REGIONAL POPULATION PROJECTIONS FOR LABRADOR & THE NORTHERN PENINSULA 2016-2036

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Correction

Figure 1.0 Labrador Study/IGA Regions and Functional Economic Region (FER) Classification, pages 5 and 12

The map (Figure 1.0) in the original report displayed only the IGA administrative area for the Northern Peninsula. However, the projections given in the report were for a larger area of the Northern Peninsula, made necessary because of data limitations related to age structure and fertility rates for that particular IGA administrative area. Figure 1.0 now indicates the correct projection area. No changes have been made to the projections themselves.

The Population Project: Newfoundland and Labrador in Transition

In 2015, Newfoundland and Labrador had the most rapidly aging population in the country – which when combined with high rates of youth out-migration, declining birth rates, and an increasing number of people moving from rural parts of the province to more urban centres, means that the province is facing an unprecedented population challenge. Without intervention, this trend will have a drastic impact on the economy, governance, and the overall quality of life for the people of the province. Planning for this change and developing strategies to adjust and adapt to it is paramount.

The Harris Centre's Population Project will develop potential demographic scenarios for the province and its regions for the next 20 years and will explore a number of the issues arising. These include, but are not limited to, those concerning:

- **Labour markets** – how will future demands for labour be met given a shrinking labour supply?
- **Service demands** – what are the implications of an aging and a geographically shifting population on the demand for public, private and non-government sector services?
- **Service provision** – what are the implications of a declining rural population for the costs and delivery of services to an increasingly smaller and older, but still geographically dispersed population?
- **Governance** – how will local and senior levels of government respond to changing governance issues in the light of these demographic changes and challenges?

Utilizing expertise from both inside and outside the university, the project employs a combined research and debate approach to inform and contribute to government policy, as well as to develop strategies for the private and non-profit sectors to respond to the broad range of issues resulting from the anticipated population shift.

This report, By RAnLab, Memorial University, presents a series of population projections for Labrador for the period 2016-2036. Funded by the International Grenfell Association (IGA) it focuses on Labrador and part of the Northern Peninsula, which forms part of the IGA administrative region. The report sets the stage for further analysis of the implications that that demographic change in Labrador will have for its people, its economy and its governance, the analysis of which will be the basis of further reports. All reports generated through the Population Project will be made available online at www.mun.ca/harriscentre while more information about the project can be obtained by contacting the Project Director. Comments on the Project and reports generated are welcomed.

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Executive Summary

In 2015, Newfoundland and Labrador had the most rapidly aging population in the country – which when combined with high rates of youth out-migration, declining birth rates, and an increasing number of people moving from rural parts of the province to more urban centres, means that the province is facing an unprecedented population challenge. Without intervention, this trend will have a drastic impact on the economy, governance, and overall quality of life for the people of the province. Planning for this change and developing strategies to adjust and adapt to the change is paramount.

This report focuses specifically on Labrador. Funded by the International Grenfell Association (IGA), it provides a set of population projections for the IGA regions of Labrador and the Northern Peninsula of Newfoundland and Labrador West (Figure 1) for the period 2016-2036. These projections provide a basis for further research into the implications of demographic change in this region. Results from three projection models are presented. These models are:

- The **Natural Survival Model (NS)** where population change is dependent on recently observed age specific births and deaths only and migration is not included.
- The **Historical (Cyclic) Survival Model (HS),** which assumes recent age specific birth and death rates continue, as in the NS model, but includes migration rates as experienced during the last 10-15 years. Two scenarios for this model are offered based on different migration trend assumptions.
- The **Replacement Survival Model** (**RS**), which estimates the number of net in-migrants required to maintain the current workforce population for each region, given historical trends of births, deaths and in/out migration. Three scenarios are offered based on different replacement success factors.

The Natural (NS), Historical (HS) and Replacement Survival (RS) models provide insight to how population will change in terms of both the total number of people living in a region as well as the resulting age structure, if the assumptions of the models hold true. The NS model indicates the capacity of a region to grow by natural replacement by accounting for regional fertility and death rates, but without a migration factor in the equation. More importantly, this model identifies regions whose age structure combined with its fertility and death rates can or cannot maintain their populations without in-migration.

The HS model results provide insight into the age structure of populations if past migration trends continue into the future. For some regions in Labrador this may be likely, given that over multiple census periods there has been very little, if any, in-migration and significant out-migration of younger cohorts without replacement. The result, a decreasing and rapidly aging population, is particularly significant in those regions that will decline even where a significant labour force replacement factor is built in as indicated in the results from the RS model.

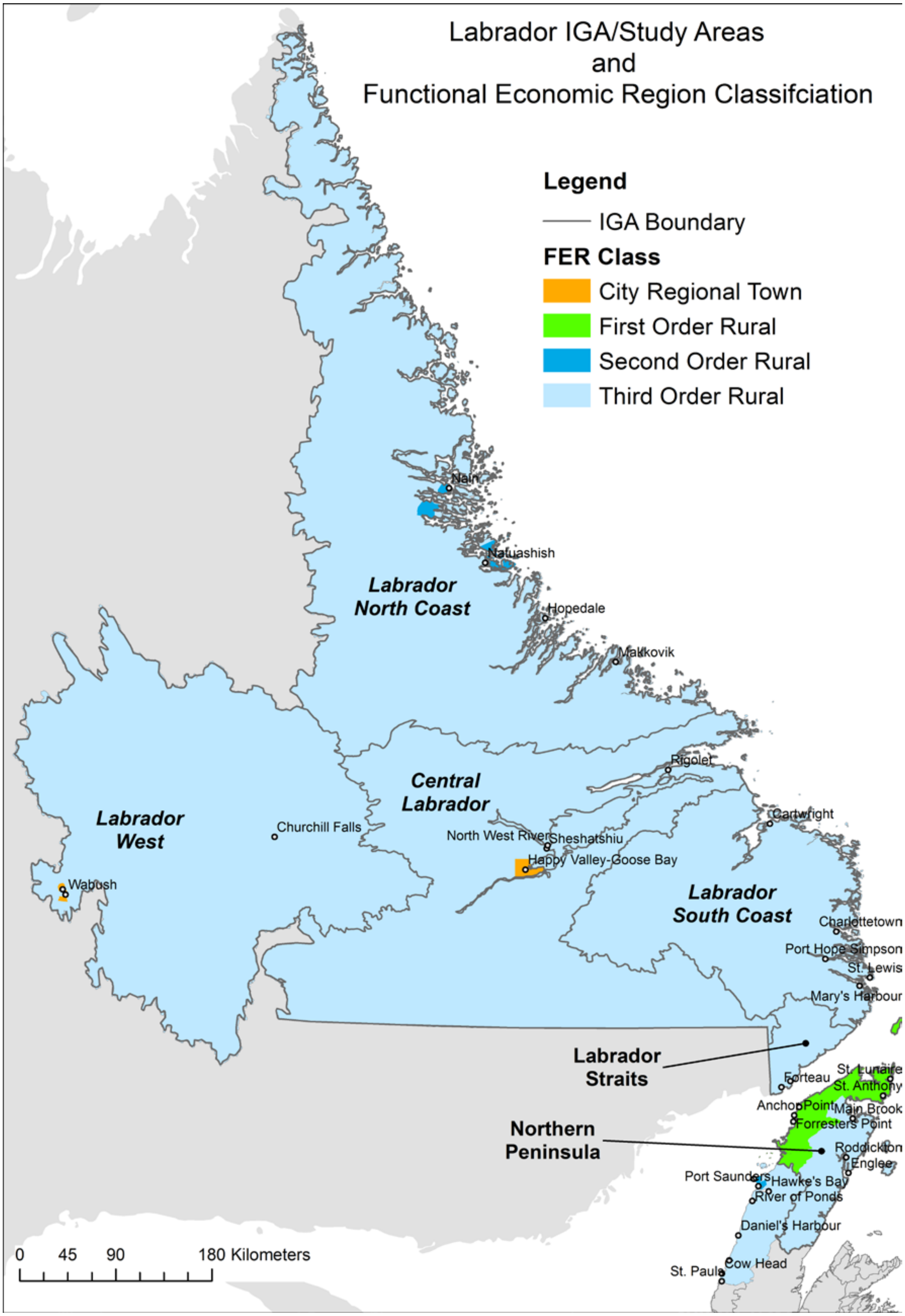


Figure 1.0 Labrador Study/IGA Regions and Functional Economic Region (FER) Classification

Workforce replacement requires that those not previously in the workforce join it, that others remain in the region rather than leave and/or there is in-migration. Given the economic base of many of Labrador's regions, the required replacement success levels necessary to maintain the workforce population, as forecast in the RS model scenarios, may be difficult to achieve. The overall conclusion is that the aging trend in Labrador suggests that there are underlying fertility and migration issues that will prevent maintaining or growing the base population in the long term.

Regional highlights from the report include:

Labrador:

For Labrador as a whole the NS model indicates that births would exceed deaths over the projection period and, excluding migration, there is an internal propensity for growth. However, when migration trends are factored in, the overall population is projected to decline by 8% between 2016 and 2036. To maintain the current workforce population to 2036 at least 50% of that workforce would need to be replaced, primarily through reduced out-migration or higher rates of in-migration. However, within Labrador there are significant differences between regions and so this overall picture may be misleading, hence the need to consider individual regions within Labrador.

Labrador North Coast:

The large number of people in the younger age cohorts indicates a natural propensity to maintain the population. However, when past migration trends are factored in, the population is projected to decrease slightly between 2016 and 2036 under a "Medium Scenario" case. To ensure that the workforce population is maintained, replacement success, through population retention and/or in-migration, would need to be in the order of 50%.

Central Labrador:

The NS model shows a population increase over the projection period. When migration trends are included the population would increase slightly to 2031 and then decline to 2019 levels by 2036. Theoretically the workforce in this region could be maintained without any replacement strategy.

Labrador South Coast:

The NS model predicts a population decline of 4% between 2016 and 2036. When past migration trends are included the population would decrease by 33% by 2036 under the Medium Scenario case. This is a region with a rapidly aging population. In 2011 the average age was 41, and by 2036 it is projected to be 55. To maintain the workforce at current levels a 50% replacement success is required, which would have to occur primarily through in-migration.

Labrador Straits:

The NS model predicts a population decline of 15.5% between 2016 and 2036. When migration trends are included this would increase to 34% under the Medium Scenario. Even if a 100% workforce replacement success could be achieved, the total population of the region would still decrease by 5% because of low fertility and low retention rates in the younger cohorts.

Labrador West:

The NS model indicates a small (0.5%) overall increase between 2016 and 2036. However, if Medium scenario migration trends are incorporated, the population would decline by 7% over this period. A workforce replacement success rate of 50% would see the population remain relatively stable. The economy of this region is dependent on iron ore mining. Replacement success through in-migration has been evident in the past, but is dependent on conditions in the iron ore market.

Northern Peninsula:

Data limitations required that a larger area of the Northern Peninsula than the IGA administrative area be used for the projections. The Northern Peninsula region, as defined by the study, has the largest population (14,220 in 2011) of the study regions. The NS model predicts a decline of 13% between 2016 and 2036 and when Medium scenario migration trends are included this would increase to 39% over the projection period. To maintain the current workforce population, a replacement success of 70% would be required.

Overall, Labrador and most of its regions require population replacement strategies if they are to maintain or grow their populations. The Labrador North Coast, Central and West have the most potential for maintaining their populations over the prediction period, assuming no significant changes in their local economies. The opposite is the case for the Labrador South Coast, the Straits and the Northern Peninsula. In the absence of significant new job opportunities, reversing out-migration trends and retaining those in the working age cohorts is a difficult task, but encouraging in-migration may be an even greater one. For most of Labrador’s regions a declining population appears to be the most likely scenario over the 2016-2036 period.

Regional Population Projections for Labrador and the Northern Peninsula 2016-2036

1.0 Introduction

Overall population growth or decline as well as change in the age structure of the population (e.g. aging populations) are major factors in decisions about infrastructure and program investments in, for example, schools, hospitals, roads, public transport, water supply, health, child and seniors care, and education and training. From an economic perspective population analysis is important to determine if the demographic trends can help maintain the existing labour supply. If not, labour retention and in-migration will be important factors in meeting future labour market demands and investment in a region as a whole to maintain the status quo. Where local economies cannot support their current populations, out-migration and lower population levels will result, requiring consideration of how the infrastructure and service needs of those who remain can best be served.

Any population forecast model therefore needs to be developed within a regional planning context insofar as the outcomes from a population forecast model should be capable of being integrated with other analytics to assess the impact on infrastructure and services and the region's ability to provide a labour supply to meet anticipated future requirements.

Population growth in a region is a function of its age structure and population trends (fertility, mortality, migration patterns, etc.), which themselves are influenced by such factors as:

- the state of the regional economy and labour demands
- the level and quality of available private and public services
- job prospects for new workers entering the labour market
- the availability of housing

Thus, any population analysis has to consider the historical trends related to the age structure, fertility, mortality and migration associated with a region. In addition, examination of the age structure of a population along with aggregate population growth is important because many services are of greater relevance to certain age groups (cohorts). For example, growth in the 5-19 cohorts would put demands on schools and recreational services and the 20+ cohort would give an indication of the potential demand for housing, while the 65+ cohort would generate other types of demands associated with the aged members of the population.

Within this context, the report presents the methods and outcomes associated with forecasting the population of the five International Grenfell Association (IGA) regions in Newfoundland and

Labrador from the base year of 2011 to 2036. The five IGA regions are: Labrador North Coast, Central Labrador, Labrador South Coast, Labrador Straits and the Northern Peninsula (Figure 1.0). It should be noted that the Northern Peninsula region defined in the study is larger than that of the Northern Peninsula IGA administrative region because of age structure and fertility data limitations for that region. Also, although Labrador West is not a part of the IGA administrative framework, it is included to assess the overall population trends for Labrador as a whole.

The Functional Economic Region Classification (FER) presented in Figure 1.0 serves to put the Labrador study regions within an economic and potential growth context. The classification recognizes that regions centred on small cities and regional towns, such as Happy Valley-Goose Bay and Labrador City/Wabush, provide more services and opportunities for growth than smaller rural areas.

By contrast, first order rural regions represent areas with smaller centres that provide some level of retail along with limited government services and have a fairly diversified economy with some potential for growth. However, second order rural regions have a total population of less than 2,000 people and provide very limited retail and government services and have limited potential for growth. Most second and third order rural areas are generally dependent on a single industry. Third order rural areas have populations of less than 600 people with only the most basic retail services available and usually lack government services. (See **Appendix II** for additional information on the FER Classification system).

The pattern of increased population concentration in larger places in remote and sparsely populated areas is a common trend in other northern Canadian regions and, as elsewhere, this increased concentration hits the smallest places hardest as even small population losses can affect the viability of basic services, further jeopardizing the future of those communities.

2.0 Methods

Population forecast models are used to predict the population count and age structure of a region at points in time from a known population. Predictions are based on assumptions about the number of births and deaths that will occur during each time period as well as the effects of in and out migration. The standard model for population analysis is the "cohort survival model" (Table 2.0). It is based on the idea of the cohort that represents a group of people in the same age category (e.g. 0-4, 5-9, 10-14 etc.). When individual age data are available, the model is referred to as an "age specific survival model". Thus, the future population of a cohort is based on how many in that cohort are expected to survive to reach another age. This is estimated by multiplying the initial population of the cohort by the survival rates for each successive cohort.

The "survival rate" includes quantitative information on births, deaths as well as in and out migration.

For this study, the "age specific survival" model is used to assess the future trends in age structure and population change. The outcomes from this analysis will provide baseline information that can be integrated with other models to assess impacts and structure policies for regional planning and development.

However, to develop population growth scenarios that are based on variations of model assumptions, the basic survival model is re-formulated with an optimization function. This re-formulation of the cohort model permits assessment of how changing the inputs to the model affect the long-term growth of the population. For example, the re-formulation allows the question of whether existing regional age structures, fertility, mortality and migration rates provide the required growth to meet future labour supply requirements in the economy. Within this model one can vary birth and death rates by age, together with in/out migration patterns and by so doing estimate various growth scenarios for each region.

Three survival models are used to forecast outcomes that are used for analyzing the future population trends in the IGA regions. These are:

> [1] The **Natural Survival Model (NS)** where the in and out-migration rates are set to zero and population change is dependent on age specific births and deaths only. Outcomes from this analysis provide information on a region's ability to maintain or increase future population levels given the combination of the region's age structure and expected fertility and mortality rates. If a region cannot maintain or grow its existing population through this natural replacement process it reflects underlying issues associated with fertility and death rates, youth retention and aging populations.
>
> [2] The **Historical (Cyclic) Survival Model (HS)** assumes existing age specific birth and death rates as in the NS model, but migration rates are set to cycle through periods of high and low growth, continuing the cyclic pattern of population changes as experienced during the last 10-15 years. The migration component of population change is decomposed into intra-provincial, interprovincial, international in-migration, and total out-migration. In addition, the migration calculation utilizes a "migration propensity" for each age group/region class/migration type combination, which ensures that migration volumes remain sensitive to shifts in population levels over time. The cyclic models represent two different migration trend analyses in which:

[1] the *medium cycle* model represents a scenario where 2001 to 2006 (lower rate) and 2006 to 2011 (higher rate) migration trends alternate on 5 year cycles whereby 2012 to 2016 reflect the lower rate forecast and 2017 to 2021 forecast is based on the higher rate. This alternating of lower and higher trends is repeated for the forecast period

[2] the *high cycle* model starts with the lower rate trend for 2012 to 2016 and uses the higher rate trend for the remaining forecast period[1]

[3] The **Replacement Survival Model** (**RS)** where net migration levels are calculated based on forecast replacement demands due to workforce aging. Firstly, retirements, worker deaths, and young workforce entrants over time are estimated using historical rates. Secondly, these values are combined to estimate the net in-migrants required to maintain the workforce population for each region, given historical trends of out-migration. The medium cycle model migration trends are used in the RS model.

The RS projections are based on the integration of different worker replacement rates with a replacement success factor and are used to estimate low, medium, and high growth scenarios. For this model, values of 50% for low, 70% for medium, and 100% for high are assigned as constants for the required workforce replacement factor. Conceptually, replacement rates of less than 100% could still allow an existing economy to be sustained by increasing the productivity of the remaining workforce and/or the hiring of currently unemployed people if their skillsets matched industry requirements.

The model indicates what replacement levels are required to maintain the workforce population. It says nothing about how these replacement levels may be achieved and in regions characterized by high levels of out-migration, reversing that process and encouraging in-migration maybe very difficult. Policies that encourage retention of working age members of the population may have more chance of success, but this too should not be expected to be an easily achievable solution.

[1] The high cycle model is based on assumptions used by some provincial governments whereby the first five years of the forecast is based on a five-year low migration trend and the remaining 15 years are based on a high five-year trend. Note that in the model migration is decomposed into inter/intra provincial and international migration factors. In all cases out migration trends are a single factor and cannot be decomposed by destination

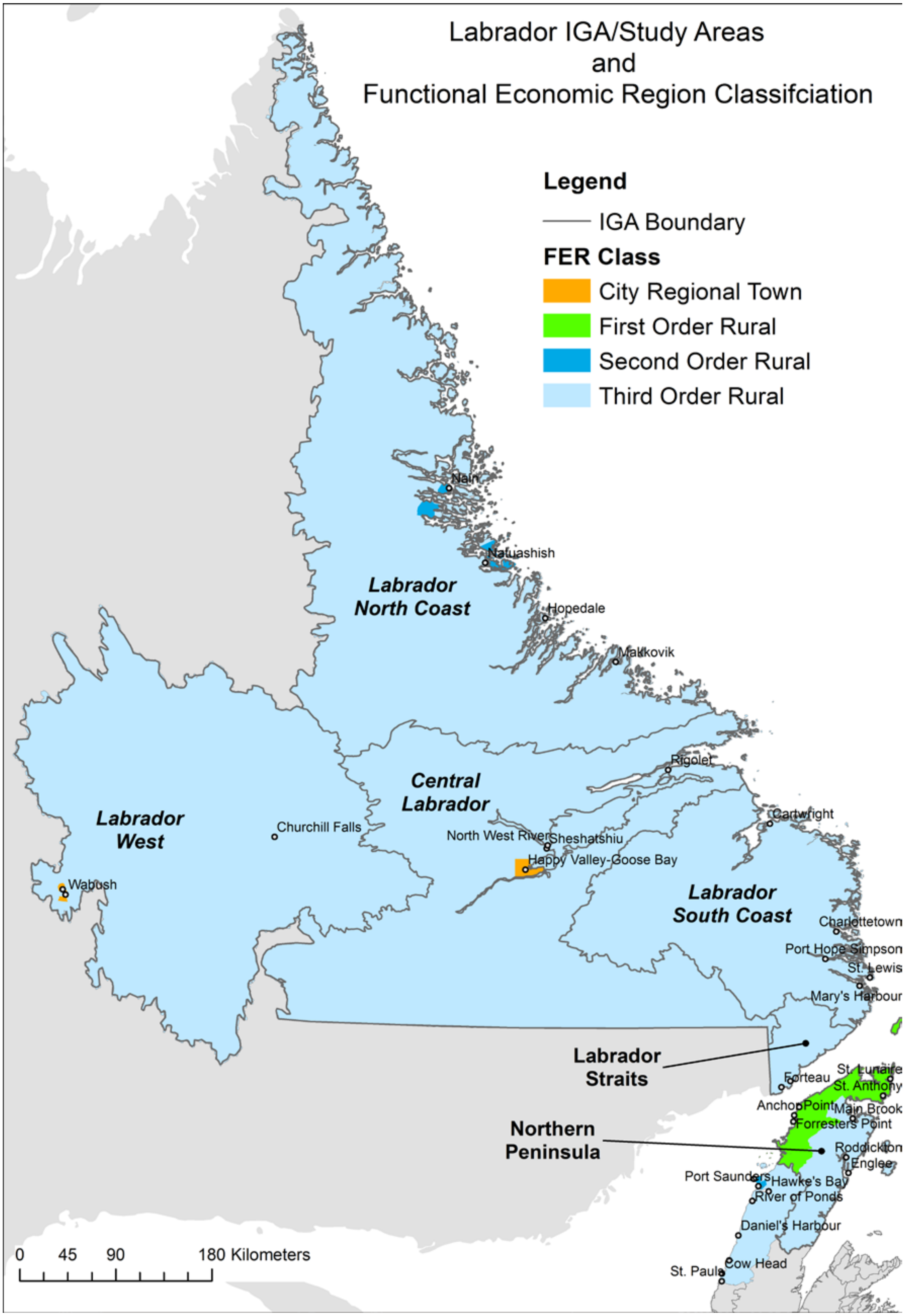


Figure 1.0 Labrador Study/IGA Regions and Functional Economic Region (FER) Classification

Table 2.0 Structure of the Cohort Survival Model

Cohort Survival Model					
Age Group	Base Year Population	Fertility Rate	Mortality Rate	Net Migration	Future Population
0-4	P_0	FR_0	MR_0	NM_0	
5-9	P_1	FR_1	MR_1	NM_1	$P_0FR_0MR_0+NM_0$
10-14	P_2	FR_2	MR_2	NM_2	$P_1FR_1MR_1+NM_1$
15-19	P_3	FR_3	MR_3	NM_3	$P_2FR_2MR_2+NM_2$
…	…	…	…	…	…
…	…	…	…	…	…
…	…	…	…	…	…
80-84	P_{16}	FR_{16}	MR_{16}	NM_{16}	$P_{15}FR_{15}MR_{15}+NM_{15}$
85+	P_{17}	FR_{17}	MR_{17}	NM_{17}	$P_{16}FR_{16}MR_{16}+NM_{16}$

The assumptions regarding fertility, mortality and migration for the survival models (see Appendix I for list of these assumptions) are based on three levels of geography. For the purpose of population analyses, all three geographies can be aggregated, decomposed or integrated using Statistics Canada's census geographies (e.g. census subdivisions or census-consolidated subdivisions).

Two of these geographies are entities created by the Newfoundland and Labrador Provincial Government Statistics Agency (Local Areas) and the Department of Health and Community Services (Regional Health Authorities). The Local Areas geography is a combination of Statistics Canada's Census Consolidated Subdivisions (CCS) (80 Local Areas) and there are four Regional Health Authorities – Eastern, Central, Western and Labrador-Grenfell.

The third level of geography is based on Simms *et al.* (2013), a methodology that defines five types of functional economic regions (FERs) for Newfoundland and Labrador, and that delineates regional boundaries by using a distance-constrained regional analytics model that ensures at least 90% of the daily labour market commuting occurred within the regional boundaries[2] (Figure 1.0). The final classification for region types utilizes an urban hierarchy-type

[2] FER geography is based on the 2011 Statistics Canada Census Subdivisions (CSDs).

