 2010 to December 2018, both provided by the Government of New Brunswick. We also use 2011 and 2016 data from Statistics Canada's Census of Population. We use this information to illustrate trends in the use of public libraries in NB between 2010 and 2018. We also provide a complementary analysis on the annual volume of electronic circulations of public libraries' eBooks and eAudiobooks between 2011 and 2017. Our dataset covers 63 public libraries in NB.

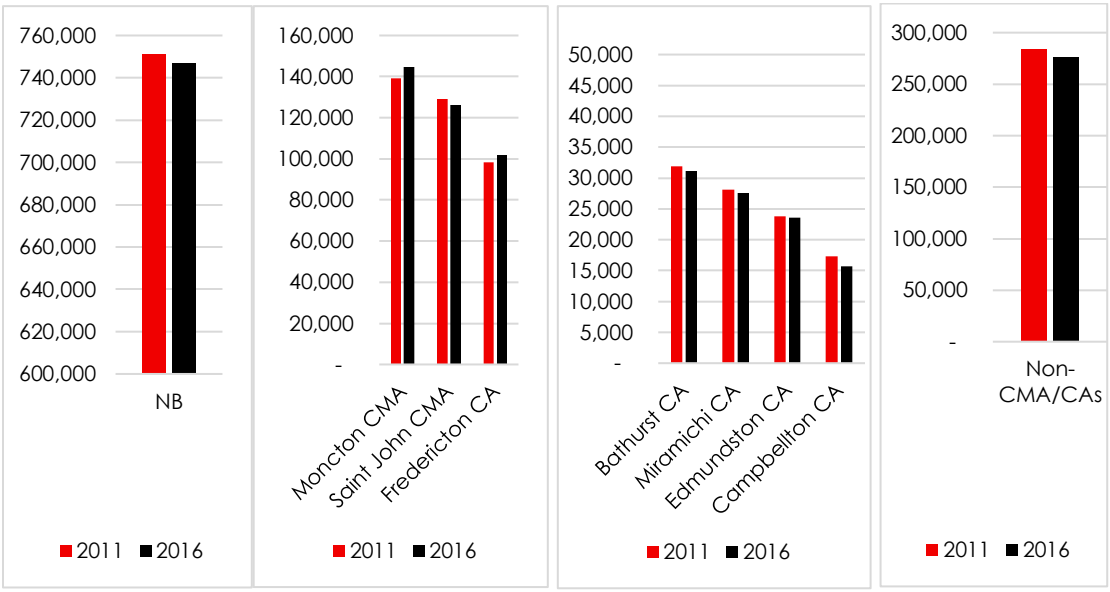
We were also provided with a complete list of events that would have disrupted access to public libraries in New Brunswick during the study period. (See Appendixes A and B for the events that occurred to public libraries in NB between 2010 and 2018). The list provided to us by the Government of New Brunswick includes events of disruption, change in access, and improvements that lasted more than one week. With these events, we can investigate how changes in access to library services impact the long-term use of libraries.

DESCRIPTIVE STATISTICS

1. Population in New Brunswick

We look at changes to the population in NB during the 2010-2018 study period, since population changes in the province can influence the use of public libraries. Statistics Canada, which collects population data every five years through a census, has the most recent data for illustrating population change in NB. Only 2011 and 2016 Census data are investigated, however, since other census years are simply out of the range of our 2010-2018 timespan.

Figure 1: NB Population, Total and by Census Area, 2011 & 2016



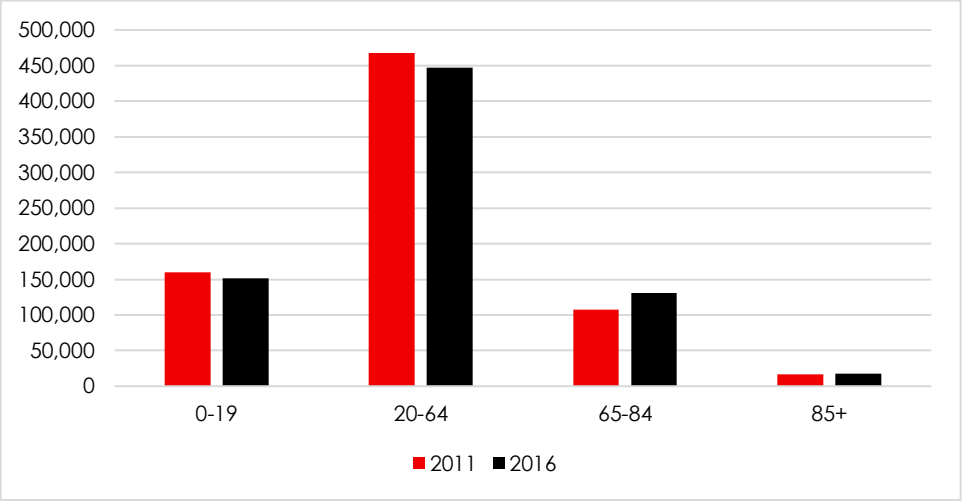
Source: Statistics Canada

In 2016, the population of NB was 747,101, which represents a change of -0.5% from 2011 population numbers. According to Statistics Canada (2016), NB is the only province in Canada that saw a population decline between 2011 and 2016, during which time the country's population grew at a national rate of 5.0%. The populations in the Moncton CMA and Fredericton CA both increased at a rate of 4% between the 2011-2016 intercensal period, while the Saint John CMA saw population decline at a rate of -2%. Overall, the population in the three largest Census Areas increased by 2%, with 6,108 more Canadians residing in these Census Areas in 2016 than in 2011. Over the same intercensal period, the populations in the remaining CAs and non-CMAs/CAs in the province all experienced declines.

We point out that around 37% of the NB population lived in non-CMA/CA areas during both censuses, which is more than double the national rate of 17% (Statistics Canada [StatCan], 2016). The number of persons living in the CMAs and CAs of the province accounted for around 63% of the population – again, lower than the national rate of 83% (StatCan, 2016).

NBjobs[6] completed a thorough analysis of the age distribution in the province between 2011 and 2016 and found that the number of New Brunswickers below the age of 20 and between the ages of 20 and 64 decreased by 5.2% and 4.5%, respectively. Meanwhile, the number aged 65-84 years increased by 22.4%, and the number over the age of 84 increased by 7.0%.

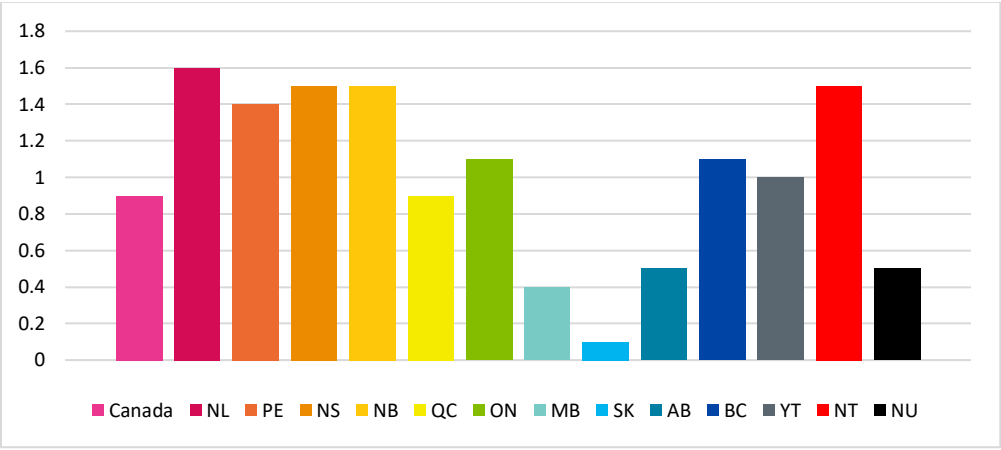
Figure 2: NB Population, by Age Group, 2011 & 2016



Source: Statistics Canada

Overall, the proportion of New Brunswickers under the age of 20 decreased by 1% between 2011 and 2016, and the proportion aged 20-64 decreased by 2.4%. The proportion aged 65-84 increased by 3.3%, and the proportion over the age of 84 increased by 0.2%. This confirms the trend of an aging population in New Brunswick between 2011 and 2016, when the province saw a smaller population below the age of 65 and a greater population over the age of 65.

Figure 3: Change in Average Age, by Province, 2011-2016

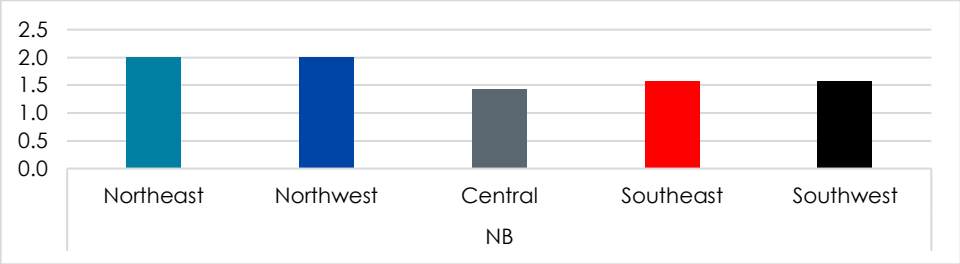


Source: NBjobs.ca

[6] NBjobs is an organization funded by the Government of Canada and the Province of New Brunswick through the Canada-New Brunswick Labour Market Development Agreement. It aims to provide job opportunities and employment-related training and research in NB.

According to the analysis conducted by NBjobs (2017), the average age in NB increased by 1.5 years (from 42.1 to 43.6) between 2011 and 2016, while the national average age grew by 0.9 years. This increase was only surpassed by Newfoundland and Labrador, and it was in line with the increases experienced in the other Atlantic provinces (NBjobs, 2017).

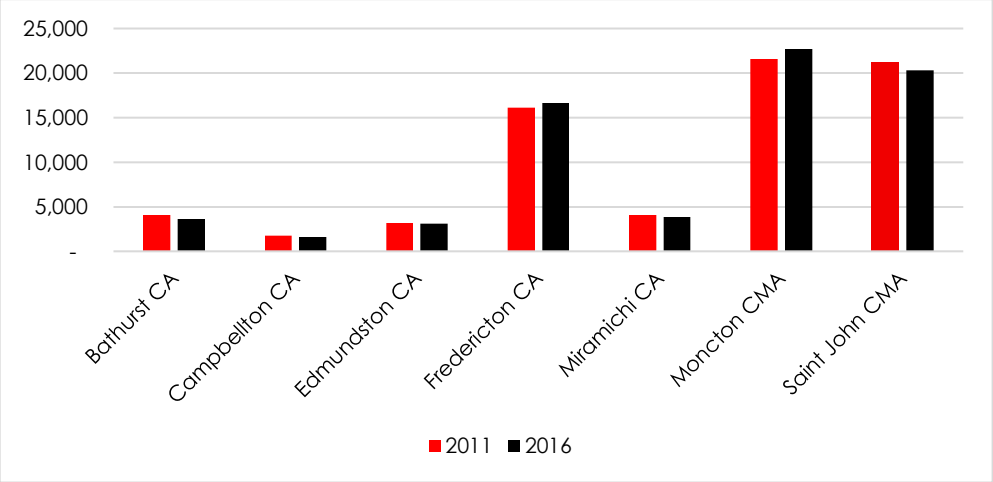
Figure 4: Change in Average Age in NB, by Region, 2011-2016



Source: NBjobs.ca

The average age of the population in Northern NB grew faster than in the central and southern parts of the province. Specifically, the average age in the north increased by 2 years during the intercensal period in question, while the average age in the south increased by 1.6 years, and the average age in central NB increased by 1.4 years.

