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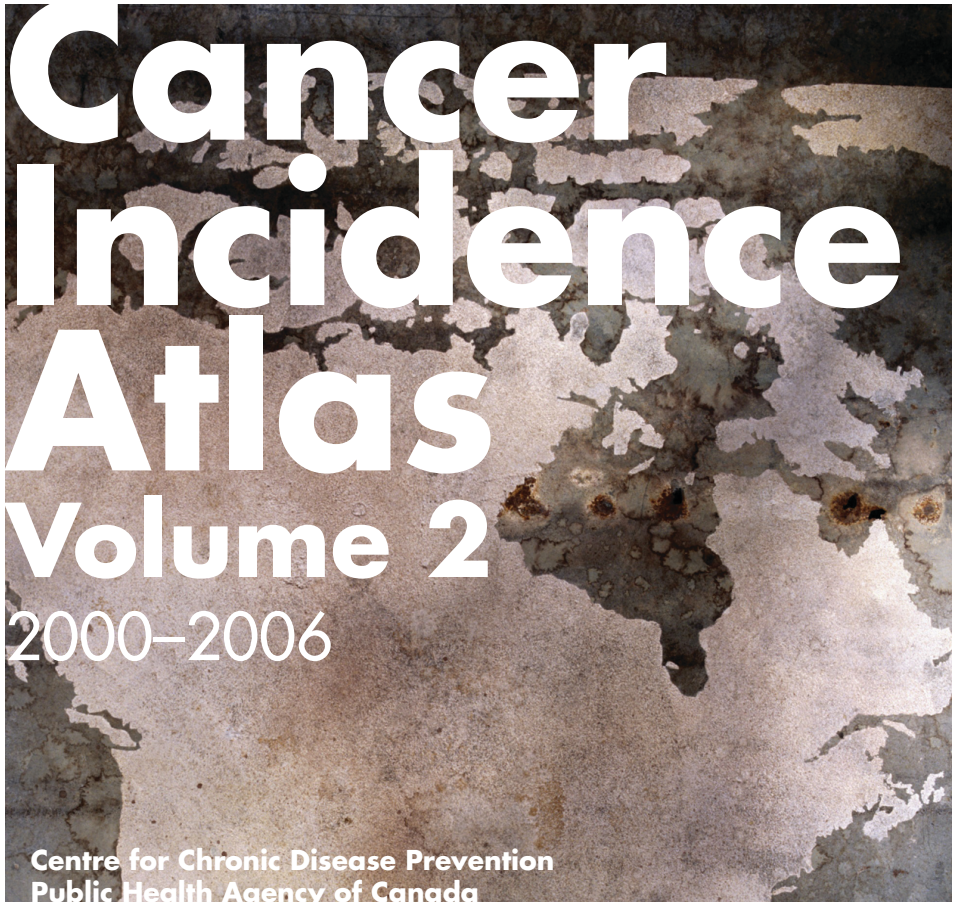
Canadian Cancer Incidence Atlas

Volume 2

2000–2006



Centre for Chronic Disease Prevention
Public Health Agency of Canada

Canada

TO PROMOTE AND PROTECT THE HEALTH OF CANADIANS THROUGH LEADERSHIP, PARTNERSHIP, INNOVATION AND ACTION IN PUBLIC HEALTH.

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Highlights

- The *Canadian Cancer Incidence Atlas* is designed for individuals interested in geographic variations of cancer incidence in Canada, such as epidemiologists, health planners, health researchers, clinicians, cancer registry staff and administrators.
- The atlas is useful for hypothesis generation and development of regional and national health priorities (potential for health promotion and risk reduction).
- Readers should be aware, however, that variations in cancer incidence may be a result of differences in cancer treatment and registration practices, in addition to lifestyle or environmental factors. As with other epidemiological studies using grouped data, the mapped data may indicate an association but should not be interpreted as proof of causation.
- Cancer incidence data were provided by the provincial and territorial cancer registries through the Canadian Cancer Registry database at Statistics Canada.
- The atlas includes 37 maps of incident cancers for 2000 to 2006 (32 sex- and site-specific maps; 5 site-specific maps, both sexes combined).
- Maps present data for the health regions of Canada (2007 boundaries).
- Maps demonstrate incidence rate ratios (for health regions relative to the Canadian average) and statistical significance.
- A second series of maps presents smoothed standardized incidence ratios (observed to expected cases) to illustrate broad spatial patterns.
- Summary text for each map includes descriptive epidemiology, known or suspected risk factors and assessment of geographical patterns.
- Possible explanations for the observed significant spatial aggregation varied by site, and included differences in lifestyle factors, such as diet and smoking, and cancer registration practices.

Introduction

The purpose of this atlas is to present the spatial variation of cancer incidence in Canada, thus contributing to further understanding about cancer, its etiology and prevention among epidemiologists, educators, health researchers, health planners, clinicians and administrators. It is hoped that the atlas will be useful in the development of surveillance programs, research initiatives, and health promotion and risk reduction interventions.

The data in this report identify health regions in Canada that exhibit incidence rates for certain types of cancer that are either higher or lower than the rate for Canada as a whole. The nature of the data, however, does not allow for the identification of factors that may contribute to these differences in rates. The maps provide an important first step to identify etiologic hypotheses that can be investigated using stronger, more appropriate study designs. Volume 2 of the *Canadian Cancer Incidence Atlas* updates Volume 1[1] with more recent data and coding systems.

Mapped information

The incidence rate is the number of newly diagnosed cases per 100,000 population per year. The first series of maps (1-37) presents a comparison of the all-age age-standardized rates for each health region with the rate for Canada. The ratio presented, the comparative incidence figure (CIF), is calculated as the ratio of the health region cancer incidence rate to the Canadian rate.

A value close to 1.0 indicates that the health region rate is close to the national rate. The age-standardized rates used the direct method and the 1991 Canadian Census population structure (Appendix 1). The use of a standard population results in more meaningful incidence rate comparisons because it adjusts for variations in population age distributions across geographic areas. Separate maps are provided for southern Ontario/southwestern Quebec and southern British Columbia due to the number of health regions with a small area on the national map.

Each map presents a combination of the ranking of the age-standardized rate and its statistical significance. The colour presenting the ranking is based on the 5 quintiles of the CIF. The background is solid or dotted depending on the significance level of the comparison of the health region rate (R2) and the national rate (R1) at the 0.05 level using a log transform[2] that refers to tables of the normal distribution based on a normal approximation.

$$SE(\log R_2 - \log R_1) = \sqrt{[SE(\log R_2)]^2 + [SE(\log R_1)]^2}$$

The dots needed to be of sufficient size and density so that at least one dot was visible for each health region. Maps are presented using a sequential single hue, with higher rates presented with increasing darkness.[3] The middle quintile includes the CIF value of 1.0, which indicates that a health region age-standardized rate is equal to the national rate.

To determine whether a health region in the middle quintile with a rate statistically significantly different from the national rate has a CIF greater or less than 1.0, it is necessary for the reader to check the statistics for the map in the spreadsheet file for the atlas containing the health region data presented in the atlas. There are 2 spreadsheet files provided in addition to the atlas text and maps, 1 containing statistics for health regions (Appendix 5) and 1 for provinces and territories (Appendix 6).

The distribution of the health regions age-standardized incidence rates (ASIRs) is presented as a smoothed histogram at the bottom of the Canada map of CIFs. The y-axis shows the percentage of regions in the intervals centred around the mid-points shown on the x-axis. For example, if mid-points include 0.8, 0.9, 1.0 and so on, the interval centred at 0.9 ranges from 0.85 to 0.95. The minimum rate is zero, however. The colour bar below this graph shows the correspondence to the mapped rate categories. For cancers with high outliers, the highest category on the plot is truncated at the 99th percentile of the distribution and the actual CIF for the maximum age-standardized rate is indicated above the horizontal axis to the right of the distribution.

The second series of maps (41-77) presents smoothed standardized incidence ratios (SIRs). For each health region, the SIR is the number of observed cases divided by the number of expected cases, with the number expected calculated based on the national cancer rates and the age-specific populations in the health region. This smoothed SIR was implemented with a Besag-York-Mollié model[4,5] using the WinBUGS program (Bayesian inference using Gibbs sampling, running under Microsoft Windows).[6] Maps are again presented using a sequential single hue, with higher rates presented with increasing darkness.[3]

The purpose of the smoothed maps is to illustrate broad spatial patterns. The modelled results for a health region, particularly for those with smaller populations, draw on information from surrounding regions to build reliability if spatial correlation is present.

Basics of methodology

Information on cancer incidence was obtained from the Canadian Cancer Registry (CCR) database at Statistics Canada based on the International Agency for Research on Cancer (IARC) rules for determining multiple primary sites (created in collaboration with the International Association of Cancer Registries; see http://www.iacr.com.fr/MPrules_july2004.pdf, as implemented by the CCR).[7] Intercensal and post-censal population estimates were obtained from the Census and Demographics Branch of Statistics Canada.[8,9] Population data were available for each sex and for 5-year age groups, and estimates were available for each

year. To enhance stability, the rates are based on incident cancers diagnosed in the 7-year period 2000-2006 available on the July 2009 CCR data release.

The World Health Organization's International Classification of Diseases for Oncology, Third Edition (ICD-O-3) coding rules were used.[10] Cancer sites and the order of presentation follow the recode tables of the United States Surveillance, Epidemiology and End Results (SEER) Program for ICDO-3 codes and include *in situ* bladder cancer cases (see Appendix 2).[11]

The analysis includes all newly diagnosed cases and is not restricted to the first primary case for each person. Table 1 presents incidence rates for all cancer sites combined using IARC rules, as compared with rates of first malignant primary cases, along with the ratio of the 2 rates, for the period 2004-2006. The ratio was relatively consistent over province/territory of residence, which provides some justification for mapping all cancer sites combined.

Cancer sites were included in the atlas if the number of cases was sufficiently large that less than 25% of the health regions were expected to have a coefficient of variation of more than 50% (standard error of the health region rate divided by the rate). Due to the potential for diagnostic misclassification and to reduce the number of cancer sites with smaller numbers of cases, combined results are presented for colon and rectum; brain and other nervous system; and the leukemias. Also to reduce the number of sites with smaller numbers of cases, results are presented for males and females combined for cancers of the esophagus, liver, larynx and thyroid, and for Hodgkin lymphoma. The following site groups are included in tables for the atlas but are not mapped: other digestive system; other female genital system; and other, ill-defined and unknown. The site-specific discussion includes a description of provinces and territories with significantly low or high rates, followed by an overview of health region patterns for the comparative incidence figures (unsmoothed CIF maps). Clusters were identified with the SaTScan™ software, using a purely spatial analysis for high and low rates at the 0.05 significance level and using a discrete Poisson probability model and elliptical scanning regions.[12-14]

Health regions in effect for December 2007 boundaries were selected as the spatial unit of analysis within provinces and territories. Health regions are of interest since they represent geographic areas of responsibility for hospital boards or regional health authorities. A reason for presenting rates at a health region level is to determine whether the region is statistically significant in relation to Canada as a whole, thereby allowing the region to identify priorities for health promotion strategies. Results adjusted for known cancer risk factors are not included in the present atlas but also may be of interest.

Map A1 and Appendix 3 present the 2007 health regions. Health regions have been abolished in Prince Edward Island, and counties are used in their place.

To avoid the need to suppress data due to small numbers of incident cancers, some health regions were grouped for presentation in this atlas. For example, in Manitoba, Churchill Regional Health Authority (4690) is combined with Burntwood Regional Health Authority (4680) and referred to as "Burntwood/Churchill (4685)." The same approach was followed for health regions in Saskatchewan, as follows: Athabasca Health Authority (4713) is combined with Mamawetan Churchill River Regional Health Authority (4711) and Keewatin Yatthé Regional Health Authority (4712) to form "Mamawetan/Keewatin/Athabasca (4714)." In Quebec, Région des Terres-Cries de la Baie-James (2418) is combined with Région du Nord-du-Québec (2410) and Région du Nunavik (2417), and assigned region number 2419. Région des Terres-Cries de la Baie-James comprises multiple geographic areas within the 2 other health regions. A star symbol is displayed in the reference map at each of the component areas of Région des Terres-Cries de la Baie-James to differentiate this region from the surrounding health regions of Région du Nord-du-Québec and Région du Nunavik. After combining the regions in Quebec, Manitoba and Saskatchewan as described above, 2006 health region population estimates ranged from 19,000 to 2,611,000.

Cancers were assigned to health regions using the postal code of the residence where the individual lived when his/her cancer was diagnosed. The postal codes were used to obtain the census dissemination area by using postal code conversion software (PCCF+), followed by applying the correspondence files of the 2006 dissemination area to the health region.[15,16] If the health region code is determined independently by different organizations, including the handling of records with partial and missing postal codes, a limitation is that the resulting rates produced by each organization will vary slightly. The percentage of cases for which a full postal code was available, or at least a standard geographic code at the municipal level was available, was close to 100% (Table 2).

The standard error of the age-standardized rate was calculated using the method of Breslow and Day.[2] For each cancer type, the standard error was then multiplied by a model-based estimate of the extra-Poisson variation.[17,18] This Poisson regression model included categorical terms for age group and health region, and an interaction term created from the product of age group as a continuous variable and health region. The confidence intervals for the age-standardized rates were produced using the method of Swift, which performs well for small counts.[19] Confidence intervals for the CIFs are based on those of the age-standardized rates, assuming that the standard error of the Canadian rate is small compared with the health region rate. The comparison

of the provincial/territorial rate and the national rate included in the spreadsheet data table takes into account the covariance between the rates. For the spreadsheets showing the rates and confidence intervals for health regions and provinces/territories, rates based on less than 6 cases are suppressed to meet confidentiality requirements. A ranking of health regions by age-standardized rates does not imply that 1 region has a statistically significant difference in rates in relation to another region since the variance of the rates needs to be considered and, in many situations, the confidence intervals of the rates will overlap.

Health region boundary files provided by Statistics Canada were displayed using a Lambert conformal conic projection.[16] Populated areas were shaded in their appropriate colour, providing they had a minimum population density of about 0.4 persons per square kilometre (approximately 1 person per square mile). This approach avoided the problem of having large but sparsely populated areas dominate the maps. In areas with low population density, generalization was accomplished by selecting dissemination areas that fell within the defined threshold, aggregating these areas where appropriate and locating them to the nearest recognizable population centre (e.g., a small town). This procedure ensured that all adequately populated areas in health regions (known as "ecumene pockets") were visible for small-scale thematic mapping and that there was at least 1 shaded area of population in each health region. A large rural area may have population in only a fraction of its total area. The ecumene format means that the populated areas will be coloured based on the rate value while other areas with few people will only have a fixed light background shading used to indicate sparsely populated areas. All residents in a particular health region contributed to the shading for that health region, and all ecumenes in a health region received the same colour based on the overall rate. Since the ecumene boundary layer that was available for the atlas did not match perfectly with the health region boundary layer, thin lines of the colour for the health region also appear along some water boundaries.

Appendix 4 provides a glossary defining some of the technical terms used in this atlas, as well as a list of the abbreviations used.

Limitations

Readers should be aware that variation in cancer incidence rates may be a result of differences in cancer registration practices, and known differences in practices are noted below in the site-specific text. Also, in situations where the variation in a cancer rate and the prevalence of a risk factor agree, one cannot assume that the relationship is causal based on health region or provincial/territorial level information alone. A relationship that applies with respect to groups of people does not necessarily apply at the individual level. Such a study design is called "ecological,"

and the evidence it provides for a cause-effect relationship is relatively weak. A determination that the relationship is likely causal could only be made after more detailed studies, often long-term, have been conducted.

Regional estimates of rates may mask important intraregional heterogeneities. It is also important to note that, for many cancers, there is a long interval between exposure to a risk factor and the occurrence of disease, and often the information on the prevalence of risk factors from previous decades is inadequate.

Where issues of data quality have been ruled out and associations with cancer risk factors have been demonstrated in epidemiologic studies, these findings can be used in planning cancer control programs that aim to reduce the burden of cancer. One source of risk factor prevalence information is the Infobase web mapping tool and data cubes of the Public Health Agency of Canada, which can be found at www.infobase.phac-aspc.gc.ca.

Death certificate only (DCO) cases are those for which vital statistics is the only source of diagnostic information. Table 3 shows the percentage of DCO cases for 2000-2006 by site and province. An ideal range for Canadian data is 1-3%.[20] The other, ill-defined and unknown category had the highest rate of DCO cases, followed by the other digestive system category and cancer of the pancreas. However, having no recorded DCO cases suggests incomplete use of death certificate data and is not ideal.

Table 4 presents the percentage of cases with microscopic confirmation by cancer site. Close to 85% of Canada's cancer cases are microscopically confirmed, but there is considerable variation between anatomic sites and between registries.[21] Specific deficiencies are noted for liver, pancreatic, other digestive system, lung, kidney and brain cancers, multiple myeloma and leukemia, with less than 80% being microscopically confirmed. For leukemia the low proportion is due to haematology reports not consistently being supplied to some registries. The percentage of non-specific unknown primary sites of cancer (ICDO-3 site codes C76, C80.9) refers to those cancers that are too difficult to be classified, and it is difficult to use these cases for any thorough analysis. Current recommendations are that less than 5% of all cases should be categorized as non-specific,[20] and these guidelines were met for 2000-2006.

When calculating incidence rates, failure to remove from the denominator women who are not at risk for developing cancers of the uterine corpus, cervix or ovaries because of hysterectomy/bilateral salpingo-ophorectomy results in underestimation of the rates. Based on data from the 2003 Canadian Community Health Survey (Cycle 2.1), Table 5 presents the prevalence (percentage) of women aged 40 or more who reported a

hysterectomy, by province or territory of residence. The reported prevalence was higher in the Atlantic provinces and Quebec than in other provinces or territories. Responses from the 2000/2001, 2003 and 2005 surveys (responses for 2005 were not available for those aged 50 or more) were used to adjust the population at risk for cancer of the cervix and of the uterus excluding cervix. The prevalence of women who have had both ovaries removed is about one-half that reporting a hysterectomy,[22] and there were not sufficient data available to make a prevalence estimate at the health region level in order to allow a population adjustment for ovarian cancer for this atlas.

The use of population estimates from Alberta Health Insurance resulted in ASIRs for the Alberta Northern Lights Health Region that were higher than those reported in the current atlas (11% higher for females and 18% higher for males). Such a difference in rates could lead to a failure to detect a significantly elevated rate for a cancer type. Similarly, a cancer type in this health region could be evaluated as being significantly low in error. Alberta Health Services has reported lower cancer incidence rates in 2002-2004 for the Northern Lights Health Region than for Alberta as a whole.[23]

In Quebec, because of the registry's dependence on hospital data, the numbers of microscopically confirmed prostate, melanoma and bladder cases have been estimated to be under-reported.[24] For Ontario *in situ* bladder cancer cases have not been reported for the period covered by this atlas. To make comparisons more useful, rates presented in the atlas for melanoma exclude Quebec and rates presented for bladder cancer exclude Ontario. Rates in the Outaouais region of Quebec are under-reported since information on residents diagnosed and treated exclusively in Ontario has not been completely incorporated into the Quebec registry. Case-ascertainment studies have been carried out by some provincial registries,[25] and the *Registry Comparability Report* was prepared by the Colorectal Cancer Network for the Canadian Partnership Against Cancer.[26]

The number of newly diagnosed cases for 2006 for specific cancers is provided below in the site-specific sections as an indication of the disease burden. These numbers are updated with later data releases of the Canadian Cancer Registry.

Table 1. Incidence rates for all cancer sites (combined) using IARC rules compared with rates of first malignant primary cases, and ratio, by province or territory of residence, Canada, 2004-2006

	Rates using IARC rules		Rates of first malignant primaries		Ratio of first malignant primaries to IARC rules-based rates	
Province/territory	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**
Newfoundland and Labrador	313.8	436.8	291.8	380.9	0.93	0.87
Prince Edward Island	352.0	543.2	318.3	462.1	0.90	0.85
Nova Scotia	385.5	541.3	353.8	466.8	0.92	0.86
New Brunswick	360.3	518.2	334.2	458.2	0.93	0.88
Quebec	364.9	485.7	331.8	422.7	0.91	0.87
Ontario	364.3	462.9	344.1	432.5	0.94	0.93
Manitoba	357.4	439.2	331.1	385.2	0.93	0.88
Saskatchewan	338.7	466.0	309.5	407.4	0.91	0.87
Alberta	354.7	459.1	323.1	395.9	0.91	0.86
British Columbia	321.7	408.5	297.3	357.5	0.92	0.88
Yukon	343.4	366.8	315.7	332.2	0.92	0.91
Northwest Territories	308.9	434.7	288.5	411.2	0.93	0.95
Nunavut	565.1	499.6	524.6	475.8	0.93	0.95
CANADA	356.6	462.6	330.5	414.1	0.93	0.90

Note: Rates are per 100,000 persons per year.

Table 2. Percentage of cases for which a full, 6-digit postal code signifying usual residence at time of diagnosis has been registered and the percentage that at least had a valid SGC code, by province or territory of residence, Canada, 2000-2006

	Percentage of Cases	
	Full postal code	**Valid SGC**
Province/terrirory		
Newfoundland and Labrador	100.0	100.0
Prince Edward Island	100.0	100.0
Nova Scotia	100.0	100.0
New Brunswick	100.0	100.0
Quebec	NA	99.8
Ontario	97.7	99.1
Manitoba	100.0	100.0
Saskatchewan	100.0	100.0
Alberta	99.9	99.9
British Columbia	99.7	99.7
Yukon	98.0	98.0
Northwest Territories	99.9	100.0
Nunavut	100.0	100.0
CANADA	NA	99.6

NA: Not available. SGC: Standard geographic code

Table 3. Percentage of death certificate only (DCO) cases using method of the most accurate diagnostic confirmation, by cancer site and province or territory of residence, Canada, 2000-2006

	Province/territory													
Cancer site	**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**	**Canada**
All sites	0.0	0.1	1.1	0.0	2.6	1.8	2.1	2.3	0.3	1.7	3.1	0.6	2.7	1.8
Buccal cavity and pharynx	0.0	0.0	0.2	0.0	2.3	0.9	0.4	0.3	0.1	0.5	0.0	0.0	0.0	1.0
Esophagus	0.0	0.0	1.6	0.0	4.0	2.0	2.8	2.0	0.0	1.1	7.1	0.0	0.0	2.1
Stomach	0.0	1.2	1.4	0.0	3.3	1.8	2.4	2.8	0.4	2.0	0.0	0.0	0.0	2.1
Colon and rectum	0.0	0.0	1.0	0.1	2.3	1.6	1.8	1.9	0.3	1.6	2.1	0.8	1.3	1.6
Liver	0.0	0.0	1.2	0.0	6.2	3.4	6.1	14.0	1.2	5.0	0.0	0.0	66.7	4.4
Pancreas	0.0	0.0	3.2	0.0	5.1	6.3	4.9	7.4	0.7	5.5	7.7	0.0	0.0	5.0
Other digestive system	0.0	0.0	3.4	0.0	9.6	2.7	5.9	4.5	1.1	6.3	0.0	14.3	12.5	5.2
Larynx	0.0	0.0	0.4	0.0	2.3	0.8	0.0	0.0	0.0	0.7	0.0	0.0	0	1.1
Lung and bronchus	0.0	0.1	1.7	0.0	4.1	3.5	3.0	4.3	0.4	2.5	11.1	0.0	4.8	3.1
Melanoma of skin	0.0	0.0	0.2	0.0	0.6	0.2	0.1	0.1	0.1	0.2	0.0	0.0	0.0	0.2
Female breast	0.0	0.0	0.7	0.0	1.6	0.8	0.9	0.8	0.2	0.5	0.0	0.0	0.0	0.9
Cervix uteri	0.0	0.0	0.2	0.0	1.0	0.8	0.6	0.7	0.1	0.5	0.0	0.0	0.0	0.6
Uterus excluding cervix	0.0	0.0	1.0	0.0	1.9	1.0	0.7	0.5	0.1	0.7	0.0	0.0	0.0	1.0

Table 3. (continued)

Percentage of death certificate only (DCO) cases using method of the most accurate diagnostic confirmation, by cancer site and province or territory of residence, Canada, 2000-2006

	Province/territory													
Cancer site	**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**	**Canada**
Ovary	0.0	0.0	0.7	0.0	2.0	1.9	1.9	2.7	0.7	1.8	0.0	0.0	0.0	1.7
Other female genital system	0.0	0.0	0.0	0.0	4.9	1.1	0.0	1.5	0.0	1.1	0	0.0	0	1.7
Prostate	0.0	0.1	0.6	0.1	2.0	0.6	1.8	1.1	0.2	0.9	0.0	0.0	0.0	0.9
Testis	0.0	0.0	0.0	0.0	0.2	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Bladder	0.0	0.0	0.1	0.1	0.9	1.2	0.8	0.4	0.3	0.7	3.3	0.0	0.0	0.8
Kidney and renal pelvis	0.0	0.0	0.8	0.0	1.6	1.4	2.4	2.0	0.2	2.1	13.3	0.0	0.0	1.4
Brain and nervous system	0.0	0.0	0.2	0.0	1.5	2.0	1.2	2.4	0.1	1.5	0.0	11.1	0.0	1.5
Thyroid	0.0	0.0	0.2	0.0	0.2	0.1	0.4	0.5	0.0	0.1	0.0	0.0	0.0	0.1
Hodgkin lymphoma	0.0	0.0	1.1	0.0	0.1	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Non-Hodgkin lymphoma	0.0	0.0	0.6	0.0	1.2	0.8	1.1	0.5	0.1	0.6	0.0	0.0	0.0	0.8
Multiple myeloma	0.0	0.0	1.8	0.0	1.8	1.8	1.9	2.0	0.4	1.5	0.0	0.0	0.0	1.6
Leukemia	0.0	0.0	3.0	0.0	2.8	2.3	3.1	2.3	0.4	3.3	6.7	0.0	0.0	2.3
Other, ill-defined and unknown	0.0	0.0	3.4	0.1	6.6	8.2	7.9	10.3	1.6	6.6	13.6	11.1	0.0	6.6

Table 4. Percentage of cases with microscopic confirmation, by cancer site and province or territory of residence, Canada, 2000-2006

	Province/territory													
Cancer site	**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**	**Canada**
All sites	96.8	92.3	89.2	92.1	76.2	84.1	87.6	89.5	91.7	90.1	90.6	94.8	91.9	84.4
Buccal cavity and pharynx	98.0	100.0	98.3	97.7	84.4	92.6	98.3	98.0	99.1	98.0	85.7	100.0	100.0	92.7
Esophagus	97.7	94.5	89.7	96.3	75.1	89.6	93.9	92.5	95.1	94.1	92.9	100.0	80.0	88.0
Stomach	99.2	95.1	90.4	95.4	82.4	87.3	91.6	93.3	95.9	93.3	92.9	100.0	100.0	88.4
Colon and rectum	99.3	94.1	92.7	95.0	86.8	89.0	92.5	94.4	95.5	94.1	94.8	94.6	94.7	90.4
Liver	89.2	84.6	53.0	69.0	40.5	61.6	42.2	67.1	59.0	49.6	100.0	0.0	33.3	53.2
Pancreas	74.9	58.6	48.7	55.0	44.4	50.0	44.8	58.5	59.4	56.1	84.6	86.7	85.7	50.5
Other digestive system	81.9	69.8	69.5	66.7	50.6	60.9	61.5	79.0	75.6	68.8	83.3	71.4	85.7	61.4
Larynx	98.8	100.0	96.9	96.8	89.4	94.0	96.7	99.0	97.9	97.2	100.0	100.0	–*	93.4
Lung and bronchus	90.6	84.6	77.4	82.4	66.5	76.4	78.6	78.6	82.6	82.1	69.1	91.3	89.0	75.0
Melanoma of skin	99.5	100.0	99.8	99.8	76.2	97.5	99.8	99.9	99.9	99.5	100.0	100.0	100.0	95.6
Female breast	99.4	98.7	97.6	98.3	92.6	95.7	97.2	97.9	98.8	98.5	99.1	100.0	96.8	95.8
Cervix uteri	97.8	100.0	99.3	99.6	87.8	93.6	98.5	98.9	98.7	98.3	100.0	90.0	100.0	94.3
Uterus excluding cervix	99.7	99.2	97.8	99.2	91.1	93.1	98.8	98.5	98.7	98.2	100.0	100.0	100.0	94.6

Table 4. (continued) Percentage of cases with microscopic confirmation, by cancer site and province or territory of residence, Canada, 2000-2006

	Province/territory													
Cancer site	**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**	**Canada**
Ovary	92.6	89.7	89.3	90.7	78.7	75.2	88.2	89.8	91.0	89.2	100.0	100.0	100.0	81.0
Other female genital system	97.1	100.0	97.5	98.4	80.8	86.8	97.9	96.2	97.6	97.0	0.0	100.0	–*	88.9
Prostate	99.6	95.8	96.9	97.7	76.2	94.3	92.5	92.9	92.0	95.9	98.5	94.1	100.0	91.0
Testis	98.6	95.5	99.4	99.1	96.3	95.2	99.1	99.5	99.6	98.9	100.0	100.0	100.0	97.0
Bladder	99.7	98.2	95.8	98.0	90.5	77.2	95.2	96.8	96.9	97.4	96.7	100.0	100.0	89.3
Kidney and renal pelvis	93.0	84.7	84.4	87.7	74.5	76.0	70.5	81.1	82.8	83.4	73.3	81.8	87.5	78.0
Brain and nervous system	84.3	89.3	76.2	79.5	68.9	70.2	76.5	87.9	81.6	83.4	85.7	77.8	50.0	73.8
Thyroid	99.6	100.0	98.8	99.6	95.7	87.6	99.4	99.5	99.6	99.3	100.0	100.0	100.0	92.7
Hodgkin lymphoma	100.0	100.0	98.9	100.0	91.0	94.3	99.5	100.0	99.8	99.9	87.5	100.0	100.0	95.4
Non-Hodgkin lymphoma	98.8	99.5	96.2	98.9	82.8	88.5	93.3	97.8	98.3	96.8	95.8	100.0	100.0	90.3
Multiple myeloma	96.0	96.0	84.9	95.2	56.2	64.7	83.1	82.8	91.5	86.4	100.0	85.7	0.0	70.2
Leukemia	98.5	97.9	89.3	99.3	48.8	62.5	91.0	85.9	99.1	81.1	66.7	100.0	100.0	69.1
Other, ill-defined and unknown	87.2	67.6	64.7	69.9	37.5	51.7	63.9	59.4	76.8	64.5	63.6	77.8	87.5	53.8

* 0 cases

Table 5. Prevalence (%) of women aged 40 or more who reported having a hysterectomy, by province or territory of residence, Canada, 2003

	Prevalence (%)	
	Estimate	95% CI
Province/terrirory		
Newfoundland and Labrador	28.7	(25.4–32.0)
Prince Edward Island	33.5	(28.2–38.8)
Nova Scotia	37.4	(34.2–40.6)
New Brunswick	35.2	(32.2–38.2)
Quebec	28.1	(26.7–29.4)
Ontario	23.0	(22.1–23.9)
Manitoba	21.7	(19.3–24.1)
Saskatchewan	26.8	(24.2–29.4)
Alberta	26.2	(24.3–28.2)
British Columbia	25.0	(23.4–26.5)
Yukon	29.8[E]	(15.8–43.8)
Northwest Territories	15.2	(10.3–20.2)
Nunavut	19.9[E]	(9.8–29.9)
CANADA	25.8	(25.2–26.4)

CI: Confidence interval. E: Warning: large sampling variability. Source: Canadian Community Health Cycle 2.1 (2003), Share File, using sample weights

Table 6. Incidence-to-mortality ratio for all cancer sites combined, by province or territory of residence, Canada, 2000-2006

Province/territory	Ratio
Newfoundland and Labrador	1.83
Prince Edward Island	2.40
Nova Scotia	2.24
New Brunswick	2.32
Quebec	2.20
Ontario	2.34
Manitoba	2.22
Saskatchewan	2.33
Alberta	2.46
British Columbia	2.33
Yukon	1.61
Northwest Territories	1.89
Nunavut	1.50
Canada	2.29

Geographic Patterns by Cancer Site

All cancer sites (Maps 1 and 2)

In 2006, there were approximately 159,000 new cases of cancer in Canadians. The variation in overall cancer incidence rates is determined mostly by the variation in the incidence of leading cancer sites across the country. From 2000 to 2006, 4 sites collectively accounted for over half of all cancers (i.e., breast [28%], colon and rectum [13%], and lung [13%] among females, and prostate [26%], lung [16%], and colon and rectum [14%] among males).

The distribution of cancers is influenced in part by variation in the past prevalence of risk factors across the country, in keeping with the long latency between the start of exposure and the appearance of most cancers. For lung cancer, this latent period is recognized as a considerable fraction of a lifetime and is measured in decades. Cancer risk factors include cigarette smoking, alcohol consumption, obesity, low fruit and vegetable consumption, food contaminants, radiation, some chronic infections, medicinal drugs, immunosuppression, and occupational and environmental contaminants. Short-term variation in cancer incidence may also be due to the availability of screening and diagnostic services for breast, colorectal, prostate and cervical cancers; places with such services can detect more cancers than places without these services. These factors are discussed in more detail by type of cancer.

In Canada, the 2006 age-standardized incidence rate (ASIR) of cancer for all sites combined (excluding non-melanoma skin cancer) is 29% higher in males than in females. Prior to age 55, females have a higher rate of cancer, mostly because of breast cancer. However, the all-site incidence rate for males increases more rapidly with age than that for females after age 55, and it is nearly double the female rate by age 85 years or over.[27]

The annual ASIRs of cancer for all sites combined were relatively stable for the period 1997-2006.[28] The 5-year relative survival is better among females (63%) than males (61%) (statistically significant), and it has increased by 4.5 percentage points for the period 2002-2004 versus 1992-1994 (absolute difference in age-standardized relative survival rates).[29]

Geographic Variation

In Newfoundland and Labrador, overall cancer incidence rates were statistically significantly lower than the Canadian rates for both females and males. Some cancers are not included in the cancer registry for that province because information from death certificates was not included in the registry for the period of data used in this publication. This falsely lowers the number of newly diagnosed cases, mainly among those cancers with a poor prognosis, such as lung and pancreatic cancers. However, the

percentage of death certificate only cases is relatively small for all cancers combined, and these cases do not entirely explain the lower incidence rates. The incidence-to-mortality ratio based on the ratio of the age-standardized rates from 2000 to 2006 is presented in Table 6. This ratio is a crude surrogate of survival, and low values may indicate under-ascertainment. The ratio was 1.83 in Newfoundland and Labrador, while the national average was 2.29; in other provinces, it ranged from 2.20 to 2.46. Although Newfoundland and Labrador had low incidence rates of cancer overall at the provincial/territorial level (compared with the rest of Canada) and for several major cancer sites, the incidence rates of oral cancer among men, and of stomach, colorectal, laryngeal and cervical cancers were significantly elevated in comparison with national rates. British Columbia had lower overall cancer incidence rates for females and for males. The lower rates in British Columbia partly reflect its lower rates of colorectal, breast and lung cancers. All cancer rates were also lower among females in Saskatchewan and among males in Ontario and Manitoba.

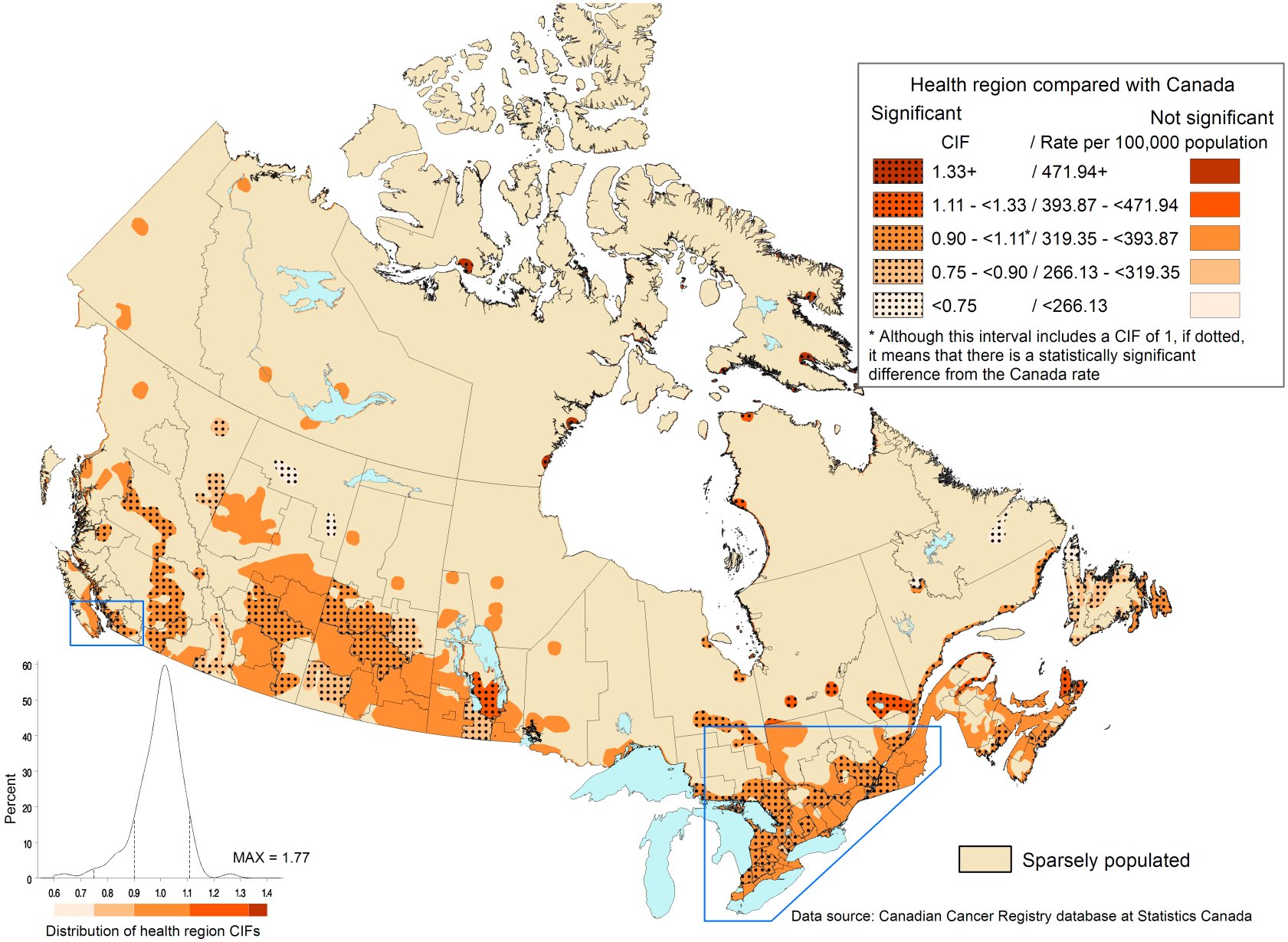
Significantly higher overall incidence rates were observed among females in Nova Scotia, Quebec, Ontario, Manitoba and Nunavut. For males, increased rates occurred in Prince Edward Island, Nova Scotia, New Brunswick, Quebec and Alberta.

Regions with lower overall cancer rates included British Columbia, where 11 of 16 health regions reported significantly low rates among females and 14 of 16 reported significantly low rates among males. A second region with low rates was southern Ontario, where the City of Toronto, York Regional, Peel Regional, Waterloo and City of Ottawa health regions had significantly low rates among both sexes. Many regions in Nova Scotia, New Brunswick (for men) and Quebec, as well as Nunavut, had higher overall cancer incidence rates than the Canadian rate, partly due to higher rates of lung cancer in these regions of the country.

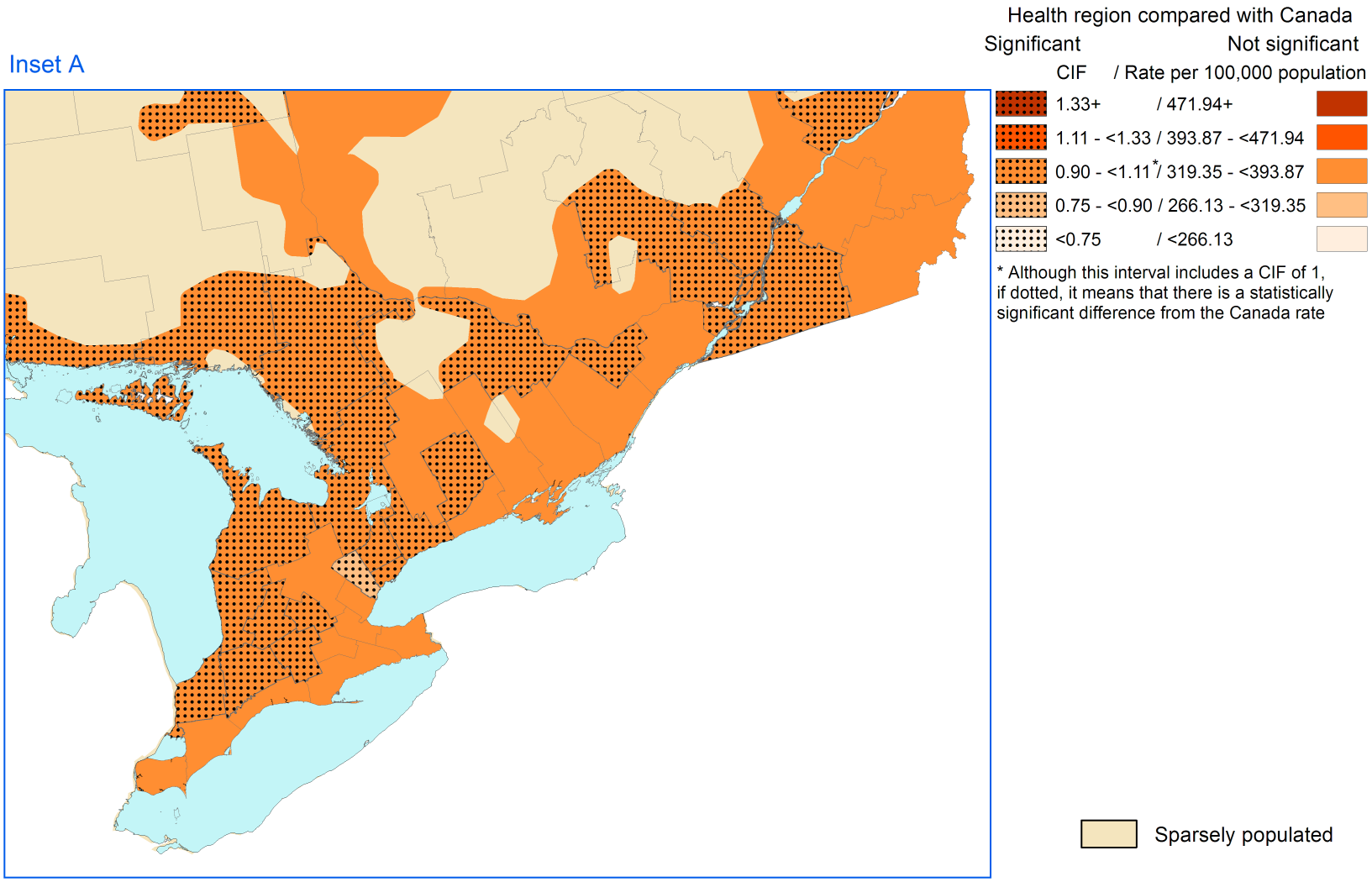
Tables 7A, 7B and 7C present the number (and percentage) of health regions with significantly high and low cancer incidence rates when each health region's age-standardized rate is compared with the Canadian rate. Results are presented by province/territory for all cancers combined and for specific cancers.

The maps also demonstrate the difficulty of interpretation for the more extreme rates (high and low) in those health regions where the populations are smaller (northern Quebec, northern Manitoba and the territories).

Map 1. All sites, females, 2000-2006, all ages

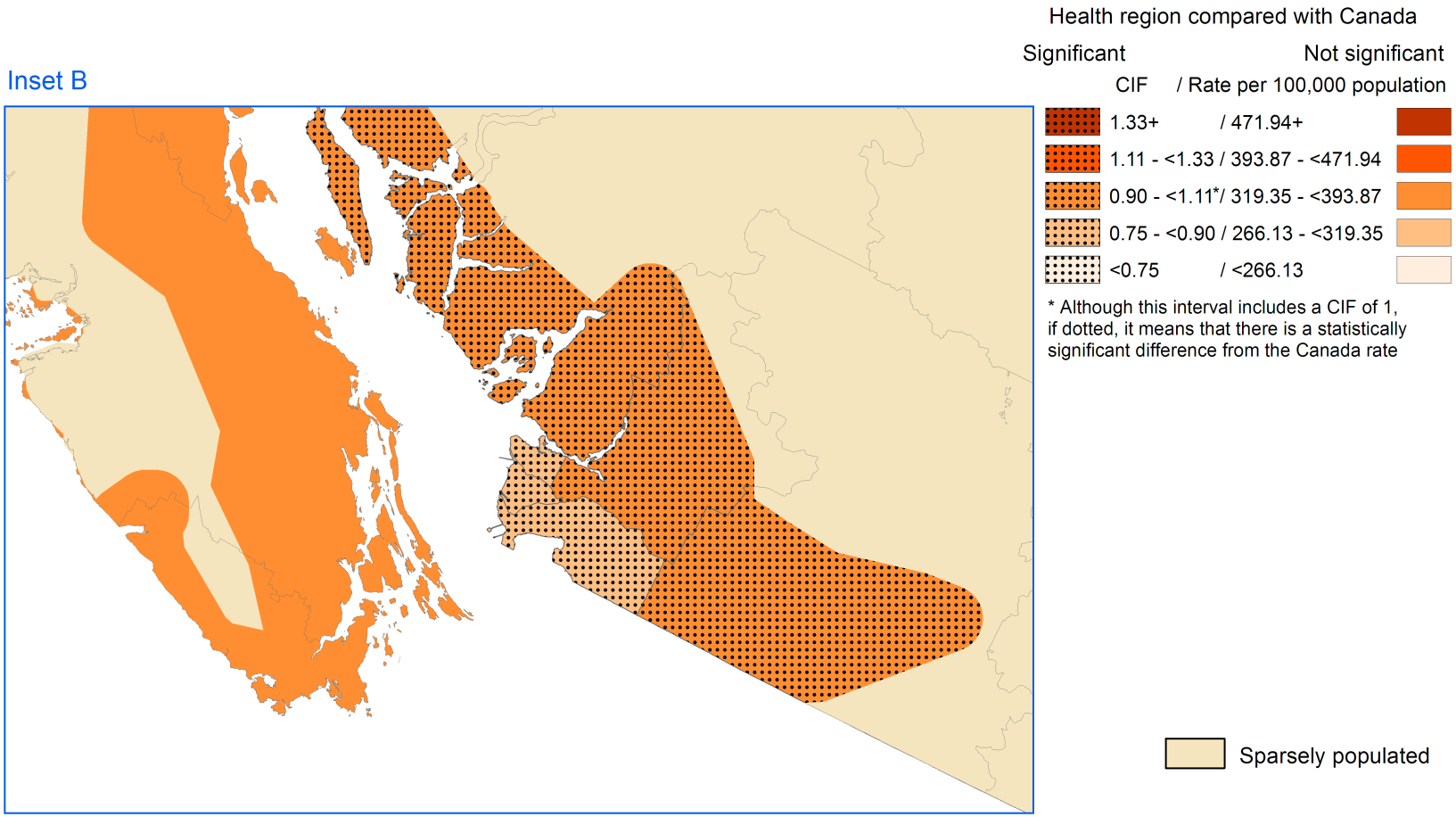


Map 1-A. All sites, females, 2000-2006, all ages



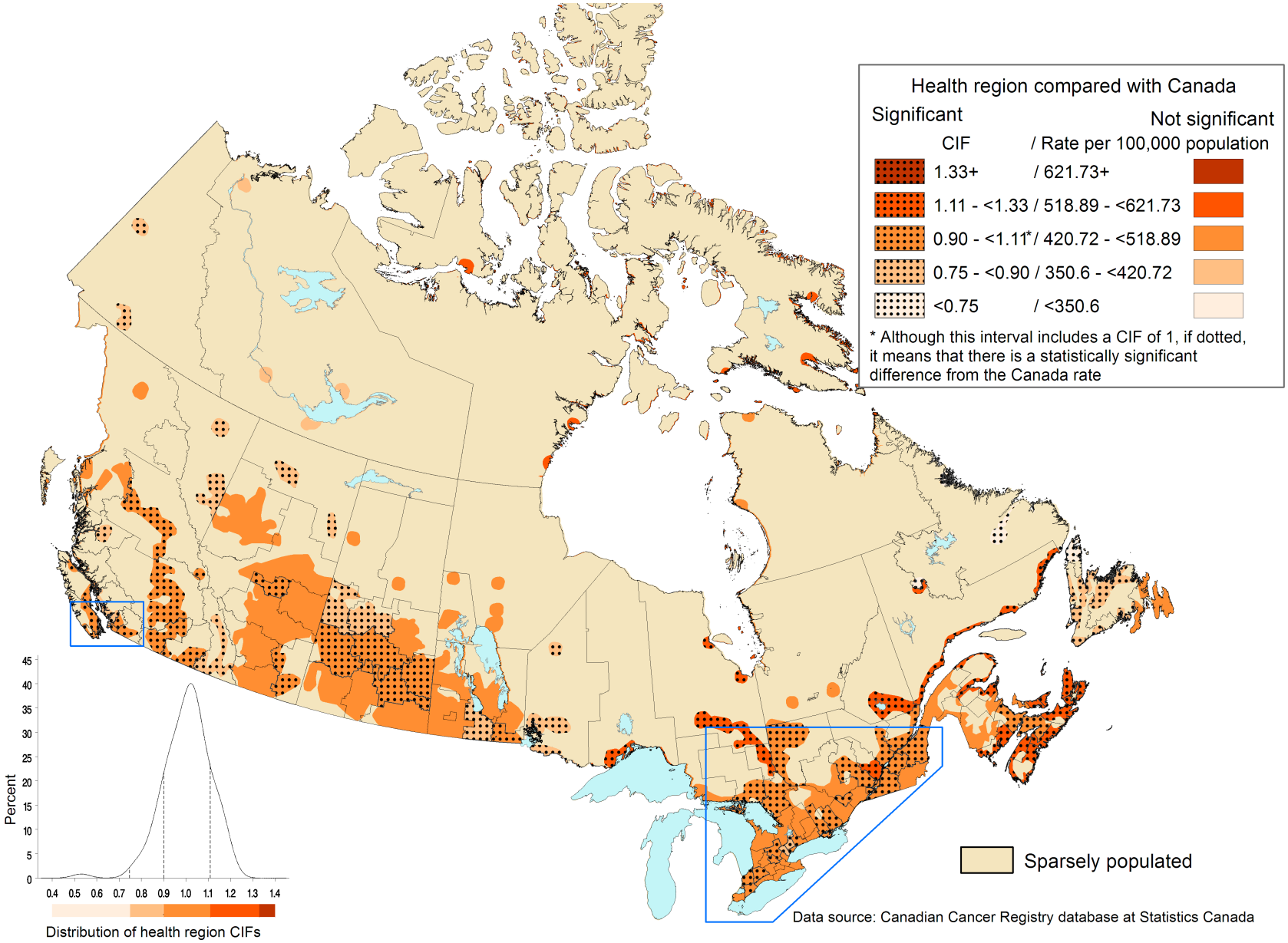
Data source: Canadian Cancer Registry database at Statistics Canada

Map 1-B. All sites, females, 2000-2006, all ages

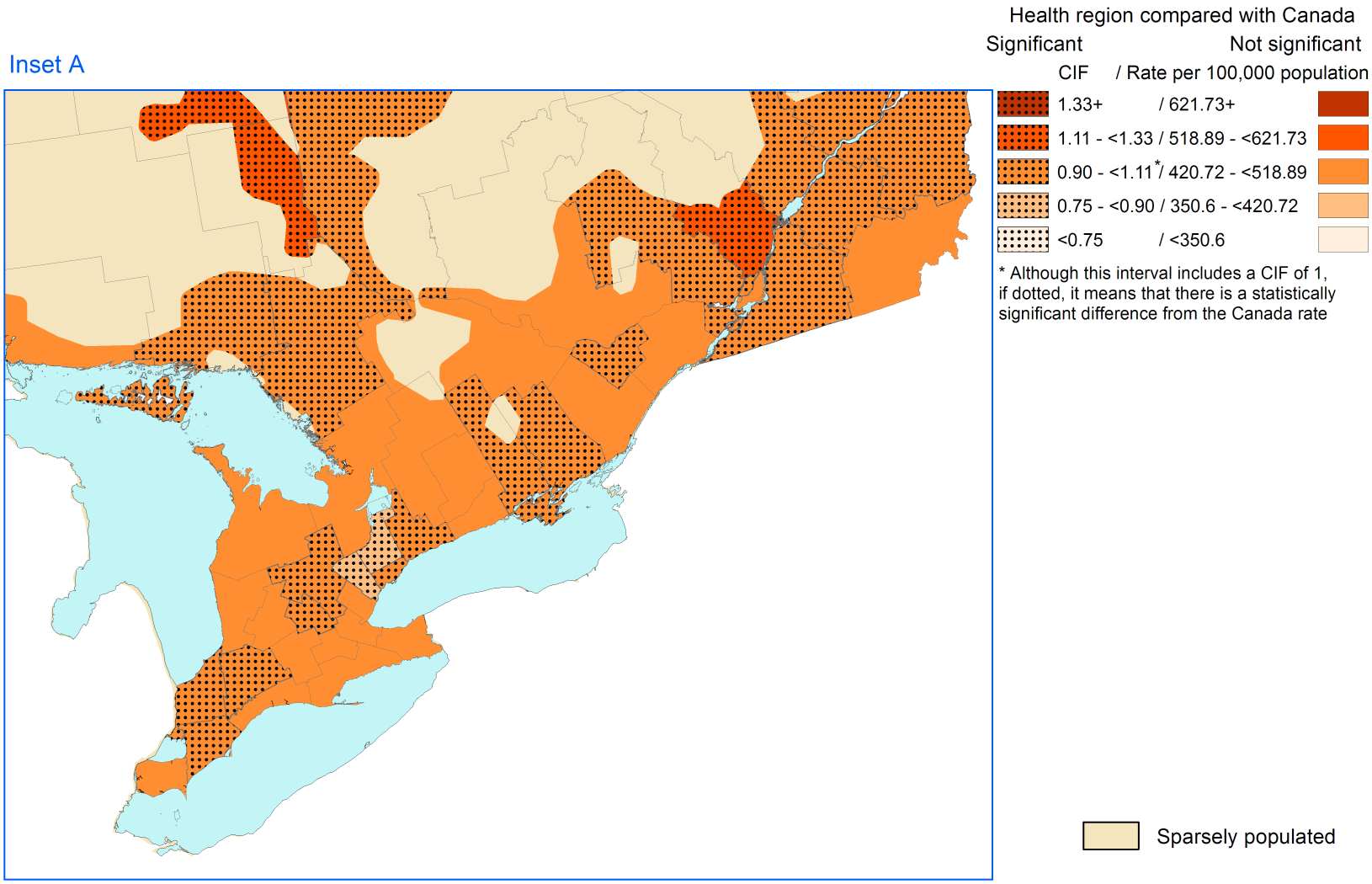


Data source: Canadian Cancer Registry database at Statistics Canada

Map 2. All sites, males, 2000-2006, all ages

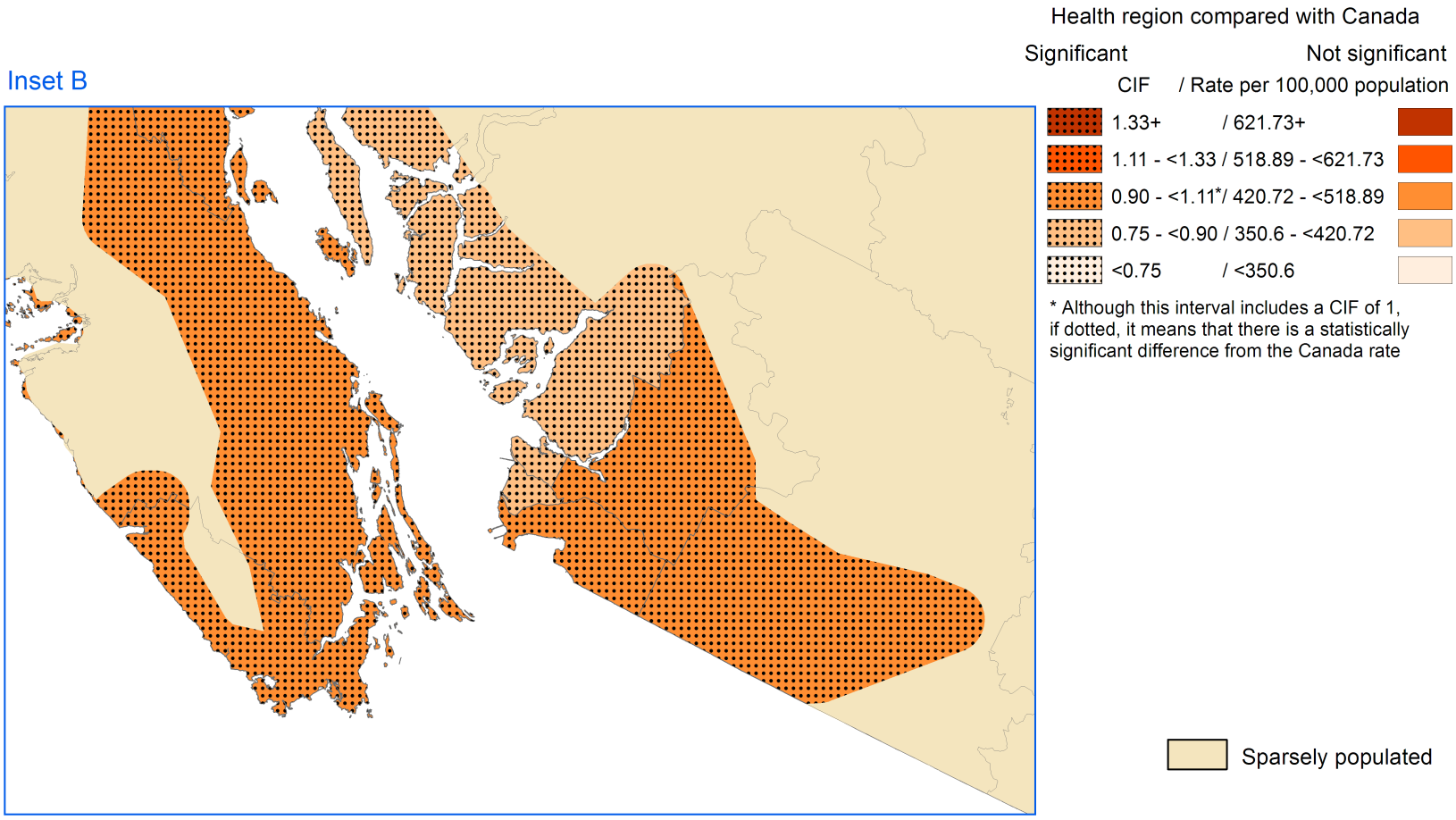


Map 2-A. All sites, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 2-B. All sites, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Table 7A. Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, females

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
All sites	High	N	0	0	2	1	10	13	2	0	1	0	0	0	1
		%	0	0	33	14	63	36	20	0	11	0	0	0	100
	Not significant	N	0	3	4	6	6	17	7	6	6	4	1	1	0
		%	0	100	67	86	38	47	70	55	67	31	100	100	0
	Low	N	4	0	0	0	0	6	1	5	2	11	0	0	0
		%	100	0	0	0	0	17	10	45	22	69	0	0	0
Buccal cavity and pharynx	High	N	0	0	0	0	1	2	2	0	0	0	0	0	1
		%	0	0	0	0	6	6	20	0	0	0	0	0	100
	Not significant	N	3	3	6	6	15	33	8	11	9	16	1	1	0
		%	75	100	100	86	94	92	80	100	100	100	100	100	0
	Low	N	1	0	0	1	0	1	0	0	0	0	0	0	0
		%	25	0	0	14	0	3	0	0	0	0	0	0	0
Stomach	High	N	3	0	0	1	7	1	0	0	0	0	0	1	0
		%	75	0	0	14	44	3	0	0	0	0	0	100	0
	Not significant	N	1	3	5	6	9	24	9	10	8	11	1	0	1
		%	25	100	83	86	56	67	90	91	89	69	100	0	100
	Low	N	0	0	1	0	0	11	1	1	1	5	0	0	0
		%	0	0	17	0	0	31	10	9	11	31	0	0	0

Table 7A. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, females

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Colon and rectum	High	N	2	2	5	0	6	6	0	0	0	0	0	1	1
		%	50	67	83	0	38	17	0	0	0	0	0	100	100
	Not significant	N	2	1	1	6	10	26	10	11	7	9	1	0	0
		%	50	33	17	86	63	72	100	100	78	56	100	0	0
	Low	N	0	0	0	1	0	4	0	0	2	7	0	0	0
		%	0	0	0	14	0	11	0	0	22	44	0	0	0
Pancreas	High	N	0	0	1	1	9	0	0	1	2	2	0	0	1
		%	0	0	17	14	56	0	0	9	22	13	0	0	100
	Not significant	N	1	3	5	6	7	28	10	10	7	14	1	1	0
		%	25	100	83	86	44	78	100	91	78	88	100	100	0
	Low	N	3	0	0	0	0	8	0	0	0	0	0	0	0
		%	75	0	0	0	0	22	0	0	0	0	0	0	0
Other digestive system	High	N	0	0	0	0	8	0	0	0	3	1	0	0	0
		%	0	0	0	0	50	0	0	0	33	6	0	0	0
	Not significant	N	3	3	6	7	8	30	10	11	6	15	1	1	1
		%	75	100	100	100	50	83	100	100	67	94	100	100	100
	Low	N	1	0	0	0	0	6	0	0	0	0	0	0	0
		%	25	0	0	0	0	17	0	0	0	0	0	0	0

Table 7A. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, females

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Lung and bronchus	High	N	0	0	2	1	12	14	3	1	1	3	0	0	1
		%	0	0	33	14	75	39	30	9	11	19	0	0	100
	Not significant	N	0	3	4	6	3	16	6	9	6	8	1	1	0
		%	0	100	67	86	19	44	60	82	67	50	100	100	0
	Low	N	4	0	0	0	1	6	1	1	2	5	0	0	0
		%	100	0	0	0	6	17	10	9	22	31	0	0	0
Melanoma of the skin (Quebec not included, see text for details)	High	N	0	1	2	1		12	0	0	1	3	0	0	0
		%	0	33	33	14		33	0	0	11	19	0	0	0
	Not significant	N	3	2	3	5		18	9	11	5	8	1	1	1
		%	75	67	50	71		50	90	100	56	50	100	100	100
	Low	N	1	0	1	1		6	1	0	3	5	0	0	0
		%	25	0	17	14		17	10	0	33	31	0	0	0
Female breast	High	N	0	0	1	0	5	5	0	0	1	0	0	0	0
		%	0	0	17	0	31	14	0	0	11	0	0	0	0
	Not significant	N	1	3	5	6	10	27	8	10	5	8	1	1	0
		%	25	100	83	86	63	75	80	91	56	50	100	100	0
	Low	N	3	0	0	1	1	4	2	1	3	8	0	0	1
		%	75	0	0	14	6	11	20	9	33	50	0	0	100

Table 7A. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, females

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Cervix uteri	High	N	1	0	4	2	1	5	0	1	4	1	0	0	0
		%	25	0	67	29	6	14	0	9	44	6	0	0	0
	Not significant	N	3	3	2	5	13	26	10	9	5	9	1	1	1
		%	75	100	33	71	81	72	100	82	56	56	100	100	100
	Low	N	0	0	0	0	2	5	0	1	0	6	0	0	0
		%	0	0	0	0	13	14	0	9	0	38	0	0	0
Uterus excluding cervix	High	N	0	0	1	1	0	9	1	1	5	0	0	0	0
		%	0	0	17	14	0	25	10	9	56	0	0	0	0
	Not significant	N	2	3	5	6	14	24	9	10	4	12	1	0	1
		%	50	100	83	86	88	67	90	91	44	75	100	0	100
	Low	N	2	0	0	0	2	3	0	0	0	4	0	1	0
		%	50	0	0	0	13	8	0	0	0	25	0	100	0
Ovary	High	N	0	0	0	1	2	5	1	0	0	0	0	0	0
		%	0	0	0	14	13	14	10	0	0	0	0	0	0
	Not significant	N	1	2	4	6	13	30	9	11	5	13	1	1	1
		%	25	67	67	86	81	83	90	100	56	81	100	100	100
	Low	N	3	1	2	0	1	1	0	0	4	3	0	0	0
		%	75	33	33	0	6	3	0	0	44	19	0	0	0

Table 7A. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, females

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Other female genital system	High	N	0	0	0	0	0	10	0	0	0	0	0	0	0
		%	0	0	0	0	0	28	0	0	0	0	0	0	0
	Not significant	N	4	3	6	7	12	26	10	11	9	13	1	1	1
		%	100	100	100	100	75	72	100	100	100	81	100	100	100
	Low	N	0	0	0	0	4	0	0	0	0	3	0	0	0
		%	0	0	0	0	25	0	0	0	0	19	0	0	0
Bladder (Ontario not included, see text for details)	High	N	0	0	0	1	4		0	0	0	1	0	0	0
		%	0	0	0	14	25		0	0	0	6	0	0	0
	Not significant	N	3	3	6	5	11		10	10	7	11	1	1	1
		%	75	100	100	71	69		100	91	78	69	100	100	100
	Low	N	1	0	0	1	1		0	1	2	4	0	0	0
		%	25	0	0	14	6		0	9	22	25	0	0	0
Kidney and renal pelvis	High	N	0	0	3	4	8	4	3	1	0	0	0	0	1
		%	0	0	50	57	50	11	30	9	0	0	0	0	100
	Not significant	N	4	3	3	3	8	29	7	9	9	7	1	1	0
		%	100	100	50	43	50	81	70	82	100	44	100	100	0
	Low	N	0	0	0	0	0	3	0	1	0	9	0	0	0
		%	0	0	0	0	0	8	0	9	0	56	0	0	0

Table 7A. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, females

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Brain and other nervous system	High	N	0	0	0	0	3	1	0	0	0	0	0	0	0
		%	0	0	0	0	19	3	0	0	0	0	0	0	0
	Not significant	N	4	3	6	7	13	35	9	11	8	12	1	1	1
		%	100	100	100	100	81	97	90	100	89	75	100	100	100
	Low	N	0	0	0	0	0	0	1	0	1	4	0	0	0
		%	0	0	0	0	0	0	10	0	11	25	0	0	0
Non-Hodgkin lymphoma	High	N	0	0	0	1	1	5	1	0	1	1	0	0	0
		%	0	0	0	14	6	14	10	0	11	6	0	0	0
	Not significant	N	2	3	6	6	13	30	9	11	7	12	1	1	1
		%	50	100	100	86	81	83	90	100	78	75	100	100	100
	Low	N	2	0	0	0	2	1	0	0	1	3	0	0	0
		%	50	0	0	0	13	3	0	0	11	19	0	0	0
Multiple myeloma	High	N	0	0	0	1	2	6	1	0	0	0	0	0	0
		%	0	0	0	14	13	17	10	0	0	0	0	0	0
	Not significant	N	2	3	6	6	14	29	8	10	8	11	1	1	1
		%	50	100	100	86	88	81	80	91	89	69	100	100	100
	Low	N	2	0	0	0	0	1	1	1	1	5	0	0	0
		%	50	0	0	0	0	3	10	9	11	31	0	0	0

Table 7A. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, females

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Leukemia	High	N	0	0	0	0	2	1	1	3	2	0	0	0	0
		%	0	0	0	0	13	3	10	27	22	0	0	0	0
	Not significant	N	1	3	6	7	13	32	8	8	7	14	1	1	1
		%	25	100	100	100	81	89	80	73	78	88	100	100	100
	Low	N	3	0	0	0	1	3	1	0	0	2	0	0	0
		%	75	0	0	0	6	8	10	0	0	13	0	0	0
Other, ill-defined and unknown	High	N	0	0	1	0	5	2	1	0	0	0	0	0	0
		%	0	0	17	0	31	6	10	0	0	0	0	0	0
	Not significant	N	1	3	5	2	10	27	9	11	9	14	1	1	1
		%	25	100	83	29	63	75	90	100	100	88	100	100	100
	Low	N	3	0	0	5	1	7	0	0	0	2	0	0	0
		%	75	0	0	71	6	19	0	0	0	13	0	0	0

Table 7B. Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, males

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
All sites	High	N	0	2	6	4	11	9	0	3	1	1	0	0	0
		%	0	67	100	57	69	25	0	27	11	6	0	0	0
	Not significant	N	1	1	0	3	5	18	8	5	6	1	0	1	1
		%	25	33	0	43	31	50	80	45	67	6	0	100	100
	Low	N	3	0	0	0	0	9	2	3	2	14	1	0	0
		%	75	0	0	0	0	25	20	27	22	88	100	0	0
Buccal cavity and pharynx	High	N	1	0	2	1	3	7	3	1	0	0	0	0	0
		%	25	0	33	14	19	19	30	9	0	0	0	0	0
	Not significant	N	3	3	4	6	12	26	7	8	7	12	1	1	1
		%	75	100	67	86	75	72	70	73	78	75	100	100	100
	Low	N	0	0	0	0	1	3	0	2	2	4	0	0	0
		%	0	0	0	0	6	8	0	18	22	25	0	0	0
Stomach	High	N	3	0	1	2	6	1	0	0	0	0	0	0	1
		%	75	0	17	29	38	3	0	0	0	0	0	0	100
	Not significant	N	1	3	5	5	10	28	9	10	8	11	1	1	0
		%	25	100	83	71	63	78	90	91	89	69	100	100	0
	Low	N	0	0	0	0	0	7	1	1	1	5	0	0	0
		%	0	0	0	0	0	19	10	9	11	31	0	0	0

Table 7B. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, males

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Colon and rectum	High	N	2	1	5	0	12	6	0	0	0	0	0	1	0
		%	50	33	83	0	75	17	0	0	0	0	0	100	0
	Not significant	N	1	2	1	7	4	26	10	10	6	8	1	0	1
		%	25	67	17	100	25	72	100	91	67	50	100	0	100
	Low	N	1	0	0	0	0	4	0	1	3	8	0	0	0
		%	25	0	0	0	0	11	0	9	33	50	0	0	0
Pancreas	High	N	0	0	1	1	10	2	0	1	0	1	0	0	0
		%	0	0	17	14	63	6	0	9	0	6	0	0	0
	Not significant	N	1	3	5	6	6	27	10	10	9	13	1	1	1
		%	25	100	83	86	38	75	100	91	100	81	100	100	100
	Low	N	3	0	0	0	0	7	0	0	0	2	0	0	0
		%	75	0	0	0	0	19	0	0	0	13	0	0	0
Other digestive system	High	N	0	0	0	0	8	2	1	0	0	0	0	0	0
		%	0	0	0	0	50	6	10	0	0	0	0	0	0
	Not significant	N	2	3	6	7	8	34	9	11	9	9	1	1	1
		%	50	100	100	100	50	94	90	100	100	56	100	100	100
	Low	N	2	0	0	0	0	0	0	0	0	7	0	0	0
		%	50	0	0	0	0	0	0	0	0	44	0	0	0

Table 7B. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, males

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Lung and bronchus	High	N	0	1	6	7	16	5	2	1	0	0	0	0	1
		%	0	33	100	100	100	14	20	9	0	0	0	0	100
	Not significant	N	2	2	0	0	0	16	5	5	2	4	1	1	0
		%	50	67	0	0	0	44	50	45	22	25	100	100	0
	Low	N	2	0	0	0	0	15	3	5	7	12	0	0	0
		%	50	0	0	0	0	42	30	45	78	75	0	0	0
Melanoma of the skin (Quebec not included, see text for details)	High	N	0	1	3	1		15	0	0	1	4	0	0	0
		%	0	33	50	14		42	0	0	11	25	0	0	0
	Not significant	N	2	2	2	5		17	8	6	2	7	1	1	1
		%	50	67	33	71		47	80	55	22	44	100	100	100
	Low	N	2	0	1	1		4	2	5	6	5	0	0	0
		%	50	0	17	14		11	20	45	67	31	0	0	0
Prostate	High	N	0	3	3	3	0	17	0	6	7	3	0	0	0
		%	0	100	50	43	0	47	0	55	78	19	0	0	0
	Not significant	N	2	0	2	4	0	16	7	5	2	9	1	1	0
		%	50	0	33	57	0	44	70	45	22	56	100	100	0
	Low	N	2	0	1	0	16	3	3	0	0	4	0	0	1
		%	50	0	17	0	100	8	30	0	0	25	0	0	100

Table 7B. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, males

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Testis	High	N	0	0	1	0	0	4	0	1	0	0	0	0	0
		%	0	0	17	0	0	11	0	9	0	0	0	0	0
	Not significant	N	4	3	5	7	16	30	10	10	9	15	1	1	1
		%	100	100	83	100	100	83	100	91	100	94	100	100	100
	Low	N	0	0	0	0	0	2	0	0	0	1	0	0	0
		%	0	0	0	0	0	6	0	0	0	6	0	0	0
Bladder (Ontario not included, see text for details)	High	N	0	0	3	1	8		0	0	0	1	0	0	0
		%	0	0	50	14	50		0	0	0	6	0	0	0
	Not significant	N	2	3	2	6	7		8	8	5	9	1	0	1
		%	50	100	33	86	44		80	73	56	56	100	0	100
	Low	N	2	0	1	0	1		2	3	4	6	0	1	0
		%	50	0	17	0	6		20	27	44	38	0	100	0
Kidney and renal pelvis	High	N	0	1	4	4	9	0	4	2	1	0	0	0	0
		%	0	33	67	57	56	0	40	18	11	0	0	0	0
	Not significant	N	4	2	2	3	7	28	6	9	8	3	1	1	1
		%	100	67	33	43	44	78	60	82	89	19	100	100	100
	Low	N	0	0	0	0	0	8	0	0	0	13	0	0	0
		%	0	0	0	0	0	22	0	0	0	81	0	0	0

Table 7B. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, males

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Brain and other nervous system	High	N	0	0	0	0	6	1	0	0	0	0	0	0	0
		%	0	0	0	0	38	3	0	0	0	0	0	0	0
	Not significant	N	4	3	6	7	10	33	8	10	7	12	1	1	1
		%	100	100	100	100	63	92	80	91	78	75	100	100	100
	Low	N	0	0	0	0	0	2	2	1	2	4	0	0	0
		%	0	0	0	0	0	6	20	9	22	25	0	0	0
Non-Hodgkin lymphoma	High	N	0	0	1	1	1	5	1	0	0	2	0	0	0
		%	0	0	17	14	6	14	10	0	0	13	0	0	0
	Not significant	N	0	3	5	6	13	29	9	10	9	14	1	1	1
		%	0	100	83	86	81	81	90	91	100	88	100	100	100
	Low	N	4	0	0	0	2	2	0	1	0	0	0	0	0
		%	100	0	0	0	13	6	0	9	0	0	0	0	0
Multiple myeloma	High	N	0	1	0	0	4	4	0	0	0	0	0	0	0
		%	0	33	0	0	25	11	0	0	0	0	0	0	0
	Not significant	N	2	2	6	7	12	31	9	11	8	13	1	1	1
		%	50	67	100	100	75	86	90	100	89	81	100	100	100
	Low	N	2	0	0	0	0	1	1	0	1	3	0	0	0
		%	50	0	0	0	0	3	10	0	11	19	0	0	0

Table 7B. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, males

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Leukemia	High	N	0	1	0	0	1	6	1	4	2	0	0	0	0
		%	0	33	0	0	6	17	10	36	22	0	0	0	0
	Not significant	N	0	2	6	5	14	27	9	6	7	11	1	1	1
		%	0	67	100	71	88	75	90	55	78	69	100	100	100
	Low	N	4	0	0	2	1	3	0	1	0	5	0	0	0
		%	100	0	0	29	6	8	0	9	0	31	0	0	0
Other, ill-defined and unknown	High	N	0	0	3	0	7	3	1	0	2	0	0	0	0
		%	0	0	50	0	44	8	10	0	22	0	0	0	0
	Not significant	N	1	3	3	2	9	28	9	11	7	12	1	1	1
		%	25	100	50	29	56	78	90	100	78	75	100	100	100
	Low	N	3	0	0	5	0	5	0	0	0	4	0	0	0
		%	75	0	0	71	0	14	0	0	0	25	0	0	0

Table 7C. Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, males and females combined

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Esophagus	High	N	0	0	2	0	1	11	1	0	0	6	1	0	0
		%	0	0	33	0	6	31	10	0	0	38	100	0	0
	Not significant	N	4	3	4	7	14	22	8	11	9	10	0	1	1
		%	100	100	67	100	88	61	80	100	100	63	0	100	100
	Low	N	0	0	0	0	1	3	1	0	0	0	0	0	0
		%	0	0	0	0	6	8	10	0	0	0	0	0	0
Liver	High	N	0	0	0	0	2	3	0	0	2	3	0	0	0
		%	0	0	0	0	13	8	0	0	22	19	0	0	0
	Not significant	N	1	3	2	2	13	14	9	6	5	12	1	1	1
		%	25	100	33	29	81	39	90	55	56	75	100	100	100
	Low	N	3	0	4	5	1	19	1	5	2	1	0	0	0
		%	75	0	67	71	6	53	10	45	22	6	0	0	0
Larynx	High	N	2	1	1	2	15	3	0	0	0	0	0	0	0
		%	50	33	17	29	94	8	0	0	0	0	0	0	0
	Not significant	N	2	2	5	5	1	28	7	9	5	5	1	1	1
		%	50	67	83	71	6	78	70	82	56	31	100	100	100
	Low	N	0	0	0	0	0	5	3	2	4	11	0	0	0
		%	0	0	0	0	0	14	30	18	44	69	0	0	0

Table 7C. (continued) Distribution of statistical significance of age-standardized cancer incidence rates of health regions compared with Canada, by province/territory, 2000-2006, males and females combined

			Province/territory of residence												
Cancer	**Significance level**		**NL**	**PE**	**NS**	**NB**	**QC**	**ON**	**MB**	**SK**	**AB**	**BC**	**YT**	**NT**	**NU**
Thyroid	High	N	0	0	0	1	1	9	0	0	1	0	0	0	0
		%	0	0	0	14	6	25	0	0	11	0	0	0	0
	Not significant	N	1	2	2	5	6	14	3	6	4	1	0	1	1
		%	25	67	33	71	38	39	30	55	44	6	0	100	100
	Low	N	3	1	4	1	9	13	7	5	4	15	1	0	0
		%	75	33	67	14	56	36	70	45	44	94	100	0	0
Hodgkin lymphoma	High	N	0	0	0	0	1	2	0	0	0	0	0	0	0
		%	0	0	0	0	6	6	0	0	0	0	0	0	0
	Not significant	N	2	2	6	7	15	34	10	10	9	13	1	1	1
		%	50	67	100	100	94	94	100	91	100	81	100	100	100
	Low	N	2	1	0	0	0	0	0	1	0	3	0	0	0
		%	50	33	0	0	0	0	0	9	0	19	0	0	0

Site-Specific Cancer Distribution

Buccal cavity and pharynx

(ICDO-3 C00-C14, Maps 3 and 4)

Cancers of the buccal cavity and pharynx, also referred to as oral cancer, were responsible for approximately 2.1% of all new Canadian cases of cancer in 2006 (1,102 in females; 2,228 in males).[27] Oral cancer includes cancers of the mouth, salivary glands and pharynx. The pharynx is the hollow tube about 13 centimetres (5 inches) long that starts behind the nose and leads to the esophagus (the tube that goes to the stomach) and the trachea (the tube that goes to the lungs). The age-at-incidence curve indicates that the incidence rates for both sexes are low before about age 35. Rates then increase and reach a plateau at ages 70-74 or greater among females and at ages 65-69 or greater among males, with the risk for males being about twice that of females.[27] In recent years, the age-standardized incidence rates for females have remained relatively static, while they have gradually declined among males. The 5-year relative survival rate for the period 2002-2004 was 66% in females and 62% in males.[29]

Geographic Variation

At the provincial/territorial level, significantly lower incidence rates for mouth and pharynx cancers among females were observed in Newfoundland and Labrador, New Brunswick and Quebec. Among males, lower rates occurred in Alberta and British Columbia. Significantly higher incidence rates for mouth and pharynx cancers were observed among females in Ontario, Manitoba and Nunavut. Among males, increased rates occurred in Newfoundland and Labrador, Nova Scotia, Quebec and Manitoba.