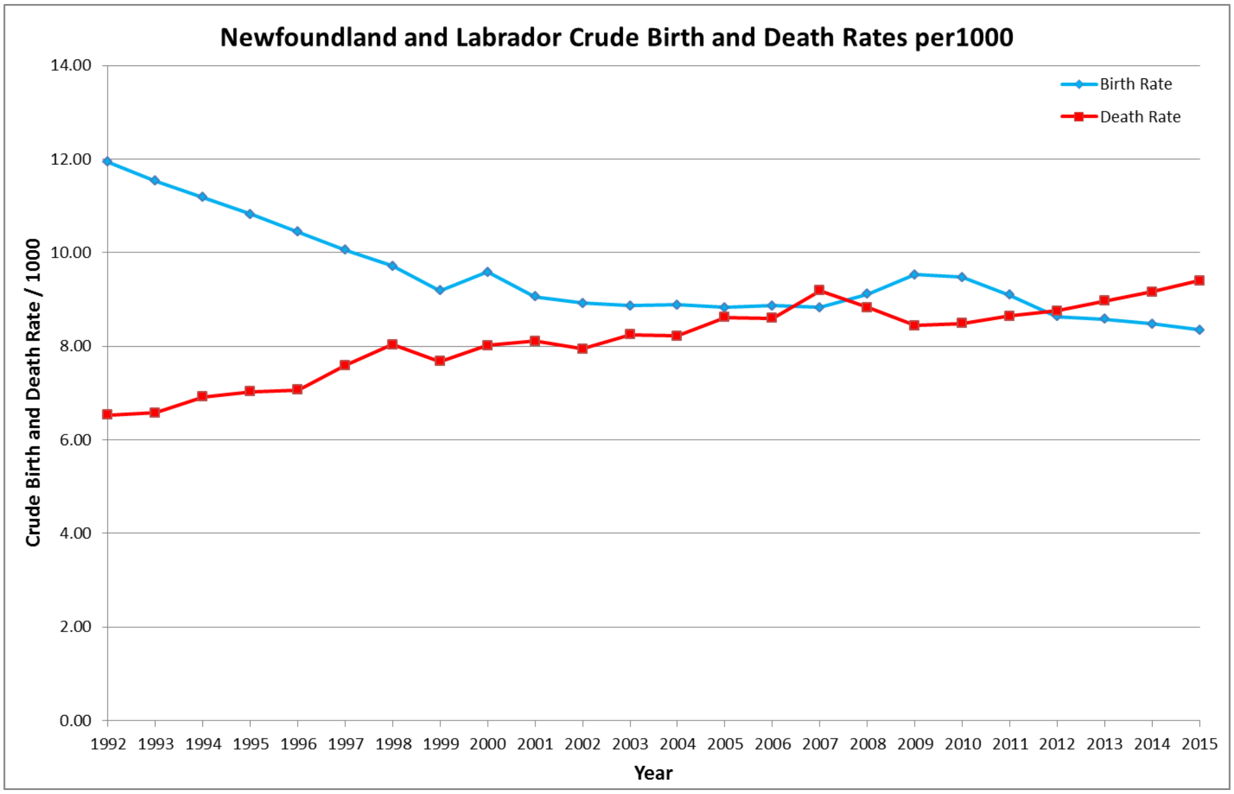
model, as well as a grouping function that uses socio-economic characteristics whereby the intra-regional variability is minimized while maximizing inter-regional variability (see Appendix II for more information). The results produce a consistent regional taxonomy that fit the geography and regional economy of Newfoundland and Labrador as well as the Maritime provinces.

For the purpose of this study, fertility rates are developed for the Local Area geography because of issues with data availability or suppression, and because missing data did not produce data issues at this scale. However, death and migration rates are aggregated to five FER regional classes to avoid small data issues when calculating migration trends[3].

The Local Area fertility rates for the study area range from a high of 2.8 to a low of less than 1.0. A rate of 2.1 is required to maintain the 2011 population levels. However, a population with a very low or high proportion of females in the 24 to 34-age cohort will impact the outcomes in the natural growth component of the model.

Death rates are fairly consistent and the increasing number of deaths is due to an aging population rather than a significant change in the mortality rate. Given the decline in births and the increasing number of deaths due to an aging population (Figure 2.0) in-migration is, for many areas in Newfoundland and Labrador, the only potential for future growth. However, the propensity for younger cohorts to out-migrate from smaller rural areas to larger centres creates a retention problem and contributes to population decline in those smaller rural areas. For example, when analyzing the provincial migration trends, 65% of the out-migrants from Third Order Rural areas are less than 35 years of age while only 8% are 65 years or older. These patterns are associated with the characteristics of Third Order Rural areas, many of which are dominated by single industry communities with populations of less than 600 people, have limited opportunities for young workers and have generally have been in chronic decline for multiple census periods. The “propensity-to-migrate function” in the models account for the fact that younger cohorts are more mobile than older cohorts. The survival models are designed to work at multiple levels of geography and population forecasts can be quickly generated as more detailed or updated data become available.

[3] These issues are especially evident for the Island part of the province. In this case when a Local Area is “completely contained” within a FER region type is it is assigned the death rate for that that FER.



Source: Statistics Canada Births and Deaths by Province

Figure 2.0 Crude Birth and Death Rates 1992 to 2015.

The three models used in the analysis follow "best practice" as identified by Statistics Canada and provincial governments[4]. However, like any population projection analysis, these models are constrained by the assumptions made and all outcomes should be interpreted as what would happen *if* the assumptions hold throughout the forecast period. Thus, the final projections may not be what actually happen because of unforeseen factors related to the economy, government policies as well as random short-term decreases/increases in fertility or mortality. The random factor is especially influential on smaller regions. Overall, the outcomes from the models are reflections of observed trends and where there is a propensity to grow, decline or age it will be captured in the projections, even if the population numbers are under- or over-estimated.

All data used in the models were either downloaded from the Newfoundland and Labrador Statistics Agency Community Accounts or Statistics Canada 2011 Census and CANSIM data portals.

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[4] A good example of best practices is the British Columbia Statistics report on "Population Extrapolation for Organizational Planning with Less Error (P.E.O.P.L.E)", Population Section, BC Statistics, Ministry of Finance and Corporate Relations, Government of British Columbia, August, 1999

3.0 Population Forecasts 2012 to 2036

The following sections present outcomes from the Natural (NS), Historical (Cyclic) (HS) and Replacement Survival (RS) models. Included are total populations by year, study region tables, percent change temporal trend graphs for the NS model, and selected trends for both the HS and RS Models. The baseline 2011 population data used for the forecast are the Statistics Canada postcensal estimates where “postcensal estimates are based on the 2011 Census counts adjusted for census net undercoverage (CNU) (including adjustment for incompletely enumerated Indian reserves (IEIR) and the components of demographic growth that occurred since that census. Intercensal estimates are produced using counts from two consecutive censuses adjusted for CNU (including (IEIR) and postcensal estimates” (Statistics Canada, CANSIM 51-0001).

For each study region, the NS as well as the Medium and High HS projected age distributions for 2016, 2026 and 2036 are also included. As will be seen, although the RS model essentially maintains the population through in-migration, the age structures forecast remain relatively close to the HS outcomes. This is due to the fact that the HS migration cycles are an integral part of the RS model.

3.1 Labrador

For this analysis, the five Labrador regions of North Coast, Central, South Coast, Straits and West, but not the Northern Peninsula, are included. The baseline 2011 population for Labrador is 27,368. The NS model indicates that the population age structure in relation to birth and death rates can maintain the overall population with predicted values of 28,735, 30,640, and 31,183 for 2016, 2026 and 2036 respectively. However, if recent migration trends are included, the HS model predicts a decreasing population over time whereby the population will drop to 27,267 by 2016 and potentially range from 25,125 to 26,523 in 2036 (Table 3.0). Overall, if replacement strategies were to be implemented successfully, Labrador’s population will grow. The 50% to 100% RS scenarios predict that by 2016, the population will range from 28,646 to 28,674 and, if the trend continues, by 2036 the population will range from 29,811 to 29,919 (Table 3. 0). These outcomes indicate a need to have a long-term population strategy that focuses on in-migration if the region’s overall population is to be maintained or grow.

Figure 3.0 indicates that the NS model trend predicts positive percent differences from the 2011 baseline – specifically that the population increases by 5.0% by 2016 and by 13.9% by 2036. Thus, based solely on projected birth and death rates, the population has an internal propensity for growth. However, when past migration pattern data are included the HS model predicts that

while the population will remain relatively stable until 2020, by 2026 it will have declined by 1.7% and by 8.2% by 2036, with out-migration offsetting any natural population growth.
The third element of Figure 3.0 illustrates the effect of replacing those in the workforce who retire, die or leave the region. The Medium Replacement scenario illustrated indicates what would happen if 70% of the “lost” workforce were to be replaced. In this case the population would increase by 9.3% to 2026, and thereafter decline slightly such that the overall increase to 2036 would be 9.1%.

Workforce replacement could occur primarily through retention of those who might otherwise leave the region, or by in-migration. Experience suggests that while neither may be easy to achieve, retention may be easier than attracting new in-migrants, unless there is a significant increase in economic opportunities that would attract migrants. In Labrador, other than booms in iron ore activity in Labrador West, there have been few opportunities encouraging significant levels of in-migration. The RS model predictions thus indicate what would be *necessary* to maintain or grow the population. It says nothing about how this might be approached, or how successful any strategies implemented might be.

If nothing is done to replace the workforce population, the HS model provides the most likely scenario for the projection period. From a policy perspective, this implies that government has to consider how it can best meet the needs of a smaller overall population in Labrador in the future, needs that are complicated by an increasingly aging population in the region as a whole.

Central Labrador and Labrador West, because of their larger populations, dominate Labrador’s overall population age structure (see Figures 3.1, 3.2 and 3.3). Overall, the Labrador population structure can be characterized as one with high birth and death rates, shifting to a slightly decreasing birth rate over time. Given the population dynamics within Labrador this type of structure masks the details where some regions are in chronic decline and aging, while others exhibit population structures with higher birth rates and death rates.

Predictions for 2016 show the effect of migration as indicated by the differences between the NS and HS cycle scenarios (Figure 3.2). This is more pronounced by 2026, especially for the 1 to 10 and 20 to 40 cohorts (Figure 3.3) with a 24% and 27% difference respectively. By 2036, the gap between the NS and HS models illustrates the long-term effects of out-migration (Table 3.0). Thus, without a retiree replacement strategy, and with the age cohorts skewing towards the older 60+ cohorts, together with a decreasing birth rate related to the out-migration of young cohorts, the long-term forecast is for a decrease in population. This trend is evident with a shift in the average age of the population from 35 years in 2011 to 43 and 46 years by 2026 and 2036 respectively.

Table 3.0 Labrador: Population Estimates 2012 to 2036 by Model Type

Year	Natural Survival Model	Historical (Cyclic) Survival Model		Replacment Survival Model		
		Medium Cycle	High Cycle	Low Replacement	Medium Replacement	High Replacement
2011	27368	27368	27368	27368	27368	27368
2012	27697	27409	27409	27695	27697	27701
2013	27972	27393	27393	27963	27968	27975
2014	28242	27370	27370	28215	28222	28233
2015	28493	27324	27324	28439	28448	28462
2016	28735	27267	27267	28646	28657	28674
2017	28976	27359	27359	28840	28853	28873
2018	29216	27445	27445	29023	29039	29062
2019	29438	27515	27515	29185	29202	29229
2020	29657	27576	27576	29335	29355	29384
2021	29853	27619	27619	29464	29485	29517
2022	30034	27501	27647	29575	29599	29633
2023	30208	27373	27663	29675	29700	29738
2024	30362	27229	27663	29758	29785	29825
2025	30508	27071	27648	29828	29857	29900
2026	30640	26898	27618	29885	29915	29961
2027	30748	26840	27565	29924	29956	30003
2028	30847	26772	27501	29954	29987	30037
2029	30932	26689	27422	29973	30008	30060
2030	31005	26594	27331	29981	30018	30072
2031	31064	26485	27225	29978	30016	30072
2032	31109	26231	27106	29963	30002	30061
2033	31139	25967	26976	29938	29978	30039
2034	31156	25692	26833	29903	29944	30006
2035	31176	25414	26684	29862	29904	29968
2036	31183	25125	26523	29811	29854	29919

Note: Table row values for **Year 2011*** is the baseline population for all model estimates

The overall picture may hide the effects of differences in population structure and migration propensities in Labrador's regions. To address this regional projections for Labrador are presented in the following sections.

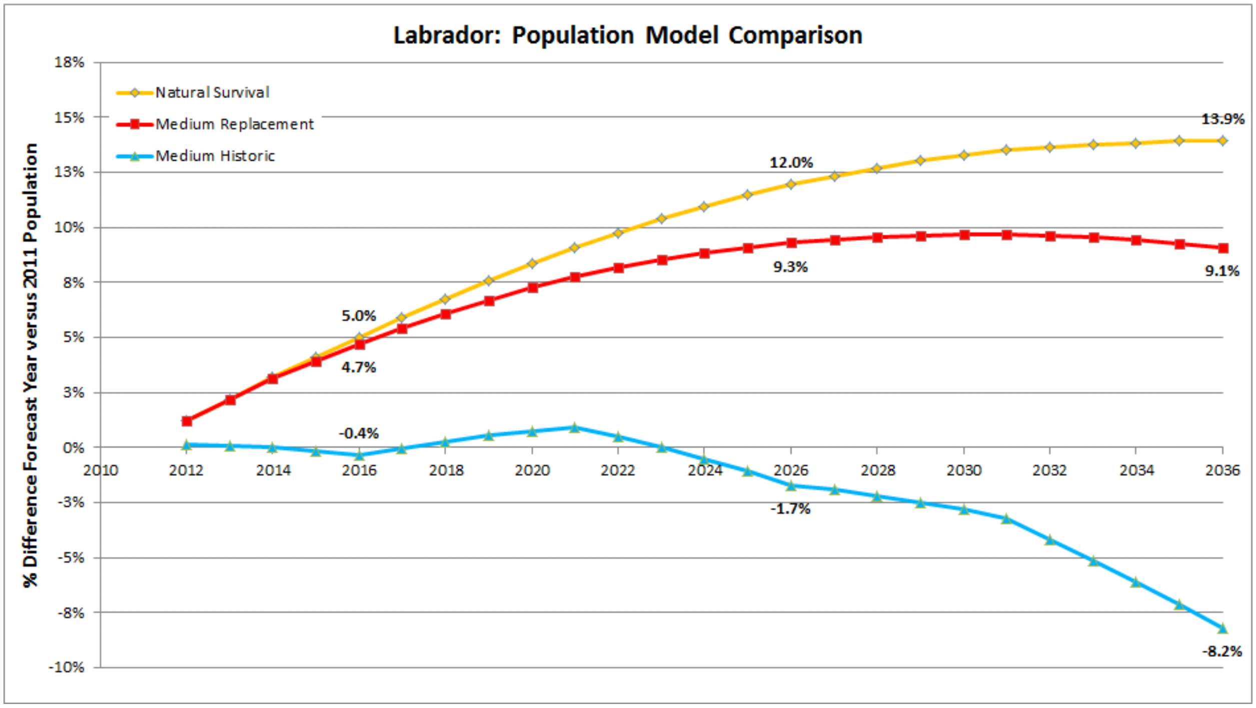

Figure 3.0 Labrador: Natural Survival, Historic Survival and Medium Replacement Models Predicted Percent Population Change (Baseline Year – 2011)

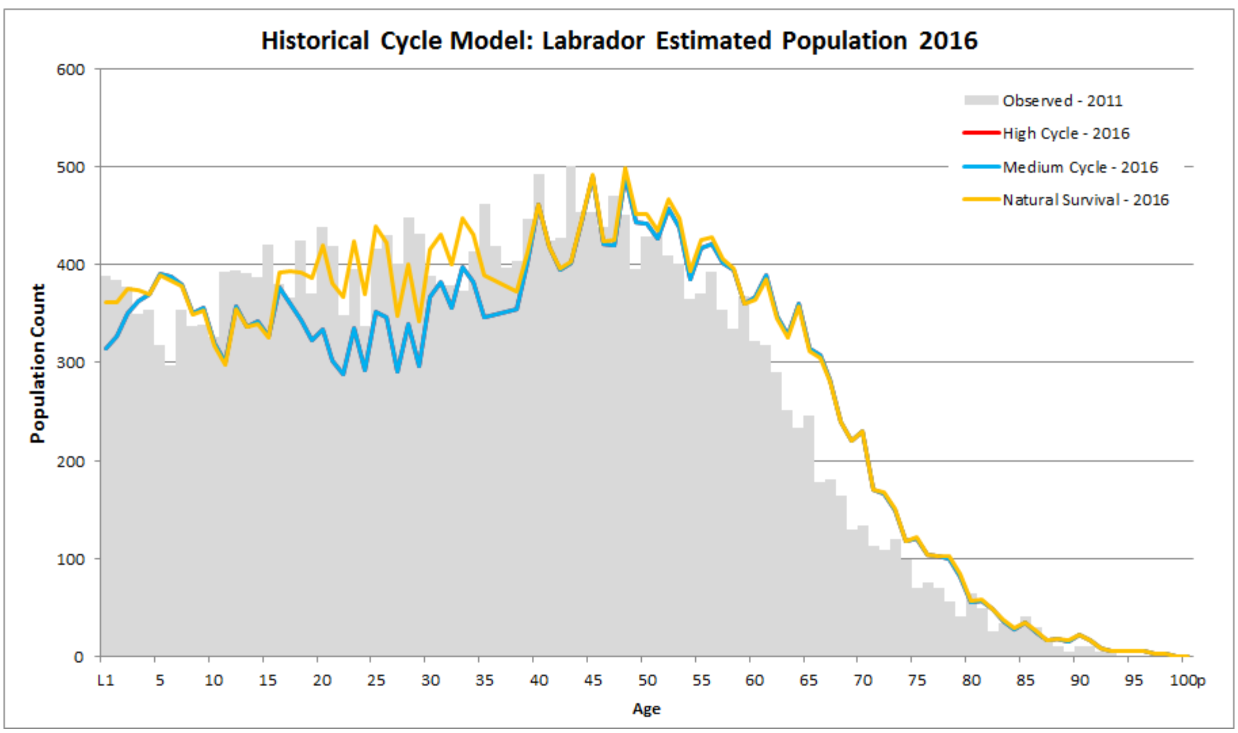

Figure 3.1 Labrador: Observed Versus Natural and Historic Survival Models 2016 Predicted Population Age Structure

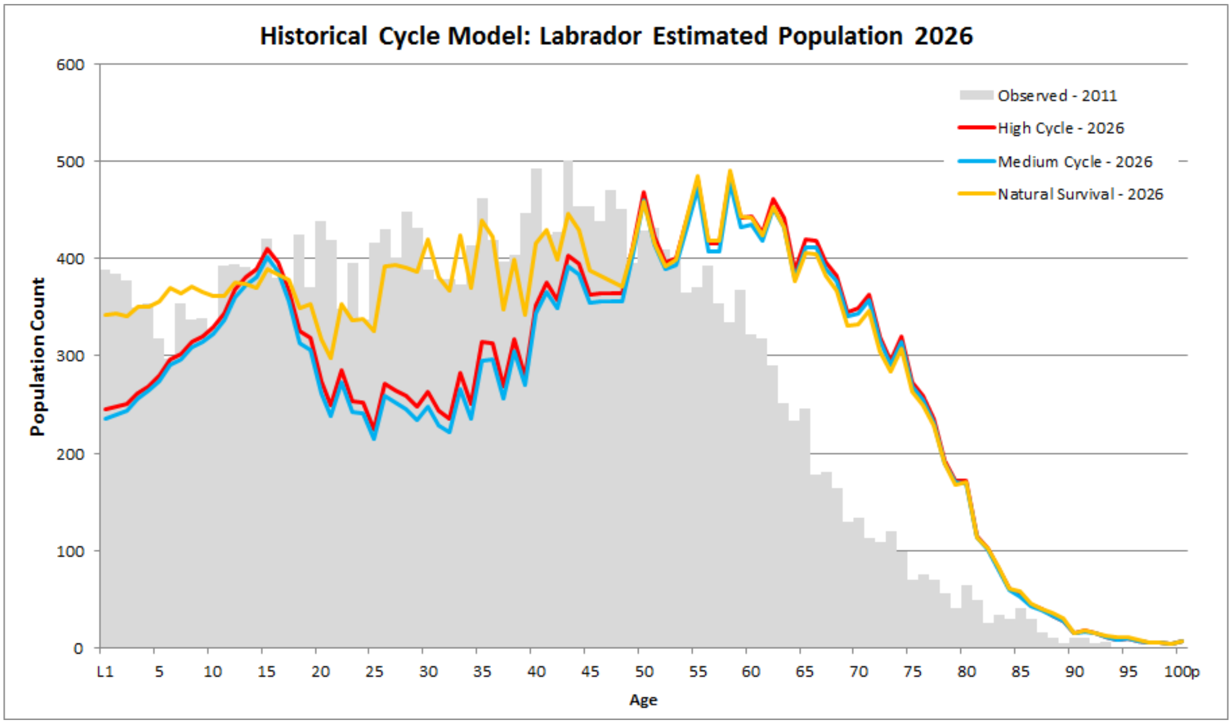

Figure 3.2 Labrador: Observed Versus Natural and Historic Survival Models 2026 Predicted Population Age Structure

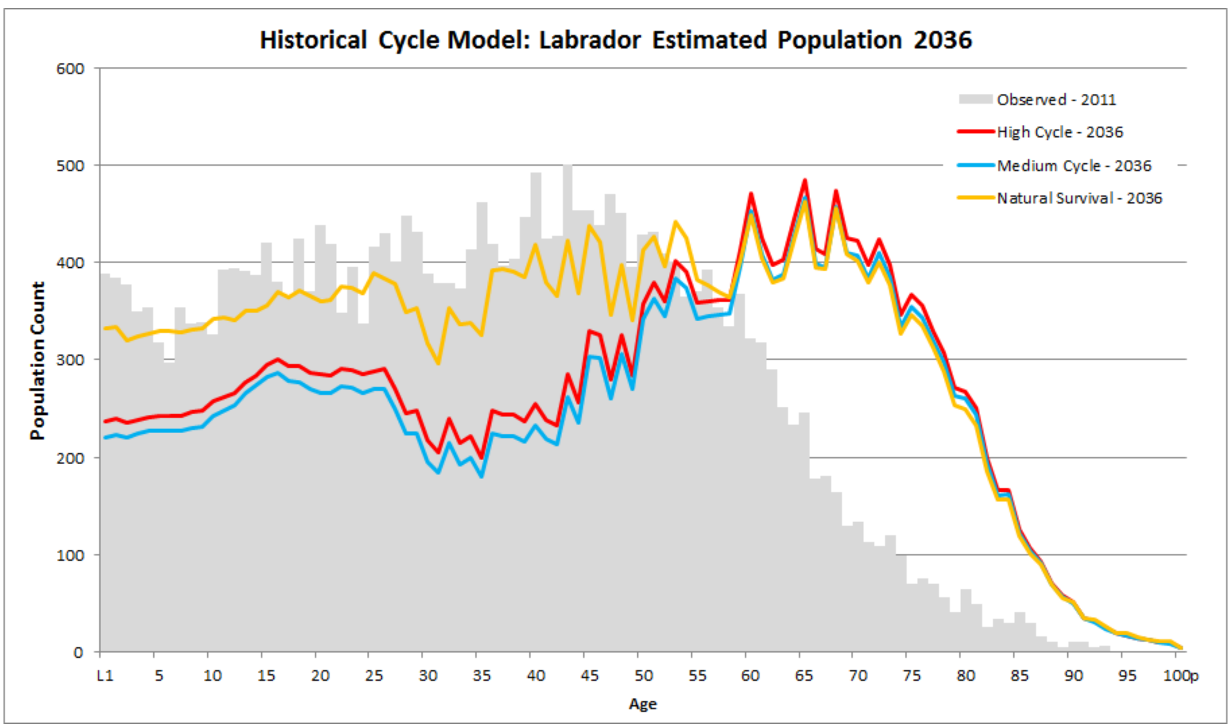

Figure 3.3 Labrador: Observed Versus Natural and Historic Survival Models 2036 Predicted Population Age Structure

3.2 Labrador North Coast

The 2011 baseline population for the Labrador North Coast region is 3,299. The NS model suggests that the population would increase to 3,749 by 2016 and to 5,177 by 2036. This suggests that the population components of birth and death rates along with a high portion of younger cohorts for this region have the natural ability to maintain this region's population (Table 3.1). However, the HS outcomes for Medium and High migration trends indicate that if the migration cycles repeat in the future, and there is no population replacement policy, then the population would decrease slightly. In this case, the Medium HS outcomes suggest the population would decrease from 3,299 in 2011 to 3,291 by 2016 and to 2,872 by 2036 (Table 3.2).

The results for the RS model are similar, but show a smaller decrease in population. The estimated future population indicates that with replacing retiree workers the population will increase over the forecast periods. For example, the Medium RS scenario (70% replacement) indicates the population will increase to 3,623, 3,983 and 4,199 in 2016, 2026 and 2036 respectively (Table 3.2). While the HS models are limited, in that there are no guarantees that the migration cycles will repeat in the future, the RS models represent target numbers indicating what would be required for population stability and growth.