Figure 5: Number of Youths (ages 0-14) in NB, by CMA/CA, 2011 & 2016



Source: NBjobs.ca

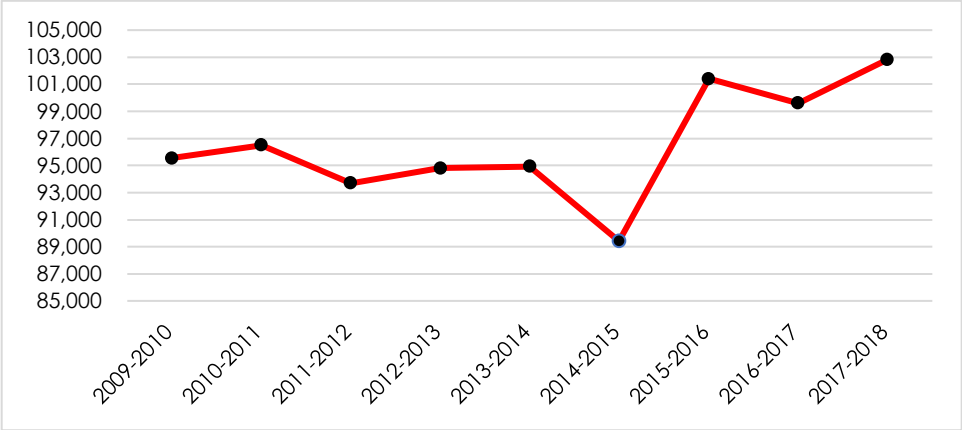
We also retrieved the number of youths (ages 0 to 14) in all NB CMAs/CAs for the 2011-2016 period. The three largest Census Areas in NB housed the largest number of youths, and Moncton and Fredericton were the only Census Areas to experience increases in the youth population.

2. The use of NB public libraries

Next, we investigate trends in the annual count of active borrowers from 2010 to 2018, as well as yearly and monthly counts of physical circulations from January 2010 to December 2018.

2.1 annual count of active borrowers

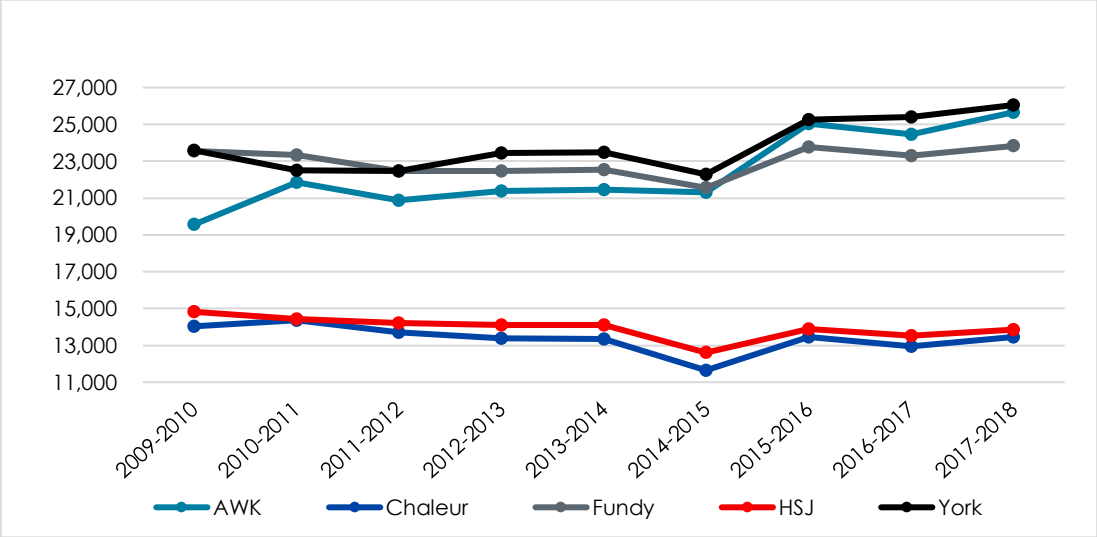
Figure 6: Active Borrowers in NB, 2010-2018



Source: Government of New Brunswick (GNB)

The total count of active borrowers for 63 public libraries in the province grew 8% from 95,534 in 2010 to 102,831 in 2018. Although the number of borrowers experienced an abrupt drop in 2014/15, the increase beginning in 2015/16 not only compensated for the previous decrease but also brought the number to a new high.

Figure 7: Active Borrowers in NB, by Region, 2010-2018



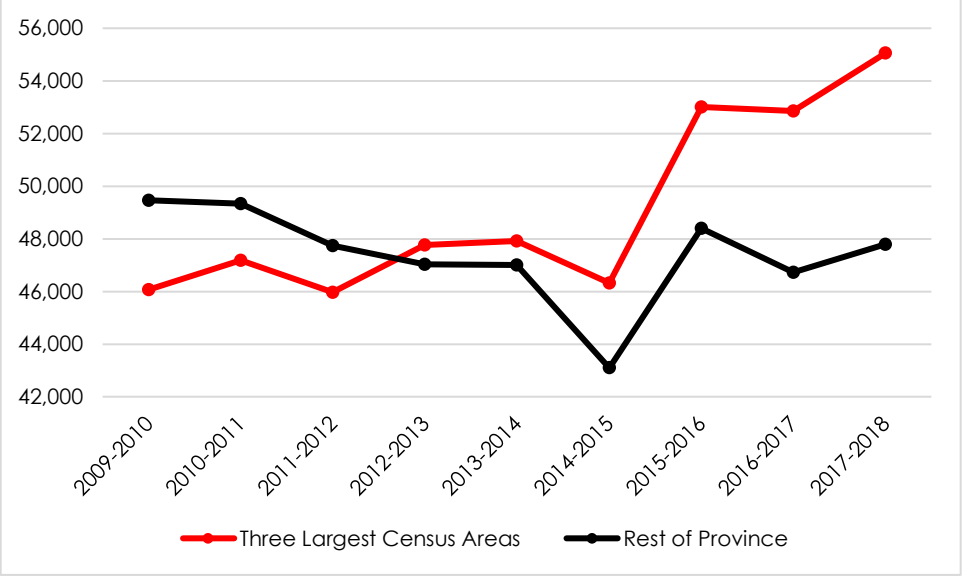
Source: GNB

The York, Fundy, and Albert-Westmorland-Kent (AWK) regions saw increasing numbers of active borrowers from local public libraries, whereas the Haut-Saint-Jean (HSJ) and Chaleur regions saw decreasing numbers.

The number of active borrowers in York increased by 10% from 23,590 to 26,050 between 2010 and 2018, while AWK saw an increase of 31% from 19,560 to 25,656, and Fundy saw a slight increase of 1%. The total number of active borrowers in Chaleur and HSJ decreased between 2010 and 2018 by 4% and 7%, respectively, from 14,024 and 14,821 active borrowers in 2010 to 13,452 and 13,846 in 2018.

During the 2014/15 period, every region except AWK experienced a significant decrease in the number of active borrowers. AWK, on the other hand, managed to maintain its numbers. In the following 2015/16 period, all regions experienced different levels of increase in the number of active borrowers – especially AWK, which saw the most significant growth in active borrowers.

Figure 8: Active Borrowers in NB, 3 Largest Census Areas vs. Rest of Province, 2010-2018



Source: GNB

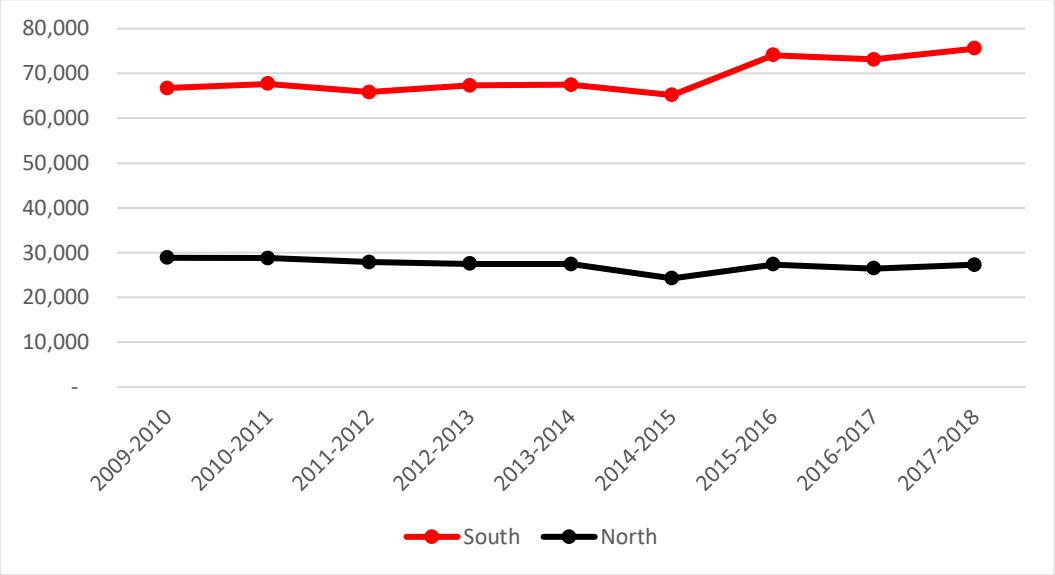
The three largest Census Areas in New Brunswick are the Moncton and Saint John CMAs and the Fredericton CA, in descending order of size. There are seven public libraries serving the Moncton CMA, five serving the Saint John CMA, and four serving the Fredericton CA.

The number of active borrowers in these three Census Areas increased by 19% from 46,070 to 55,047 between 2010 and 2018, while the number of active borrowers in the rest of the province decreased 3% from a total of 49,464 to 47,784. The annual count of active borrowers in the rest of the province was higher than that of the three largest Census Areas between 2010 and 2012. Since then, however, the number of active borrowers in the three largest Census Areas has surpassed the rest of the province, and the gap between them has continued to grow.

So far, we have learned that NB saw a significant decrease in active borrowers between 2014 and 2015, followed by a significant increase between 2015 and 2016. The 2014/15 decrease is explained by the greater reduction in the number of active borrowers in public libraries outside the three largest Census Areas, and the post-2015 increase is explained by the higher growth experienced by public libraries in the three largest Census Areas.

While the number of active borrowers in the three largest Census Areas has since continued to grow, the rest of the province recently experienced another significant decrease of 3% between 2016 and 2017.

Figure 9: Active Borrowers in NB, South vs. North, 2010-2018



Source: GNB

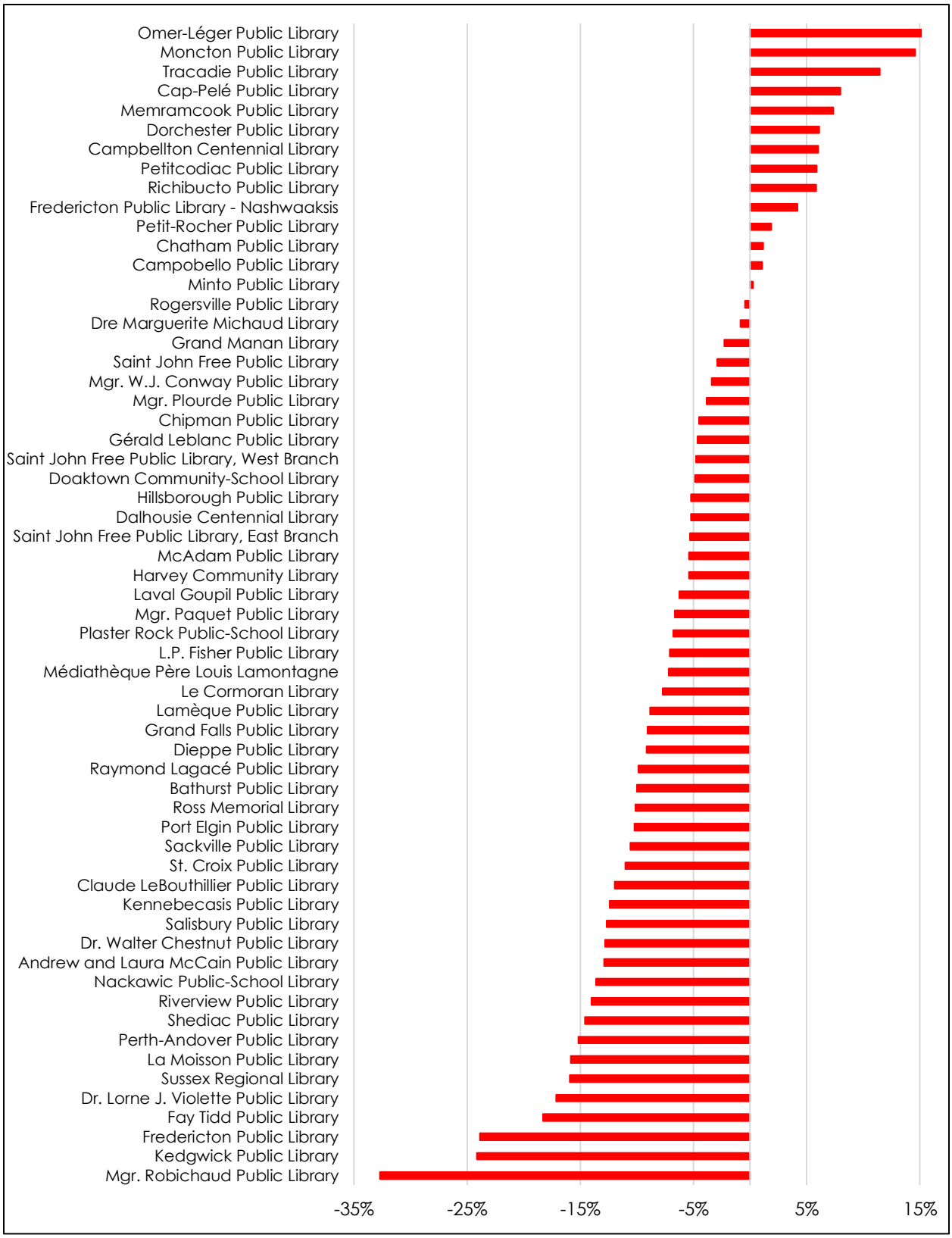
The York, Fundy, and AWK regions are in the southern part of New Brunswick, while HSJ and Chaleur are in the north. Unsurprisingly, southern NB houses more active borrowers than northern NB, since a greater portion of the NB population resides in the south.