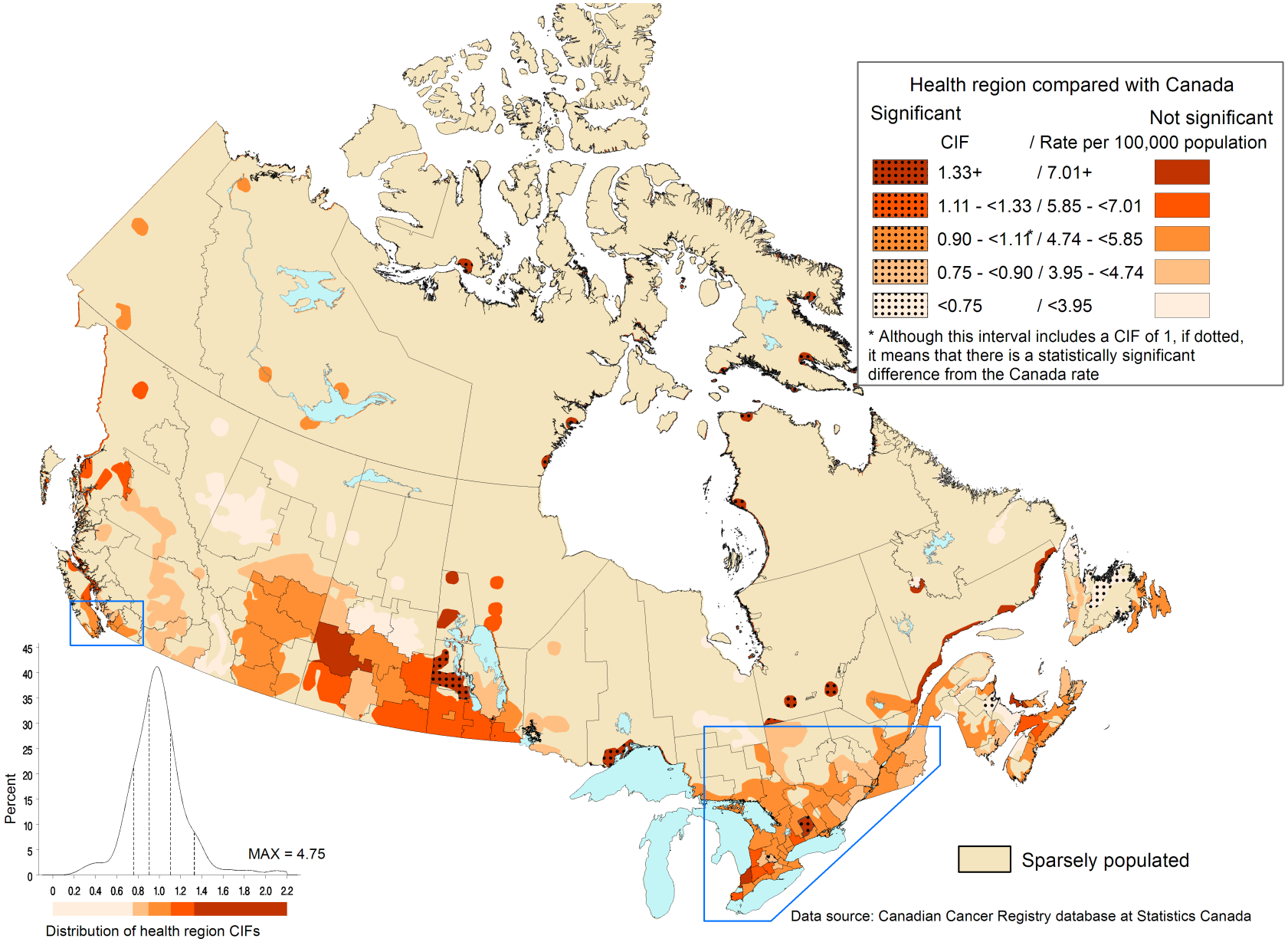
An area of low rates among females was observed in New Brunswick and in southern Quebec, with 1 health region rate being significantly low. Significantly low regional rates among males were observed in the interior of British Columbia. Incidence rates of cancers of the mouth and pharynx were elevated among females in health regions in Manitoba and northwestern Ontario as well as in Nunavut and northern Quebec. Among males, rates were significantly elevated in close to 20 dispersed health regions from Newfoundland through to Manitoba.

Known and Suspected Risk Factors

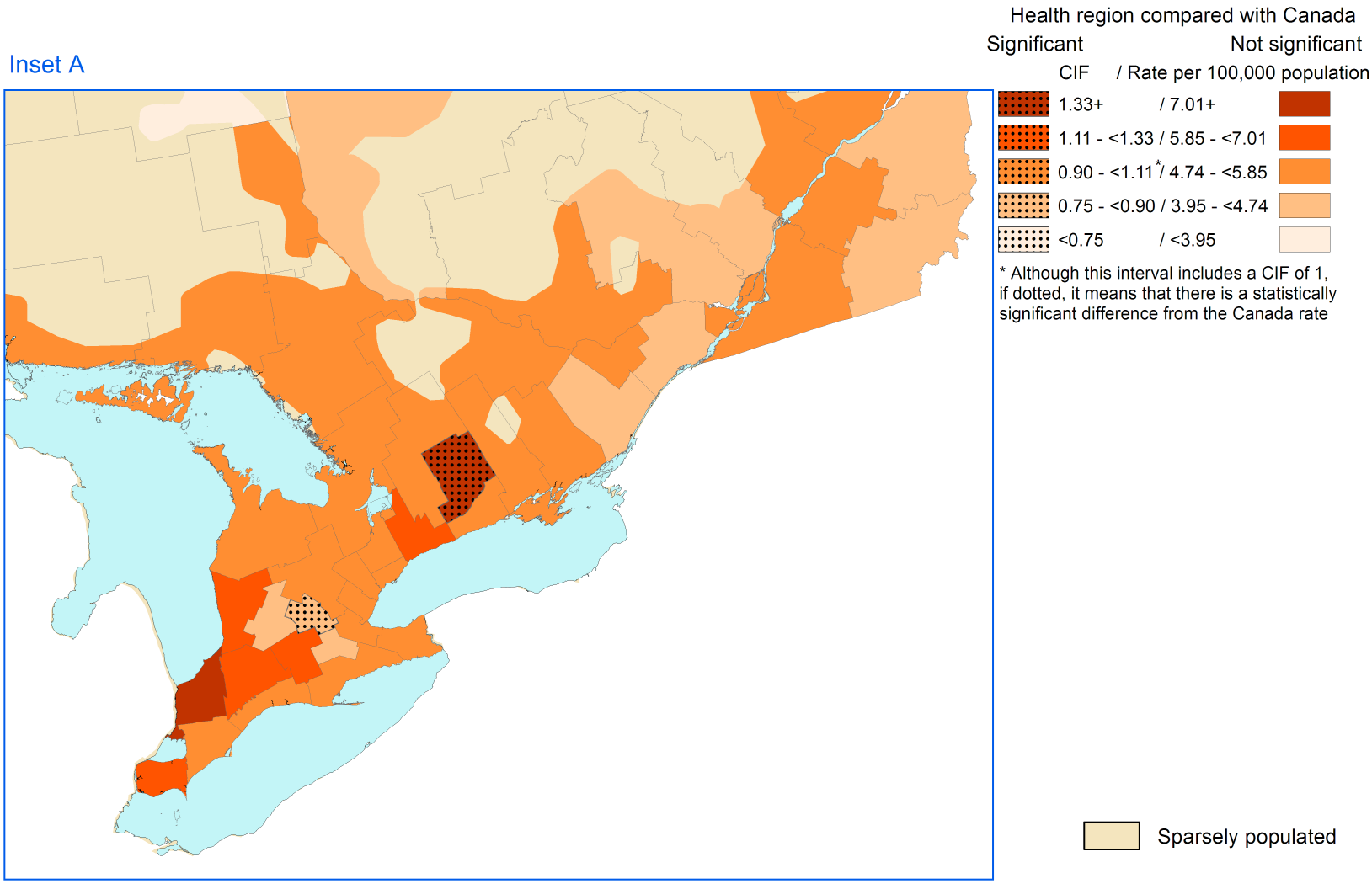
Tobacco and alcohol, both risk factors for buccal cavity and pharyngeal cancers, have been implicated as independent risk factors whose combined effects are synergistic. With the exception of salivary gland, nasopharyngeal and lip cancers, more than 80% of oral cancers in some regions can be attributed to alcohol and tobacco use[30]; when the other sites are included, 80% of oral cancers can be attributed to these 2 principal factors.[31]

Two infectious agents, human papilloma virus (HPV) and Epstein-Barr virus (EBV), also are implicated in distinct pathways resulting in cancer. Studies vary with respect to the percentage of oral and oropharyngeal cancers caused by HPV. Some have estimated as high as 50% for oropharyngeal cancers,[32] the site with the highest effect. Other risk factors such as wood dust, formaldehyde, alcohol, tobacco, deep-fried foods and salted fish have been associated with nasopharyngeal carcinoma.[32,33]

Map 3. Buccal cavity and pharynx, females, 2000-2006, all ages

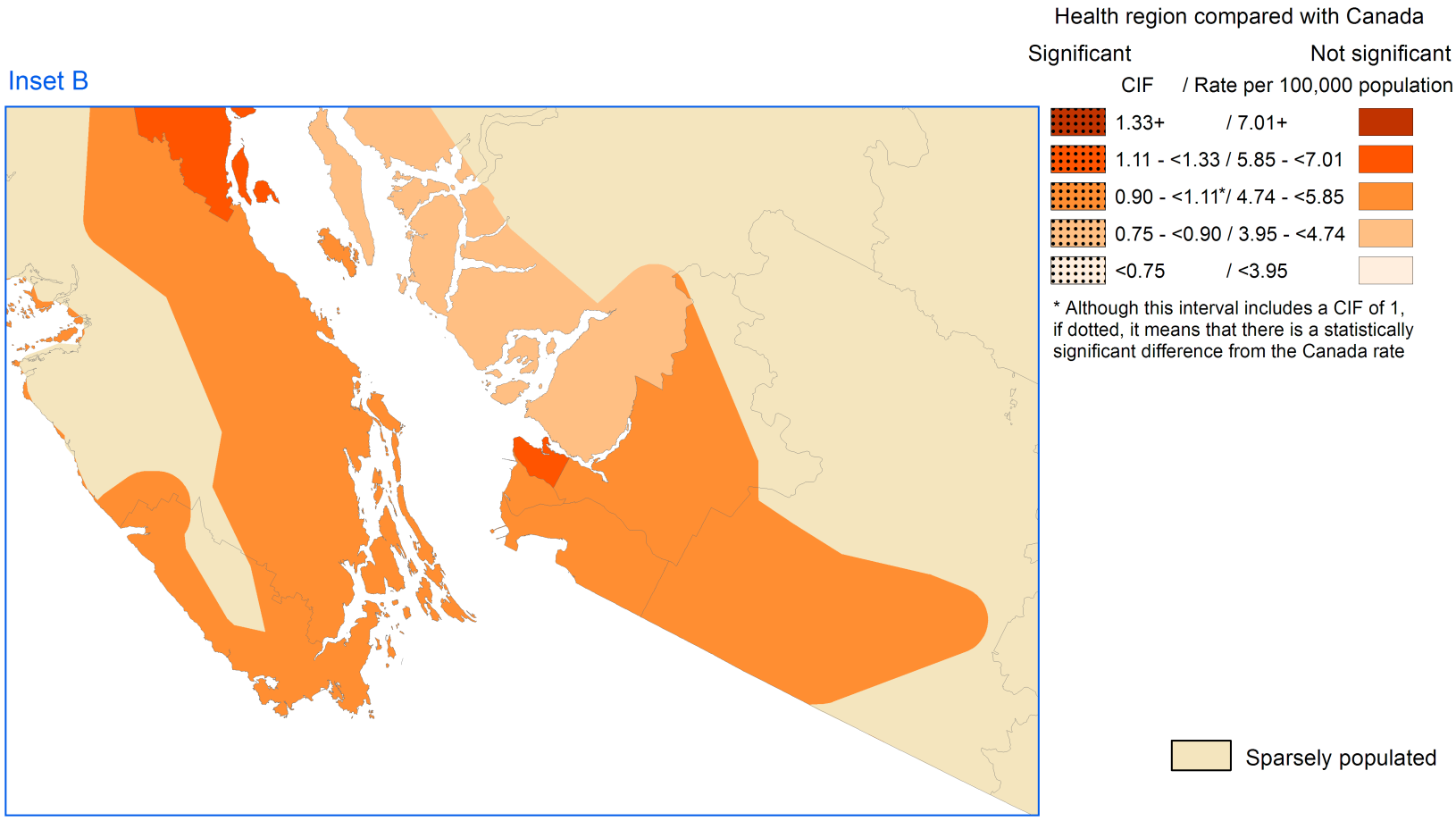


Map 3-A. Buccal cavity and pharynx, females, 2000-2006, all ages



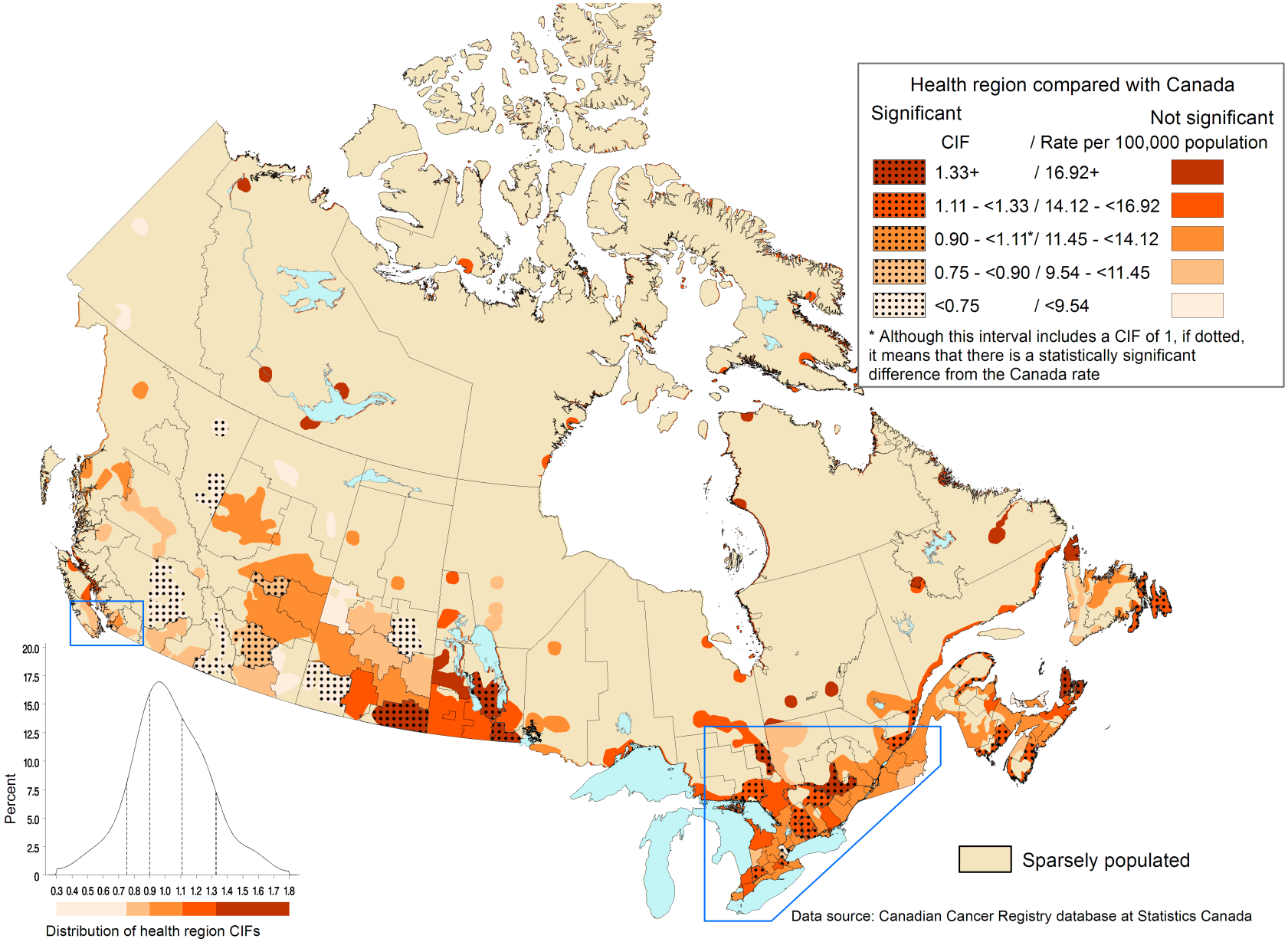
Data source: Canadian Cancer Registry database at Statistics Canada

Map 3-B. Buccal cavity and pharynx, females, 2000-2006, all ages

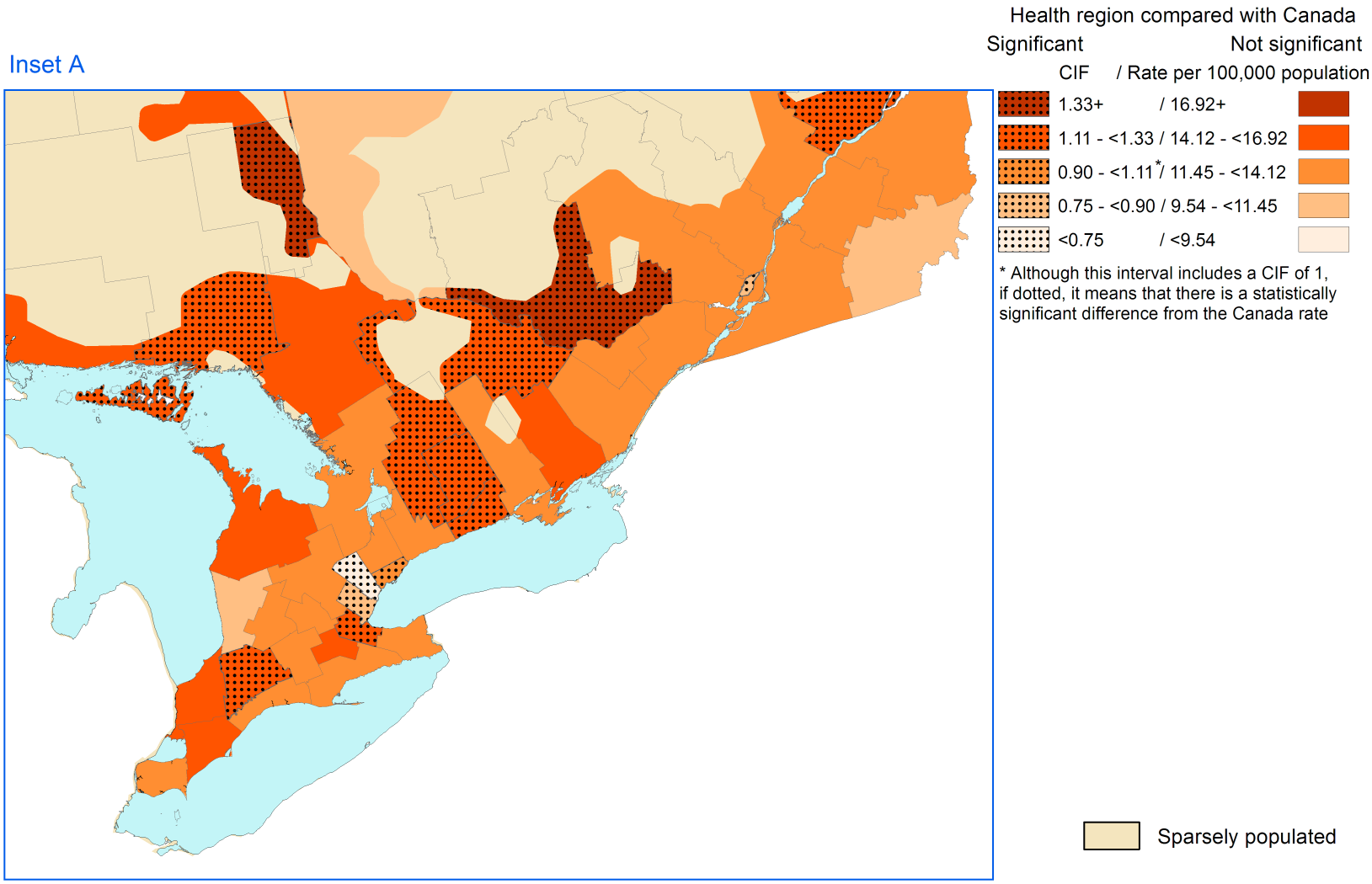


Data source: Canadian Cancer Registry database at Statistics Canada

Map 4. Buccal cavity and pharynx, males, 2000-2006, all ages

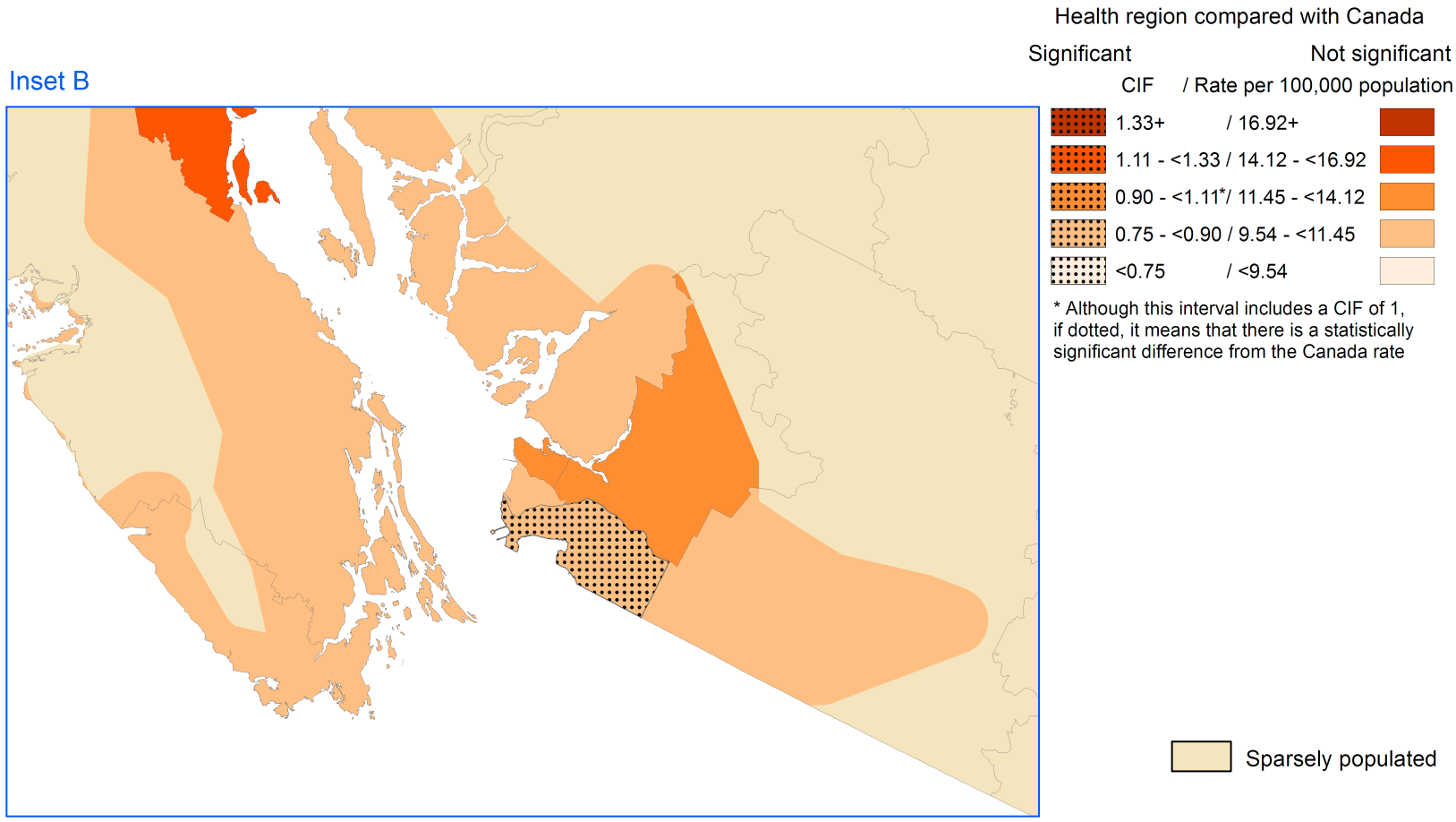


Map 4-A. Buccal cavity and pharynx, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 4-B. Buccal cavity and pharynx, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Esophagus (ICDO-3 C15, Map 5)

In 2006 in Canada, there were approximately 1,500 cases (401 among females; 1,101 among males) and a similar number of deaths.[27,34] The age-at-incidence curve indicates that those aged 75 and older are at the highest risk when the population in each age group is taken into account. The age-standardized incidence rates during 1997-2006 were relatively stable.[28] This cancer has a rapid fatality with a poor overall 5-year relative survival, at 14%, for both sexes combined for the period 2002-2004, with little variation between females and males.[29]

Geographic Variation

At the provincial/territorial level, significantly lower incidence rates for cancer of the esophagus were observed in Newfoundland and Labrador, Quebec and Saskatchewan. Increased rates were observed in Nova Scotia, British Columbia and Yukon.

Incidence rates for cancer of the esophagus were significantly lower than the Canadian rate for the Région de Montréal in southern Quebec and for the City of Toronto, York Regional and Peel Regional health units in southern Ontario, but they were significantly elevated in many health regions in eastern and northern Ontario, in Yukon, and in southern and central British Columbia excluding the Vancouver and Richmond health regions.

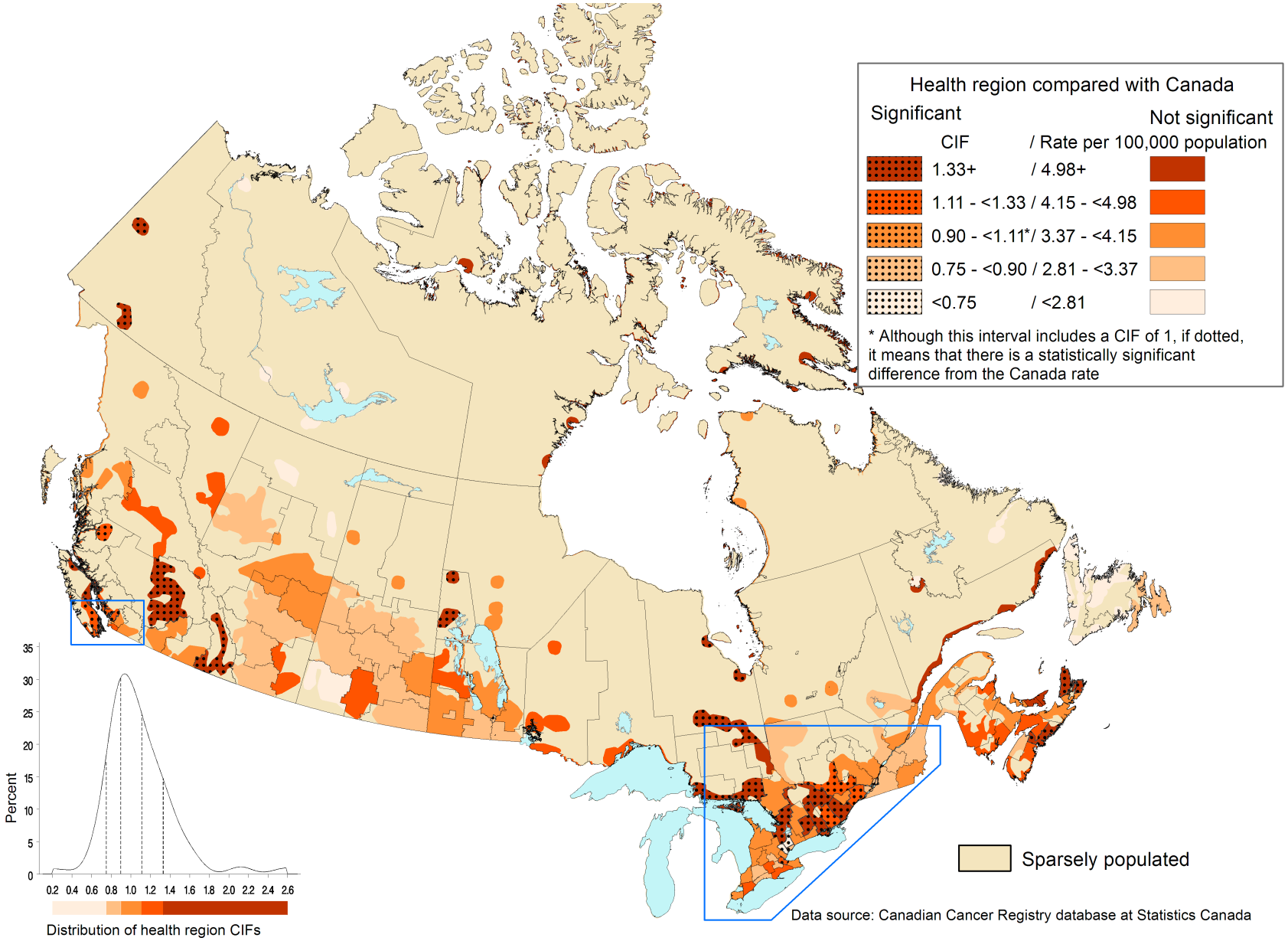
Known and Suspected Risk Factors

Esophageal cancer is divided into either squamous cell carcinoma (SCC), the most common histologic type of esophageal cancer, or adenocarcinoma (AC), which has a better prognosis than the former type.[35] Combined, these 2 epithelial carcinomas account for 95% of the esophageal cancers.[36] In contrast to the pattern of decreasing or stable rates for esophageal cancer as a whole, rates of esophageal AC have increased.

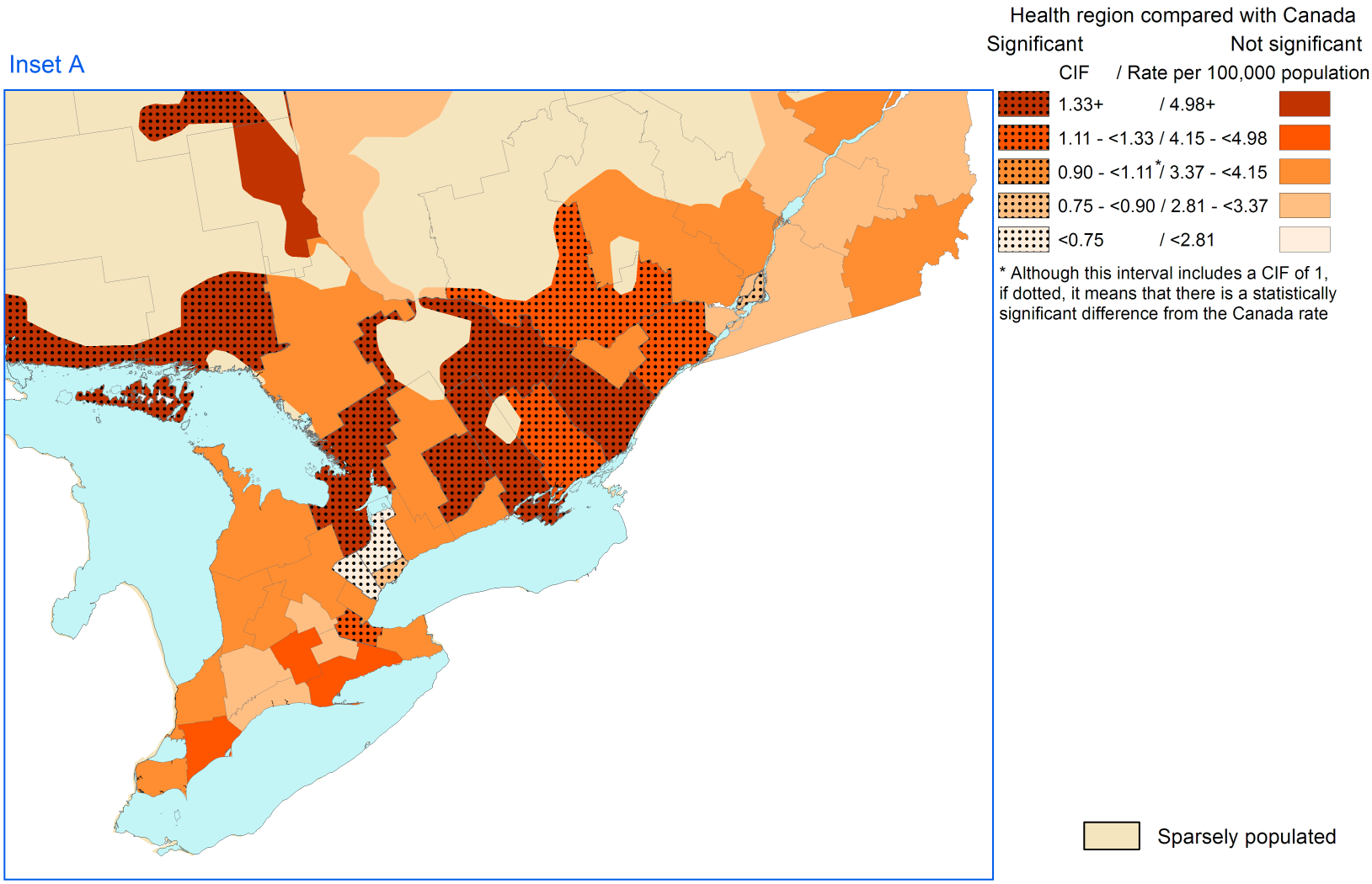
These 2 main histologic types have slightly different etiologic factors. The 2 central etiologic factors, alcohol use and tobacco use, are more pronounced in SCC; alcohol is not an important risk factor for AC, and AC is only weakly associated with tobacco use. In Western Europe and in North America, these 2 factors combined can account for up to 90% of the risk of esophageal SCCs.[37] Alcohol consumption and smoking function synergistically, increasing the risk for esophageal cancer by up to 100 times.[32,38] Dietary factors are probable causes of the disease. In particular, diets high in calories, total fat, saturated fat, cholesterol, butter and oils, and diets low in fibre have been shown to increase the risk for esophageal cancer and for esophageal AC, in particular.[32,33,39-41]

Gastroesophageal reflux disease (GERD), a precursor stage to Barrett's syndrome, is noted as a strong risk factor for the development of esophageal AC. Obesity is a risk factor for GERD and consequently increases the risk for esophageal AC by 7-fold.[36,37] Some studies have shown that the use of non-steroidal anti-inflammatory drugs, or NSAIDs (such as aspirin and other drugs that reduce fever, swelling, pain and redness), is associated with a reduced risk of developing both SC and AC of the esophagus, but potentially serious side-effects need to be considered.[42] *Helicobacter pylori* bacteria can cause inflammation and ulcers in the stomach lining, resulting in gastric atrophy (cells that line the stomach are destroyed) and subsequent increased risk of esophageal SCC. However, infection with *Helicobacter pylori* may reduce the risk of esophageal AC.[43]

Map 5. Esophagus, 2000-2006, all ages

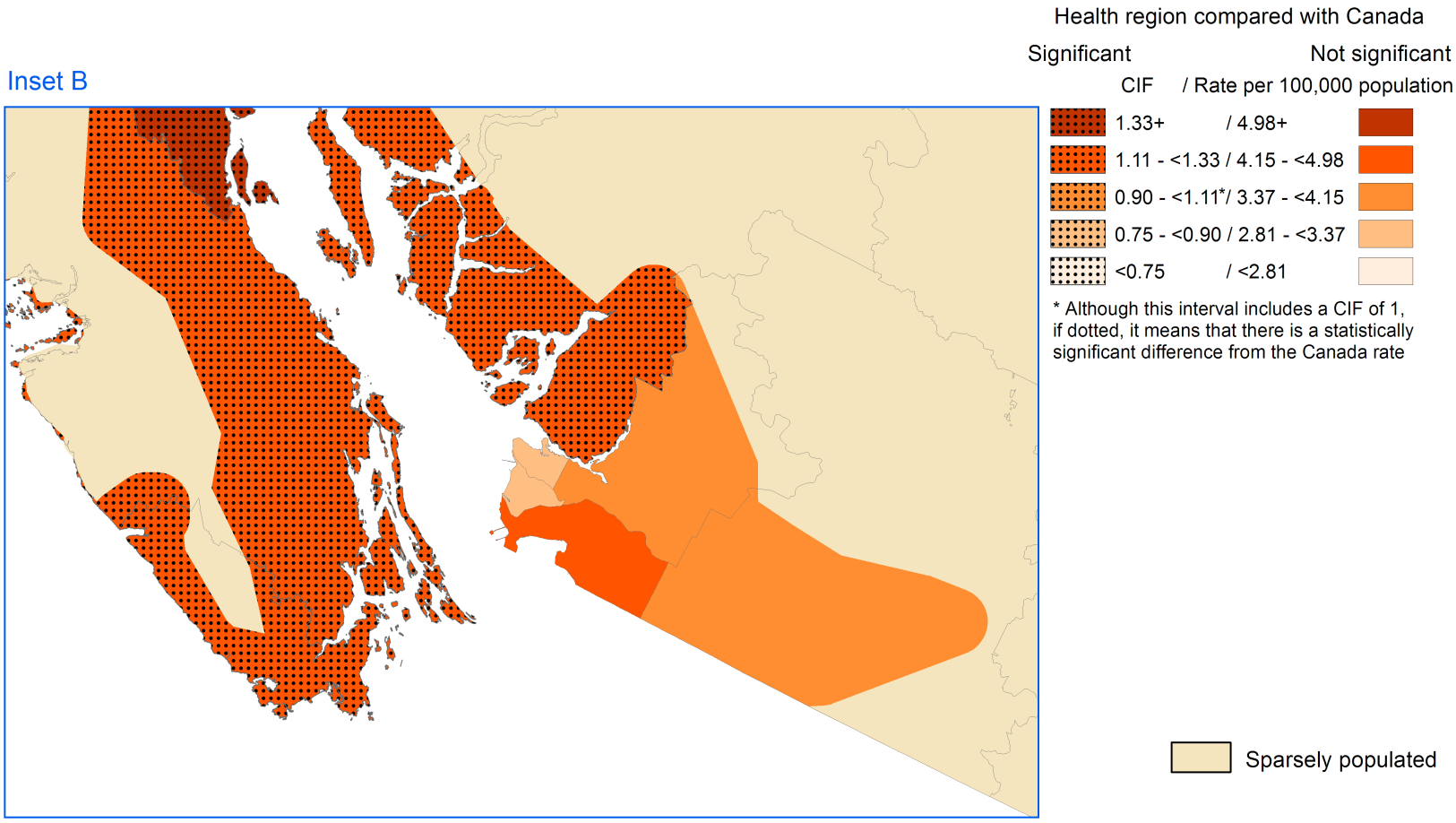


Map 5-A. Esophagus, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 5-B. Esophagus, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Stomach (ICDO-3 C16, Maps 6 and 7)

In Canada, stomach cancer accounted for 1,083 cases among females and 1,928 cases among males in 2006, indicating that the risk among males is about double that among females.[27] During the period 1997-2006, annual average declines in age-standardized incidence rates were 1.6% among females and 2.1% among males.[28] Incidence increases rapidly with age, although this may partly reflect lower rates among younger birth cohorts. The 5-year survival for this cancer for the period 2002-2004 was only 22-24%.[29] This cancer is divided into two main classes based on location: gastric cardia cancer (the top inch of the stomach, where it meets the esophagus) and non-cardia gastric cancer (all other areas of the stomach). About 90% of stomach tumours are adenocarcinomas, which are subdivided into 2 main histological types: (1) well-differentiated or intestinal type, and (2) undifferentiated or diffuse type.

Geographic Variation

At the provincial/territorial level, significantly lower incidence rates for stomach cancer were observed in Ontario, Saskatchewan and British Columbia, and among males in Prince Edward Island and Alberta. Increased rates were observed in Newfoundland and Labrador, Quebec and Northwest Territories among females and Nunavut among males.

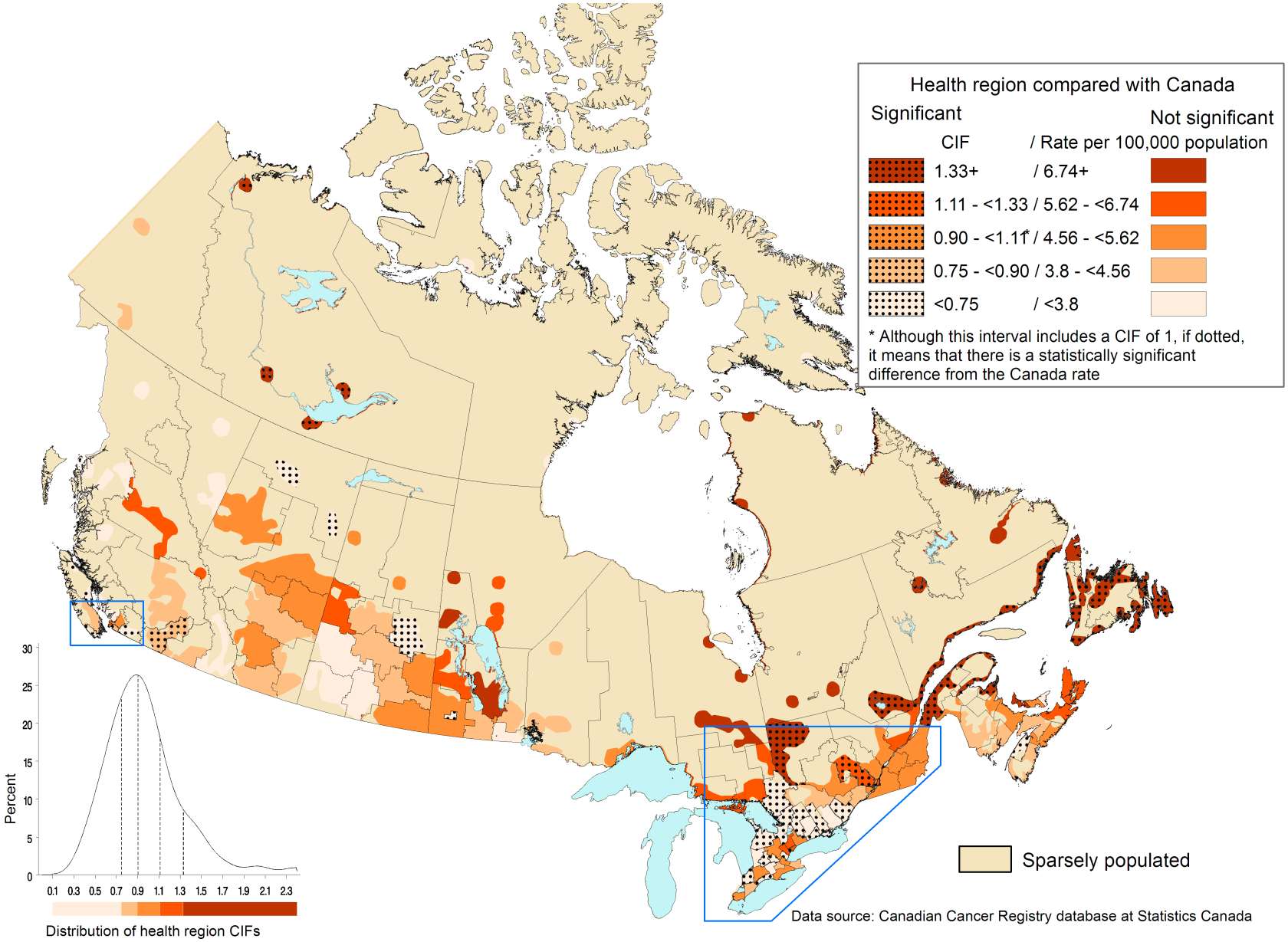
Significantly low regional rates were observed in much of western Canada, central Ontario (excluding the City of Toronto Health Unit) and eastern Ontario. Higher incidence rates for stomach cancer were observed in health regions in Newfoundland and Labrador, northern Nova Scotia, northern New Brunswick, eastern Quebec and central Quebec.

Known and Suspected Risk Factors

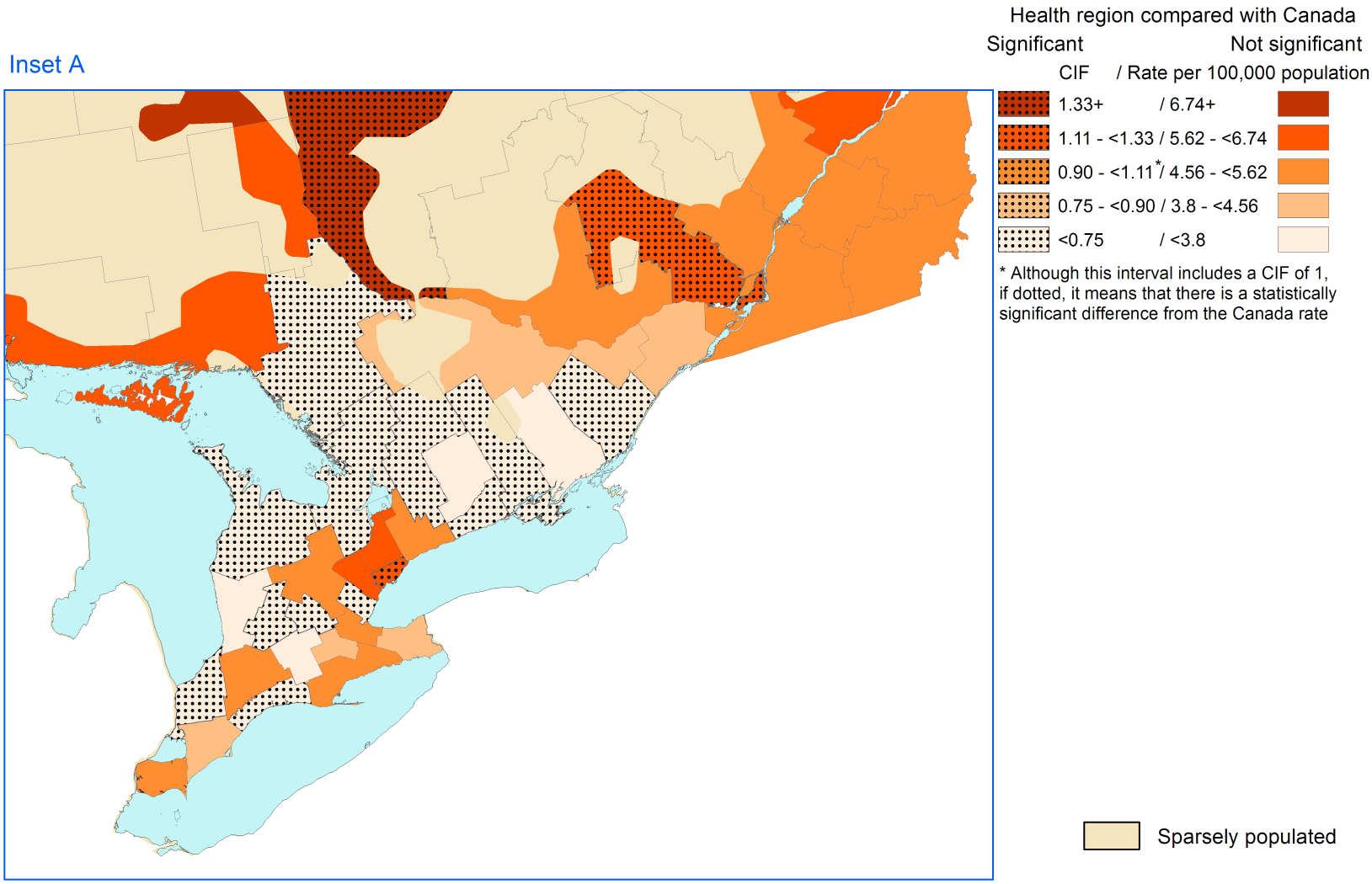
Cancer develops through the initiation of long-term chronic inflammation.[44,45] One of the strongest etiological factors for gastric cancer, a group I carcinogen as defined by the International Agency for Research on Cancer (IARC),[44] is *Helicobacter pylori (H. pylori)*. Worldwide, the countries with the highest gastric cancer rates concurrently have the highest prevalence for *H. pylori*, a trend consistent with the declines in the incidence of *H. pylori* in countries with low gastric cancer incidence.[44,45] The gram-negative bacterium is believed to cause anywhere from a 3- to 6-fold increase in the risk for noncardia carcinoma, adenocarcinoma and primary non-Hodgkin lymphoma of the stomach lining.[32,37] The lymphomas are primarily marginal zone B-cell lymphomas of the MALT-type (mucosa-associated lymphoid tissue) and diffuse large B-cell lymphoma not otherwise specified. The lymphomas are not included with stomach cancer statistics.

Salted and salt-preserved foods may facilitate the risk of *H. pylori* infection and function synergistically in the development of cancer.[44,46] Low intake of fruits and vegetables also enhances the risk for gastric cancer.[41] High consumption of cured or smoked meats or fish (containing N-nitroso compounds), well-cooked meats and pickled vegetables may increase the risk for gastric cancer. The IARC has evaluated ingested nitrate or nitrite under conditions that result in endogenous nitrosation as probably being carcinogenic to humans (Group 2A).[47,48]

Map 6. Stomach, females, 2000-2006, all ages

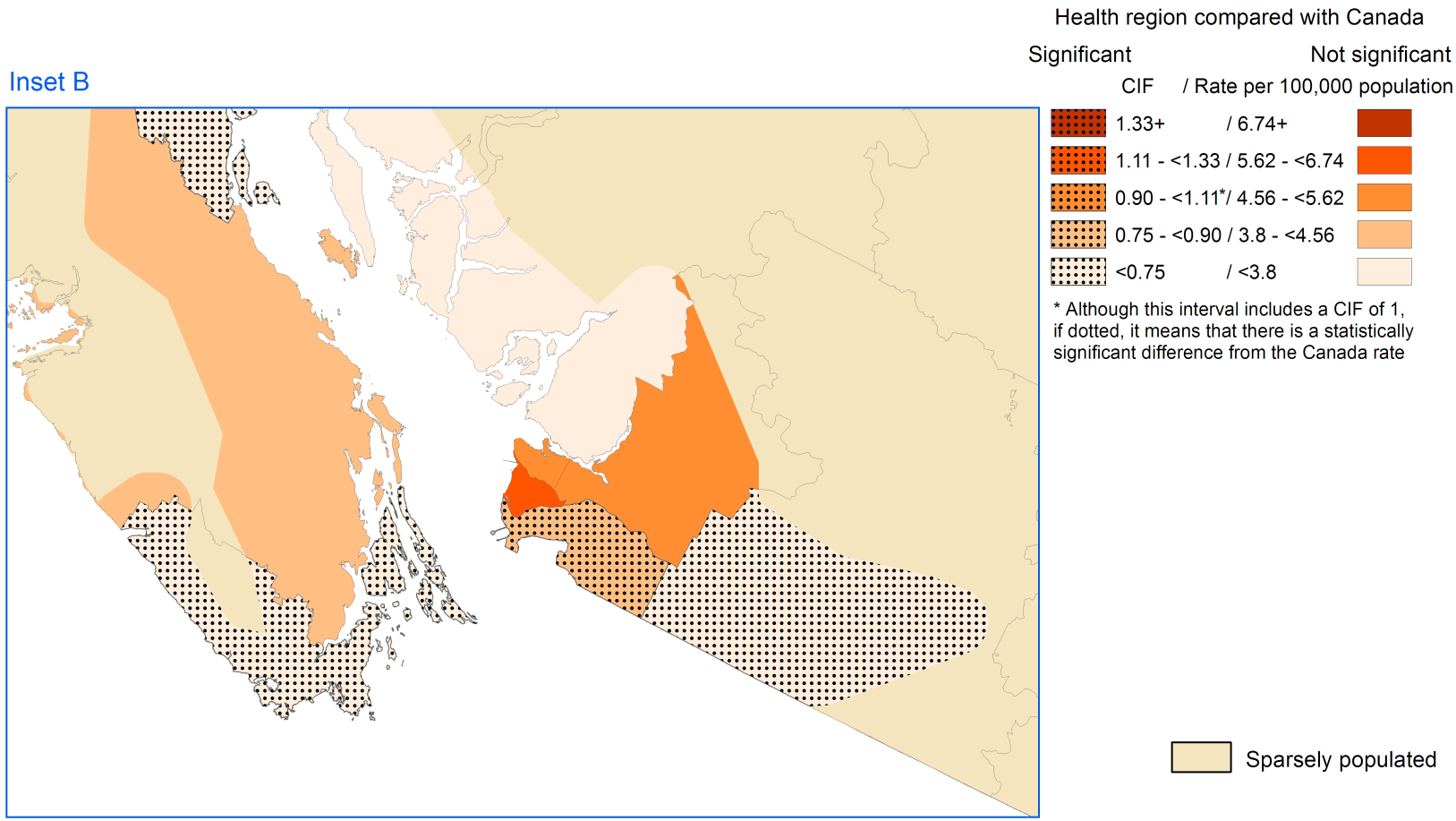


Map 6-A. Stomach, females, 2000-2006, all ages



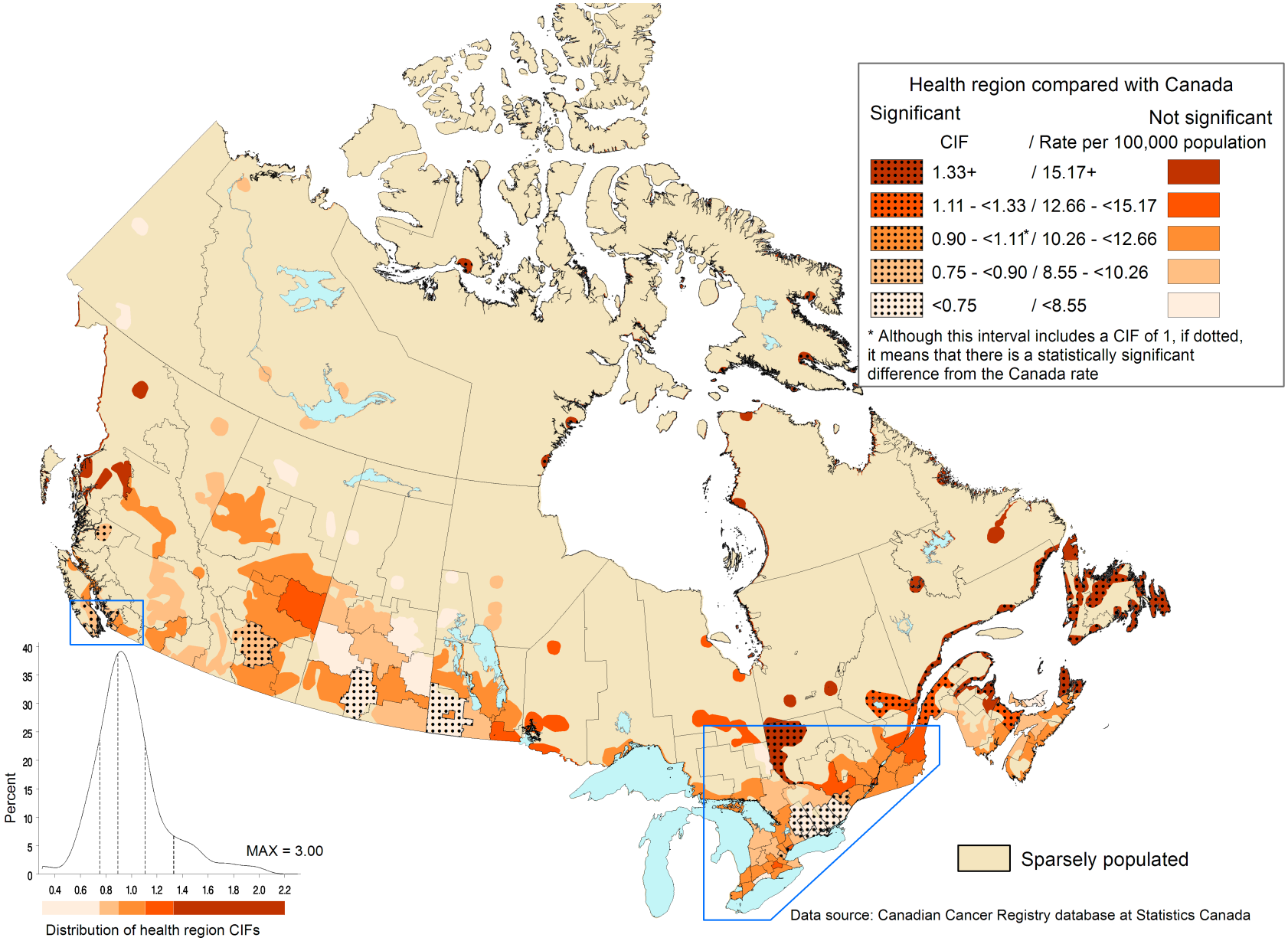
Data source: Canadian Cancer Registry database at Statistics Canada

Map 6-B. Stomach, females, 2000-2006, all ages

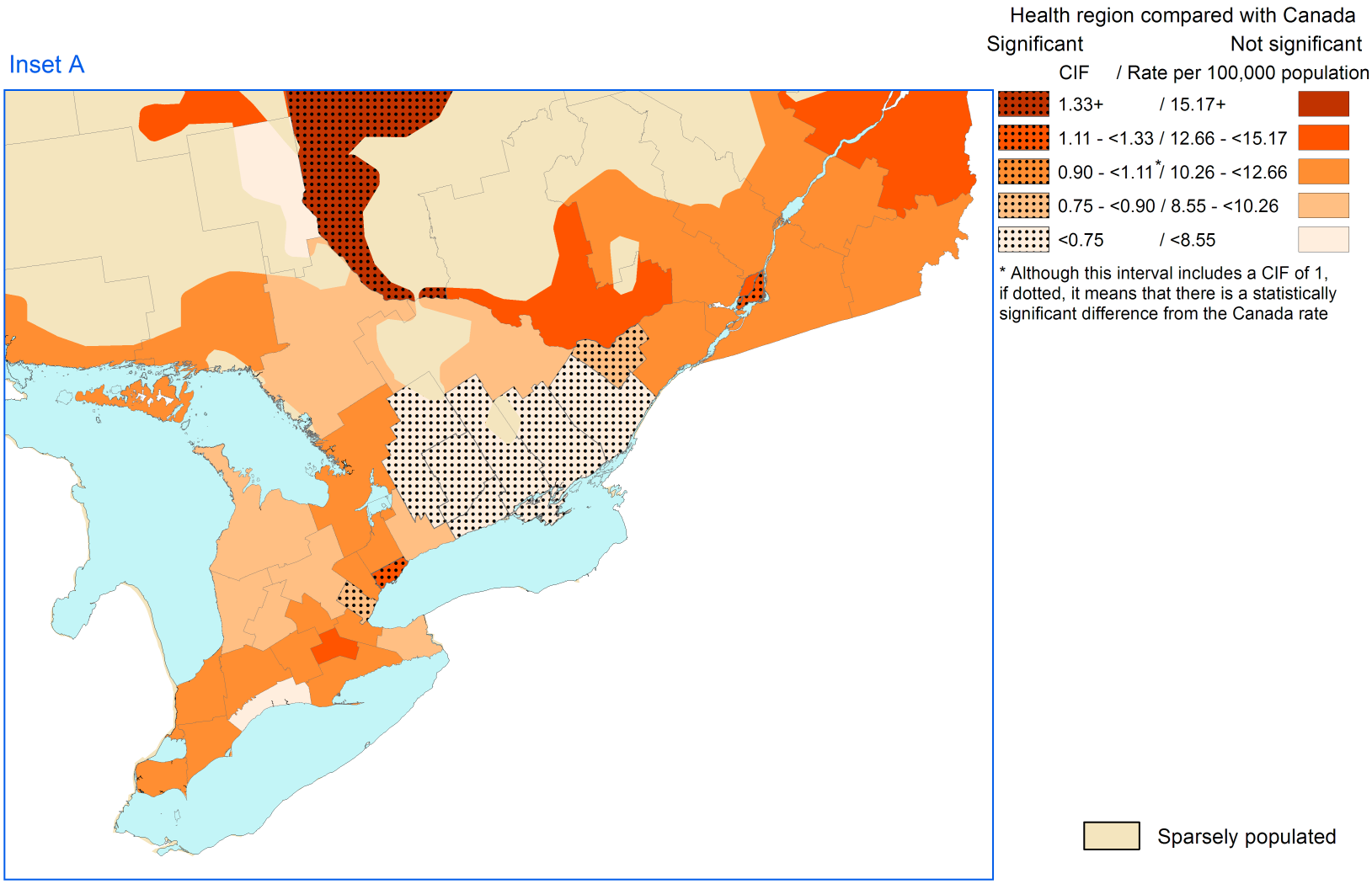


Data source: Canadian Cancer Registry database at Statistics Canada

Map 7. Stomach, males, 2000-2006, all ages

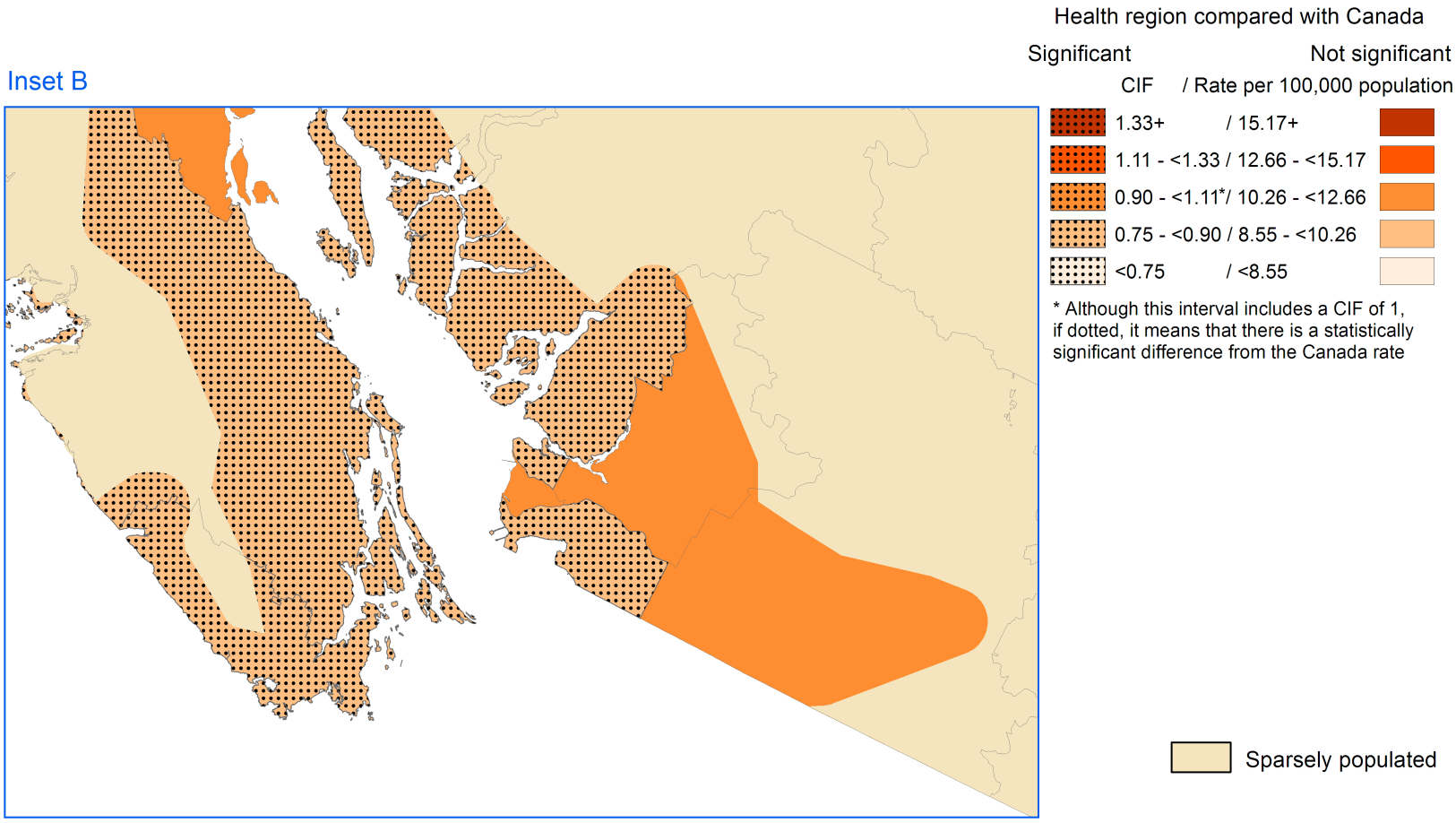


Map 7-A. Stomach, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 7-B. Stomach, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Colon and rectum (ICDO-3 C18-C20, C26.0, Maps 8 and 9)

Colorectal cancer was responsible for 12.5% of all new Canadian cases of cancer in 2006 (9,021 in females; 10,837 in males).[27] Slightly more than two-thirds of new cases of colorectal cancer are cancers of the colon. Several changes in trend have been observed over the past 25 years. For both sexes, the incidence rose between 1980 and 1985, then declined to the mid-1990s (more strongly in females than in males), and then rose again through 2000 only to decline significantly thereafter.[28]

The dominant morphology for colorectal cancer is adenocarcinoma, accounting for over 95% of the morphologically confirmed cases. The age-specific incidence rises throughout life to age 90, although this rise is attenuated after age 50, particularly among females.[27] About 93% of all colorectal cancers occur in females and males aged 50 and above. The 5-year relative survival rate has slowly improved to 62% for both sexes combined for the period 2002-2004.[29]

Geographic Variation

At the provincial/territorial level, significantly lower incidence rates for colorectal cancer were seen in Ontario, Alberta and British Columbia. Increased rates were seen in Newfoundland and Labrador, Nova Scotia, Quebec and the Northwest Territories, and among females in Prince Edward Island and Nunavut.

Incidence rates for cancer of the colon and rectum were significantly low for both females and males in the City of Toronto, York Regional and Peel Regional health units. An area of low rates was also observed for health regions in southern Saskatchewan, southern Alberta and southern British Columbia. Incidence rates were highest in regions in Newfoundland and Labrador, Prince Edward Island, Nova Scotia, Quebec, eastern and northern Ontario, the Northwest Territories and Nunavut.