When examining the growth or decline as a percentage change of the 5-yearly forecast versus the 2011 baseline population (Figure 3.4), the NS model outcomes always exceed the HS and Medium RS Model estimates. For example, by 2026, under the NS model assumptions the population is estimated to increase by 36.9%. The medium HS model, which includes migration, indicates that there would be a –4.25% decline in the population for the same period. Under the Medium RS Model there would be a 20.7% growth. The fact that predicted RS Model population growth is less than that for the NS model indicates a net loss through migration even when 70% of retirees are replaced. This outcome indicates that there is a need for planning for youth retention or an in-migration policy to ensure the long-term maintenance of the regional workforce and population of this area.

Figures 3.5, 3.6 and 3.7 present the region's projected population age structure for 2016, 2026 and 2036. For each year, the 2011 baseline data are presented together with Medium and High HS projections. For 2016 the difference between the Medium and High HS forecasts are negligible and cannot be differentiated within the resolution of the graph.

Table 3.1 Labrador North Coast: Population Estimates 2012 to 2036 by Model Type

Year	Natural Survival Model	Historical (Cyclic) Survival Model		Replacment Survival Model		
		Medium Cycle	High Cycle	Low Replacement	Medium Replacement	High Replacement
2011	3299	3299	3299	3299	3299	3299
2012	3409	3320	3320	3381	3389	3394
2013	3497	3318	3318	3440	3455	3465
2014	3585	3315	3315	3495	3518	3533
2015	3669	3307	3307	3542	3574	3595
2016	3749	3291	3291	3583	3623	3649
2017	3835	3299	3299	3626	3674	3706
2018	3921	3307	3307	3665	3722	3760
2019	4005	3309	3309	3700	3765	3809
2020	4089	3311	3311	3733	3807	3856
2021	4166	3307	3307	3761	3843	3898
2022	4241	3283	3302	3785	3876	3937
2023	4311	3255	3292	3805	3905	3972
2024	4378	3224	3279	3822	3932	4004
2025	4447	3192	3265	3839	3958	4037
2026	4516	3161	3252	3856	3983	4068
2027	4583	3145	3236	3871	4008	4099
2028	4646	3126	3217	3884	4030	4127
2029	4708	3105	3197	3896	4052	4155
2030	4772	3085	3176	3909	4073	4183
2031	4834	3063	3154	3920	4094	4210
2032	4901	3025	3133	3932	4116	4239
2033	4968	2987	3111	3944	4137	4266
2034	5033	2948	3088	3954	4157	4293
2035	5107	2911	3068	3967	4179	4321
2036	5177	2872	3045	3976	4199	4347

Note: Table row values for **Year 2011*** is the baseline population for the survival model estimates.

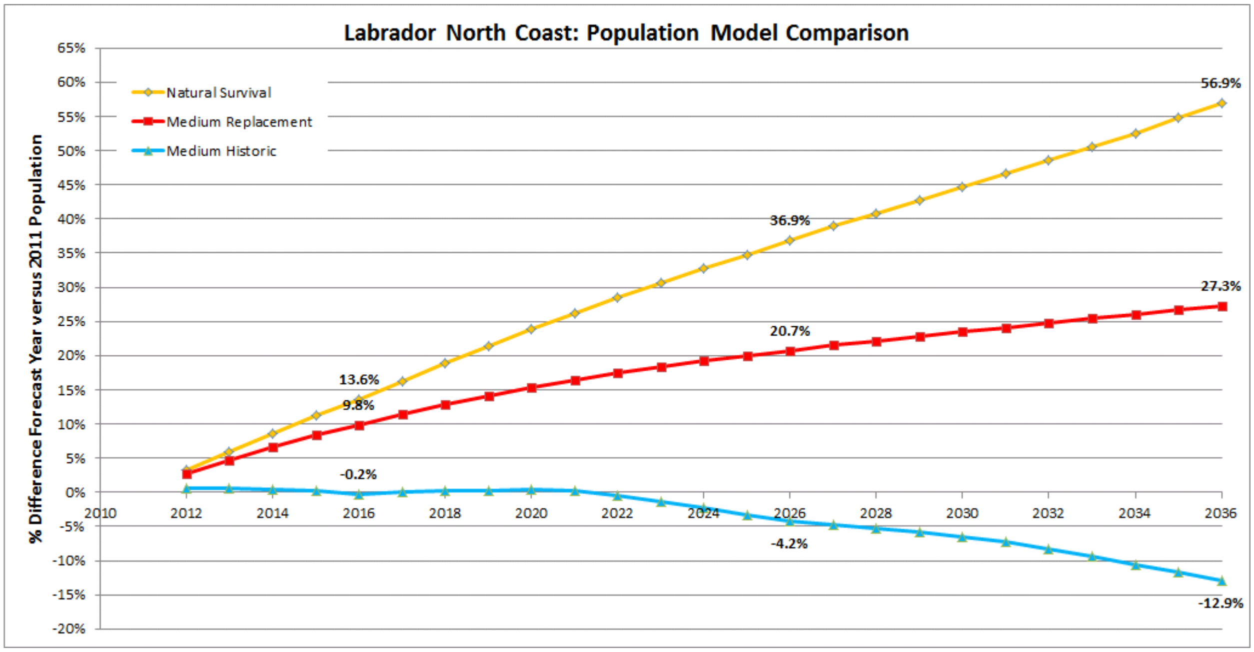

Figure 3.4 Labrador North Coast: Natural Survival, Historic Survival and Medium Replacement Models Predicted Percent Population Change (Baseline Year – 2011)

For the 2016 outcomes (Figure 3.5), there is very little difference between the Medium and High HS scenarios, but there is a marked difference between the HS and NS scenarios. The difference between these two models would suggest that the migration factor has a significant influence on the model outcomes. The NS outcomes also suggest that if the regional birth and death rates remain constant over time, there is a shift in the youth-oriented 2011 age structure to an older age structure by 2036 (Figure 3.7). For example, the average age in 2011 was 28 years, but by 2036, this will increase to 39 years[5].

[5] Average age for each year is computed as a weighted average where (Individual Age * Count) / Total Count

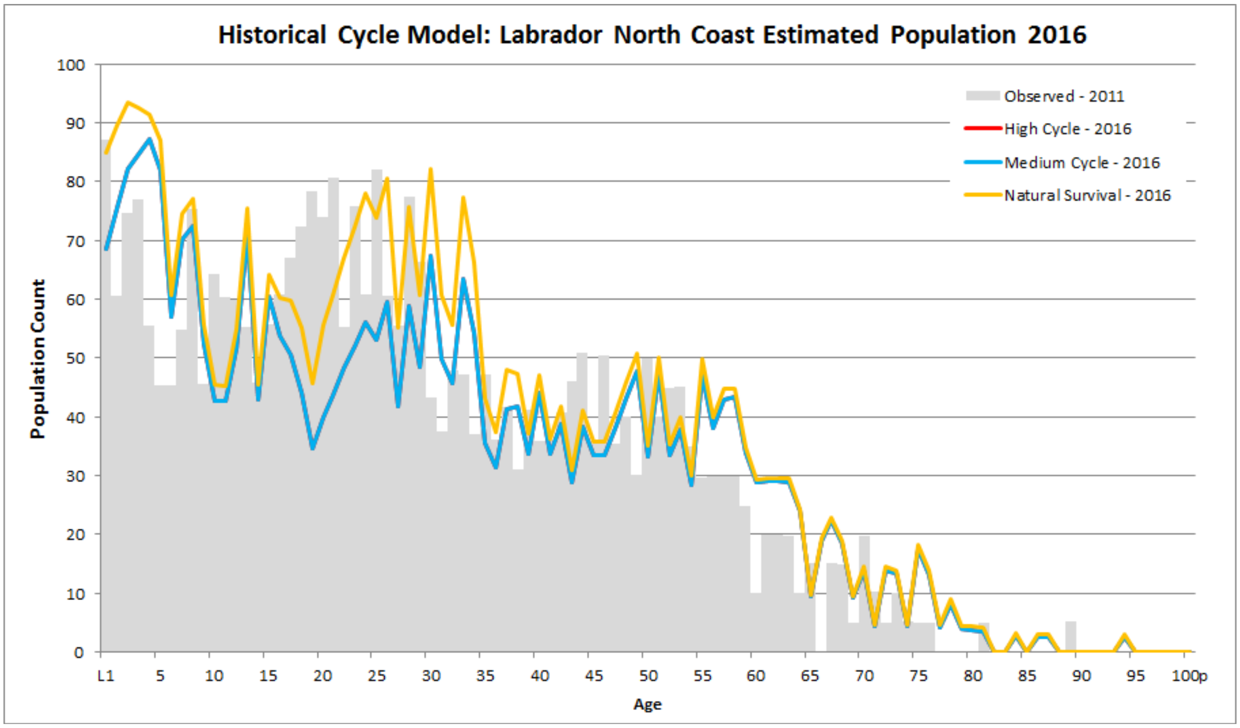

Figure 3.5 Labrador North Coast: Observed Versus Natural and Historic Survival Models 2016 Predicted Population Age Structure

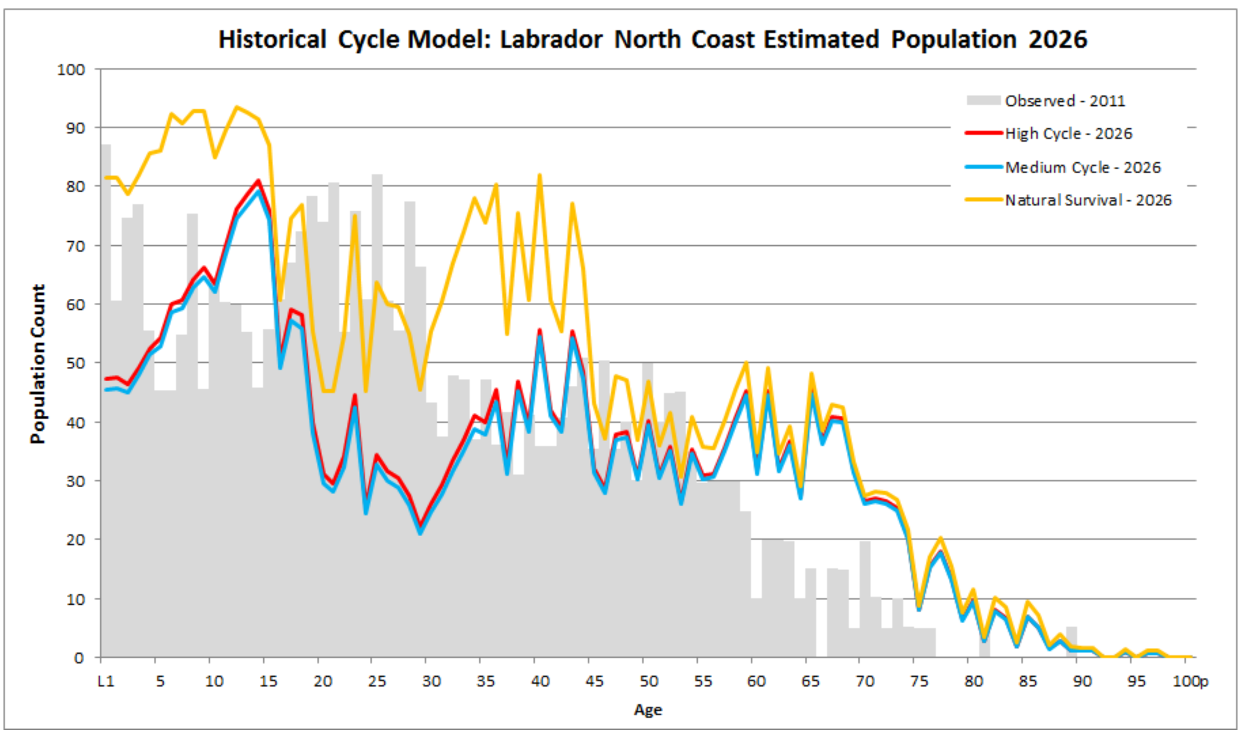

Figure 3.6 Labrador North Coast: Observed Versus Natural and Historic Survival Models 2026 Predicted Population Age Structure

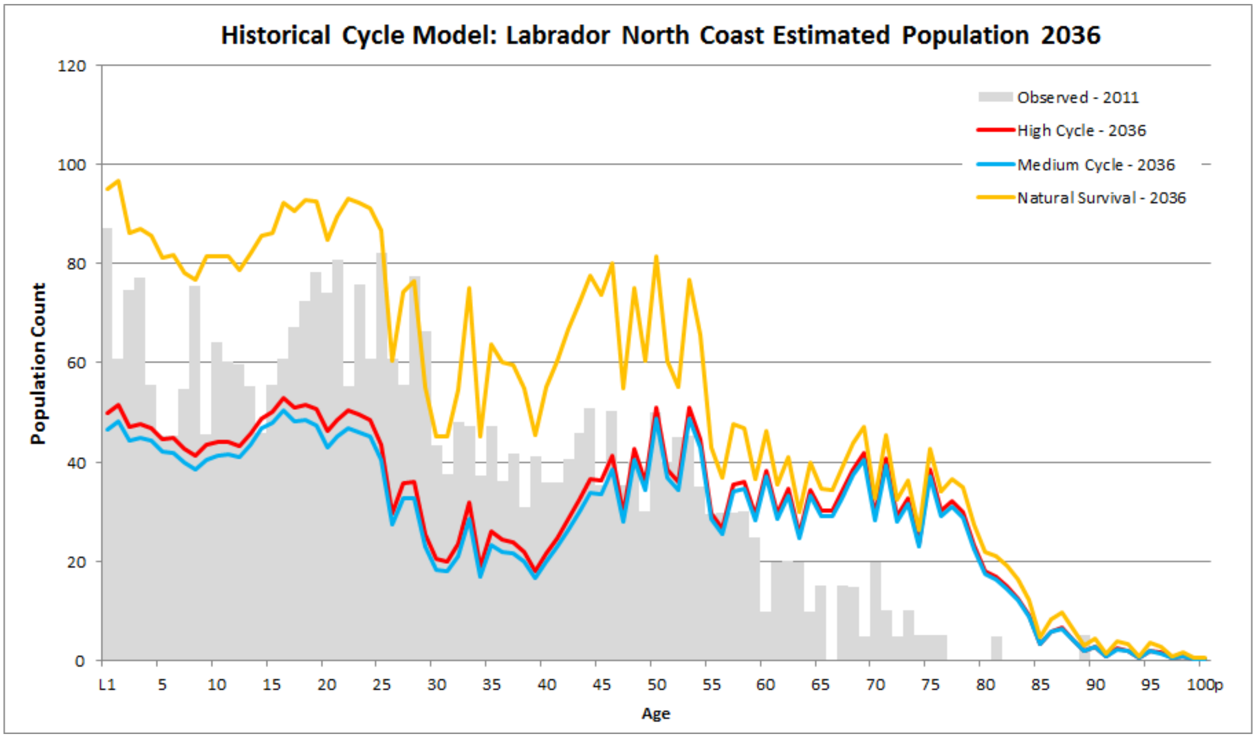

Figure 3.7 Labrador North Coast: Observed Versus Natural and Historic Survival Models 2036 Predicted Population Age Structure

3.2 Central Labrador

The baseline 2011 population for Central Labrador is 9,997. The NS Model indicates that without migration as a factor the population will increase to 11,461 by 2026 and further increase to 11,891 in 2036. This is indicative of a predominantly younger population whose age structure and fertility characteristics indicate a propensity for growth. With the introduction of a migration factor, the Medium HS Model indicates that the population would increase to 10,222 by 2016 and 10,614 by 2026, but would experience a slight decrease to 10,425 by 2036.

The High HS scenario (100% replacement) shows an increasing population over the forecast period, although again with a slight decrease from 2033 to 2036 (Table 3.2). The estimated population using the Medium RS Model (70% replacement) indicates the population will increase to 10,501 and 11,041 by 2016 and 2026 respectively will then continue to increase until 2033 and subsequently decline slightly to 11,109 in 2036 (Table 3.2).

The sustainability factor for the Central Labrador population is evident (at least until 2030) in Figure 3.8, where the NS, Medium HS and Medium RS models all show overall positive growth. The NS model outcomes confirm that, given the 2011 age structure along with the existing birth

Table 3.2 Central Labrador: Population Estimates 2012 to 2036 by Model Type

Year	Natural Survival Model	Historical (Cyclic) Survival Model		Replacment Survival Model		
		Medium Cycle	High Cycle	Low Replacement	Medium Replacement	High Replacement
2011	9997	9997	9997	9997	9997	9997
2012	10117	10052	10052	10111	10113	10114
2013	10233	10101	10101	10217	10220	10222
2014	10347	10147	10147	10316	10320	10324
2015	10458	10186	10186	10407	10414	10418
2016	10568	10222	10222	10493	10501	10506
2017	10675	10312	10312	10572	10581	10587
2018	10780	10398	10398	10645	10656	10664
2019	10879	10478	10478	10711	10723	10732
2020	10974	10554	10554	10770	10785	10794
2021	11066	10625	10625	10825	10841	10852
2022	11154	10635	10692	10873	10891	10903
2023	11239	10640	10754	10918	10937	10950
2024	11318	10639	10810	10956	10977	10991
2025	11392	10631	10861	10989	11012	11028
2026	11461	10614	10902	11016	11041	11057
2027	11522	10644	10936	11037	11064	11081
2028	11581	10671	10967	11056	11084	11103
2029	11633	10690	10989	11070	11099	11119
2030	11683	10705	11009	11080	11112	11133
2031	11728	10715	11022	11087	11120	11142
2032	11768	10665	11029	11090	11125	11148
2033	11804	10611	11033	11089	11126	11150
2034	11836	10552	11032	11085	11124	11149
2035	11865	10490	11027	11078	11118	11145
2036	11891	10425	11020	11067	11109	11137

Note: Table row values for **Year 2011*** is the baseline population for the survival model estimates.

and death rates, the population has the internal natural components to maintain growth. Without a migration factor, the population would increase by 18.9% by 2036. However, the Medium HS outcome, which includes a migration component, indicates growth until 2031 and then a decline to 2036. The Medium RS model outcome shows a steady increase of the population until 2026 (10.4%) after which there is negligible growth to 2036.

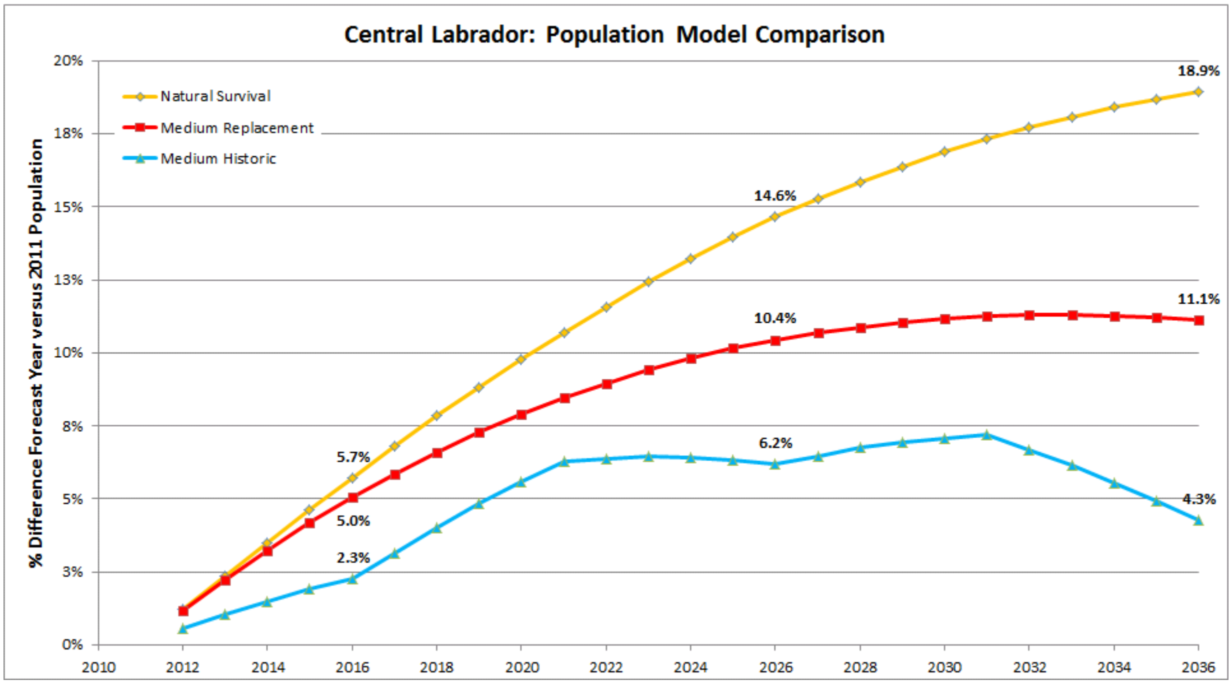

Figure 3.8 Central Labrador: Natural Survival, Historic Survival and Medium Replacement Models Predicted Percent Population Change (Baseline Year – 2011)

Theoretically, for the forecast period, the Central Labrador population can be maintained without replacement. Without replacement of retirees and a continuation of historical cycles the 2016, the population would increase to 2.3% above the 2011 baseline, to 6.2% by 2026, though the difference would only be 4.3% by 2036 (Figure 3.8).

The 2011 observed population for Central Labrador as well as the projected NS and HS age structures for 2016, 2026 and 2036 are presented in Figures 3.9, 3.10 and 3.11. The same interpretation rules as stated in Section 3.1 apply.

The short-term 2016 outcomes for the NS and HS models exhibit the greatest differences for ages 15 to 40, but for the 40 + cohorts the outcomes are very similar. Note that the differences between the Medium and High cycle HS scenarios are negligible and because of the scale of the y-axis, the High scenario is not visible. Also there is very little difference between HS scenarios. Overall, the present age structure of the population is generally preserved (Figure 3.9). Of note is that the initial 2011 age structure exhibits the characteristics of a transitional structure with high birth rates and increasing longevity.