In the south, the number of active borrowers increased from 66,689 in 2010 to 75,533 in 2018 (13%). Although Southern NB experienced some negative growth in active borrowers in both 2014/15 and 2016/17, the significant 14% increase from 65,164 to 74,065 between 2015 and 2016 contributed to an overall upward trend.

Northern NB, on the other hand, has shown a downward trend in the number of active borrowers, which decreased from 28,265 in 2010 to 27,298 in 2018 (-3%). There have been some fluctuations in this trend, with the northern part of the province seeing its most significant decrease (-12%) between 2014 and 2015, followed by a significant 13% increase in active borrowers the following year.

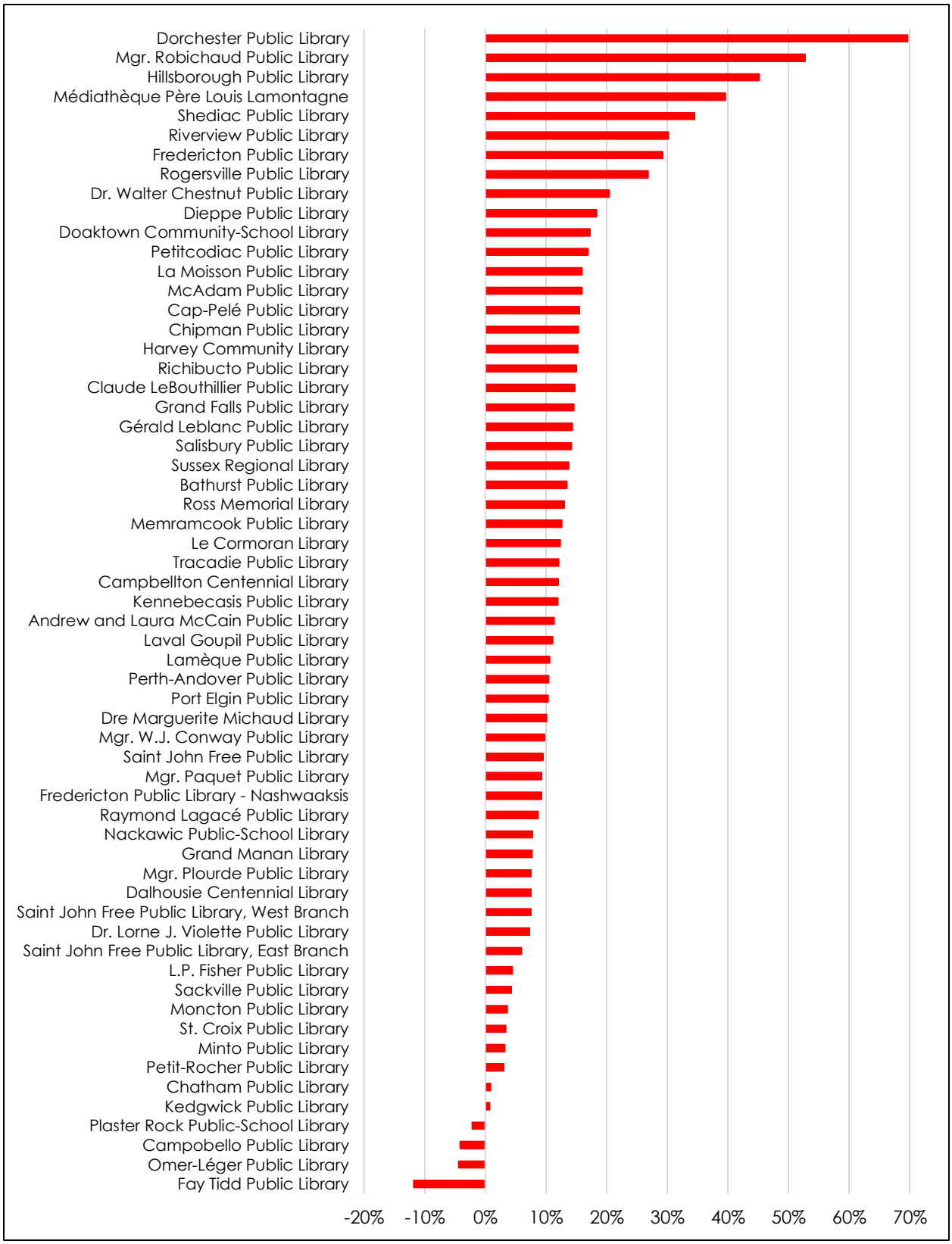
Since we have observed the abrupt drop in number of active borrowers during 2014/15 and a significant increase in the following 2015/16 period, we illustrate the percentage change in active borrowers per public library in these two specific timeframes to further investigate these trends.

Figure 10: Active Borrowers in NB, Percentage Change, 2014-2015



Source: GNB

Figure 11: Active Borrowers in NB, Percentage Change, 2015-2016



Source: GNB

Between 2014 and 2015, 46 public libraries experienced drops in the number of active borrowers, whereas 17 public libraries experienced unchanged numbers or increases. The libraries with the highest drops in number were Tracadie Public Library (-33%), Mgr. Plourde Public Library (-24%), and McAdam Public Library (-24%).

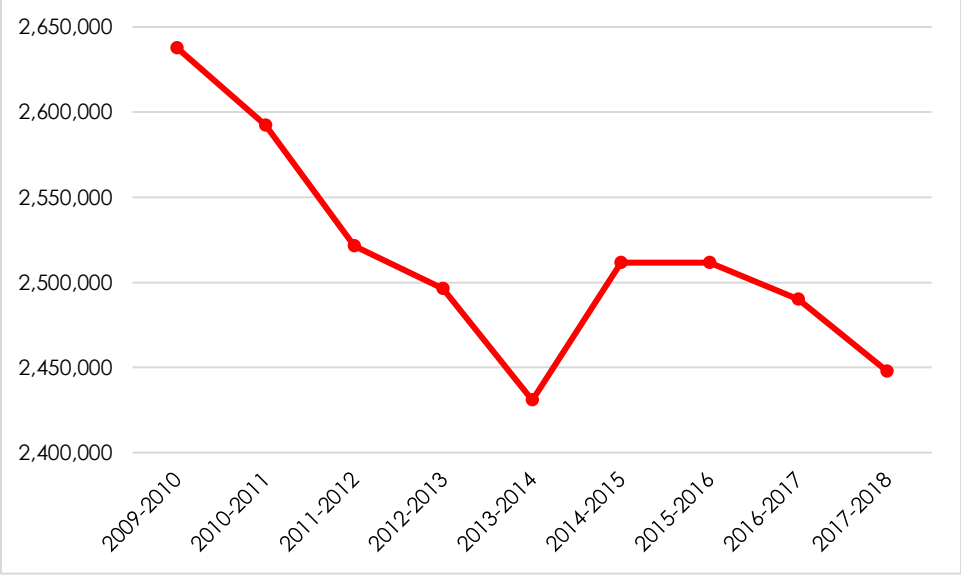
Only four public libraries experienced declines in the number of active borrowers between 2015 and 2016: Harvey Community Library (-12%), Richibucto Public Library (-4%), Le Cormoran Library (-4%), and Doaktown Community-School Library (-2%). Moreover, these declines seem to have been minor. We also note that Harvey Community Library and Doaktown Community-School Library were the only public libraries in NB to experience consecutive declines in the number of active borrowers in both 2014/15 and 2015/16. All other public libraries experienced different levels of increase in the number of active borrowers in 2015/16, with most seeing increases ranging from 1% to 20%, and 9 public libraries seeing increases of more than 20% up to 70%.

Aside from a few exceptions, we see that most increases in the number of active borrowers in public libraries in the 2015/16 period offset the decreases experienced in the previous 2014/15 period.

2.2 annual physical circulations

In analyzing the physical circulation of public library items and materials between 2010 and 2018, we consider time trends by both years and months.

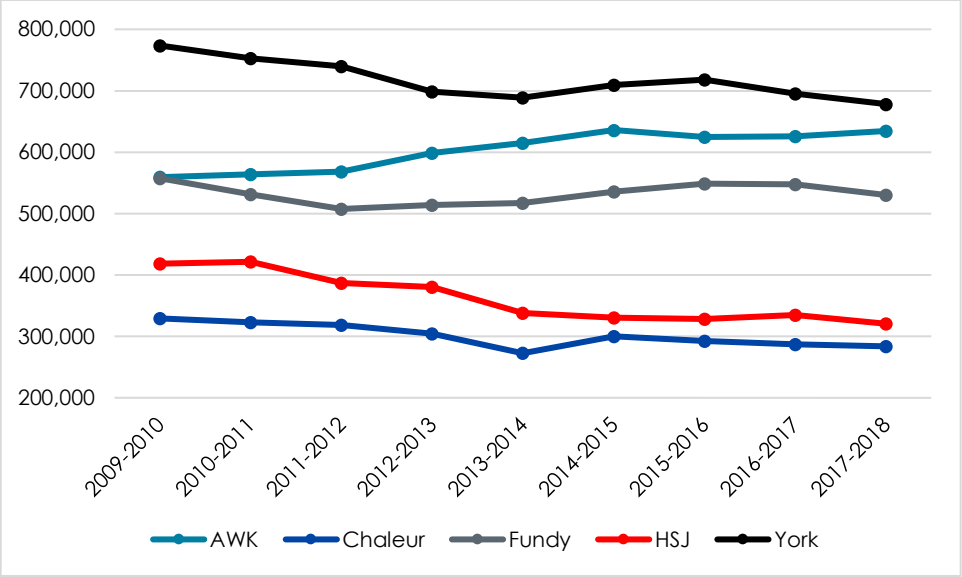
Figure 12: Physical Circulations of Public Library Materials in NB, 2010-2018



Source: GNB

The total volume of physical circulations of public library items has been decreasing over time with the exception of the period between 2014 and 2015, which saw a bump up that almost brought the total volume back to 2012 levels.

Figure 13: Physical Circulations of Public Library Materials in NB, by Region, 2010-2018



Source: GNB

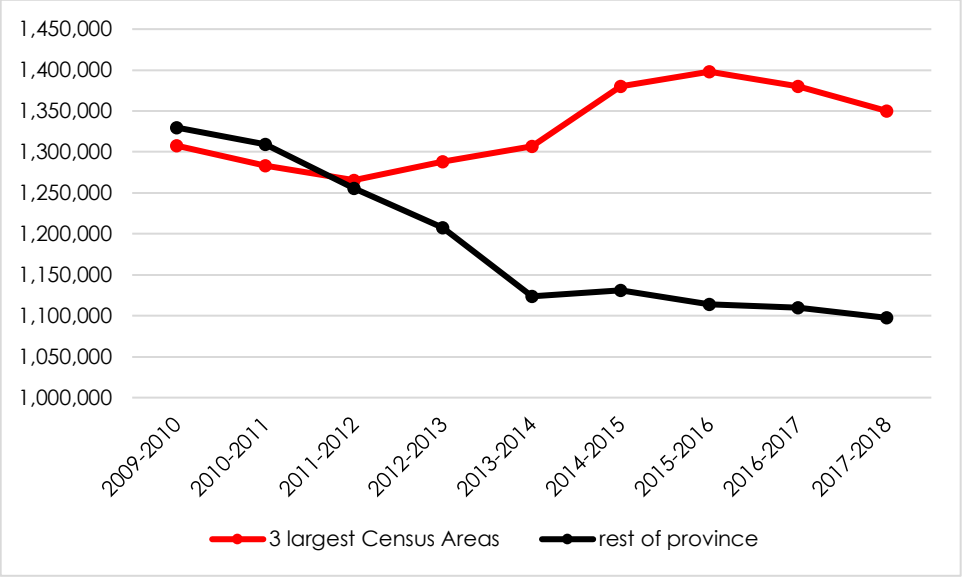
Between 2010 and 2018, AWK saw the physical circulation of library materials grow, while the other regions in NB experienced varying levels of decline. Physical circulations in AWK increased 13% from 559,268 to 634,614, and circulations in York declined 12% from 773,609 to 678,282.