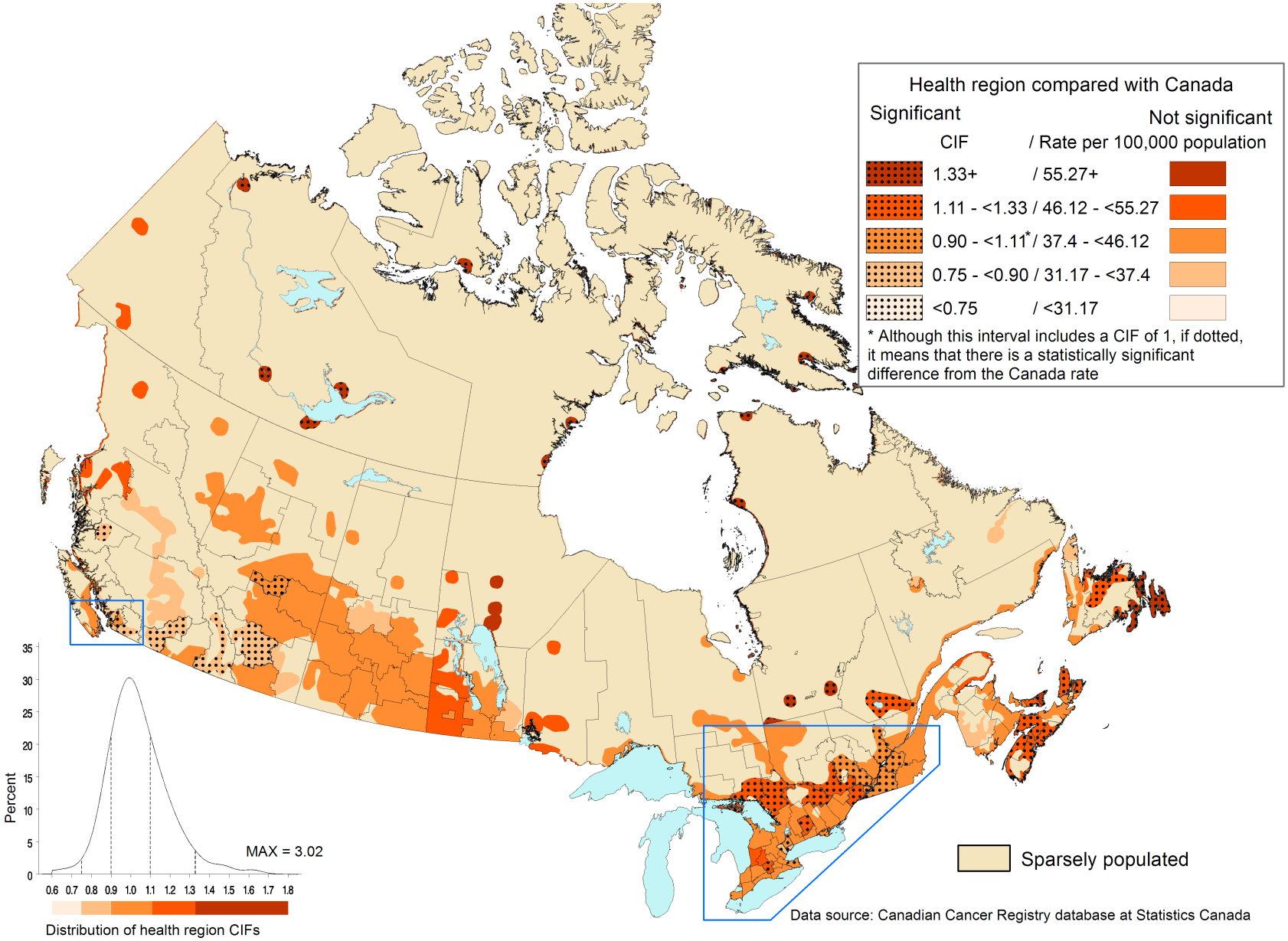
Known and Suspected Risk Factors

Red meat is a recognized risk factor for colorectal cancer, and there is suggestive evidence that diets high in fat and low in fruits and non-starchy vegetables also result in increased risk.[32,37,41,49,50]

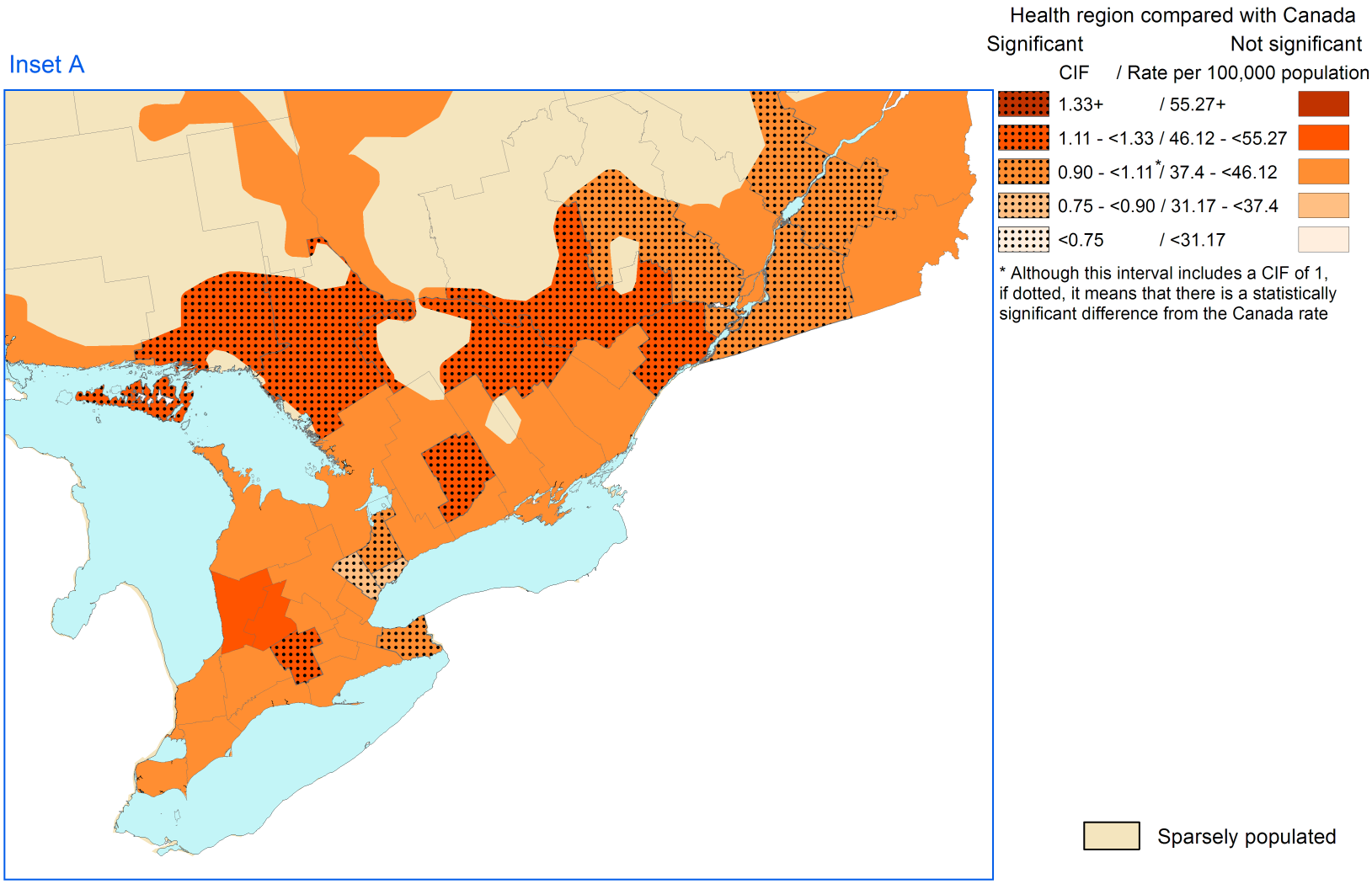
Obesity and physical inactivity, in association with poor dietary intake, have also been associated with increased risk for colorectal cancer.[49,50] Individuals with a body mass index (BMI) in the top 20% have a 2-fold elevated risk for colorectal cancer when compared with those in the lower 20% of BMIs; this relationship is stronger for colon cancer.[37,49,50]

Any disease, illness or syndrome that increases the likelihood of polyps indirectly increases the probability of developing colorectal cancer. Genetic factors are implicated in the development of adenomatous polyps and colorectal cancer.[37] Familial adenomatous polyposis, an autosomal dominant disorder, accounts for between 1% and 5% of colorectal cancer.[33,37,51]

Map 8. Colon and rectum, females, 2000-2006, all ages

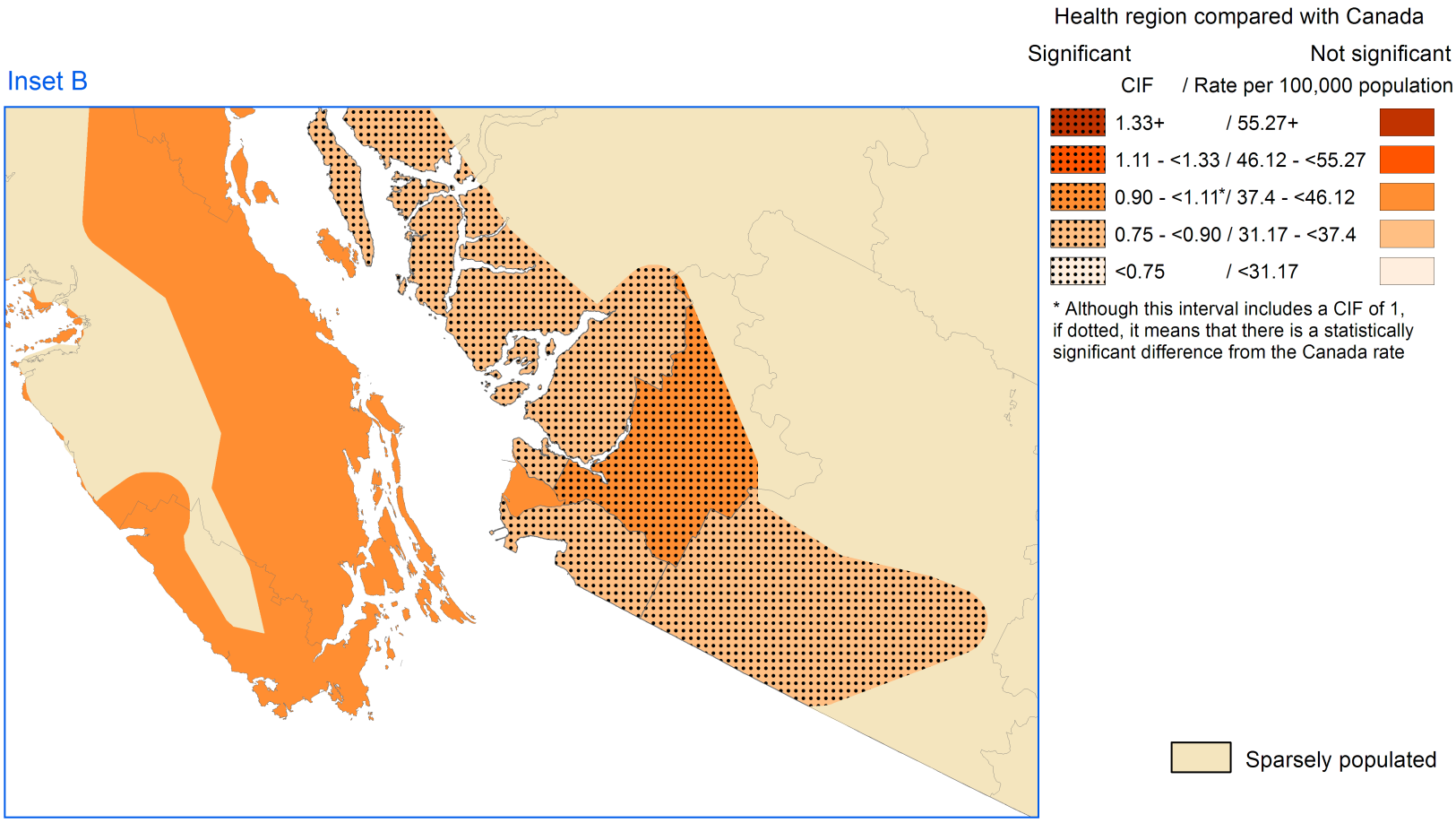


Map 8-A. Colon and rectum, females, 2000-2006, all ages



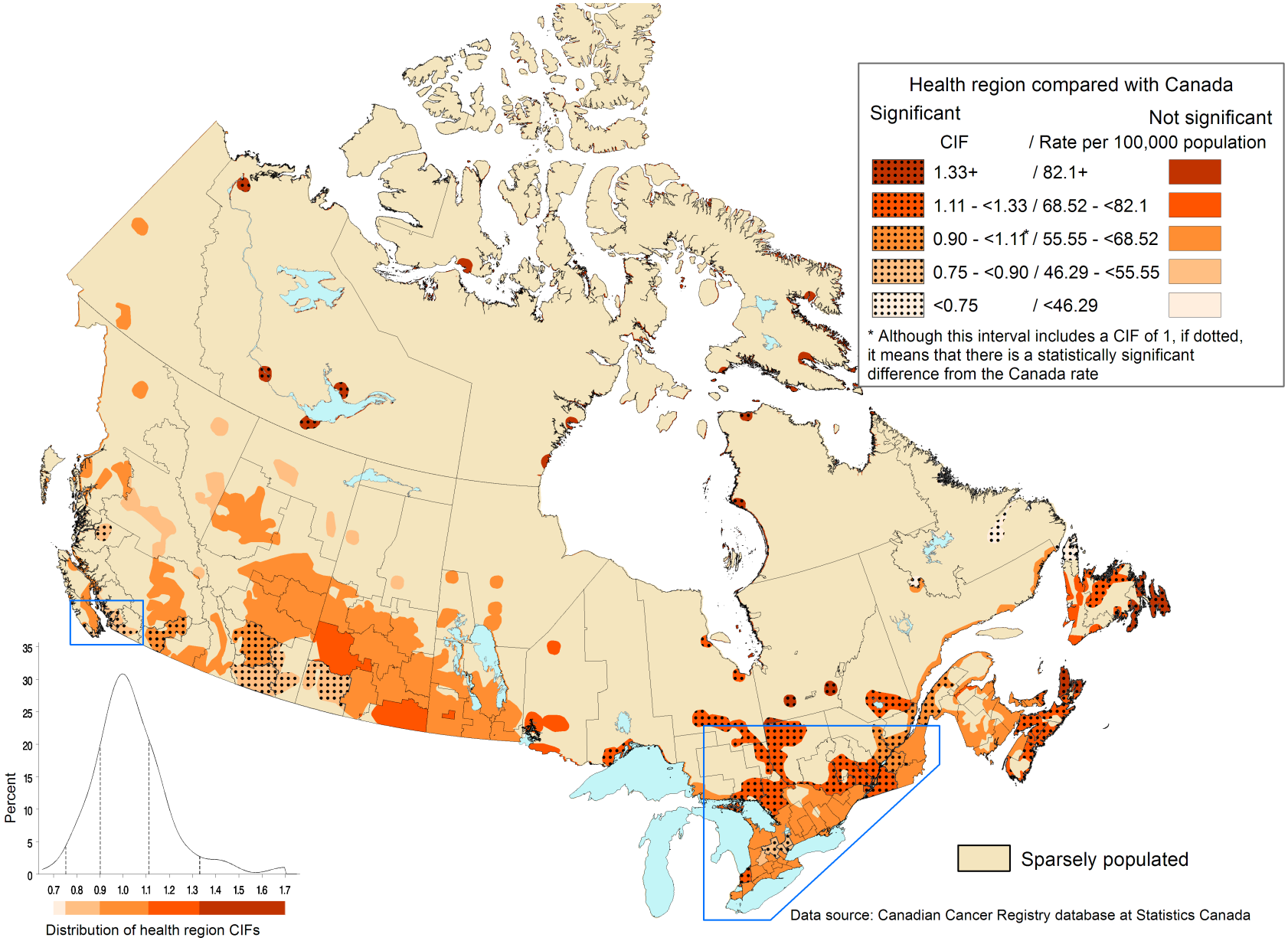
Data source: Canadian Cancer Registry database at Statistics Canada

Map 8-B. Colon and rectum, females, 2000-2006, all ages

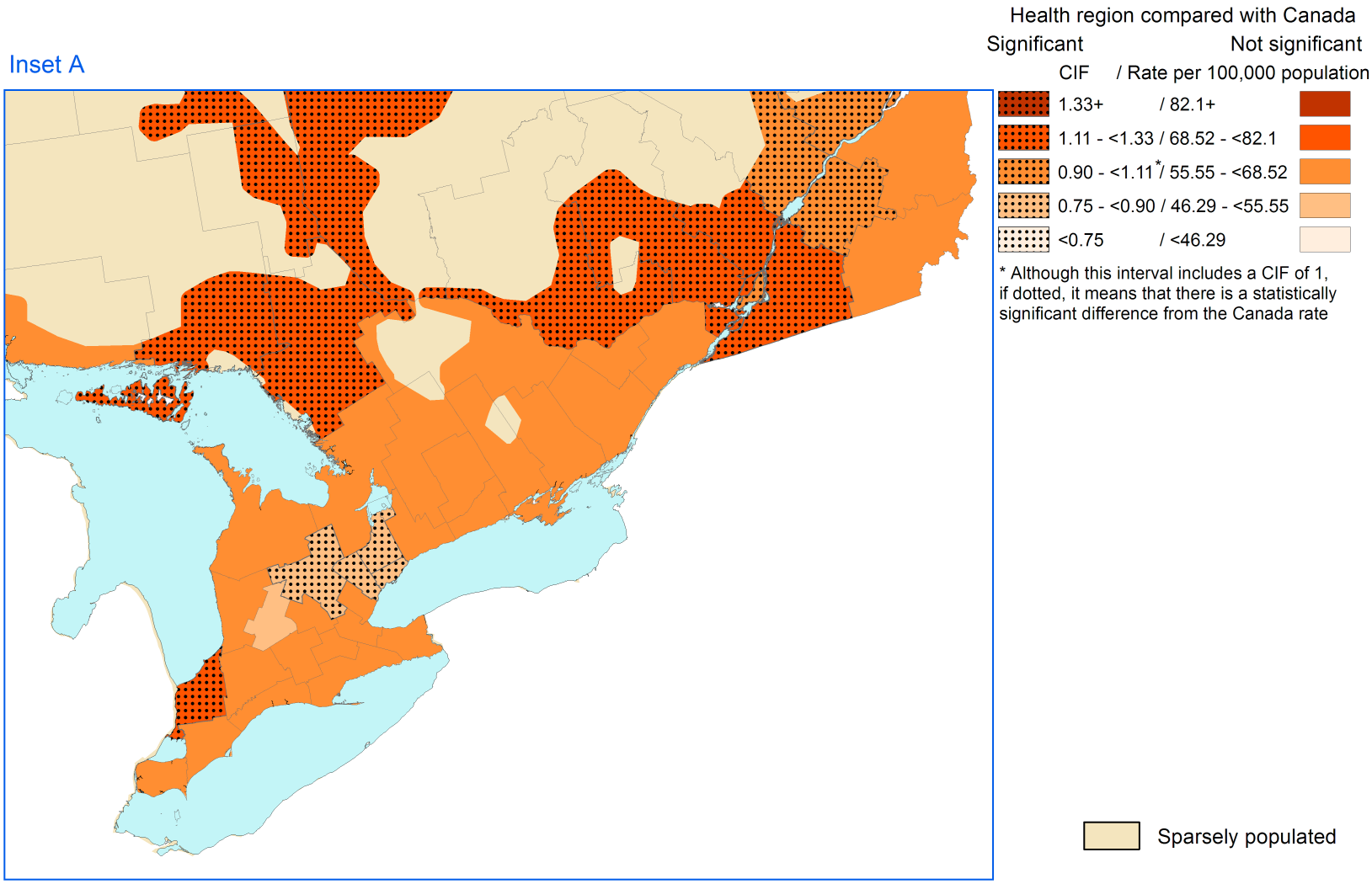


Data source: Canadian Cancer Registry database at Statistics Canada

Map 9. Colon and rectum, males, 2000-2006, all ages

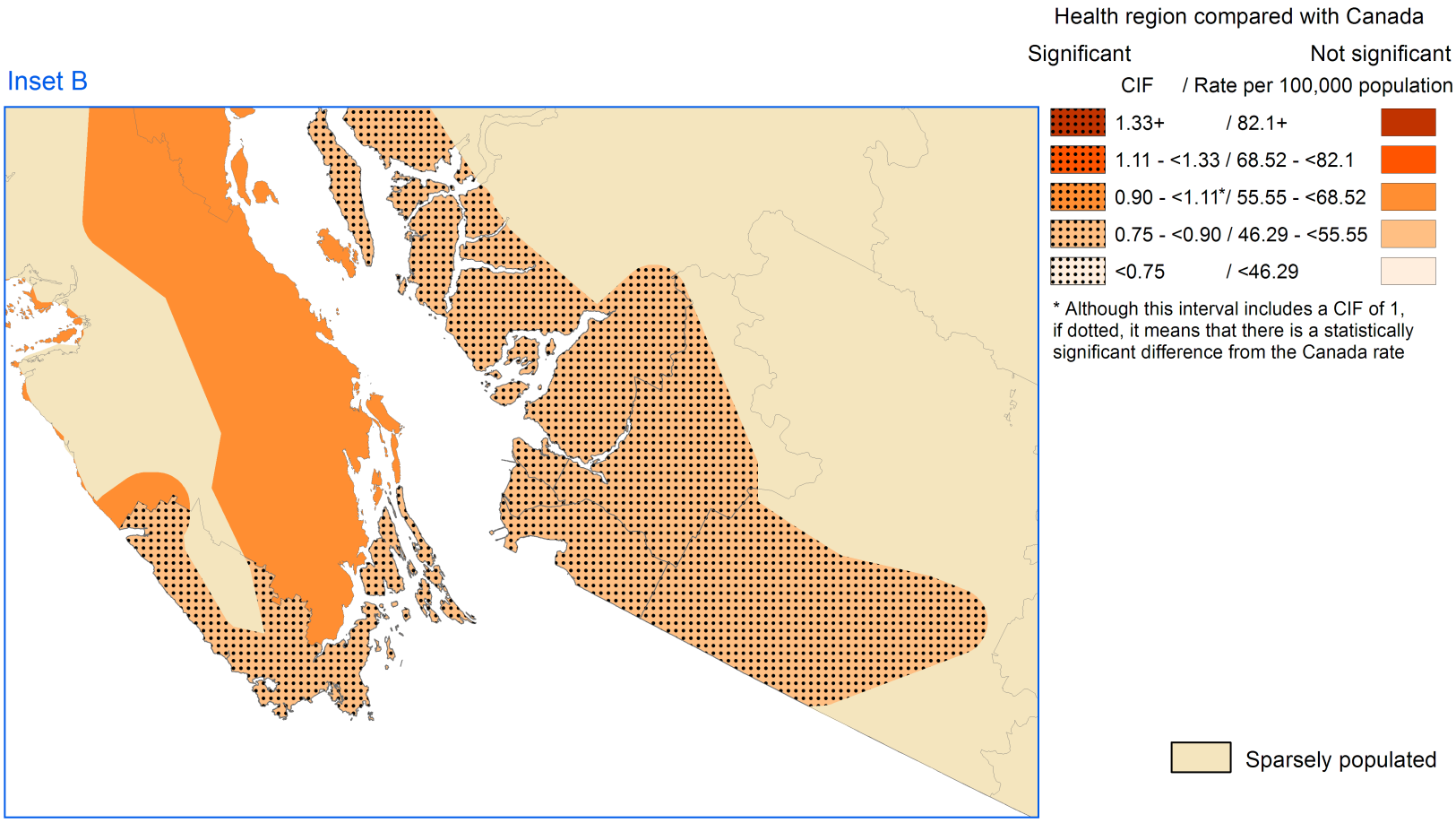


Map 9-A. Colon and rectum, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 9-B. Colon and rectum, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Liver (ICDO-3 C22.0, Map 10)

Primary malignancies of the liver accounted for 1,465 new Canadian cancer cases in 2006 (394 in females; 1,071 in males).[27] These figures exclude cases of intrahepatic bile duct cancer. Survival is poor, with a 5-year relative survival rate of 18% for the period 2002-2004.[29] For 1997-2006, the annual percentage change in age-standardized rates was 2.3% among females and 3.1% among males.[28] Liver cancer is very rare below age 40, but the risk increases from age 40 to ages 70-74 and the rate remains relatively constant for older age groups.[27] About 90% of these cases are hepatocellular carcinoma (HCC).

Geographic Variation

At the provincial/territorial level, significantly lower incidence rates for liver cancer were observed in Nova Scotia, New Brunswick and Saskatchewan. Increased rates were observed in Quebec, Alberta and British Columbia.

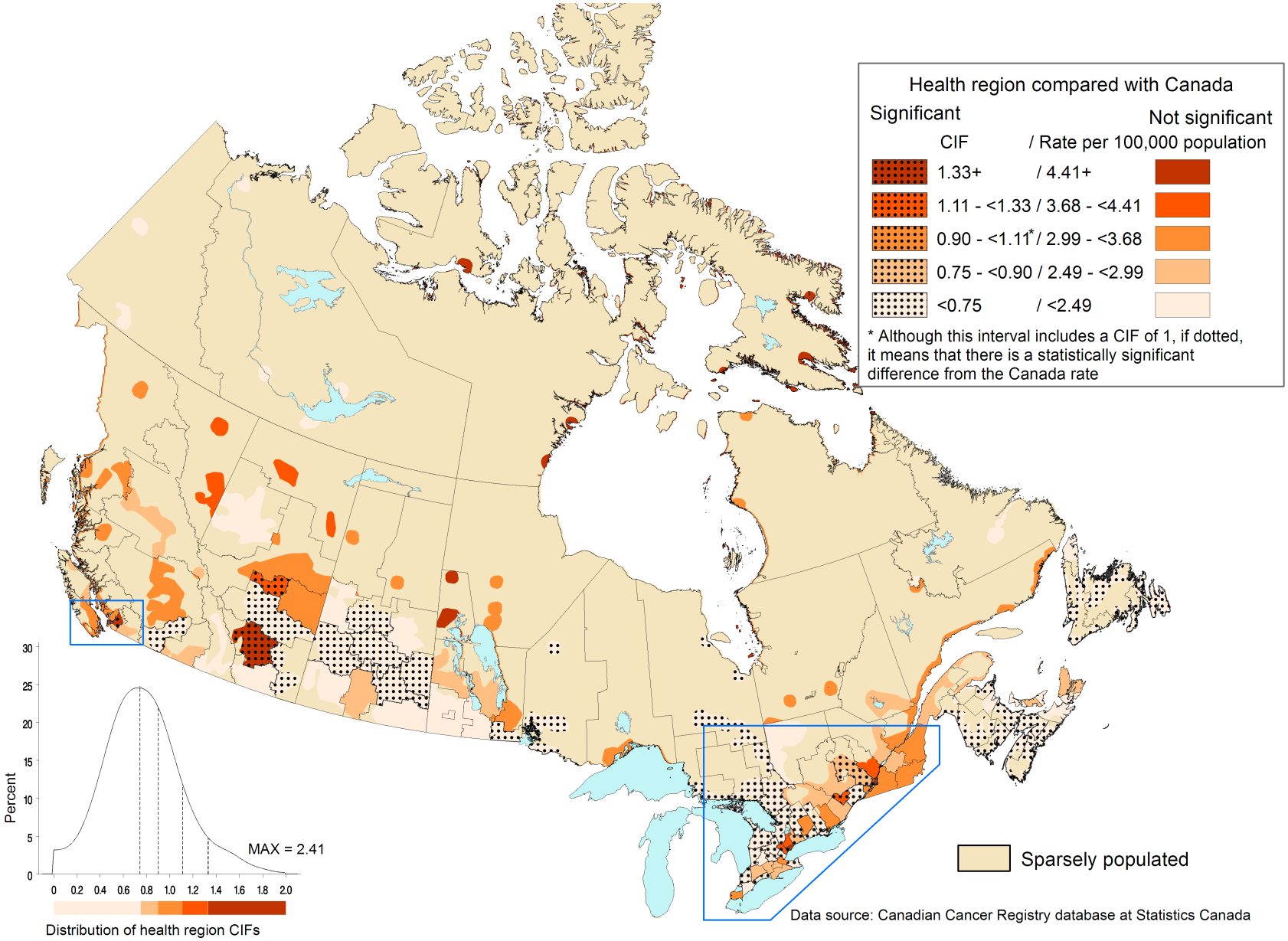
Significantly low incidence rates were seen in health regions in Newfoundland and Labrador, Nova Scotia, New Brunswick, central and northern Ontario, southern Manitoba and southern Saskatchewan. Incidence rates for liver cancer were significantly elevated in the urban health regions of Montreal, Toronto, Calgary and Vancouver. Liver cancer is associated with chronic infection with hepatitis B and hepatitis C viruses, which are more likely to be found in persons in these urban centres, probably as a result of the clustering of higher proportions of immigrants and of drug and alcohol abuse in urban centres.[52-54]

Known and Suspected Risk Factors

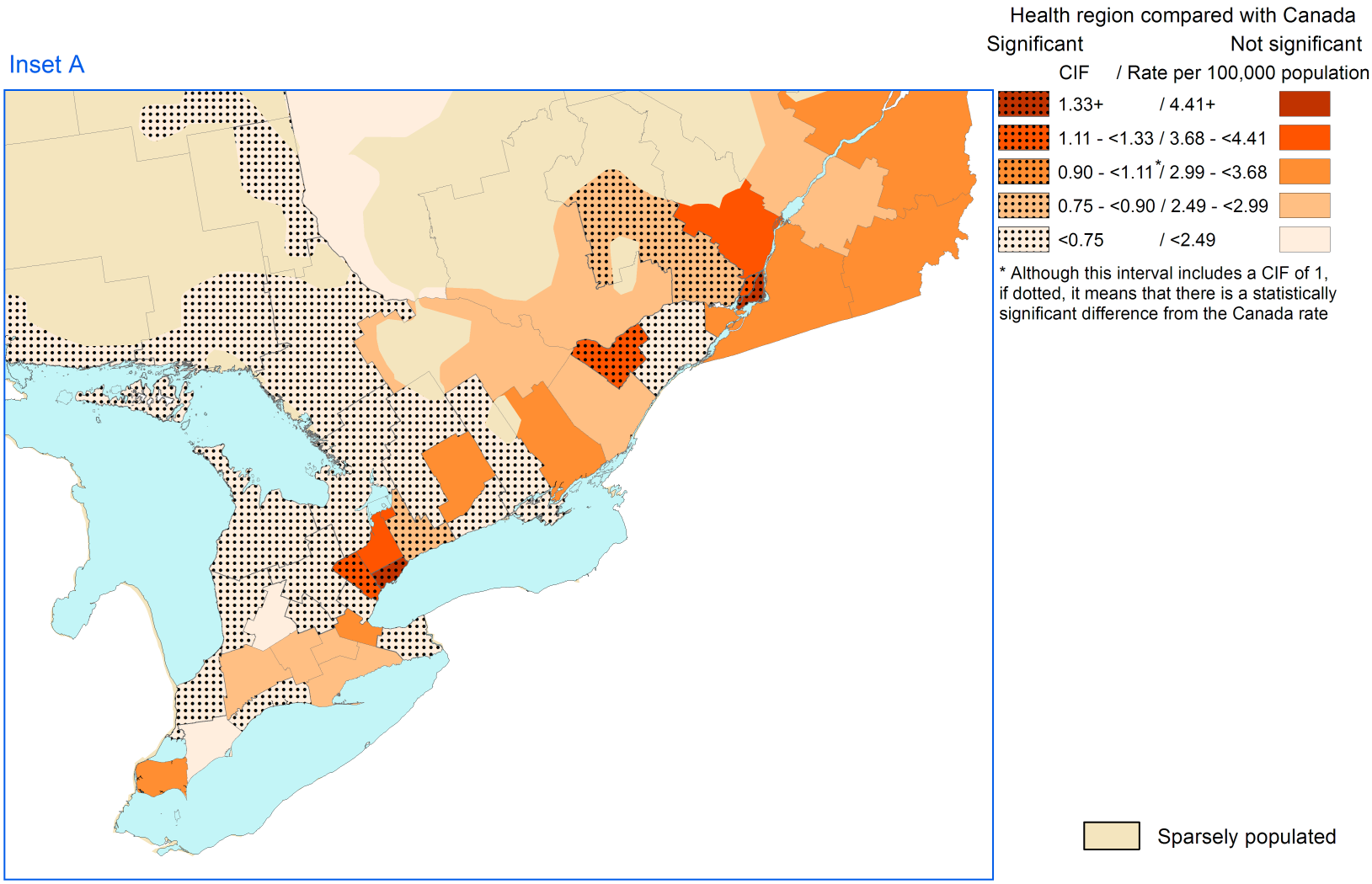
Cirrhosis of the liver is a risk factor for HCC. Approximately 80% of patients with HCC have concurrent cirrhosis.[33,55] Whether cirrhosis is itself a predisposing factor or whether the underlying causes of cirrhosis are responsible for the development of HCC still needs clarification.[37] There are multiple causes of cirrhosis, including alcohol-related liver disease, chronic hepatitis B, C and D, nonalcoholic fatty liver disease, autoimmune hepatitis, diseases that damage or destroy bile ducts such as primary biliary cirrhosis or primary sclerosing cholangitis, inherited diseases, drugs, toxins and infections.[56]

Chronic infection with the hepatitis B virus (HBV) or the hepatitis C virus (HCV) is a leading risk factor for the development of a majority of the cases of HCC. Whereas HBV is more common in the developing world, HCV is more prevalent in the Western world – especially in Canada. Although infection with HBV is declining and was 3.1 per 100,000 people in 2000, HCV infection is increasing and was 61.0 per 100,000 people in the same year.[57] An HBV vaccination in early childhood will greatly reduce the likelihood of the disease.[58] Currently, all provinces and territories have a childhood hepatitis B immunization program.

Map 10. Liver, 2000-2006, all ages

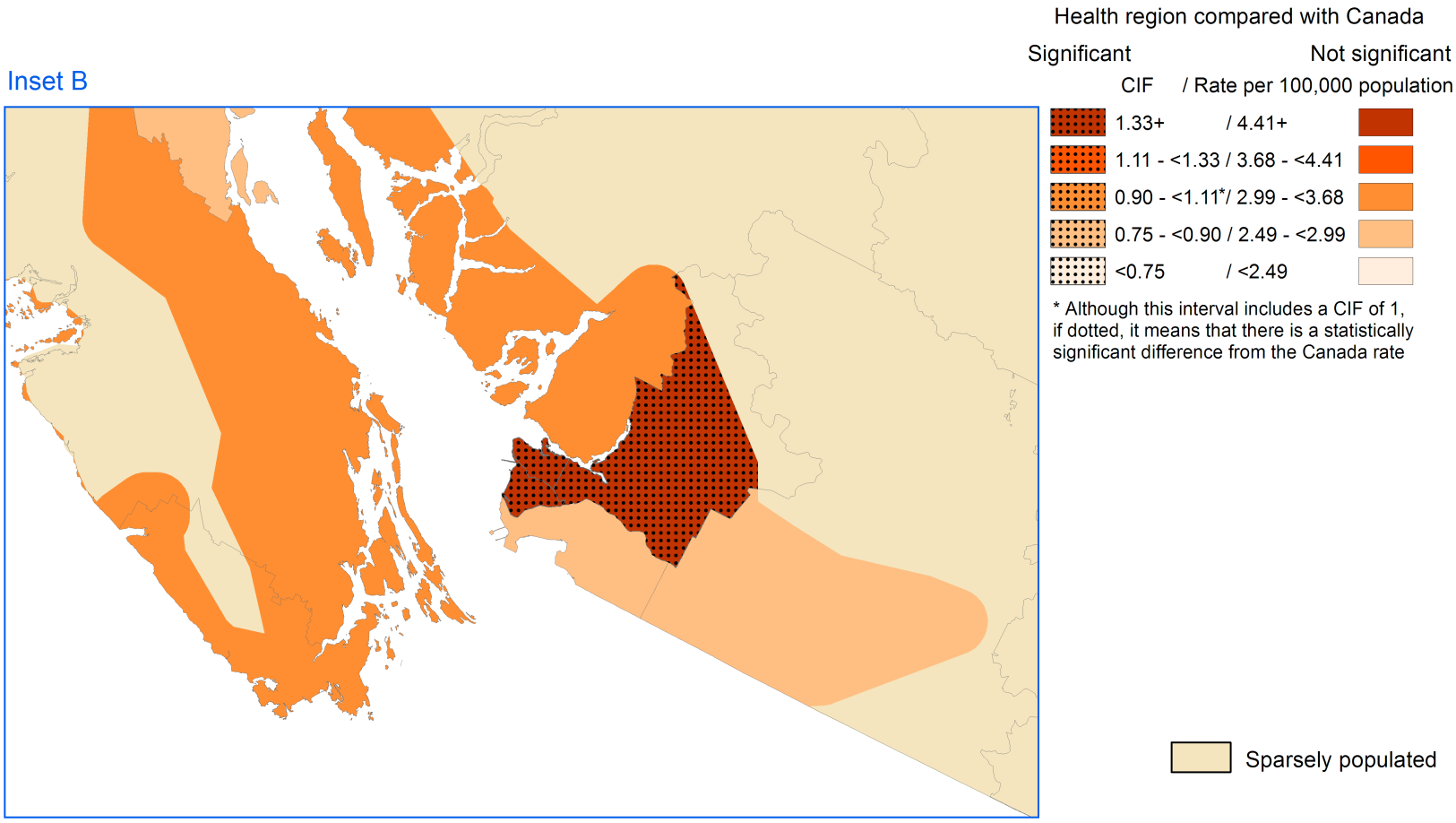


Map 10-A. Liver, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 10-B. Liver, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Pancreas (ICDO-3 C25, Maps 11 and 12)

Cancer of the pancreas is the second most common digestive system cancer after colorectal cancer. In Canada in 2006, there were 3,651 new cases diagnosed (1,850 in females; 1,801 in males).[27] The disease is very rare before the age of 40, at which point the risk increases steadily to the age group of 85 or more. Of the leading cancers, pancreatic cancers have the poorest 5-year relative survival rate, at just 6% for the period 2000-2002,[29] and this can largely be attributed to the fact that 80% of the cancers are diagnosed at the metastatic state.[37] However, a small percentage of total cases, those diagnosed with pancreatoblastomas (a cancer with an early age at diagnosis and more common in children), have a 55% overall 5-year survival rate.[37] Incidence and mortality rates have remained relatively constant during the last decade.

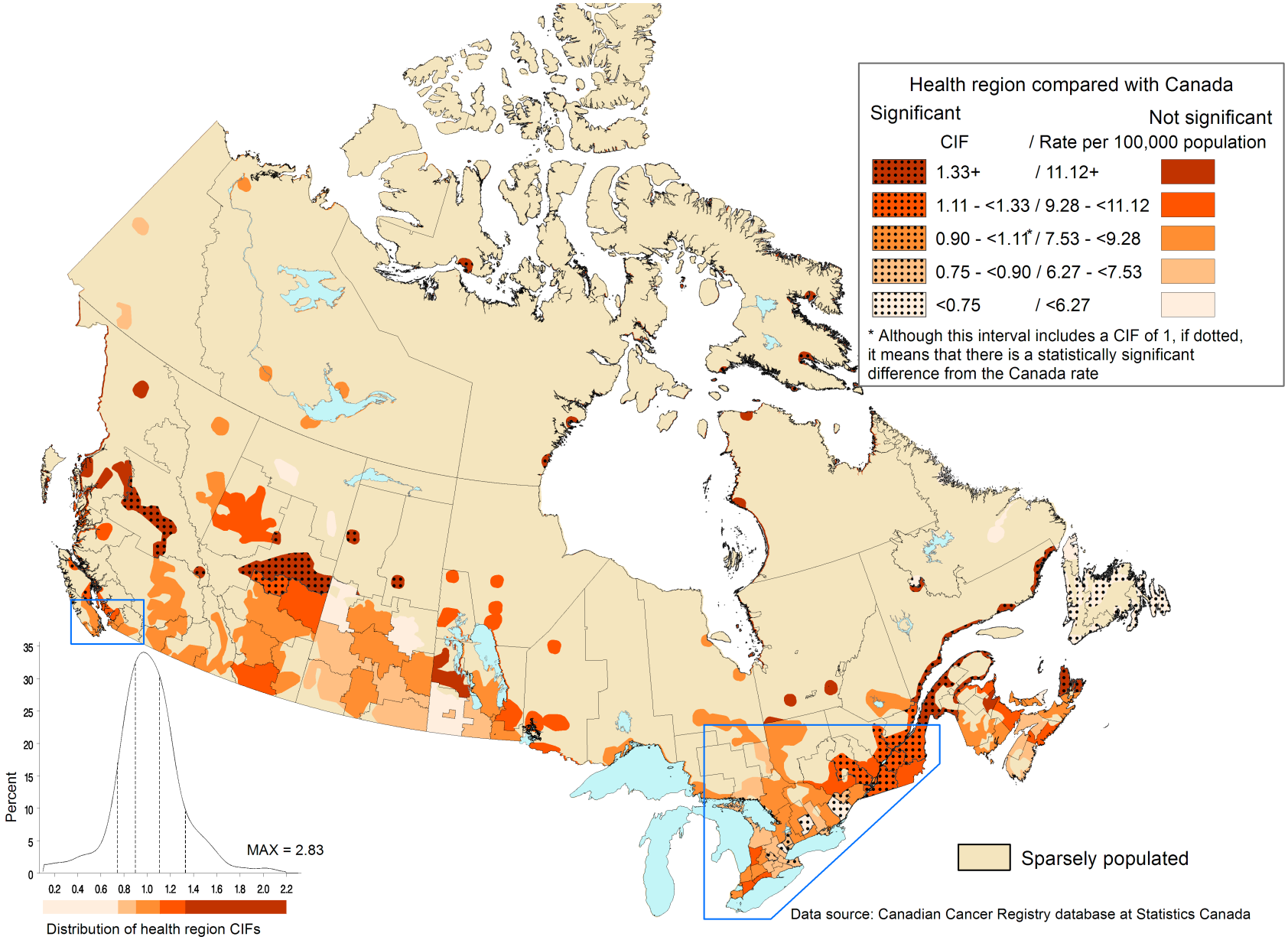
Geographic Variation

Significantly lower incidence rates for cancer of the pancreas were observed in Newfoundland and Labrador and Ontario, and among males in British Columbia. Increased rates were observed in New Brunswick and Quebec, and among females in Alberta. Low rates in Newfoundland and Labrador are likely artefactual and caused by the lack of information from death certificates in the cancer registry until recently. Pancreatic cancer incidence rates were low in south-central Ontario. For both females and males, health regions with high incidence rates for cancer of the pancreas were found in Quebec and New Brunswick, with Quebec having the highest percentage of regions with statistically significantly elevated rates.

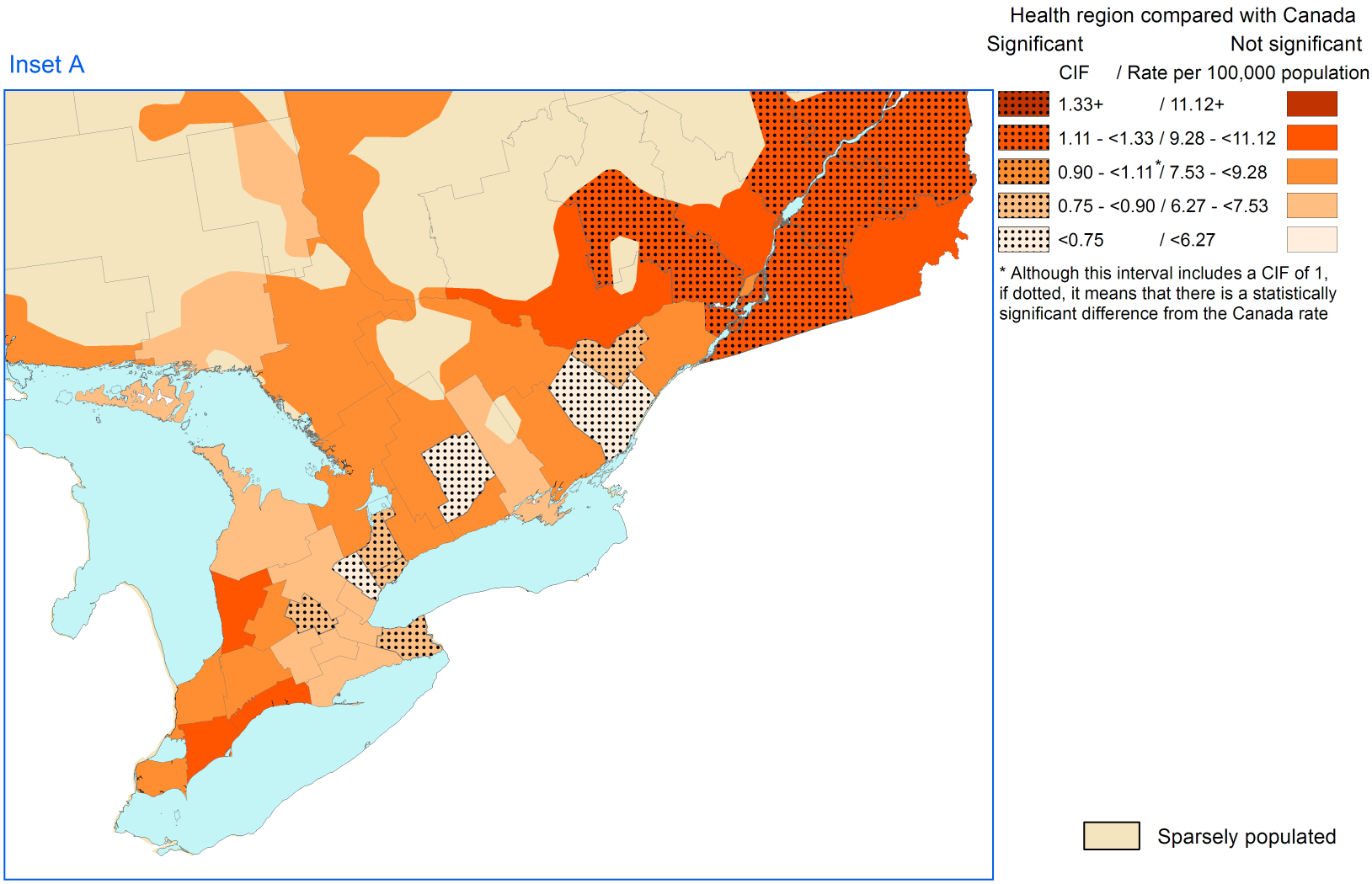
Known and Suspected Risk Factors

Cigarette smoking is a risk factor for pancreatic cancer. In some studies, the relative risk was 2.5 times greater in smokers than in non-smokers,[59] while this relative risk was seen at 3.3 in heavy smokers.[60] The risk for developing pancreatic cancer is dependent on duration and amount; studies estimate that tobacco smoking contributes to between 27% and 33% of pancreatic cancers.[32,61] Certain hereditary conditions such as hereditary pancreatitis also increase the risk.[33,37,62] Body mass index and increased height have both been found to be risk factors for this cancer.[37,63] Diabetes mellitus is positively associated with malignancies of the pancreas, with insulin resistance-related hyperinsulinemia hypothesized to play a role in the etiology.[64,65]

Map 11. Pancreas, females, 2000-2006, all ages

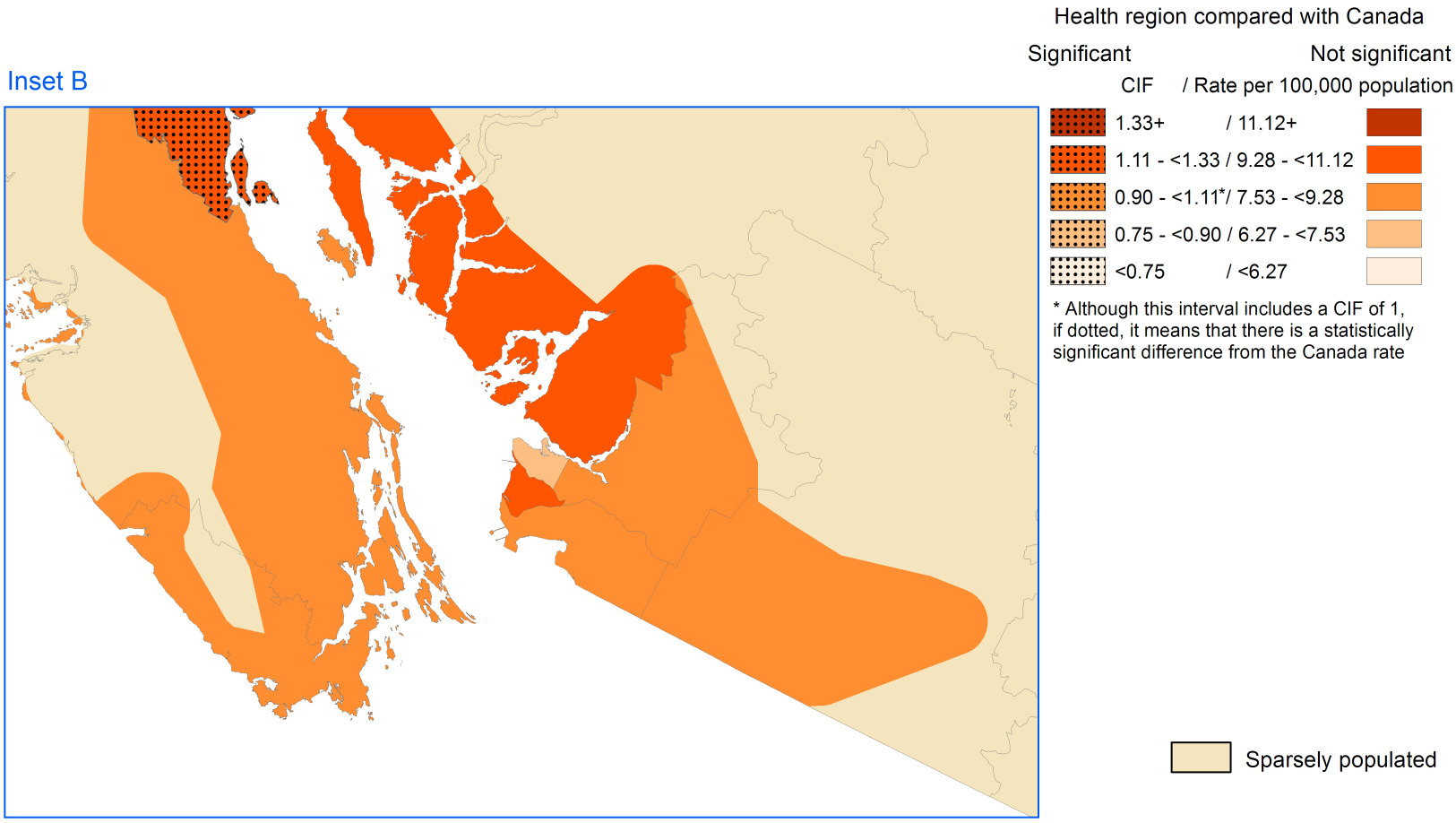


Map 11-A. Pancreas, females, 2000-2006, all ages



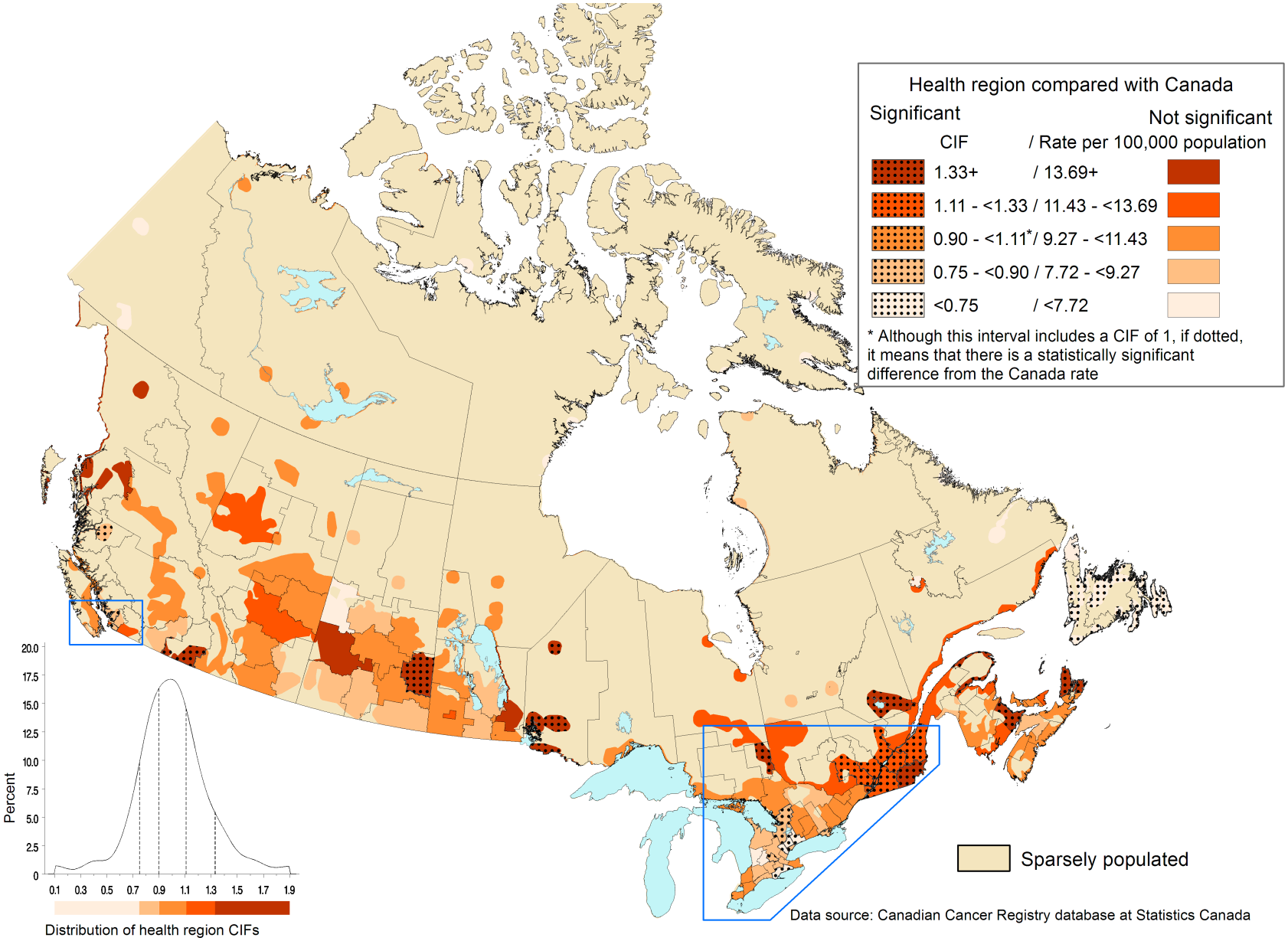
Data source: Canadian Cancer Registry database at Statistics Canada

Map 11-B. Pancreas, females, 2000-2006, all ages

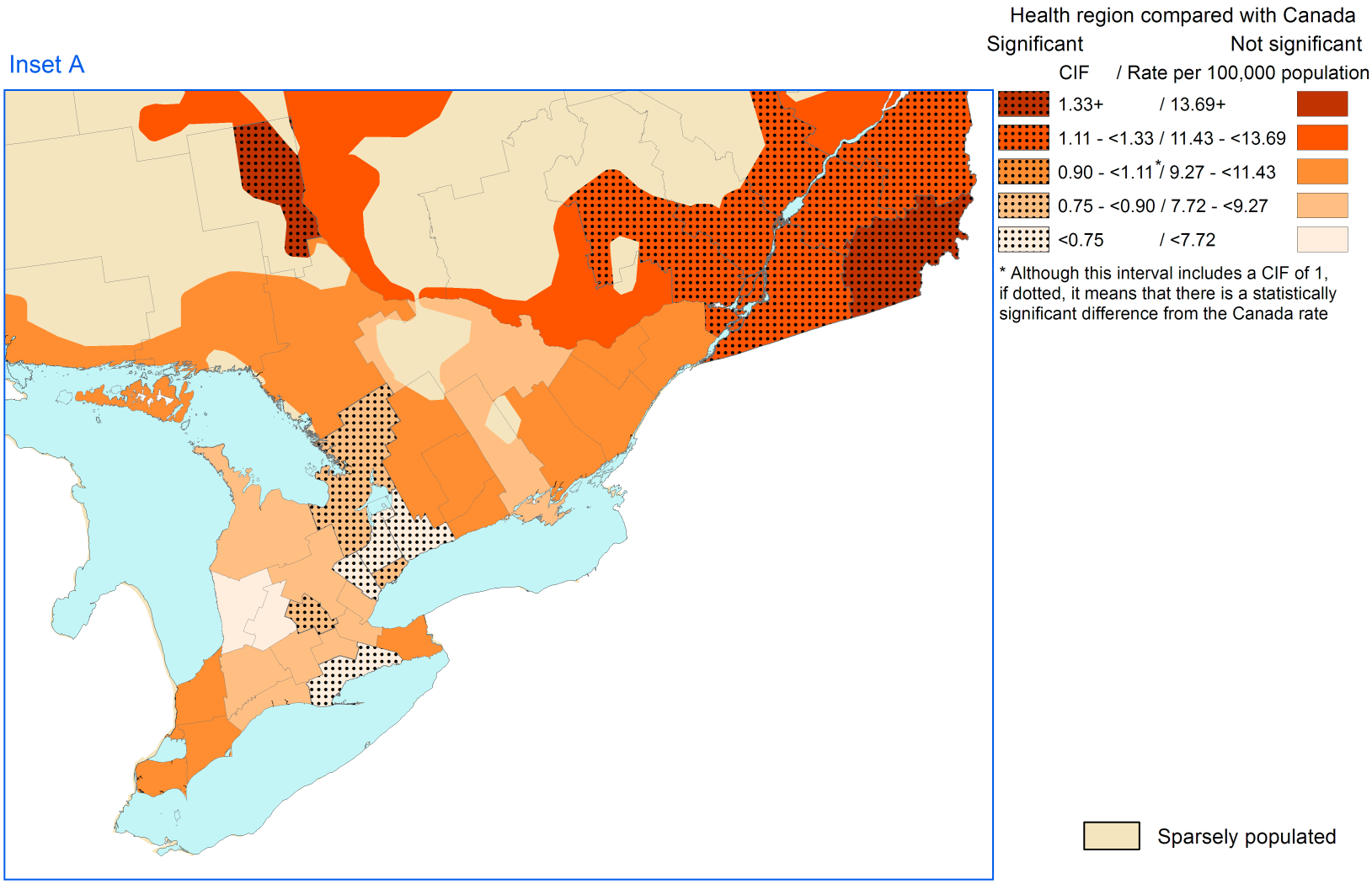


Data source: Canadian Cancer Registry database at Statistics Canada

Map 12. Pancreas, males, 2000-2006, all ages

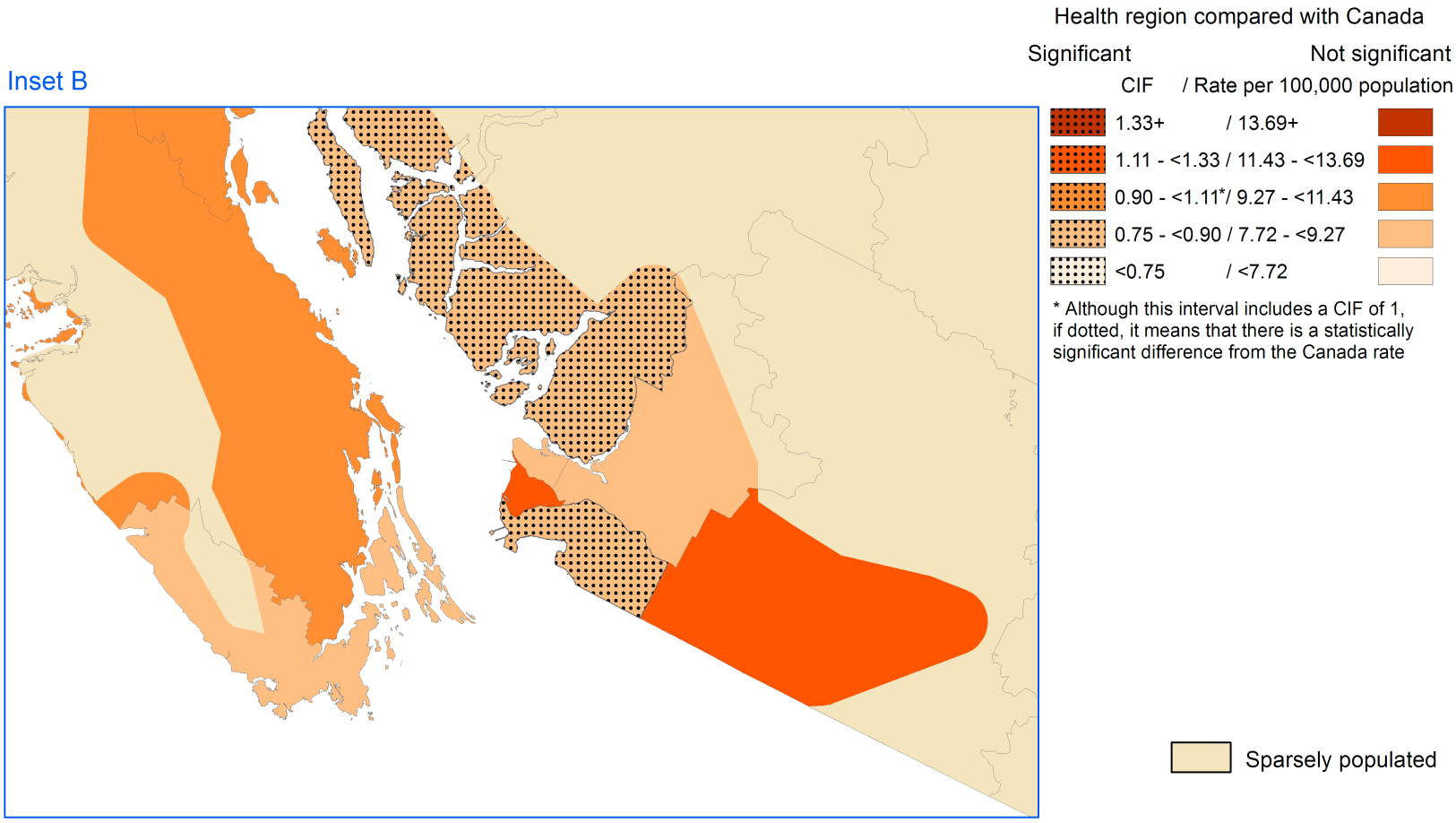


Map 12-A. Pancreas, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 12-B. Pancreas, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Larynx (ICDO-3 C32, Map 13)

Cancer of the larynx is relatively rare, accounting for less than 1% (1,024 cases) of all cancer cases in 2006, with over 80% of cases found among males.[27] The annual percentage change in incidence rates has been a decrease of over 3% per year among both sexes.[28] Cancer of the larynx is rarely seen below age 50; rates peak among persons aged 70-79 and then decline.[27] The overall 5-year relative survival rate for both sexes combined for the period 2002-2004 was 65%.[29]

Geographic Variation

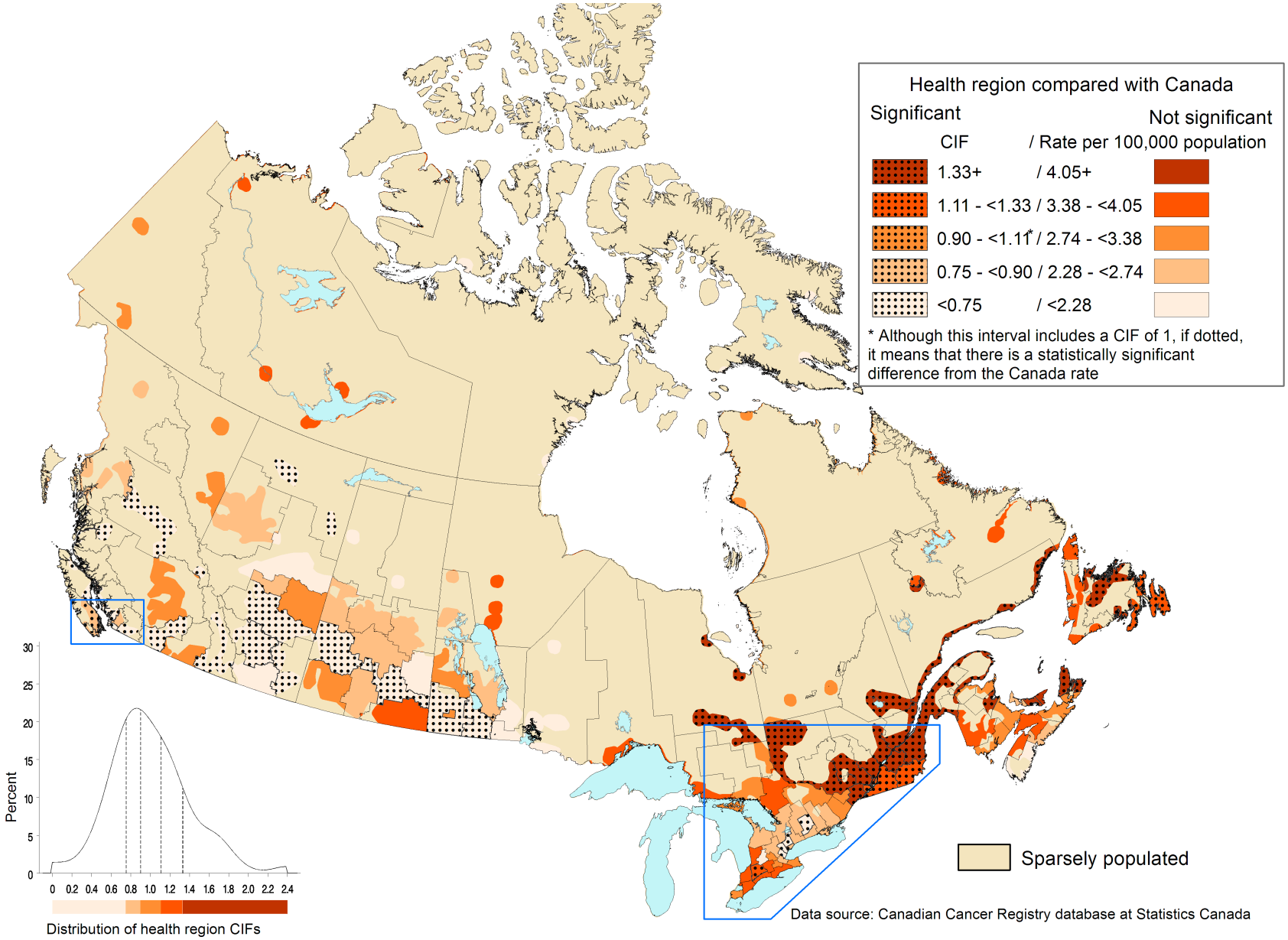
Due to the smaller number of cases, rates for females and males combined are mapped. At the provincial/territorial level, significantly lower incidence rates for cancer of the larynx were observed from Ontario to British Columbia. Significantly elevated rates were observed in Newfoundland and Labrador, Prince Edward Island and Quebec.

Low incidence rates were observed in health regions from Manitoba to British Columbia with few exceptions, as well as in the City of Toronto, Halton Regional, Peel Regional, York Regional and Peterborough County-City health units. Higher incidence rates of cancer of the larynx were observed in Quebec, with all except one of the health regions having significantly elevated rates. This pattern of elevated rates extended to north-eastern Ontario, New Brunswick, Nova Scotia Health Region 5, Prince Edward Island and Newfoundland and Labrador.

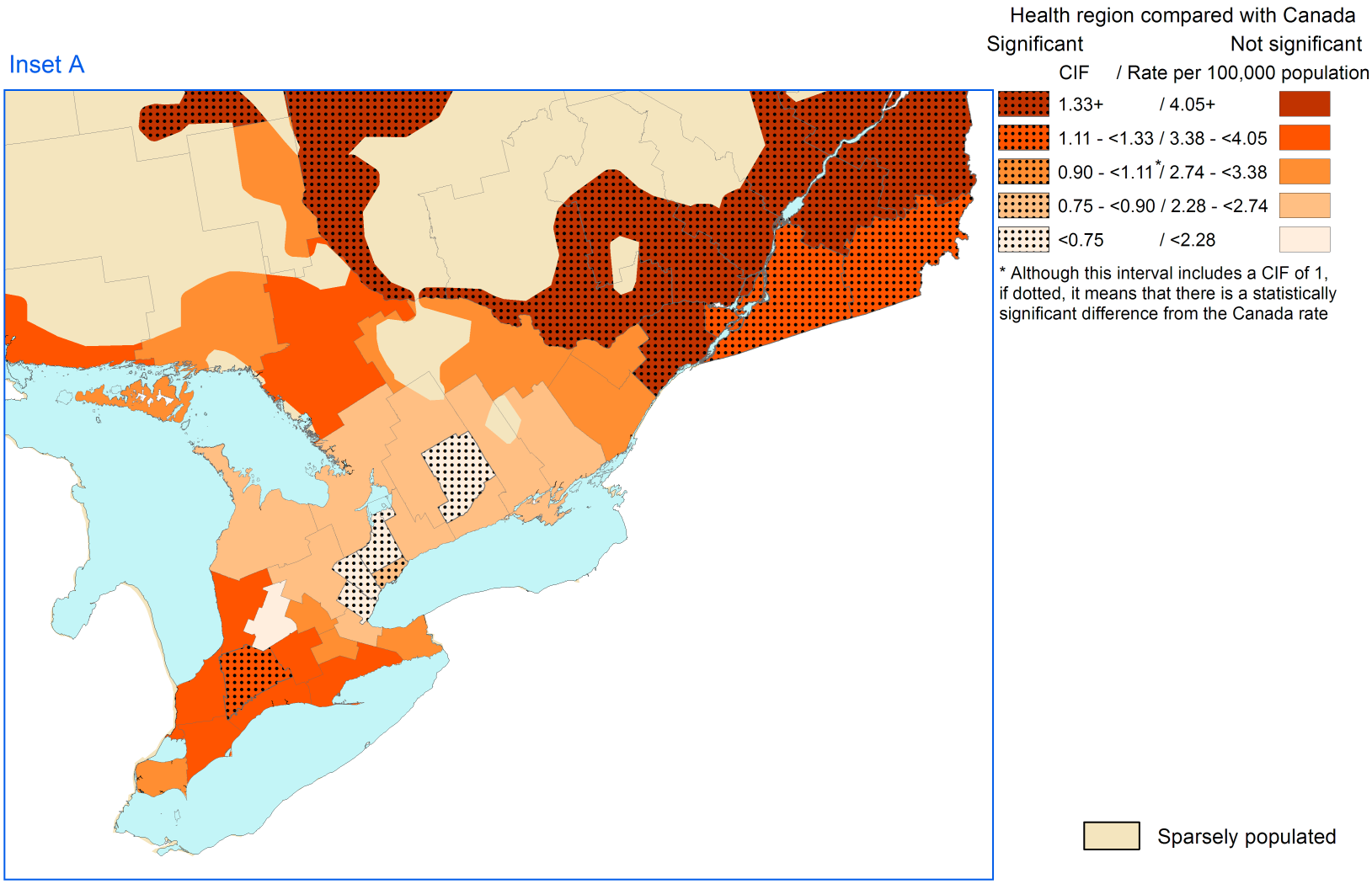
Known and Suspected Risk Factors

Despite the difficulties in separating the effects of alcohol consumption and smoking, the 2 risk factors are believed to act independently and jointly. Alcohol, the weaker of the 2 factors, is believed to facilitate carcinogenic effects such as those of tobacco and of other unrecognized carcinogens.[66] It has been suggested that 25% of laryngeal cancer cases are attributable to alcohol consumption and that the risk is increased by 3- to 4-fold.[67,68]

Map 13. Larynx, 2000-2006, all ages

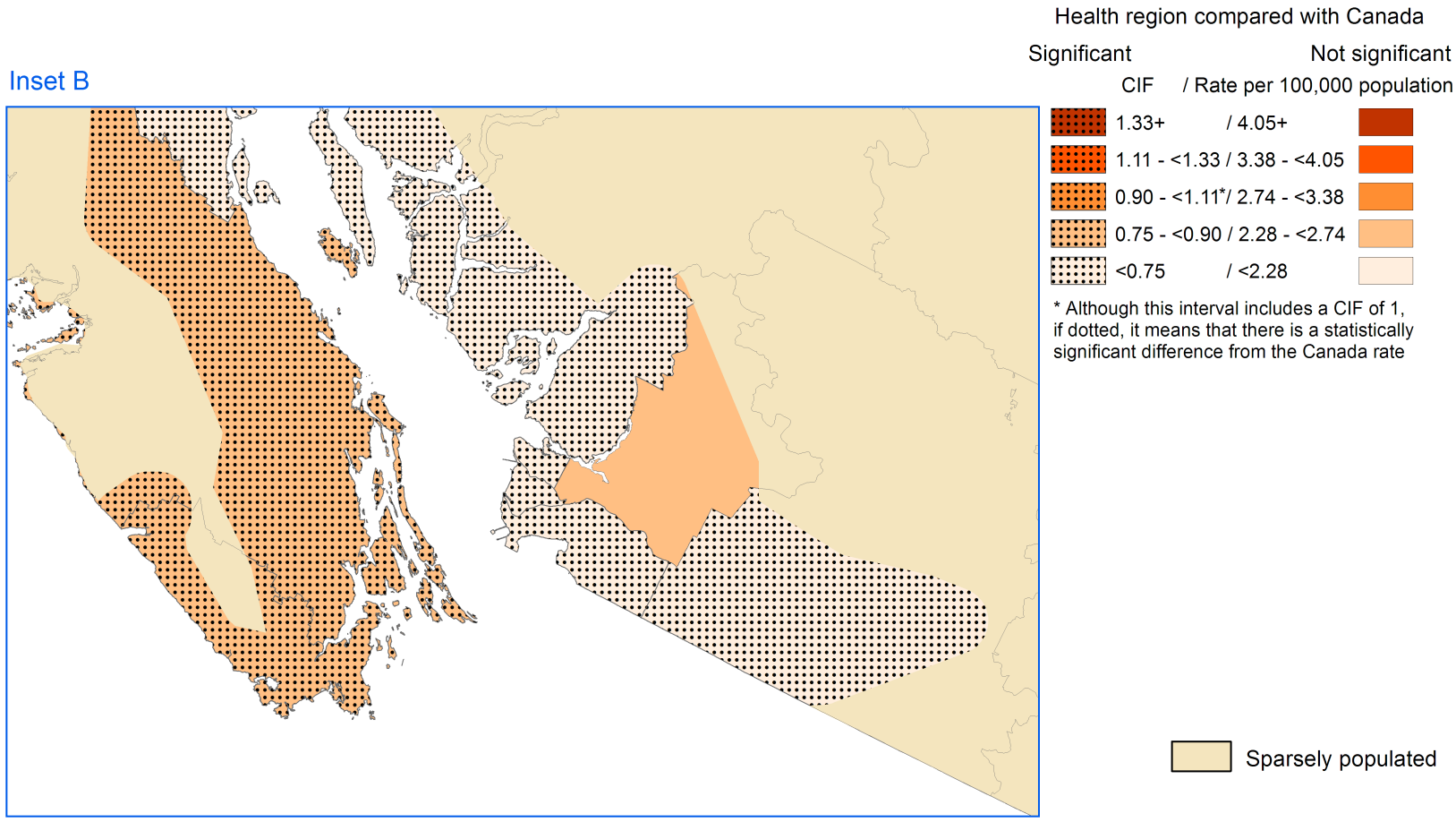


Map 13-A. Larynx, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 13-B. Larynx, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Lung and bronchus (ICDO-3 C34, Maps 14 and 15)

Lung cancer, which includes tumours of the bronchus and lung (but not trachea and pleura), accounted for 22,534 new cases in 2006 (10,238 in females; 12,296 in males).[27] Among females, incidence rates increased by 1.2% per year while, among males, incidence rates declined by 2.1% per year for the period 1997-2006. As a result, the male-to-female ratio of age-standardized rates has decreased to about 1.4.[28] For females less than age 55, incidence rates are currently higher than for males. Lung cancer is rare before age 35, and incidence rates currently peak among those aged 80-84.[27] Lung cancer continues to have a poor prognosis: the 5-year relative survival rate for the period 2000-2002 was 17% among females and 13% among males.[29]

Geographic Variation

At the provincial/territorial level, significantly lower incidence rates for lung cancer were observed for Newfoundland and Labrador, Ontario, Alberta and British Columbia, and among males in Manitoba and Saskatchewan. The significantly lower rates in Newfoundland and Labrador may be artefactual because death certificates were not available to the cancer registry for the period of data covered by this publication, so some individuals with lung cancer were not counted in the registry.

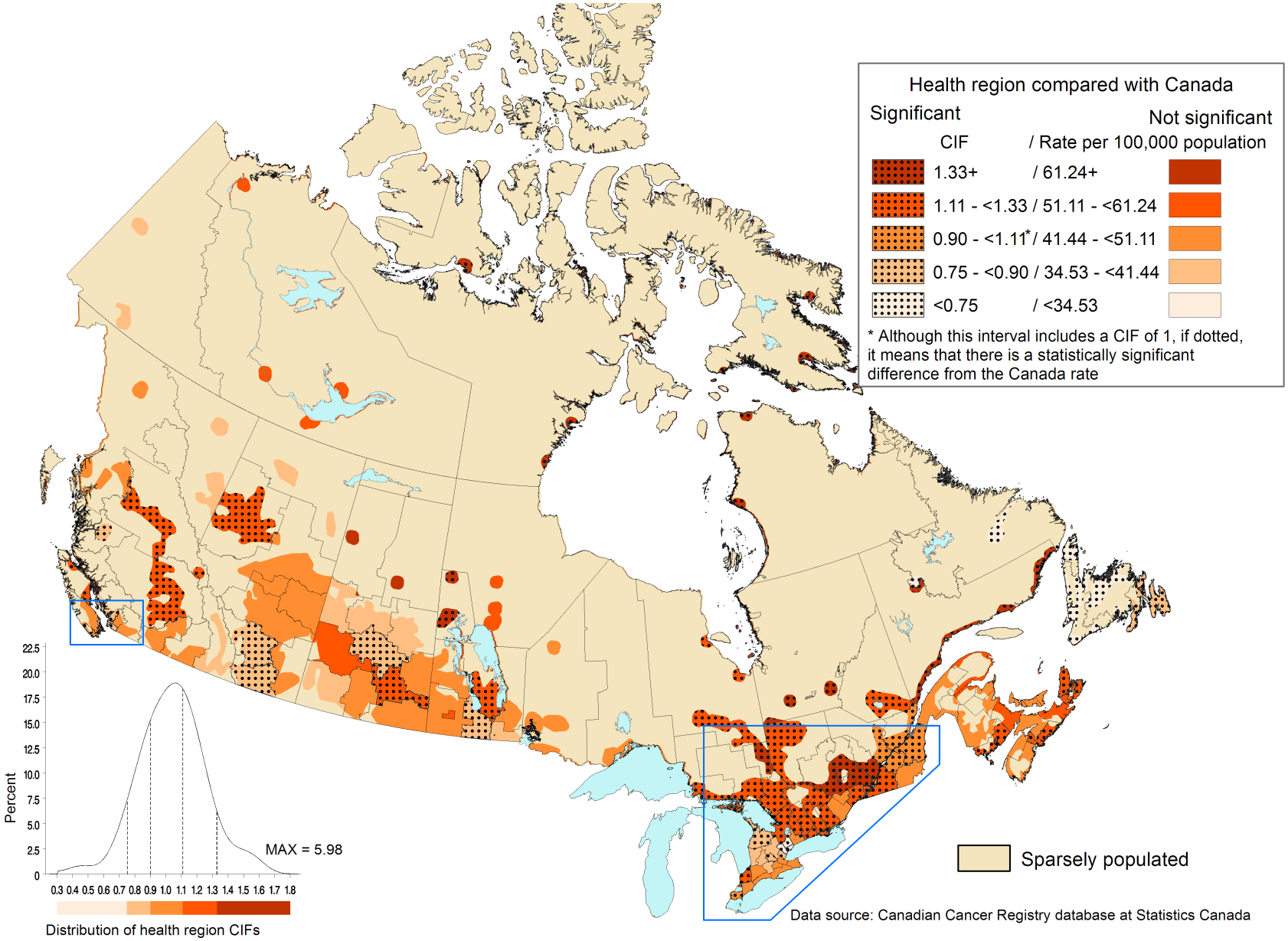
Significantly elevated rates were observed in Nova Scotia, New Brunswick, Quebec and Nunavut, and among males in Prince Edward Island.