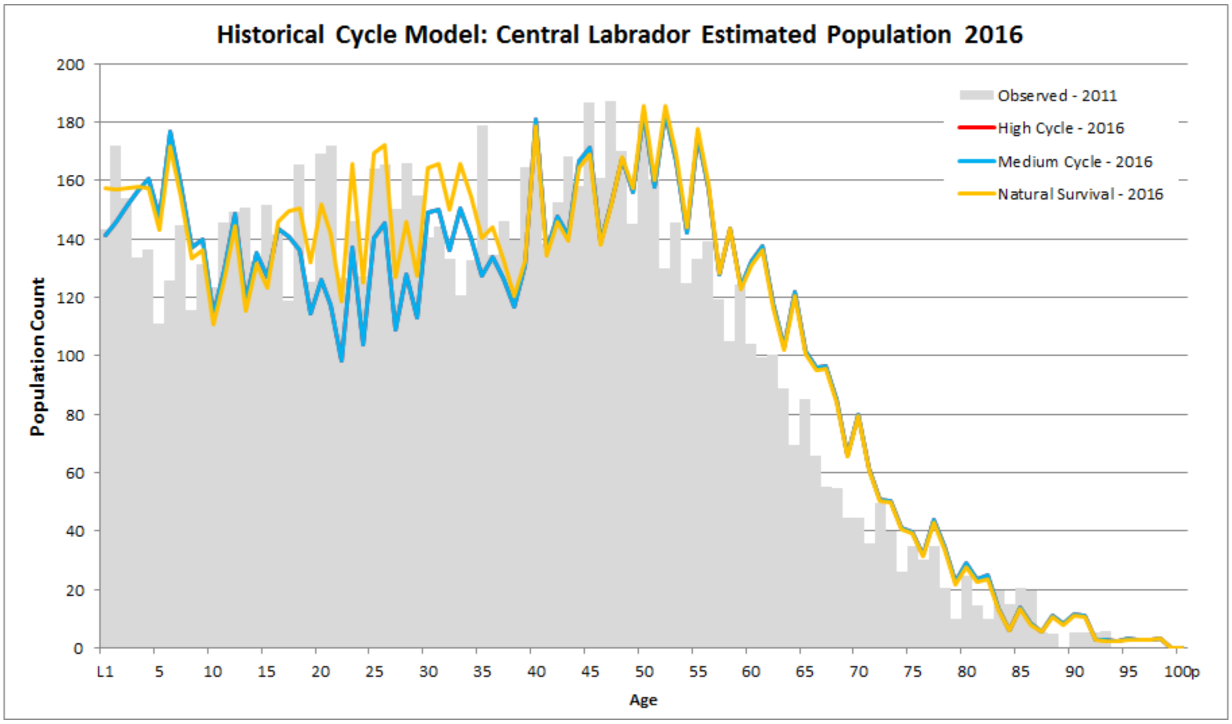

Figure 3.9 Central Labrador: Observed Versus Natural and Historic Survival Models 2016 Predicted Population Age Structure

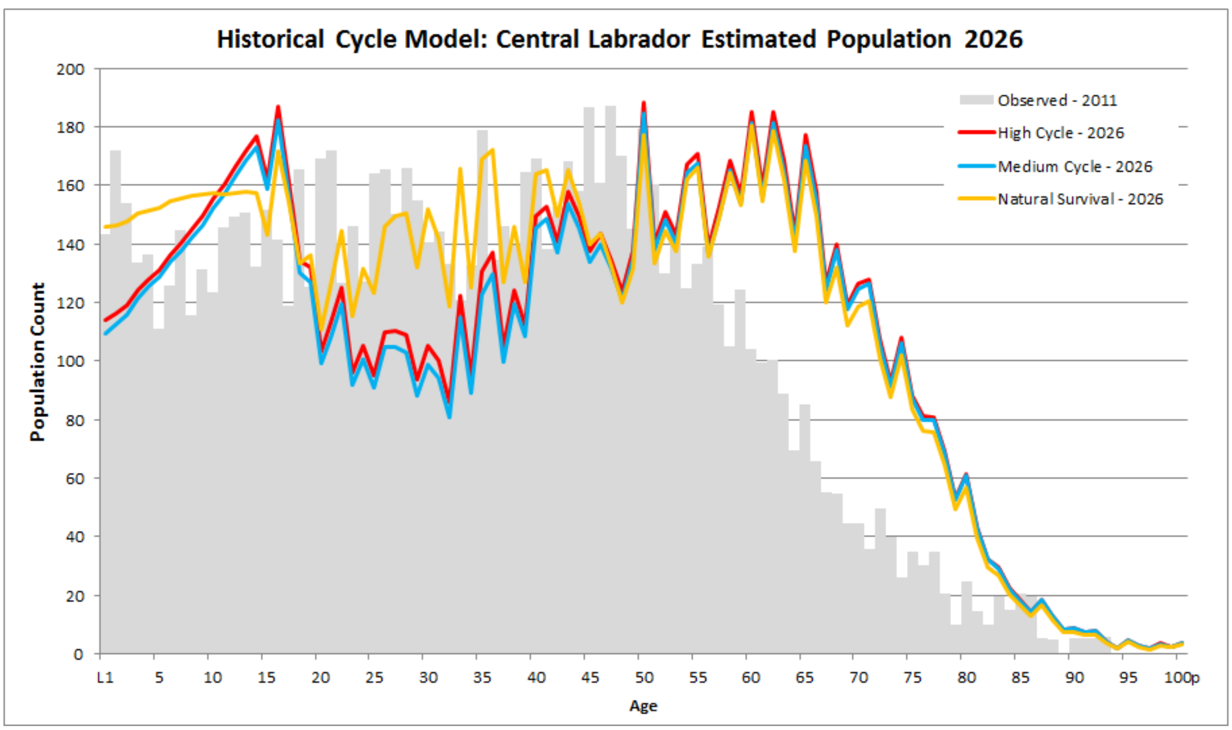

Figure 3.10 Central Labrador: Observed Versus Natural and Historic Survival Models 2026 Predicted Population Age Structure

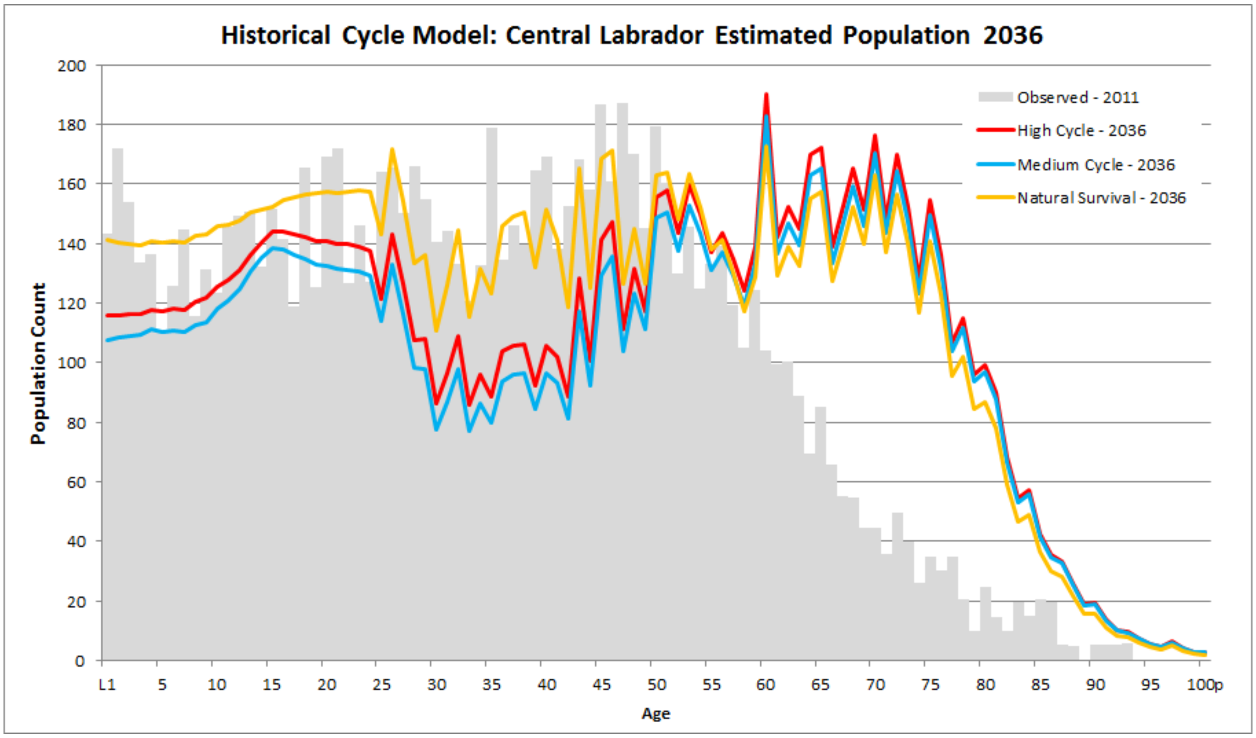

Figure 3.11 Central Labrador: Observed Versus Natural and Historic Survival Models 2036 Predicted Population Age Structure

The projected age structures presented in Figures 3.10 and 3.11 for years 2026 and 2036 indicate that if the birth, death and migration cycles continue without replacement, the population will age significantly. For example, the average age in 2011 was 35 years. The Medium HS results indicate that this will increase to 40 by 2026 and to 44 years by 2036. The NS model suggests that if out-migration is minimal or offset by in-migration, the population can essentially be maintained (Figure 3.10).

In 2026, the projected largest deficit is associated with the 20 to 35 age cohorts (Figure 3.10) with a projected decrease of 46% from 2011. This is the combined result of an overall fertility of less than 2.1 and a migration factor whereby younger cohorts are most likely to leave the region if employment opportunities are limited. Any retiree replacement policy would need to target younger workers to replace the retirees and offset the expected aging trend.

3.3 Labrador South Coast

With a 2011 population of 2,241, the NS model for Labrador's South Coast estimates a population of 2,279 by 2016, while the Medium HS model estimates a population of 2,102, which represents a decline (Table 3.3). For the same period, the RS model predicts a population increase in the Low scenario of 2,303 and 2,329 in the High case. This trend continues through

2026 whereby the NS and RS models predict population increases, while the HS model indicates an overall decline in the population. By 2036, the NS model predicts a decline to 2,191 with the HS scenarios predicting declines, to 1,378 in the Medium case and to 1,448 in the High case. This is the overall result of lower fertility rates for the region and out-migration factors.

The RS model predicts that the population will increase from 2,345 (Low scenario) to 2,482 (High scenario). For all yearly predictions, the RS model predicts higher growth than the NS model while the HS model indicates a continual decline if historical trends continue. Therefore, without retiree replacement through migration this region will experience population decline over the projection period. The limited growth constraint is support by the predicted percent change trends displayed in Figure 3.12, where the NS model trends indicate a low capacity to maintain population growth.

The NS percent difference is 1.9% in 2016, 2.9% in 2026 and declines to -2.2% by 2036. The Medium HS model indicates that out-migration is a major factor where the predicted percentage differences range from -7.9% by 2016 to -38.5% in 2036. Under the Medium RS model assumptions the 2036 percentage difference from the 2011 baseline would be 7.1%. Maintaining the labour force at 2011 levels with moderate growth potential in this region requires at least a 50% workforce population replacement given the assumed trends for births, deaths and migration.

The 2011 age structure presented in Figure 3.13 shows a bimodal age distribution (1 to 20 and 21 plus), which is the remnant of a population age structure with a high birth and increasing longevity, transitioning to one of lower births and increasing longevity. This bimodal age structure is also related to a young adult retention issue whereby many young people who leave the community in their early 20s do not necessarily return when they are older. A characteristic of this structure type is a slower growth rate that will eventually create issues because of an aging population and overall population decline. For example, the NS trend line in Figure 3.12 is indicative of a region with slowing natural population growth. By 2026 and 2036 the age structure of the population has shifted to one of lower births and increasing longevity (Figures 3.13, 3.14 and 3.15). For example, the average population age for 2011 is 41 years, increasing to 50 by 2026 and to 55 by 2036. Without a strategy for retiree replacements and if the historical trends continue, the region cannot maintain its 2011 population levels over the projection period.

Table 3.3 Labrador South Coast: Population Estimates 2012 to 2036 by Model Type

Year	Natural Survival Model	Historical (Cyclic) Survival Model		Replacment Survival Model		
		Medium Cycle	High Cycle	Low Replacement	Medium Replacement	High Replacement
2011	2241	2241	2241	2241	2241	2241
2012	2261	2217	2217	2264	2266	2269
2013	2265	2177	2177	2273	2277	2283
2014	2272	2141	2141	2285	2291	2301
2015	2276	2102	2102	2294	2302	2315
2016	2279	2064	2064	2303	2313	2329
2017	2285	2038	2038	2313	2325	2344
2018	2288	2010	2010	2320	2335	2358
2019	2293	1984	1984	2329	2346	2372
2020	2298	1958	1958	2337	2357	2385
2021	2300	1930	1930	2343	2365	2397
2022	2302	1894	1903	2349	2373	2408
2023	2307	1858	1877	2356	2382	2420
2024	2306	1820	1847	2359	2387	2429
2025	2306	1782	1818	2362	2393	2438
2026	2306	1745	1789	2366	2399	2447
2027	2298	1713	1756	2366	2401	2453
2028	2294	1682	1724	2367	2404	2460
2029	2287	1650	1692	2367	2406	2465
2030	2278	1618	1659	2366	2408	2470
2031	2267	1585	1625	2364	2408	2474
2032	2252	1543	1590	2361	2407	2476
2033	2237	1501	1554	2357	2405	2477
2034	2220	1459	1518	2353	2403	2479
2035	2205	1418	1483	2349	2401	2480
2036	2191	1378	1448	2345	2400	2482

Note: Table row values for **Year 2011*** is the baseline population for the survival model estimates

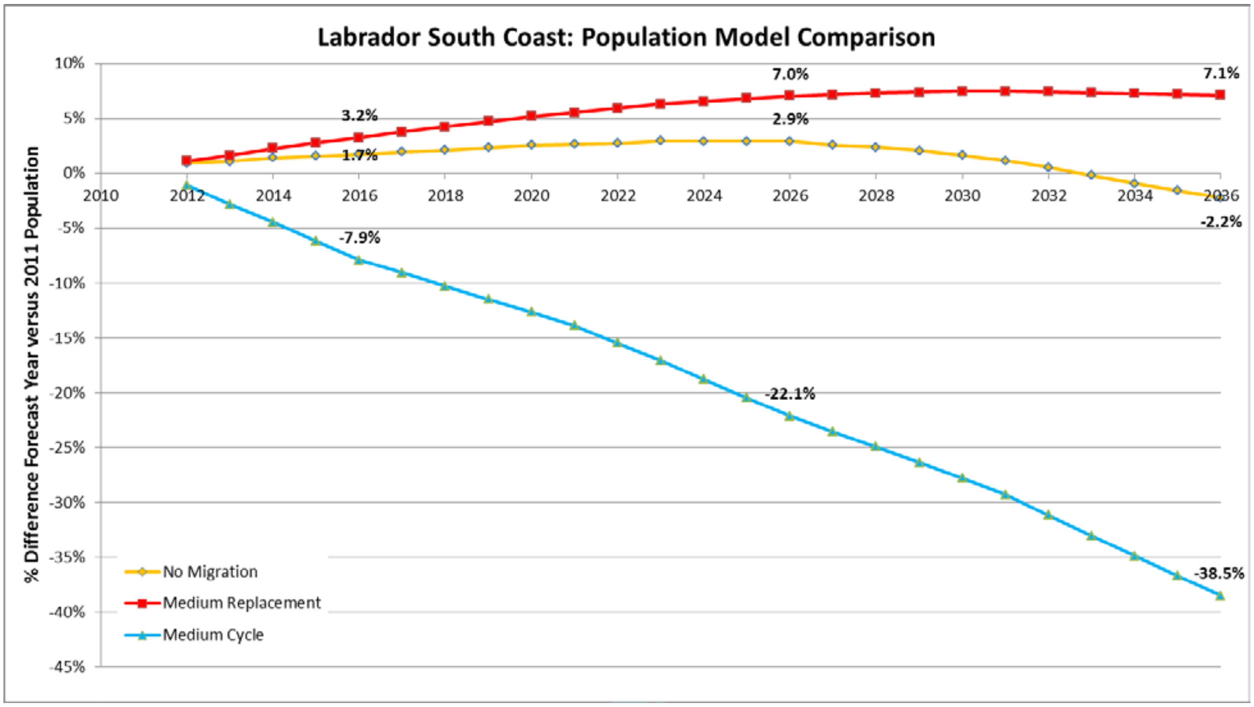

Figure 3.12 Labrador South Coast: Natural Survival, Historic Survival and Medium Replacement Models Predicted Percent Population Change (Baseline Year – 2011)

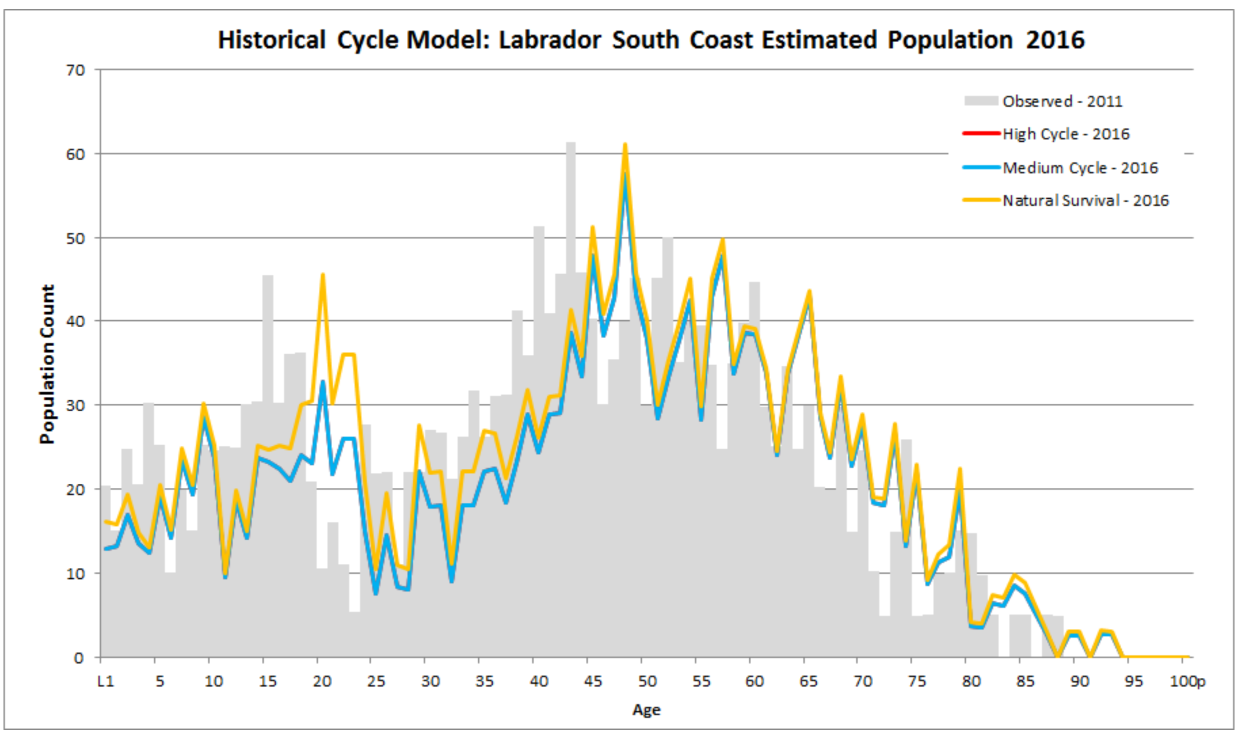

Figure 3.13 Labrador South Coast: Observed Versus Natural and Historic Survival Models 2016 Predicted Population Age Structure

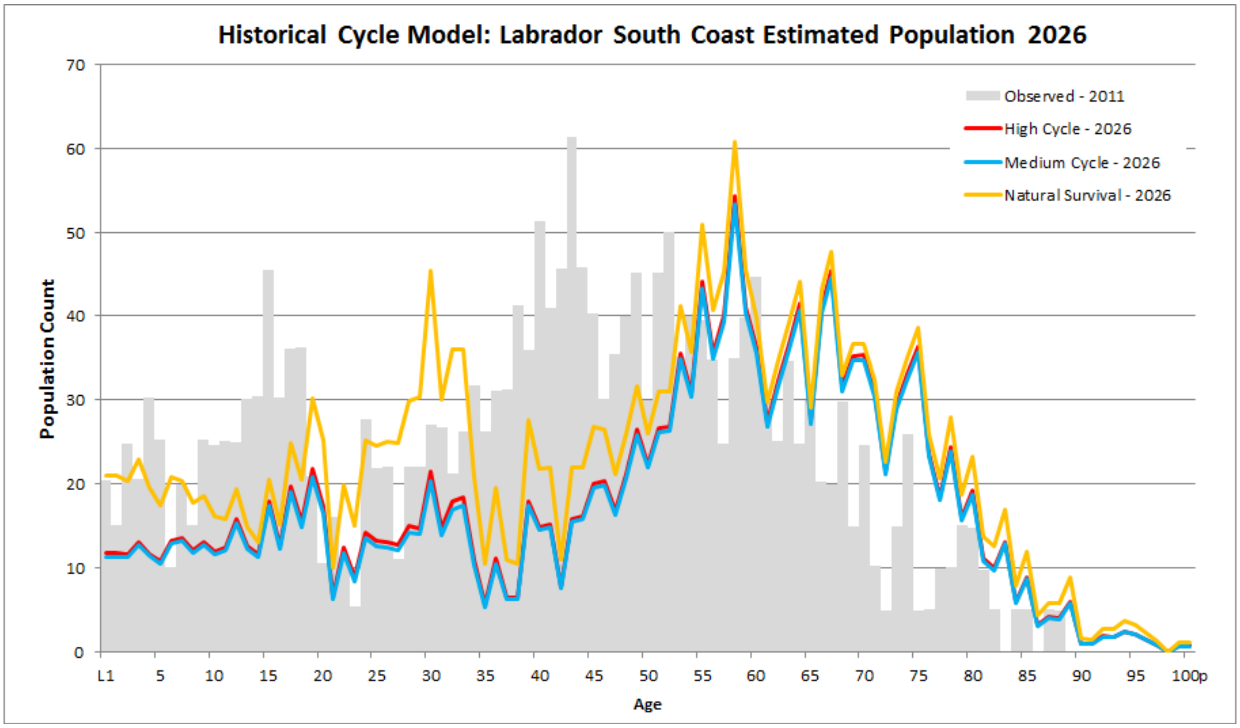

Figure 3.14 Labrador South Coast Observed Versus Natural and Historic Survival Models 2026 Predicted Population Age Structure

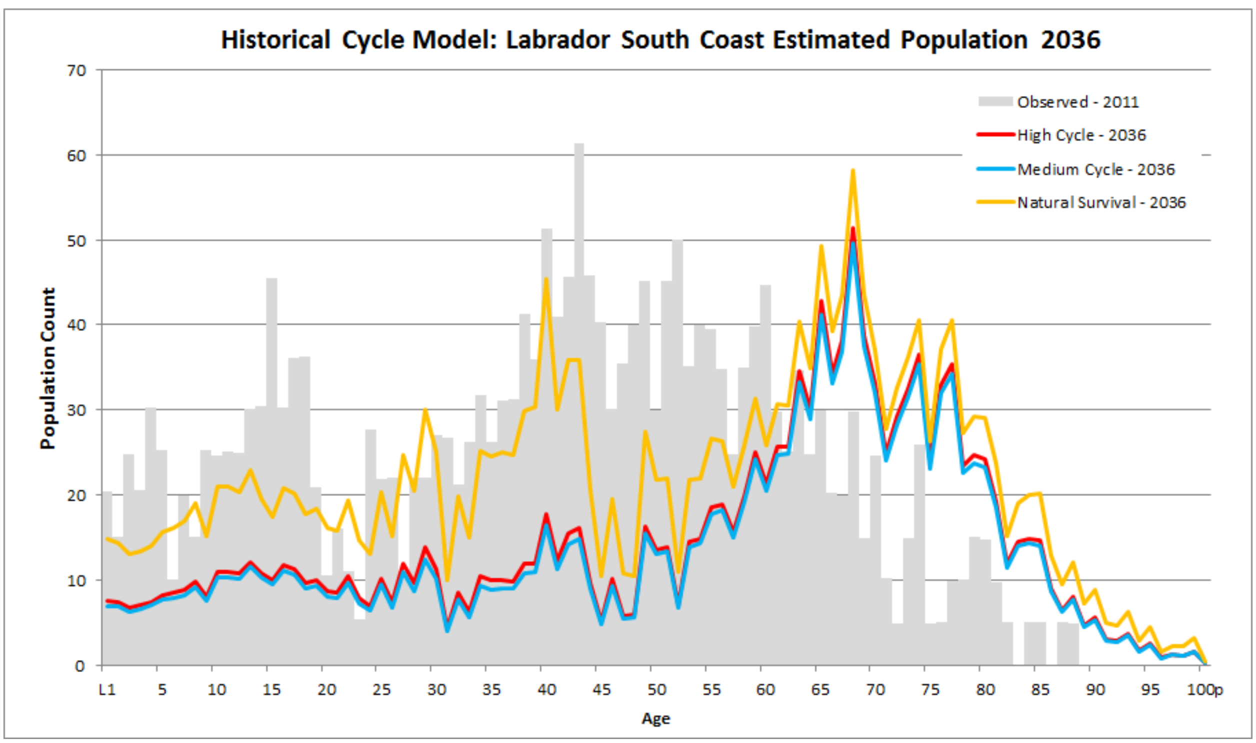

Figure 3.15 Labrador South Coast: Observed Versus Natural and Historic Survival Models 2036 Predicted Population Age Structure

3.4 Labrador Straits

The 2011 population of the Labrador Straits was 1,724. The NS Model predicts a decline to 1,435 by 2036, which indicates that under the assumptions for fertility and death rates the region cannot maintain its population through natural replacement. The HS model projects a population decrease to 1,585 in 2016 and a further decrease to between 1,041 (Medium scenario) and 1,085 (High scenario) by 2036 (Table 3.4).

Note that the difference between the Medium and High HS models is negligible. This is related to both the fertility and mobility factors within the population, whereby the low youth/young adult numbers and a higher number of people in the older cohorts produces an age structure such that varying migration levels between Medium and High assumption rates do not produce significant differences in the predictions. This is because older cohorts have a much lower propensity to migrate than younger cohorts (20 to 35 years) resulting in the migration factor having less influence on the model outcomes.

The RS model scenarios predict a population that ranges from 1,721 (Low scenario) to 1,745 (High scenario) by 2016. Long-term RS forecasts for 2036 show the population will decline under each scenario. Even under the High (100%) replacement assumption the model projects an overall decrease from 1,724 in 2011 to 1,633 by 2036. Thus, for the region to maintain its 2011 population it requires more than 100% replacement over the long term and a strategy for attracting or retaining younger replacement workers.

The prospective decline in population is further illustrated in Figure 3.16. The NS predictions illustrate that the population cannot replace itself and there would be a 16.8% decline in the population between 2011 and 2036. Under the Medium HS model assumptions, which include migration, the population would decrease by 39.6% by 2036. Under the Medium (70%) RS model the population remains relatively stable until 2020 and declines thereafter. This region can be described as one of chronic decline, whereby the age structure cannot maintain its 2011 population levels without more than retiree replacement.