Meanwhile, Fundy's circulations dropped 5% from 557,512 to 530,599; the number in HSJ dropped 23% from 418,140 to 320,583; and Chaleur saw a decrease of 14% from 329,272 to 283,519. The number of physical circulations in York was consistently higher than every other region between 2010 and 2018, while Chaleur, on the other hand, experienced the lowest.

The volume of physical circulations in the three largest Census Areas in NB increased between 2012 and 2016, while the rest of the province experienced a downward trend. Over the 2010-2018 study period, the number of physical circulations in the three largest Census Areas increased by 3%, growing from 1,308,002 to 1,350,172. The rest of the province saw a decrease of 17%, with the number falling from 1,329,799 to 1,097,425.

Initially, the number of physical circulations in the rest of province was higher than in the three largest Census Areas, but this gap closed in 2012 due to the decreasing rate of circulations in the rest of the province. Between 2012 and 2016, the gap increased once more, as the number of physical circulations in the three Census Areas surpassed the rest of the province. However, since 2016, the gap has been shrinking due to the decrease in the number of circulations in the three Census Areas.

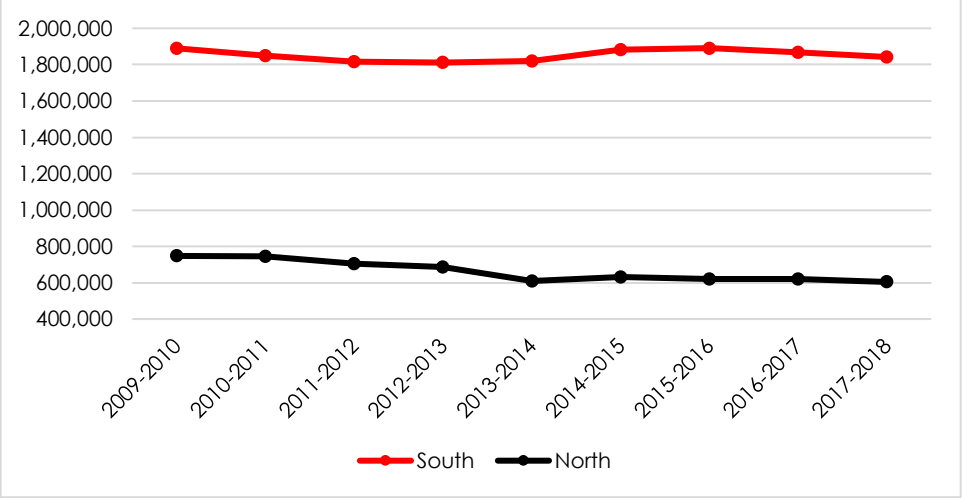
Figure 14: Physical Circulations of Public Library Materials in NB, 3 Largest Census Areas vs. Rest of Province, 2010-2018



Source: GNB

From 2010-2018, the volume of physical circulations in Southern NB was consistently at least twice as high as in the north, where continuing negative trends could still increase this gap.

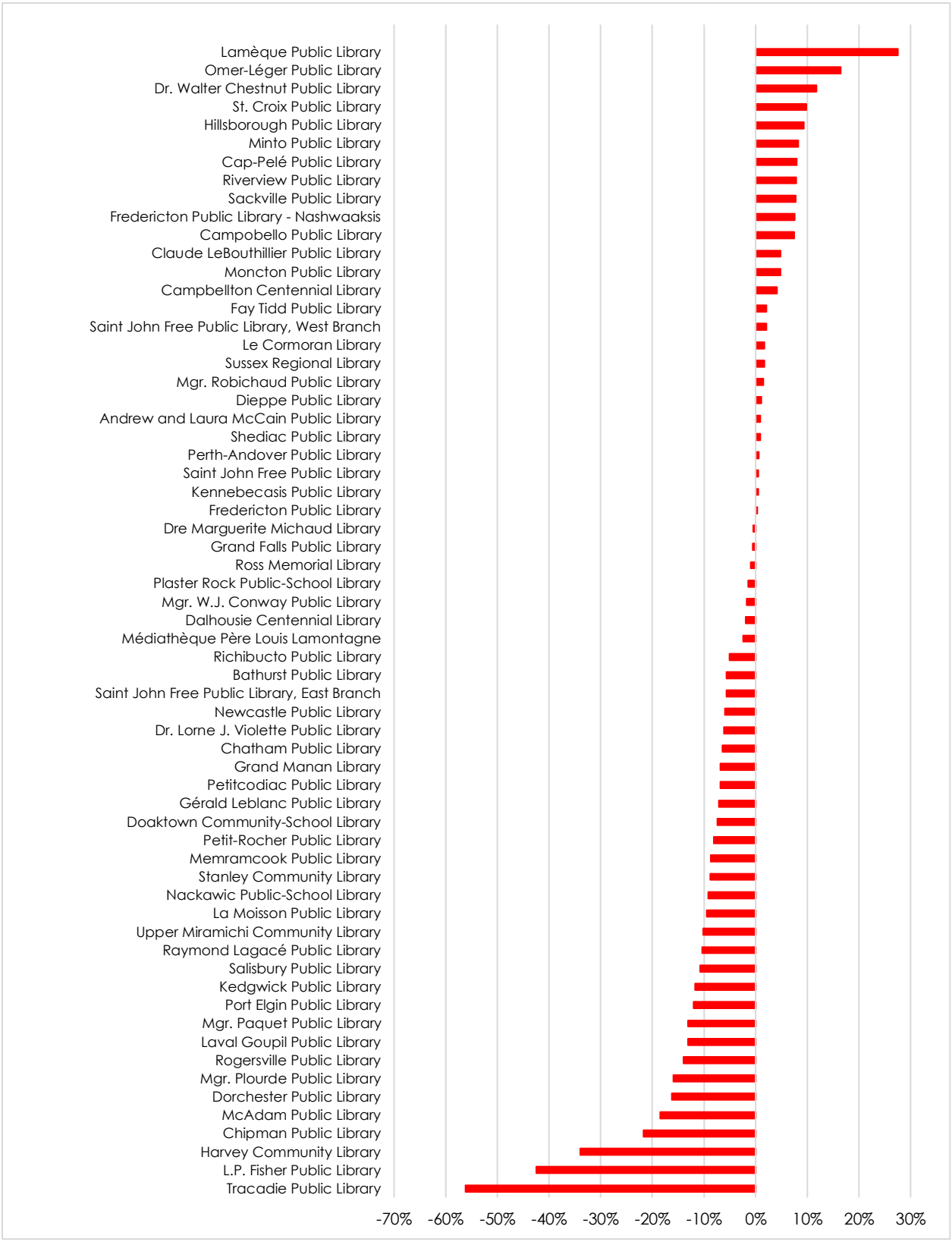
Figure 15: Physical Circulations of Public Library Materials in NB, South vs. North, 2010-2018



Source: GNB

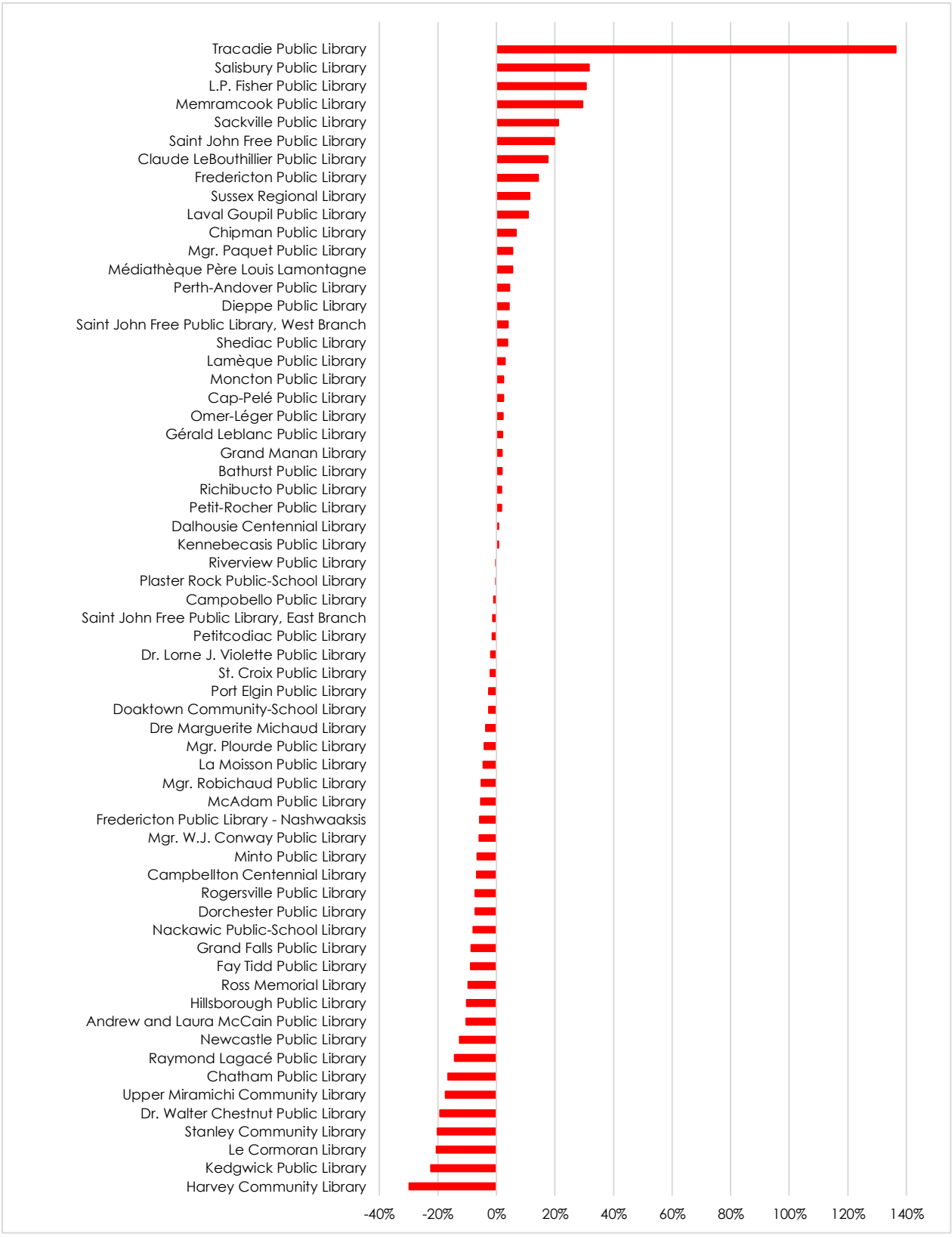
We also examine which public libraries were most greatly influenced by the yearly trends in 2013/14 and 2014/15. Overall, physical circulations in the province experienced a significant drop during the 2013/14 period and a large bump up in the 2014/15 period.