Significantly low rates were observed among females in the City of Toronto Health Unit as well as in Peel Regional, York Regional and Halton Regional health units. Significantly low rates were observed among males from the Grey Bruce Health Unit and then south to health regions along Lake Erie and east to the Durham Regional Health Unit. Low rates were also observed in health regions in southern Manitoba, southern Saskatchewan, southern Alberta and southern British Columbia. Significantly elevated rates were observed among females in health regions in Nunavut, Nova Scotia, northern and eastern Ontario, and in three-quarters of the health regions in Quebec. Rates among males were significantly elevated in Quebec for all of the health regions and for health regions in Nova Scotia, New Brunswick, eastern and northern Ontario, and for Nunavut.

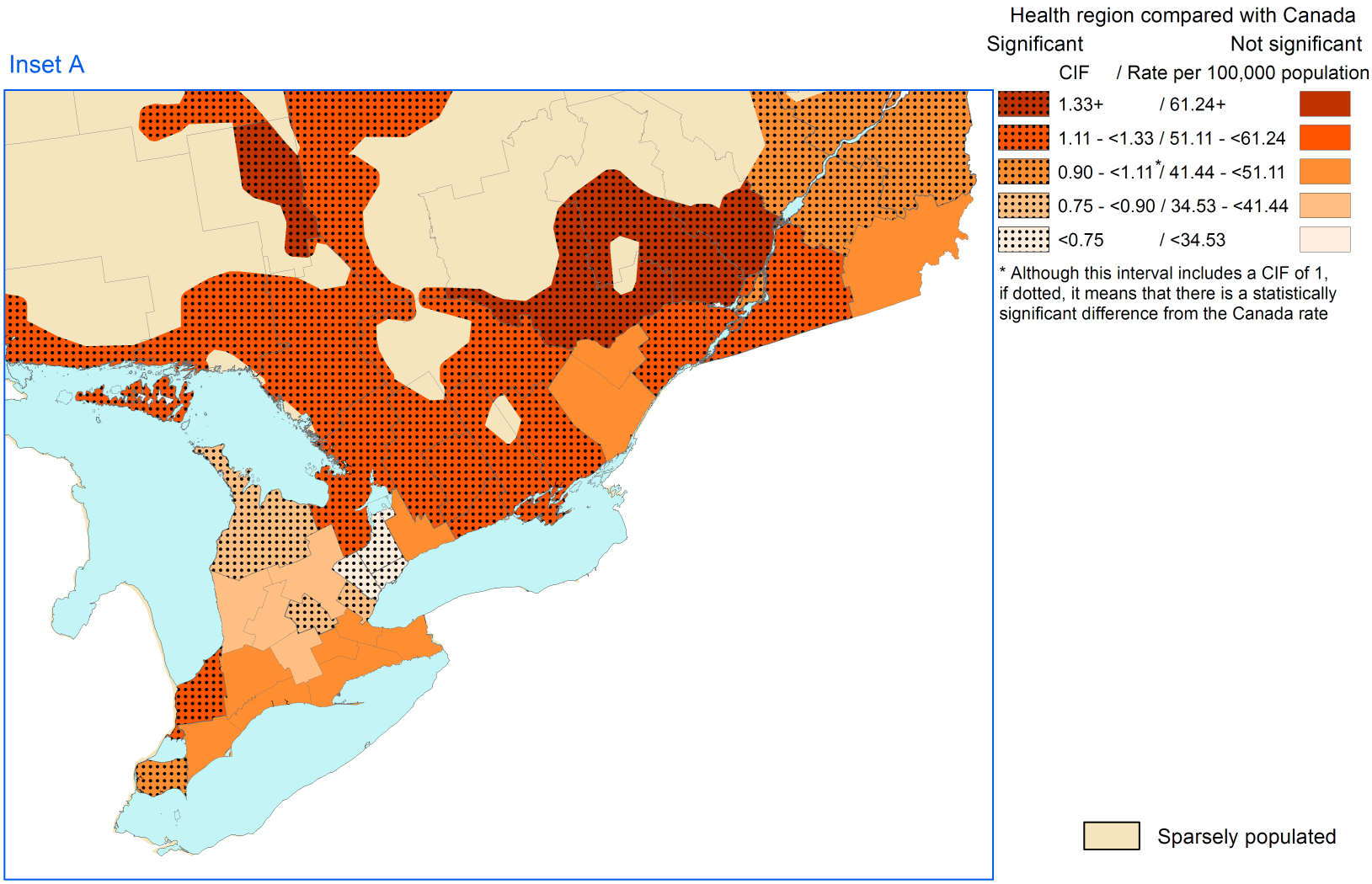
Known and Suspected Risk Factors

In populations with a long duration and heavy intensity of cigarette usage, the proportion of lung cancer attributable to smoking is of the order of 90%. The new filters and low-tar cigarettes have not been found to diminish cancer rates appreciatively; users of such cigarettes engage in deeper inhalation and in more vigorous puffing, and often consume more cigarettes.[37,69] Increases in the proportion of adenocarcinoma cases have been reported to be associated with the introduction of filter-tip cigarettes.[70] Residential exposure to radon has been estimated to be responsible for over 1,500 cases of lung cancer a year in Canada (about 8% of lung cancer cases).[71] A number of techniques are available to homeowners to reduce radon concentrations in their homes.

Map 14. Lung and bronchus, females, 2000-2006, all ages

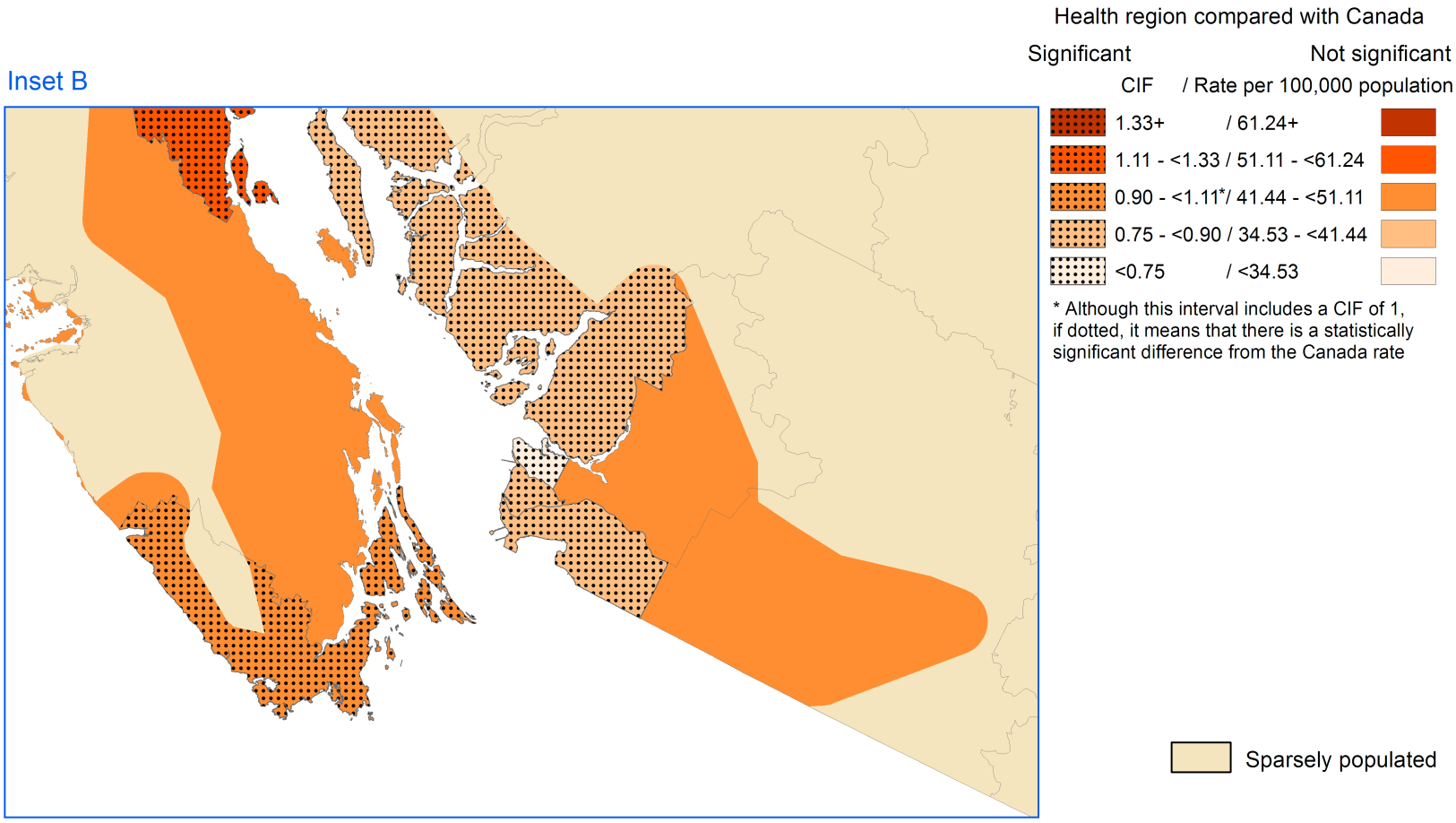


Map 14-A. Lung and bronchus, females, 2000-2006, all ages



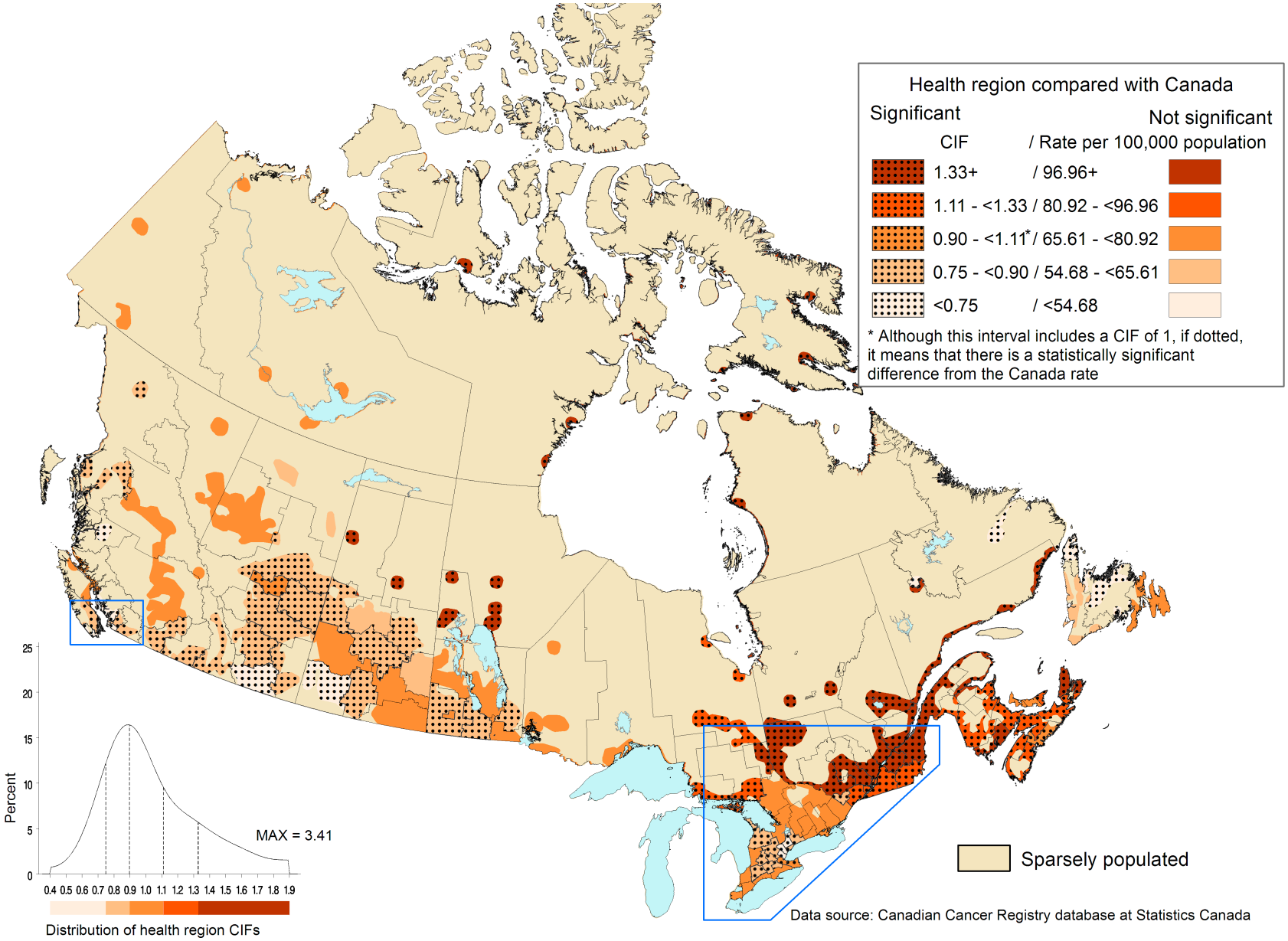
Data source: Canadian Cancer Registry database at Statistics Canada

Map 14-B. Lung and bronchus, females, 2000-2006, all ages

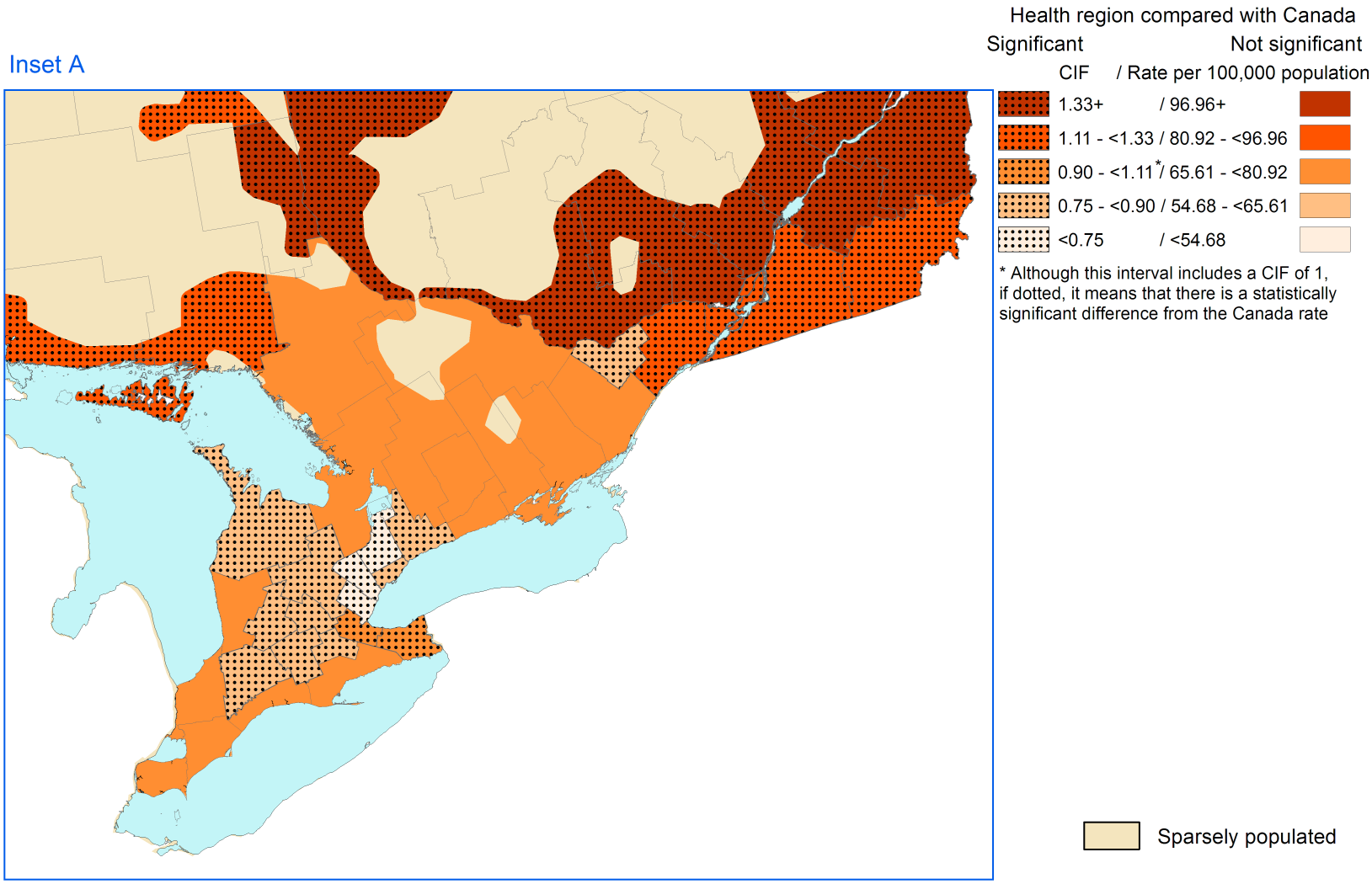


Data source: Canadian Cancer Registry database at Statistics Canada

Map 15. Lung and bronchus, males, 2000-2006, all ages

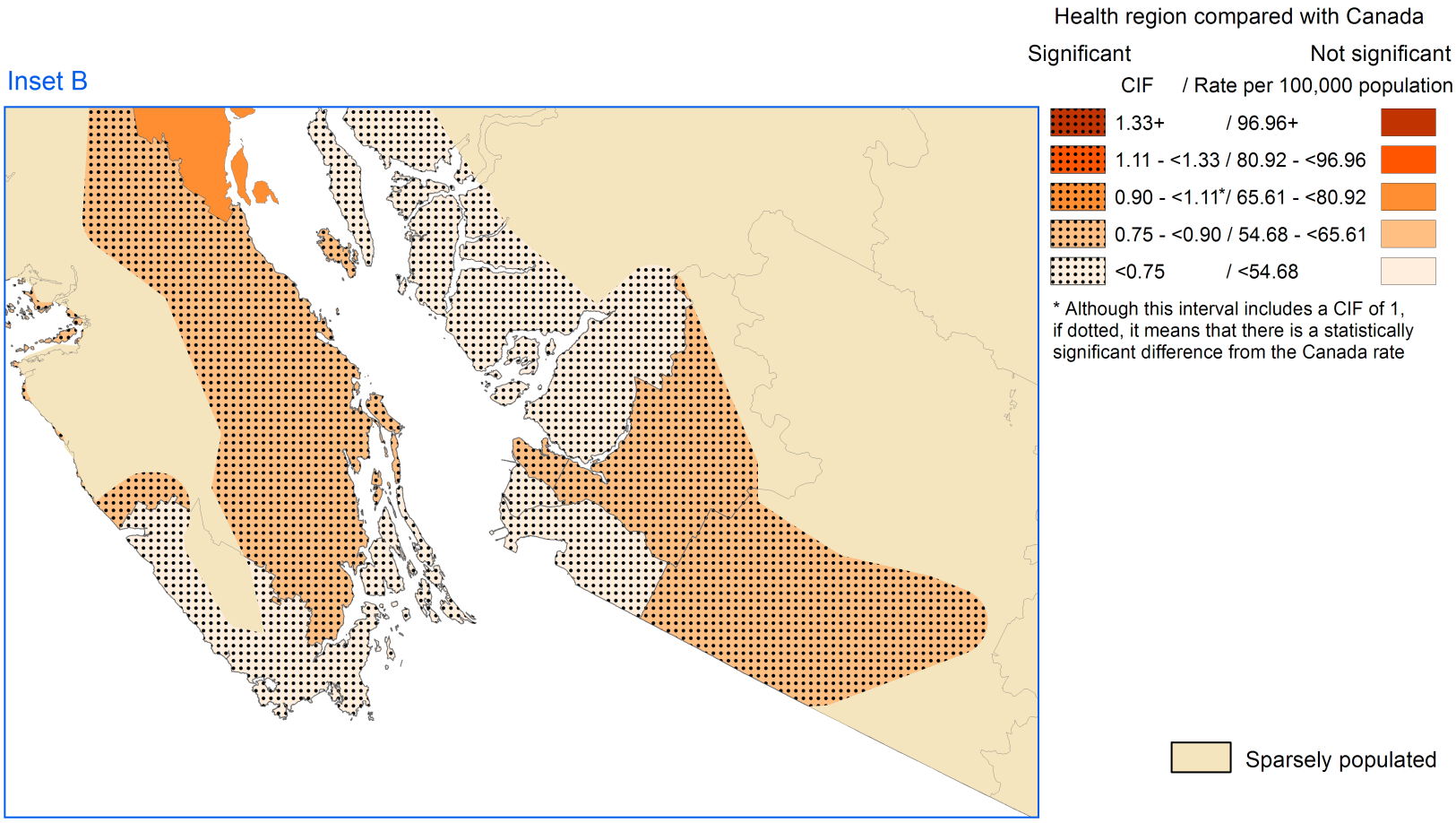


Map 15-A. Lung and bronchus, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 15-B. Lung and bronchus, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Melanoma of the skin

(ICDO-3 C44 histology 8720-8790, Maps 16 and 17)

Melanoma is the most serious histological type of skin cancer, representing tumours that arise in the melanocytes. In 2006, there were 4,580 cases in Canada (2,135 in females; 2,445 in males).[27] The annual percentage change for 1997-2006 has been a 1.2% increase among females and a 1.5% increase among males.[28] Melanoma is one of the most common cancers in young adults. Incidence rates increase with increasing age, but for those aged 50 or more the increase is less pronounced among females than males, and age-standardized rates are lower than for males above this age group.[27] For the period 2000-2002, the 5-year survival rate was higher for females (93%) than for males (86%).[29] The rate of survival is greatly dependent on the tumour thickness.[72]

Geographic Variation

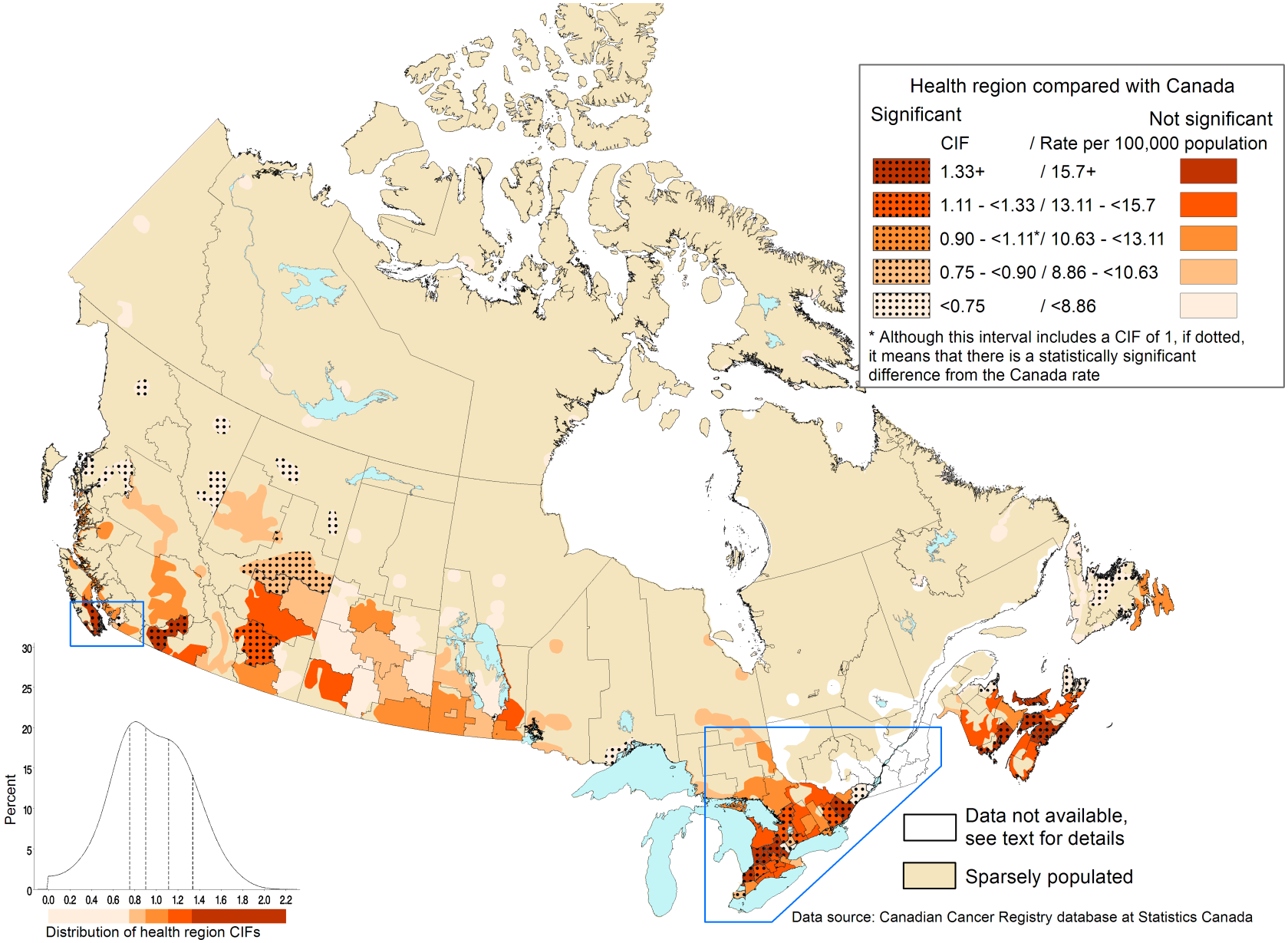
At the provincial/territorial level, significantly lower incidence rates for melanoma were observed in Newfoundland and Labrador, Manitoba and Saskatchewan, and among males in Alberta. Significantly elevated rates were observed in Nova Scotia and among females in Prince Edward Island and among males in Ontario. Quebec is excluded since the number of cases are under-reported (see Limitations).

Northern regions of the provinces had lower rates as well as Yukon, the Northwest Territories and Nunavut. Southern health regions of Nova Scotia, New Brunswick, Ontario, Alberta and British Columbia experienced significantly elevated incidence rates of melanoma, although this was not the case for the City of Toronto and Vancouver health regions as well as for additional adjacent health regions.

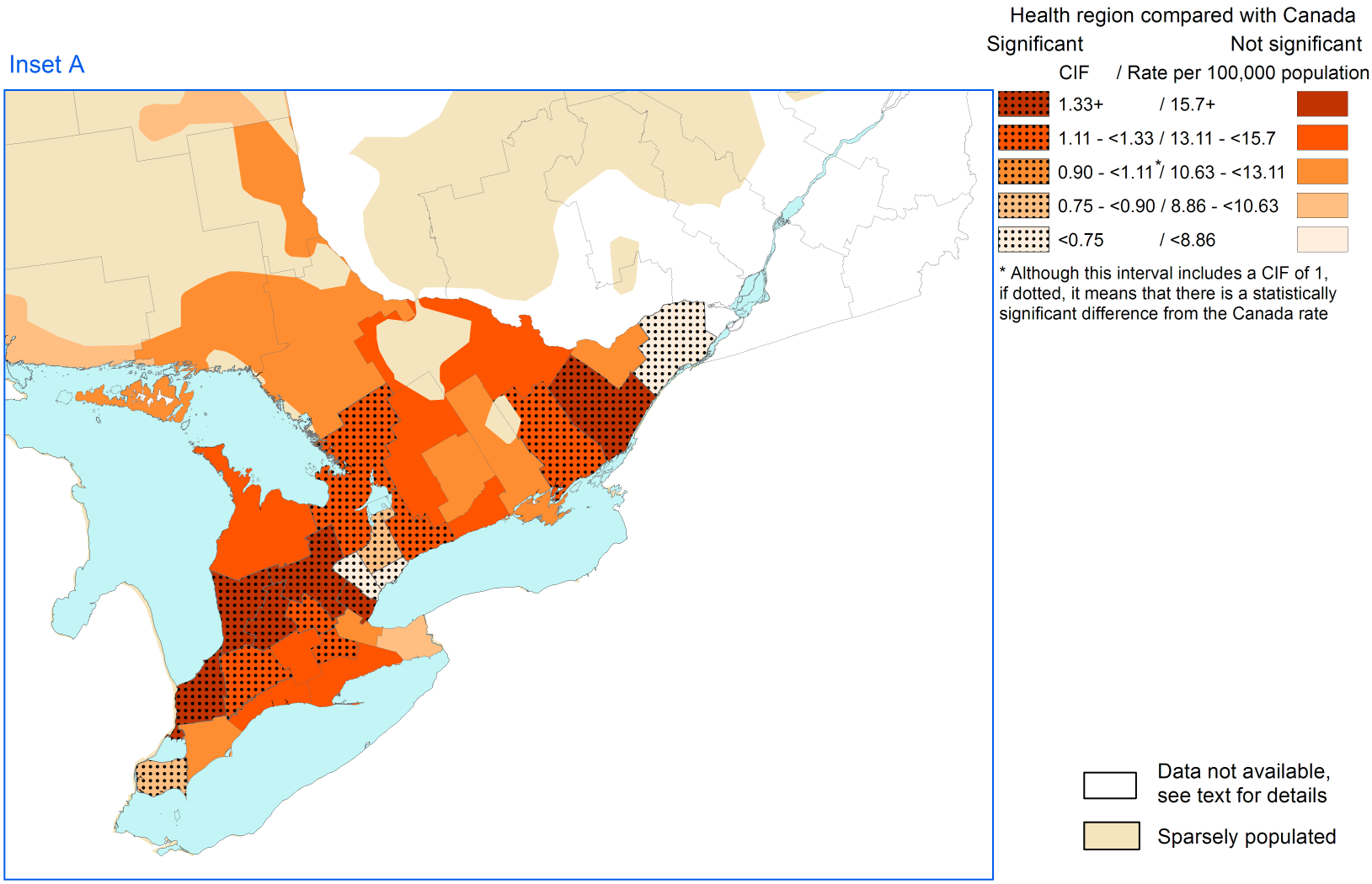
Known and Suspected Risk Factors

Exposure to ultraviolet radiation is implicated in as much as 80% or more of melanomas.[69,73,74] The risks associated with intense and intermittent exposure tend to be greater than those associated with chronic exposure, especially for younger individuals.[75] People with fair complexions are generally at higher risk. Red hair colour, the presence of multiple benign or atypical nevi and the presence of freckles are also risk factors.[32,76,77] Having a history of severe sunburn increases melanoma risk,[32,55,77] and being easily susceptible to burning has been shown to increase the risk by 2- to 3-fold.[37] A previous history of melanoma is also known to elevate the lifetime risk by at least 3%,[55] and perhaps as high as 5-10%.[37] In addition, a family history of melanoma is a strong indicator for risk, with at least 10% of patients reporting the presence of the disease in a close relative.[37] When compared with the general population, the presence of a family history of melanoma increases the risk of the disease by 3-4 times[33] and is suggestive of a possible genetic influence.

Map 16. Melanoma of the skin, females, 2000-2006, all ages

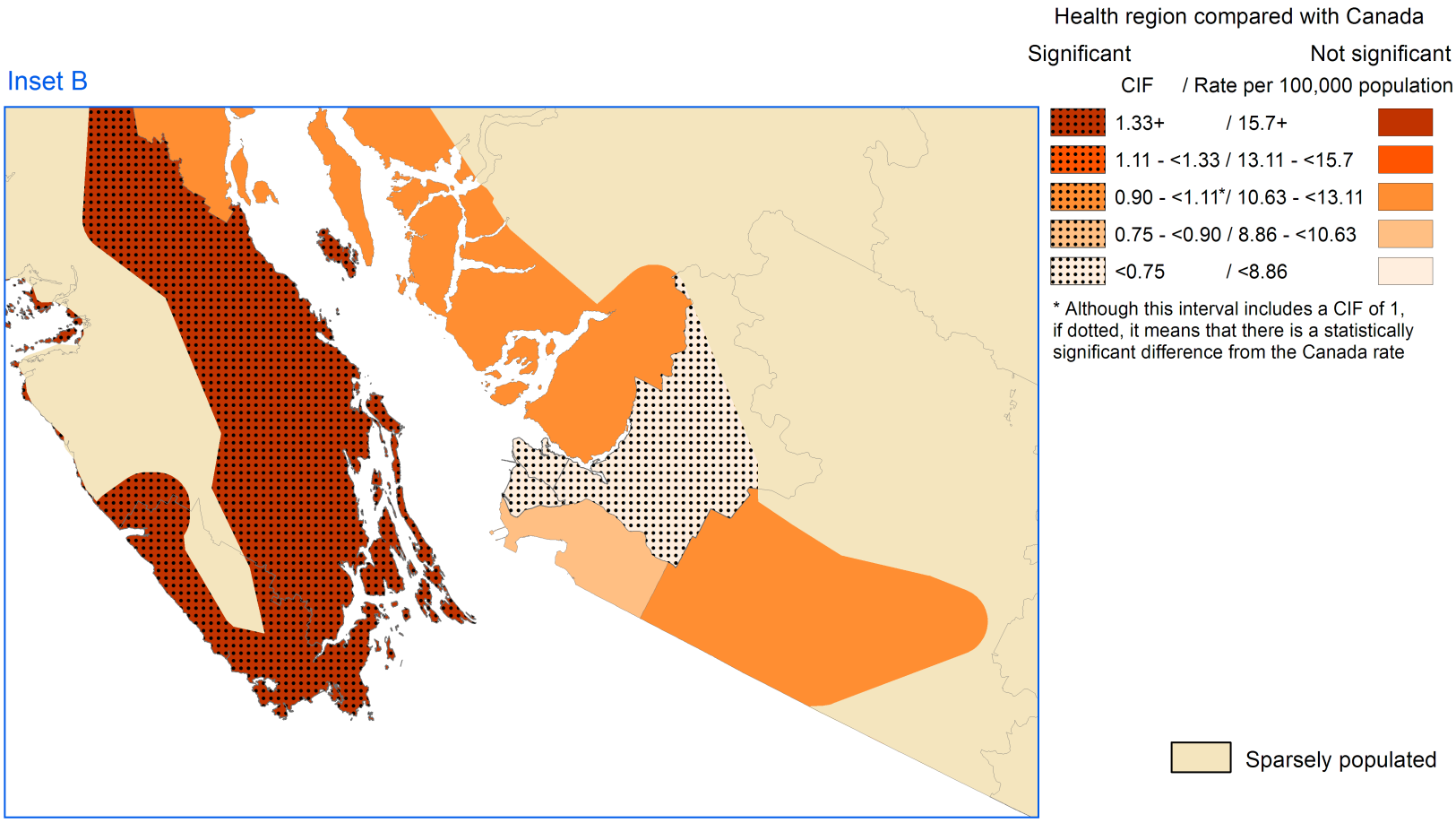


Map 16-A. Melanoma of the skin, females, 2000-2006, all ages



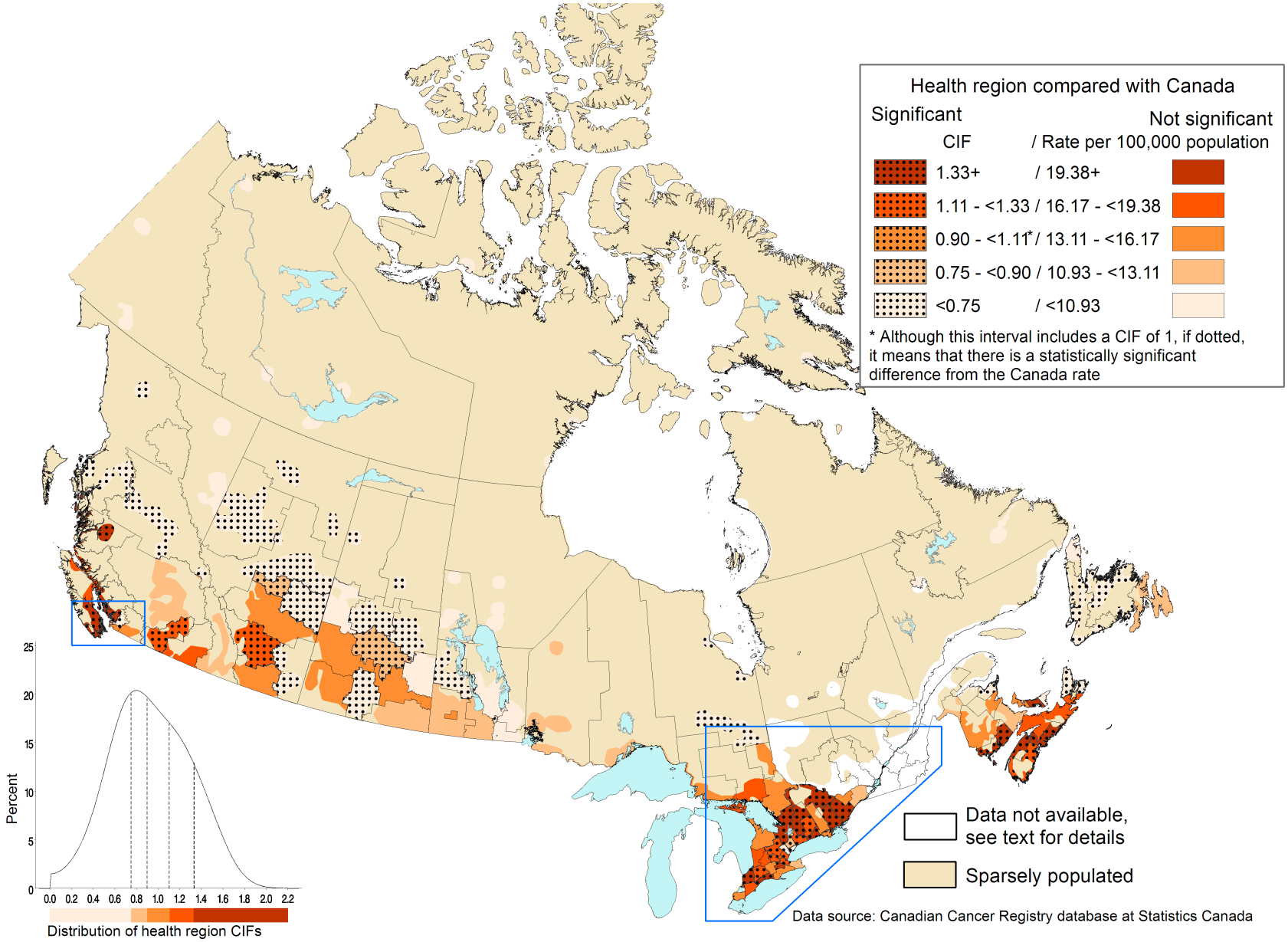
Data source: Canadian Cancer Registry database at Statistics Canada

Map 16-B. Melanoma of the skin, females, 2000-2006, all ages

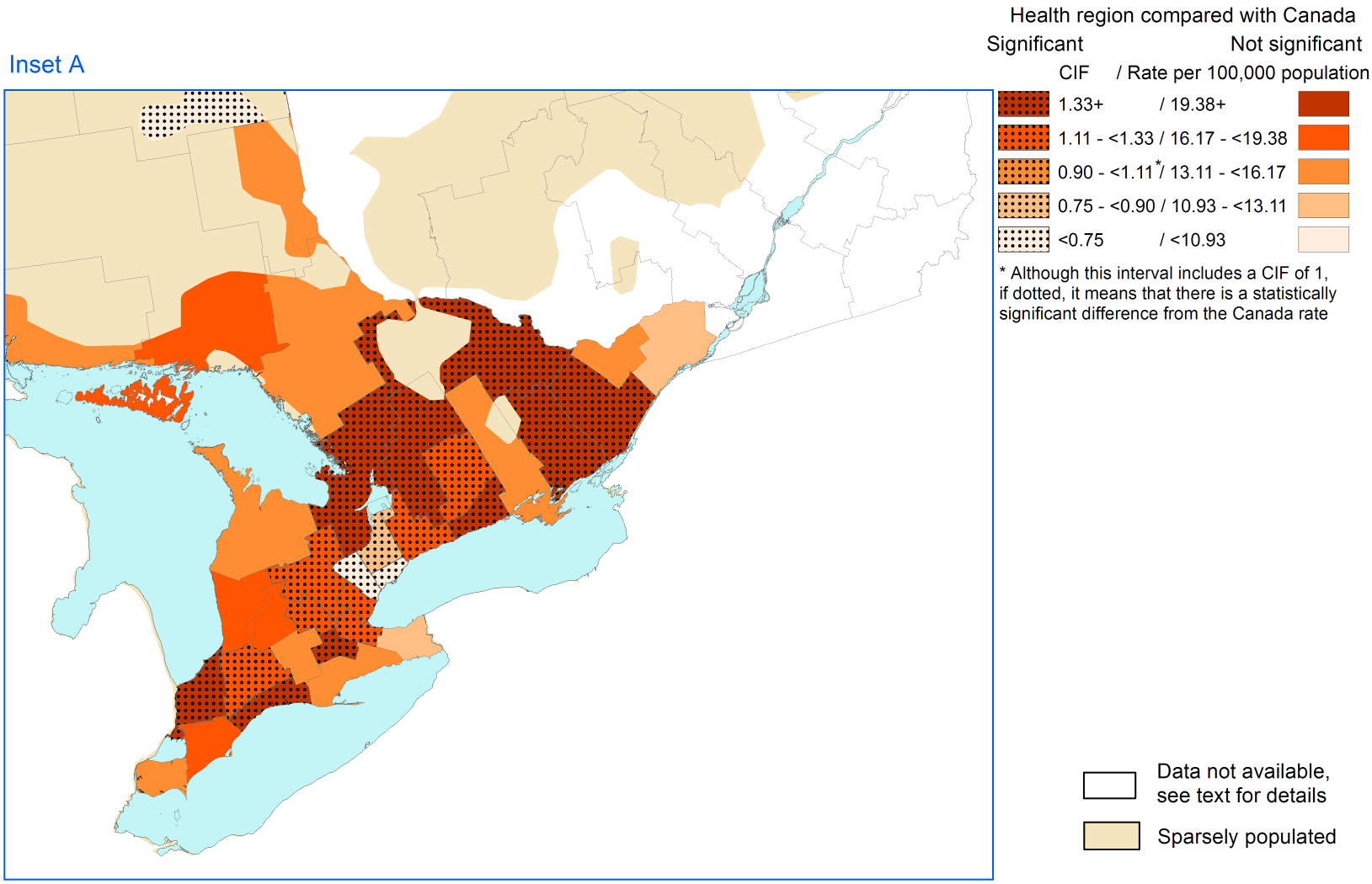


Data source: Canadian Cancer Registry database at Statistics Canada

Map 17. Melanoma of the skin, males, 2000-2006, all ages

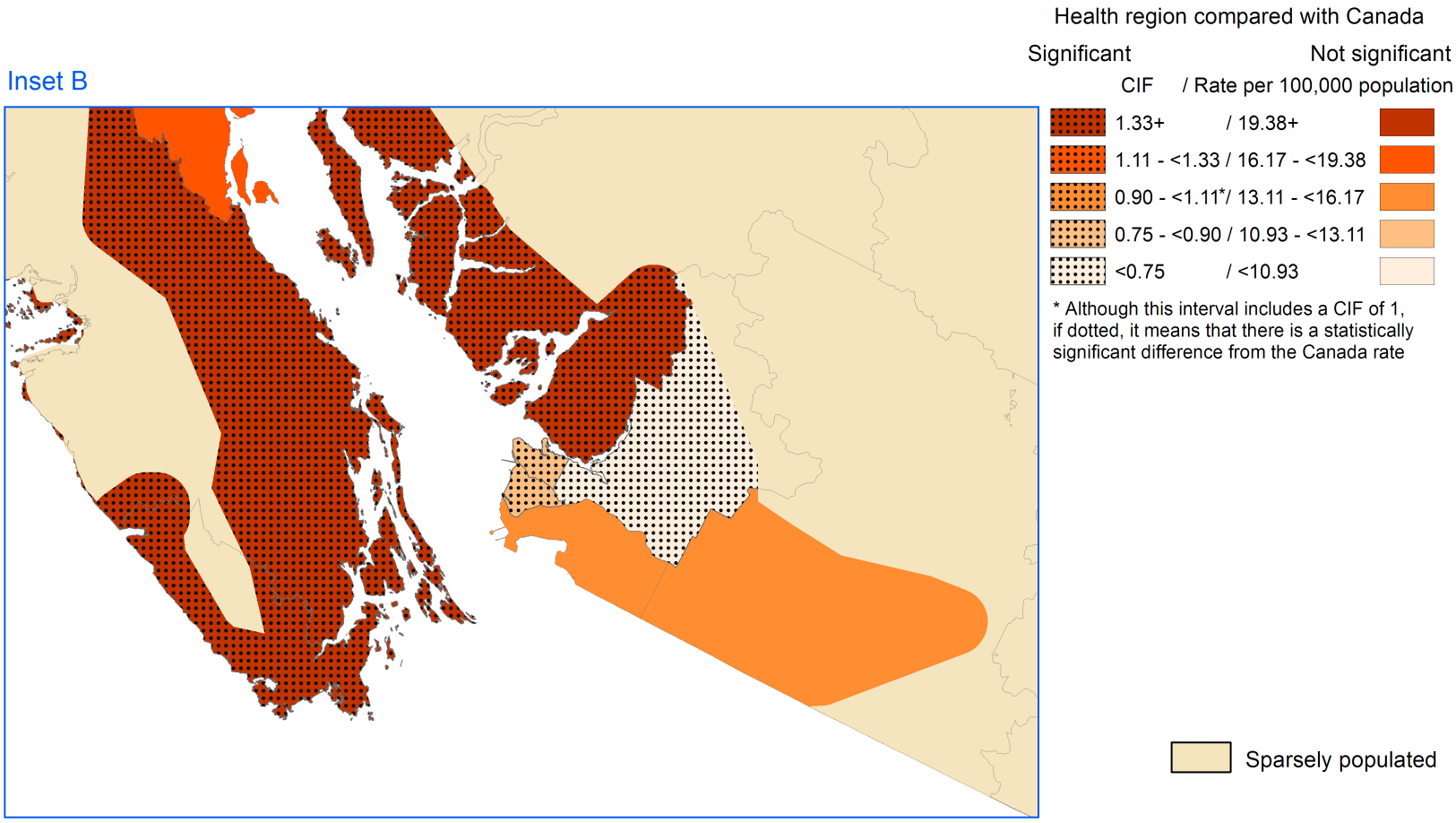


Map 17-A. Melanoma of the skin, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 17-B. Melanoma of the skin, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Female breast (ICDO-3 C50, Map 18)

One in every 9 Canadian women develops breast cancer in her lifetime, based on current rates. In 2006, there were over 20,600 new cases.[27] These statistics exclude *in situ* breast cancer cases. Incidence rates have been relatively stable since the early 1990s, with evidence of a recent decline of about 1% per year from 1999 to 2006. By ages 30-34, breast cancer is the most common cancer among women. The age-specific incidence rates rise to a plateau for women aged 65-69 or greater.[27] The 5-year relative survival has improved to 87% for the period 2002-2004.[29]

Carcinomas of the breast are ordinarily divided into ductal and lobular histologies. The former account for 65-80% of cases and the latter, for 5-10% of cases; other types, including medullary, adenoid cystic, mucinous and tubular, make up the remainder. Breast cancers are also classified by estrogen receptor and progesterone receptor status, human epidermal growth factor type 2 receptor (HER2/neu) overexpression, stage and nuclear grade.

Screening mammography for breast cancer is available across the country. Early detection of breast cancer through screening programs can improve quality of life and reduce the risk of death from breast cancer.[78,79] For ages 50 to 69, screening has been shown to reduce mortality.

Equivocal evidence is found with screening in younger women. It should be noted that a significant fraction (15-30%) of screen-detected cancers of the breast are indolent and quite likely would not have become clinically apparent in the absence of screening. This "over-diagnosis" could well distort spatial patterns if there is sufficient spatial variation in screening activity.[80,81]

Geographic Variation

There was a relatively uniform distribution of the incidence of breast cancer among women across the country. Significantly lower incidence rates for cancer of the breast were observed in Newfoundland and Labrador, New Brunswick, Saskatchewan and British Columbia. Significantly elevated rates were observed in Quebec, but the increase in the age-standardized rate compared with Canada was small, at 4%.

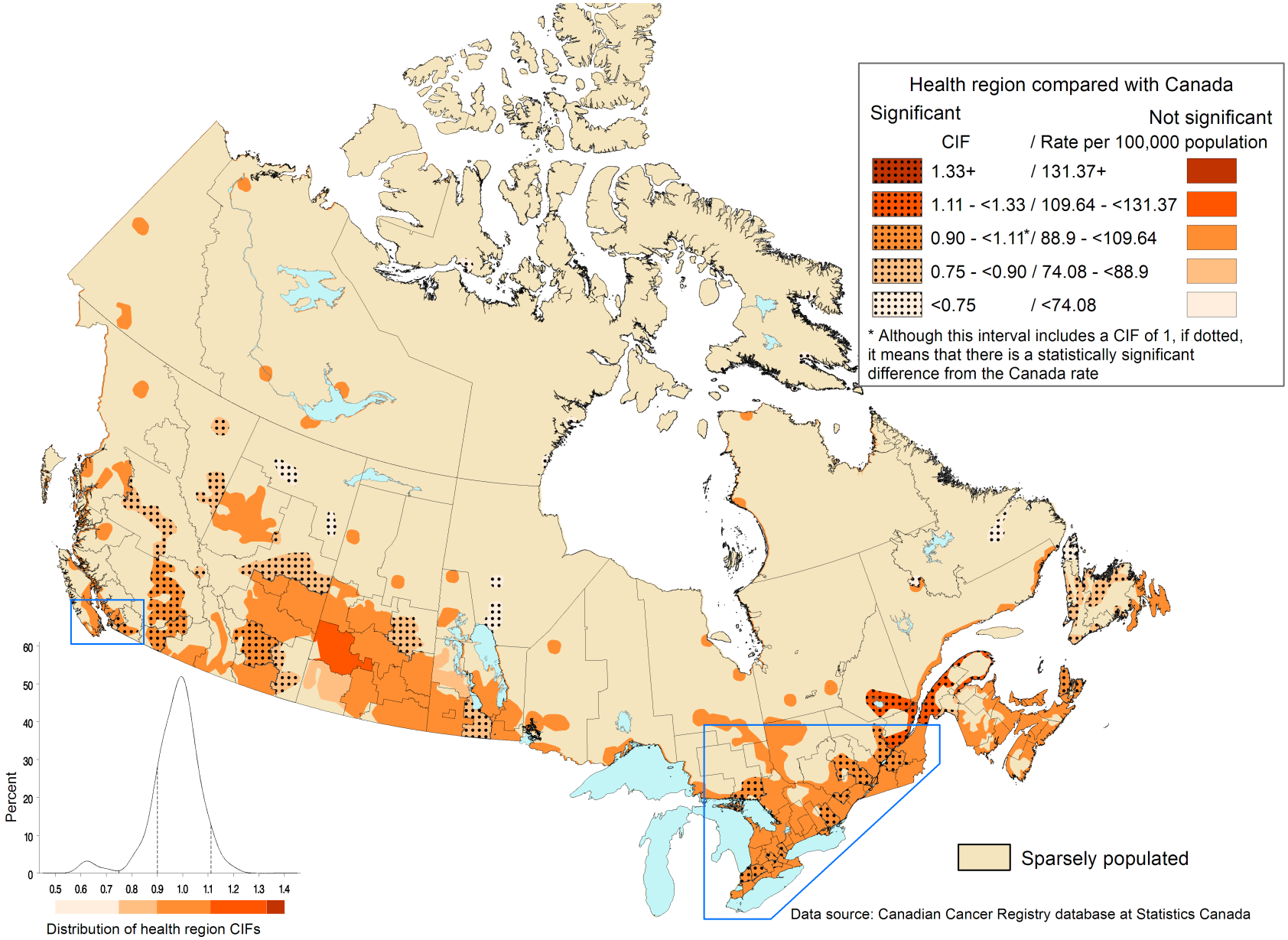
Significantly lower incidence rates were found in Burntwood/Churchill Regional Health Authority and in health regions of southern British Columbia. Significantly elevated incidence rates were found in a small number of health regions in the lower St. Lawrence region of Quebec, southwestern Quebec, eastern Ontario and southwestern Ontario.

Known and Suspected Risk Factors

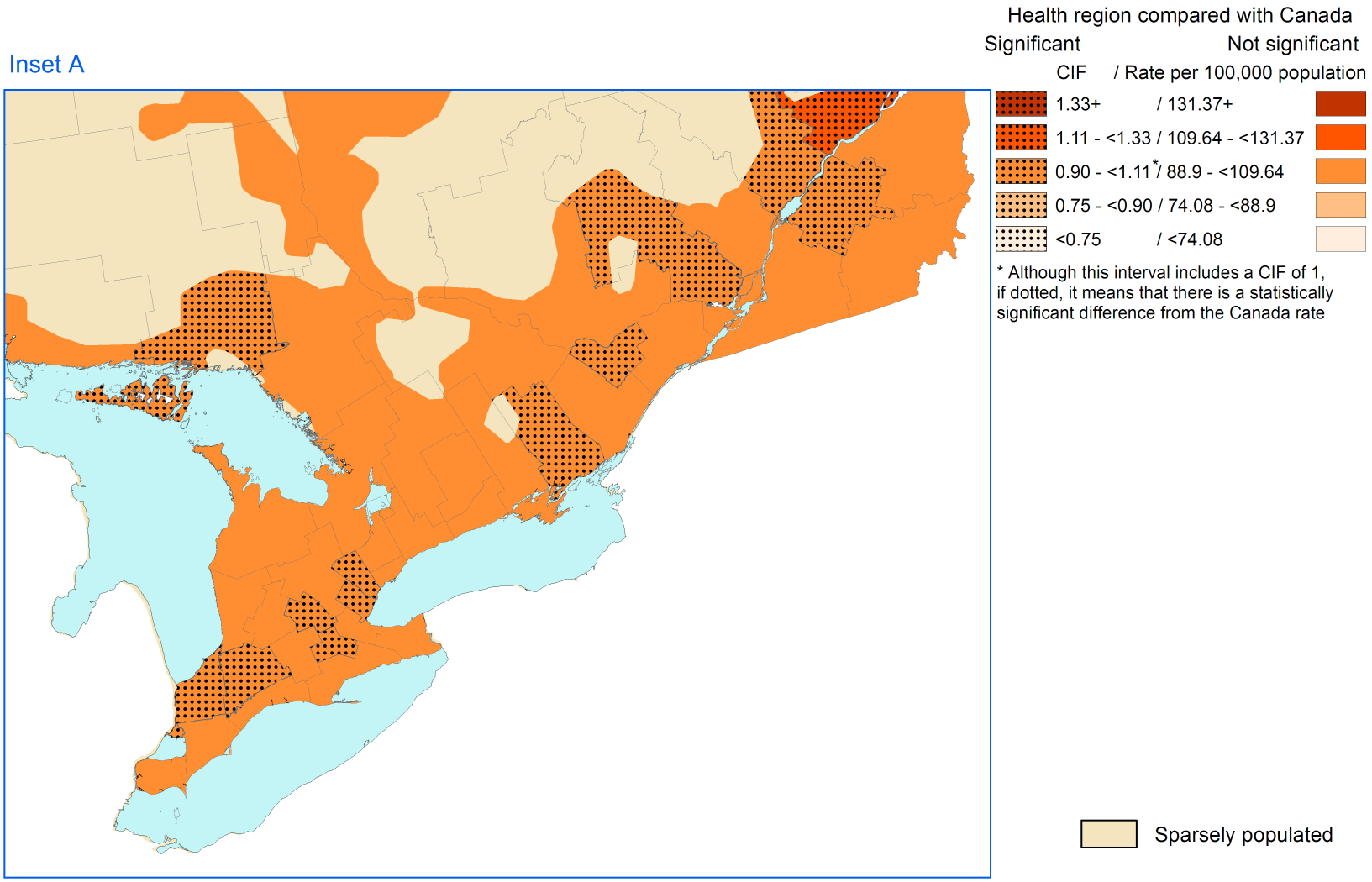
There is considerable evidence that the major risk factors for breast cancer are largely related to reproductive hormones. Women with early menarche, those with late menopause and women who have never been pregnant have increased risks.[82] A woman who has a late first pregnancy has a higher risk for breast cancer than a woman who has never had a full-term pregnancy. Oral contraceptives, especially when taken in the early teenage years, may modestly increase the incidence for breast cancer.[83] Hormone replacement therapy may slightly raise the risk for breast cancer, though this depends on duration and marginally on formulation.[84]

Tamoxifen treatment reduces the incidence of breast cancer, but the benefit is partly offset by increased risks of thromboembolic events and endometrial cancer.[85] Exercising strenuously for more than 4 hours per week is associated with reduced breast cancer risk of up to 40%.[86] Family history is also a risk factor. Mutations in the autosomal dominant BRCA1 and BRCA2 genes increase the lifetime risk to 40-85%[32] and account for less than 10% of breast cancer cases.[87,88] Premenopausal obesity is probably protective, whereas the opposite is true among postmenopausal women and obesity increases their risk of breast cancer.[32,37,89,90] There is a linear increase in risk for breast cancer with increased alcoholic beverage consumption.[41]

Map 18. Female breast, 2000-2006, all ages

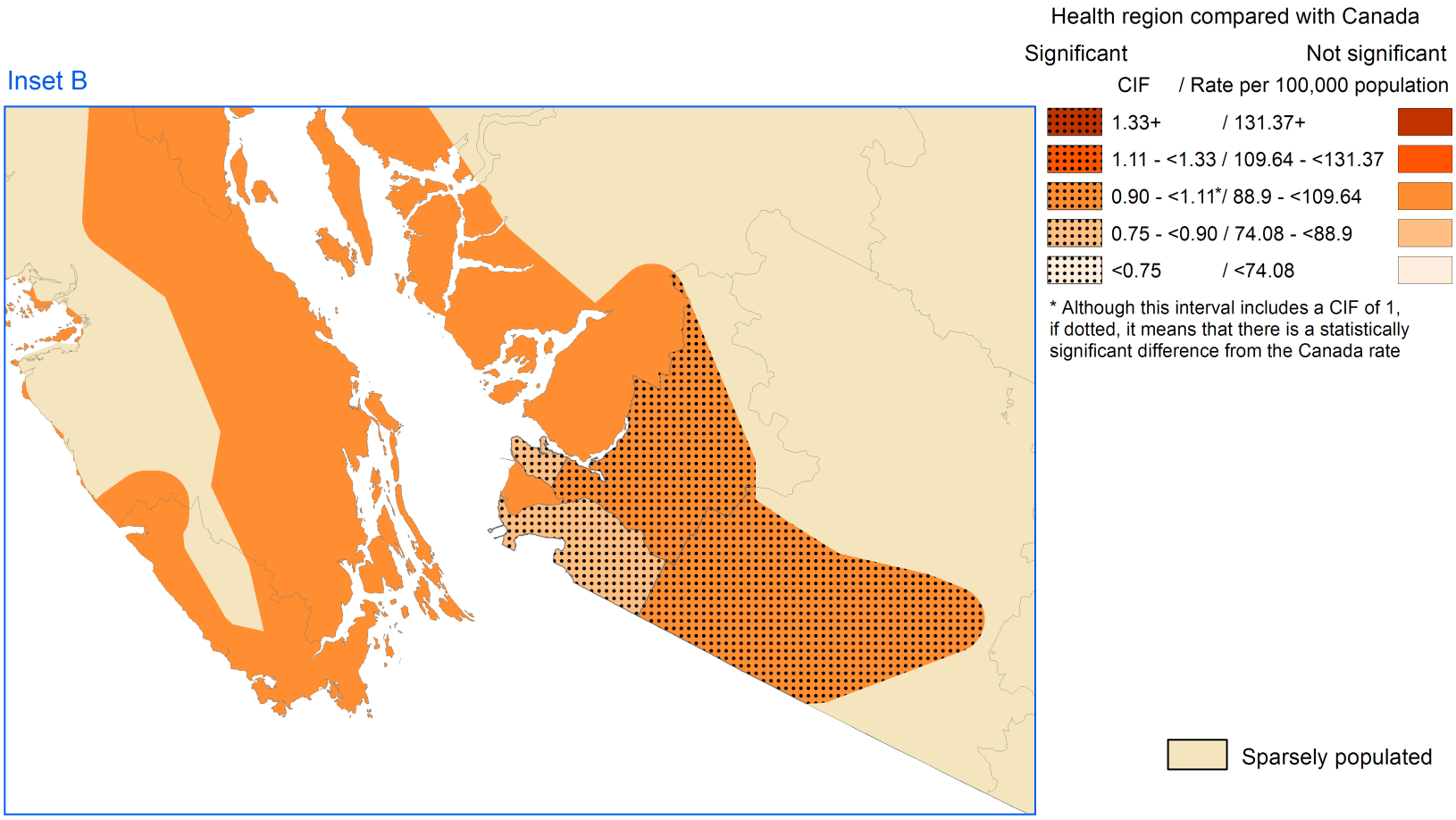


Map 18-A. Female breast, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 18-B. Female breast, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Cervix uteri (ICDO-3 C53, Map 19)

Due in large part to early detection of pre-malignant and malignant lesions by screening with Papanicolaou (Pap) tests, the incidence rates of cervical cancer have declined substantially; the annual percentage change for 1997-2006 was a decline of 1.8%,[28] with 1,332 cases in 2006.[27] The age-at-incidence curve rises steeply from puberty to age 40, after which it plateaus.[27] The relative 5-year survival rate for the period 2002-2004 was 75%.[29]

There are 2 major histological subtypes of cervical cancer. Squamous cell carcinoma (SCC) accounts for 80-85% of the cases, while adenocarcinoma (AC) is less common, accounting for approximately 10-15% of the cases. The last 30 years have been marked by changing trends as the incidence of SCC has decreased and stabilized, whereas the incidence of AC has been increasing.[32,33,55,91]

Geographic Variation

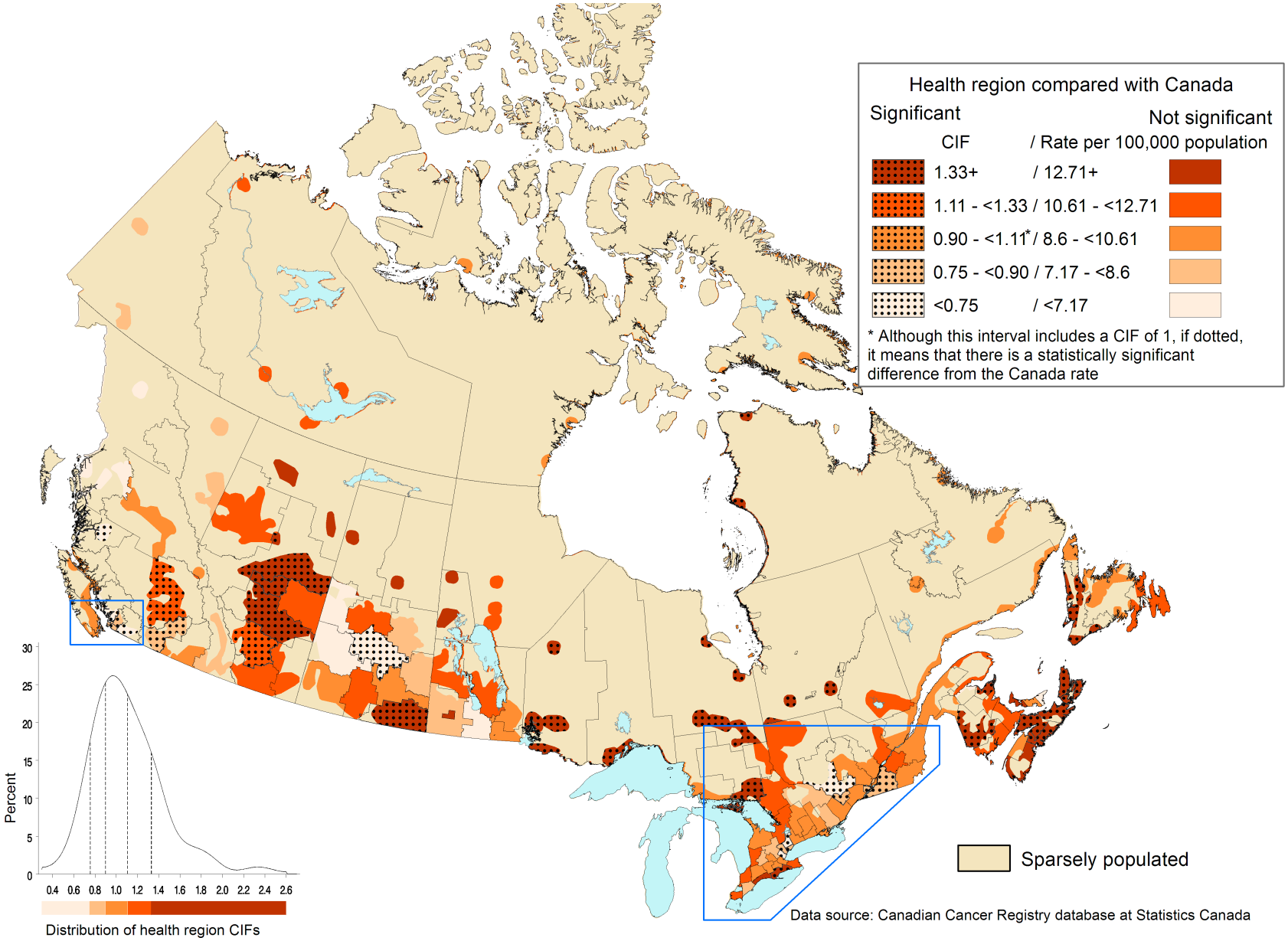
At the provincial/territorial level, significantly lower incidence rates for cancer of the cervix were observed for Quebec and British Columbia. Significantly elevated rates were observed in Newfoundland and Labrador, Nova Scotia, New Brunswick and Alberta.

The health regions for Montreal, Ottawa-Gatineau and Toronto as well as a number of surrounding health regions recorded significantly low rates of cancer of the cervix, while rates were significantly elevated in 4 of 6 health regions in Nova Scotia and in the northern regions of provinces from Quebec to Alberta.

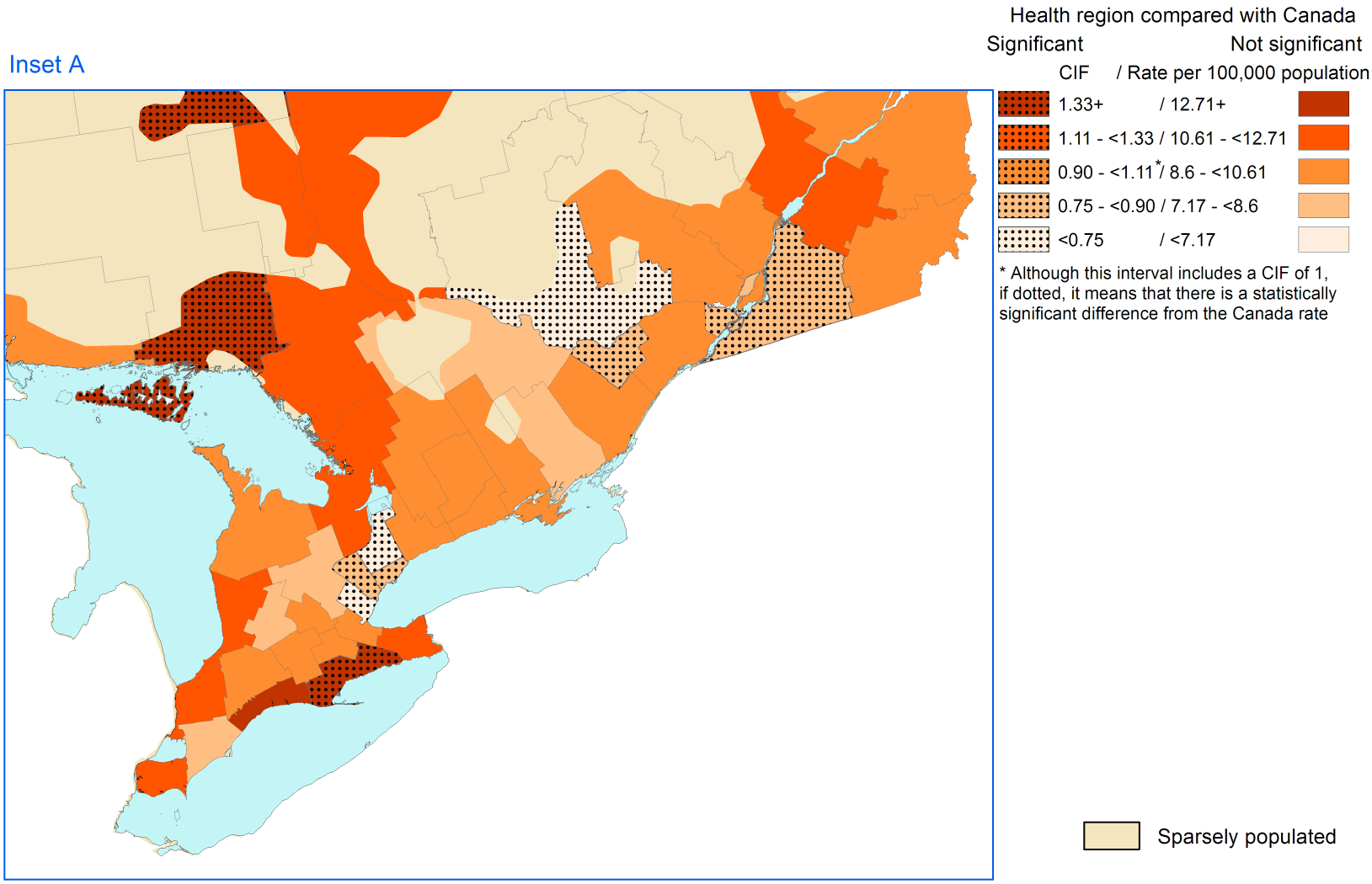
Known and Suspected Risk Factors

Infection with human papillomavirus (HPV) plays the strongest etiologic role in the development of cervical neoplasia. HPV DNA has been identified in more than 99% of cervical carcinomas.[37] HPV types 18 and 16 have been identified as human carcinogens that jointly cause greater than 70% of all cervical carcinomas.[92,93] The overall prevalence of high- and low-risk HPV types was estimated among women in the United States aged 14 to 59 as 15.2% and 17.8%, respectively.[94] HPV DNA point prevalence will most certainly underestimate cumulative incidence of infection because many infections clear up. A vaccine has been shown to prevent infection with HPV-16 and HPV-18, the types that cause most cervical cancers. Smoking, in conjunction with HPV-16, functions synergistically in the development of cervical cancer.[95] Overall, the risk of developing cervical cancer that is attributable to cigarette smoking is generally 2-fold and increases with duration and intensity.[32]

Map 19. Cervix uteri, females, 2000-2006, all ages

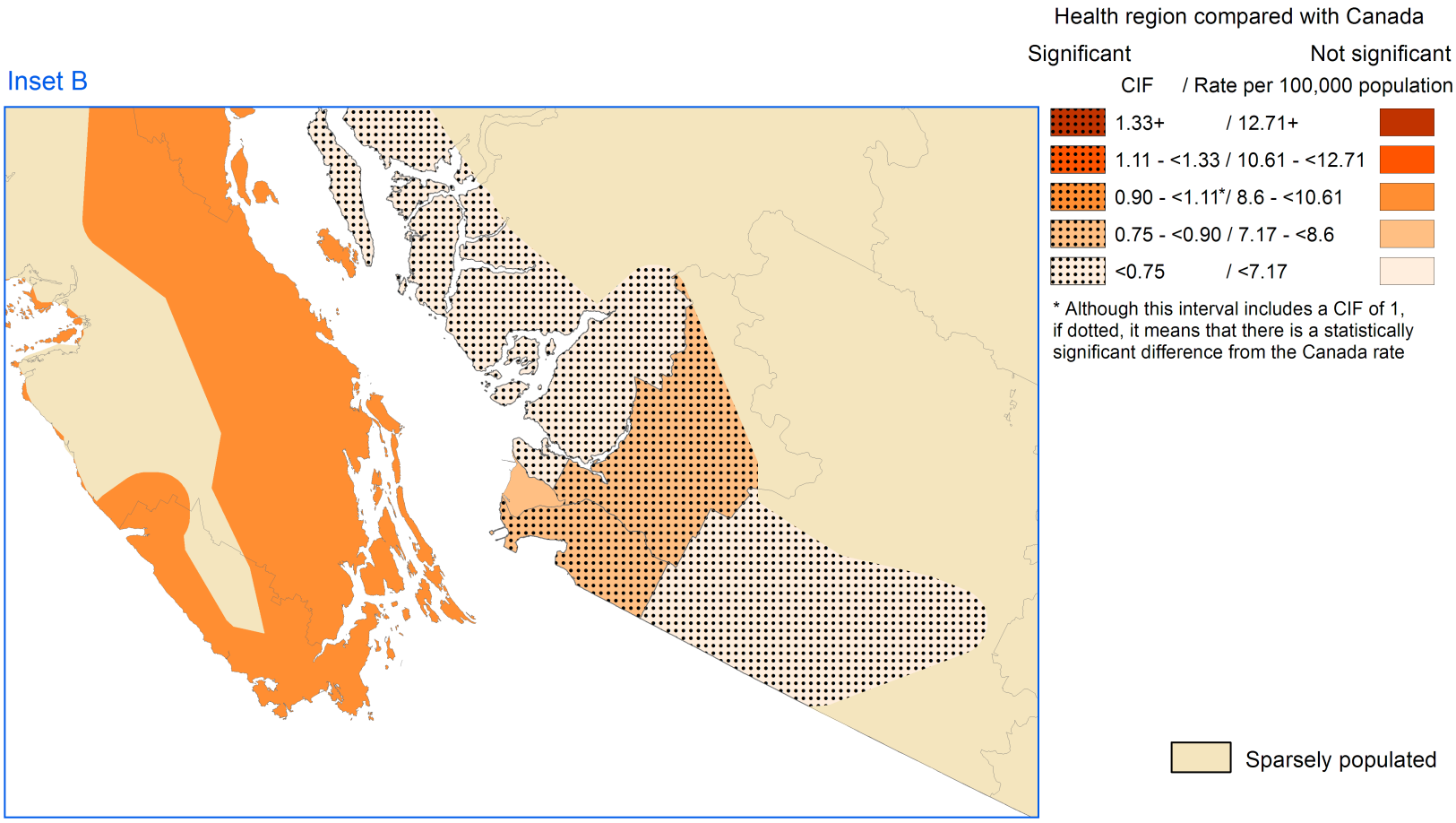


Map 19-A. Cervix uteri, females, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 19-B. Cervix uteri, females, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Uterus excluding cervix (ICDO-3 C54-C55, Map 20)

Uterine cancer, or endometrial cancer, most of which arises in the body of the uterus, is the most common gynecological malignancy and was responsible for 4,242 cases in 2006.[27] The age-standardized incidence rate has gradually risen slightly over the last decade, with an annual percentage change of 0.4%.[28] Incidence of uterine cancer is rare before age 30, and the rate peaks between ages 65 and 69. About 2% of the cases occur in women below age 40, and approximately 48% occur among those aged 60-79.[27] Of all gynecological cancers, it has the highest overall 5-year relative survival rate, at 85% for the period 2002-2004 (excludes uterus unspecified).[29] Most cancers in the group are adenocarcinomas of the endometrium (lining of the uterus), while a small percentage of the cases (less than 5%) are sarcomas of the myometrium (thick, middle muscular layer).