Table 3.4 Labrador Straits: Population Estimates 2012 to 2036 by Model Type

Year	Natural Survival Model	Historical (Cyclic) Survival Model		Replacment Survival Model		
		Medium Cycle	High Cycle	Low Replacement	Medium Replacement	High Replacement
2011	1724	1724	1724	1724	1724	1724
2012	1728	1705	1705	1731	1732	1735
2013	1724	1678	1678	1731	1735	1740
2014	1718	1649	1649	1730	1735	1744
2015	1707	1616	1616	1724	1732	1743
2016	1699	1585	1585	1721	1731	1745
2017	1686	1558	1558	1714	1726	1743
2018	1681	1537	1537	1713	1726	1746
2019	1670	1512	1512	1707	1723	1746
2020	1663	1491	1491	1703	1721	1747
2021	1654	1467	1467	1698	1717	1746
2022	1641	1436	1442	1690	1712	1744
2023	1629	1406	1417	1684	1707	1742
2024	1617	1376	1393	1676	1701	1739
2025	1605	1346	1369	1668	1695	1736
2026	1591	1316	1344	1659	1688	1731
2027	1577	1290	1318	1648	1679	1726
2028	1565	1267	1294	1639	1672	1721
2029	1554	1243	1270	1630	1664	1716
2030	1539	1217	1244	1619	1655	1710
2031	1527	1193	1219	1608	1647	1705
2032	1510	1162	1193	1596	1636	1697
2033	1491	1132	1166	1583	1625	1689
2034	1470	1101	1139	1570	1614	1680
2035	1453	1071	1112	1557	1603	1671
2036	1435	1041	1085	1544	1591	1663

Note: Table row values for **Year 2011*** is the baseline population for the survival model estimates

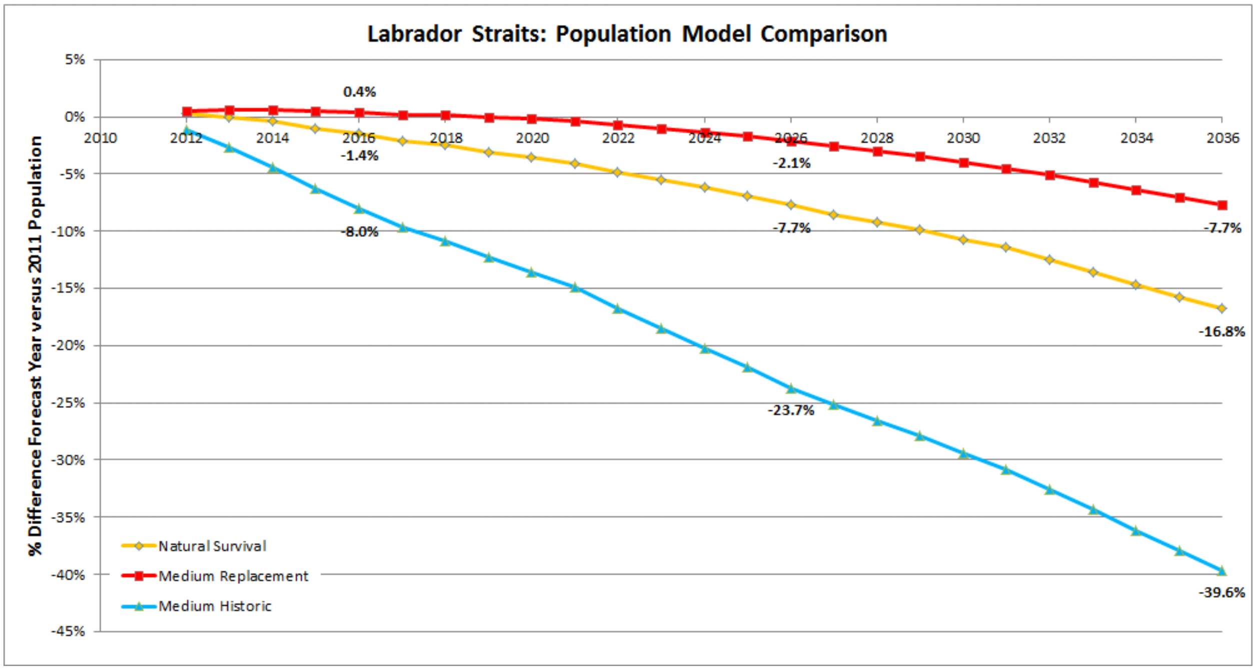

Figure 3.16 Labrador Straits: Natural Survival, Historic Survival and Medium Replacement Models Predicted Percent Population Change (Baseline Year – 2011)

The 2011 age structure of the Labrador Straits is bi-modal with a bias towards the older age cohorts (Figure 3.17). This population has shifted to an age structure associated with very low birth rates and increased longevity. Regions with these characteristics tend to be low growth, or declining regions whose future growth is dependent on relatively high levels of in-migration. However, because of the rapid aging factor, simple replacement of retirees will not maintain this region's population. Future stability of the size of the working population requires a more in-depth strategy that examines fertility and young worker retention issues. In 2011, the average age of the population was 45. By 2026 and 2036 (Figures 3.18 and 3.19) the average age is forecast to increase to 55 and 59 years respectively.

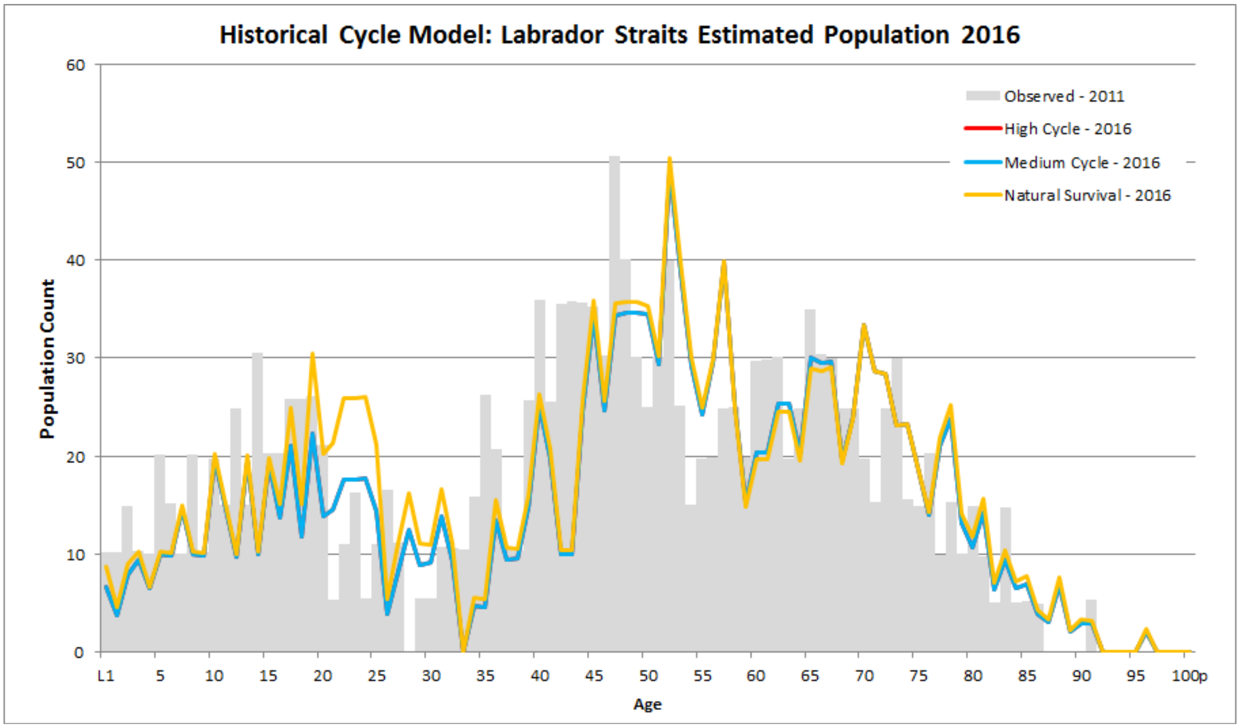

Figure 3.17 Labrador Straits: Observed Versus Natural and Historic Survival Models 2016 Predicted Population Age Structure

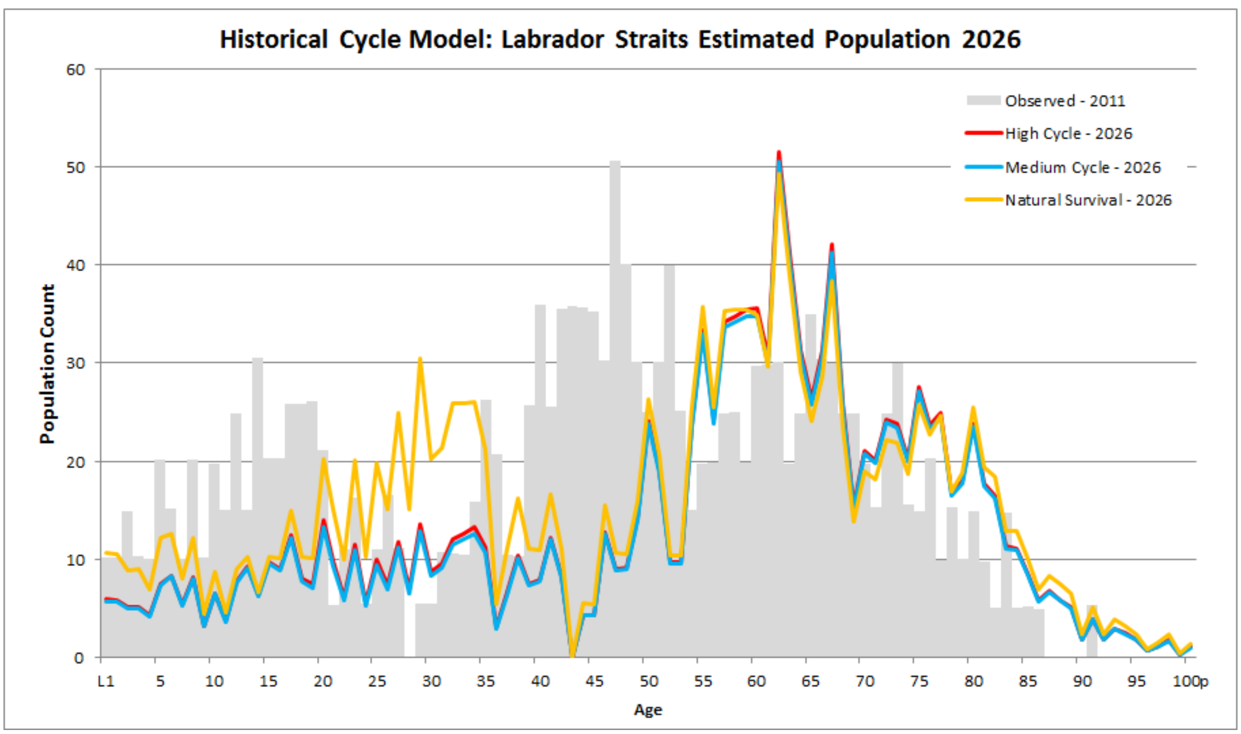

Figure 3.18 Labrador Straits: Observed Versus Natural and Historic Survival Models 2026 Predicted Population Age Structure

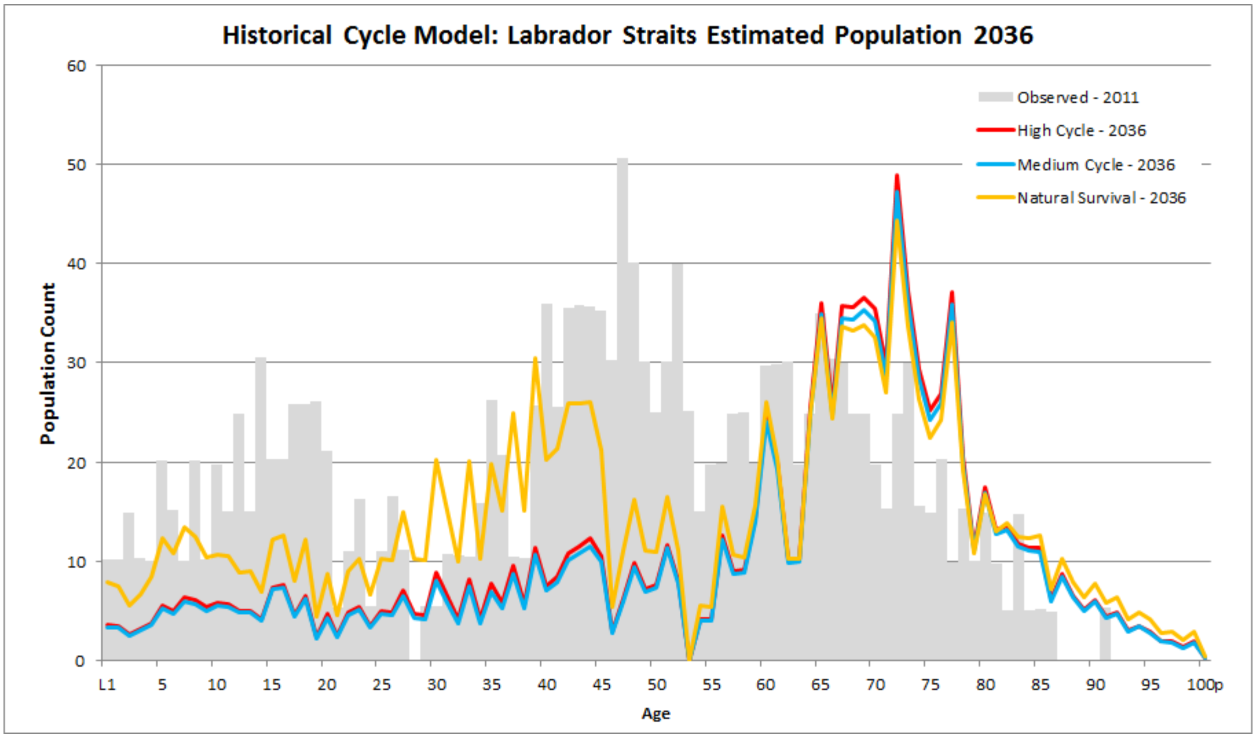

Figure 3.19 Labrador Straits: Observed Versus Natural and Historic Survival Models 2036 Predicted Population Age Structure

3.5 Northern Peninsula

The Northern Peninsula region, as defined by this study, is larger than the IGA administrative region, but does not include all of the sub-regions that would normally constitute the Northern Peninsula. This larger area is used for the projections because of age structure and fertility rate data issues associated with the smaller IGA administrative area. With a 2011 population of 14,220 this is the largest of the study regions. For the NS model, a slight decline is projected to 14,134 by 2016, with a further decline to 12,263 by 2036 (Table 3.5). This is a function of the internal age structure and prevailing “Local Area” birth and death rates that cannot maintain the population at the 2011 levels without replacing more than 50% of the retiree portion of the population.

The HS model projects that the population would decrease to 12,876 by 2016, and if the trends persist through 2036, the population will continue to decrease to 7,870 and 8,261 respectively, under the Medium and High HS scenarios.

The RS model estimates that the 2016 population could range from 14,364 to 14,585 for the Low (50%) and High (100%) retiree replacement scenarios. The range is greater for 2036 where

Table 3.5 Northern Peninsula: Population Estimates 2012 to 2036 by Model Type

Year	Natural Survival Model	Historical (Cyclic) Survival Model		Replacment Survival Model		
		Medium Cycle	High Cycle	Low Replacement	Medium Replacement	High Replacement
2011*	14220	14220	14220	14220	14220	14220
2012	14248	13982	13982	14283	14300	14326
2013	14227	13703	13703	14308	14343	14395
2014	14198	13422	13422	14327	14380	14459
2015	14170	13150	13150	14349	14419	14525
2016	14134	12876	12876	14364	14452	14585
2017	14097	12669	12669	14380	14486	14646
2018	14047	12455	12455	14386	14511	14698
2019	13995	12242	12242	14392	14535	14750
2020	13947	12034	12034	14400	14561	14803
2021	13888	11818	11818	14400	14580	14850
2022	13830	11547	11603	14401	14599	14896
2023	13766	11276	11385	14398	14615	14941
2024	13690	11000	11158	14389	14624	14978
2025	13611	10725	10932	14379	14633	15014
2026	13522	10447	10700	14362	14635	15043
2027	13428	10218	10466	14343	14635	15071
2028	13323	9985	10228	14319	14629	15094
2029	13212	9750	9988	14292	14620	15113
2030	13091	9512	9745	14261	14608	15129
2031	12968	9273	9502	14228	14594	15143
2032	12834	8988	9254	14191	14576	15153
2033	12698	8706	9007	14153	14557	15162
2034	12561	8427	8761	14115	14537	15170
2035	12413	8148	8511	14073	14513	15174
2036	12262	7870	8261	14029	14488	15177

*Note: Table row values for **Year 2011*** is the baseline population for the survival model estimates*

the estimates vary from 14,029 (Low) to 15,177 (High) for the same scenarios (Table 3.5). Again, a population replacement strategy is required in order to maintain the working population at or above 2011 levels. The percent difference between the forecast and 2011 population values in Figure 3.20 reinforces the issue concerning the capacity of the region to maintain its 2011 population level without retiree replacement. The NS model percent difference is -0.6% by 2016 and increases to –13.8% by 2036. The Medium HS forecast, which includes a migration component, indicates a significant population decrease, – 44.7% by 2036. Only with a 70% (Medium RS model) replacement of the working population are population numbers likely to

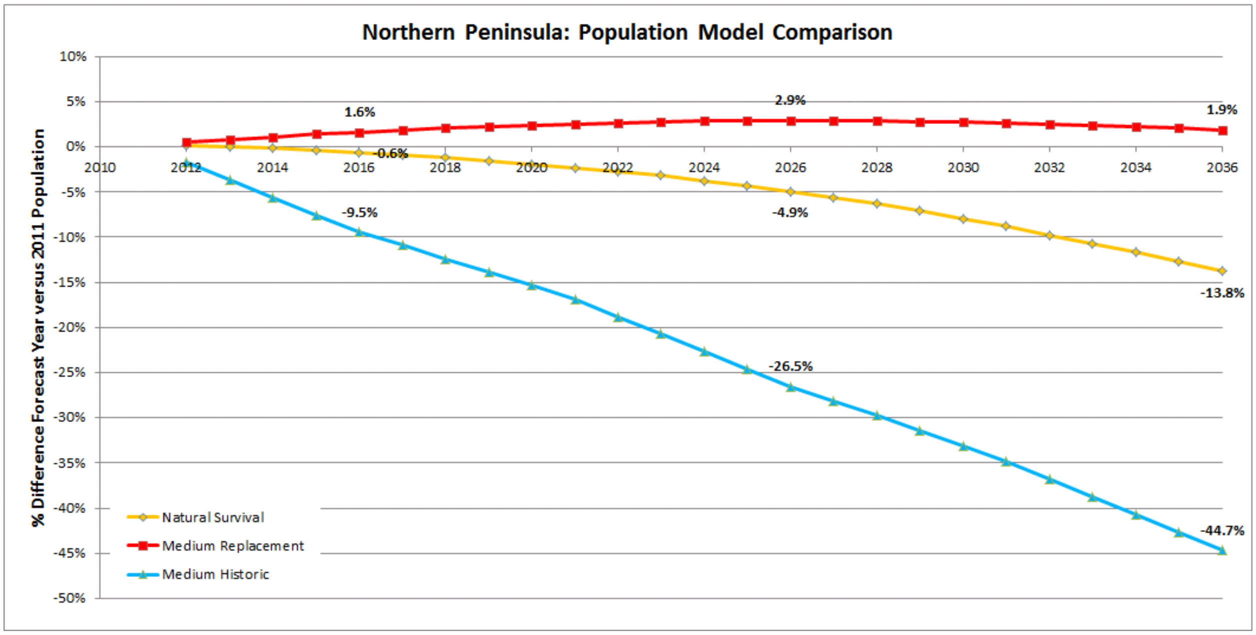

Figure 3.20 Northern Peninsula: Natural Survival, Historic Survival and Medium Replacement Models Predicted Percent Population Change (Baseline Year – 2011)

remain stable. Any potential for growth in the region is dependent on either or both of a higher replacement factor or productivity increases.

Under a 100% (High) replacement assumption, a 6.9% increase in population is forecast by 2036. If there is no replacement and the Medium HS model assumptions hold, the changes from the 2011 population are -9.5% by 2016 to -44.7% by 2036.

The Northern Peninsula 2011 age structure is similar to that of the Labrador Straits in that it is a region with low birth rates and increasing longevity (Figure 3.21). However, with its larger population the region can maintain its 2011 population level and even grow slightly if the retiree replacement is at least 70% (Table 3.5 and Figure 3.20). If the HS trends persist and there is no replacement strategy, the population will decline and will also become dominated by age cohorts 50 years and greater. Under this scenario, the region will not be able to maintain its 2011 population level. Since both models contain the same birth and death rates, the gap between the NS and Medium HS outcomes can be interpreted as aging and migration effects on the estimates (Figures 3.22 and 3.23). For example, the percentage differences between the Medium HS and the NS 20-35 cohort projections for 2026 and 2036 are -29% and -55% respectively. Furthermore, the estimated average age of the population increases from 45 years in 2011 to 54 by 2026 and 58 years by 2036.

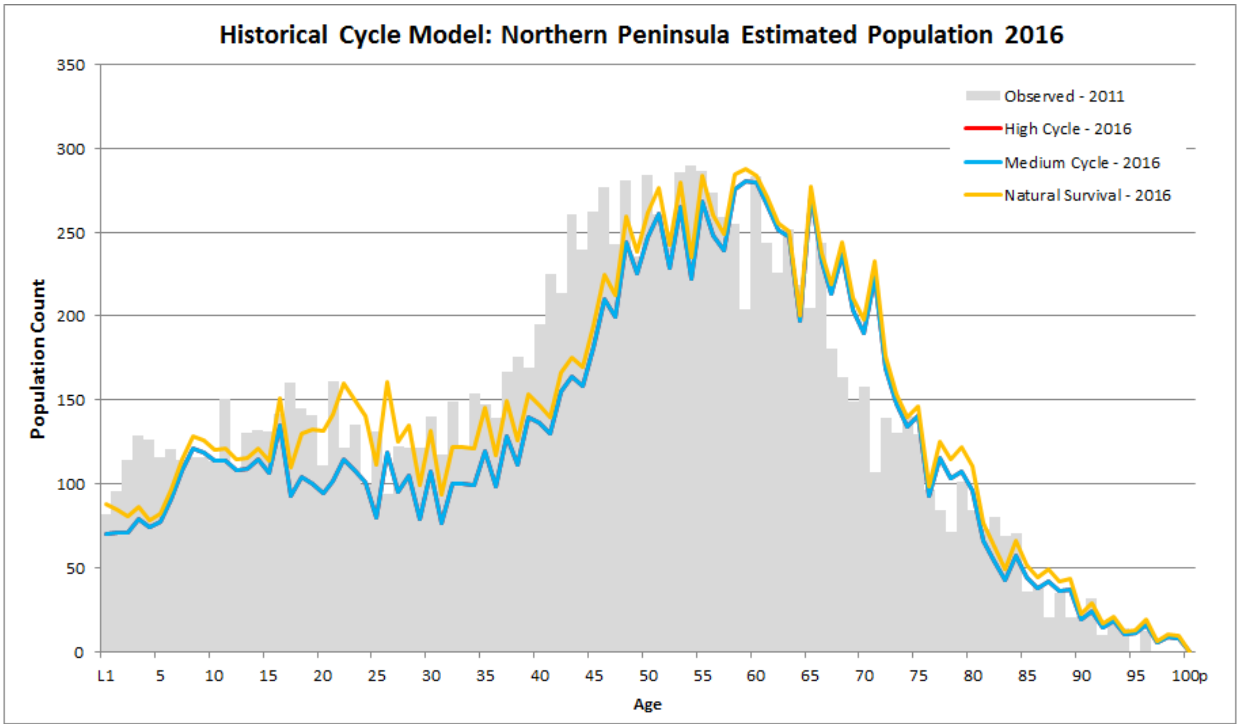

Figure 3.21: Northern Peninsula: Observed Versus Natural and Historic Survival Models 2016 Predicted Population Age Structure

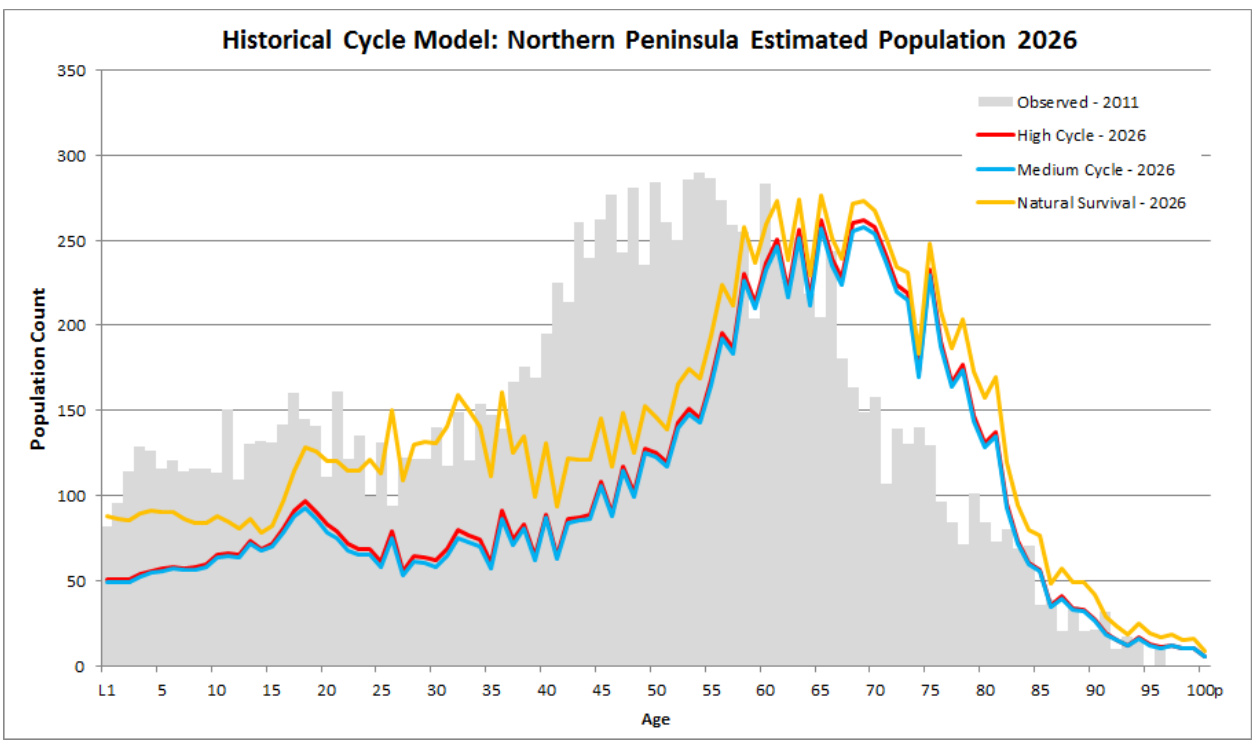

Figure 3.22: Northern Peninsula: Observed Versus Natural and Historic Survival Models 2026 Predicted Population Age Structure