Figure 16: Physical Circulations of Public Library Materials, 2013-2014



Source: GNB

Figure 17: Physical Circulations of Public Library Materials, 2014-2015



Source: GNB

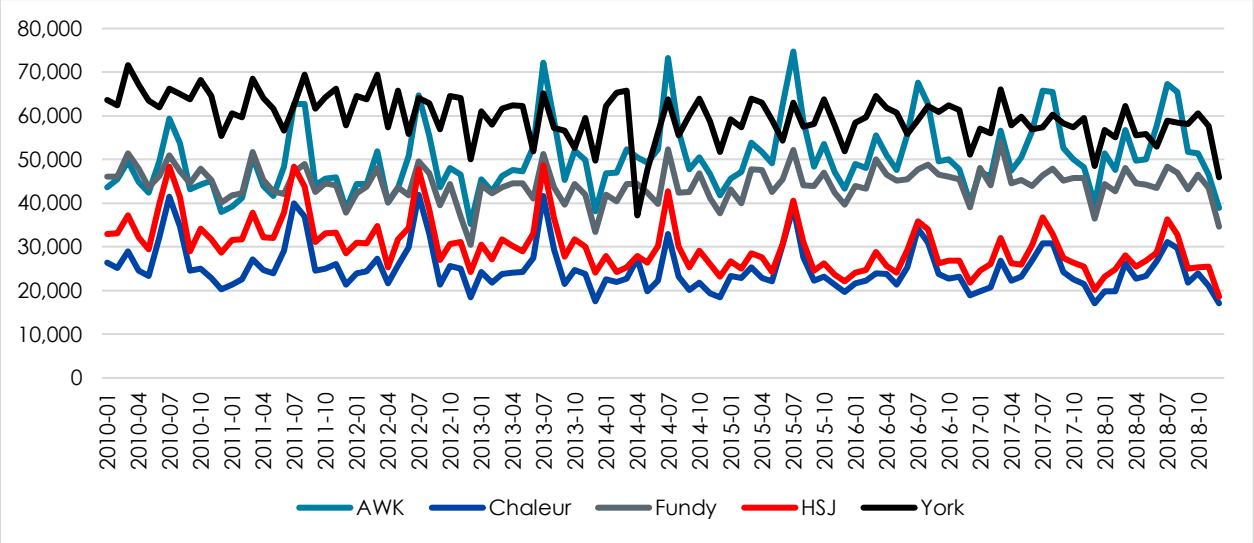
In 2013/14, 36 public libraries experienced a reduced number of physical circulations, and four public libraries saw no change in volume. The libraries that saw the largest reduction of physical circulations were Tracadie Public Library (-56%), L.P. Fisher Public Library (-42%), Harvey Community Library (-34%), and Chipman Public Library (-22%).

In the following period (2014/15), 30 public libraries saw unchanged or increasing volumes of physical circulations. Tracadie Public Library – which experienced a 56% reduction the previous year – saw the highest increase in volume by 136%. Meanwhile, Salisbury Public Library and L.P. Fisher Public Library – the latter of which had previously seen a 42% decrease – both experienced increases in physical circulations of more than 30%.

2.3 monthly physical circulations

From January 2010 to May 2013, the York region had the highest volume of physical circulations in NB, while Chaleur had the lowest. Since then, however, the number of physical circulations in the AWK region has surpassed that of York during the summer months, though the number of physical circulations in Chaleur has remained the lowest in the province.

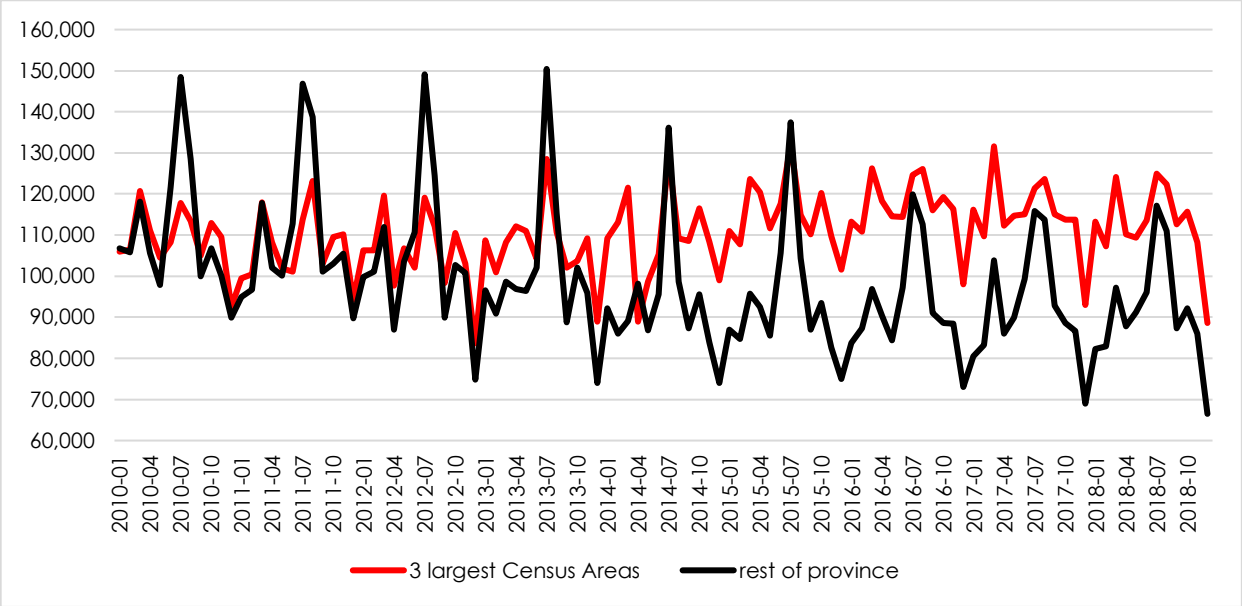
Figure 18: Physical Circulations of Public Library Materials in NB, by Region, January 2010-December 2018



Source: GNB

The volume of circulations in AWK, HSJ, and Chaleur show strong seasonal fluctuation, with more circulations in July and less in December, whereas York and Fundy show moderate fluctuation. Since 2014, the seasonality of circulations has decreased for Chaleur and HSJ – possibly due to a declining number of active borrowers and a shrinking population of youth using the libraries in the summer months.

Figure 19: Physical Circulations of Public Library Materials in NB, 3 Largest Census Areas vs. Rest of Province, January 2010-December 2018



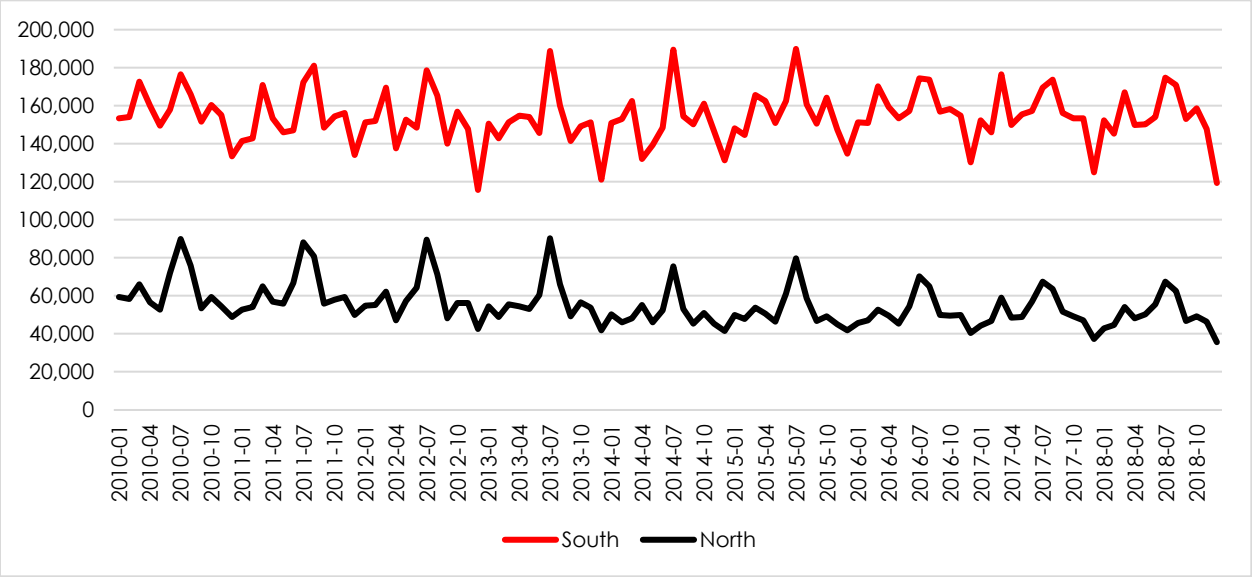
Source: GNB

Between 2010 and 2013, the rest of the province saw a higher volume of physical circulations than the three largest Census Areas in the months of June, July, and August. In 2014 and 2015, the rest of the province saw a higher volume of physical circulations in July, but the high demand did not continue afterward.

Although public libraries in the rest of the province still see seasonal demands for library materials, the fluctuations are moderate compared to before. We also note that physical circulations in the rest of the province have been decreasing in the winter months, especially in December.

Similar trends are found in public libraries in the three largest Census Areas, but their monthly fluctuations are more moderate compared to the rest of the province, suggesting the demand for physical materials is steadier in these areas.

Figure 20: Physical Circulations of Public Library Materials in NB, South vs. North, January 2010-December 2018



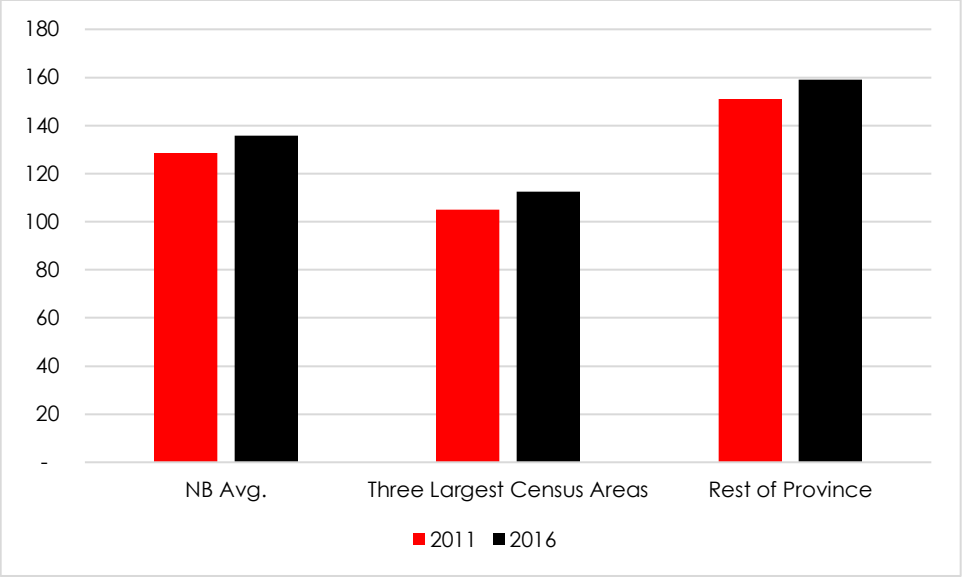
Source: GNB

The volume of physical circulations in public libraries in the south is consistently higher than in the north. Nonetheless, public libraries in both parts of the province experienced similar trends between January 2010 and December 2018. Libraries in both parts saw comparable fluctuations, implying that physical circulations increased between April and August and decreased between September and December every year. This indicates a seasonal demand for physical items throughout the province. However, seasonal fluctuation decreased after 2015 in Northern NB.

2.4 rate of active borrowers per thousand local residents, rate of physical circulations per active borrower

We divide the volume of physical circulations by active borrowers in NB to calculate the rates of physical circulations per active borrower from 2010 to 2018. By incorporating 2011 and 2016 Census data, we are also able to derive the rates of active borrowers per thousand local residents.