Geographic Variation

Provinces/territories with significantly low rates for cancer of the uterus excluding cervix included Newfoundland and Labrador, Quebec, British Columbia and the Northwest Territories. Provinces with significantly higher rates included Manitoba and Alberta.

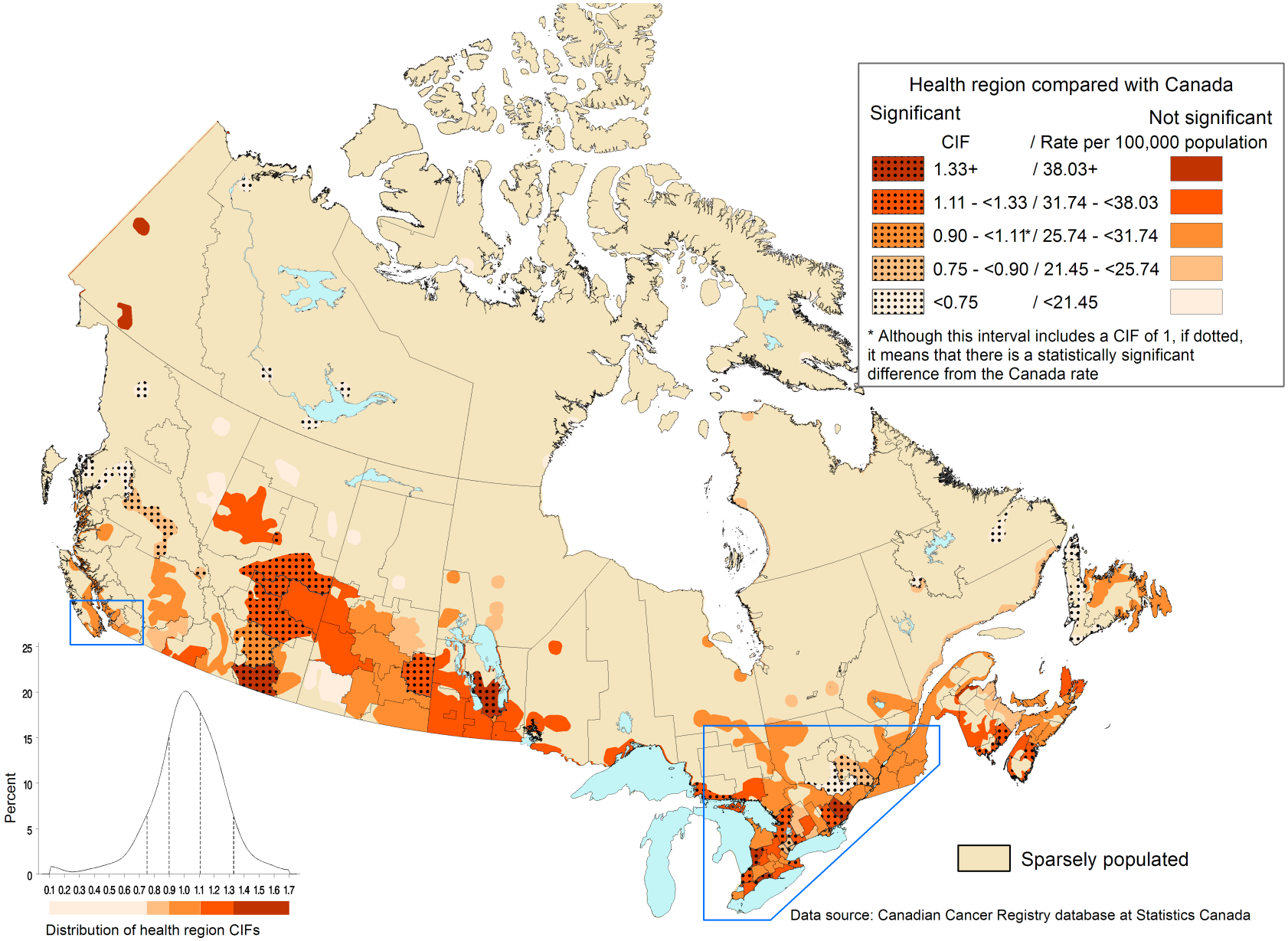
Rates were significantly low for the City of Toronto Health Unit as well as for Peel Regional and York Regional health units. High rates of cancer of the uterus excluding cervix were found in 9 Ontario health regions and in 5 Alberta health regions.

Known and Suspected Risk Factors

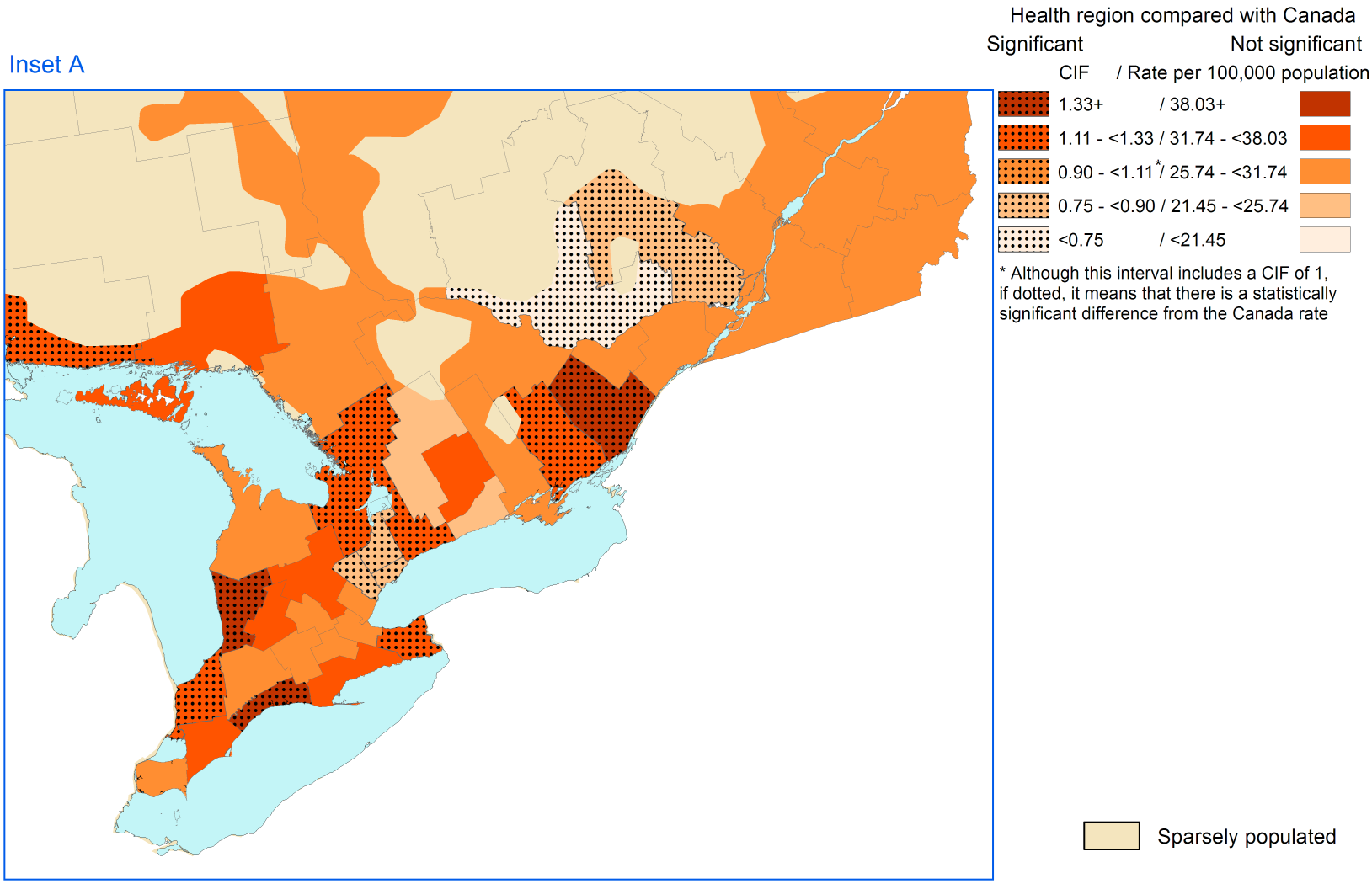
Chronic estrogen exposure unopposed by progesterone, be it endogenous or exogenous, is known to increase the risk of hyperplasia, an abnormal increase in the number of normal cells. Related factors include low parity or nulliparity, early menarche, late menopause and extended periods of absence of ovulation (commonly seen in polycystic ovarian syndrome).[32,55,96,97]

Excess weight is known to be a significant risk factor and is estimated to account for close to half of all cases of endometrial cancer in Europe and the United States.[97,98] A meta-analysis has reported a relative risk for endometrial cancer of 1.59 for a 5 kg/m^2 increase in BMI.[98] It is believed that obesity facilitates reactions in the adipose tissue, increasing the levels of estrogen.[97]

Map 20. Uterus excluding cervix, females, 2000-2006, all ages

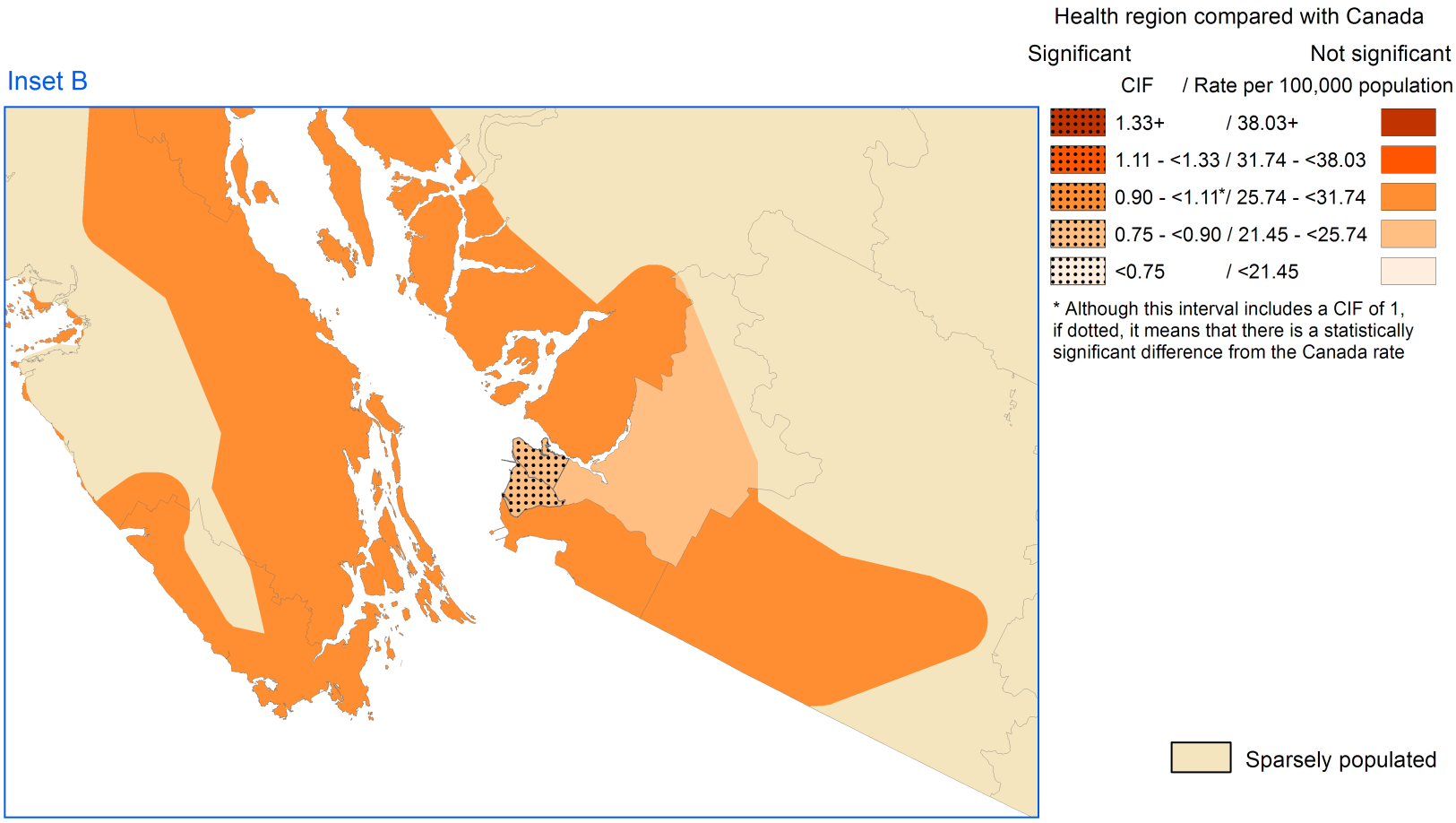


Map 20-A. Uterus excluding cervix, females, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 20-B. Uterus excluding cervix, females, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Ovary (ICDO-3 C56, Map 21)

Ovarian cancer is the leading form of gynecological cancer death and was responsible for 1,569 deaths and 2,410 new cases in 2006.[27,34] Both incidence and mortality rates have been relatively stable over the most recent decade. Incidence rates are low among adolescents and young adults below age 35, and then increase to a plateau at ages 75 or more.[27] Approximately three-quarters of the cases occur in postmenopausal women (aged 52 and above). The 5-year relative survival rate is low, at 40% for the period 2002-2004.[29]

Three types of ovarian cancer predominate: epithelial tumours, germ cell tumours and sex cord-stromal tumours. The epithelial type accounts for 85-90% of all malignant cases, which generally occur in women aged 40 and over, and arise from the surface epithelium of the ovary.[32,37]

Geographic Variation

Significantly lower incidence rates for cancer of the ovary were observed in 3 eastern provinces (Newfoundland and Labrador, Prince Edward Island and Nova Scotia) and 3 western provinces (Saskatchewan, Alberta and British Columbia). Significantly elevated rates were observed in Ontario, with the ratio of the Ontario rate to the Canada rate at 1.06, making it 6% higher than the national rate.

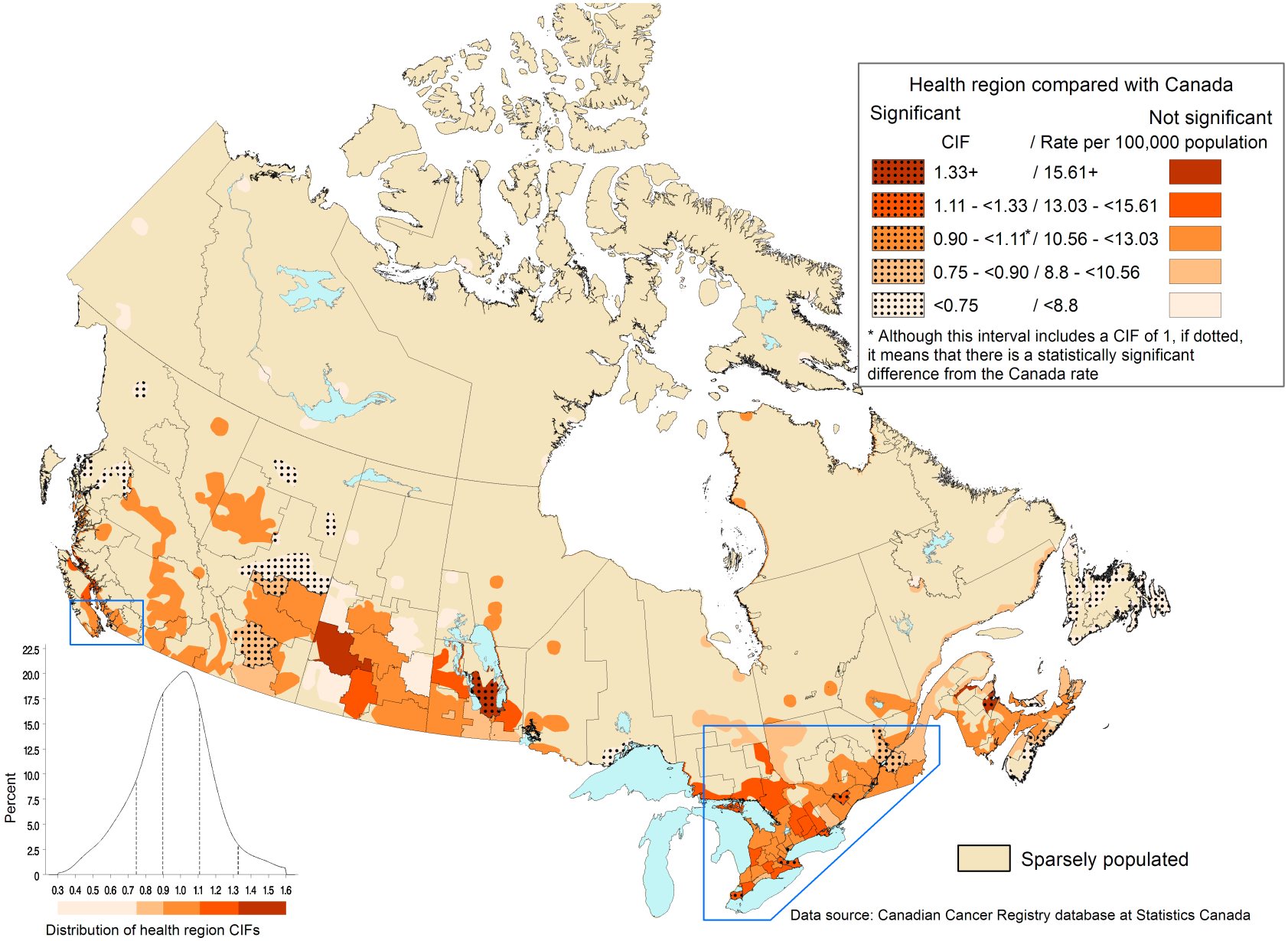
Low rates were observed in Newfoundland and Labrador and in northern health regions of Alberta and British Columbia, as well as in Yukon, the Northwest Territories and Nunavut. Rates of ovarian cancer were significantly above the national average in 5 dispersed health regions in southern Ontario. The map of smoothed standardized incidence ratios enlarged the area of elevated rates in south-central Ontario.

Known and Suspected Risk Factors

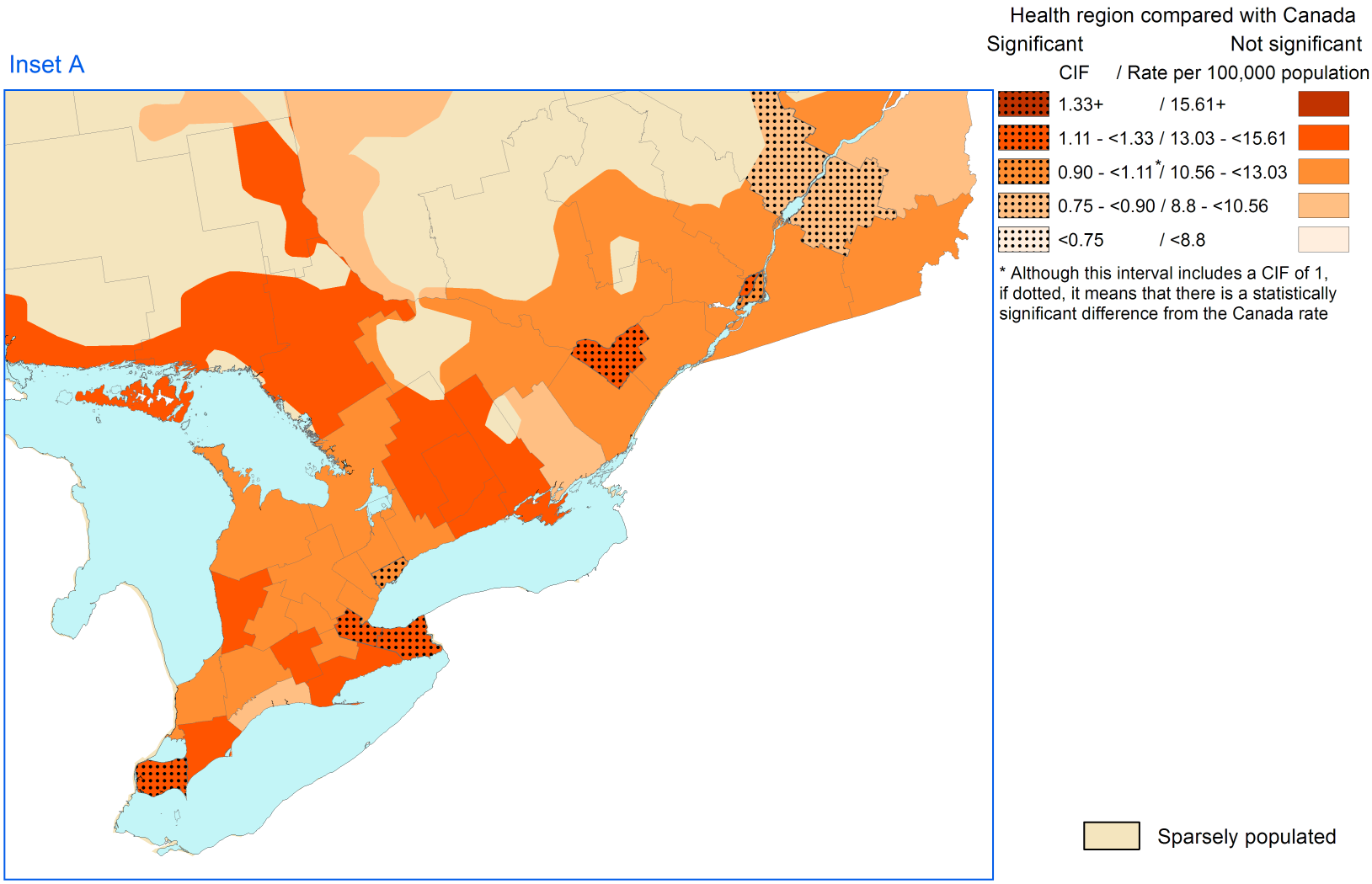
Established risk factors for epithelial ovarian cancer are reproductive and genetic in nature.[99] Uninterrupted and prolonged ovulary cycles can significantly increase the risk of ovarian cancers, as demonstrated in the increased incidence of ovarian cancer among nuns, single women and women who have never been pregnant. Protective effects have been observed for oral contraceptive use and increases in the number of births.[32,100] Oral contraceptive use for just 1 year decreased the risk of ovarian cancer by 15% – a value that increases to 38% with 6 years or more of use.[100] A single pregnancy significantly reduces the risk for ovarian cancer, with a risk ratio of 0.4 to 0.7, and there is a further reduction in the odds of ovarian cancer of about 12% for each additional birth.[55,101] As body mass index increases, the risk of ovarian cancer increases; however, this effect is modest.[102]

A family history of ovarian or breast cancer is also a risk factor. Studies indicate a hereditary basis for about 5-10% of cases; however, the risk changes and is 4-fold in women who have a first-degree relative with the disease.[37,69,103] Different authors associate between 60% and 90% of these hereditary cases with the breast-ovarian cancer syndrome with mutations in the BRCA1 and BRCA2 genes.[37,55,103] Those women with mutations in BRCA1-associated cancers are believed to have a 16-63% lifetime risk and an average age of diagnosis of 48.[37,55] The lifetime risk for those with BRCA2-associated cancers is 10-35%, and an average age at diagnosis is 61.[37,55] Hereditary nonpolyposis colorectal cancer syndrome, or Lynch Type II syndrome, is also a known risk factor, accounting for approximately 5% of all hereditary ovarian cancer cases.[55]

Map 21. Ovary, females, 2000-2006, all ages

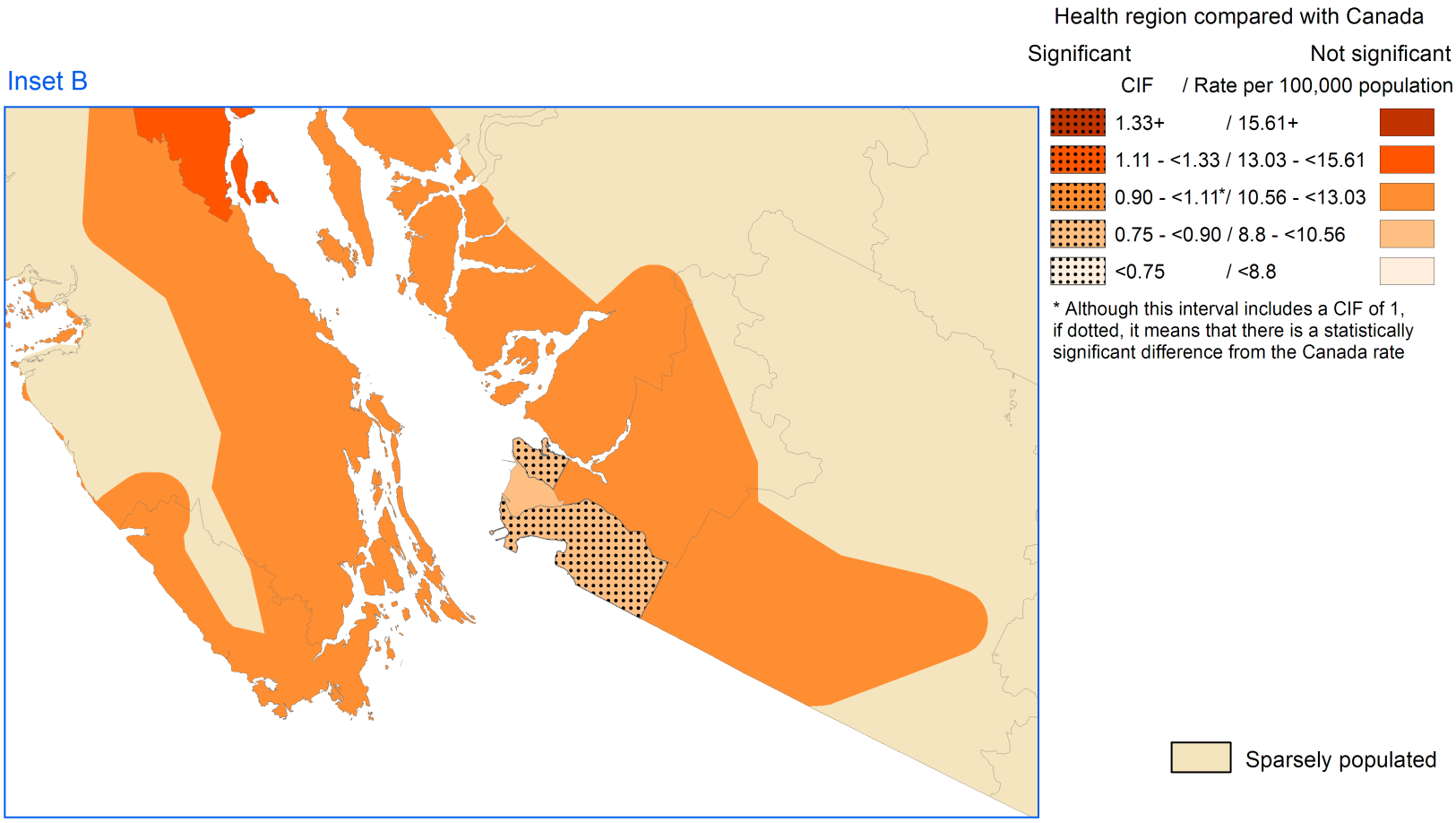


Map 21-A. Ovary, females, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 21-B. Ovary, females, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Prostate (ICDO-3 C61, Map 22)

The clinical presentation and progression of prostate cancer can vary greatly. Patients with prostate cancer may receive prognoses of short life expectancies, or the disease may have no effect on either their longevity or their quality of life. Prostate cancer is the most frequently diagnosed cancer in Canadian men. In 2006, 22,610 new cases were reported.[27] Incidence is rare below age 40, but rates then increase so that about 36% of cases occur by the age of 65.[27] The risk for developing prostate cancer increases with age more than any other major cancer. Currently, 1 in 7 Canadian men will develop the disease in their lifetime, and 1 in 26 will die of it.[29]

Peaks in incidence rates of prostate cancer occurred in 1993 and 2001, probably due to increased screening. Since 2001, incidence rates have been stable. In contrast, mortality rates have decreased significantly in the last decade. Since 1992-1994, the 5-year relative survival rate increased by about 7 percentage points to reach 95% for the period 2002-2004.[29]

Geographic Variation

All provinces reported statistically significant rates, either low or high. Low rates were reported in Newfoundland and Labrador, Quebec, Manitoba, British Columbia and Nunavut, while high rates were reported in Prince Edward Island, Nova Scotia, New Brunswick, Ontario, Saskatchewan and Alberta. Incidence rates would be expected to be higher in places that have more screening for prostate cancer with the prostate-specific antigen (PSA) test. Nevertheless, published rates of provincial/territorial PSA screening rates from the Canadian Community Health Survey for 2000 and 2003 do not indicate an obvious relationship with cancer incidence rates for 2000-2006.[104,105] Low rates in Quebec are probably a result of the registry relying on hospitalization data and the resulting incomplete inclusion of all individuals with prostate cancer in the cancer registry.

Significantly low rates were observed in all Quebec health regions. Elevated rates for prostate cancer occurred in southern Saskatchewan, southern Alberta and southwestern Ontario.

Known and Suspected Risk Factors

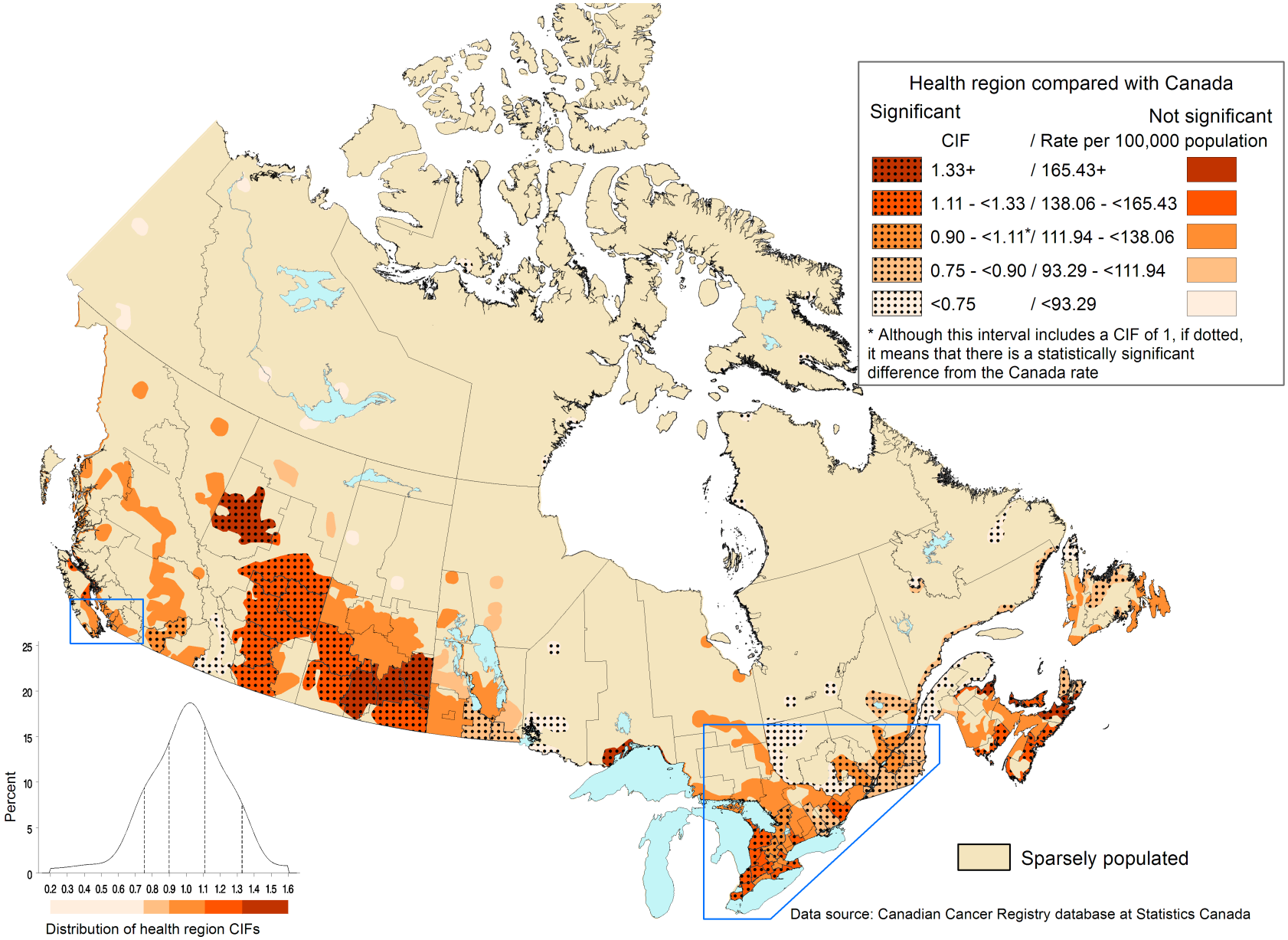
The causes of prostate cancer are largely unknown. The risk for prostate cancer increases among men as they age, but many of these cancers are slow-growing and don't cause a problem. As early as their 20s, 10% of men show evidence of non-clinical prostate carcinoma.[106] However, the change from virtual non-existence to pathogenesis decades later remains a mystery. By the age of 80, as many as 60-70% of men show histologic evidence of carcinoma of the prostate.[32]

Other well-established risk factors include race and family history. It is known that African American men have an age-adjusted incidence rate 1.6-fold higher than Caucasian Americans, who in turn have an incidence rate of about 1.6-fold that of Asian Americans. A genetic component that functions in a Mendelian fashion is also implicated, and 6 potential susceptibility loci have been identified.[107] In addition, an increased risk for prostate cancer is seen for males having a relative with the disease, and the risk increases if the relative is a first-degree relative. Studies generally indicate that family history may account for 5-10% of all prostate cancers.[108]

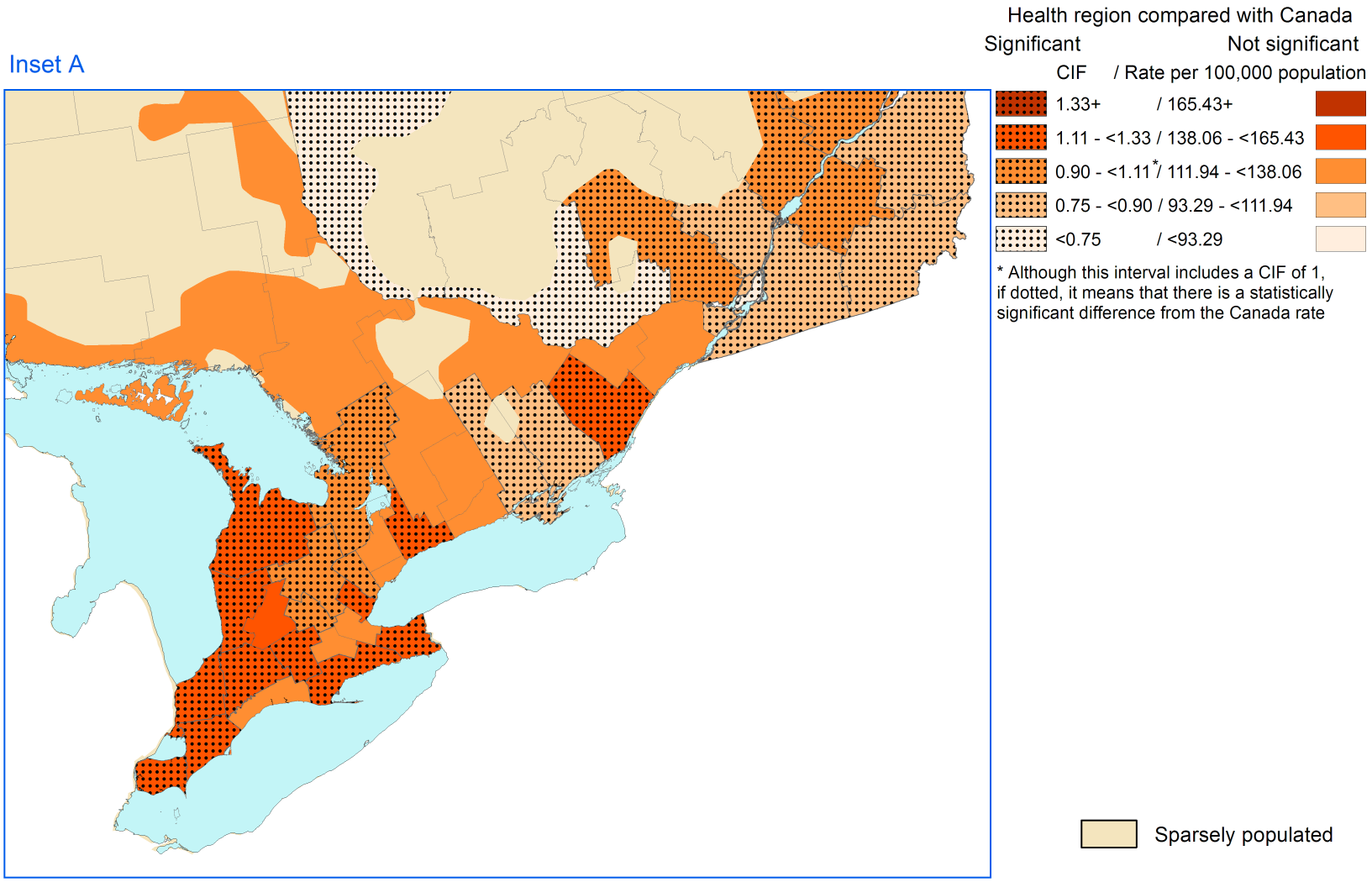
Dietary factors have also been suggested as a risk factor, but evidence to date is limited.[41] This conjecture is given more credence by the fact that Americans of Japanese origin, whose native country has a lower incidence of prostate cancer and a pattern of low-fat diets, reported incidence rates higher than men in Japan.[109]

This result is largely attributed to the Western lifestyle and diet, since Western diets are generally higher in caloric intake and substantially greater in fat content. Certain studies have rejected the influence of caloric intake alone; however, fats, particularly saturated fats, were highly correlated with increased risk. Intake of total meat, red meat and animal fat were also implicated as risk factors, as was the possibility of alpha-linolenic acid.[32,107]

Map 22. Prostate, males, 2000-2006, all ages

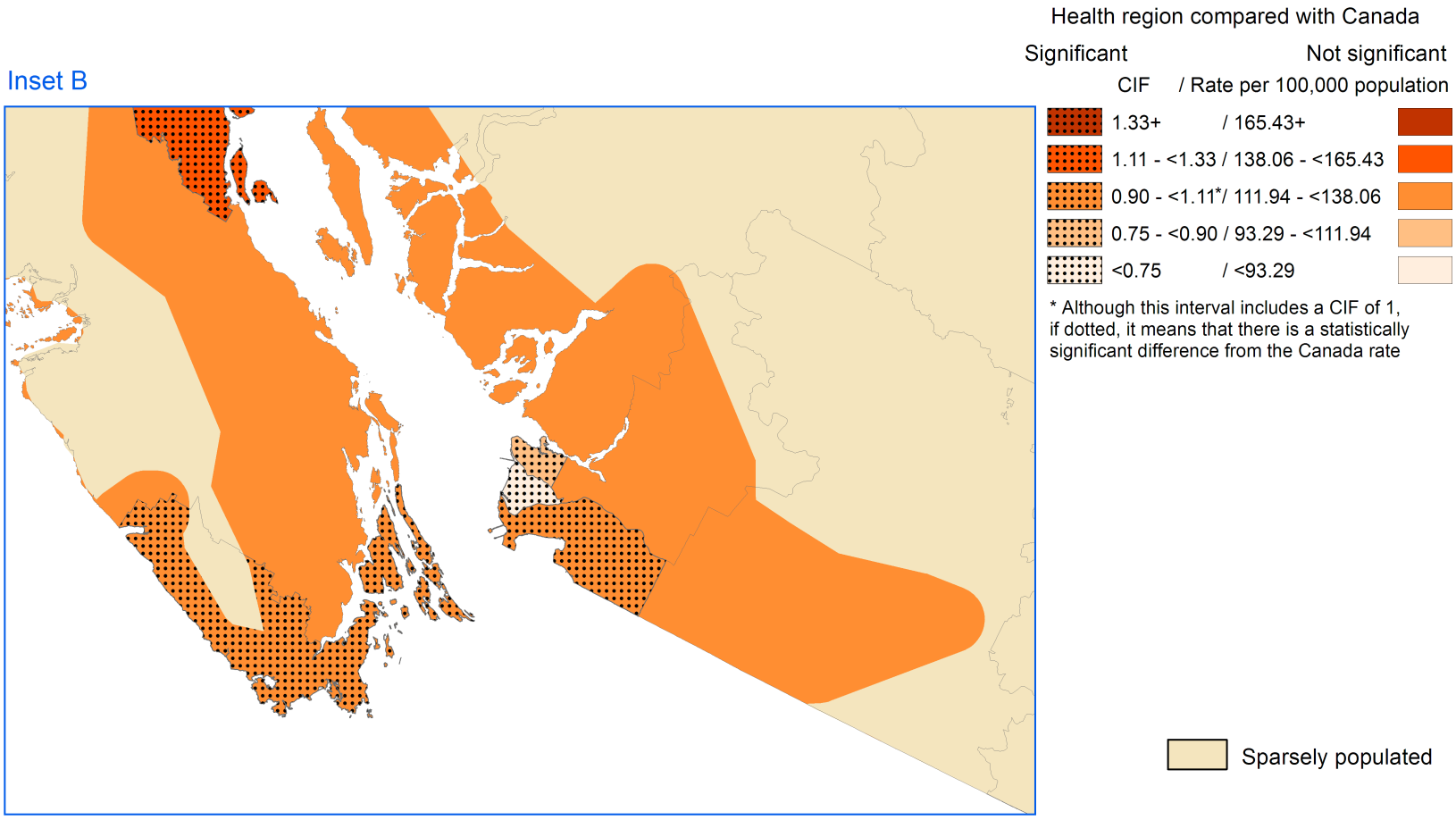


Map 22-A. Prostate, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 22-B. Prostate, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Testis (ICDO-3 C62, Map 23)

With 845 cases in 2006, testicular cancer represented 1.0% of the cancers in males.[27] It occurs predominantly among young and middle-aged men. Typically manifesting as early as age 15, it is the leading cause of cancer in males aged between 15-39. The age-standardized incidence rate (ASIR) increases relatively rapidly beginning between ages 15 and 19 and peaks between ages 25 and 34; thereafter, the rate gradually declines. By age 55-59, the cancer becomes rare.[27] A high 5-year relative survival rate of 96% was reported for the period 2002-2004.[29] The all-age incidence rate of testicular cancer in Canada has increased by about 80% in the last quarter of the 20th century, and the ASIR continues to rise, albeit marginally so in recent years.[29,110]

The vast majority (95%) of all testicular neoplasms arise in the germ cells of the testes, referred to as germ cell tumours (GCTs); the remaining cases arise in the sex cord-stromal tissue.[32,33] Two main cell types of testicular cancer are seminomas, which are more sensitive to radiation, and nonseminomas.

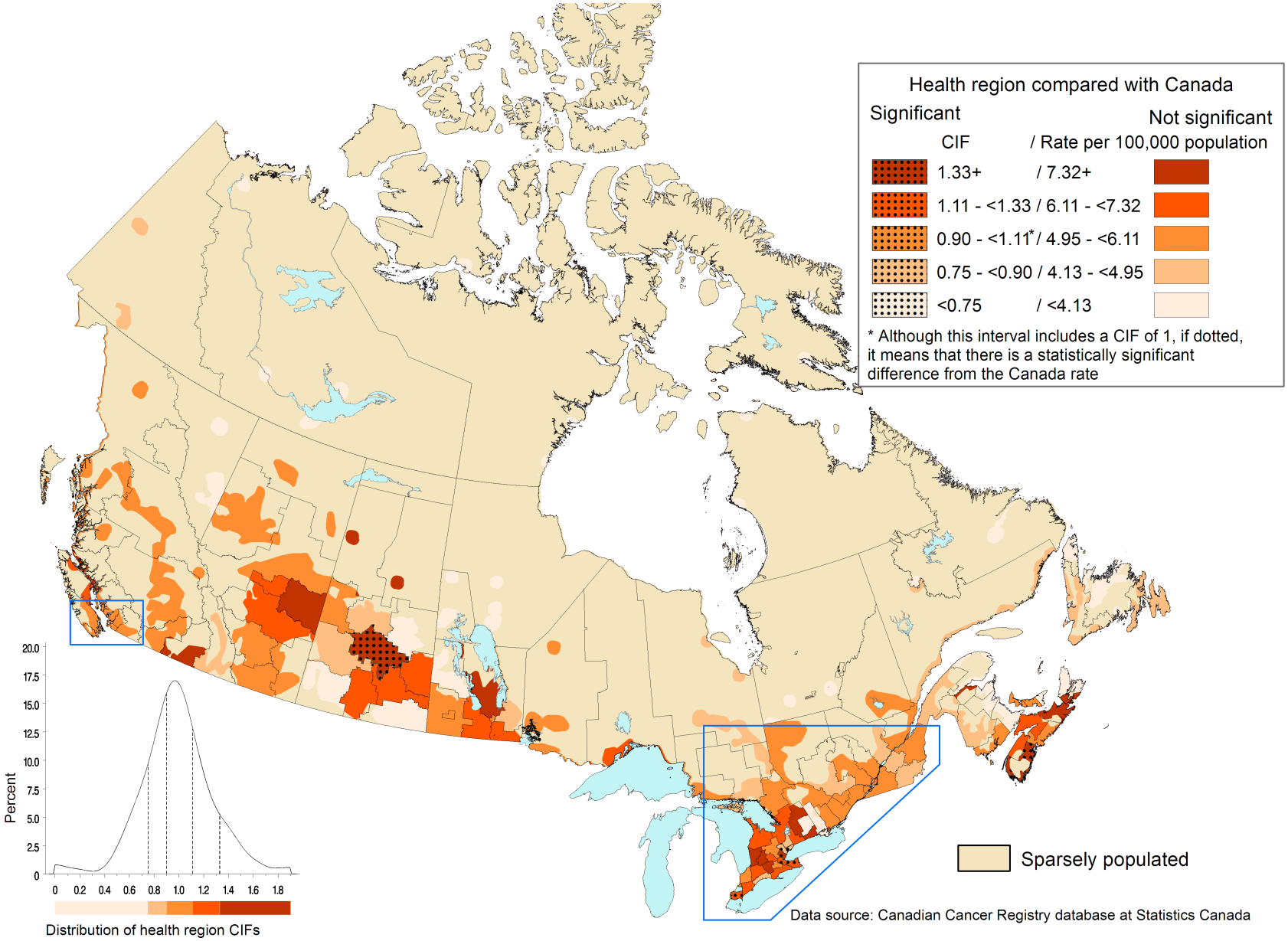
Geographic Variation

At the provincial/territorial level, significantly low rates for cancer of the testis were observed in Newfoundland and Labrador, New Brunswick and Quebec, while high rates were observed in Alberta. Low rates were observed in dispersed health regions in southern Quebec and southern Ontario, but significantly low rates were seen only in the City of Toronto Health Unit and Peel Regional Health Unit. Significantly elevated rates were observed in 3 health regions along the western shores of Lake Ontario and for 1 health region in southwestern Ontario. The map of smoothed standardized incidence ratios shows an area of elevated rates in southwestern Ontario.

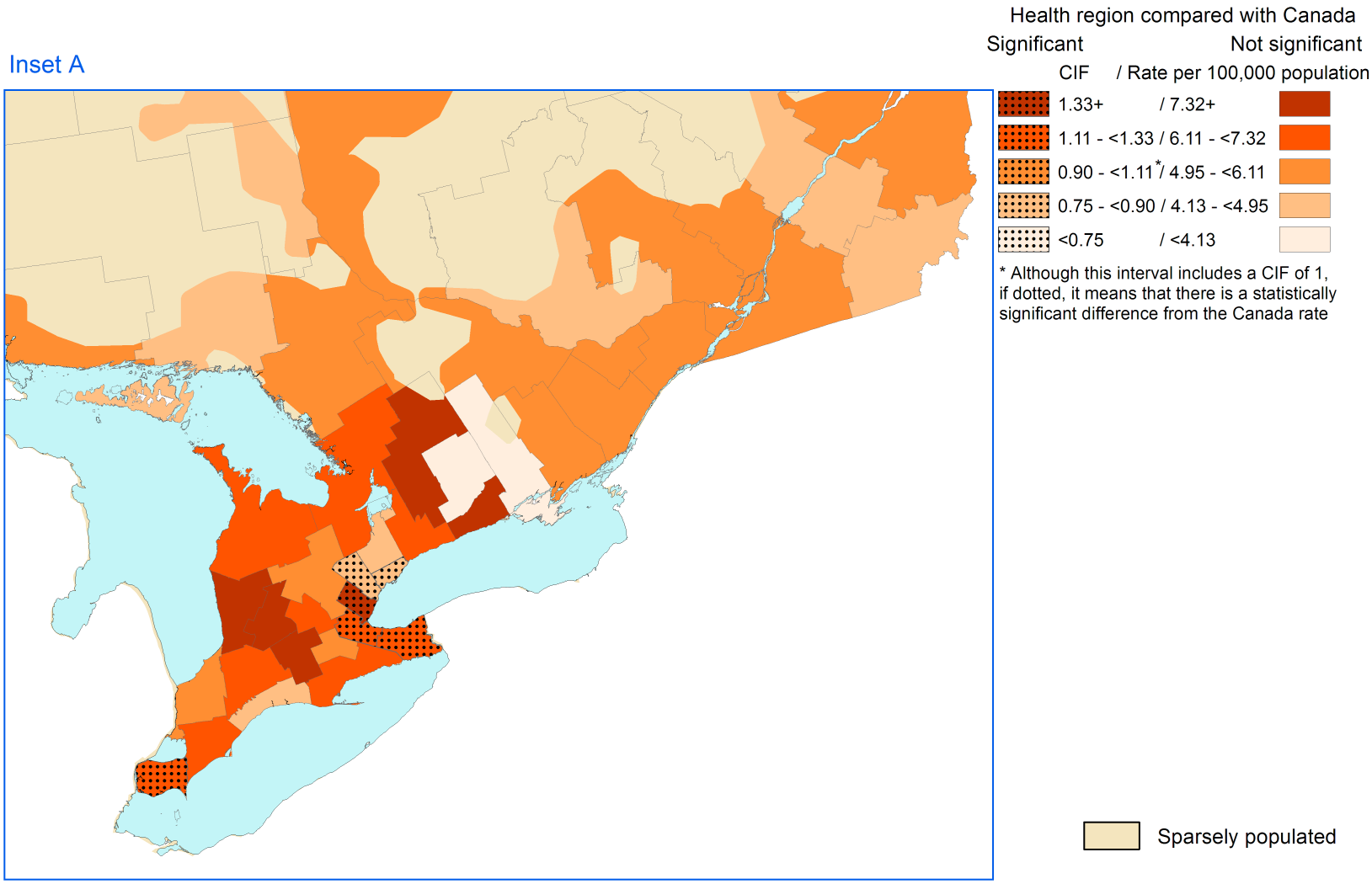
Known and Suspected Risk Factors

The causes of testicular cancer are largely unknown. Syndromes noted for abnormal testicular and urogenital development are known to elevate risk. A history of cryptorchidism, a condition in which 1 or both testes fail to descend normally, can account for approximately 10% of all cases of GCTs and increases the relative risk by between 2.5 times and 15 times.[32,33] Furthermore, in approximately 5-20% of cryptorchid patients, tumours develop in the contralateral normally descended testis.[32,33,37] Klinefelter's syndrome is another hereditary disorder that has also been suggested for predisposition to the neoplasm; approximately 10% of all mediastinal nonseminomatous GCTs are attributable to Klinefelter's syndrome.[32,37,69,111]

Map 23. Testis, males, 2000-2006, all ages

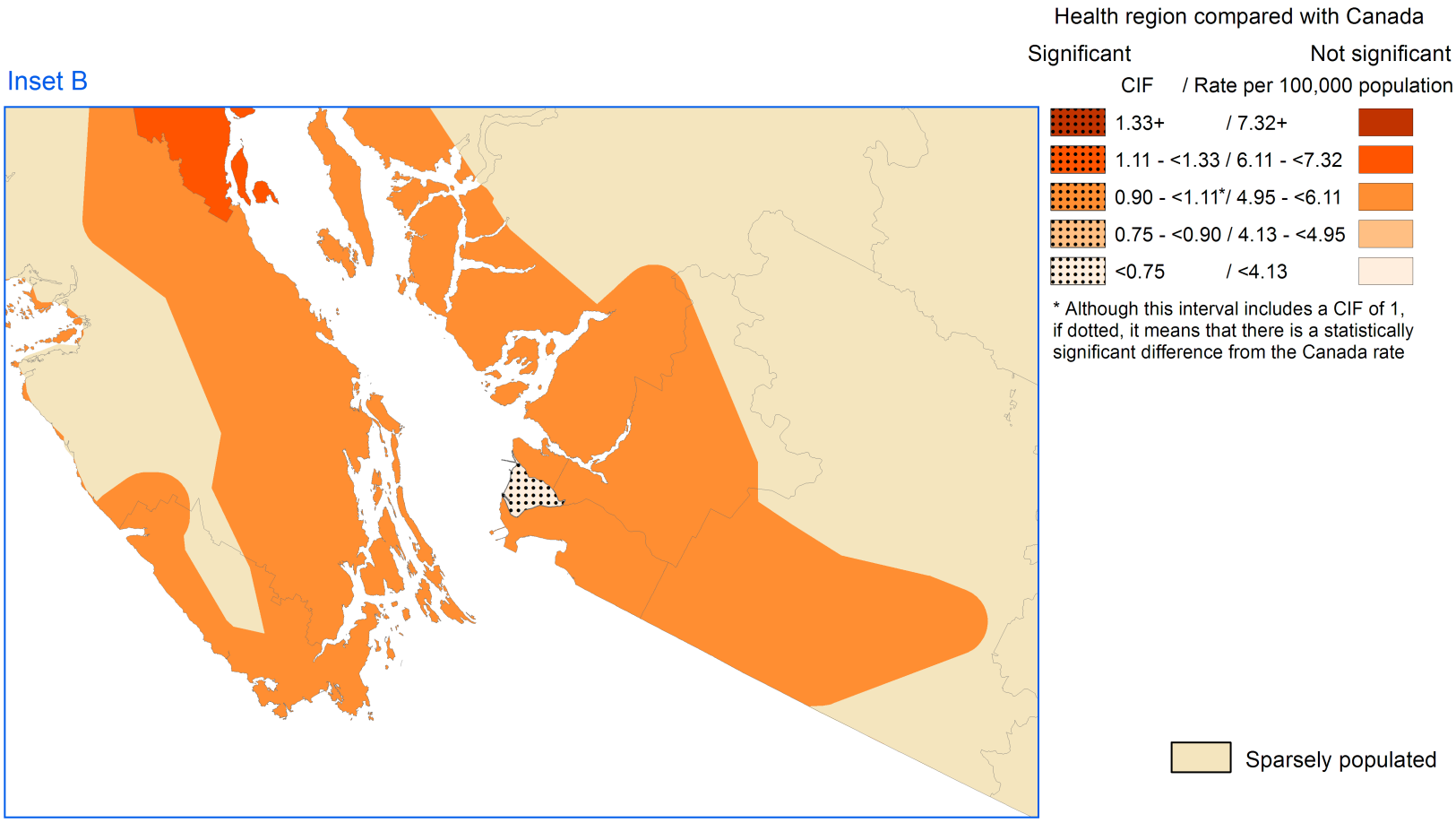


Map 23-A. Testis, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 23-B. Testis, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Bladder (ICDO-3 C67 including *in situ*, Maps 24 and 25)

Bladder cancer was responsible for 6,607 new cancer cases in 2006 (1,695 cases among females; 4,912 cases among males).[27] The age-standardized incidence rates (ASIRs) for the period 1997-2006 decreased on average by 0.3% per year among females and by 0.7% among males.[28] The incidence increases greatly with age; the age-at-incidence curve is exponential for males and is linear for females. The incidence for men aged 75-79 is approximately 11 times greater than it is for men aged 50-54; in women, the incidence is 8 times greater for the same age cohorts. Moreover, approximately 70% of cases occur in seniors (aged 65 and above).[27] The all-age 5-year relative survival rate was 75% among females and 78% among males for the period 2002-2004.[29]

The large majority of bladder cancers in Canada are transitional cell carcinomas (over 90%); about another 2% are squamous cell carcinomas and 2% are adenocarcinomas.

Geographic Variation

At the provincial/territorial level, significantly lower rates for cancer of the bladder were observed in Saskatchewan, Alberta and British Columbia and for males in Newfoundland and Labrador, Manitoba and the Northwest Territories, while significantly higher rates were observed in Nova Scotia, and for males in Quebec. Ontario is excluded since *in situ* bladder cancer cases have not been reported for the period covered by this atlas.

Significantly lower rates of bladder cancer were observed in a total of 7 health regions for women and 13 health regions for men in southern Saskatchewan, Alberta and British Columbia. In Quebec for women 25% of health regions and for men 50% of health regions had significantly higher rates.

The provincial and territorial cancer registries now report the combined total of *in situ* and invasive bladder cancers. This is due to the difficulty in distinguishing the presence or absence of superficial or early invasion in pathology reports and the high recurrence and progression rates of the tumours classified to the *in situ* group with their associated significant morbidity and mortality.

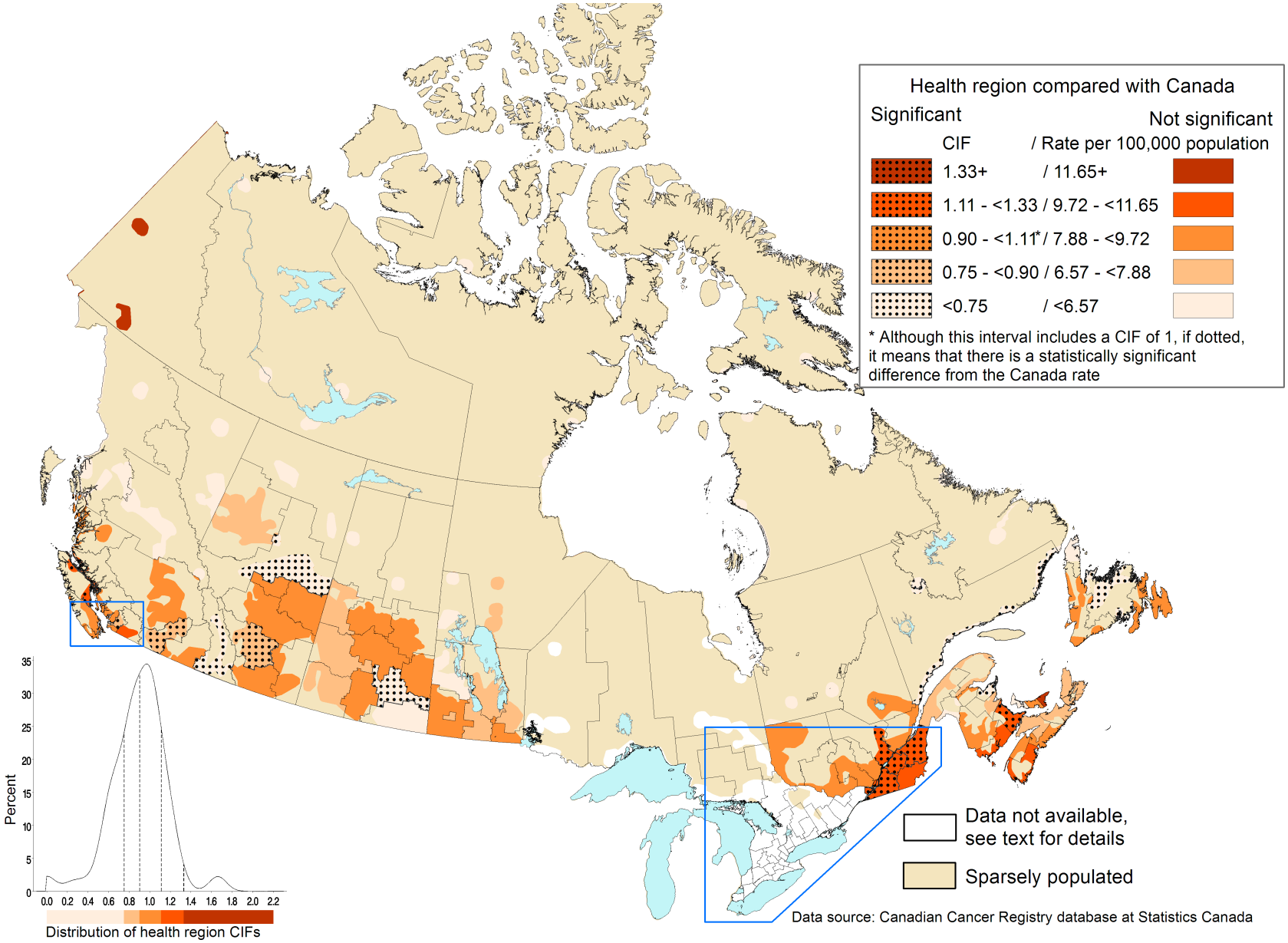
The large inter-provincial/territorial variation seen for bladder cancer rates is likely due to differences in the reporting of bladder cancer *in situ*.

Known and Suspected Risk Factors

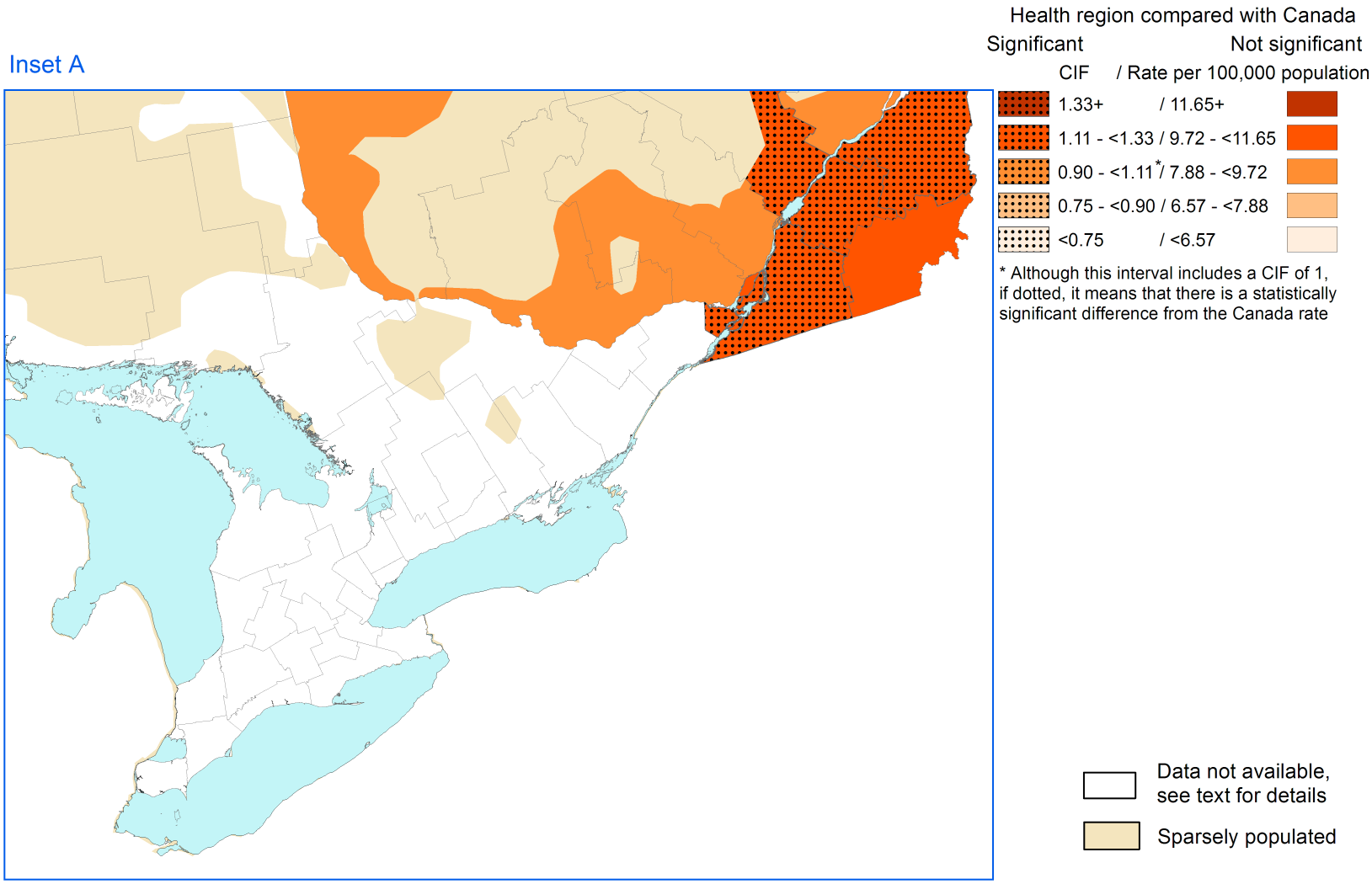
Cigarette smoking is the most important risk factor associated with bladder cancer. Individuals who smoke are thought to have a 2- to 4-fold increase in risk for bladder cancer compared with those who do not smoke.[112,113] Moreover, in industrialized countries, approximately 66% of male bladder cancer cases and 23-33% of all female cases of bladder cancer can be attributed to cigarette smoking.[32,33,112-114]

A case-control study in the Montreal area during 1979-1986 estimated that 6.5% (95% confidence interval 2.0-9.9) of bladder cancer cases were attributable to occupational exposures.[115] A study in Canada reported that elevated risks were also observed among miners, mechanics, lumber processors and primary metal workers, all of whom were linked in their exposure to combustion products and/or oils.[116] A history of schistosomiasis, a parasitic infectious disease, also increases the risk of bladder cancer, with endemic areas including most of Africa and several West Asian countries.[69,112,117]

Map 24. Bladder, females, 2000-2006, all ages

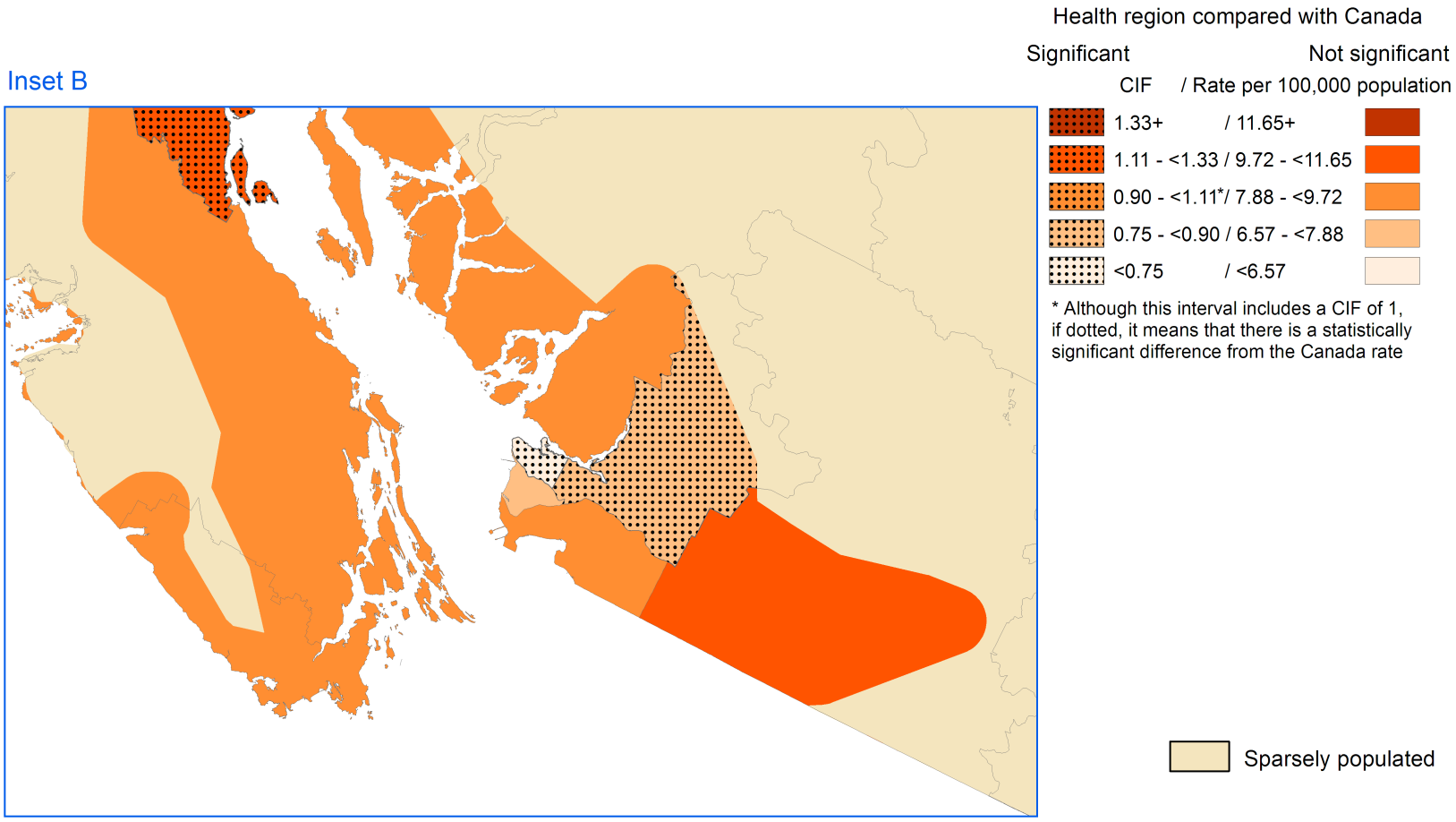


Map 24-A. Bladder, females, 2000-2006, all ages



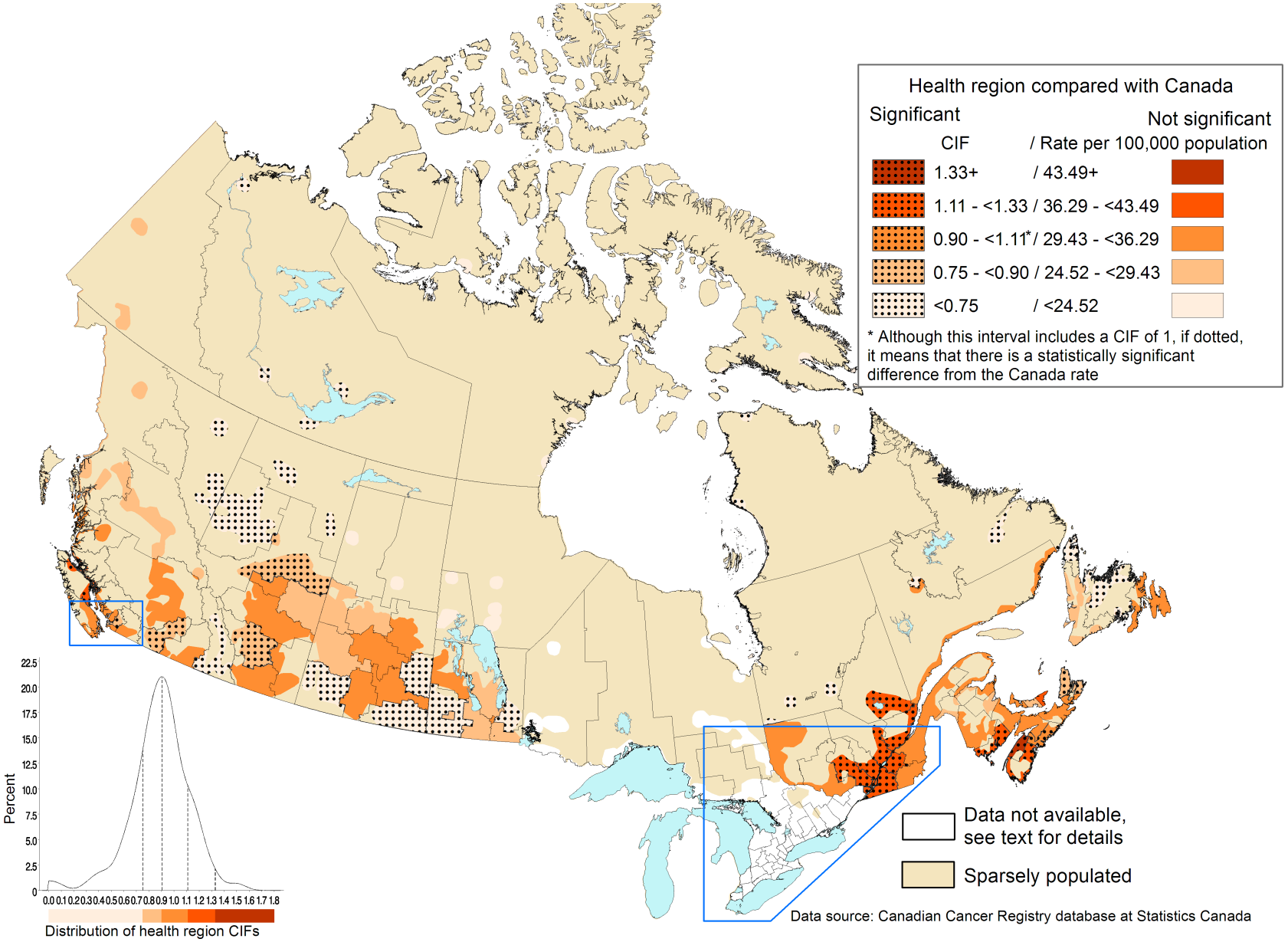
Data source: Canadian Cancer Registry database at Statistics Canada

Map 24-B. Bladder, females, 2000-2006, all ages

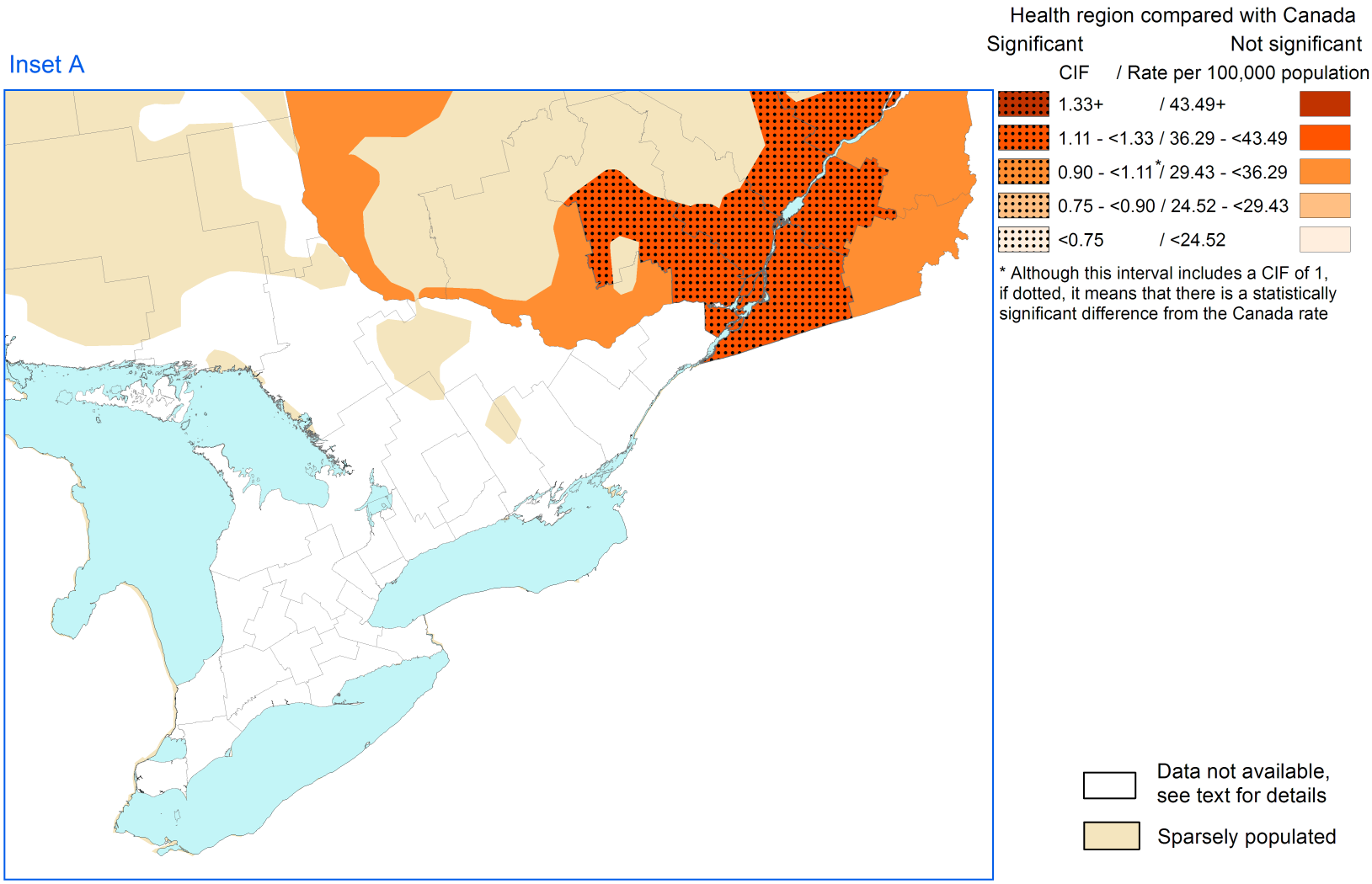


Data source: Canadian Cancer Registry database at Statistics Canada

Map 25. Bladder, males, 2000-2006, all ages

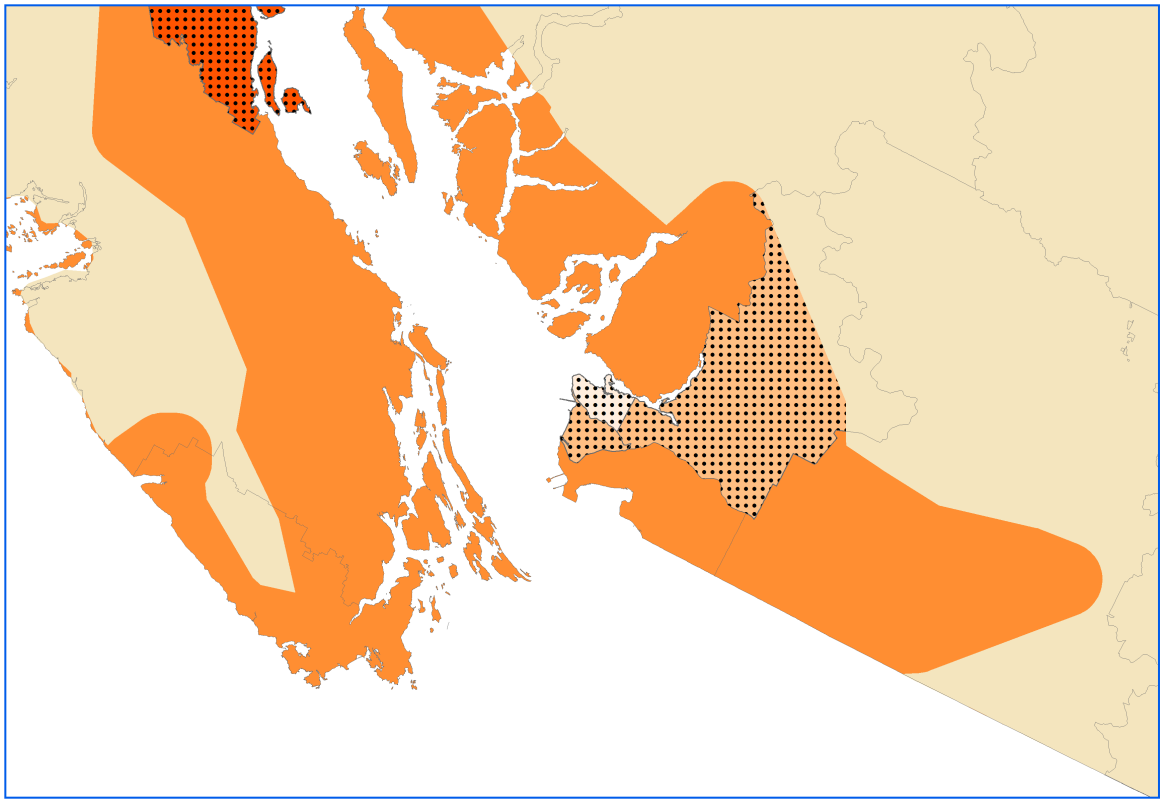


Map 25-A. Bladder, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 25-B. Bladder, males, 2000-2006, all ages



Health region compared with Canada

Significant		Not significant
CIF	/ Rate per 100,000 population	
1.33+	/ 43.49+	
1.11 - <1.33	/ 36.29 - <43.49	
0.90 - <1.11*	/ 29.43 - <36.29	
0.75 - <0.90	/ 24.52 - <29.43	
<0.75	/ <24.52	

* Although this interval includes a CIF of 1, if dotted, it means that there is a statistically significant difference from the Canada rate

Sparsely populated

Data source: Canadian Cancer Registry database at Statistics Canada

Kidney and renal pelvis

(ICDO-3 C64-C65, Maps 26 and 27)

Kidney cancer is a broad term encompassing many histological types of cancer, each with its unique clinical course. Taken in its broad meaning, kidney cancer was responsible for 4,436 new cases of cancer in 2006 and accounted for approximately 2.8% of all new cases in Canada (1,697 female cases; 2,739 male cases).[27] The annual age-standardized incidence rates are rising gradually, and this cannot be attributed merely to increases in detection. The annual percentage change for 1997-2006 was 1.4% among females and 1.0% among males.[29]

Age-specific incidence shows a peak in early childhood and then follows the more usual pattern of a steep rise through adulthood. While the 5-year relative survival rate was 66% for the period 2002-2004,[29] the rate drops to between 5% and 10% once metastatic disease develops.[33] Moreover, the rate is highly dependent on the type of kidney neoplasm and the histologic subtype.