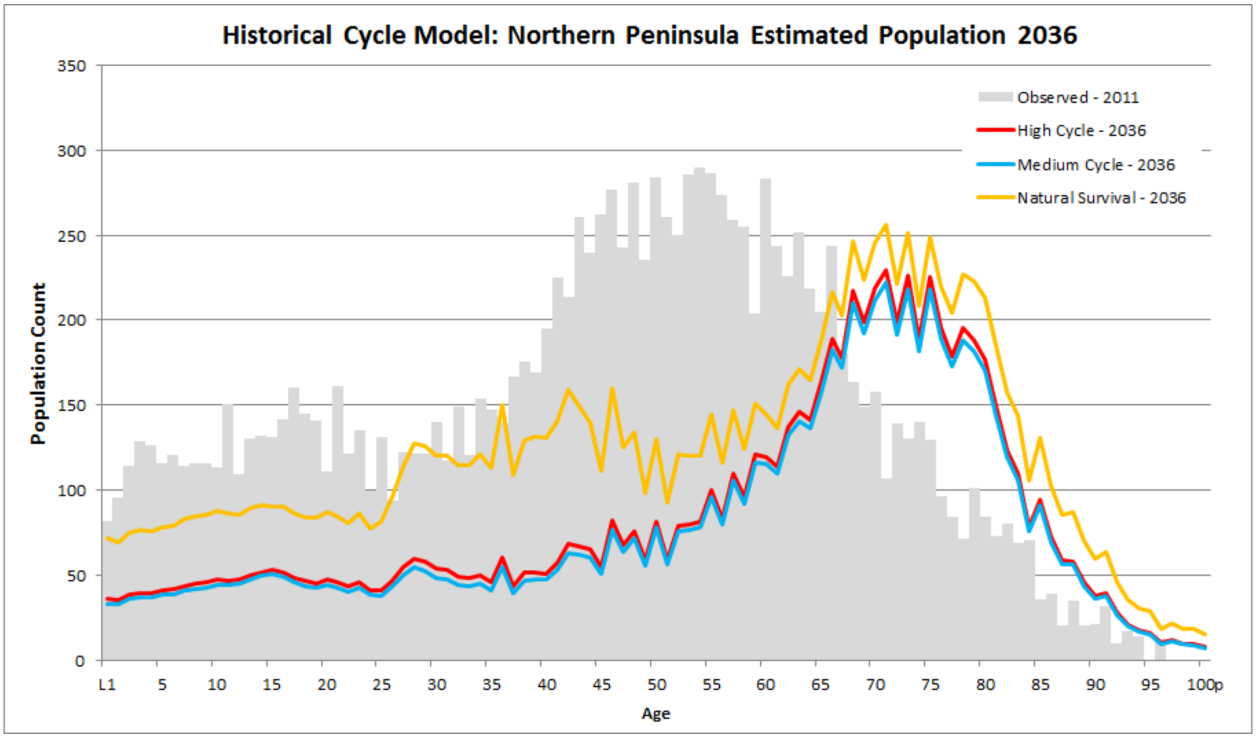

Figure 3.23: Northern Peninsula: Observed Versus Natural and Historic Survival Models 2036 Predicted Population Age Structure

3.6 Labrador West

Labrador West is not a part of the IGA regional framework; however, because of its importance to the Labrador economy it is included in the modelling process for Labrador as a whole. The 2011 census population for the region was 10,108. Like Central Labrador, this region has the capacity to maintain its population over the short term. For 2026, the NS estimate is 10,766 and the HS Medium and High scenarios estimates range from 10,063 to 10,332 (Table 3.6). This suggests that the internal age structure and corresponding birth, death and migration rate dynamics provide potential conditions for maintaining the 2011 population levels.

Under the RS model the replacement rate can be 50% or lower and growth could still be maintained from 2011 to 2016. If there are no replacements for retirees, the HS model predicts that by 2036, the population will range from a low of 9,409 (Medium scenario) to 9,925 (High scenario). This is lower than the 10,438 to 10,731 range estimated by the Low (50%) and High (100%) RS model scenarios for the same period.

Table 3.6 Labrador West: Population Estimates 2012 to 2036 by Model Type

Year	Natural Survival Model	Historical (Cyclic) Survival Model		Replacment Survival Model		
		Medium Cycle	High Cycle	Low Replacement	Medium Replacement	High Replacement
2011*	10108	10108	10108	10108	10108	10108
2012	10182	10115	10115	10193	10198	10205
2013	10254	10119	10119	10272	10281	10295
2014	10320	10119	10119	10344	10357	10378
2015	10382	10114	10114	10408	10427	10454
2016	10440	10105	10105	10467	10489	10524
2017	10495	10152	10152	10520	10547	10589
2018	10545	10194	10194	10567	10599	10647
2019	10591	10231	10231	10608	10645	10700
2020	10632	10263	10263	10644	10685	10748
2021	10667	10289	10289	10672	10719	10788
2022	10696	10254	10308	10695	10746	10823
2023	10722	10214	10323	10714	10770	10853
2024	10743	10170	10333	10727	10788	10879
2025	10757	10119	10335	10734	10799	10897
2026	10766	10063	10332	10735	10805	10910
2027	10767	10048	10319	10729	10804	10916
2028	10761	10027	10299	10718	10797	10916
2029	10750	10001	10275	10702	10786	10913
2030	10733	9969	10244	10680	10769	10903
2031	10709	9929	10205	10653	10747	10887
2032	10677	9835	10161	10620	10718	10866
2033	10640	9736	10111	10582	10685	10839
2034	10596	9632	10055	10539	10646	10808
2035	10546	9523	9993	10491	10603	10772
2036	10490	9409	9925	10438	10555	10731

Note: Table row values for **Year 2011*** is the baseline population for the survival model estimates

The percent change trends presented in Figure 3.24 also confirm that the inherent characteristics of the population can maintain the 2011 population and result in some growth in the short term. The NS and Medium RS model outcomes are almost identical, with values of 3.3% and 3.8% for 2016 and values of 3.8% and 4.4% for 2036. This suggests that the migration factor in population change, in this case is similar to the retiree replacement component. However, the Medium HS model demonstrates that without retiree replacement the estimated

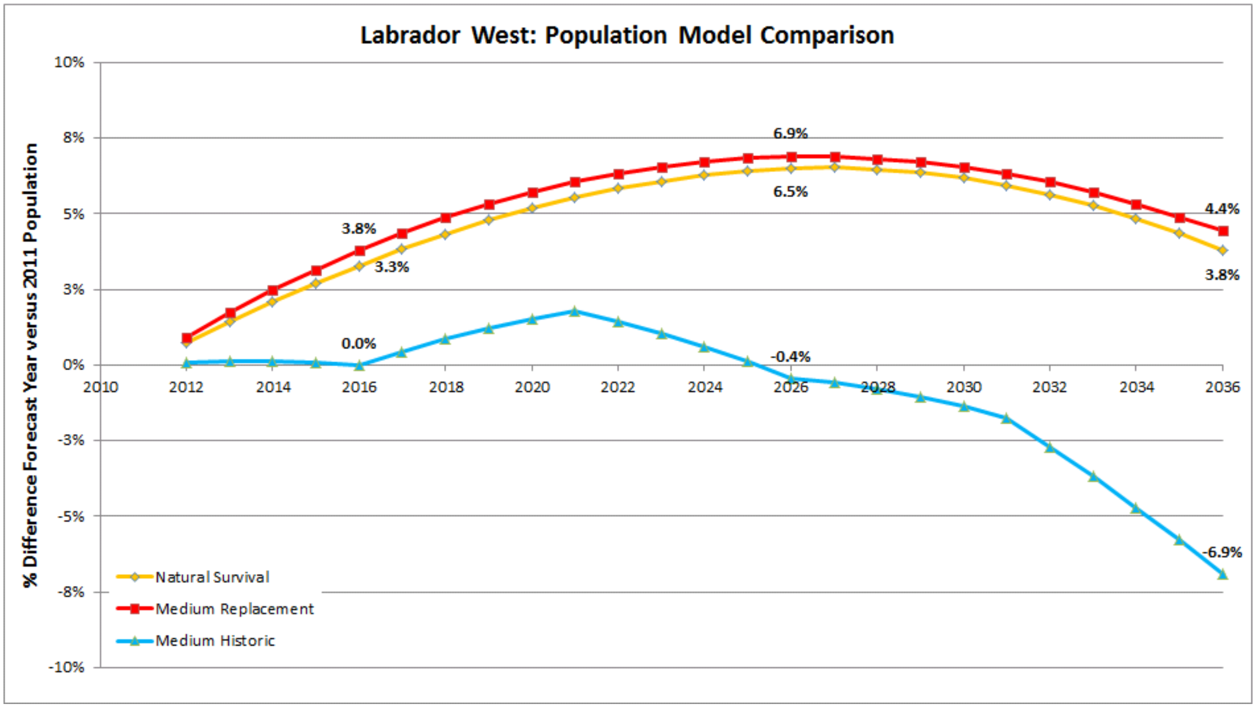

Figure 3.24 Labrador West: Natural Survival, Historic Survival and Medium Replacement Models Predicted Percent Population Change (Baseline Year – 2011)

percent population difference for 2011 to 2016 indicates zero growth, 2016 to 2025 shows growth then decrease, after which there is an increasing rate of decrease to 2036. These scenarios indicate that any long-term population stability or growth in the region would require some level of retiree replacement.

The age structure of the region's population in 2011 reflects the geographic and economic circumstances of its economy, the basis of which is the mining industry. In this case, the age structure appears to be that of high birth and death rates and a cohort distribution in which there are very few people in the 65+ cohort (Figure 3.25). The dynamic of the region's population is such that many of the workers, when they reach the retirement age of 65, out-migrate from the region and are replaced by younger workers. This on-going cycle ensures a stable population base as long as retiring workers are replaced. Given the current iron ore market situation, this seems unlikely, at least in the in the short term. Until markets improve there is likely to be increased out-migration of members of all cohorts.

The Medium HS model produces outcomes showing an age structure similar to a population with decreasing birth rates and increasing longevity that is associated with a slow growth population (Figures 3.26 and 3.27). In this case, the average age of the population would increase from 35 in 2011 to 44 and 49 years in 2026 and 2036 respectively.

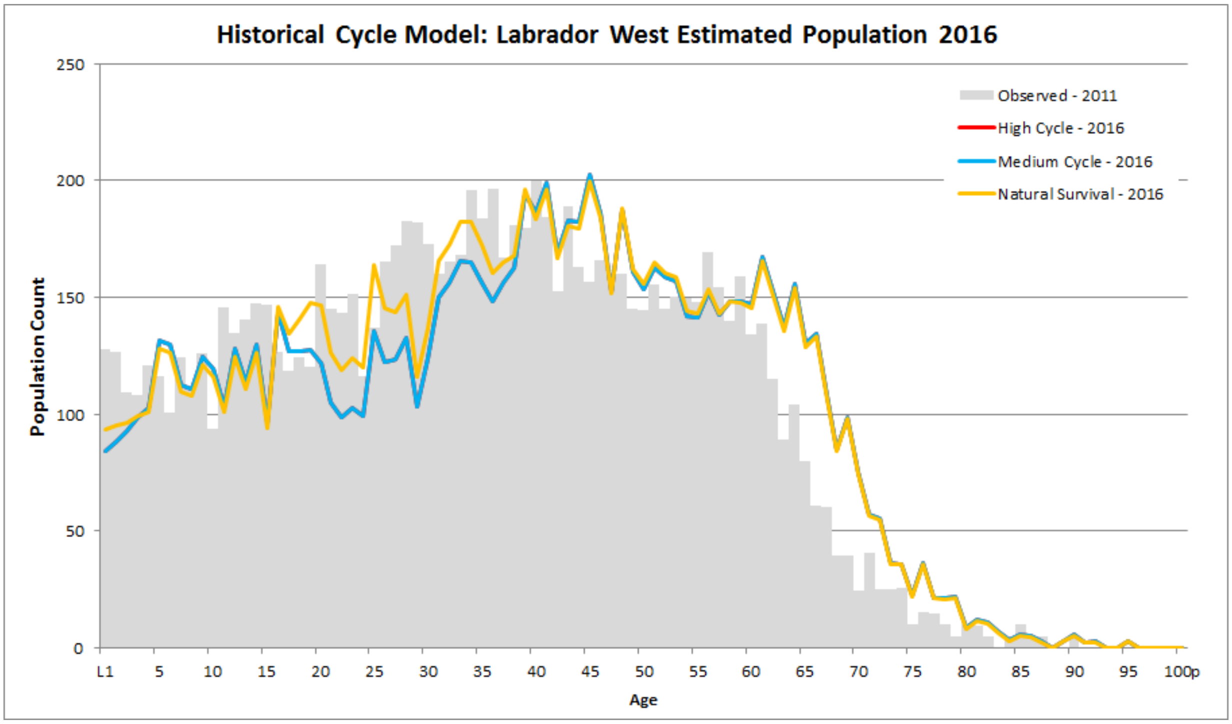

Figure 3.25 Labrador West: Observed Versus Natural and Historic Survival Models Predicted Population Age Structure

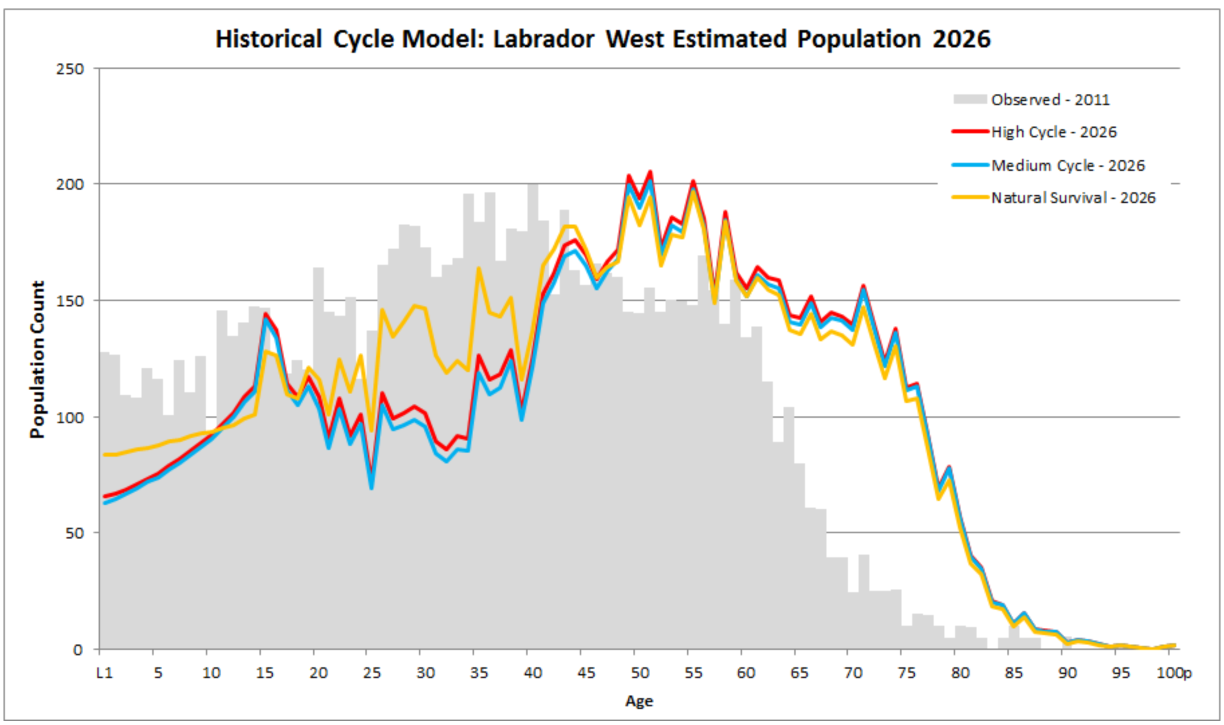

Figure 3.26 Labrador West: Observed Versus Natural and Historic Survival Models 2026 Predicted Population Age Structure

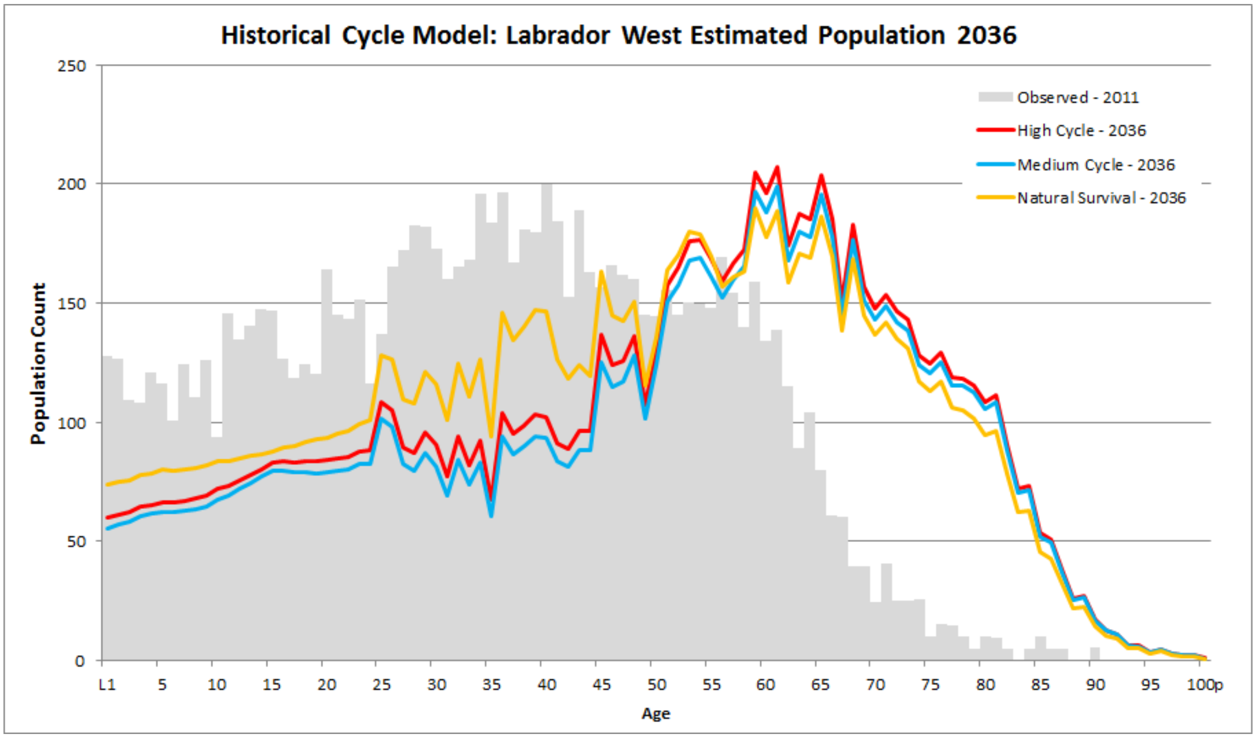

Figure 3.27 Labrador West: Observed Versus Natural and Historic Survival Models 2036 Predicted Population Age Structure

4.0 Summary

In the context of this study, the Natural (NS), Historical (HS) and Replacement Survival (RS) models provide insight into how population will change in terms of both the total number of people living in a region, as well as the resulting age structure if the assumptions of the models hold true. The NS model informs on the capacity of a region to grow by natural replacement, by accounting for regional fertility and death rates, but without a migration factor in the equation. More importantly, this model identifies regions whose age structures, combined with their fertility and death rates can, or cannot maintain their populations without in-migration. The HS model results provide insight into the age structure of populations if the past migration trends continue into the future. For some regions in Labrador this may be likely, given that over multiple census periods there has been very little, if any, in-migration and significant out-migration of younger cohorts without replacement. The result - a decreasing and rapidly aging population - is particularly significant in those regions that will decline even though a significant labour force replacement factor is built in.

The report provides a selection of outcomes for Labrador as a whole, the Labrador IGA regions (Labrador North Coast, Central Labrador, Labrador South Coast, Labrador Straits and the Northern Peninsula), and Labrador West[6].

Overall, Labrador and its regions require a population replacement strategy to maintain or grow its populations. Tables 4.0 and 4.1 present the absolute and percentage differences between the Medium RS and Medium HS models respectively. Table 4.0 provides an insight as to how many migrants would be required to maintain the existing labour force. For example, by 2026 the Labrador Straits will require an additional 372 migrants, while the Northern Peninsula will need 4,187 migrants if historical trends continue. Viewed in another way, the projected outcome data given in Table 4.1 indicate that the Labrador Straits area population will be reduced by 28.3% by 2026 if a successful replacement policy is not in place, while that of the Northern Peninsula will be reduced by 40%. Labrador Central and Labrador West show the lowest percentage differences between the Medium RS and Medium HS model results.

Table 4.0 Differences between Medium RS versus Medium HS Model Predictions

Year	Labrador	Labrador North Coast	Labrador Central	Labrador South Coast	Labrador Straits	Northern Peninsula	Labrador West
2011	0	0	0	0	0	0	0
2016	1389	332	279	249	145	1576	384
2026	3017	823	427	653	372	4187	742
2036	4729	1326	684	1022	550	6618	1146

Table 4.1 Percent Difference between Medium RS and Medium HS Model Predictions

Year	Labrador	Labrador North Coast	Labrador Central	Labrador South Coast	Labrador Straits	Northern Peninsula	Labrador West
2011	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2016	5.10	10.07	2.73	12.09	9.16	12.24	3.80
2026	11.22	26.02	4.02	37.43	28.28	40.08	7.38
2036	18.82	46.17	6.57	74.13	52.89	84.09	12.18

Fertility, mortality and migration are the building blocks upon which the predictions are based. Fertility is a generational cultural factor that has been decreasing over the long term and generally does not change rapidly in the short term. Mortality is also a factor that remains relatively constant over time, unless some environmental or disease factor influences the rate

[6] All data generated by the three models are available from RAnLab in EXCEL spreadsheet format.

over the short term. Migration rates, however, may change rapidly in response to changes in the economy and as a consequence are far less predictable. For regional planning and economic development, the change in total number of people over time in a region has implications for maintaining the existing economy as well as for services provision. However, it is the present and predicted age structure of a region that influences the capacity of a region to maintain its potential working age (20 – 64 years) population, the group that provides the primary income base which helps support the youth (0-19 years) and the older segments of the population (65 +)[7] (Nam *et al*., 1984). This relationship can be expressed as the "demographic dependency ratio" where:

[1] The "youth demographic dependency ratio" is the number of youth in a population divided by the working age population of a region and expressed as a ratio per 100 workers. If this ratio decreases over time it implies a potential shortfall in the working population and, by extension, fewer social and economic resources to support the 65+ cohorts.

[2] The "retiree or senior demographic ratio" is the number of seniors (aged 65+) divided by the potential working age (20 – 64) population. When this ratio increases in relation to the working age population, it implies an increasing social and financial pressure on the working population to support retirees.

The outcomes from this study indicate that regardless of whether the population is decreasing or increasing within a region there are an increasing number of retirees. For example, only one region in the Labrador study area (Labrador North Coast) exceeds the requisite replacement fertility rate of 2.1 (here the rate is 2.8) while all other regions range from 0.86 to 1.75. Thus, over the long term, if these rates persist, together with historical out-migration trends, the result will be fewer individuals in the youth cohorts. Replacement of retiring workers is the only option if current numbers in the working age population are to be maintained.

Generally, the demographic age structure of Labrador displays no discernable gaps in the younger cohorts (Figure 4.0). However, the structure is marginal with regards to its sustainability capacity.[8] Even with a medium (70%) RS model replacement factor built in the situation does not improve. This is mainly due to a combination of an overall fertility rate of less than 2.1 and historic migration patterns. The outcome from these characteristics is a fairly stable youth dependency ratio ranging from 41.05 in 2011 to predicted values of 41.33 and 39.51 for the 2026 HS and RS models respectively (Figure 4.1). However, the most notable shift

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[7] See http://www.statcan.gc.ca/pub/82-229-x/2009001/demo/dep-eng.htm for age specific notes.
[8] Low sustainability is characteristic of populations where the fertility rate is approximately 2.1. These populations have the capacity to maintain their current populations over the short term, but in the long term, unless there is replacement, they will experience declining and aging populations.