Figure 21: Rate of Active Borrowers Per Thousand Local Residents, 2011 & 2016



Source: GNB and Statistics Canada

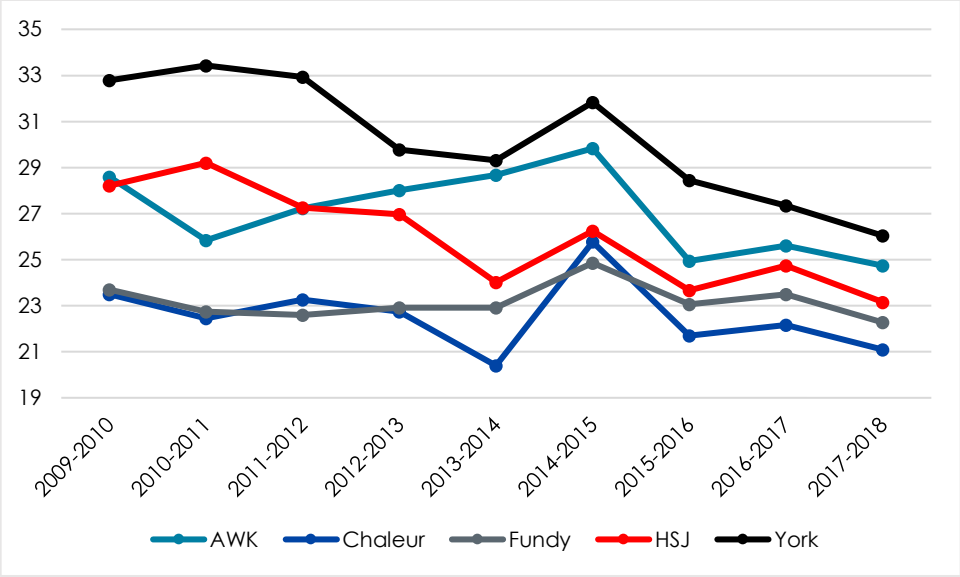
The rate of active borrowers per thousand local residents measures the intensity of public library usage in NB in 2011 and 2016. The number of active borrowers per thousand New Brunswickers increased from 128 to 136 during the intercensal period at the provincial rate of 6%, indicating that there were eight more active borrowers per every thousand in 2016 than in 2011.

The number of active borrowers per thousand local residents has always been lower in the three largest Census Areas than in the rest of the province, although the former has a higher rate of growth (7%) than the provincial rate (6%). Specifically, there were 105 active borrowers per thousand in the three largest Census Areas in 2011, and 112 in 2016, while the number for the rest of the province increased from 151 to 159.

Between 2010 and 2018, all regions in NB experienced declines in the rate of physical circulations per active borrower. Specifically, York saw the rate decline from 33 circulations to 26; AWK saw a decrease from 29 to 25; HSJ saw a decline from 28 to 23; Fundy's rate decreased from 24 to 22; and Chaleur saw a decline from 23 to 21. Apart from AWK, every region saw a decline in the rate of physical circulations per active borrower between 2010 and 2014.

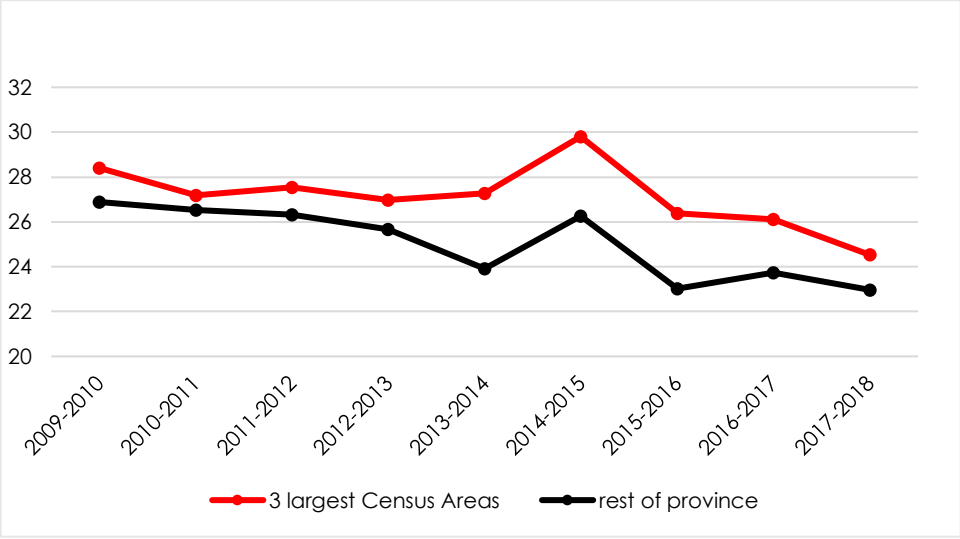
AWK followed a trend similar to the other regions post-2014, when the rate increased (particularly in Chaleur) and then decreased again in 2015/16. After 2016, minor rate decreases occurred in all regions except AWK, which maintained the same rate.

Figure 22: Rate of Physical Circulations Per Active Borrower in NB, by Region, 2010-2018



Source: GNB

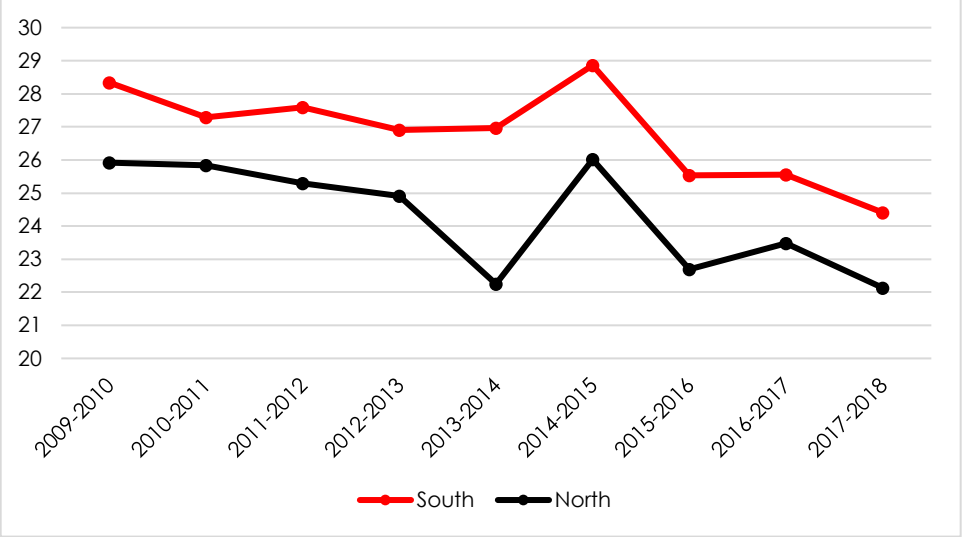
Figure 23: Rate of Physical Circulations Per Active Borrower in NB, 3 Largest Census Areas vs. Rest of Province, 2010-2018



Source: GNB

The rate of physical circulations per active borrower in NB was at a minimum of 23 between 2010 and 2018. During this time, the rate in the three largest Census Areas was consistently higher than in the rest of the province. Both rates follow similar trends, though, showing significant increases between 2014 and 2015 and decreases between 2015 and 2016. The bump up in the rates of physical circulations per active borrower in 2014/15 can be explained by the declining number of active borrowers, accompanied by the increasing number of physical circulations in and outside the three largest Census Areas during this period. The reduced rates in 2015/16 are explained by the significant increases in the number of active borrowers for public libraries both in and outside the three largest Census Areas.

Figure 24: Rate of Physical Circulations Per Active Borrower in NB, South vs. North, 2010-2018



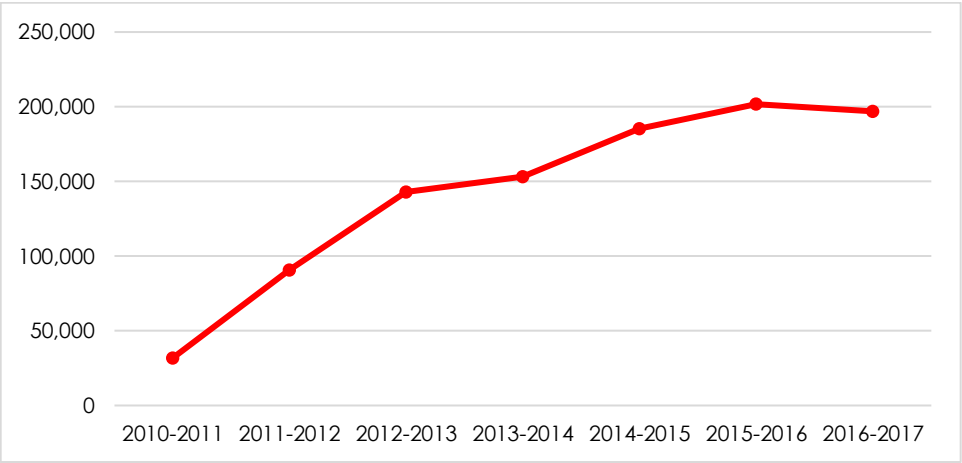
Source: GNB

The rate of physical circulations per active borrower in the south of the province remained higher than in the north throughout the study period. However, the rate has simultaneously dropped for both parts of the province. Southern NB saw the rate decrease from 28 to 24, and Northern NB saw a decline from 26 to 22. These rates dropped dramatically between 2013 and 2014 in Northern NB, after which both southern and northern parts of the province saw increases between 2014 and 2015, followed by decreases between 2015 and 2018.

2.5 electronic circulations and total circulations

We also examined the total count of electronic circulations of eBooks and eAudiobooks in the province. The data for this has been recorded since the launch of Electronic Library New Brunswick in December 2010, and it extends to March 2018.

Figure 25: Annual Electronic Circulations in NB, 2011-2017

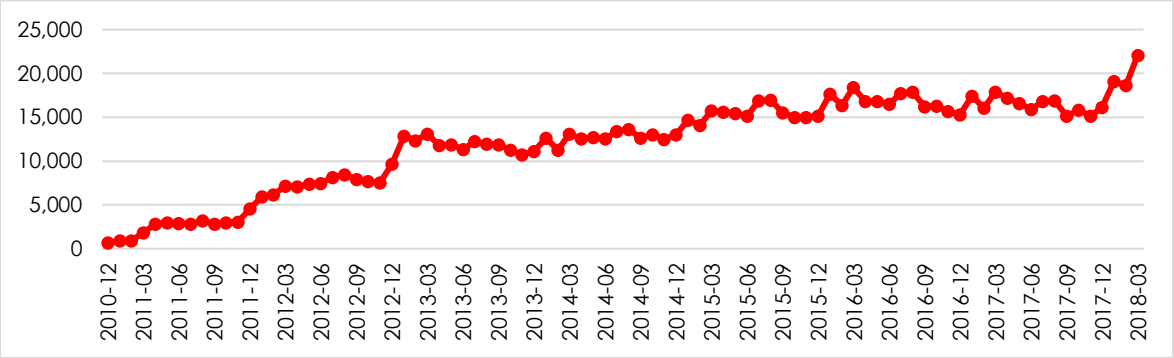


Source: GNB

From 2011 to 2017, the total volume of circulated electronic materials increased from 31,845 to 197,032. That is, approximately 505 electronic materials were circulated per library in 2011, and

that number increased to 3,127 per library in 2017. The volume of electronic circulations grew consistently between 2011 and 2016, though growth slowed after 2012.

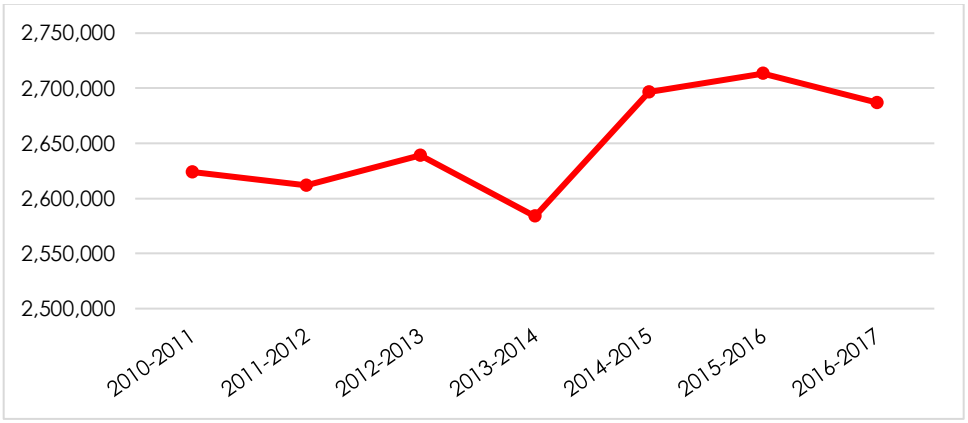
Figure 26: Monthly Electronic Circulations in NB, December 2010-March 2018



Source: GNB

The monthly trend reveals no seasonality in the use of electronic library materials in the province. Overall, the use of electronic library materials represents a small percentage of overall circulations. The public continues to borrow primarily physical collections, and the growth of electronic borrowing remains stable.