Kidney cancers primarily consist of 3 major types: renal cell carcinoma (RCC), cancer of the renal pelvis or ureter, and Wilms tumour. RCCs are found in the renal parenchyma (body of the kidney), are largely adenocarcinomas, and account for approximately 80-85% of all renal tumours.[32,55] Cancer of the renal pelvis is primarily a transitional cell neoplasm and accounts for approximately 7-8% of the cases.[32] Wilms tumour, the third major type, accounts for approximately 5-6% of the cases, principally occurring within the first 5 years of life.[32]

Geographic Variation

At the provincial/territorial level, significantly low rates for cancers of the kidney and renal pelvis were observed in Ontario and British Columbia, while high rates were observed in Nova Scotia, New Brunswick, Quebec and Manitoba, and for females in Nunavut and males in Prince Edward Island, Saskatchewan and Alberta.

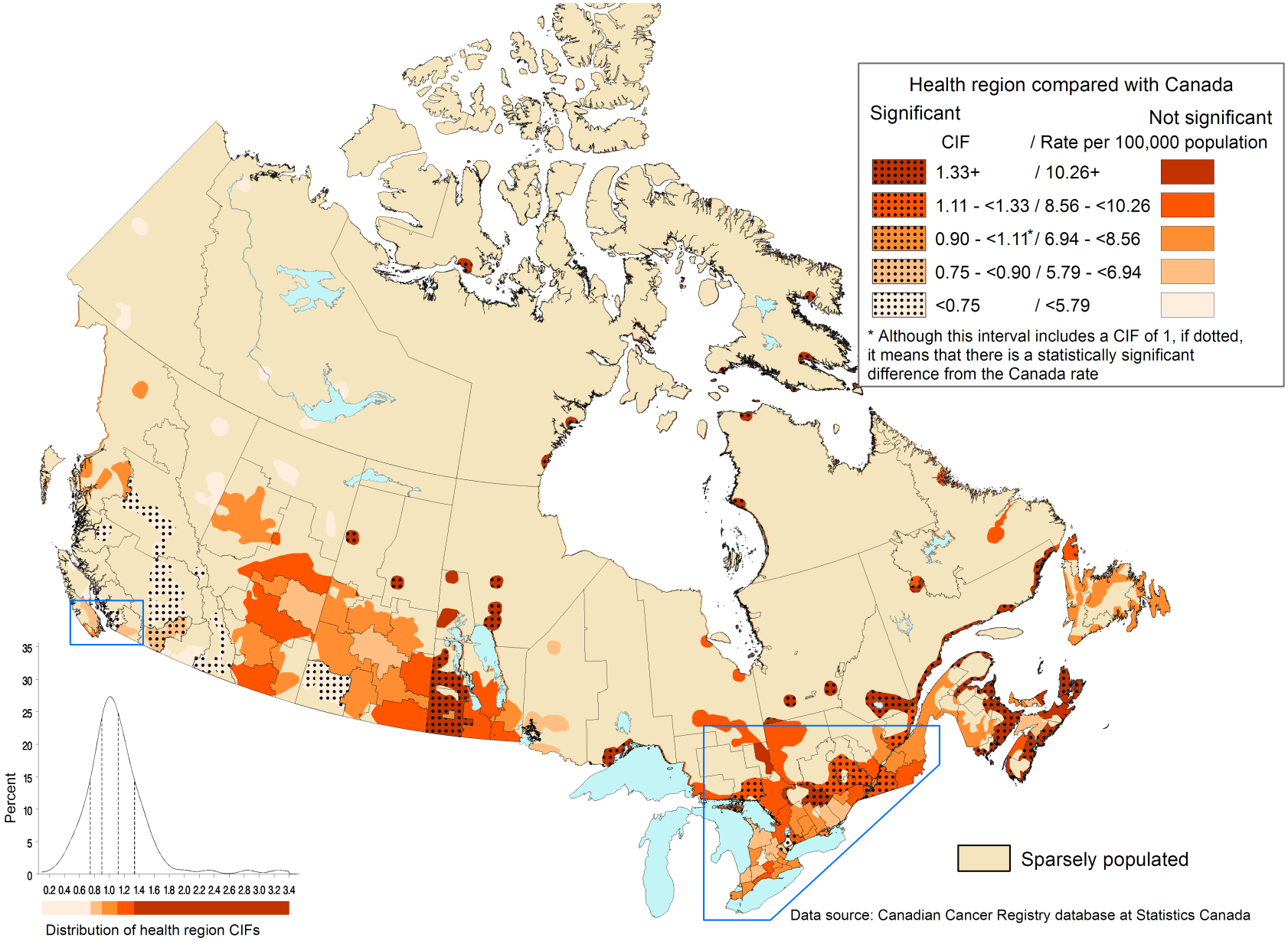
The majority of health regions in British Columbia had significantly lower rates of kidney and renal pelvic cancers. There is a pattern of health regions with significantly higher rates for Nova Scotia, New Brunswick and Quebec, and among females in 4 health regions in Ontario.

Known and Suspected Risk Factors

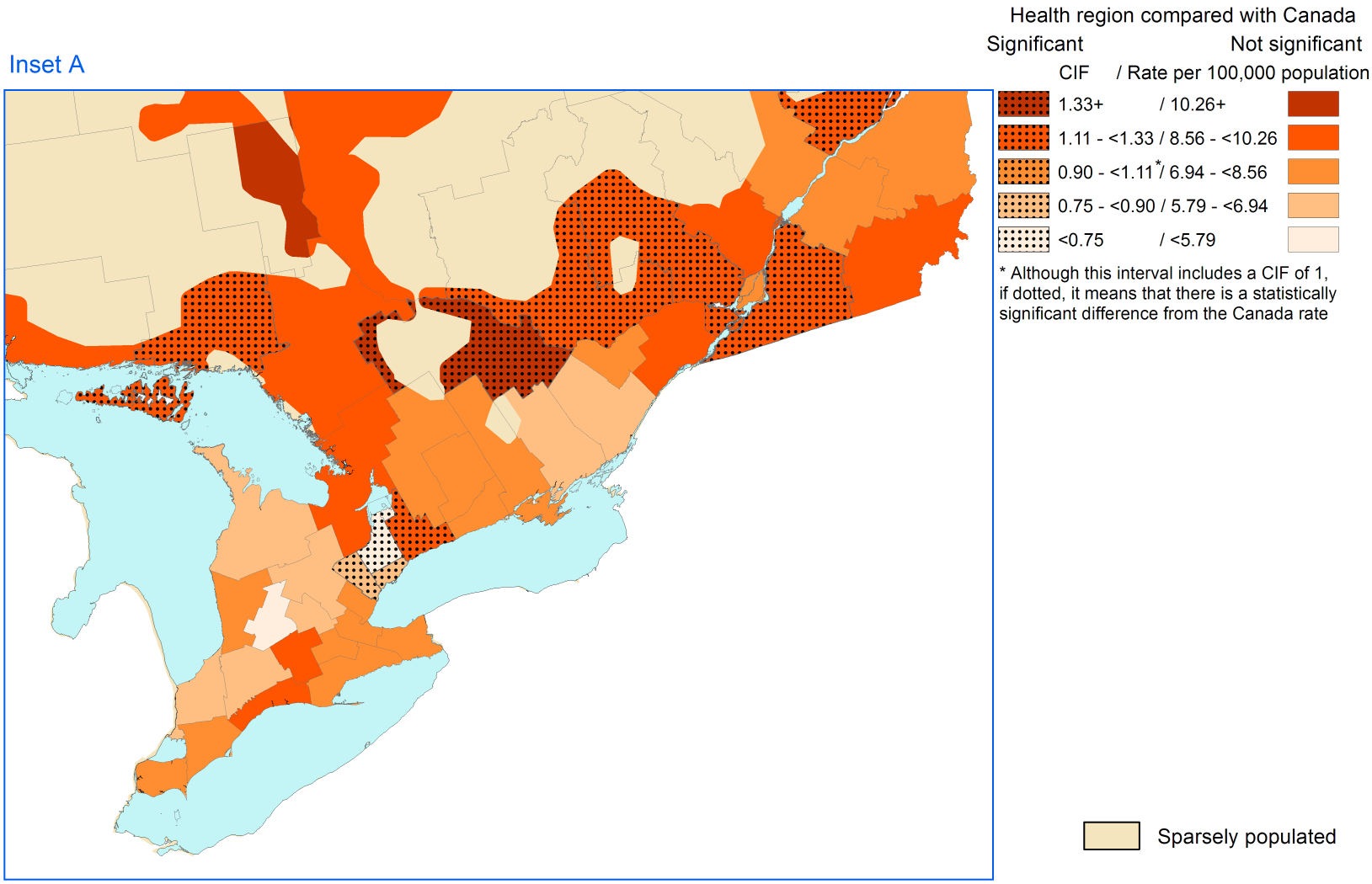
This risk factor section will largely focus on RCCs. Cigarette smoking, obesity and hypertension are the 3 major risk factors and, for example, account for up to half of all US cases.[118] Cigarette smoking is a significant risk factor for both RCC and renal pelvic cancer.[33,37] Functioning in a dose-dependent manner, the risk attributable to smoking has been assessed at approximately 20-30% in men and 10-24% in women.[37,118-120] Obesity, accounting for approximately 20% of RCC cases, is a significant risk factor for both sexes.[118,121]

Hypertension influences the development of renal cell cancer and may be associated with an excess risk ranging from 20% to 300%.[118,119] Developing cystic disease of the kidneys is known to increase the risk for developing kidney cancer by 30 times, as compared with the risk for the general population.[37,118] Hereditary forms, responsible for a small percentage of cases, are characterized as occurring earlier in life. Four such forms are von Hippel-Lindau disease, hereditary papillary renal carcinoma, hereditary leiomyomatosis renal cell carcinoma and Birt-Hogg-Dubé syndrome.[37]

Map 26. Kidney and renal pelvis, females, 2000-2006, all ages

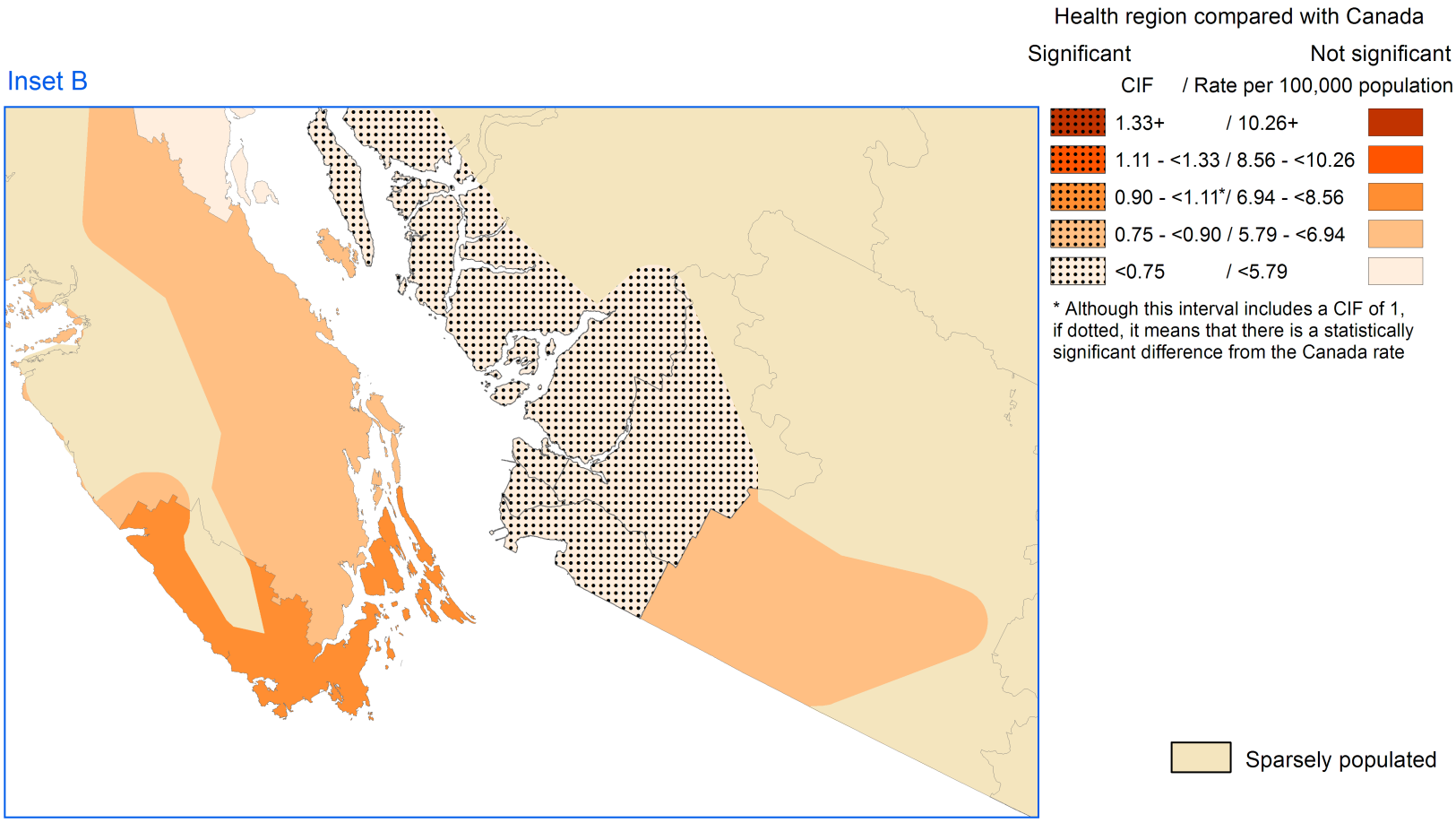


Map 26-A. Kidney and renal pelvis, females, 2000-2006, all ages



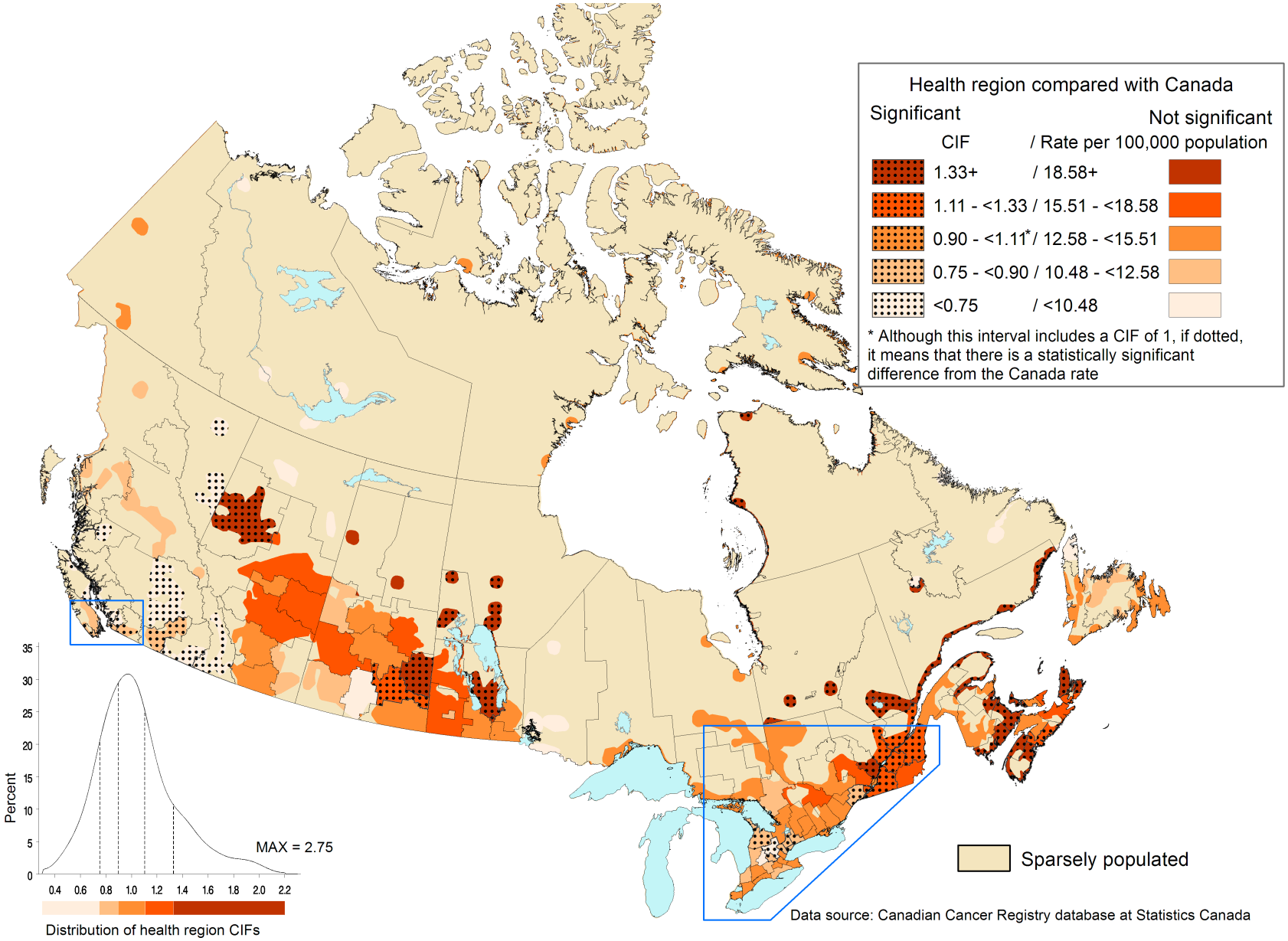
Data source: Canadian Cancer Registry database at Statistics Canada

Map 26-B. Kidney and renal pelvis, females, 2000-2006, all ages

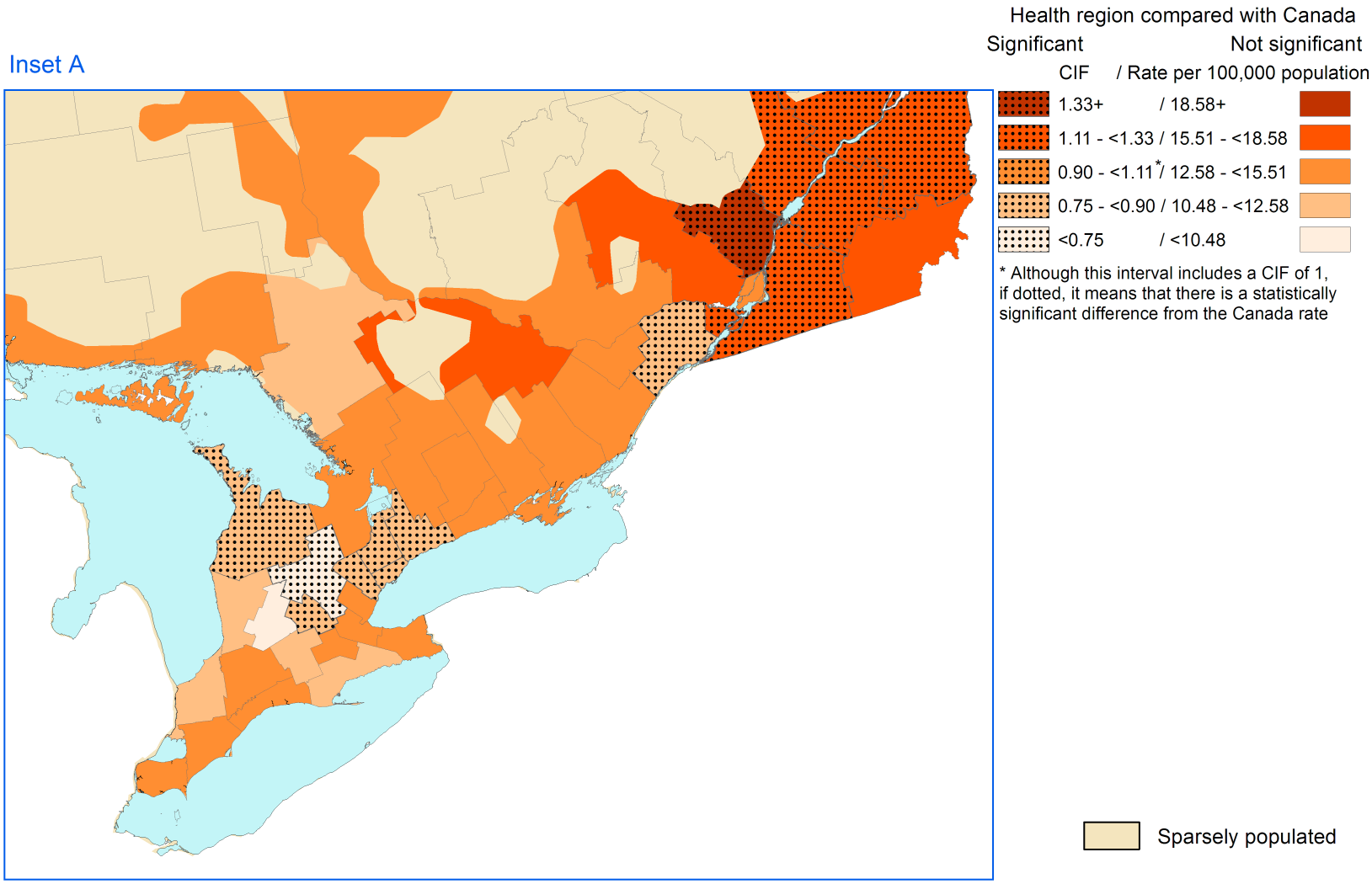


Data source: Canadian Cancer Registry database at Statistics Canada

Map 27. Kidney and renal pelvis, males, 2000-2006, all ages

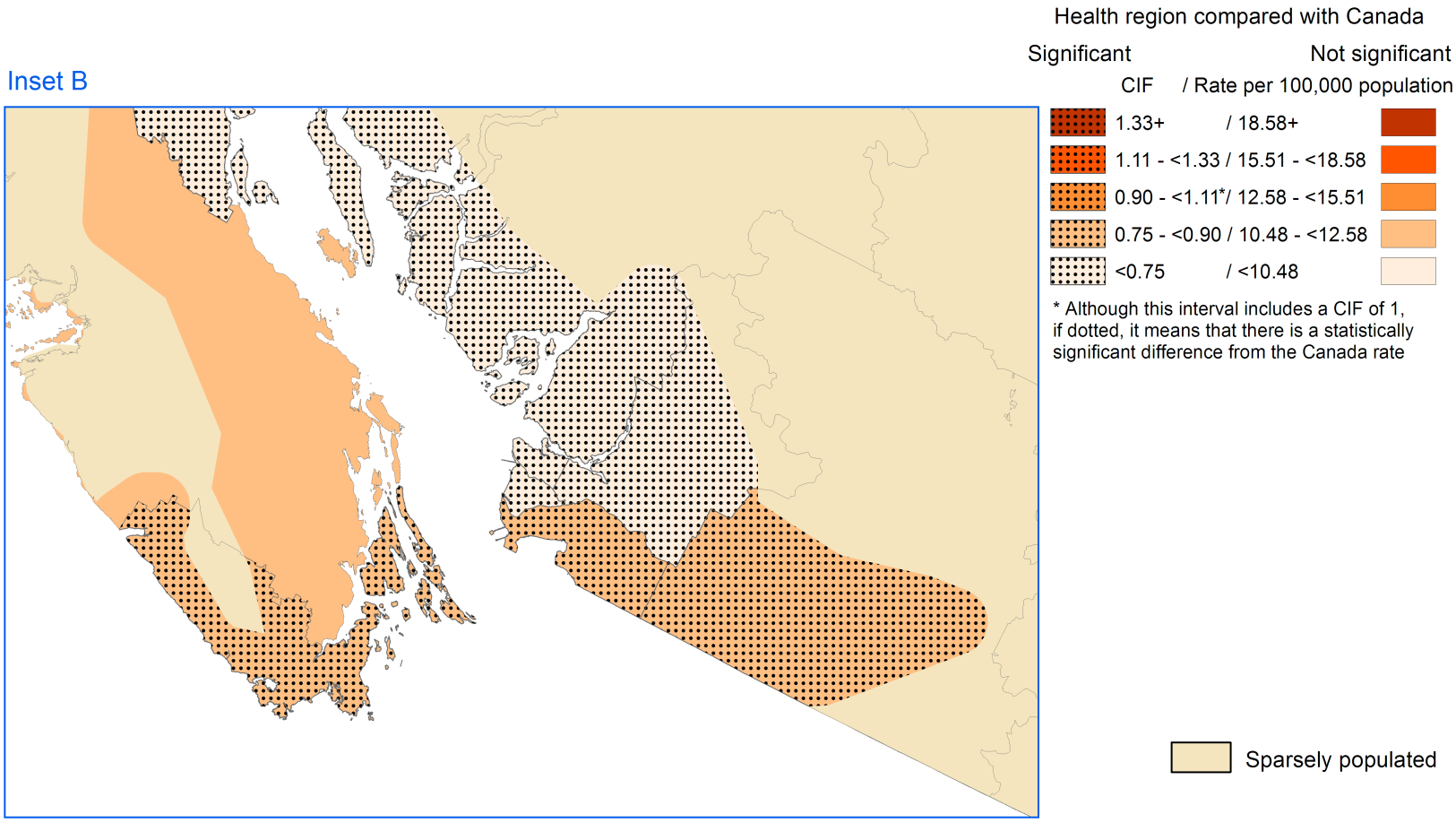


Map 27-A. Kidney and renal pelvis, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 27-B. Kidney and renal pelvis, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Brain and other nervous system

(ICDO-3 C70-C72, Maps 28 and 29)

There were over 2,400 new cases of cancers of the brain and of the nervous system in Canada in 2006 (1,068 in females; 1,383 in males).[27] Cancers of the brain and of the nervous system can be referred to collectively as "CNS" (central nervous system) cancers. The age-standardized incidence rate (ASIR) of CNS cancers has declined during the period 1997-2006 by approximately 1.1% and 0.7% per year among females and males, respectively.[28] The age-at-incidence curve is bimodal, with a small peak occurring in childhood, a slight decline in incidence during young adulthood and a gradual increase peaking between ages 60 and 79, when the rate plateaus; thereafter, the rate diminishes.[27] The peak observed during childhood is important; CNS cancer represents 20% of all cancers in children under age 15 and is the second most frequently diagnosed childhood malignancy.[29] The 5-year relative survival rate for the brain cancer cases aged 15 and above diagnosed during 1998-2000 was 22%, which is in contrast to that of the other nervous system cancer cases, which was 68%.[122] Survival is substantially better for younger adults and children.[29]
The statistics presented do not include tumours classified as benign since reporting completeness for these cases varies by registry.

There are many types of brain and other nervous system tumours. Approximately 94% of CNS cancers occur in the brain, about 3% are malignancies of the cerebral meninges, and the remainder occur in the spinal cord or cranial nerves. Of cases with known morphology, the majority (about 95%) are gliomas, of which the most common types include glioblastomas and astrocytomas. Of the remainder, the most common morphologies are malignant meningiomas and medulloblastomas.

The World Health Organization (WHO) classification includes a malignancy grade of 4 levels.[123] The WHO classification includes neuroepithelial tumours (includes glial tumours), meningeal tumours, germ cell tumours, tumours of the sellar region, tumours of uncertain histogenesis, primary CNS lymphoma (tabulated as a lymphoma), tumours of peripheral nerves that affect the CNS and metastatic tumours.[2]

Geographic Variation

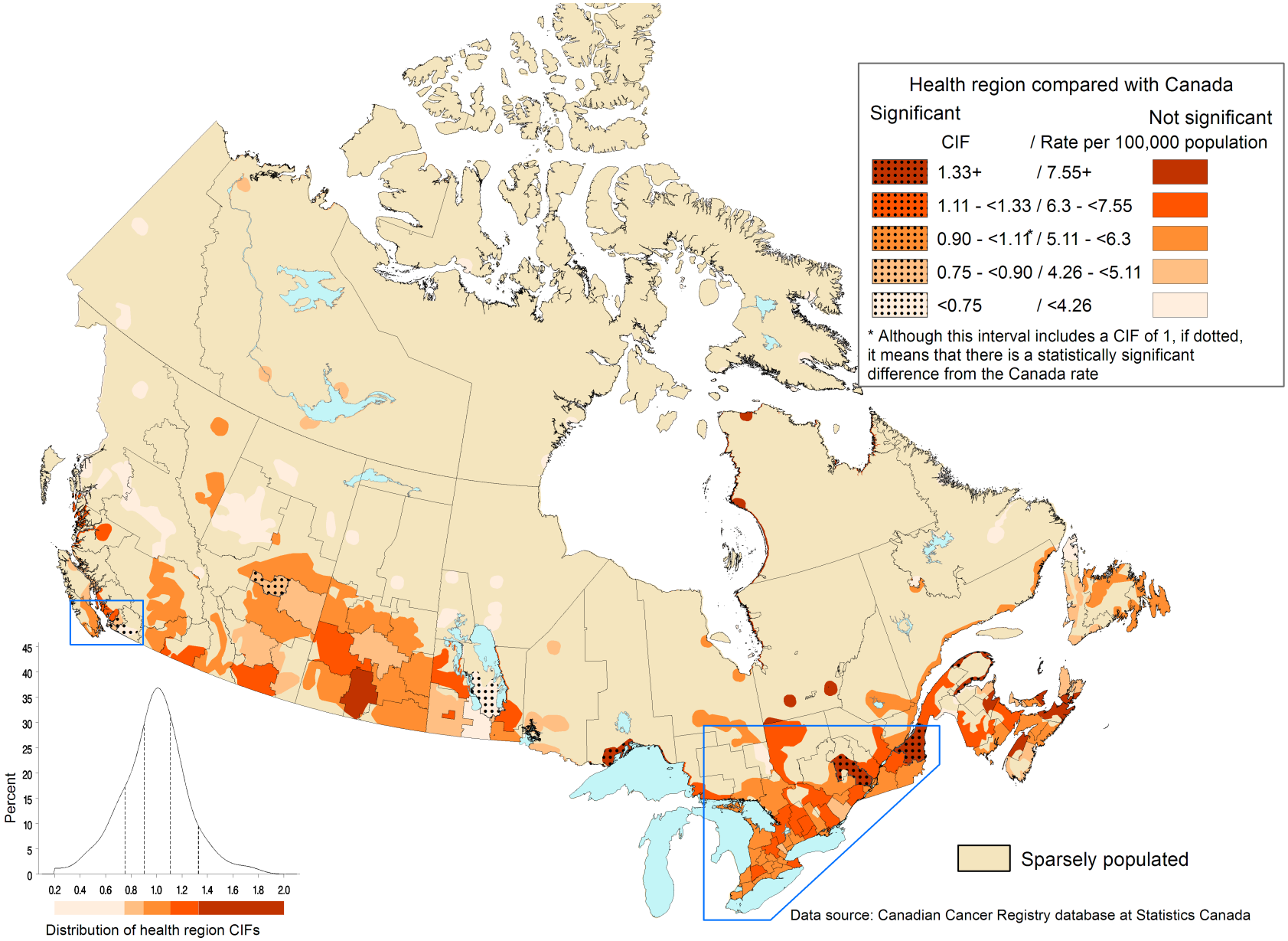
At the provincial/territorial level, significantly low rates for cancers of the brain and nervous system were observed in Manitoba and British Columbia, and among females in Alberta and males in Saskatchewan. Significantly elevated rates were observed in Quebec.

Health regions with significantly low rates were located in southern British Columbia, and a pattern of lower rates was observed in Manitoba, Saskatchewan and Alberta, but at most 1 health region in a province had a statistically significantly low rate. Rates were significantly elevated in Quebec in 3 health regions for females and in 6 health regions for males.

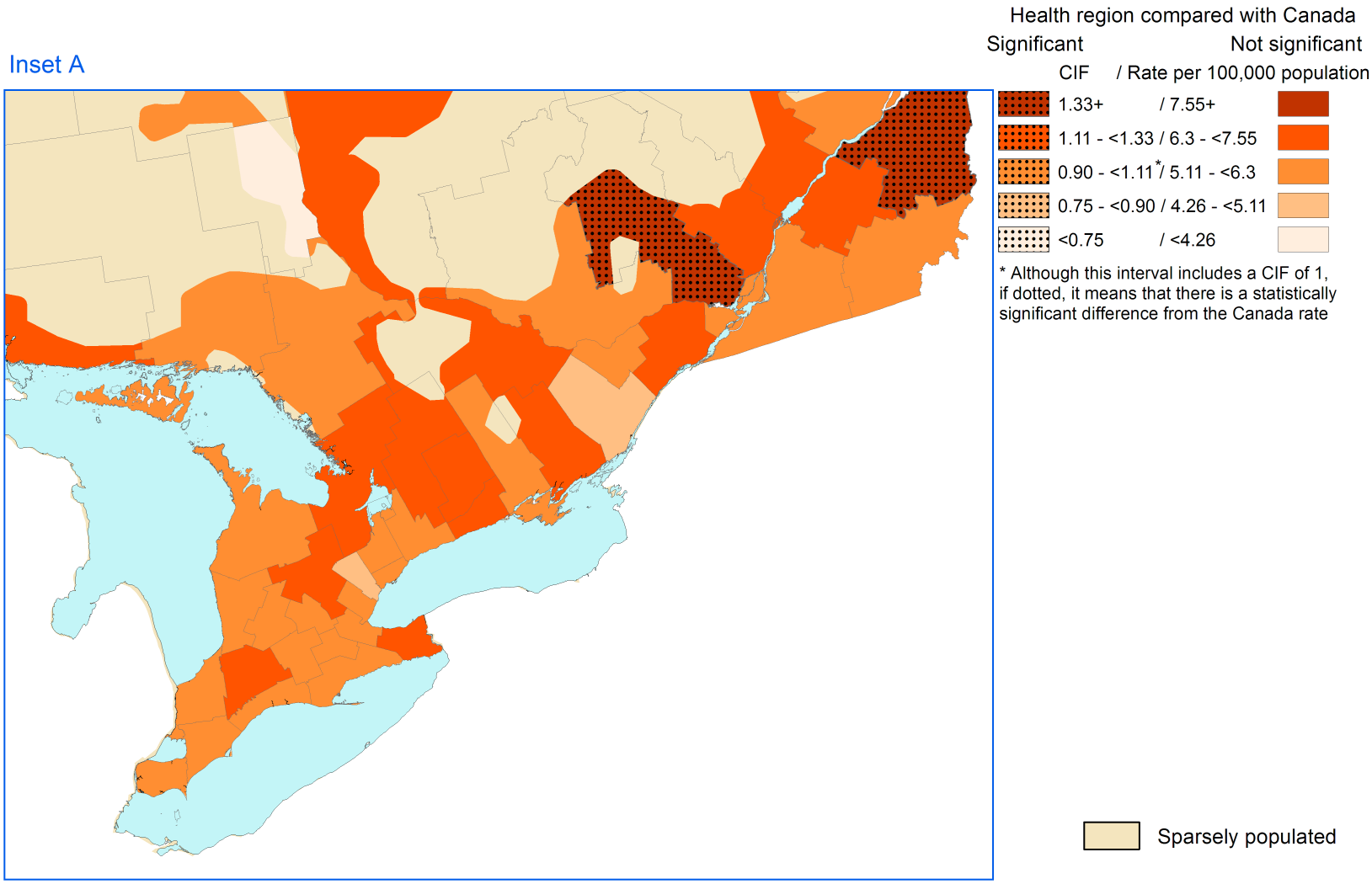
Known and Suspected Risk Factors

This section will primarily focus on malignant tumours of the brain, cranial nerves and cranial meninges, which, when pooled, account for 95% of all CNS tumours.[124] Little is known about the risk factors for CNS cancers, particularly for levels of exposure experienced by the general population. Children who are exposed to CNS irradiation as treatment for acute lymphoblastic leukemia seem to have an increased risk of developing brain tumours.[125] A study of atomic bomb survivors has shown a dose-related excess of brain tumours.[126] Genetic and hereditary disorders and syndromes can also increase risk. In childhood, CNS cancers of genetic predisposition can account for up to 5% of the cases.[127]

Map 28. Brain and other nervous system, females, 2000-2006, all ages

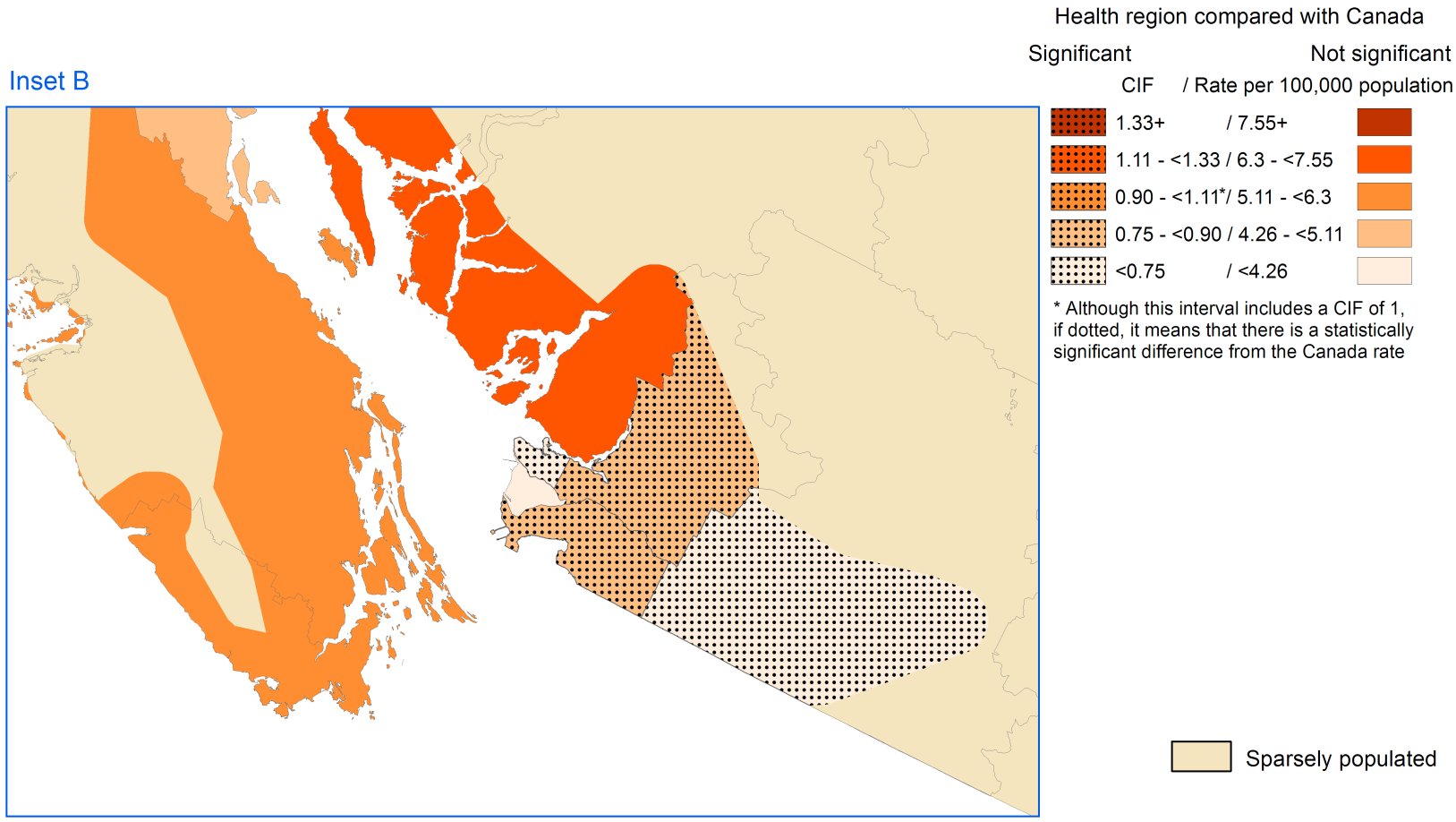


Map 28-A. Brain and other nervous system, females, 2000-2006, all ages



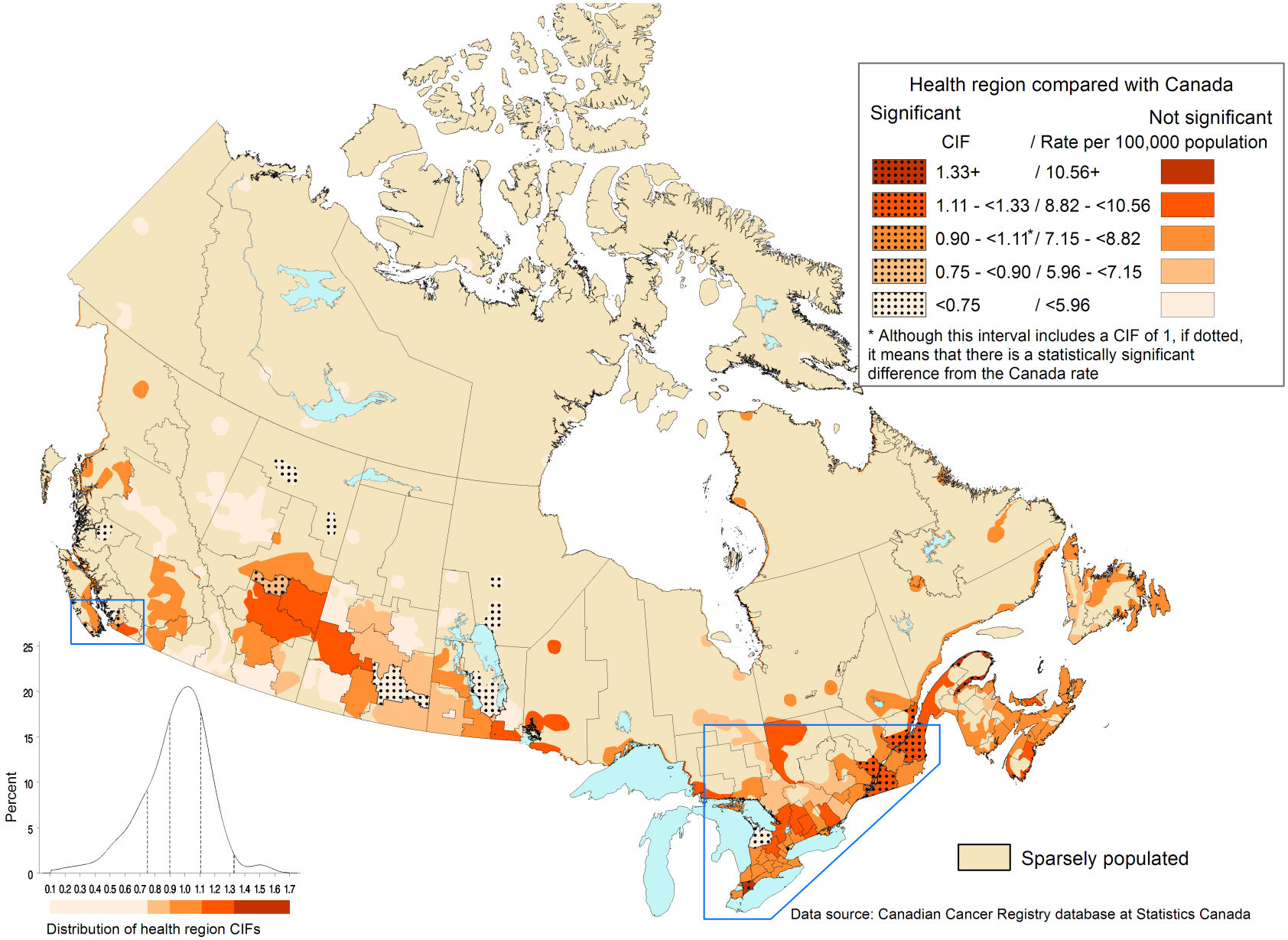
Data source: Canadian Cancer Registry database at Statistics Canada

Map 28-B. Brain and other nervous system, females, 2000-2006, all ages

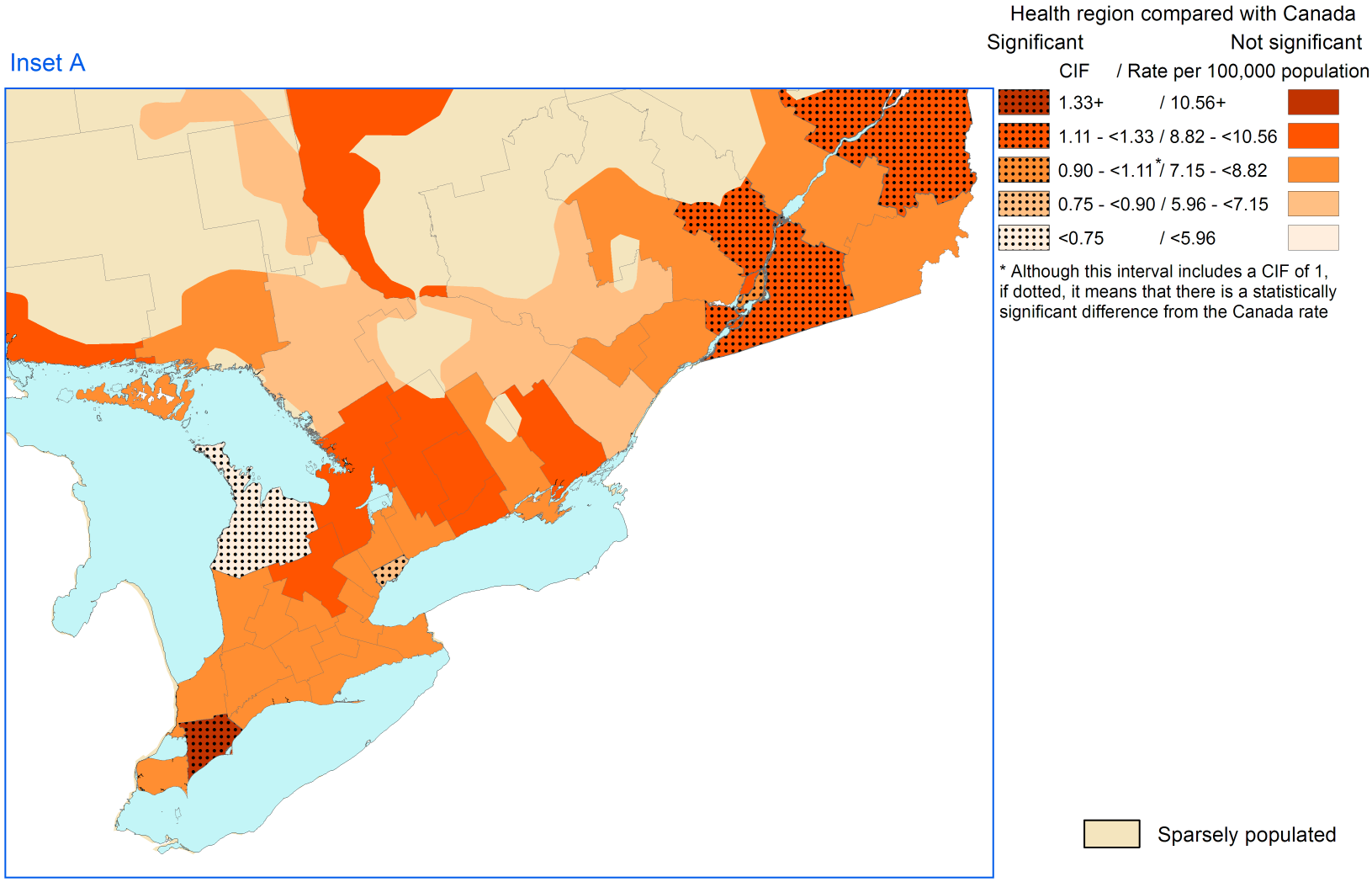


Data source: Canadian Cancer Registry database at Statistics Canada

Map 29. Brain and other nervous system, males, 2000-2006, all ages

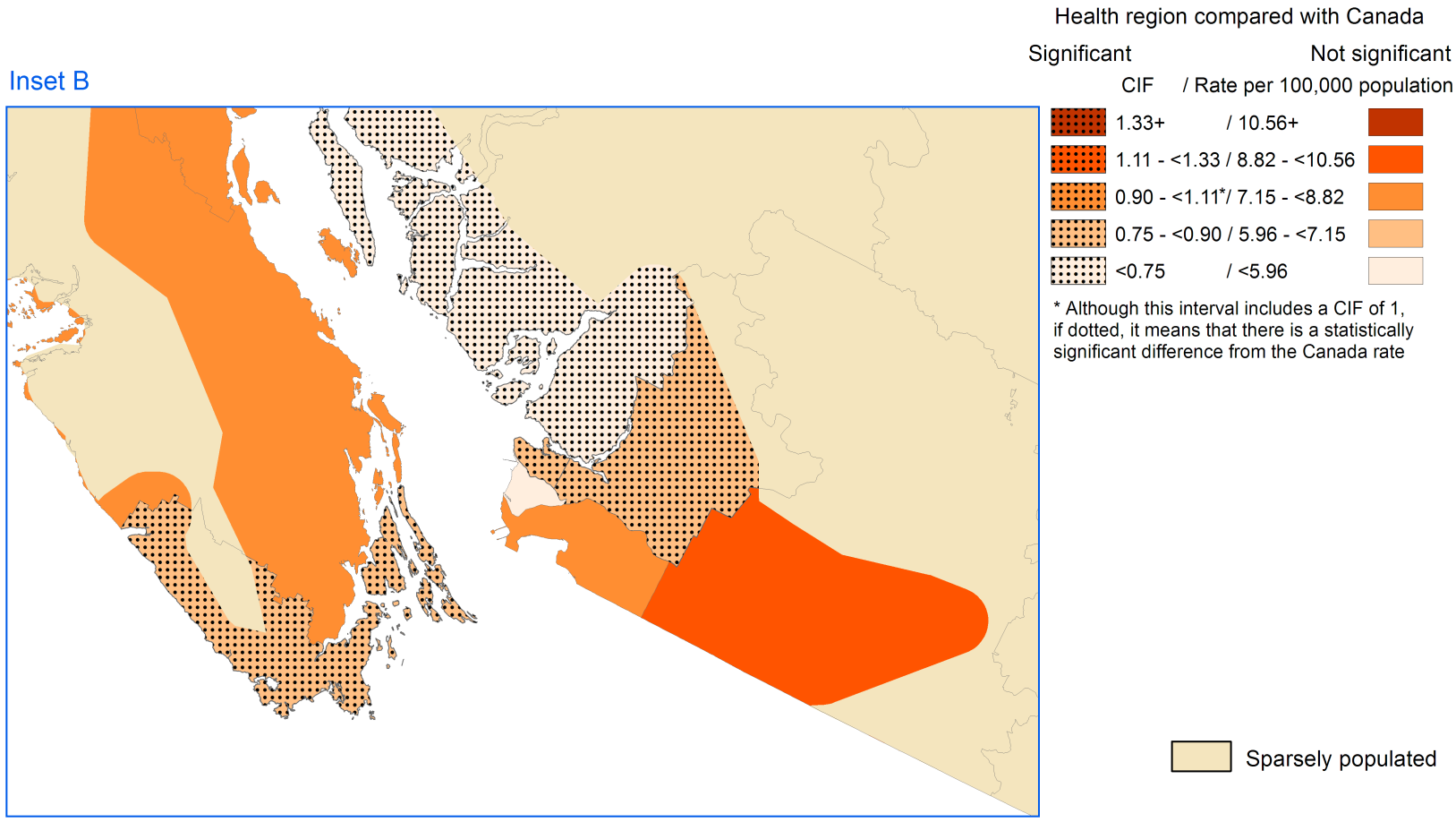


Map 29-A. Brain and other nervous system, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 29-B. Brain and other nervous system, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Thyroid (ICDO-3 C73, Map 30)

Cancers of the thyroid are unusual in that the overall female-to-male ratio is greater than 3:1 (in 2006, 2,999 cases in females; 883 in males).[27] For the period 1997-2006, the annual percentage change in the age-standardized incidence rates was 9.5% in females and 6.8% in males.[28] Developments in and more frequent use of medical imaging (ultrasound, needle biopsy, and potentially computed tomography [CT scan] and magnetic resonance imaging) may have resulted in detection of earlier stage, asymptomatic cancers more frequently than was possible in the past.[128] The survival after diagnosis with this cancer is favourable, with a 5-year survival rate of 99% among females and 94% among males for the period 2002-2004.[29] Cases are generally diagnosed at younger ages relative to other cancers. For females, approximately 55% of all thyroid cancers occur before the age of 50; for males, the corresponding percentage is approximately 40%.[27]

The histologies are chiefly composed of 2 types arising from the two cell types present in the thyroid gland: follicular and parafollicular. Well-differentiated cancers and anaplastic thyroid cancers arise from the former, whereas medullary thyroid carcinomas (MTCs) arise from the latter. Well-differentiated cancers of follicular cell origin (papillary and follicular) account for about 80-90% of all thyroid cancers.[33,37,129]

Geographic Variation

At the provincial/territorial level, significantly low rates for thyroid cancer were observed for males and females combined in Newfoundland and Labrador, Prince Edward Island, Nova Scotia, Quebec, Manitoba, Saskatchewan, British Columbia and Yukon. Significantly elevated rates for thyroid cancer were observed only in Ontario.

Outside Ontario, most health regions reported significantly low rates, with Calgary Health Region being an exception by also reporting elevated rates. Nine health regions in southern and southwestern Ontario reported incidence rates for thyroid cancer that were significantly higher than the average Canadian rate.

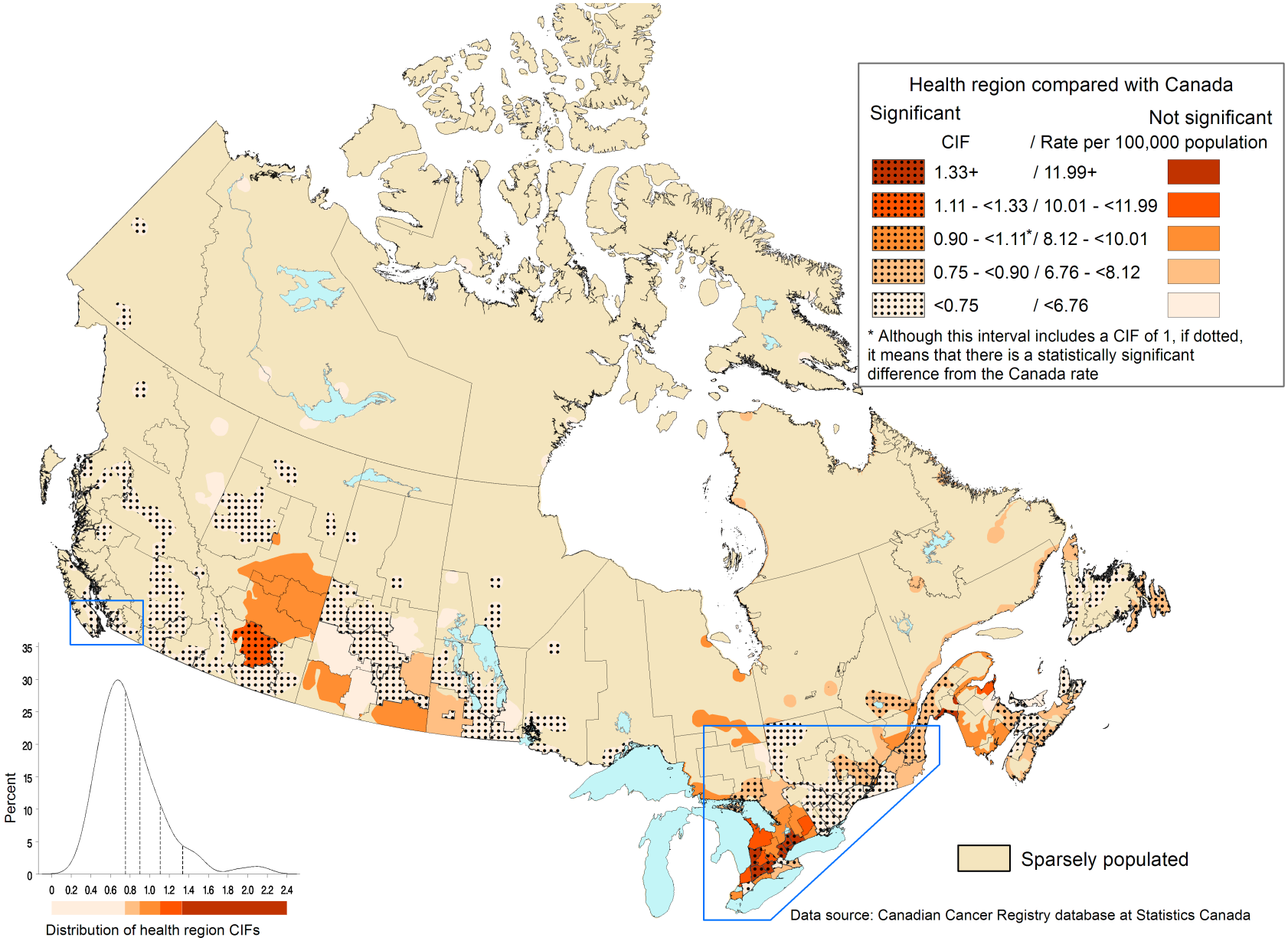
Known and Suspected Risk Factors

Radiation exposure is an established risk factor; however, both MTCs and follicular thyroid carcinomas are unaffected by such exposure and appear in a more sporadic manner. Radiation can occur by either ingestion of radioactive substances or by external exposure. Irradiation for benign conditions was common decades ago, and even today radiation is therapeutically administered to the neck for treatment of Hodgkin lymphoma.

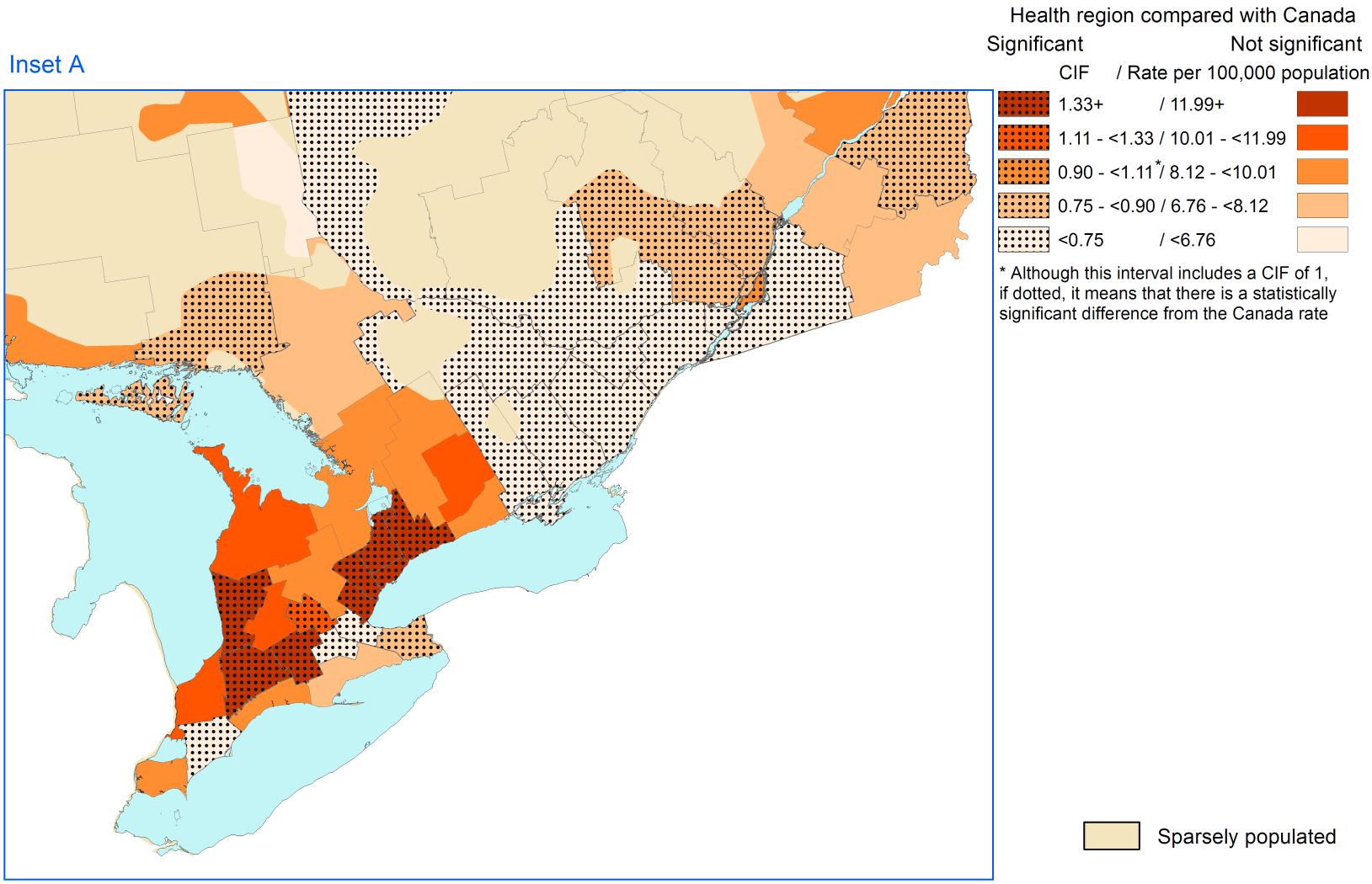
However, since more than 90% of thyroid cancer cases occur independently of radiation exposure,[37,55] other factors such as diet and environmental exposures have been suggested.[37,55,130] To date, however, none has shown any clear association. No effect of hormones, parity, menarche or menopause has been consistently shown to affect incidence.[131] The risk of thyroid cancer as a function of iodine intake is complex. Iodine-deficient diets are associated with elevated rates of follicular and anaplastic cancer, whereas diets rich in iodine are associated with papillary cancers.[37,55,69,132] Furthermore, goitres and benign nodules are also risk factors associated with elevated relative risks of 3 and 30, respectively.[69]

Genetics also influences the risk of both well-differentiated cancers and MTCs.[37,132] MTC is associated with multiple endocrine neoplasia (MEN) type 2 syndromes and familial, non-MEN medullary thyroid carcinoma. Familial adenomatous polyposis is known to increase the risk for developing papillary or follicular tumours. Follicular carcinomas are associated with Gardner's syndrome as well as Cowden's syndrome. A familial history of benign and malignant thyroid tumours also elevates risk.[133] People with first-degree relatives with well-differentiated thyroid cancers have an increased risk of between 4- and 10-fold.[37]

Map 30. Thyroid, 2000-2006, all ages

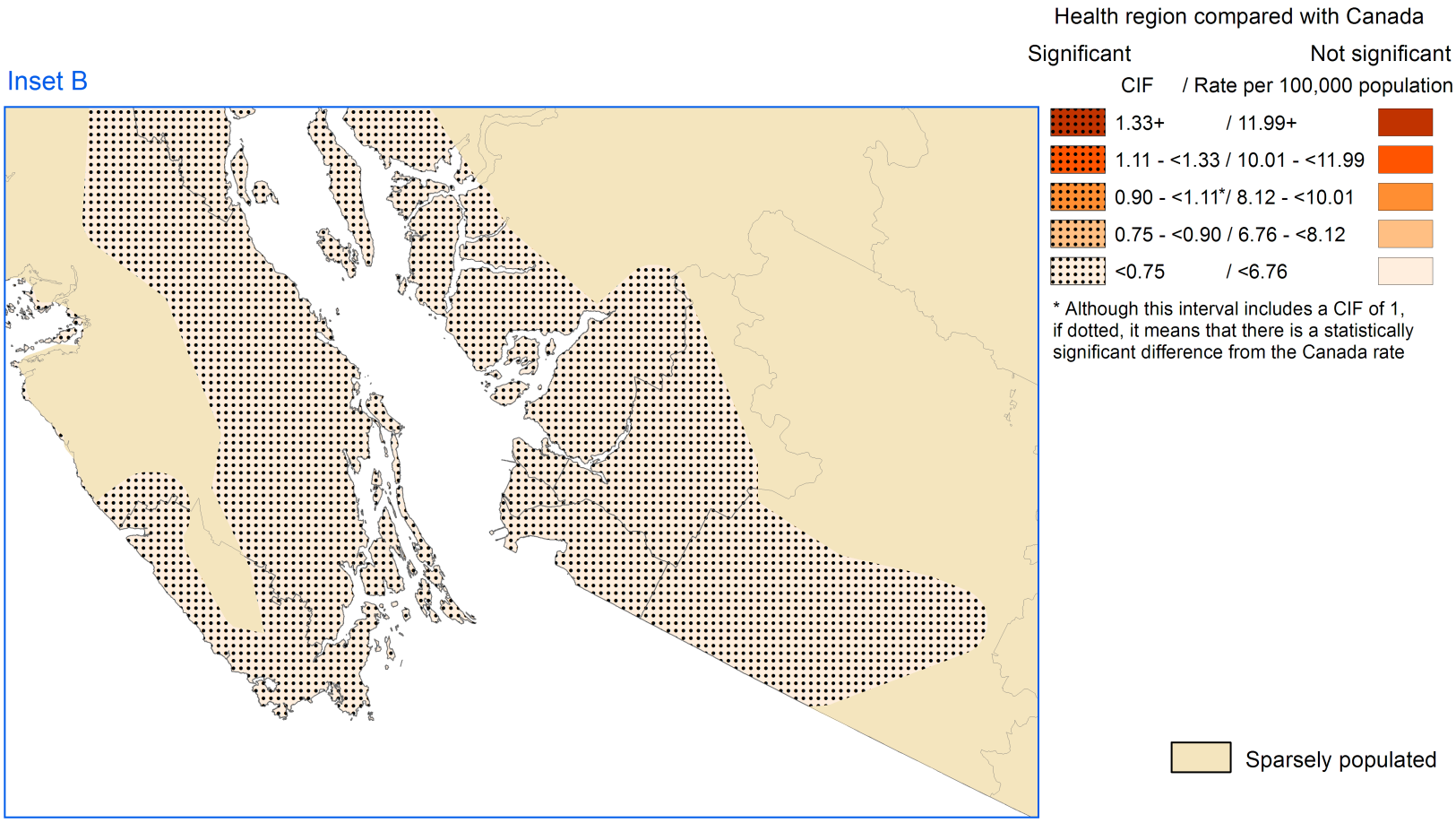


Map 30-A. Thyroid, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 30-B. Thyroid, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Hodgkin lymphoma

(ICDO-3 histologies 9650-9667, Map 31)

Hodgkin lymphoma, a malignancy of the lymph nodes, spleen and other lymphoid tissue, is a relatively rare cancer that, in 2006, accounted for 884 cases (397 in females; 487 in males).[27] Hodgkin lymphoma has a bimodal age-at-incidence curve with peaks at ages 20-24 years and 65 or more.[27] Age-standardized incidence rates have been stable over the last decade.[28] The 5-year relative survival rate for the period 2000-2004 was 86%.[29]

The 2 major types of Hodgkin lymphoma are classical Hodgkin lymphoma, the most frequent type, and nodular lymphocyte-predominant Hodgkin lymphoma, which accounts for approximately 4-5% of cases.[37,134]

Geographic Variation

At the provincial/territorial level, significantly low rates for Hodgkin lymphoma were observed for males and females combined in Newfoundland and Labrador and British Columbia. A significantly elevated rate was observed in Quebec.

Significantly low rates were observed in the Simon Fraser, Richmond and Vancouver health regions of British Columbia. Elevated rates for Hodgkin lymphoma were observed in 3 dispersed health regions in a zone from northwest Ontario to central Quebec.