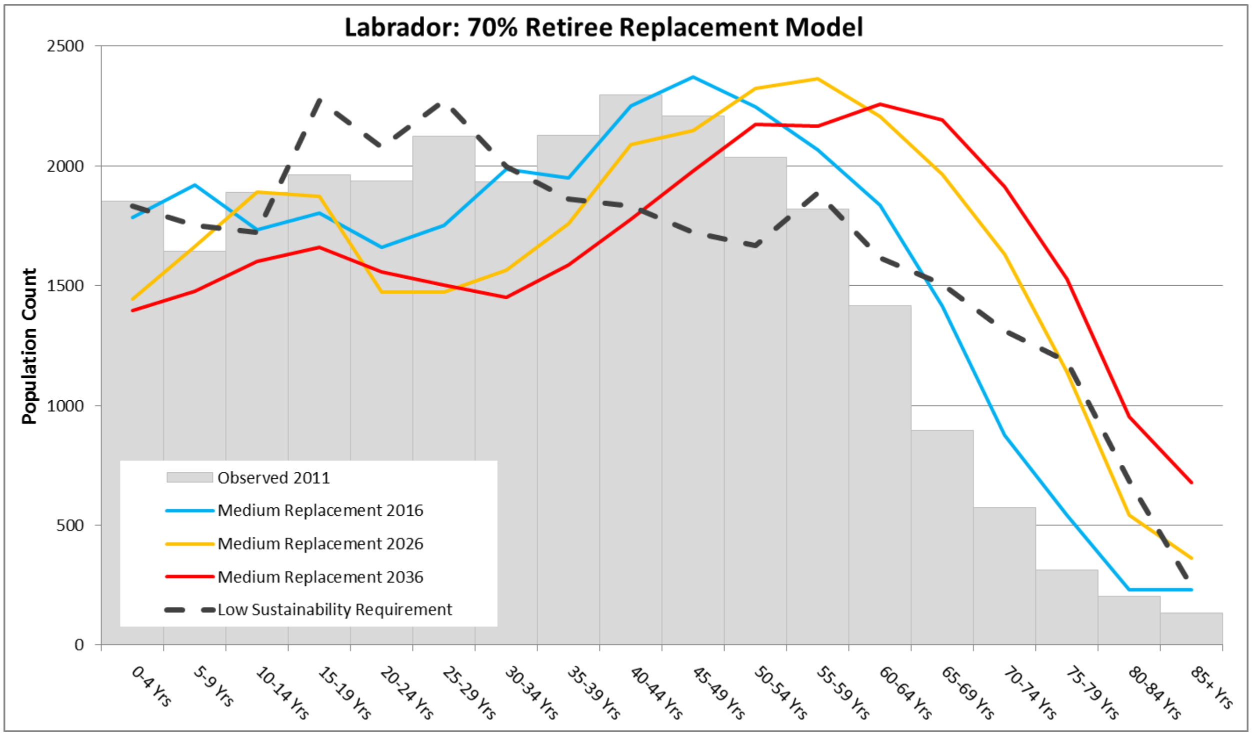
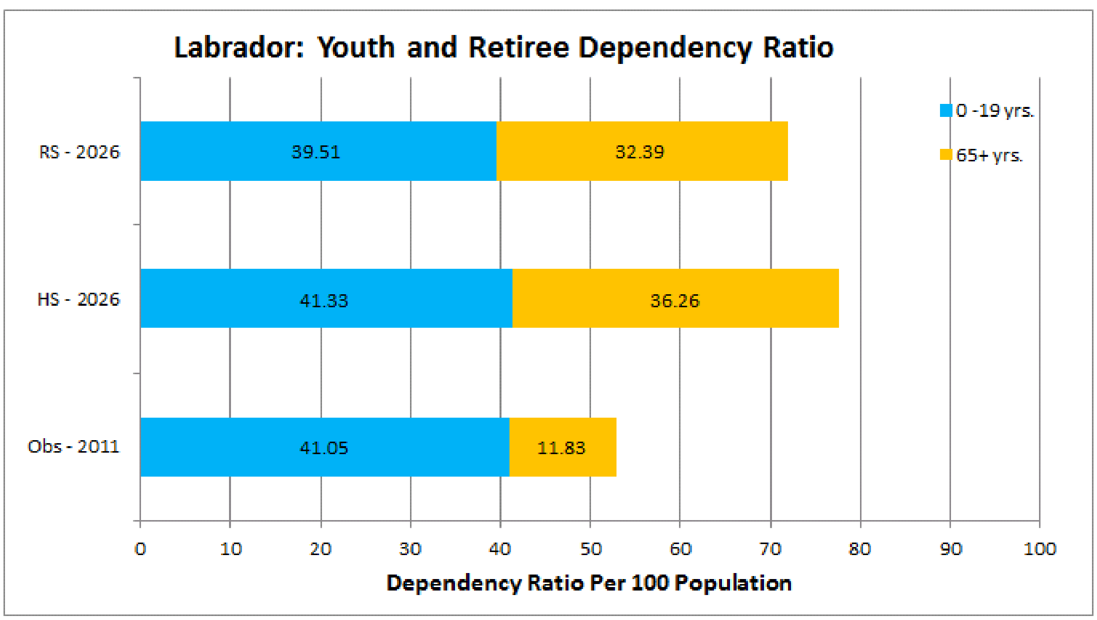


Figure 4.0 Labrador: Comparison of Population Low Sustainability Requirement and Medium RS Model - 2016 to 2036 Results



Obs = Observed, Medium HS (Historic Survival) and RS (Replacement Survival) models

Figure 4.1 Labrador: Demographic Dependency Ratio, 2011 and 2026

is in the dependency ratio for retirees, which increases from 11.83 in 2011 to a predicted HS value of 39.51 by 2026. The predicted 2026 RS ratio is lower, at 32.89 (Figure 4.1). The predicted lower youth and retiree RS dependency ratios are a result of the replacement factor because it is the working age population that grows in the model. Given the marginal nature of the overall age structure in Labrador it requires a population replacement strategy if the population is to be maintained at the current level and with a comparable age structure.

Of the six study areas, three are near or above the low sustainability requirements (i.e. fertility rates are at or greater than 2.1), while three areas are below this rate, and have declining and aging populations. The Labrador North Coast, Central and West have a greater potential for maintaining their populations, but out-migration remains an important factor and any deterioration in the local economy is likely to result in increased outflows. The situation is most serious for the Labrador South Coast, the Straits and the Northern Peninsula. Here, fertility rates are low, the population is aging, out-migration levels are high and there are few indications that labour demand will increase to help retain the population or encourage in-migration.

Figures 4.2, 4.3 and 4.4 display 2011 and predicted replacement age structures for Labrador's North Coast, Central and West study areas. The observed 2011 age structure for the North Coast is above or near the low sustainability requirements (Figure 4.2), with the 0 – 19 cohort above this threshold for the prediction period. The lower numbers for the 30 plus cohorts suggest either a youth retention issue, or some other out-migration factor. Labrador Central (Figure 4.3) was at or near the low sustainability level in 2011. The medium RS model predicted an age structure distribution that is slightly below the low sustainability requirements mainly because of the regions lower fertility rate and migration patterns. In 2011, Labrador West was near the low sustainability requirement (Figure 4.4), but its lower fertility rate and migration patterns suggest that in the long term it requires a replacement strategy.

Figures 4.5, 4.6 and 4.7 present the age-based demographic dependency ratios for Labrador North Coast, Central and West study areas. Labrador North Coast (Figure 4.5) has the highest youth to working age ratios with a value of 64.03 in 2011, and 2026 predicted values of 74.77 and 61.51 for the HS and RS models respectively. Note that the reduced value for the predicted RS model is associated with increasing the numbers in the working age group through the replacement factor incorporated into the model. The retiree ratio is also low, with an observed value of 6.19 in 2011, but increasing to a predicted high of 27.27 for the 2026 HS model and 25.42 for the 2026 RS model. Conceptually, this region exhibits a youth dependency ratio that should provide the social and economic support for its retiree population, but this conclusion requires further analysis.

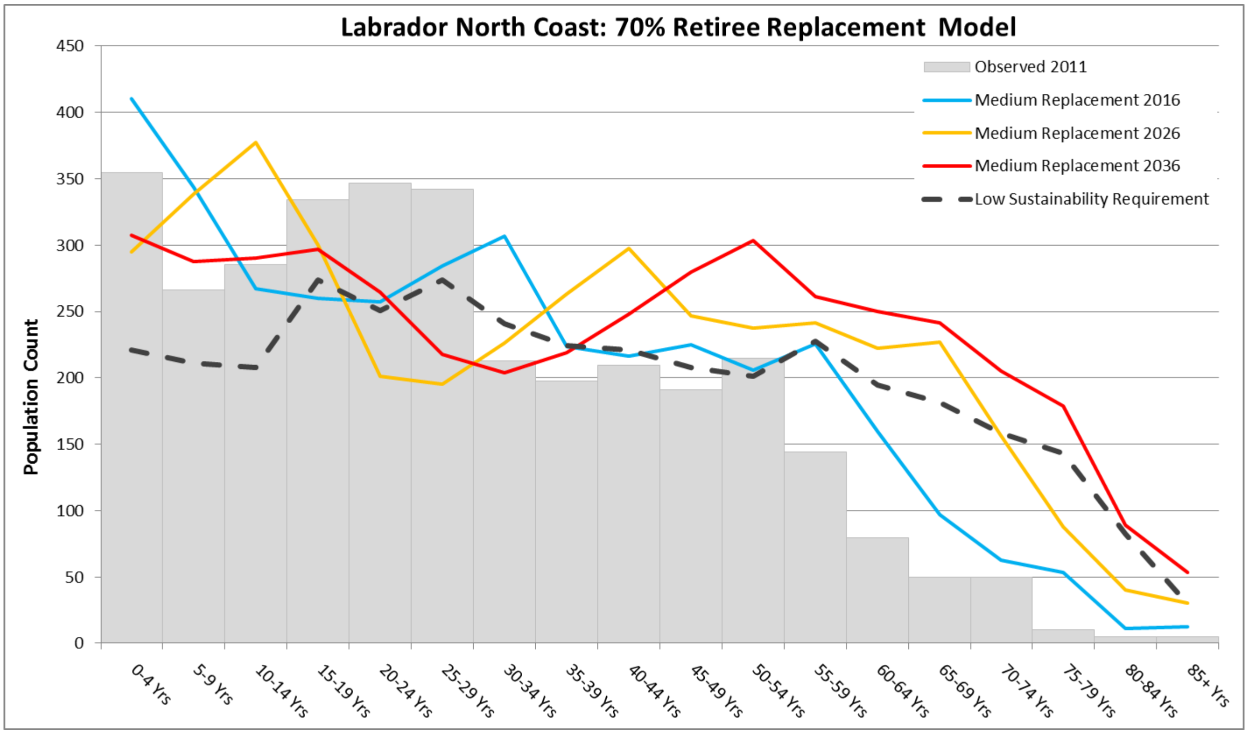


Figure 4.2 Labrador North Coast: Comparison of Population Low Sustainability Requirement and Medium RS Model - 2016 to 2036 Results

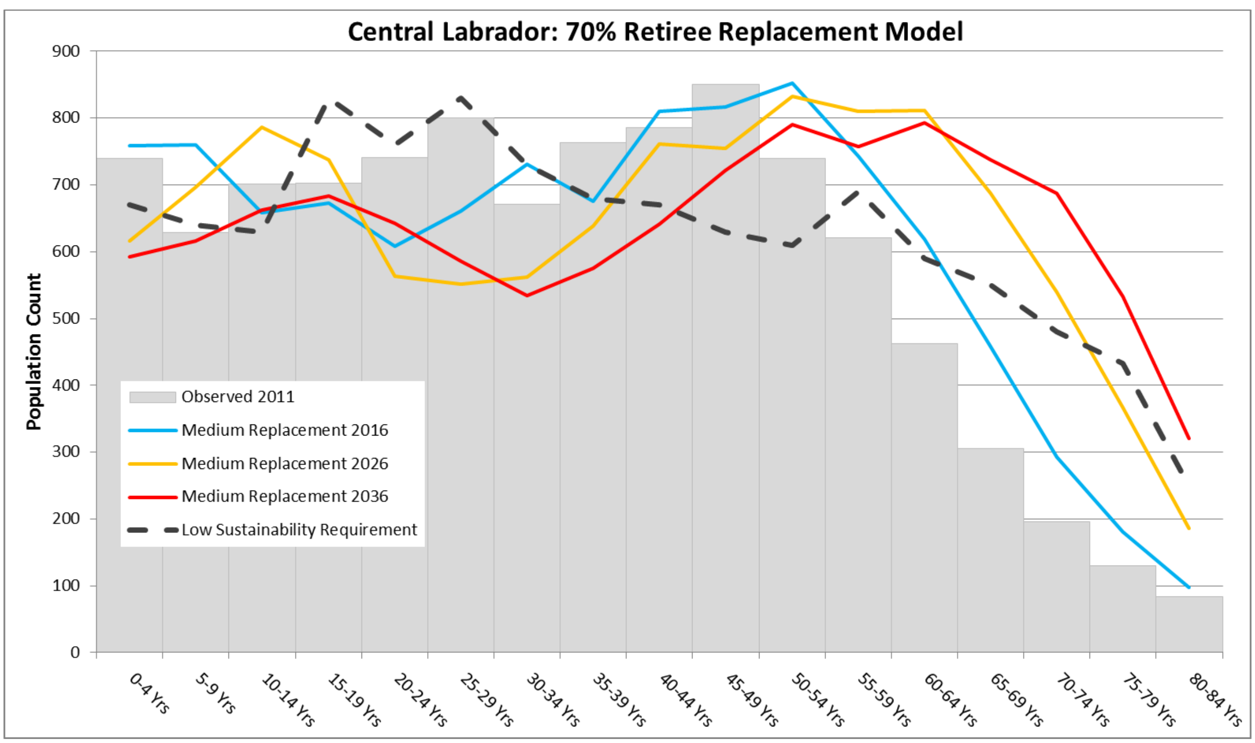


Figure 4.3 Labrador Central: Comparison of Population Low Sustainability Requirement and Medium RS Model - 2016 to 2036 Results

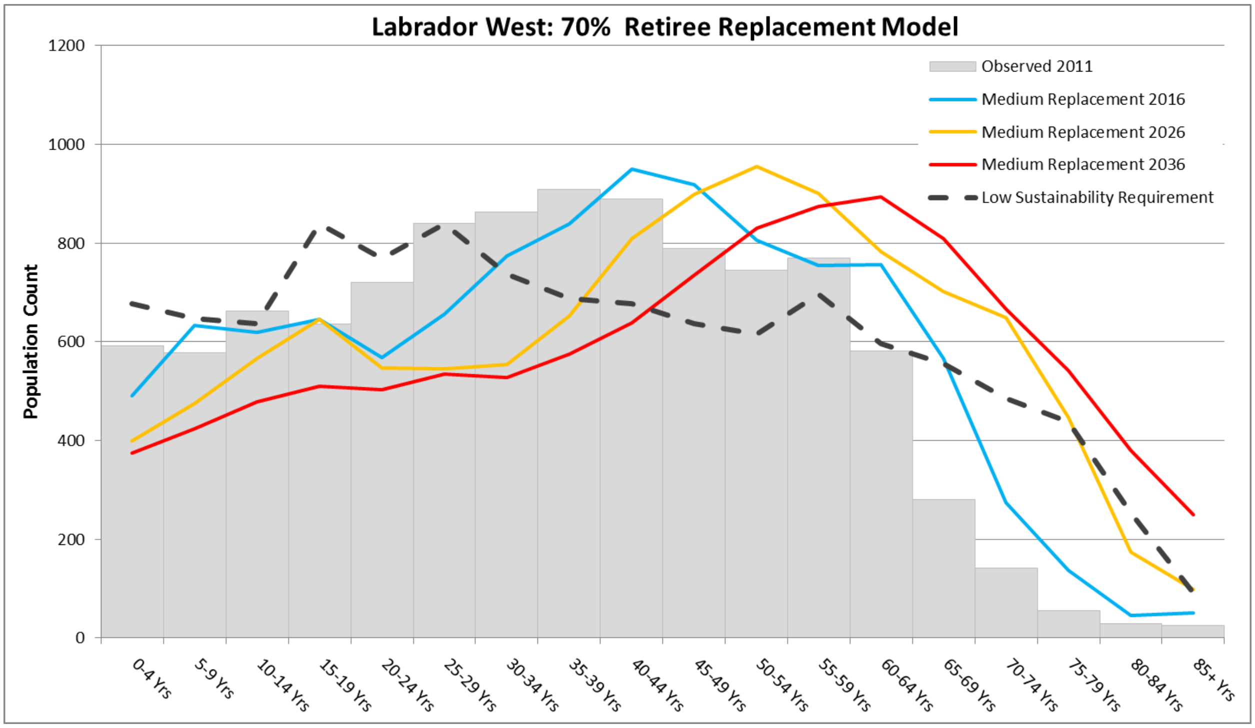
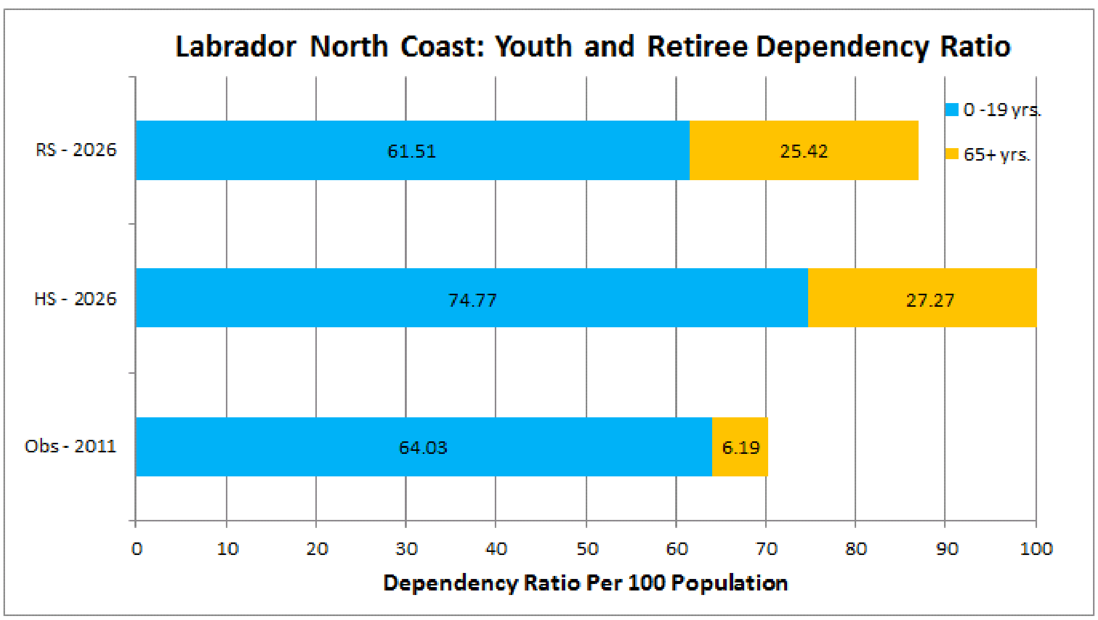
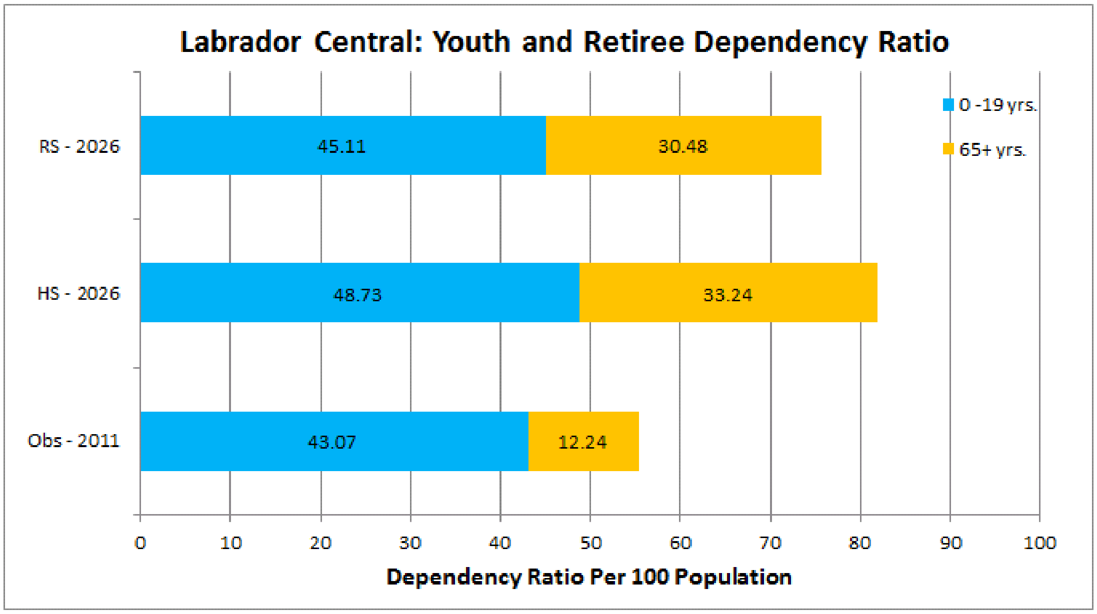


Figure 4.4 Labrador West: Comparison of Population Low Sustainability Requirement and Medium RS Model - 2016 to 2036 Results



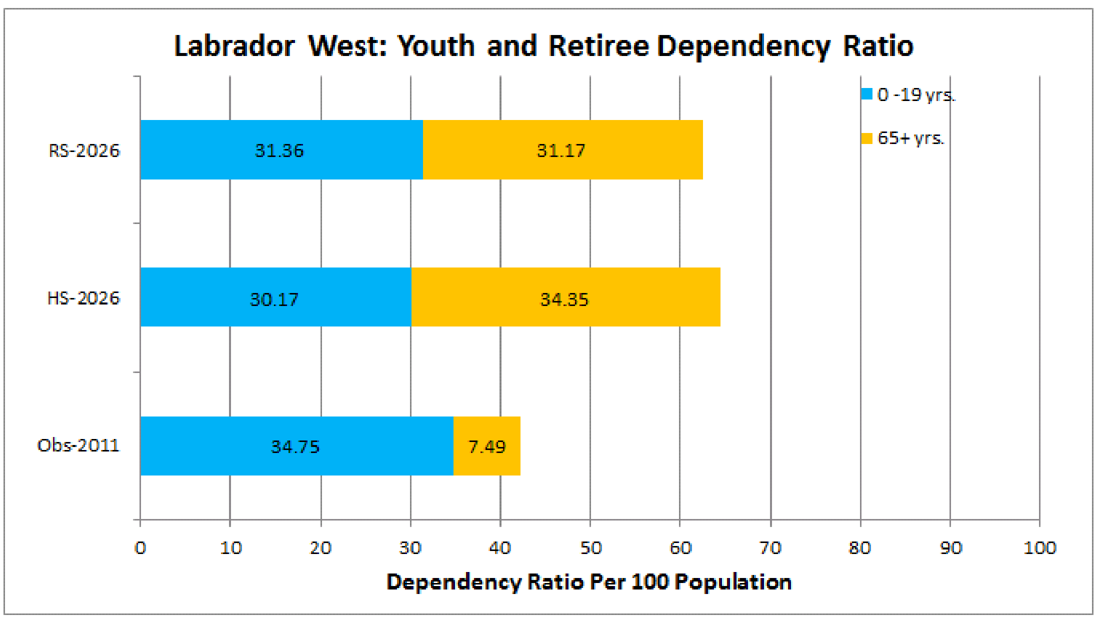
Note: Obs = Observed, Medium HS (Historic Survival) and RS (Replacement Survival) Models

Figure 4.5 Labrador North Coast: Demographic Dependency Ratio, 2011 and 2026



Note: Obs = Observed, Medium HS (Historic Survival) and RS (Replacement Survival) Models

Figure 4.6 Labrador Central: Demographic Dependency Ratio, 2011 and 2026



Note: Obs = Observed, Medium HS (Historic Survival) and RS (Replacement Survival) Models

Figure 4.7 Labrador West: Demographic Dependency Ratio, 2011 and 2026

Labrador Central (Figure 4.6) also has youth ratios that exceed the retiree ratios. For example, in 2011 the youth ratio was 45.07 along with a retiree ratio of 12.24. The predicted youth ratio for the HS and RS 2026 predictions are 48.73 and 45.11 respectively. This is combined with an aging population where both models indicates that the predicted retiree ratio will increase from 12.24 in 2011 to 33.24 or 30.48 by 2026 (Figure 4.6). However, given that the youth ratios are greater than the retiree ratios, the region has the potential to support its retiree population.

However, the aging trend also indicates that there are underlying fertility and migration issues that will prevent maintaining or growing the base population in the long term.