Figure 27: Total Physical & Electronic Circulations in NB, 2011-2017



Source: GNB

Between 2011 and 2017, the volume of total circulations increased by 2%, followed by a significant decrease between 2013 and 2014 and a dramatic increase between 2014 and 2015. The significant decrease between 2013 and 2014 was driven by the same factors affecting declines in physical circulations during the same period.

REGRESSION ANALYSIS

In preparation for OLS regression, we created a set of event indicator variables to account for disruptions and/or changes in library access during the study period. Of the examined disruptors, the testable occurred events include the following variables: ***building new facility***, ***changing location***, ***renovation***, ***expansion***, ***open-7-days pilot***, ***closure due to construction***, and ***closure due to weather***. Other occurred events were omitted from the analysis due to insufficient observations or non-variations across libraries, which undermined our ability to separate the effect of the disruption from other events that happened in the same period. All models account for library fixed effects (unobserved time invariant influences on specific libraries) and year effects (unobserved influences common to all libraries in a given year).

On the measures of active borrowers

Our results suggest that the events accounted for in our statistical models did not significantly impact the number of active borrowers on an individual library level, although the open-7-days pilot,[7] expansion, building new facility, and renovation events increased the number of active borrowers between 2010 and 2018, in descending order of impact. The numbers of active borrowers that decreased because of closure due to construction or weather were not as significant on an individual library level.

The coefficients of time variables reveal that, on average, NB public libraries experienced significant decreases in the number of active borrowers in 2012 and 2015. These reduced numbers are also significant in terms of our scale measure of active borrowers. Public libraries in NB experienced significant growth in the number of active borrowers in 2016 and 2018 by 0.17% and 0.10%, respectively. Further details are available in Appendix C.

The indicator for the public libraries located in the three largest Census Areas in NB[8] reveals that the difference in the numbers of active borrowers across regions is significantly impacted by whether a region contains the Moncton CMA, Saint John CMA, and/or Fredericton CA. For instance, the York, AWK, and Fundy regions saw significantly more active borrowers on average than the Chaleur and HSJ regions.

The open-7-days pilot, renovation, and expansion events significantly attracted thousands of active borrowers to public libraries across regions. In particular, the open-7-days pilot program, which was instituted in five NB public libraries, resulted in approximately 4,618 more active borrowers on the regional level. No occurred events seem to have significantly decreased the number of active borrowers across NB on a regional level.

Finally, our results also suggest that York has a relatively high number of active borrowers, and AWK has the lowest number of active borrowers in the province, with a significant difference between their numbers. On the regional level, there was a significantly smaller number of active borrowers post-2017. Further details are available in Appendix E.

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[7] The five NB public libraries participating in this pilot policy are the Moncton Public Library, Campbellton Centennial Library, Saint John Free Public Library - Central Branch, Mgr. W.J. Conway Public Library (Edmundston), and Fredericton Public Library.

[8] Moncton, Saint John, and Fredericton

On the measures of physical circulations

Regarding measures of the physical circulation of library items, the open-7-days pilot significantly increased the volume of physical circulations by approximately 984 items per library. Closure due to construction significantly decreased physical circulations by around 2,641 items per library – a reduction that was significant even with respect to the average growth rate of the volume of physical circulations.

Public libraries in the province saw significantly lower numbers of circulations between 2010 and 2018, with the decline accounting for 0.03% in 2010 and 0.20% in 2018. Our results suggest the circulation of public library items in the province is seasonal, since public libraries on average saw significantly more circulations in March, June, August, and October and significantly less in February and December – especially in December, when the holiday season kicks off. Further details are available in Appendix D.

The open-7-days pilot, expansions, and renovations significantly increased the volume of physical circulations for libraries in each region, in descending order of impact. Meanwhile, closure due to construction and changing location both significantly decreased the volume of physical circulations on the regional level. York had the most circulations on average in the province, whereas AWK had the least. All regions saw significantly more circulations in the month of July and fewer in December.

The time trends confirm that public libraries across regions in NB saw significantly fewer physical circulations between 2013 and 2018.

SUMMARY AND DISCUSSION

The number of active borrowers in NB grew by 8% between 2010 and 2018, with the most significant drop in numbers occurring between 2014 and 2015, followed by the most significant increase between 2015 and 2016. Public libraries in the south saw increasing numbers of active borrowers in local public libraries between 2010 and 2018, whereas Northern NB saw decreasing amounts, which could be explained by the fact that the population in the north is aging faster than in the south.

The three largest Census Areas in the province saw an increasing number of active borrowers between 2010 and 2018, whereas the rest of the province saw a decline. The large drop in the number of active borrowers between 2014 and 2015 is a one-year disruptor outside of the three largest Census Areas. Meanwhile, the post-2015 increase in active borrowers in the province is explained by the significant increase seen in the three largest Census Areas.

In terms of physical circulations, the total volume has been decreasing over time except for the period between 2014 and 2015, which saw an increase in volume. Over the 2010-2018 study period, only the AWK region saw an increased volume of physical circulations, while all other regions experienced a decrease. The number of physical circulations in the three largest Census Areas has been surpassing that in the rest of the province since 2012. However, the rate of active borrowers per thousand local residents is still highest outside the three largest Census Areas.

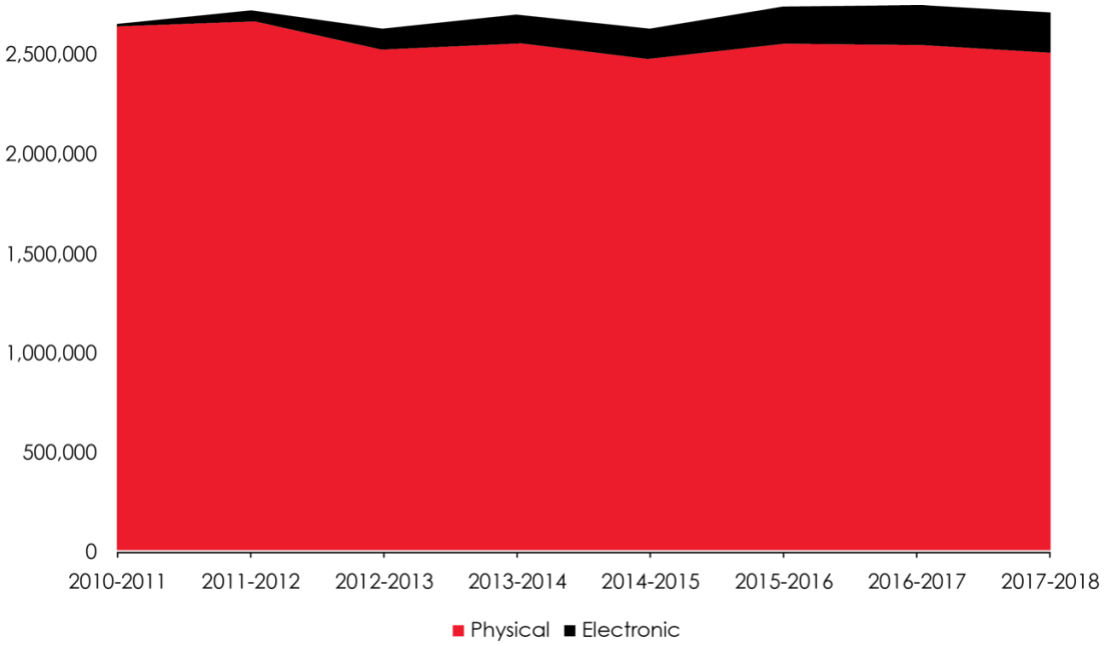
Regression results confirm that there has been a post-2015 "bump up" in the use of NB public libraries; however, this growth is not significant in terms of the number of active borrowers but in terms of the annual percentage increase of active borrowers. The post-2015 bump is shown to have significantly increased the number of circulations of materials for NB public libraries.

The regression results illustrate that events of disruption or improvement explain only a small portion of the trends of use for NB public libraries. While taking all measures into consideration, the results indicate that the changed demand for NB public libraries is not largely driven by the occurred disruptions or improvements. However, changes in access by opening the five pilot libraries seven days a week and opening all NB public libraries on Saturday had the most significant impacts on increasing the use of NB public libraries.

In general, we did not see a significant increase or decrease in the number of active borrowers over the study period except for in the years after 2015, which indicates that the number of active borrowers is not influenced by occurred disruptions and improvements, and the demand for NB public libraries in terms of the number of active borrowers is largely driven by population growth in the south. Meanwhile, the rates of active borrowers and physical circulations in the north are surprisingly resilient against population decline, with the rate of active borrowers higher outside the largest Census Areas. We see significant increases in the number of circulations by active borrowers, which is the result of opening the pilot libraries seven days a week and opening all public libraries on Saturdays.

The demand for physical items is shown to be seasonal, with more physical circulations seen during the summer and fewer during the winter. The summer months – especially July – see a significant increase in NB public library use on average, whereas libraries see less use in the month of December. However, seasonal fluctuations have declined post-2015. Although the number of physical circulations decreased over time, the launch of the electronic library in the province augmented the total volume of circulations between 2011 and 2017. The public continues to borrow primarily physical collections, and the growth of electronic borrowing remains stable.

Figure 28: Total Physical and Electronic Circulations in NB, 2011-2017



The significant increase in library use between 2015 and 2016 could be associated with the December 2014 introduction of the limited circulation card for patrons who cannot provide proof of address, as well as the elimination of overdue fines in November 2015 for children aged 12 and under. Further, post-2015 growth in the number of active borrowers in the south could be due to the recent policy instituting Saturday access for all public libraries and Sunday access for five pilot libraries.

The disruptors that occurred to public libraries in NB between 2010 and 2018 did not significantly influence measures of active borrowers on an individual library level. However, on the regional level, the open-7-days pilot, renovations, and expansions significantly attracted thousands of active borrowers to each region, while no events were found to have decreased active borrowers. The open-7-days pilot has proven to be a good policy that significantly increased the volume of physical circulations on both an individual library level and on the regional level, whereas closure due to construction significantly decreased physical circulations on both levels. Although closure due to construction has significantly impacted the volume of physical circulations, certain NB public libraries underwent projects without closing, and we encourage all public libraries in NB to try to do the same.

Overall, we find remarkable stability and growth in the use of public library services in New Brunswick despite the context of an aging population, economic stagnation, slow population growth, and technological and social changes. We attribute these trends to policy decisions and innovations regarding library access and services.

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APPENDIX

Appendix A. Event Variable Labels

Event Occurrence	Event Variable Label "1"	Event Variable Label "0"
New Facility	Period(s) of/after occurrence	Period(s) before occurrence
Renovation	Period(s) of/after occurrence	Period(s) before occurrence
Expansion	Period(s) of/after occurrence	Period(s) before occurrence
Changing Location	Period(s) of/after occurrence	Period(s) before occurrence
Closure Due to Construction	Period(s) of associated closure	Period(s) before/after closure
7-Day Library Access*	All periods as of effective date	All periods before effective date
Saturday Library Access	All periods as of effective date	All periods before effective date
Non-City Book Mobile	All periods prior to discontinuation	All periods as of discontinuation date
Non-City Book-By-Mail	All periods during/after effective date	All periods before effective date
Closure Permanently	All periods since declaration date	All periods preceding declaration date
Closure Due to Weather	The period(s) of occurrence only	All periods before/after occurrence

*These variables only apply to the five pilot libraries: Moncton Public Library, Campbellton Centennial Library, Saint John Free Public Library - Central Branch, Mgr. W.J. Conway Public Library (Edmundston), and Fredericton Public Library.