Known and Suspected Risk Factors

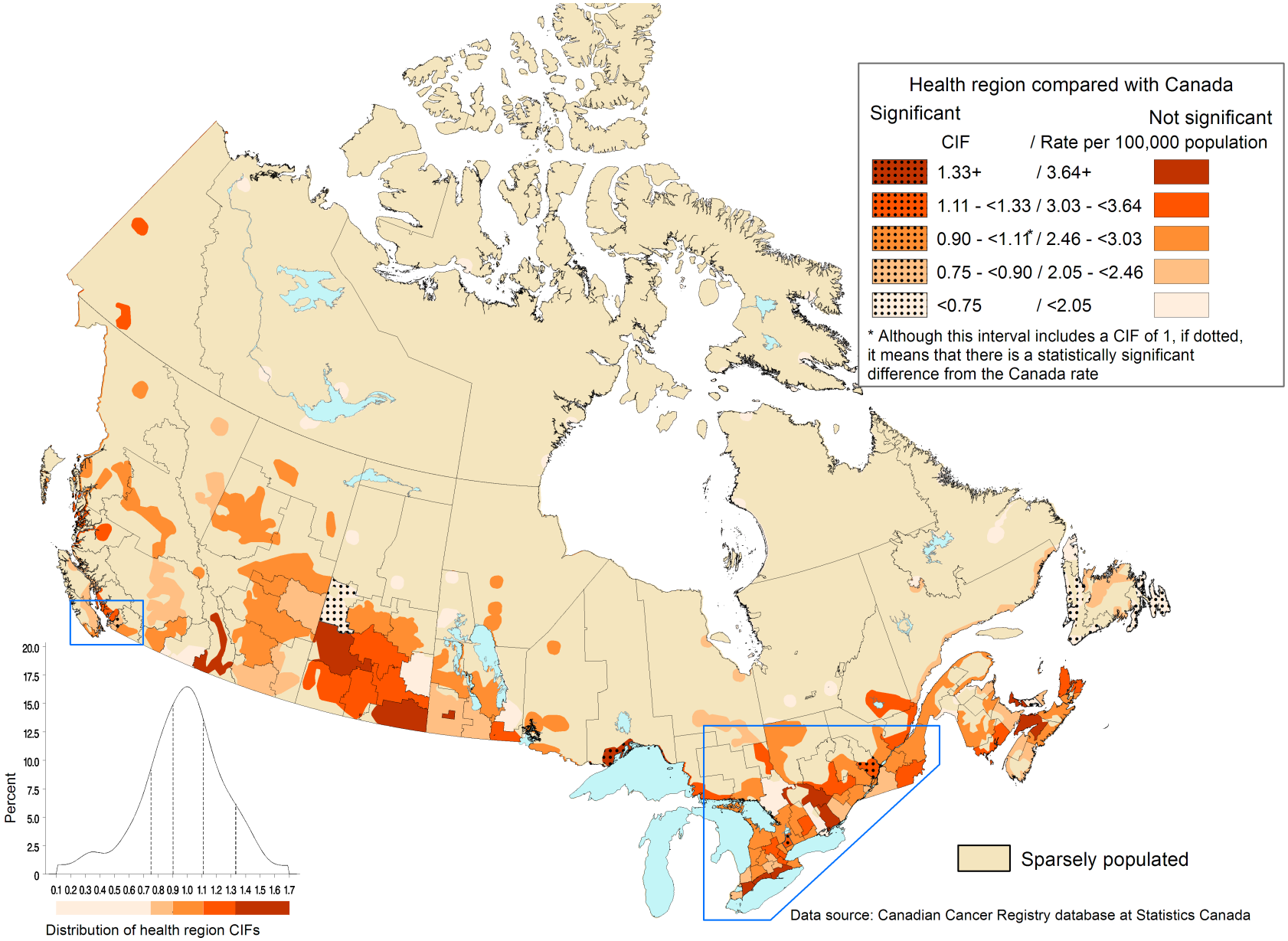
Little is known regarding causes for Hodgkin lymphoma. Although there are no established risk factors, several suspected causes and associations have been identified. Epstein-Barr virus (EBV), a ubiquitous virus infecting over 90% of the world population, has a causative role in the development of Hodgkin lymphoma for some cases. The difference between the developed and less developed nations is rooted in the time of infection. In developing countries, infection with EBV occurs within the first several years of life and has high prevalence by the age of 4. In the developed countries, however, infection with the disease occurs during one's 20s or 30s. Furthermore, it has been observed that EBV is more commonly associated with cases of Hodgkin lymphoma in older adults or younger children, possibly suggesting an alternate age-dependent pathway.[135]

When the infection is delayed, as is the case for the more developed countries, EBV causes infectious mononucleosis in up to 50% of patients.[136] This virus is associated with a 2- to 3-fold increase in the risk of developing Hodgkin lymphoma.[32,135]

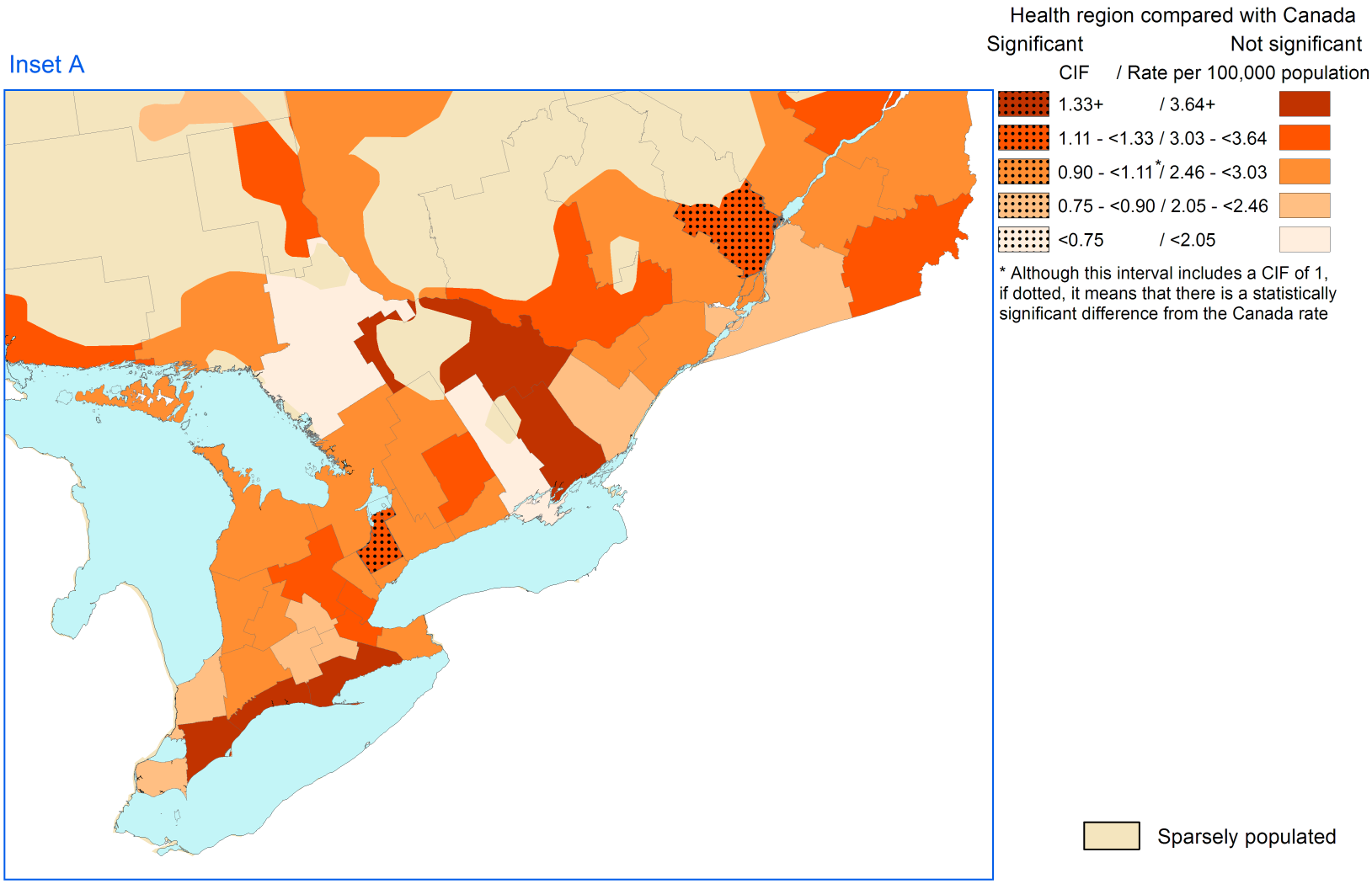
Socio-economic gradient is also associated with the risk of developing Hodgkin lymphoma for patients up to middle age. Higher socio-economic standing, lower numbers of siblings, single family housing and high level of maternal education are associated with an increased risk of developing the neoplasm. The suggested mechanism alleges that such factors mitigate exposure to common infectious agents. Early exposure, however, to infections such as chicken pox, measles, mumps, pertussis and rubella plays a protective role, apparently because it stimulates immunity.[136]

Familial history of disease or immune deficiency may also have a role. Increased incidence of Hodgkin lymphoma is observed for first-degree relatives. Siblings, for instance, have a 2- to 7-fold increased risk; same-sex siblings have a 9-fold increase – double the risk of siblings of the opposite sex.[32,37,136]

Map 31. Hodgkin lymphoma, 2000-2006, all ages

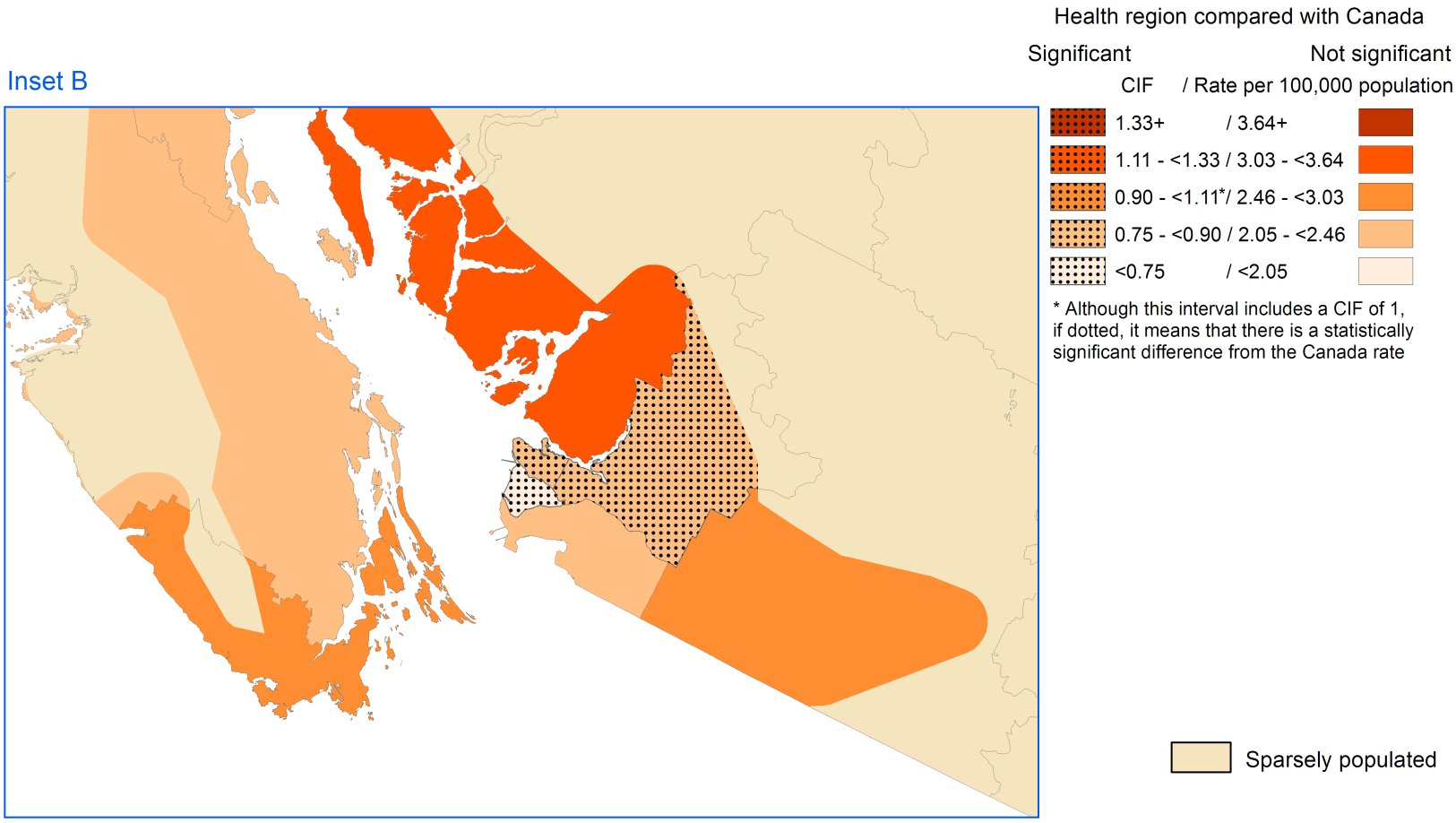


Map 31-A. Hodgkin lymphoma, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 31-B. Hodgkin lymphoma, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Non-Hodgkin lymphoma

(ICDO-3 histologies 9590-9596, 9670-9719, 9727-9729, histologies 9823 and 9827 for all sites except C42.0, C42.1 and C42.4, Maps 32 and 33)

Non-Hodgkin lymphoma (NHL) encompasses a wide variety of malignancies arising in lymphoid tissue. Depending on the subtype according to cell origin (described below), it may grow slowly or rapidly, and it often involves the bone marrow. It may arise in or spread to other organs, including the central nervous system. Although both children and adults develop non-Hodgkin lymphoma, in contrast to adult lymphomas, childhood NHL is almost never follicular and occurs predominantly in the chest and abdomen and less commonly at peripheral nodal sites.

NHL was diagnosed in 6,540 new patients in 2006 (3,048 females and 3,492 males).[27] NHL also occurs among children, with 191 cases diagnosed per year in Canada in children aged 0-14 years during 2001-2005.[29] It has an age-standardized incidence rate that increases to a maximum at ages 80-84, and approximately 99% of the cases occur in patients aged 20 and above.[27] The 5-year relative survival for the period 2002-2004 was 63% for females and 60% among males.[29] Among females, a change point in the annual incidence rates was detected starting from 2001, followed by an annual increase of 1.4%.[28] Among males, there has been a statistically significant annual percentage increase of 0.5% during the period 1997-2006.[28] Incidence rates among children aged 0-14 during this period have been stable. The lifetime risk for developing NHL is 1.9% among women and 2.2% among men.[29]

The current classification scheme for NHL is an updated World Health Organization (WHO) version of the Revised European American Lymphoma (REAL) classification, which refers to morphology and cell lineage, and divides NHL according to B-cell or T-cell/natural killer (NK)-cell origin and whether they are composed of precursor (thymic or lymphoblastic) or peripheral (mature or post-thymic) lymphocytes.[10] Mature B-cell lymphomas account for the majority of lymphomas, with the largest 2 subsets accounting for approximately 50% of NHLs: diffuse large B-cell lymphoma making up about 30% and follicular lymphoma, about 20%.[137] It is not uncommon, for lymphomas and leukemias to be different manifestations of the same entity. Lymphoblastic lymphomas and acute lymphocytic leukemias, and B-cell chronic lymphocytic leukemias and B-cell small lymphocytic lymphoma illustrate this point.

Geographic Variation

At the provincial/territorial level, NHL rates among males and females did not correspond closely. Significantly low rates for NHL were observed for both males and females in Newfoundland and Labrador and Alberta, and among females in British Columbia. Significantly elevated rates were observed among females in Ontario and among males in New Brunswick.

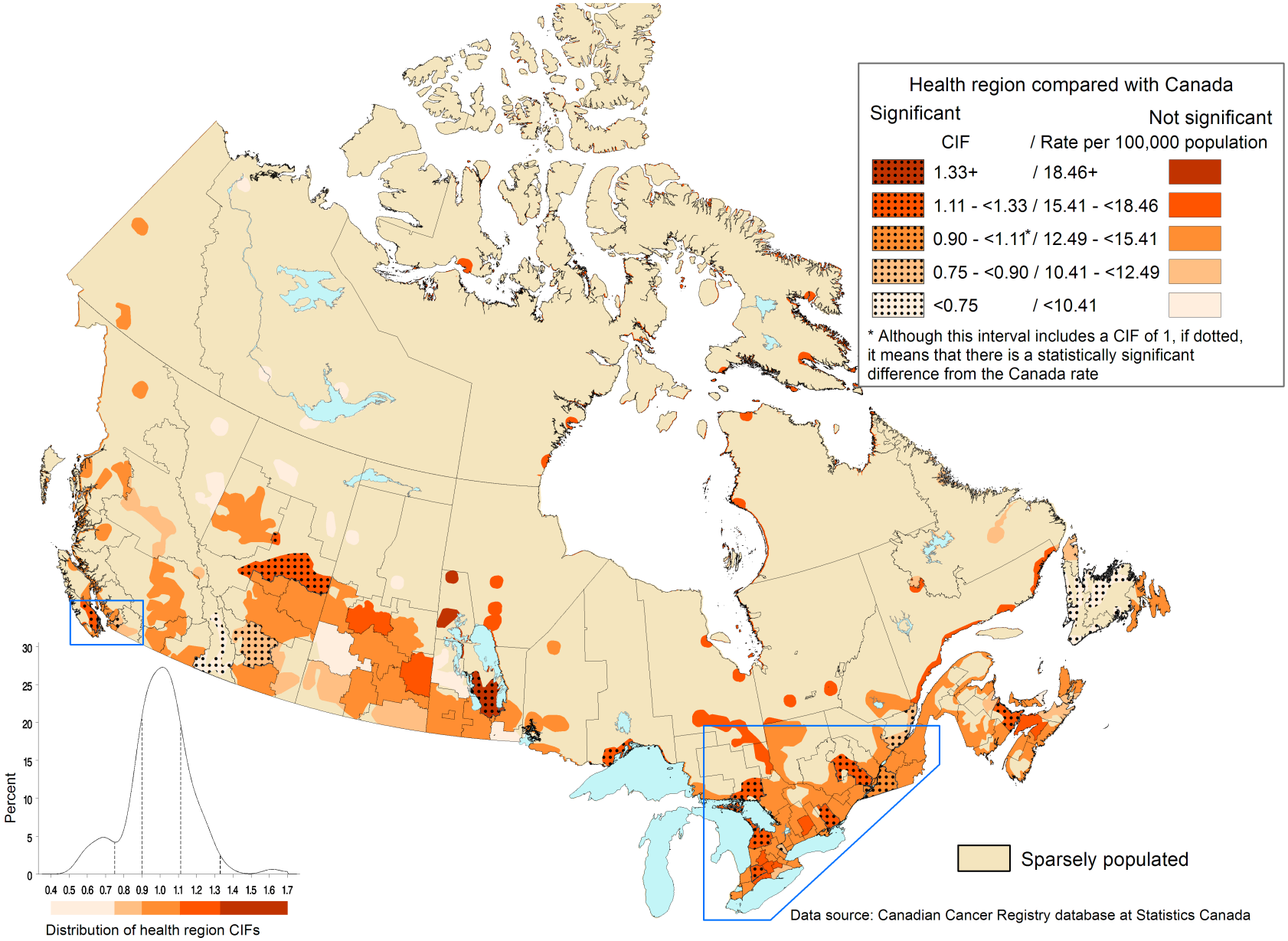
In Newfoundland and Labrador, significantly lower rates were observed among females in 2 of 4 health regions and among males in all health regions. Significantly low rates were also seen on the mainland in southern British Columbia among females. There was a zone of significantly elevated rates in eastern and northern Ontario and Manitoba. For males, New Brunswick Health Region 1 and Nova Scotia Zone 3 also had significantly elevated rates.

Known and Suspected Risk Factors

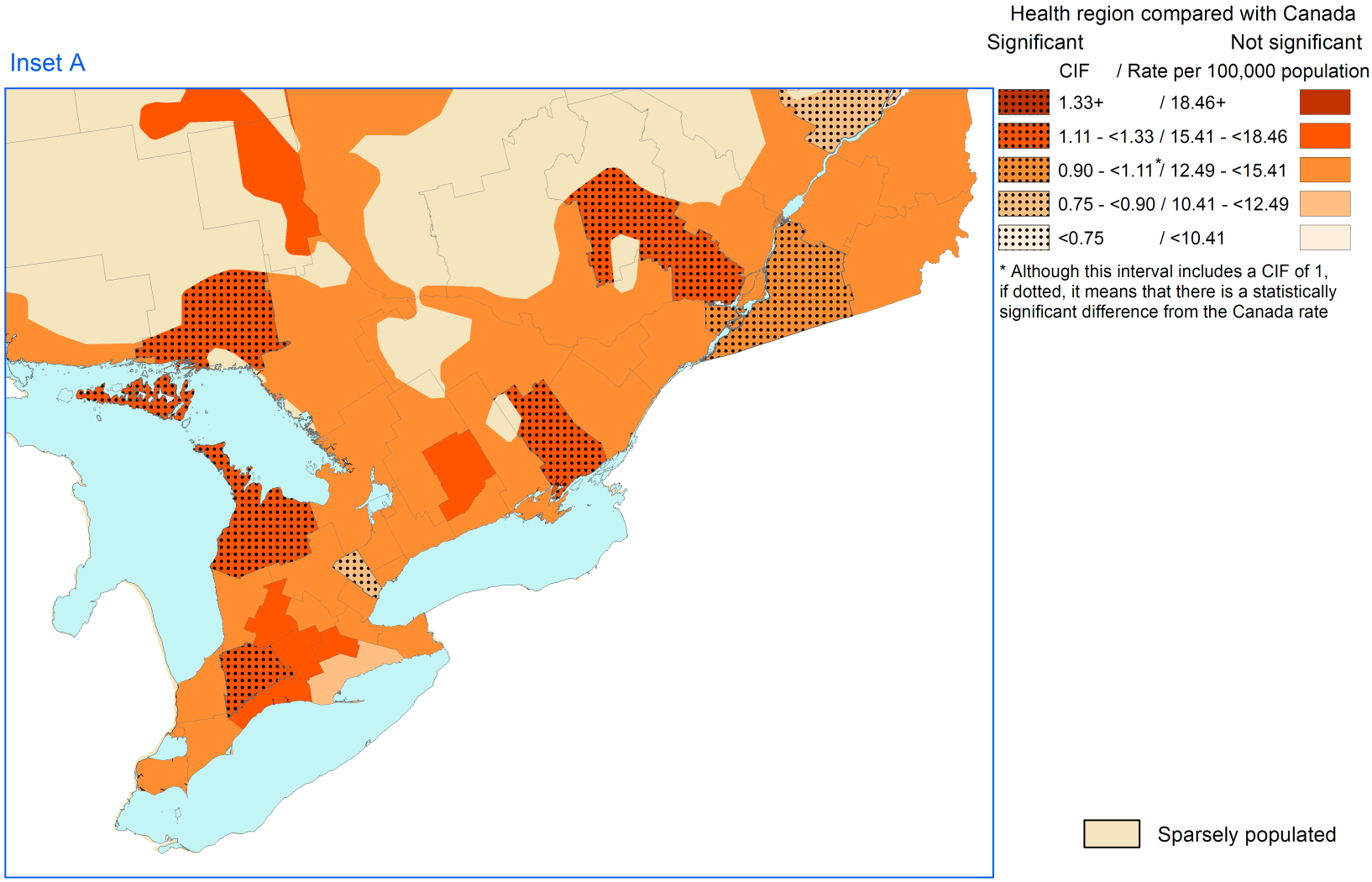
The various subtypes of NHL may each have different risk factors.[138] Major risk factors have been identified for only some specific lymphomas. Risk for NHL is positively associated with family history, and a stronger aggregation is observed among siblings.[139,140] Research has been centred on immunologic genes such as regulatory cytokines or inflammatory genes. Furthermore, both human T-cell lymphotropic virus type 1 (HTLV-1) and Epstein-Barr virus (EBV) are infectious pathogenic agents for NHL, wherein the former is responsible for adult T-cell leukemia/lymphoma.[32,33,37] EBV on the other hand, is responsible for several subtypes, including 45-70% of the cases of human immunodeficiency virus 1 (HIV-1)-related lymphoma, almost all of the cases of primary central nervous system lymphomas, approximately half of all diffuse large cell and immunoblastic NHLs, approximately 20% of the cases of Burkitt's lymphoma, and several other subtypes.[32,141]

Other infectious agents associated with increased risk of NHL include bacterial agents such as *Helicobacter pylori, Chlamydia psittaci, Campylobacter jejuni, Mycobacterium tuberculosis, Borrelia burgdorferi*, hepatitis C and human herpesvirus 8 (HHV-8).[32,33] Imunocompromised individuals have greater risk of NHL.[32,33,139] Acquired immunodeficiency syndrome (AIDS) elevates the risk for NHL by greater than 30-fold.[141] Inherited immunodeficiency diseases are rare but nevertheless increase the risk for NHL. These include diseases such as ataxia telangiectasia, Wiskott-Aldrich syndrome, Chédiak-Higashi syndrome, X-linked lymphoproliferative syndrome, severe combined immunodeficiency syndrome and common variable immunodeficiency syndrome.[32,37] Moreover, the risk for NHL increases in patients who have undergone organ transplantation (renal or cardiac) and are subsequently placed on immunosuppressive drugs;[32,139] typically the elevated risk is in the order of 10- to 50-fold with a latency as short as a year or less.[141]

Map 32. Non-Hodgkin lymphoma, females, 2000-2006, all ages

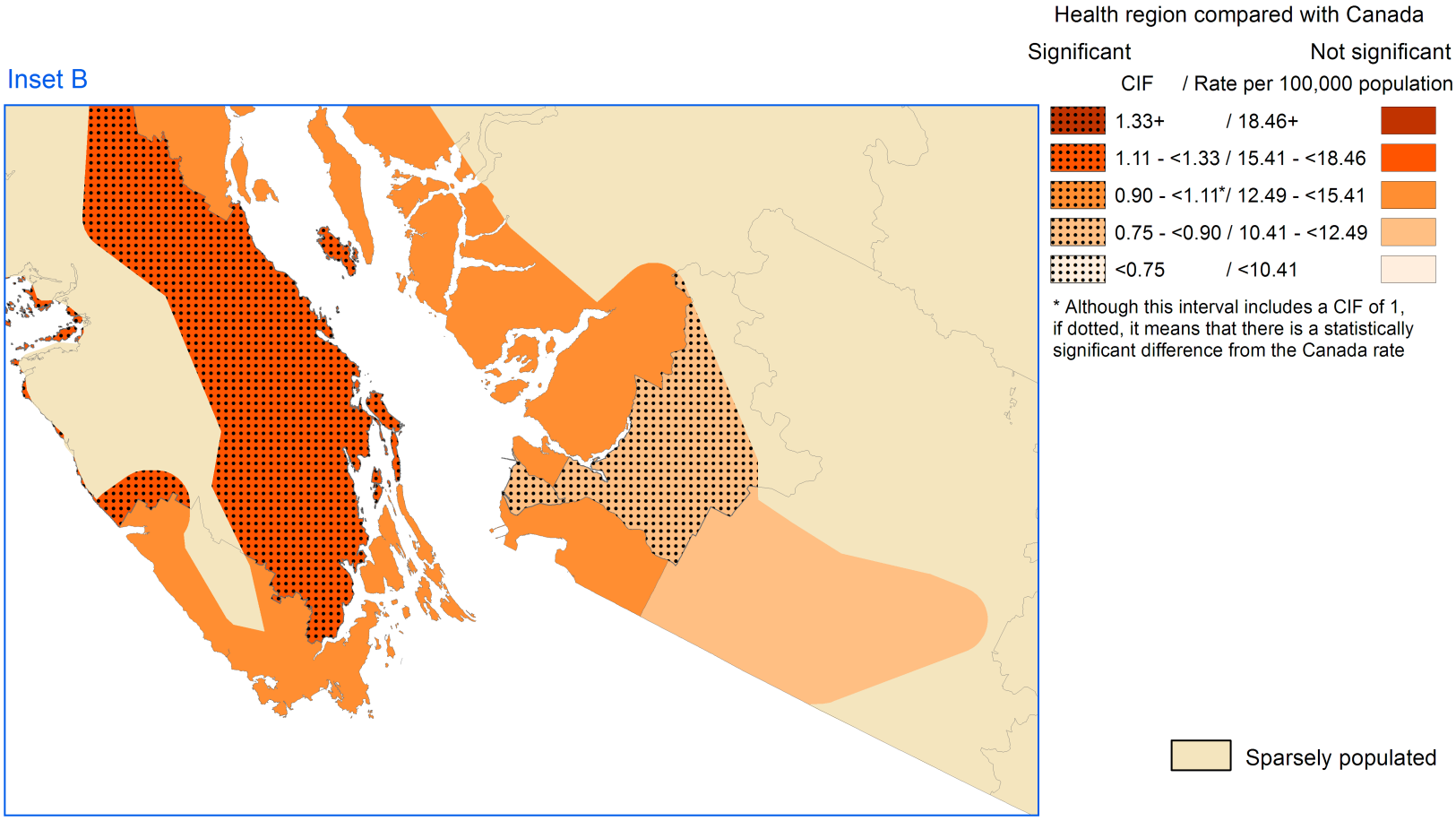


Map 32-A. Non-Hodgkin lymphoma, females, 2000-2006, all ages



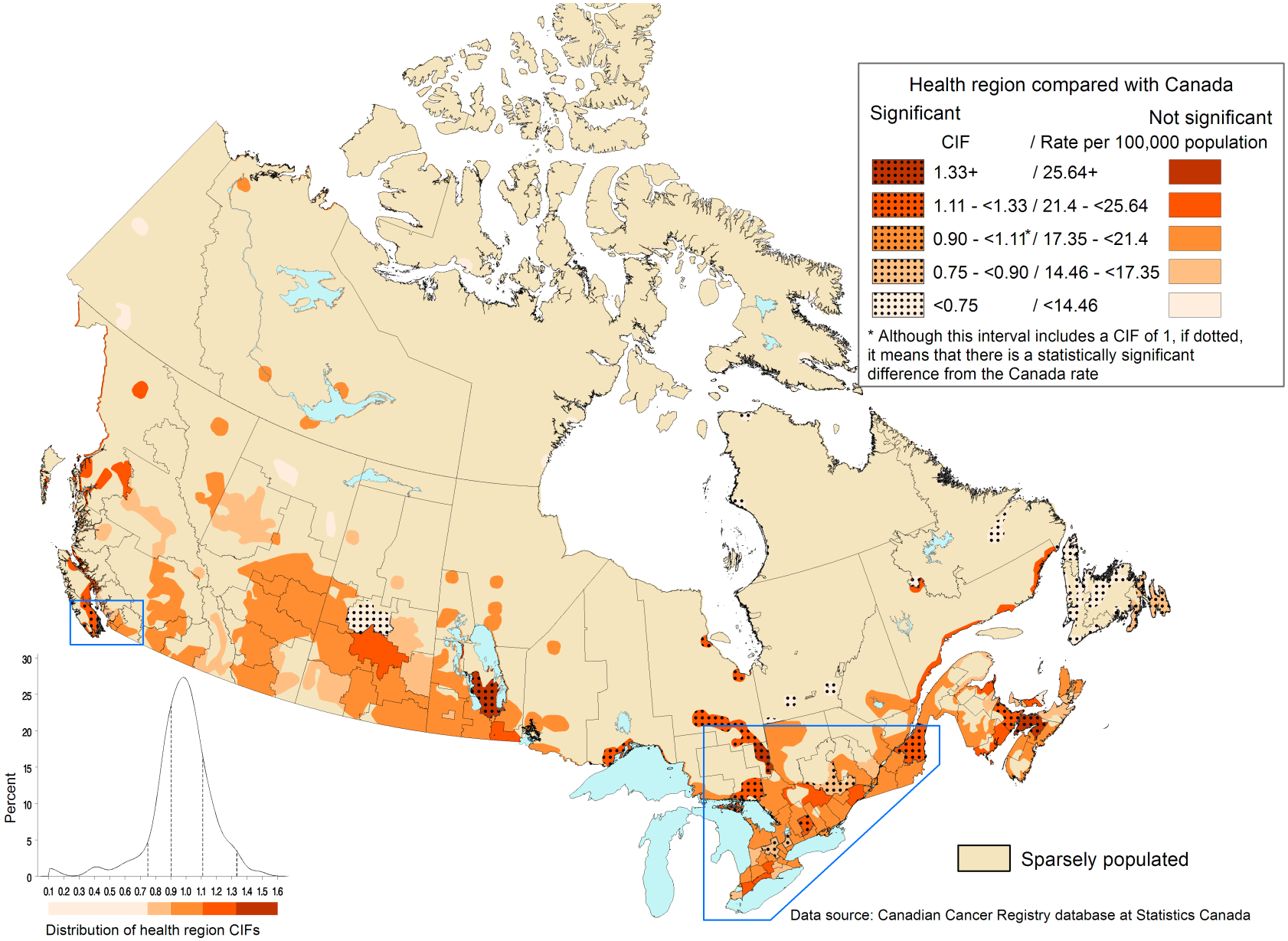
Data source: Canadian Cancer Registry database at Statistics Canada

Map 32-B. Non-Hodgkin lymphoma, females, 2000-2006, all ages

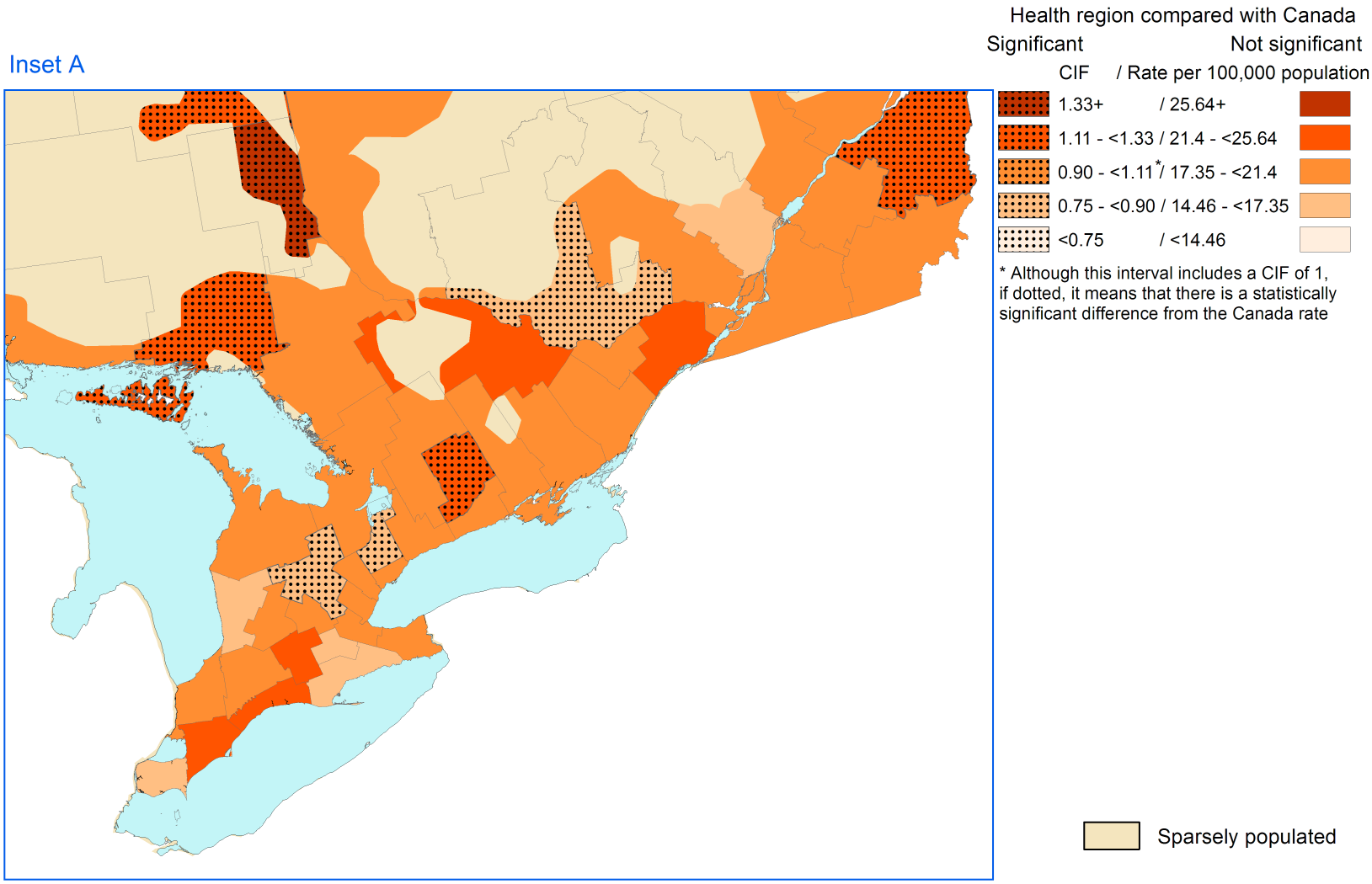


Data source: Canadian Cancer Registry database at Statistics Canada

Map 33. Non-Hodgkin lymphoma, males, 2000-2006, all ages

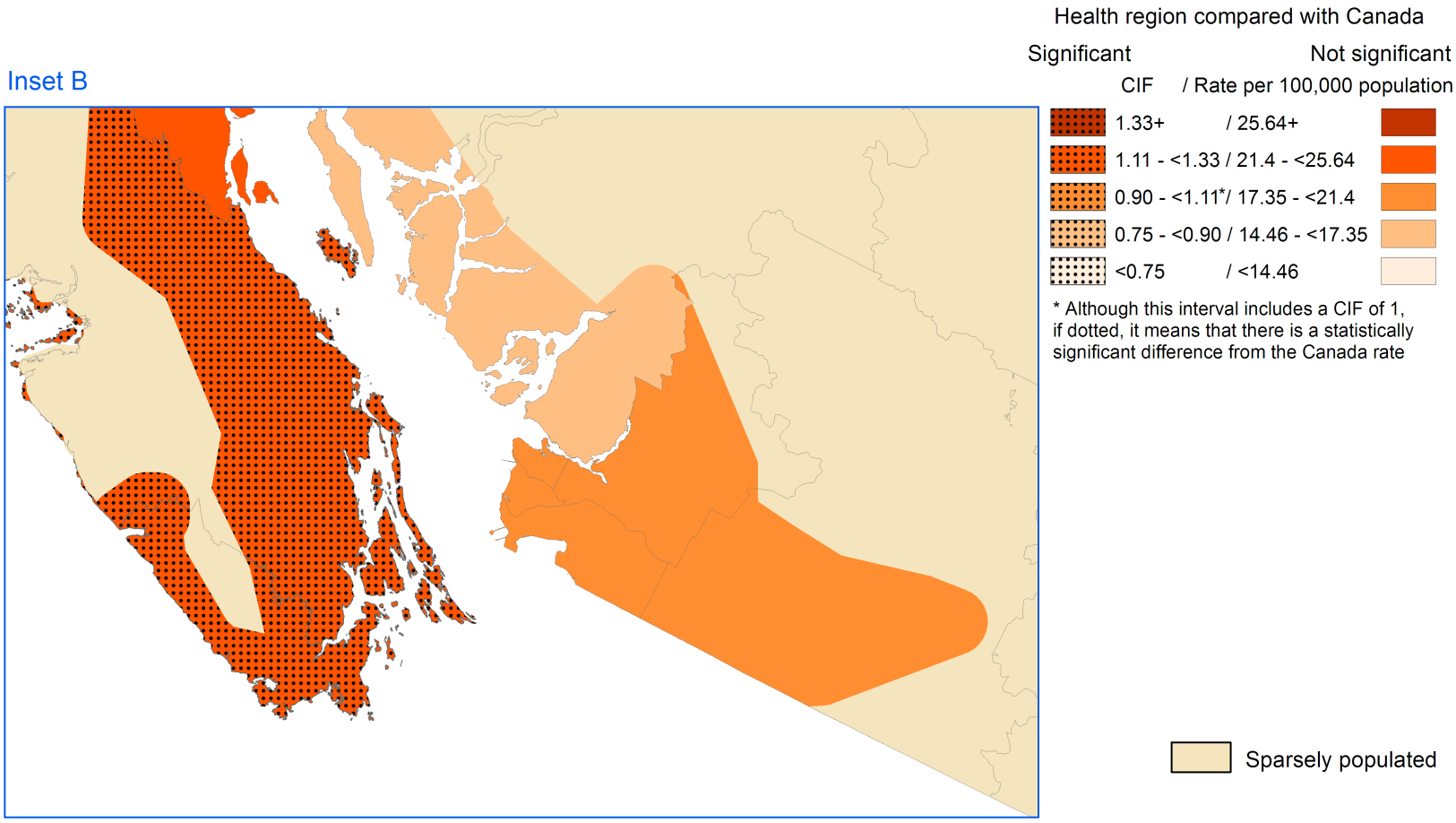


Map 33-A. Non-Hodgkin lymphoma, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 33-B. Non-Hodgkin lymphoma, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Multiple myeloma

(ICDO-3 histologies 9731-9732, 9734, Maps 34 and 35)

Multiple myeloma is the third most common hematologic cancer behind non-Hodgkin lymphoma and leukemia, accounting for 2,044 cases in 2006 (917 in females; 1,127 in males).[27] The age-standardized incidence rates have remained stable for the past decade. Among males, the age-at-incidence curve increases to age 85 or more, while the rate among females peaks among ages 80-84.[27] Multiple myeloma is rare in younger people, with only about 6% of the cases occurring before the age of 50. Relative to other hematopoietic cancers, multiple myeloma has a poor survival with a 5-year survival rate of 34% for the period 2002-2004.[29]

Multiple myeloma, or plasma cell myeloma, is a plasma cell tumour that begins when plasma cells, the final product of B-cell differentiation, excessively proliferate. Included in the multiple myeloma category is plasmacytoma, which occurs when the abnormal cells collect to form a tumour. Other types of plasma cell neoplasms not included in the multiple myeloma category include macroglobulinemia, in which abnormal plasma cells build up in the bone marrow, and monoclonal gammapathy of undetermined significance (MGUS), in which there are abnormal plasma cells in the bone marrow but which is not classified as a malignant neoplasm.

Geographic Variation

Significantly low rates for multiple myeloma were observed for both males and females in Newfoundland and Labrador and British Columbia, and among females in Alberta. Significantly elevated rates were observed in Quebec and Ontario, and among males in Prince Edward Island.

Health regions with significantly low rates were observed in southern British Columbia and eastern Newfoundland. Regions with elevated rates of multiple myeloma included Durham Regional Health Unit in Ontario and the lower St. Lawrence area of Quebec among males. However, the percentage of microscopic confirmation for multiple myeloma cases from Durham Regional Health Unit was 53%, lower than the percentage for Ontario which was 65% and the increased rate is believed to be coding related.

Known and Suspected Risk Factors

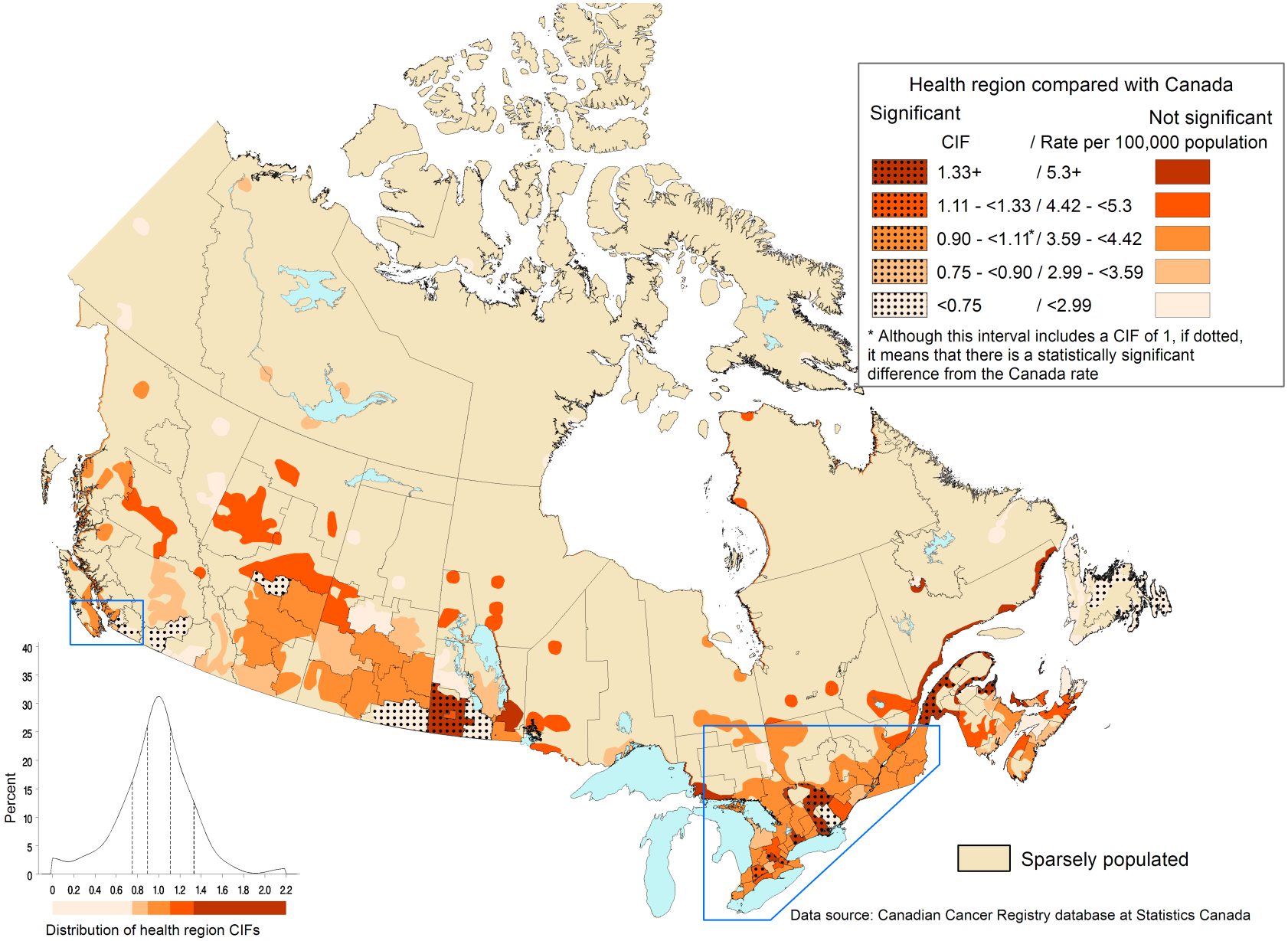
Modifiable risk factors for multiple myeloma remain largely unknown. Previously high exposure to ionizing radiation has been established as a risk factor for developing multiple myeloma, with a latent period lasting anywhere from 10 to 30 years.[33,37] This risk has been observed in occupations such as radiology, nuclear weapons industries and radium dial painters.[33,37]

Genetic and hereditary factors are believed to play a role, which increases the risk between 2- and 4-fold.[33,142,143] Moreover, multiple myeloma shows strong familial clustering, and HLA-Cw2 may be an implicated gene.[37,142] In one study,[143] the relative risk for a personal history of cancer prior to the diagnosis was 3.84, while a family history of cancer in a first-degree relative resulted in a relative risk of approximately 2-fold.

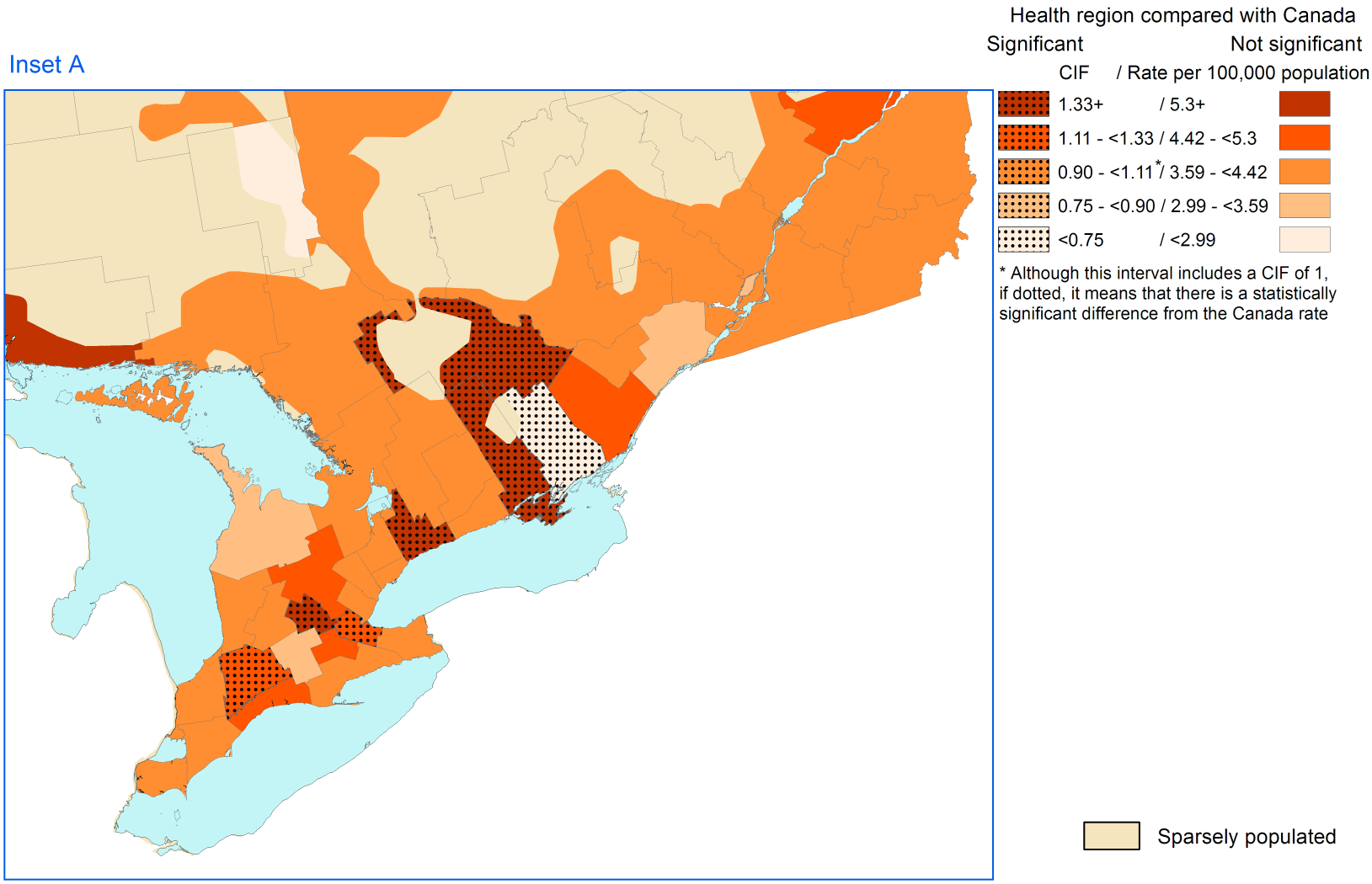
MGUS is a condition in which abnormal plasma cells produce high levels of monoclonal protein. Individuals with MGUS are at increased risk for developing multiple myeloma.[144]

A history of illness may also increase the risk for developing multiple myeloma. Illnesses include rheumatoid arthritis, shingles, tuberculosis, kidney or bladder infection, scarlet fever, pernicious anemia, musculoskeletal disorders and eczema.[143]

Map 34. Multiple myeloma, females, 2000-2006, all ages

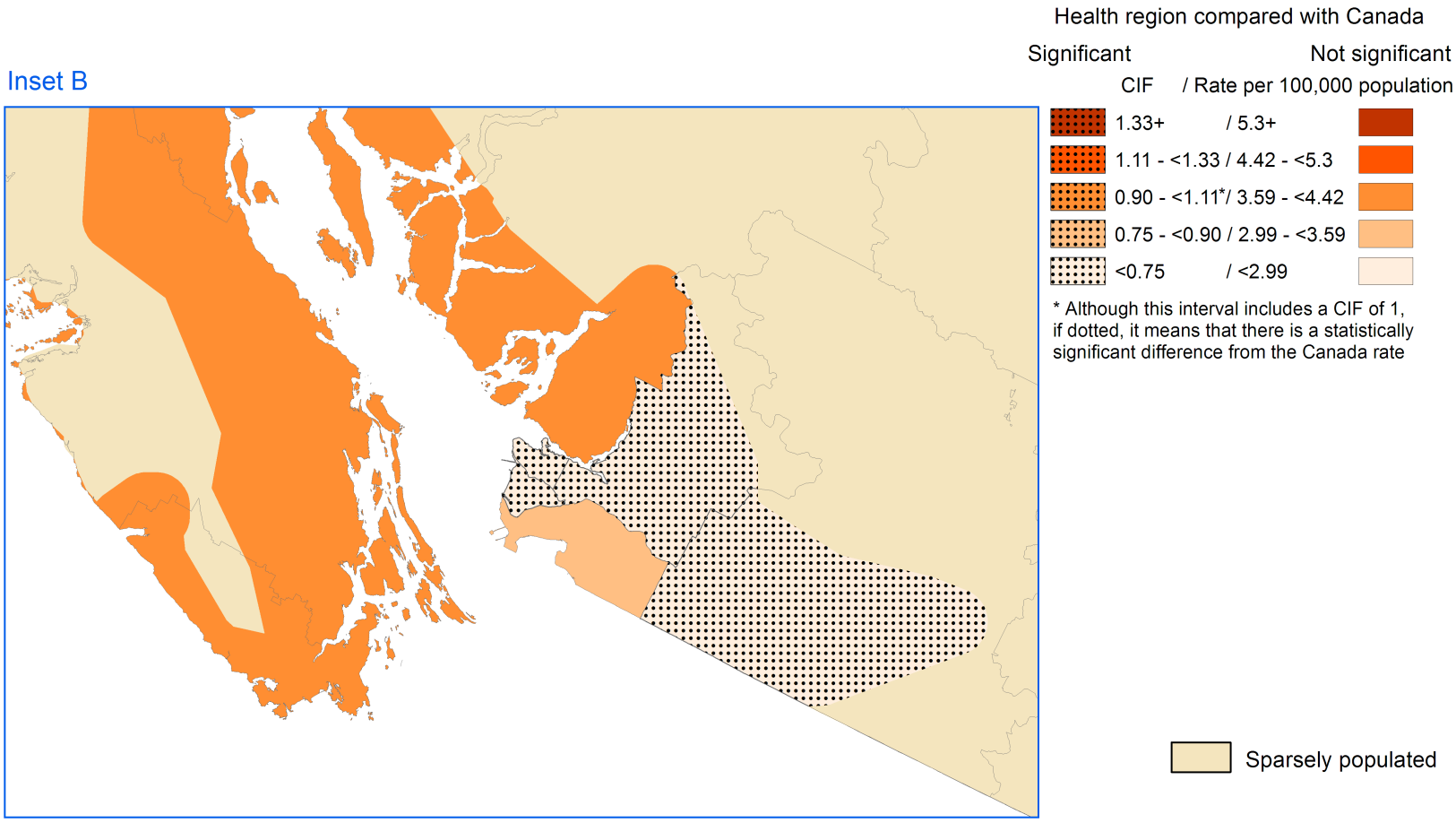


Map 34-A. Multiple myeloma, females, 2000-2006, all ages



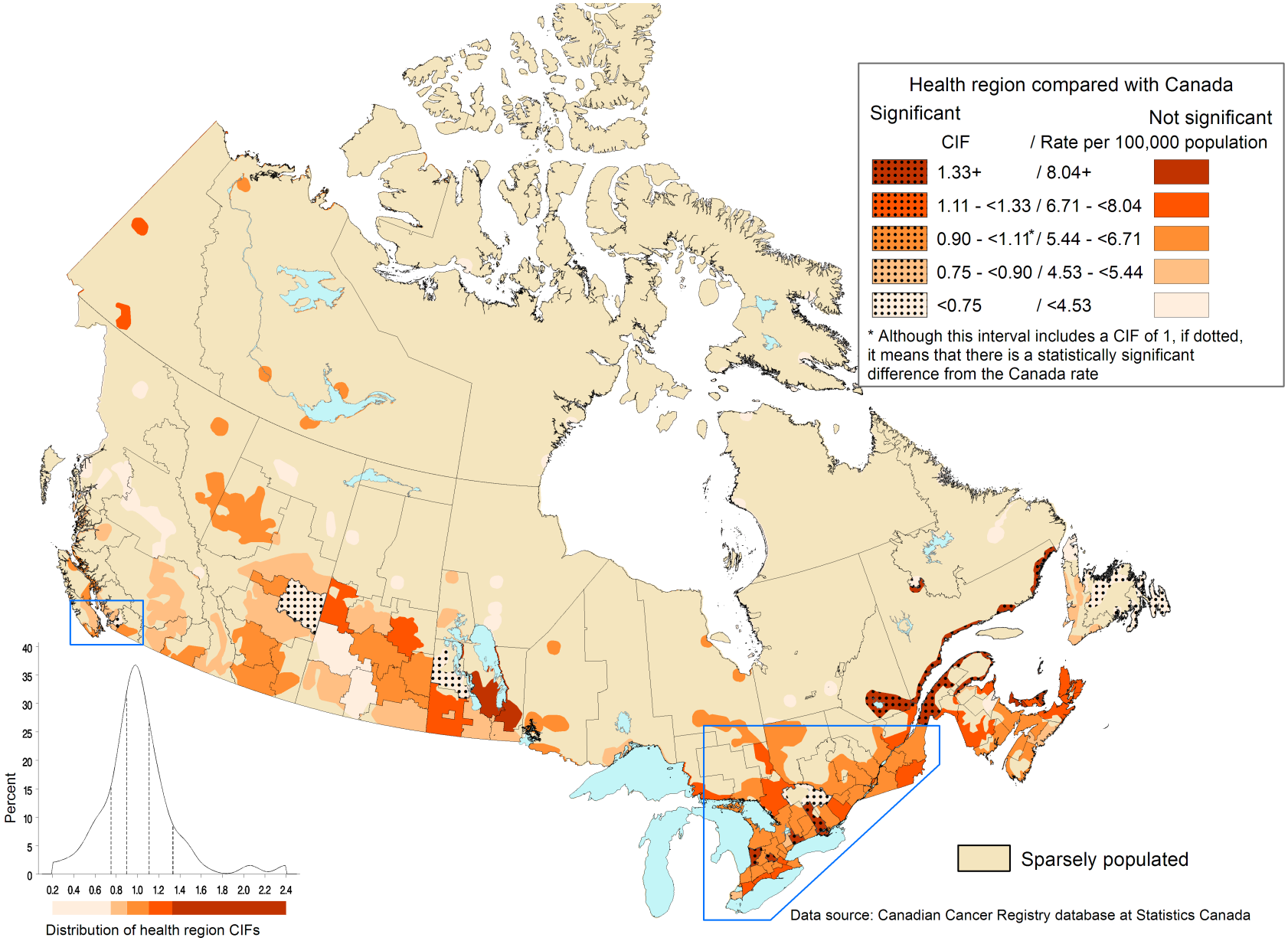
Data source: Canadian Cancer Registry database at Statistics Canada

Map 34-B. Multiple myeloma, females, 2000-2006, all ages

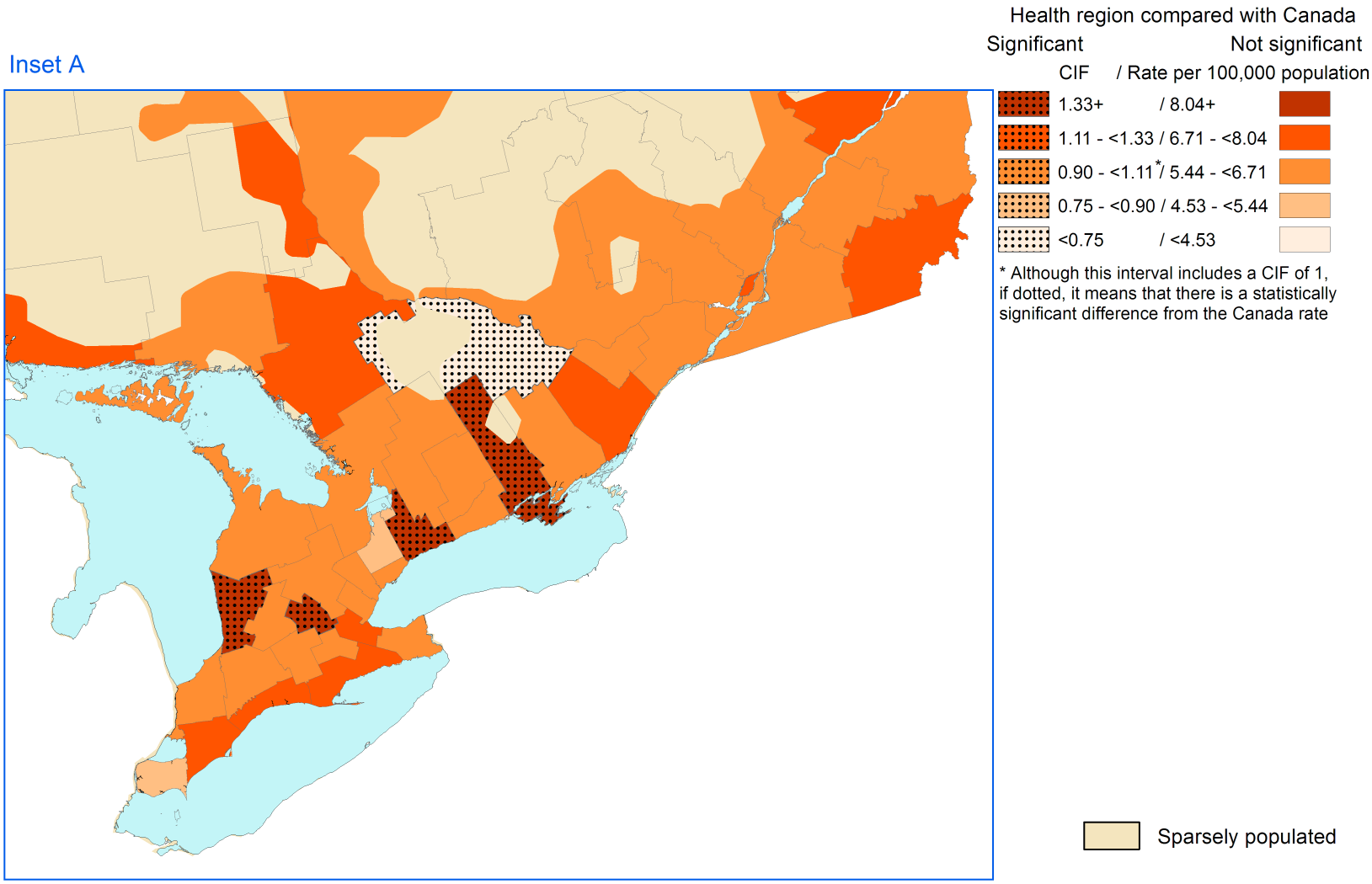


Data source: Canadian Cancer Registry database at Statistics Canada

Map 35. Multiple myeloma, males, 2000-2006, all ages

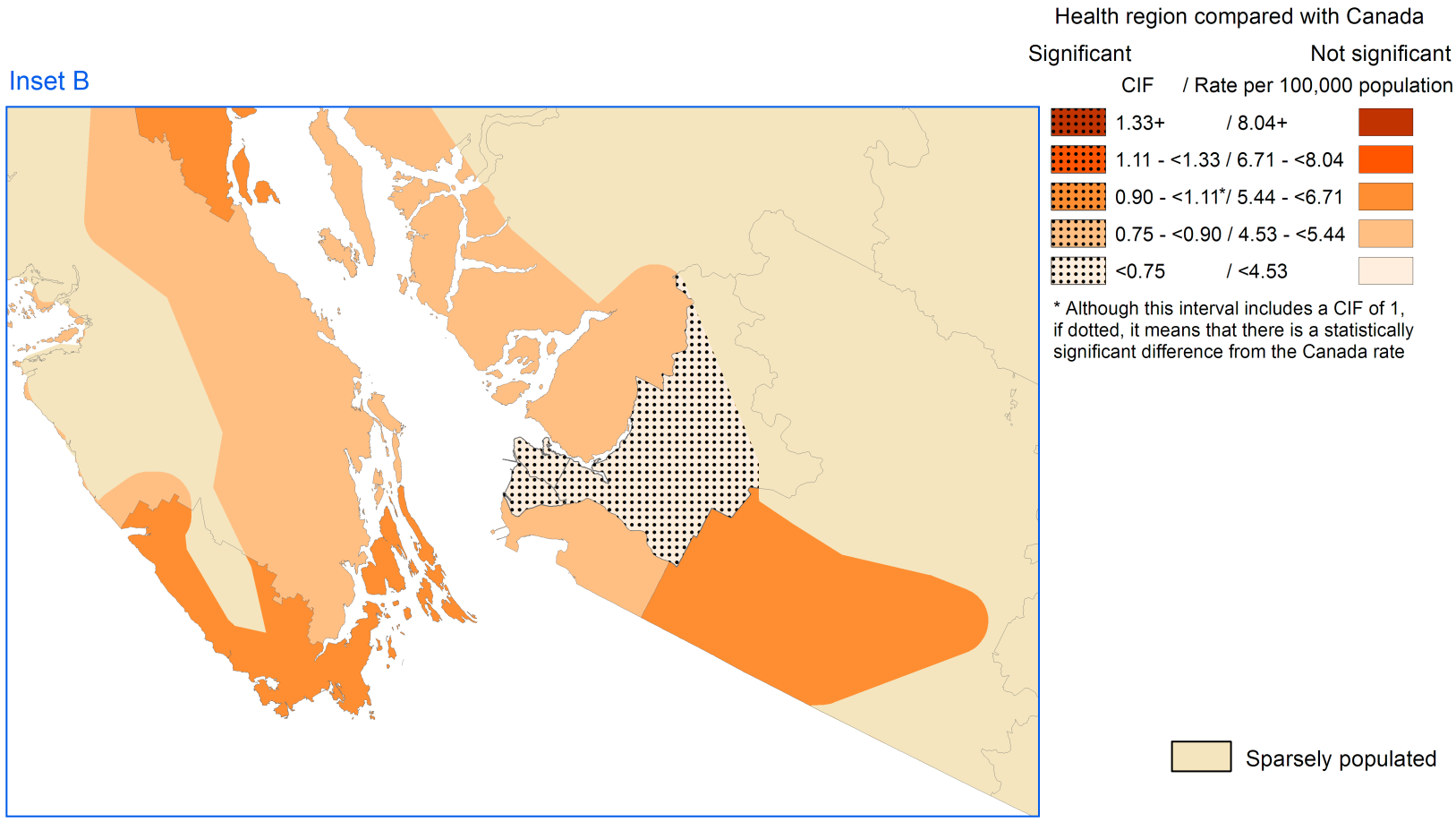


Map 35-A. Multiple myeloma, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 35-B. Multiple myeloma, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Leukemia

(ICDO-3 histology 9733, 9742, 9800-9801, 9805, 9820, 9826, 9831-9837, 9840, 9860-9861, 9863, 9866-9867, 9870-9876, 9891, 9895-9897, 9910, 9920, 9930-9931, 9940, 9945-9946, 9948, 9963-9964, histologies 9823 and 9827 for sites C42.0, C42.1, C42.4, Maps 36 and 37)

Leukemia is a heterogeneous group of neoplasms of the white blood cells, arising mostly in the bone marrow. The group is presented as a whole due to the limited numbers of cases in the subgroups. Leukemia is subdivided according to the cell origin, either lymphoid or myeloid, and also based on progression, either acute or chronic. Whereas chronic leukemia tends to be slow developing, acute leukemia grows quickly. Four distinct common leukemia categories exist: acute lymphocytic leukemia (ALL), chronic lymphocytic leukemia (CLL), acute myeloid leukemia (AML) and chronic myeloid leukemia (CML).

In 2006, there were 4,523 new cases of leukemia (1,951 in females; 2,572 in males).[27] It is the most common malignancy in early childhood (ages 0-14), accounting for 73% of hematological malignancies in this age group for 2001-2005 and 32% of all Canadian childhood malignancies.[29] The age-standardized incidence curve has a peak during early childhood (ages 0-4), then decreases and is not exceeded until the age group 50-54. Thereafter, the incidence escalates with increasing age, and the vast majority of leukemia cases (approximately 80%) occur from age 50 onward.[27] The annual percentage change for 1997-2006 was 0.8% among females and 0.5% among males.[28] The 5-year relative survival rate is moderate, at 51%, but has increased by about 5 percentage points from the period 1992-1994 to 2002-2004.[29] Among children aged 0-14, the 5-year observed survival is 86% overall, 91% for lymphoid leukemia and 67% for acute myeloid leukemia.[29]

Geographic variation

At the provincial/territorial level, significantly low rates for leukemia were observed for both males and females in Newfoundland and Labrador and British Columbia, and among males in Nova Scotia and New Brunswick. Significantly elevated rates were observed for both males and females in Manitoba, Saskatchewan and Alberta, and among males in Ontario.

Regions of significantly low rates included Newfoundland and the Simon Fraser and Richmond health regions in British Columbia, as well as 4 additional health regions in southern British Columbia among males. Regions of high incidence rates for leukemia were observed in south and central Manitoba, Saskatchewan and Alberta.

Known and Suspected Risk Factors

The causes of leukemia are largely unknown. Known risk factors can broadly be grouped into hereditary, viral and environmental categories and may vary according to subtype.