Labrador West's 2011 youth ratio was 34.79, with a relatively low retiree ratio of 7.49 (Figure 4.7). It is predicted that the youth ratio will decrease to 30.17 (HS) or 31.36 (RS) by 2026, while the retiree ratio will increase to 34.35 (HS) or 31.17 (RS). This outcome is associated with populations that are at or near the low sustainability requirement, where lower fertility rates, migration patterns, and increasing longevity result in decreasing numbers of youth and increasing numbers of retirees in a region's population. Given that Labrador West is a mining region, the replacement of workers is required to maintain existing labour force levels, assuming that 2000 to 2011 fertility and migration trends continue.

The Labrador South Coast, Straits and the Northern Peninsula represent areas characterised by population decline and aging. None of the three regions (Figures 4.8, 4.9, 4.10) meet the requirements for low population sustainability, and to a degree are "post low sustainability" because a majority of the younger age cohorts (aged 0 to 34) are below the low sustainability curve. The Medium RS model indicates that the status quo will be maintained, but the overall demographic age structure of the region will not improve. This is supported by the demographic dependency ratios for these areas (Figures 4.11, 4.12 and 4.13). In 2011, all three areas had youth ratios and retiree ratios of 35.56/20.23, 36.07/39.25 and 27.62/30.37 for the South Coast, Straits and Northern Peninsula respectively. Only the South Coast's youth ratio exceeded its retiree ratio. For the 2026 estimates, the post low sustainability requirement is most evident for the South Coast (Figure 4.11), where the youth and retiree ratios are 28.41/57.49 for the HS and 30.48/41.46 for the RS models. The Labrador Straits youth versus retiree ratios have predicted 2026 HS values of 19.62/69.92 and RS values of 23.29/56.08. The differences continue for the Northern Peninsula, where the predicted 2026 HS youth versus retiree ratios values are 25.23/79.45 while the RS numbers are slightly lower with values of 28.82/51.61.

In all three regions, the relatively low youth ratios along with the much higher retiree ratios to working age population suggest that if trends continue, and even with replacement, there will be issues maintaining the regional population as it was in 2011. Further analysis is required to determine the implications of this for the regional economies.

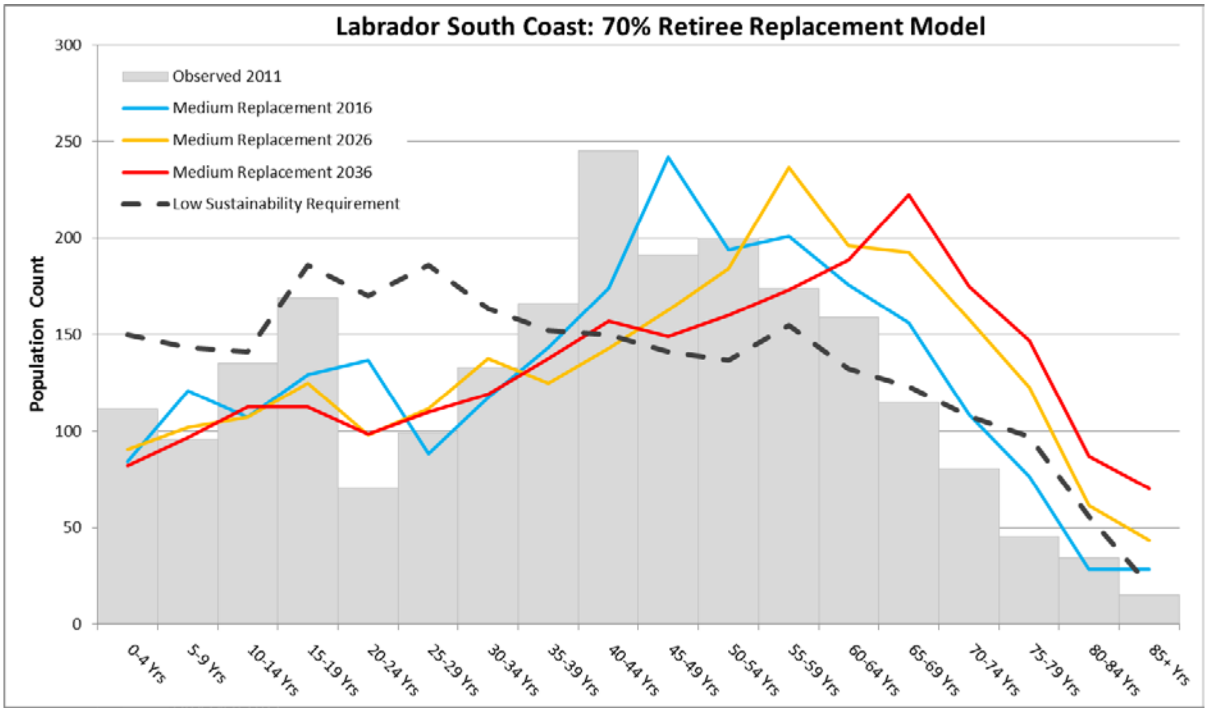


Figure 4.8 Labrador South Coast: Comparison of Population Low Sustainability Requirement and Medium RS Model - 2016 to 2036 Results

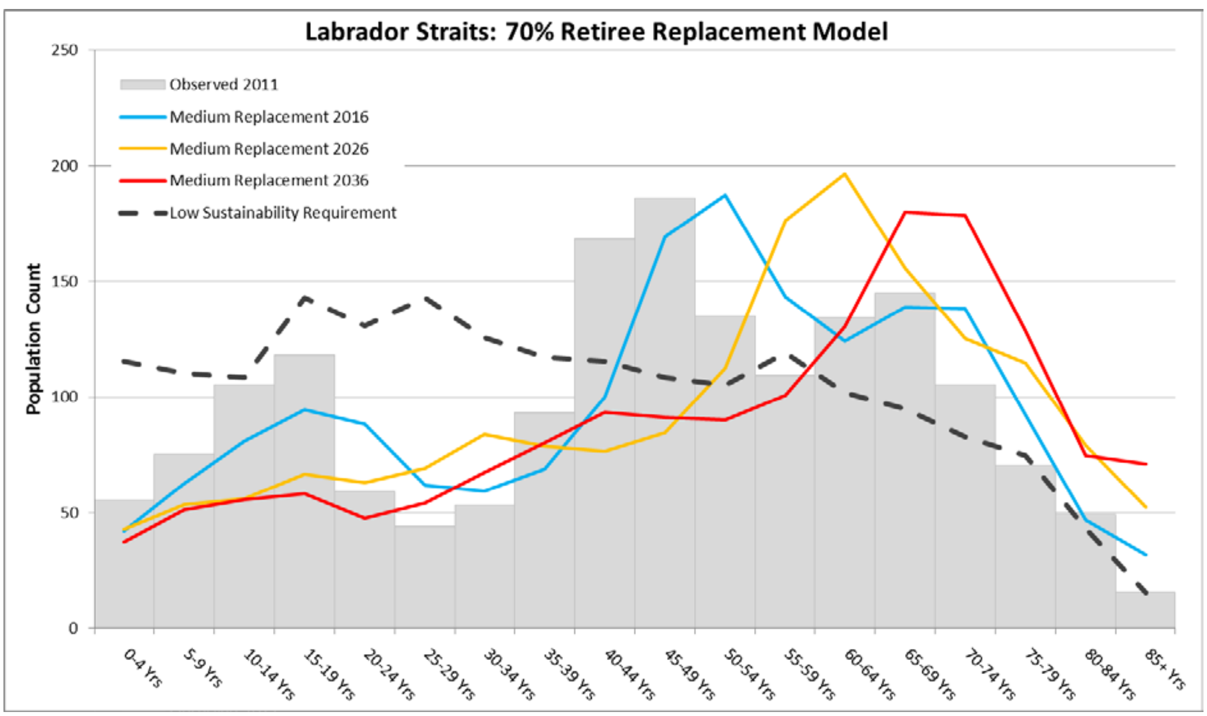


Figure 4.9 Labrador Straits: Comparison of Population Low Sustainability Requirement and Medium RS Model - 2016 to 2036 Results

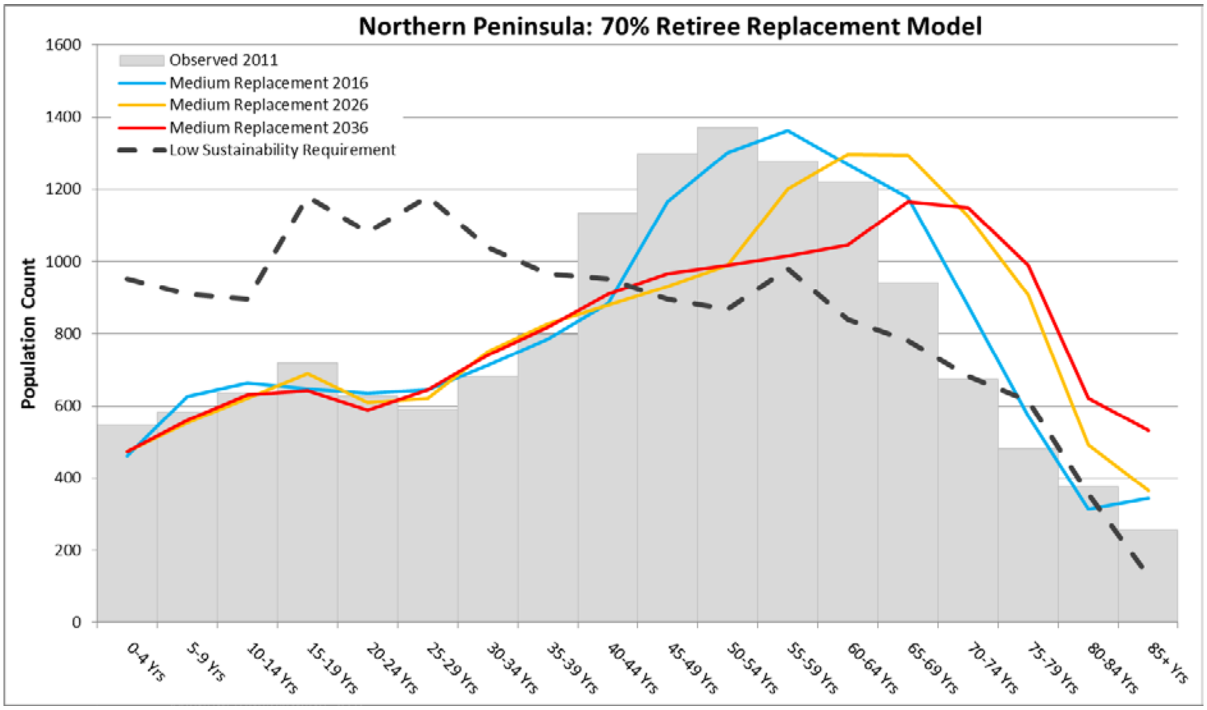
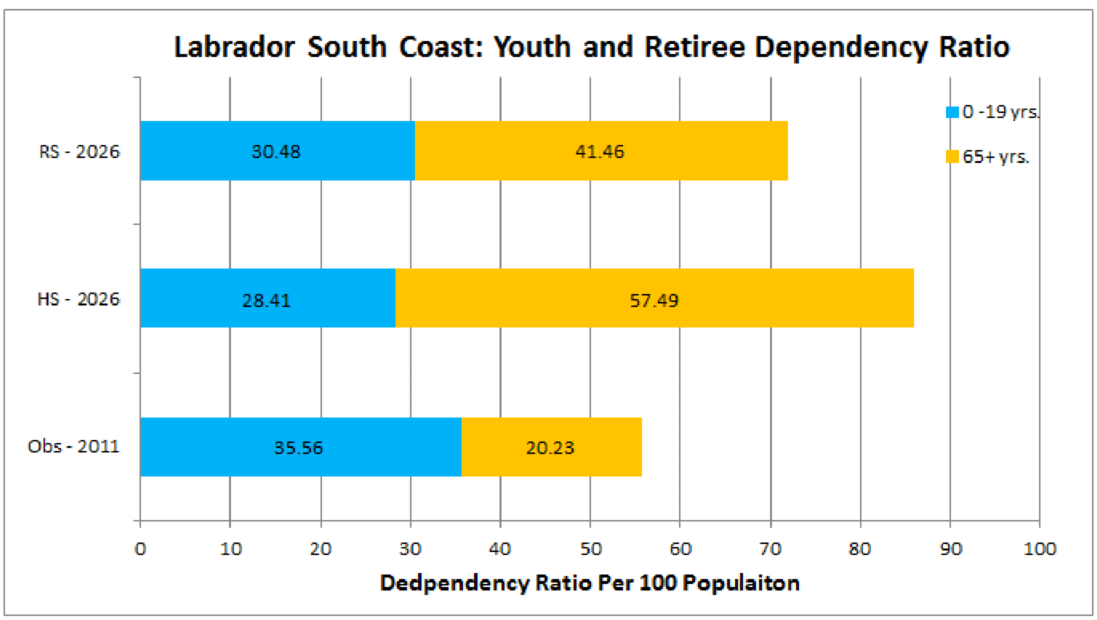
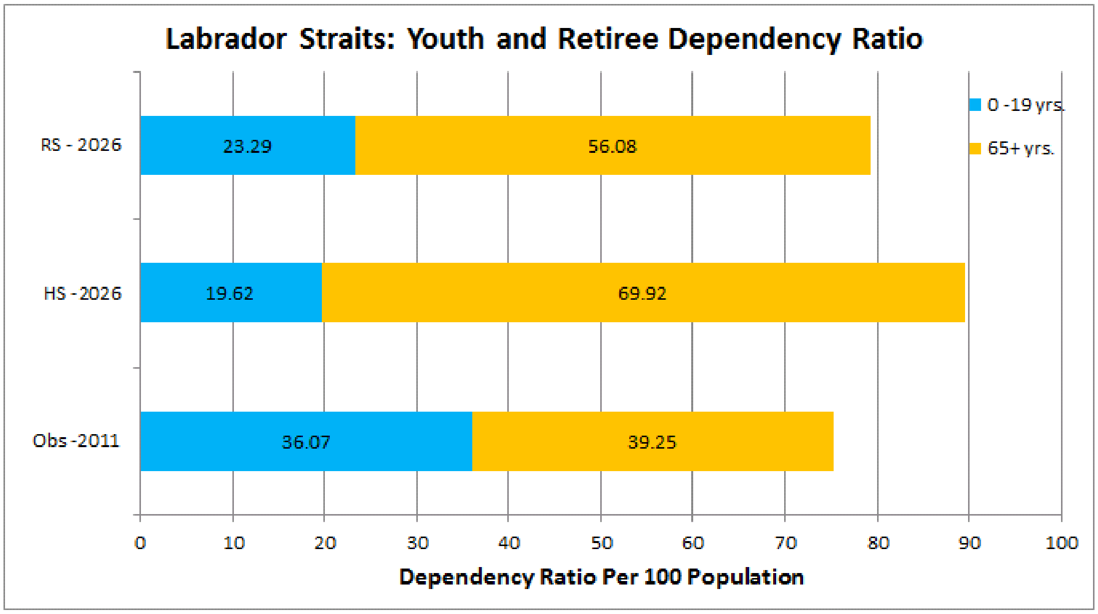


Figure 4.10 Northern Peninsula: Comparison of Population Low Sustainability Requirement and Medium RS Model - 2016 to 2036 Results



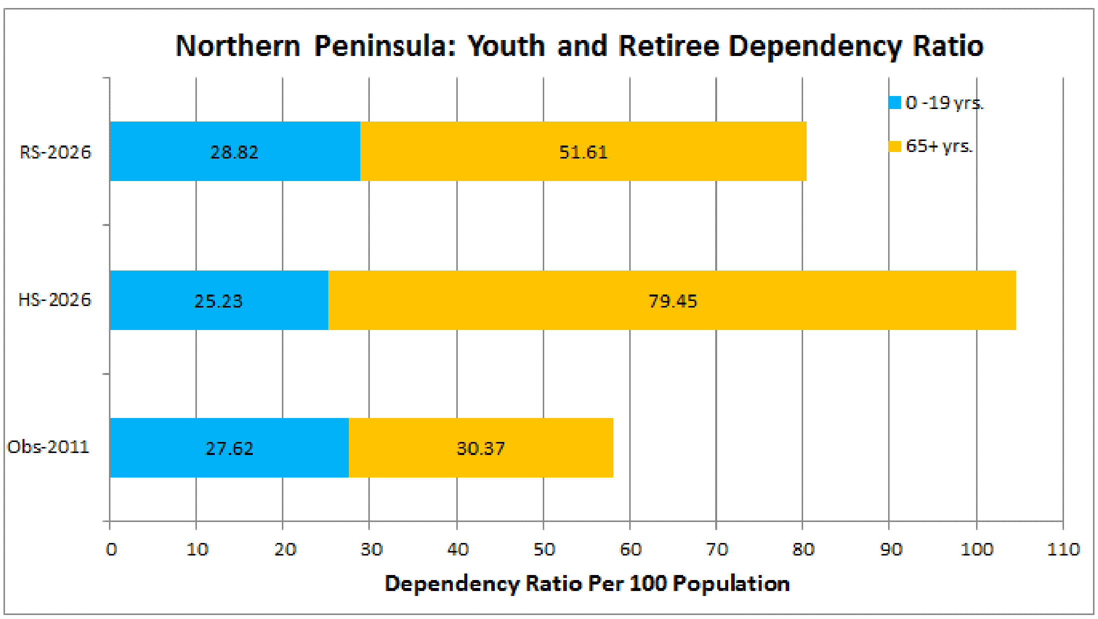
Note: Obs = Observed, Medium HS (Historic Survival) and RS (Replacement Survival) Models

Figure 4.11 Labrador South Coast: Demographic Dependency Ratio, 2011 and 2026



Note: Obs = Observed, Medium HS (Historic Survival) and RS (Replacement Survival) Models

Figure 4.12 Labrador Straits: Demographic Dependency Ratio, 2011 and 2026



Note: Obs = Observed, Medium HS (Historic Survival) and RS (Replacement Survival) Models

Figure 4.13 Northern Peninsula: Demographic Dependency Ratio, 2011 and 2026

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Statistics Canada Census Data

http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/index-eng.cfm

Appendix I

Survival Model Assumptions

The assumptions for the birth, death and migration components[9] of population growth are as follows:

[1] Predicted Births = {(Female Population by Age Class)*(Total Fertility Rate)*(Age Specific Fertility Rate/Total Fertility Rate)}

[a] Female Population by Age class geography = Local Area
[b] Baseline Total Fertility Rate year = 2011
[c] Geography for [b] = Local Area Geography
[d] (Age Specific Fertility Rate/Total Fertility Rate) trend years = 2003 to 2013
[e] Geography for [d] = Local Area

[2] Predicted Deaths = {(Male and Female Population by Age Class)*(Male and Female Death Rate by Age Class)}

[a] Male and Female Population by Age Class geography = Local Area
[b] Male and Female Death Rate by Age Class trend years = 2009-2013
[c] Geography for [b] = Functional Region Class (FERs)

[3] Migration = {(Total Population by Age Class)*(Total Migration Rate)*(Age Specific Migration Rate/Total Migration Rate)}

[a] Total Population geography = Local Area
[b] Total Migration trend years 2001 to 2011
[c] Geography for [b] = Functional Economic Region (FERs)
[d] Age Specific Migration Rate trend years = 2001 - 2006 augmented by 2011
[e] Geography for [d] = Functional Economic Region (FERs)
[d] In-Migration = Intra-Provincial, Inter-Provincial and External
[e] Out-Migration = Occurs when negative growth occurs for a forecast year after accounting for fertility, deaths and in-migration factors

[9] All data used in this study were downloaded from the NL Statistics Agency Community Accounts or Statistics Canada 2011 Census data portals.

APPENDIX II
Functional Economic Regions

The functional economic regions study (Simms *et. al*, 2013) describes how FER regions were classified and differentiated. It is evident that Urban and (Small) City Regional Town type regions comprise the higher order regions in terms of population and nearest to larger urban centres, while the three types of rural regions (First, Second and Third Order Rural) have smaller populations and generally are further away from larger urban centres or small cities. Furthermore, a statistics test of the difference of medians and distributions[10] for all 11 socio-economic indicators (e.g. nearness to urban centres, average weeks worked, education and industry diversity, etc.) indicate that the medians and distributions for each region type are significantly different with p= 0.001. This is confirmed by comparing region type density plots (see Figure 1.0 for selected economic indicators). The implication of this result is that each region type represents a different distribution for each variable and the regions are therefore distinct on these indicators.

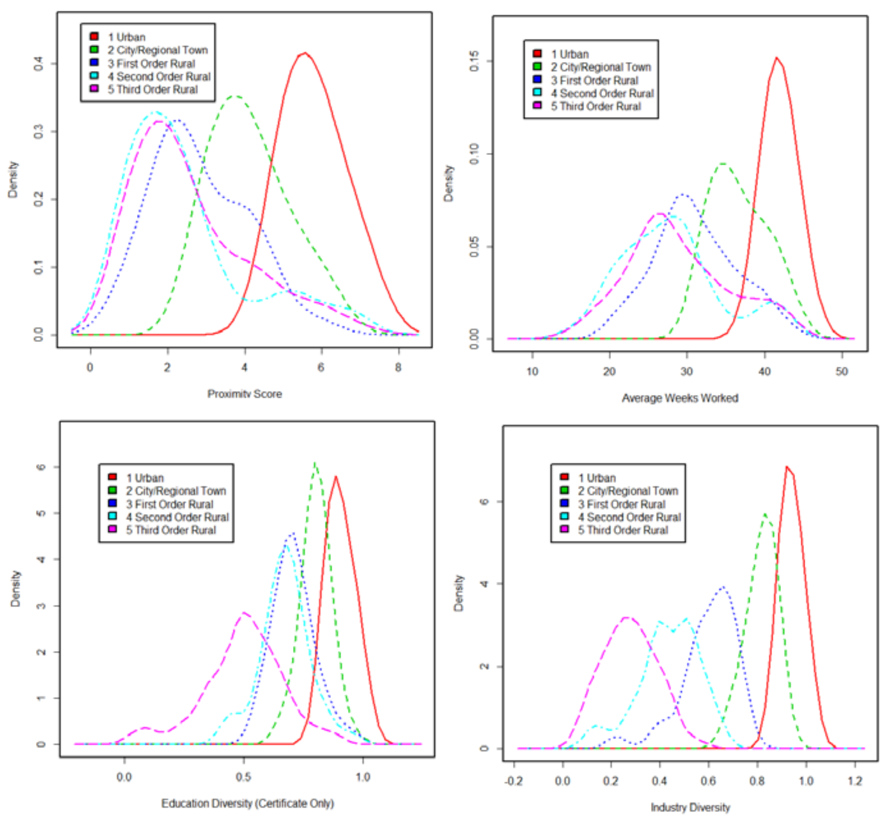

Figure 1.0 Density Distributions by Functional Region Type

[10] SPSS Medians test for k samples and Kruskal-Wallis 1 way ANOVA of k Samples were used to test the between region type differences.

This analysis produced five regional types, four of which, (Urban Centres are excluded), are relevant for the Labrador study area (Simms, *et al*., 2013 and Freshwater, *et al.,* 2014):

[1] **Urban Centres** – have populations ranging from 412,200 to a low of 45,645. All the urban regions have a relatively diversified economic structure, but regions with populations of 100,000 or more will have a comparative advantage over the smaller urban regions. Of these 91 % are classed as having very high industry diversity and 9% as high diversity. By international standards, these are all small cities, but in the context of Atlantic Canada these are the largest urban places and each has some potential to develop some sort of a self-sustaining growth process.

[2] **Small Cities and Regional Towns** – have regional populations ranging from 39,805 to 9,225. These regions are characterized by having at least one reasonably sized town that is a focal point for public services for its region and for adjacent smaller regions. Some of the regions in this category are quite distant from urban centre regions and have a significant spatial reach into other smaller regions. Other members of this group are relatively close to a larger region that dominates the broader territory. These regions are large enough to exhibit a relatively diverse economic structure by Atlantic Canada standards, with, 86% classed as having high industry diversity and 14% having moderate diversity.

[3] **First Order Rural** - these regions have total populations ranging >=2000 to < 8000, and contain communities with population sizes ranging from 50 to 6,994 people distributed across an otherwise sparsely populated region. These regions have at least one small service centre for retail as well as government services, provide services to surrounding regions, and have fairly diversified economies. The breakdown for industry diversity is 3% high, 81% moderate, 13% low and 3% very low.

[4] **Second Order Rural** - The population of communities in these functional regions ranges from more than 50 to less than 2000 with at least one larger community with a population of greater than 1000 people. Industry diversity is somewhat lower in these areas with 37% of the regions classed as moderate, 55% classed low and 8% classed very low. In many cases these are single industry towns, and a single firm often dominates employment. Again, these areas are sparsely populated with limited connectivity between communities. People have to leave their region to obtain higher order retail goods and most public services.

[5] **Third Order Rural** – – A majority of these places are considered remote and have communities whose population ranges in size from 45 to less than 600 people. These places are not connected to other regions in terms of local labour markets, but residents in these regions must travel to other regions to obtain most goods and services, because

very little is available locally. In these regions only 3% are classified as having moderate industry diversity, 55% with low diversity and 42% with very low diversity.