Appendix B. Model Specification

Libraries Fixed Effects:

number of active borrowers / scale measure of number of active borrowers / growth rate of number of active borrowers $= \alpha + \beta years_t + \delta_1$ *larger Census Area indicator* $+ \delta_2$ *building new facility* $+ \delta_3$ *changing location* $+ \delta_4$ *renovation* $+ \delta_5$ *expansion* $+ \delta_6$ *open 7 days pilot+* δ_7 *closure due to construction* $+ \delta_{10}$ *closure due to weather* $+ \theta + e_{it}$

volume of physical circulations / scale measure of volume of physical circulations / growth rate of volume of physical circulations $= \alpha + \beta_1$ *years* $+ \beta_2$ *months* $+ \delta_1$ *larger Census Area indicator* $+ \delta_2$ *building new facility* $+ \delta_3$ *changing location* $+ \delta_4$ *renovation* $+ \delta_5$ *expansion +* δ_6 *open 7 days pilot+* δ_7 *closure due to construction* $+ \delta_{10}$ *closure due to weather* $+ \theta + e_{it}$

Region Fixed Effects:

number of active borrowers / scale measure of number of active borrowers / growth rate of number of active borrowers $= \alpha + \beta years_t + \delta_1$ *larger Census Area indicator* $+ \delta_2$ *building new facility* $+ \delta_3$ *changing location* $+ \delta_4$ *renovation* $+ \delta_5$ *expansion* $+ \delta_6$ *open 7 days pilot+* δ_7 *closure due to construction* $+ \delta_{10}$ *closure due to weather +* δ_{11} *regions* $+ e_{it}$

volume of physical circulations / scale measure of volume of physical circulations / growth rate of volume of physical circulations $= \alpha + \beta_1 years_t + \beta_2$ *months* $+ \delta_1$ *larger Census Area*

indicator + δ_2 building new facility + δ_3 changing location + δ_4 renovation + δ_5 expansion + δ_6 open 7 days pilot+ δ_7 closure due to construction + δ_{10} closure due to weather + δ_{11} regions+ e_{it}

where

* Events dropped due to no variation:
  - ***Open Saturday*** for all public libraries in June 2016
  - ***Book Mobile Service*** offered by NB public libraries across the province, which discontinued in May 2015
  - ***Book Mobile Replacement*** which aims to offer mailing service for previous book mobile service users
  - ***Book by Mail*** offered to all NB residents who cannot visit a library (e.g., due to lack of transportation, illness, disability)
  - ***Electronic Library NB*** offered to all people who have library cards in December 2010
  - ***Limited Circulation Card*** offered by all NB public libraries for patrons who cannot provide address in December 2014
  - ***Elimination of Overdue Fines*** for children 12 and under, offered by all the public libraries in the province in November 2015
  - ***Two Membership Drives*** by NBPLS: one targeted at Department of Post-Secondary Education, Training and Labour employees in June 2017; the other targeted at Government of New Brunswick employees in October 2017

* Events dropped due to too few observations:
  - ***New Opening***, which was only applicable to Cap-Pelé Public Library and Rogersville Public Library in 2009
  - ***Temporary Closure of Public Library***, which only happened to Port Elgin Public Library in August 2017

* the testable occurred events include ***building new facility***, ***changing location***, ***renovation***, ***expansion***, ***open 7 days pilot***, ***closure due to construction***, and ***closure due to weather***, where δ is the average impact of these events on the measures of library uses
* $years_t$ or $months_t$ are the time trends, and β is the average impact of the time variables
* θ represents libraries fixed effects while regions fixed effects are tested by controlling regions and using York region as reference group
* e_{it} is the error term
* α is the intercept
* the year 2010 and month of January are omitted for avoiding perfect collinearity

Appendix C. Libraries Fixed Effects – Measures of active borrowers

	# of obs:	566	# of obs:	566	# of obs:	503
	# of groups:	63	# of groups:	63	# of groups:	63
	R-sq		R-sq		R-sq	
	within	0.3017	within	0.1198	within	0.1969
	between	0.3512	between	0.0012	between	0.0457
	overall	0.1467	overall	0.0035	overall	0.1790

	Measure 1		**Measure 2**		**Measure 3**	
	Y= # of Active Borrowers		Y= Ln (Active Borrowers)		Y= ΔLn (Active Borrowers)	
	Coef.	P>t	Coef.	P>t	Coef.	P>t
largest Census Areas	omitted	omitted	omitted	omitted	omitted	omitted
building new facility	221	0.432	0.20	0.258	-0.05	0.155
changing location	-241	0.322	-0.20	0.189	-0.01	0.744
renovation	2	0.984	-0.08	0.111	-0.04	0.302
closure due to construction	-172	0.093	-0.02	0.574	0.00	0.983
closure due to weather	-463	0.158	-0.32	0.354	-0.39	0.231
open 7 days pilot	717	0.091	0.07	0.136	0.03	0.086
expansion	497	0.066	0.07	0.246	0.02	0.373
_cons	1521	0.000	6.85	0.000	-0.04	0.001
2011	12	0.612	-0.03	0.208	0.02	0.455
2012	**-43**	0.027	**-0.03**	0.018	0.04	0.081
2013	-22	0.377	**-0.03**	0.040	**0.04**	0.011
2014	-44	0.099	**-0.03**	0.038	**0.05**	0.001
2015	**-131**	0.000	**-0.10**	0.000	-0.02	0.311
2016	51	0.201	0.03	0.256	**0.17**	0.000
2017	-26	0.556	-0.02	0.629	omitted	omitted
2018	59	0.275	0.03	0.463	**0.10**	0.000

Appendix D. Libraries Fixed Effects – Measures of physical circulations

	# of obs:	6804	# of obs:	6789	# of obs:	6726
	# of groups:	63	# of groups:	63	# of groups:	63
	R-sq		R-sq		R-sq	
	within	0.2102	within	0.2736	within	0.1943
	between	0.0542	between	0.0004	between	0.0075

	overall	0.0360	overall	0.0185	overall	0.1805
	Measure 1		**Measure 2**		**Measure 3**	
	Y= # of Physical Circulations		Y= Ln (Physical Circulations)		Y= △Ln (Physical Circulations)	
	Coef.	P>t	Coef.	P>t	Coef.	P>t
largest Census Areas	omitted	omitted	omitted	omitted	omitted	omitted
building new facility	-922	0.342	**-0.72**	0.039	-0.17	0.263
changing location	-249	0.563	0.07	0.605	0.08	0.051
renovation	-179	0.313	-0.03	0.695	0.01	0.141
closure due to construction	**-2641**	0.009	**-1.32**	0.000	**-0.31**	0.001
closure due to weather	-258	0.238	0.00	0.939	-0.12	0.132
open 7 days pilot	**984**	0.004	**0.16**	0.002	0.00	0.547
expansion	284	0.489	0.01	0.939	0.01	0.279
_cons	3422	0.000	7.64	0.000	0.16	0.000
2011	-66	0.084	**-0.03**	0.023	0.00	0.576
2012	**-160**	0.008	**-0.04**	0.028	**-0.01**	0.007
2013	**-195**	0.025	**-0.08**	0.001	0.00	0.931
2014	**-237**	0.005	**-0.12**	0.000	0.01	0.200
2015	-175	0.052	**-0.13**	0.001	0.00	0.891
2016	**-211**	0.018	**-0.15**	0.000	-0.01	0.190
2017	**-253**	0.008	**-0.18**	0.000	-0.01	0.207
2018	**-323**	0.009	**-0.20**	0.001	-0.01	0.138
February	**-38**	0.049	0.00	0.864	**-0.16**	0.000
March	**394**	0.000	**0.11**	0.000	**-0.04**	0.012
April	46	0.344	**0.04**	0.005	**-0.22**	0.000
May	9	0.802	**0.03**	0.013	**-0.16**	0.000
June	**197**	0.043	**0.08**	0.010	**-0.09**	0.004
July	**910**	0.000	**0.29**	0.000	**0.06**	0.018
August	**505**	0.000	**0.15**	0.001	**-0.29**	0.000
September	-29	0.539	0.00	0.933	**-0.31**	0.000
October	**156**	0.000	**0.07**	0.000	**-0.09**	0.000
November	19	0.402	0.02	0.142	**-0.20**	0.000
December	**-502**	0.000	**-0.19**	0.000	**-0.36**	0.000

Appendix E. Regions Fixed Effects – Measures of active borrowers

	# of obs:	566	# of obs:	566	# of obs:	503
	R-sq:	0.4053	R-sq:	0.2699	R-sq	0.2152
	Measure 1		**Measure 2**		**Measure 3**	
	Y= # of Active Borrowers		Y= Ln (Active Borrowers)		Y= ΔLn (Active Borrowers)	
	Coef.	P>t	Coef.	P>t	Coef.	P>t
HSJ	24	0.891	**0.34**	0.001	0.00	0.746
AWK	-429	0.081	**-0.31**	0.007	**0.05**	0.003
Chaleur	-52	0.799	**0.34**	0.003	0.04	0.065
Fundy	334	0.182	**0.47**	0.000	0.01	0.784
largest Census Areas	**1862**	0.000	**0.76**	0.000	0.01	0.528
building new facility	-62	0.710	0.22	0.116	0.02	0.592
changing location	-224	0.566	-0.21	0.319	-0.05	0.194
renovation	**1694**	0.002	**0.50**	0.013	-0.04	0.256
closure due to construction	-335	0.549	-0.09	0.691	0.00	0.991
closure due to weather	-1055	0.035	**-0.81**	0.000	-0.40	0.200
open 7 days pilot	**4618**	0.000	**1.42**	0.000	0.04	0.161
expansion	**1446**	0.006	0.21	0.301	0.05	0.146
_cons	1116	0.000	6.54	0.000	0.03	0.249
2011	21	0.946	-0.03	0.856	**-0.08**	0.020
2012	-47	0.877	-0.04	0.812	-0.06	0.081
2013	-51	0.866	-0.05	0.765	**-0.06**	0.035
2014	-199	0.482	-0.08	0.592	**-0.06**	0.028
2015	-347	0.209	-0.16	0.285	**-0.12**	0.00
2016	-227	0.432	-0.06	0.706	**0.07**	0.01
2017	**-715**	0.009	-0.24	0.101	**-0.10**	0.00
2018	**-677**	0.019	-0.18	0.243	omitted	omitted

Appendix F. Regions Fixed Effects – Measures of physical circulations

	# of obs:	6804	# of obs:	6789	# of obs:	6276
	R-sq:	0.3974	R-sq:	0.2653	R-sq:	0.1932
	Measure 1		**Measure 2**		**Measure 3**	
	Y= # of Physical Circulations		Y= Ln (Physical Circulations)		Y= △Ln (Physical Circulations)	
Y= # of Physical Circulations	Coef.	P>t	Coef.	P>t	Coef.	P>t
HSJ	**-470**	0.000	**0.30**	0.000	0.00	0.979
AWK	**-1427**	0.000	**-0.30**	0.000	0.01	0.573
Chaleur	**-1267**	0.000	**0.14**	0.000	0.01	0.626
Fundy	**-561**	0.002	**0.33**	0.000	0.00	0.885
largest Census Areas	**4370**	0.000	**0.84**	0.000	0.00	0.635
building new facility	64	0.620	0.06	0.158	0.00	0.954
changing location	**-1301**	0.000	**-0.13**	0.017	0.01	0.471
renovation	**2589**	0.000	**0.32**	0.000	0.01	0.681
closure due to construction	**-2256**	0.001	**-0.92**	0.000	-0.27	0.127
closure due to weather	-1043	0.163	-0.30	0.125	-0.11	0.131
open 7 days pilot	**9740**	0.000	**1.54**	0.000	0.00	0.958
expansion	**3651**	0.000	**0.33**	0.000	0.01	0.603
_cons	3105	0.000	7.36	0.000	0.15	0.000
2011	-111	0.609	-0.05	0.298	0.00	0.889
2012	-244	0.253	-0.06	0.160	-0.02	0.236
2013	**-482**	0.021	**-0.12**	0.009	0.00	0.850
2014	**-724**	0.000	**-0.20**	0.000	0.00	0.751
2015	**-748**	0.000	**-0.20**	0.000	0.00	0.941
2016	**-1388**	0.000	**-0.32**	0.000	-0.01	0.555
2017	**-1765**	0.000	**-0.39**	0.000	-0.01	0.469
2018	**-1910**	0.000	**-0.41**	0.000	-0.01	0.422
February	-51	0.815	-0.01	0.913	**-0.16**	0.000
March	357	0.125	0.11	0.047	**-0.04**	0.002
April	4	0.985	0.03	0.547	**-0.22**	0.000
May	-130	0.539	0.01	0.906	**-0.16**	0.000
June	62	0.780	0.06	0.242	**-0.09**	0.000
July	**772**	0.001	**0.27**	0.000	**0.06**	0.000
August	367	0.113	**0.13**	0.013	**-0.29**	0.000
September	-173	0.411	-0.02	0.689	**-0.31**	0.000
October	1	0.997	0.04	0.402	**-0.09**	0.000

November	-148	0.490	-0.01	0.907	**-0.20**	0.000
December	**-668**	0.001	**-0.21**	0.000	**-0.36**	0.000