Some hereditary syndromes are associated with increased incidence of acute leukemias; Down syndrome, characteristically seen in younger patients with ALL, for example, is associated with an increased risk ranging from 10- to 30-fold for acute leukemia.[32,33,37,145,146] Other genetic syndromes and diseases include Klinefelter's syndrome, Bloom syndrome, ataxia telangiectasia, Li-Fraumeni syndrome, Shwachman syndrome, neurofibromatosis, Patau syndrome, Kostman syndrome, Fanconi's anaemia and Wiskott-Aldrich syndrome.[33,37,145,146] Furthermore, translocations, deletions and alterations are common for chromosomes 8 and 11 in those with acute leukemias. Despite this, only about 5% of ALL and AML have been associated with inherited genetic syndromes.[147]

CLL differs from acute leukemia in that familial patterns of inheritance are consistently observed, although they account for only a small percent of cases. First-degree relatives of CLL cases have been found to have a 7-fold increased risk for CLL.[148] Furthermore, at the molecular level, 40-50% of CLL cases are characterized by cytogenic abnormalities.[37] CML is caused by an acquired genetic defect. The chromosomal abnormality, Philadelphia chromosome, occurs in 95% of CML cases, and the BCR-ABL gene has a principal role in CML pathogenesis. Despite this, these 2 anomalies are not exclusive to CML and are common in approximately 25-50% of adult ALL cases.[32,37]

Viruses, particularly retroviruses, may also be causative agents in the development of certain types of leukemia. Although viruses do not appear to induce CLL, adult T-cell leukemia/lymphoma is caused by the human T-cell lymphotropic virus type 1 (HTLV-1).[32,33,146,149] Infection occurs in clusters in Japan, Africa, the Caribbean, Colombia and Melanesia.[150] At times, infection with the disease is not sufficient to induce cancer; malignancy is often the product of infection concomitant with other cumulative alterations.[149]

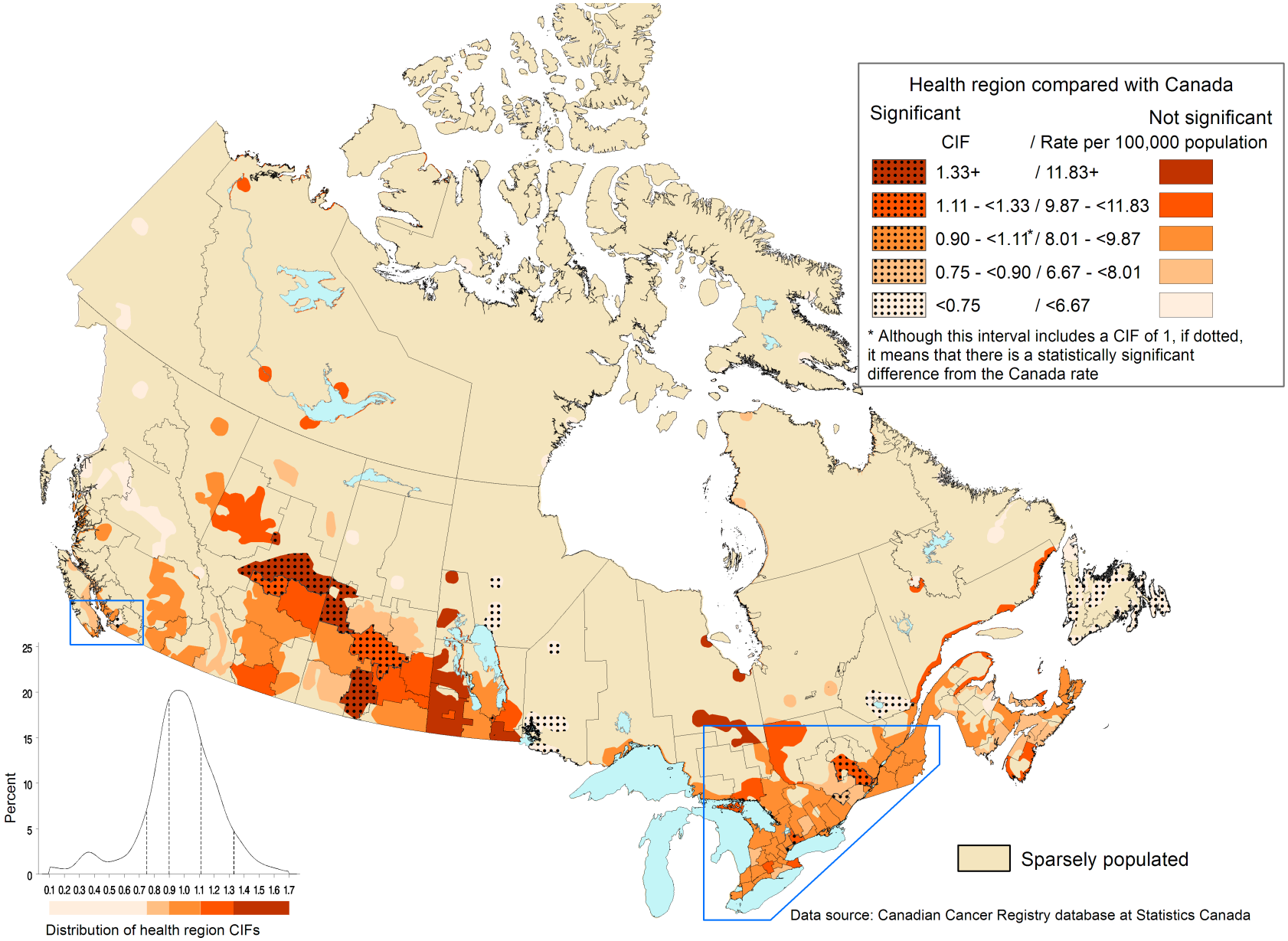
Infection with measles at an early age, psoriasis and JC polyomavirus are all associated with increased incidence of adult ALL.[33] Burkitt's lymphoma is associated with Epstein-Barr virus (EBV) and therefore may also be linked to Burkitt's leukemia (B-cell ALL). Furthermore, adult ALL and aggressive NK-cell leukemia have reported associations with EBV.[33,150,151]

Ionizing radiation is a risk factor for AML and is strongly related to increased incidence of ALL and CML. Exposures are varied and include atomic bomb exposure (Japan and Nagasaki), other nuclear exposures (Chernobyl), therapeutic radiation exposure and in utero exposure.[32,33,145,149]

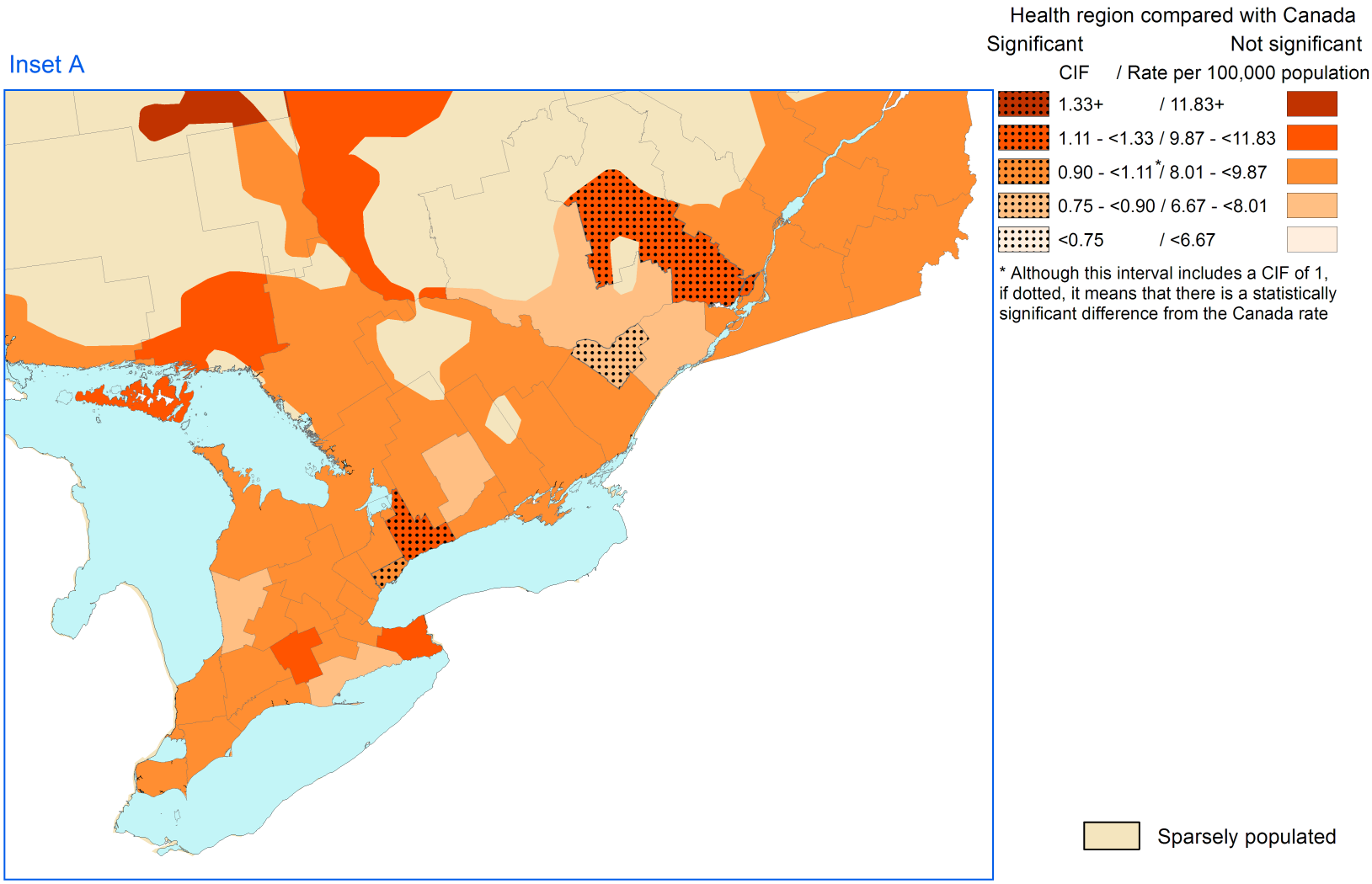
Furthermore, the use of chemo-therapeutic agents such as alkylating agents, topoisomerase II inhibitors and taxanes, and the use of other chemotherapeutic agents such as epipodophyllotoxins and anthracyclines for other malignancies (e.g., secondary ALL) are also risk factors. The International Agency for Research on Cancer (IARC) has evaluated occupational exposure to benzene as carcinogenic to humans, with excess incidence reported for AML.[152] Benzene is also found in cigarette smoke and gasoline. IARC has also evaluated formaldehyde as carcinogenic, with risk particularly for myeloid leukemia.[152]

Exposure to tobacco smoke can elevate the risk of developing AML 2-fold and may account for up to 20% of AML cases.[32,37,149] Smoking is related to both types of acute leukemia and may function in a dose-dependent manner, particularly in patients older than 60.[33,37,153]

Map 36. Leukemia, females, 2000-2006, all ages

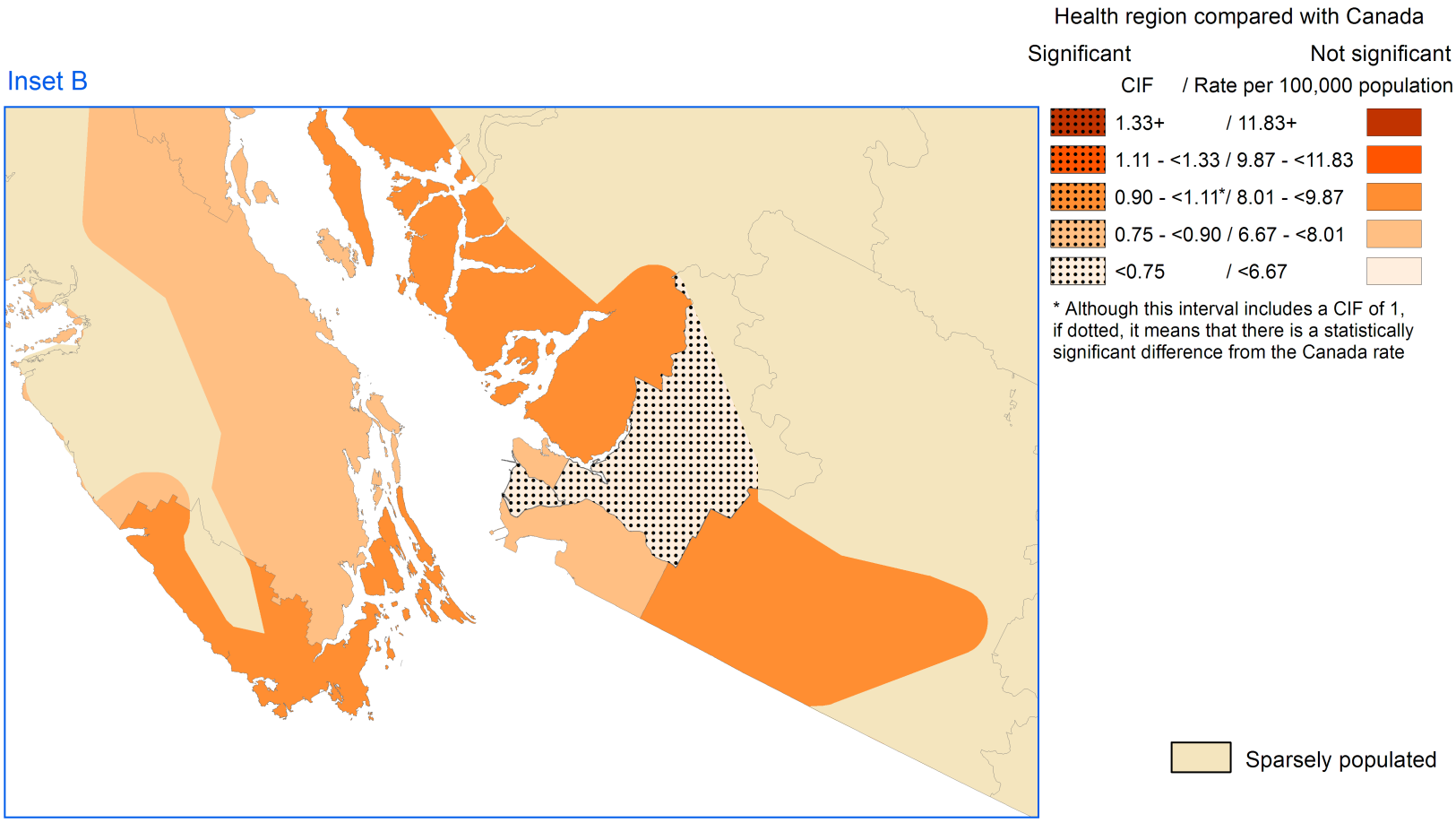


Map 36-A. Leukemia, females, 2000-2006, all ages



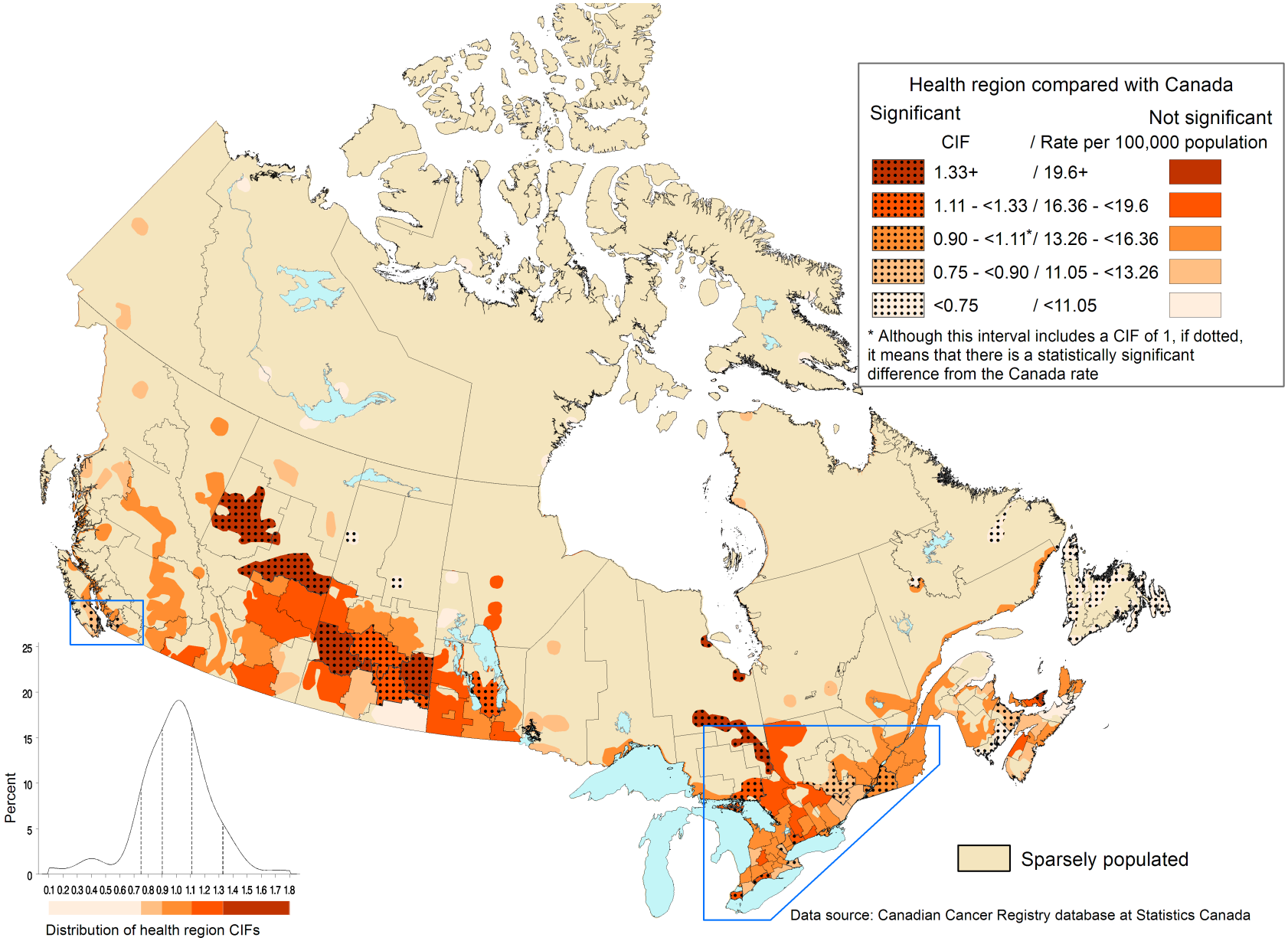
Data source: Canadian Cancer Registry database at Statistics Canada

Map 36-B. Leukemia, females, 2000-2006, all ages

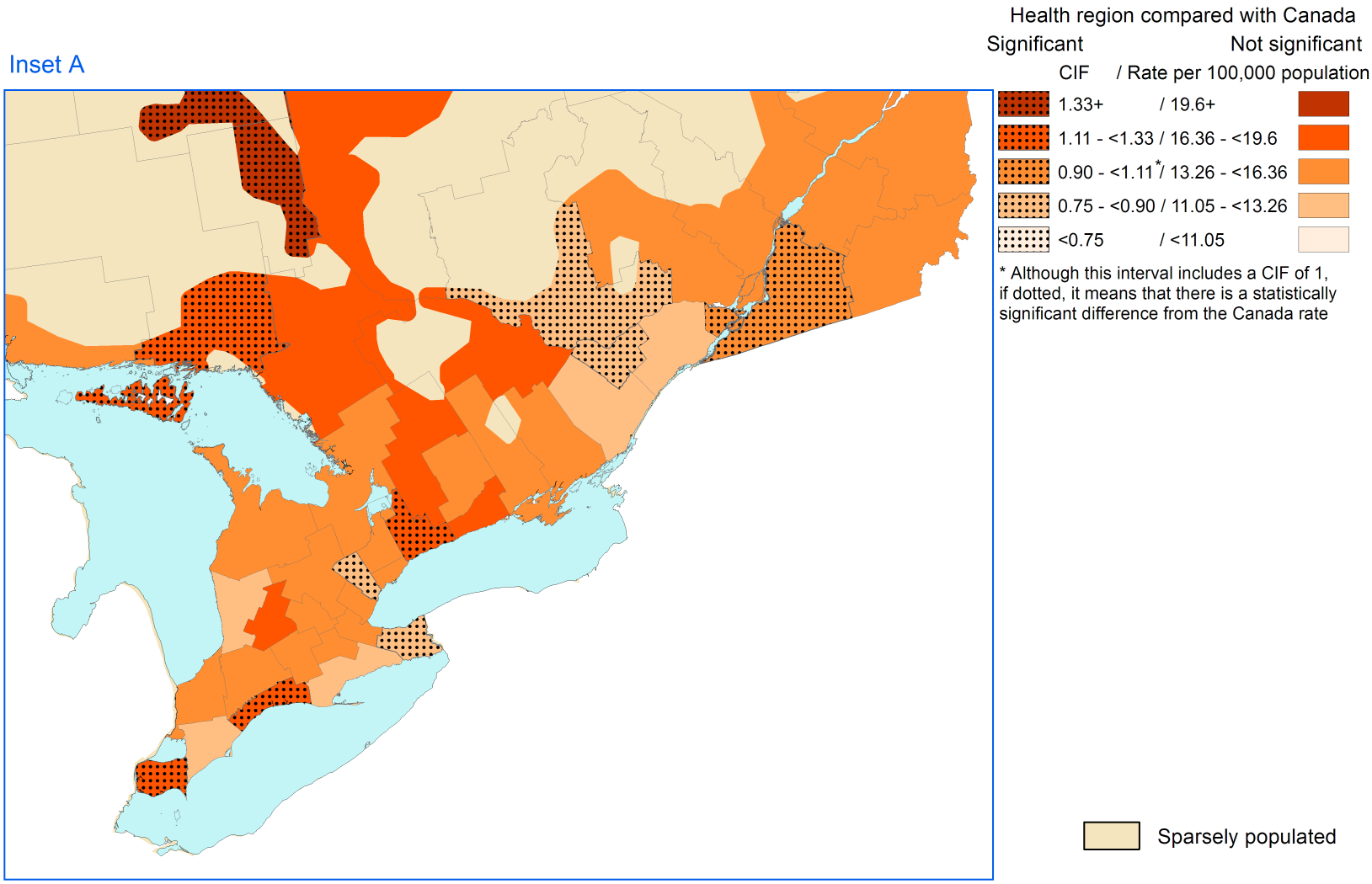


Data source: Canadian Cancer Registry database at Statistics Canada

Map 37. Leukemia, males, 2000-2006, all ages

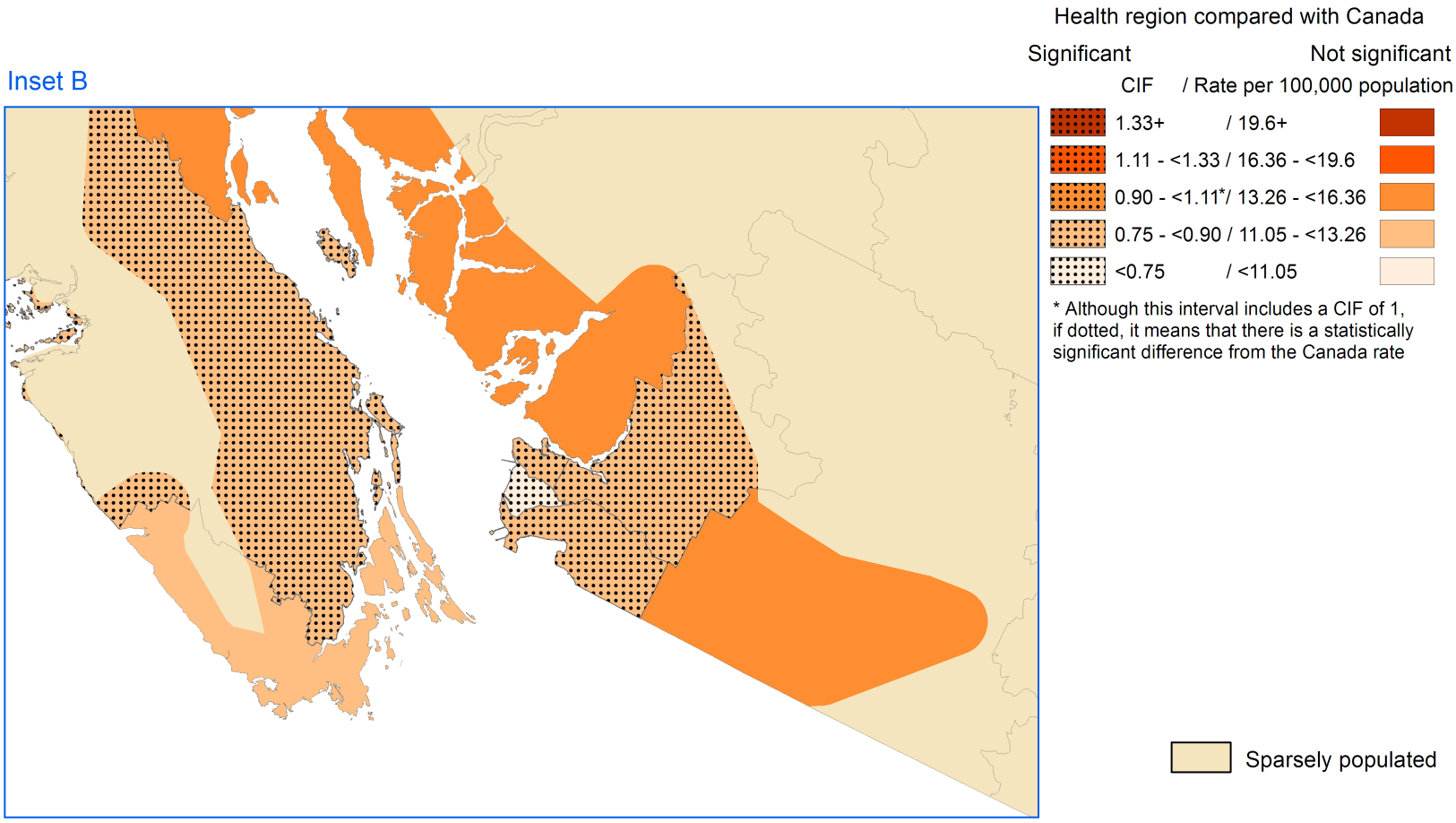


Map 37-A. Leukemia, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

Map 37-B. Leukemia, males, 2000-2006, all ages



Data source: Canadian Cancer Registry database at Statistics Canada

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APPENDIX 1. 1991 Canadian standard population

Age (years)	<1	1-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44
Percent	1.4	5.5	6.9	6.8	6.8	7.5	9.0	9.2	8.3	7.6
Age (years)	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85+	
Percent	6.0	4.8	4.4	4.2	3.9	3.0	2.2	1.4	1.0	

APPENDIX 2. Cancer definitions

Cancer	ICDO-3 Site/histology type*
Buccal cavity and pharynx	C00-C14
Esophagus	C15
Stomach	C16
Colon and rectum	C18-C20, C26.0
Liver	C22.0
Pancreas	C25
Other digestive system	C24.0-C24.9, C22.1, C48.0-C48.2, C26.8-C26.9, C48.8
Larynx	C32
Lung and bronchus	C34
Melanoma of the skin	C44 (Type 8720-8790)
Female breast	C50
Cervix uteri	C53
Uterus excluding cervix	C54-C55
Ovary	C56
Other female genital system	C52.9, C51.0-C51.9, C57.0-C58.9
Prostate	C61
Testis	C62
Bladder (including *in situ*)	C67

Cancer	ICDO-3 Site/histology type*
Kidney and renal pelvis	C64-C65
Brain and other nervous system	C70–C72
Thyroid	C73
Hodgkin lymphoma*	Type 9650-9667
Non-Hodgkin lymphoma*	Type 9590-9596, 9670-9719, 9727-9729
	Type 9823, all sites except C42.0, C42.1, C42.4
	Type 9827, all sites except C42.0, C42.1, C42.4
Multiple myeloma*	Type 9731-9732, 9734
Leukemia*	Type 9733, 9742, 9800-9801, 9805, 9820, 9826, 9831-9837, 9840, 9860-9861, 9863, 9866-9867, 9870-9876, 9891, 9895-9897, 9910, 9920, 9930-9931, 9940, 9945-9946, 9948, 9963-9964
	Type 9823 and 9827, sites C42.0, C42.1, C42.4
Other, ill-defined and unknown	Type 9740-9741, 9750-9758, 9760-9769, 9950-9962, 9970-9989
	Type 8000-9049, 9060-9139, 9141-9589, sites C42.0-C42.4, C76.0-C76.8, C77.0-C77.9, C80.9
All sites	All invasive sites

* Histology types 9590–9989 (leukemia, lymphoma and multiple myeloma) and 9050–9055 (mesothelioma) are excluded from other specific organ sites."

Note: ICDO-3 refers to the third edition of the International Classification of Diseases for Oncology (2000).
Figures are for invasive sites, including *in situ* bladder cancer and excluding non-melanoma skin cancer.

APPENDIX 3. Health regions in Canada, 2007
(names and codes)

Newfoundland and Labrador

1011 Eastern Regional Integrated Health Authority
1012 Central Regional Integrated Health Authority
1013 Western Regional Integrated Health Authority
1014 Labrador-Grenfell Regional Integrated Health Authority

Prince Edward Island

1101 Kings Country
1102 Queens Country
1103 Prince Country

Nova Scotia

1201 Zone 1
1202 Zone 2
1203 Zone 3
1204 Zone 4
1205 Zone 5
1206 Zone 6

New Brunswick

1301 Region 1
1302 Region 2
1303 Region 3
1304 Region 4
1305 Region 5
1306 Region 6
1307 Region 7

Quebec

2401 Région du Bas-Saint-Laurent
2402 Région du Saguenay - Lac-Saint-Jean
2403 Région de la Capitale-Nationale
2404 Région de la Mauricie et du Centre-du-Québec
2405 Région de l'Estrie
2406 Région de Montréal
2407 Région de l'Outaouais
2408 Région de l'Abitibi-Témiscamingue
2409 Région de la Côte-Nord
2411 Région de la Gaspésie - Îles-de-la-Madeleine
2412 Région de la Chaudière-Appalaches
2413 Région de Laval
2414 Région de Lanaudière
2415 Région des Laurentides
2416 Région de la Montérégie
2419 Région du Nord-du-Québec,
Région du Nunavik and
Région des Terres-Cries-de-la-Baie-James

Ontario

Public Health Units

3526 The District of Algoma Health Unit
3527 Brant County Health Unit
3530 Durham Regional Health Unit
3531 Elgin-St Thomas Health Unit
3533 Grey Bruce Health Unit
3534 Haldimand-Norfolk Health Unit
3535 Haliburton, Kawartha, Pine Ridge District Health Unit
3536 Halton Regional Health Unit
3537 City of Hamilton Health Unit
3538 Hastings and Prince Edward Counties Health Unit
3539 Huron County Health Unit
3540 Chatham-Kent Health Unit
3541 Kingston, Frontenac and Lennox and Addington Health Unit
3542 Lambton Health Unit
3543 Leeds, Grenville and Lanark District Health Unit
3544 Middlesex-London Health Unit
3546 Niagara Regional Area Health Unit
3547 North Bay Parry Sound District Health Unit
3549 Northwestern Health Unit
3551 City of Ottawa Health Unit
3552 Oxford County Health Unit
3553 Peel Regional Health Unit
3554 Perth District Health Unit
3555 Peterborough County-City Health Unit
3556 Porcupine Health Unit
3557 Renfrew County and District Health Unit
3558 The Eastern Ontario Health Unit
3560 Simcoe Muskoka District Health Unit
3561 Sudbury and District Health Unit
3562 Thunder Bay District Health Unit
3563 Timiskaming Health Unit
3565 Waterloo Health Unit
3566 Wellington-Dufferin-Guelph Health Unit
3568 Windsor-Essex County Health Unit
3570 York Regional Health Unit
3595 City of Toronto Health Unit

Manitoba

4610 Winnipeg Regional Health Authority
4615 Brandon Regional Health Authority
4620 North Eastman Regional Health Authority
4625 South Eastman Regional Health Authority
4630 Interlake Regional Health Authority
4640 Central Regional Health Authority
4645 Assiniboine Regional Health Authority
4660 Parkland Regional Health Authority
4670 Norman Regional Health Authority
4685 Burntwood Regional Health Authority and Churchill Regional Health Authority

Saskatchewan

4701 Sun Country Regional Health Authority
4702 Five Hills Regional Health Authority
4703 Cypress Regional Health Authority
4704 Regina Qu'Appelle Regional Health Authority
4705 Sunrise Regional Health Authority
4706 Saskatoon Regional Health Authority
4707 Heartland Regional Health Authority
4708 Kelsey Trail Regional Health Authority
4709 Prince Albert Parkland Regional Health Authority
4710 Prairie North Regional Health Authority
4714 Mamawetan Churchill River Regional Health Authority, Keewatin Yatthé Regional Health Authority and Athabasca Health Authority

Alberta

4821 Chinook Regional Health Authority
4822 Palliser Health Region
4823 Calgary Health Region
4824 David Thompson Regional Health Authority
4825 East Central Health
4826 Capital Health
4827 Aspen Regional Health Authority
4828 Peace Country Health
4829 Northern Lights Health Region

British Columbia

5911 East Kootenay
5912 Kootenay-Boundary
5913 Okanagan
5914 Thompson/Cariboo
5921 Fraser East
5922 Fraser North
5923 Fraser South
5931 Richmond
5932 Vancouver
5933 North Shore/Coast Garibaldi
5941 South Vancouver Island
5942 Central Vancouver Island
5943 North Vancouver Island
5951 Northwest
5952 Northern Interior
5953 Northeast

Yukon

6001 Yukon

Northwest Territories

6101 Northwest Territories

Nunavut

6201 Nunavut

APPENDIX 4. Abbreviations and glossary

Abbreviations

AC	- adenocarcinoma
AIDS	- acquired immunodeficiency syndrome
ALL	- acute lymphocytic leukemia
AML	- acute myeloid leukemia
ASIR	- age-standardized incidence rate
BMI	- body mass index
CCR	- Canadian Cancer Registry
CIF	- comparative incidence figure
CLL	- chronic lymphocytic leukemia
CML	- chronic myeloid leukemia
CNS	- central nervous system
DCO	- death certificate only
DNA	- deoxyribonucleic acid
EBV	- Epstein-Barr virus
GCT	- germ cell tumour
GERD	- gastroesophageal reflux disease
HBV	- hepatitis B virus
HCC	- hepatocellular carcinoma
HCV	- hepatitis C virus
HIV-1	- human immunodeficiency virus 1
HPV	- human papilloma virus
HTLV-I	- human T-cell lymphotropic virus 1
IARC	- International Agency for Research on Cancer
ICD-O-3	- International Classification of Diseases for Oncology, Third Edition
MALT	- mucosa-associated lymphoid tissue
MEN	- multiple endocrine neoplasia
MGUS	- monoclonal gammopathy of undetermined significance
MTC	- medullary thyroid carcinoma
NHL	- non-Hodgkin lymphoma
NSAIDS	- non-steroidal anti-inflammatory drugs
PSA	- prostate-specific antigen (assay)
RCC	- renal cell carcinoma
SCC	- squamous cell carcinoma
SEER	- (United States) Surveillance, Epidemiology and End Results Program
SIR	- standardized incidence ratio
WHO	- World Health Organization

Glossary

age-standardization: a procedure where weighted averages are used to adjust rates, such as incidence rates; a procedure designed to minimize the effects of differences in the age composition of given populations (such as those of census divisions) when comparing rates for these populations. In the *Canadian Cancer Incidence Atlas*, the direct method of age-standardization was used.

age-standardized incidence rate: a rate derived from the procedure described immediately above, expressed as cases per 100,000 person-years.

body mass index: defined most commonly as weight in kilograms divided by height in metres squared.

cancer registration practices: the methods by which cancer patients are registered in a provincial/territorial cancer registry database.

census division: a general term applying to counties, regional districts, regional municipalities, etc. In Newfoundland and Labrador, Manitoba, Saskatchewan, Alberta, Yukon, Northwest Territories and Nunavut, the term describes geostatistical areas that have been created by Statistics Canada in co-operation with the province/territory.

choropleth map: a map having levels (such as quintile ranges) of a variable represented by coloured shading; a mapping technique whereby established geographical regions are entirely covered by patterns or shades to symbolize data that are assumed to be homogeneous.

coefficient of variation: the standard error divided by the mean. (See "standard error" below.)

comparative incidence figure: the ratio of the health region age-standardized cancer incidence rate to the Canadian rate.

decile: the value at the 10^{th} (or multiple of 10^{th}) percentile. Note that the median is the 50^{th} percentile, which is also a decile value.

ecumene: a geographic term for significantly inhabited regions. Populated areas are shaded in their appropriate colour providing they have a minimum population density of about 0.4 persons per square kilometre (approximately 1 person per square mile).

etiology: the cause of a disease.

health regions: legislated administrative areas defined by provincial ministries of health. These administrative areas represent geographic areas of responsibility for hospital boards or regional health authorities. Each territory is presented separately as 1 health region, and census divisions are presented for Prince Edward Island because health regions have been abolished there.

incidence rate: the number of newly diagnosed cases per 100,000 population.

significance (in statistics): the probability of observing an event that is as extreme or more extreme than that which occurred under a specified null hypothesis and assumed probability distribution. The null hypothesis is that the census division rate is the same as the national rate.

standard deviation (s.d.): a measure of dispersion within a frequency distribution of values. The mean determines the centre of the distribution. The standard deviation is a summary of how widely dispersed the values are around this centre.

$$\text{s.d.} = \sqrt{\sum_{t=1} (y_t - \bar{y})^2/(N-1)}$$

spatial variation: the differences in disease rates between locations or areas.

standard error: a measure of the variability of the sample mean as an estimate of the population mean.

standardized incidence ratio: the ratio of observed cases to expected cases. The expected number of cases is based on age-specific rates.

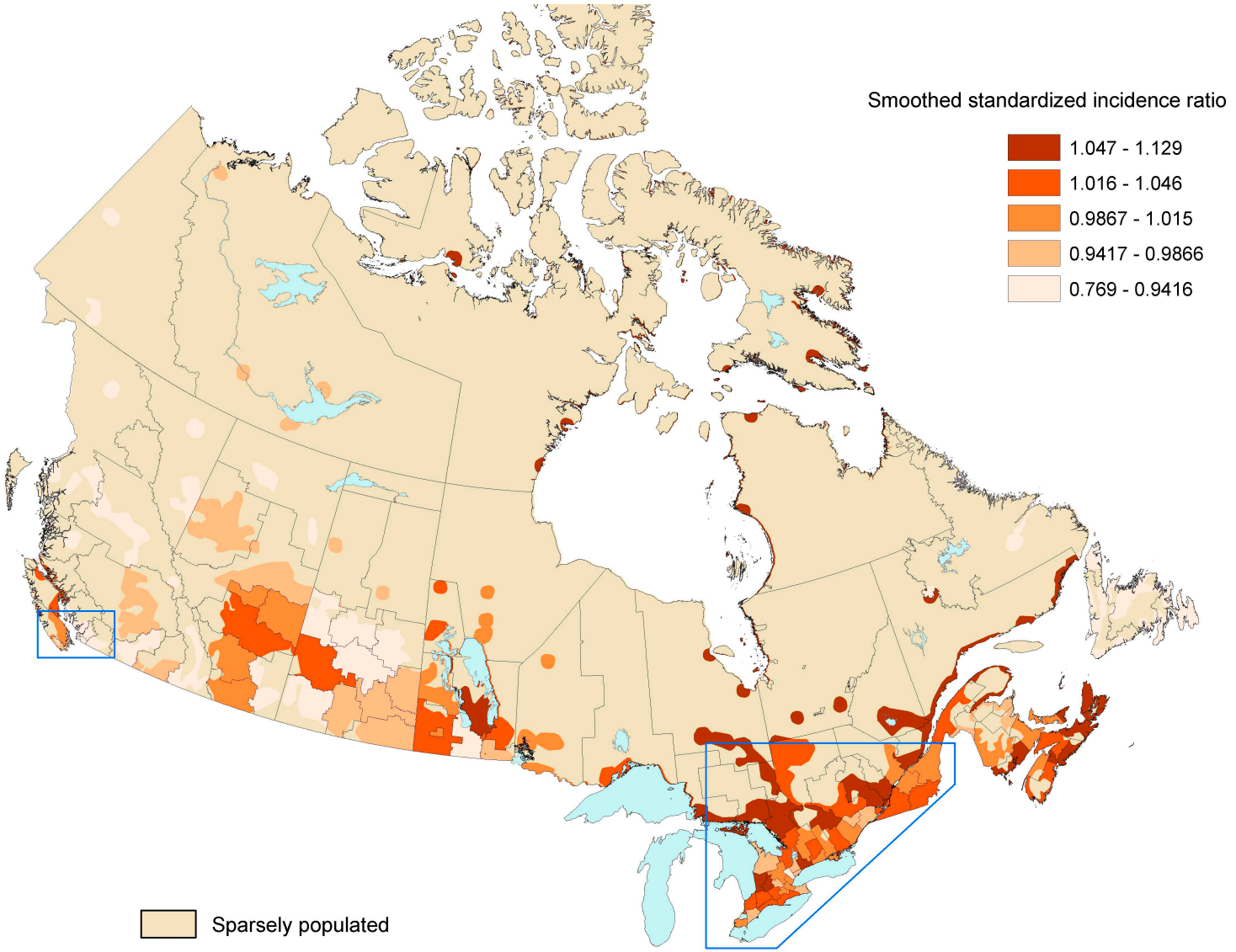
APPENDIX 5. Health Region Age-Standardized Incidence Rates, 2000-2006

(Please see files on CD)

APPENDIX 6. Provincial/Territorial Age-Standardized Incidence Rates, 2000-2006

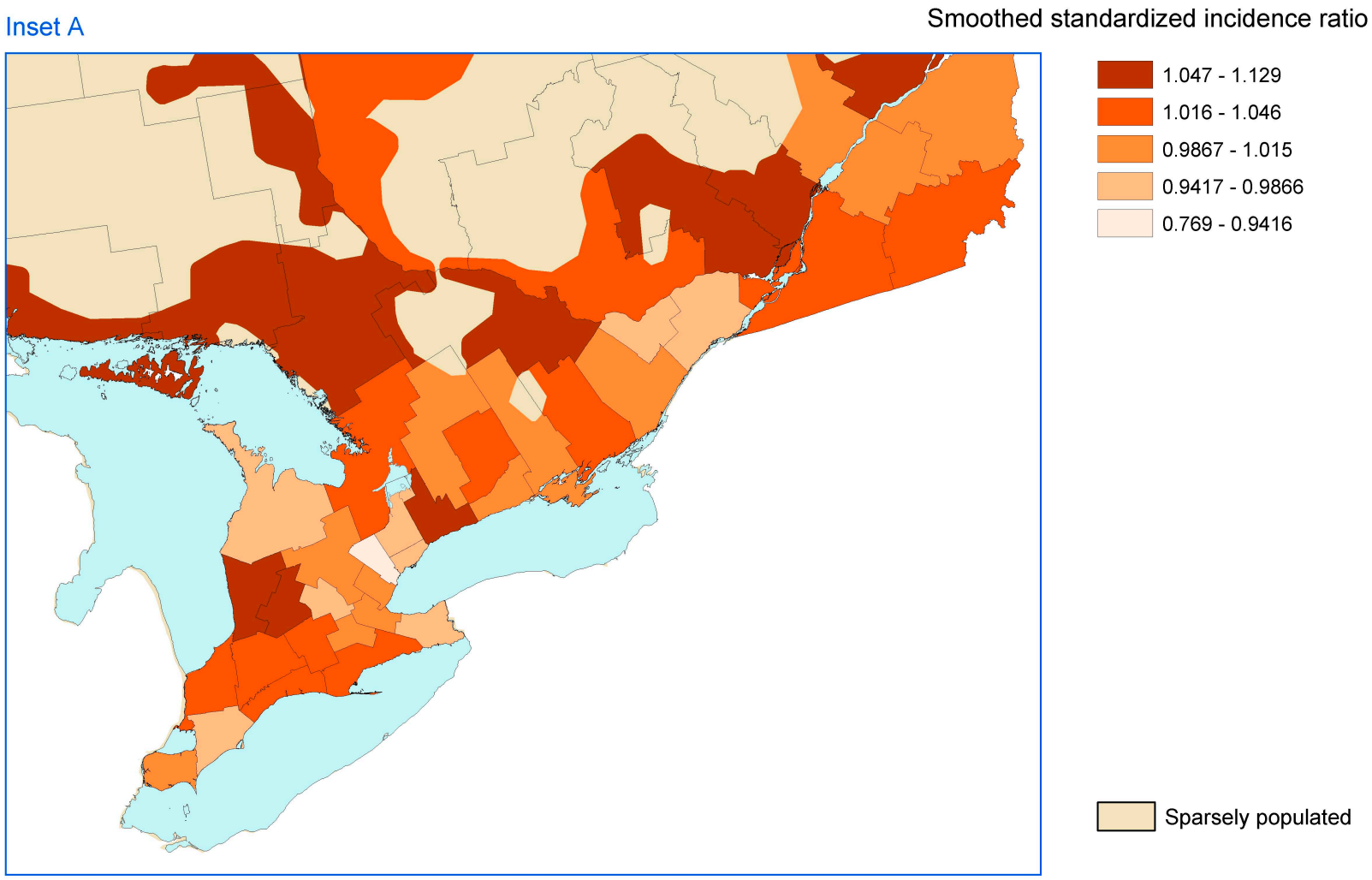
(Please see files on CD)

Map 41. All sites, females, 2000-2006, all ages



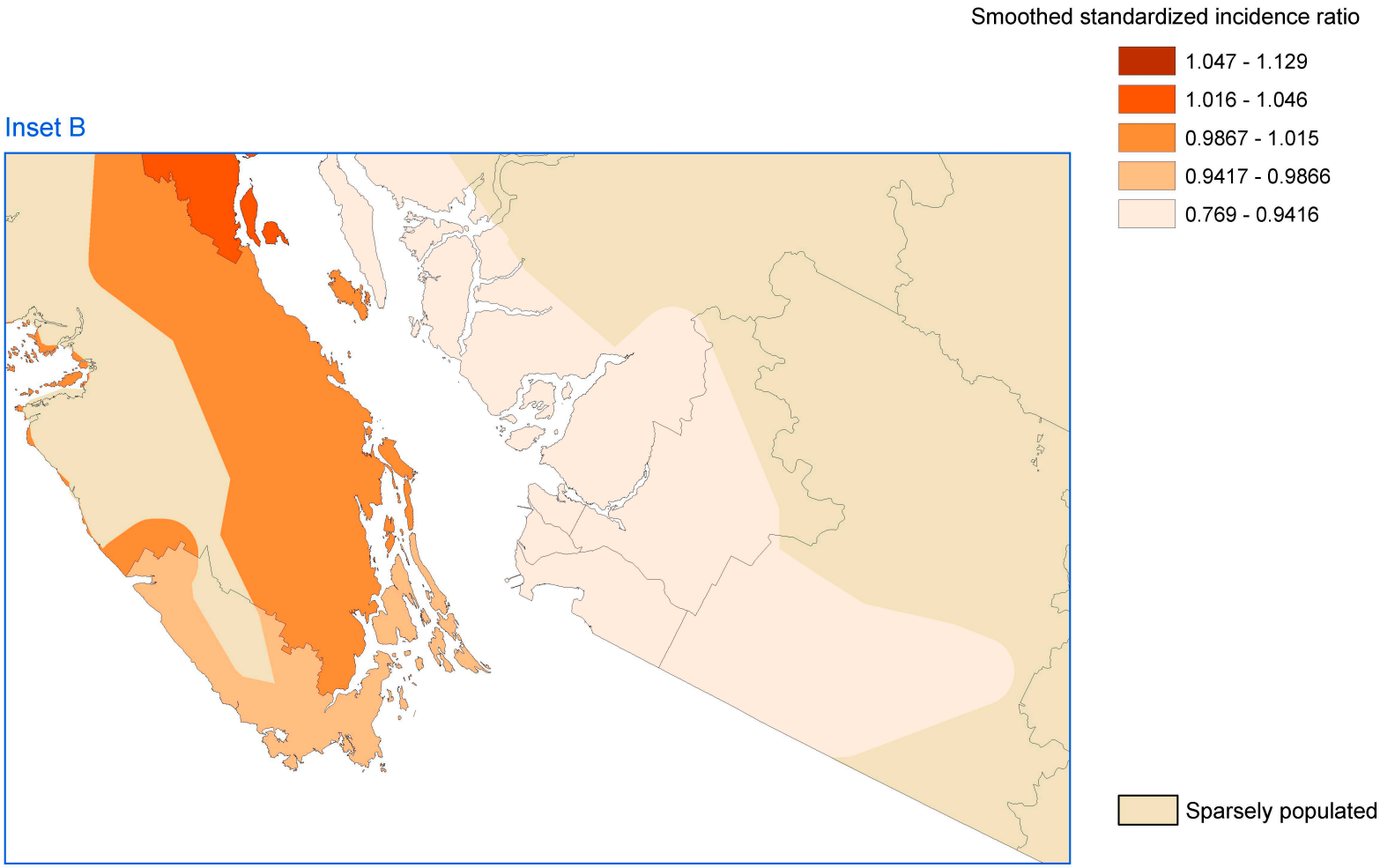
Data source: Canadian Cancer Registry database at Statistics Canada

Map 41-A. All sites, females, 2000-2006, all ages



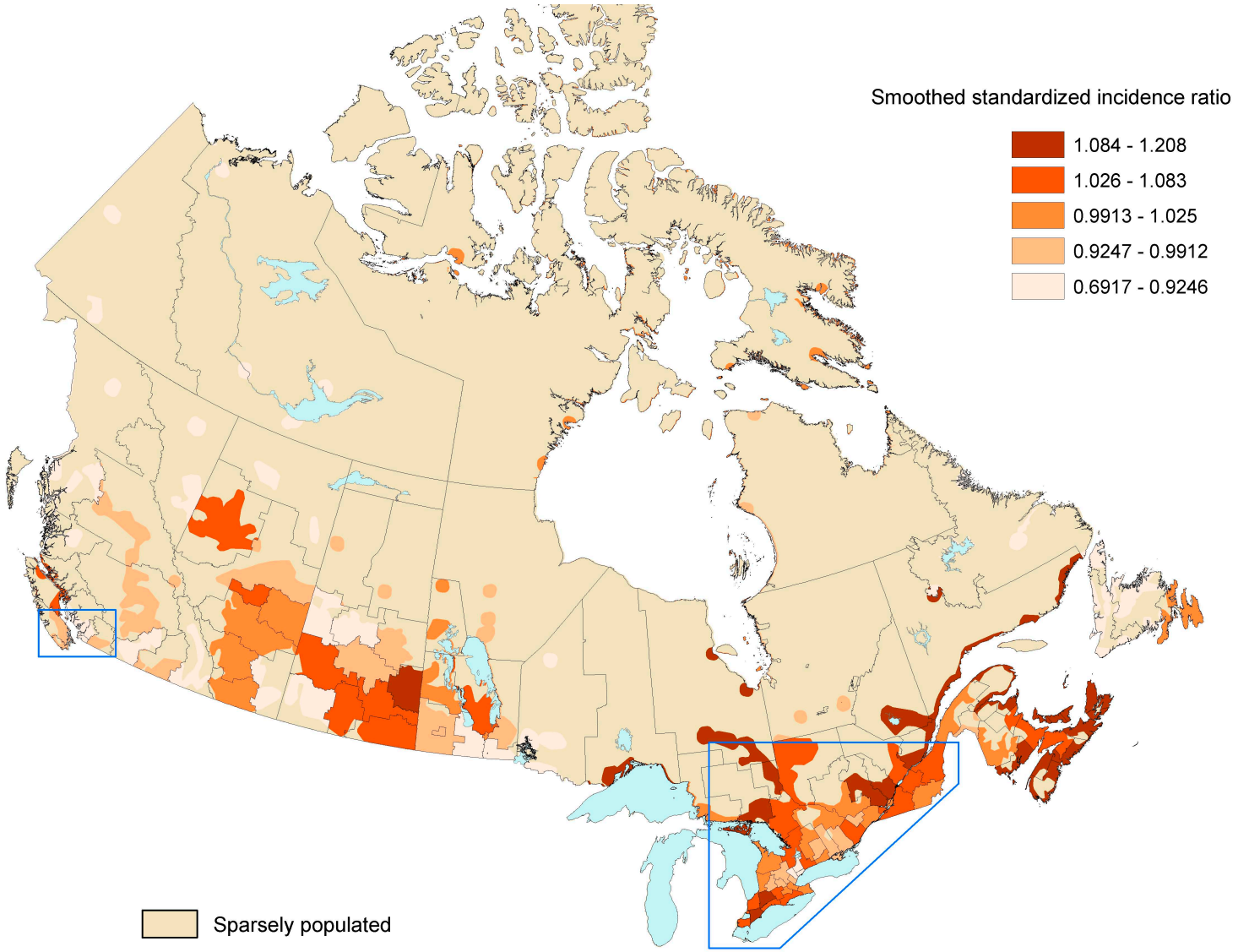
Data source: Canadian Cancer Registry database at Statistics Canada

Map 41-B. All sites, females, 2000-2006, all ages



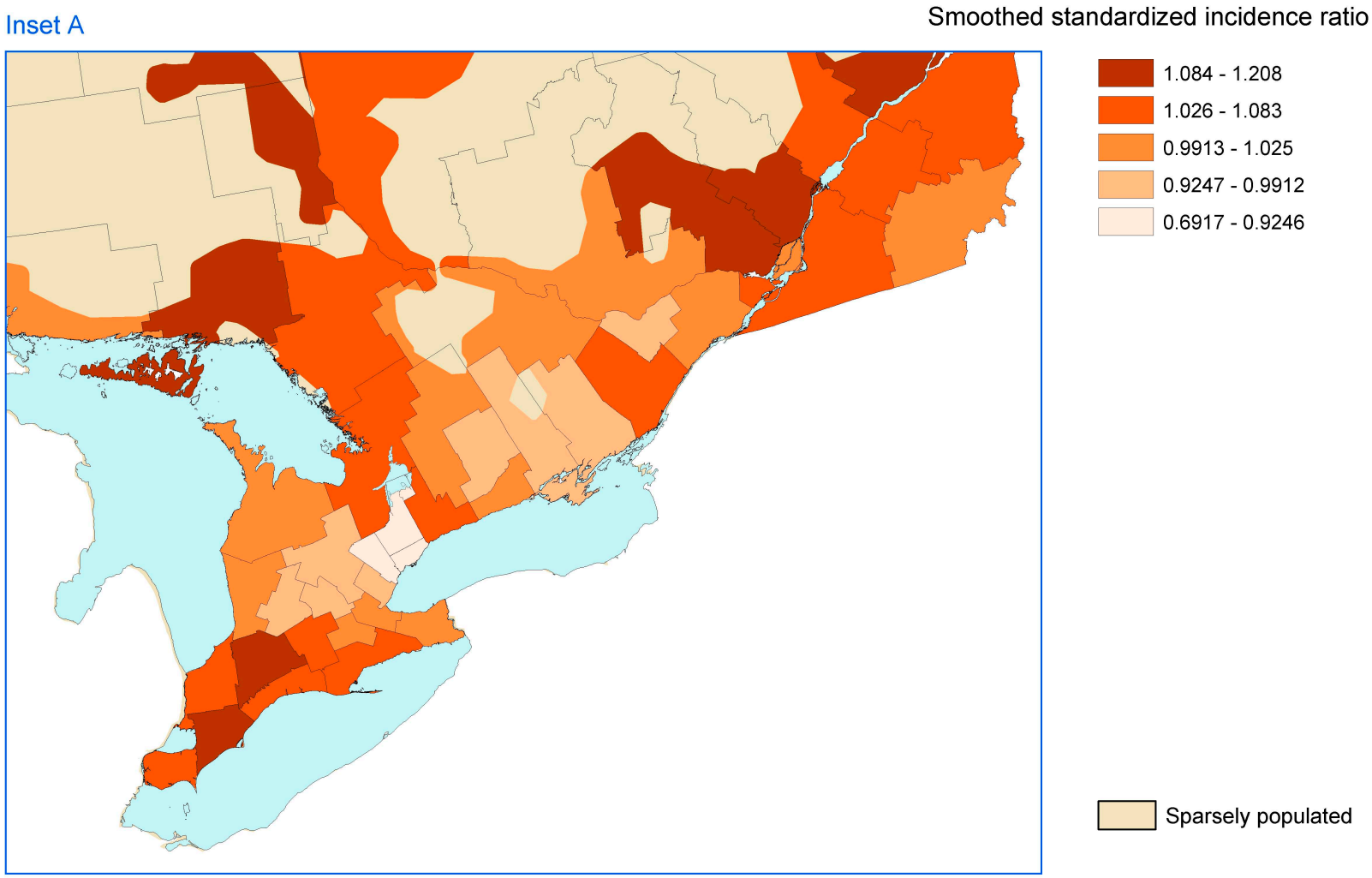
Data source: Canadian Cancer Registry database at Statistics Canada

Map 42. All sites, males, 2000-2006, all ages



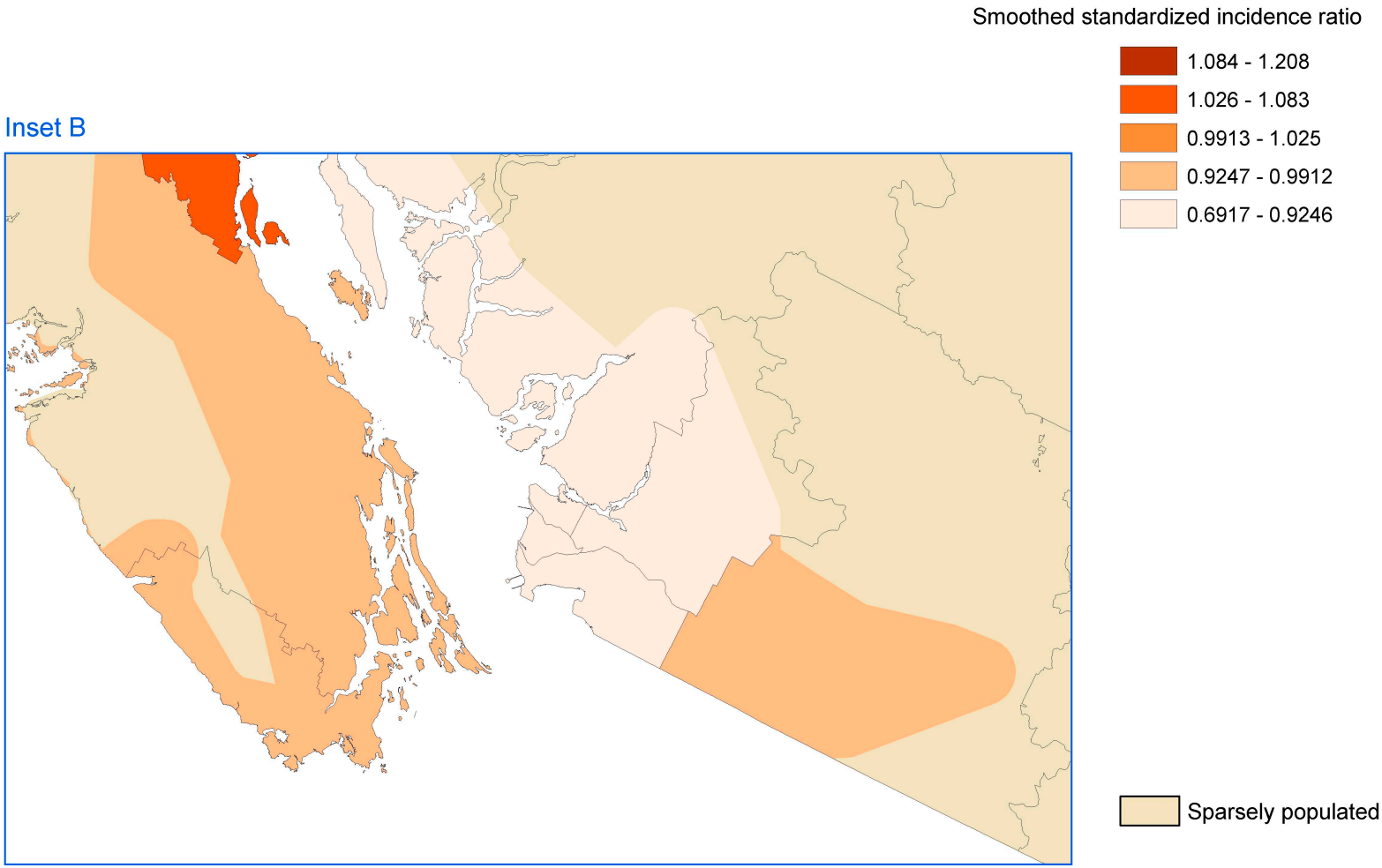
Data source: Canadian Cancer Registry database at Statistics Canada

Map 42-A. All sites, males, 2000-2006, all ages



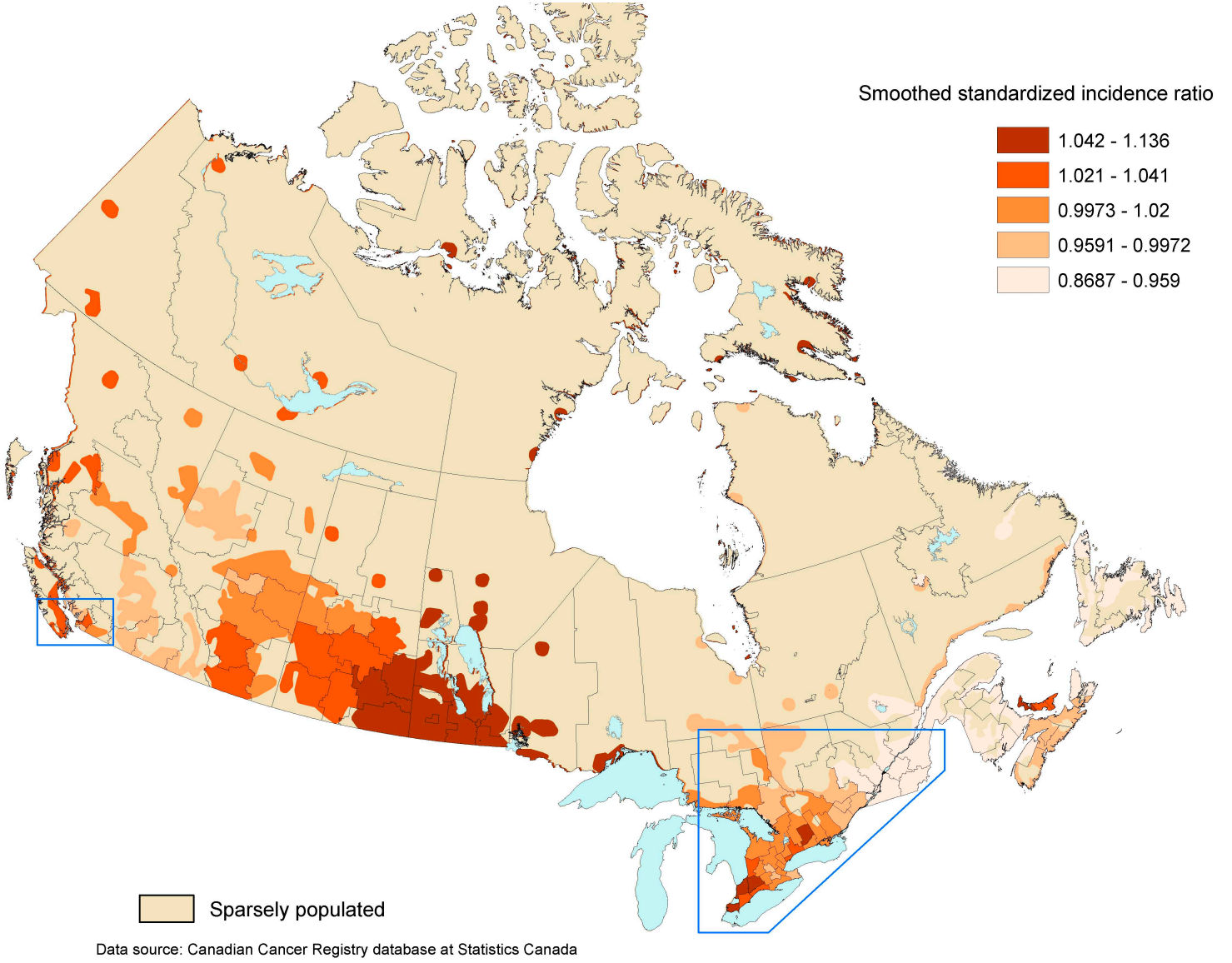
Data source: Canadian Cancer Registry database at Statistics Canada

Map 42-B. All sites, males, 2000-2006, all ages



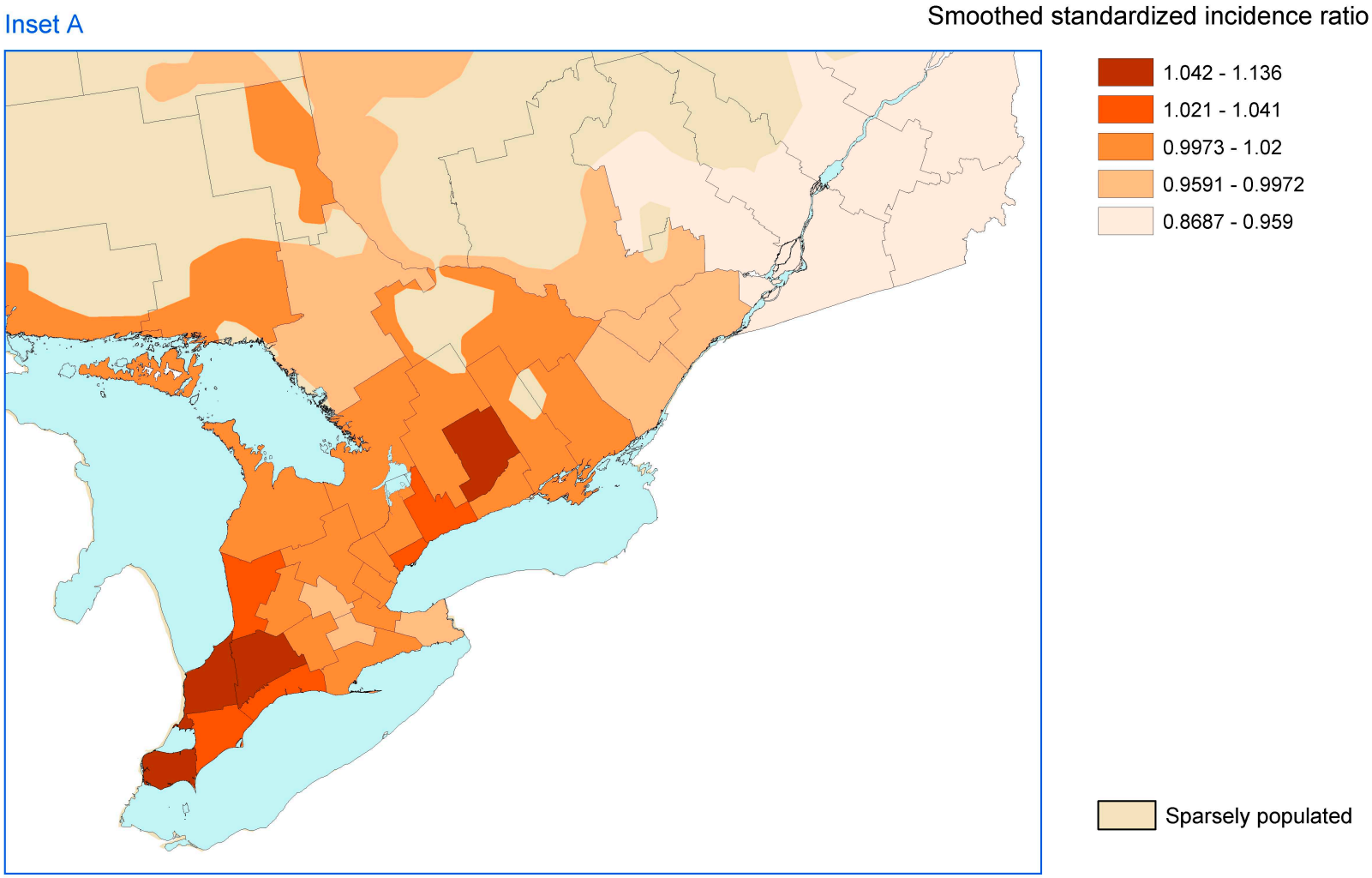
Data source: Canadian Cancer Registry database at Statistics Canada

Map 43. Buccal cavity and pharynx, females, 2000-2006, all ages



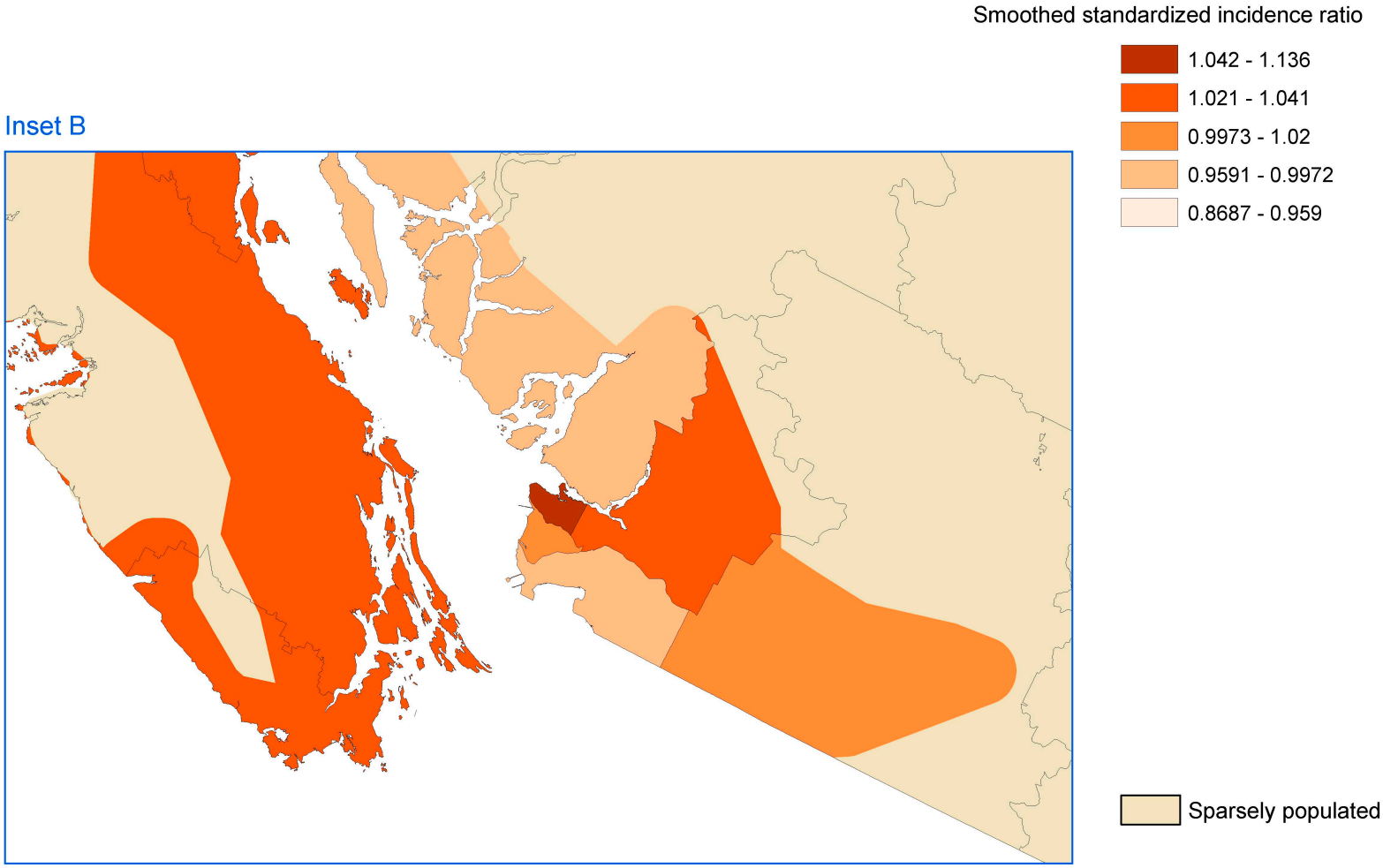
Data source: Canadian Cancer Registry database at Statistics Canada

Map 43-A. Buccal cavity and pharynx, females, 2000-2006, all ages



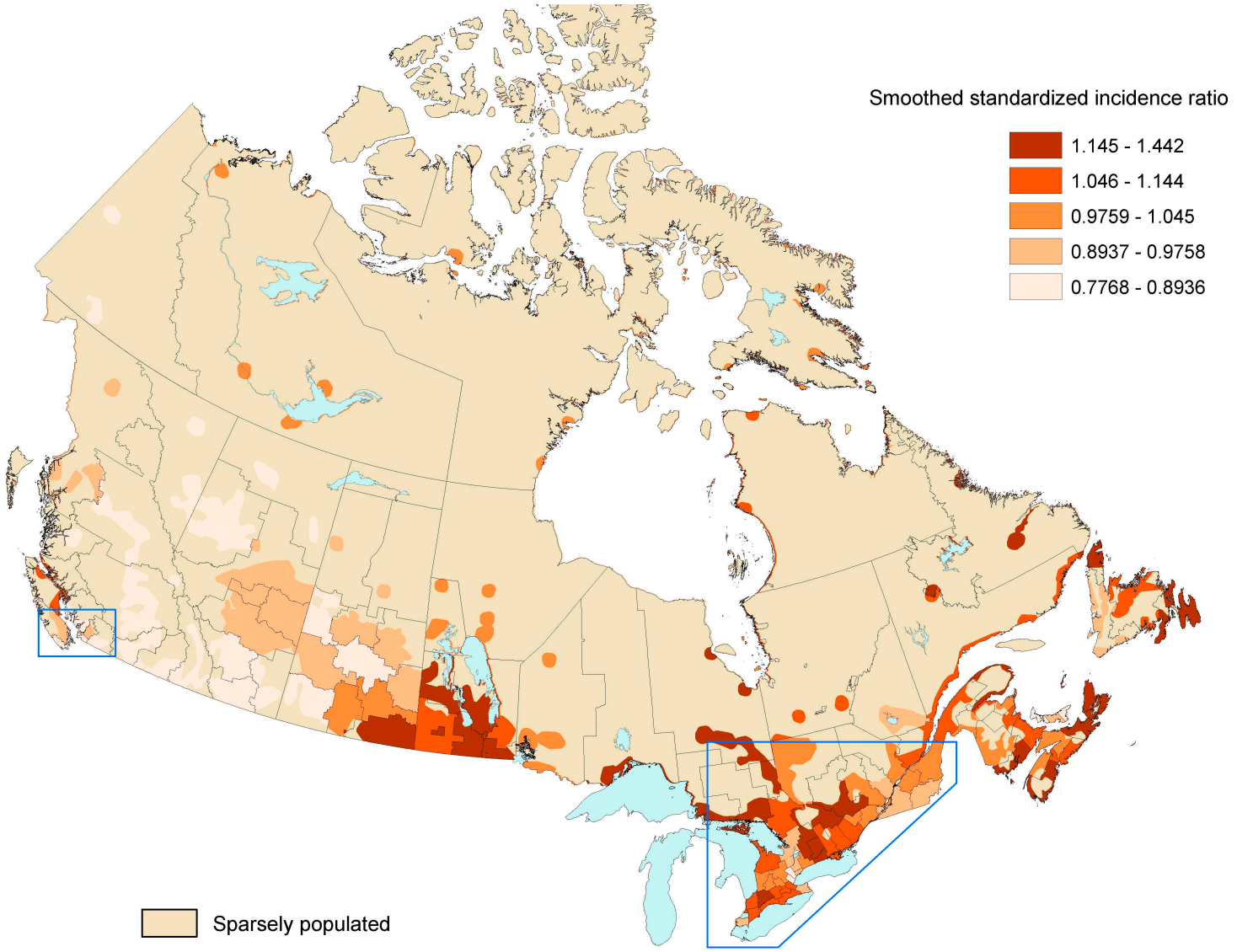
Data source: Canadian Cancer Registry database at Statistics Canada

Map 43-B. Buccal cavity and pharynx, females, 2000-2006, all ages



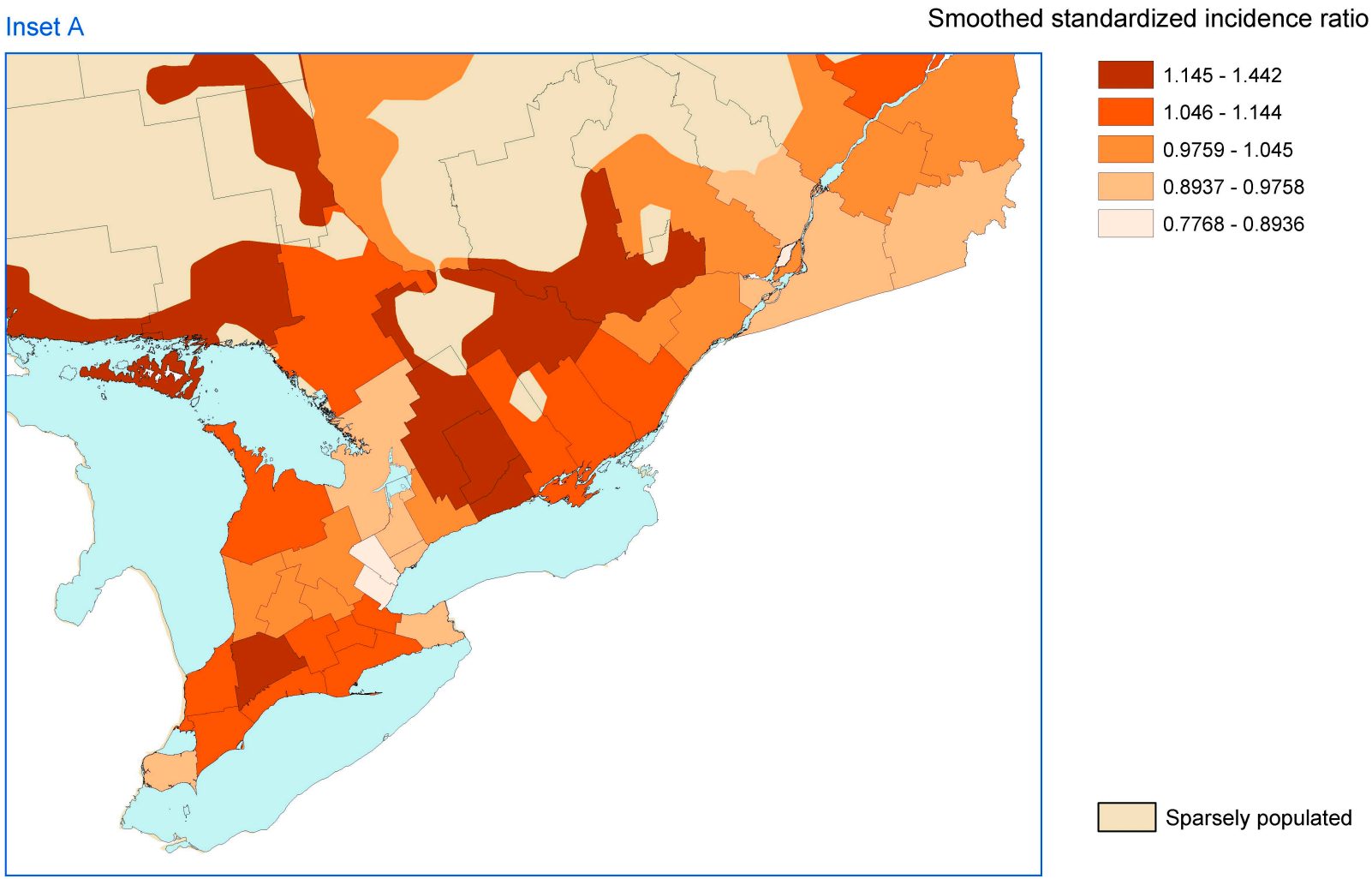
Data source: Canadian Cancer Registry database at Statistics Canada

Map 44. Buccal cavity and pharynx, males, 2000-2006, all ages



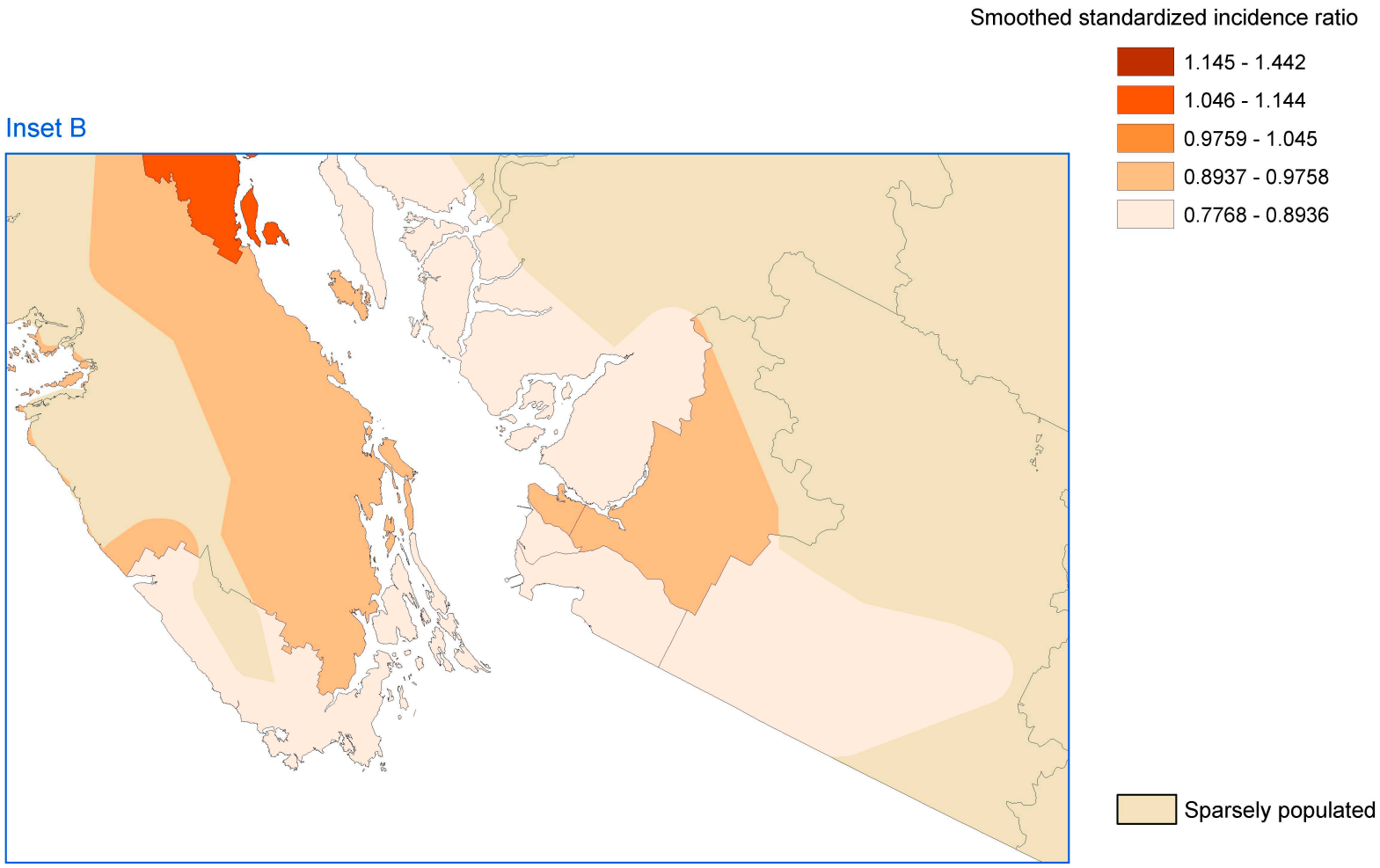
Data source: Canadian Cancer Registry database at Statistics Canada

Map 44-A. Buccal cavity and pharynx, males, 2000-2006, all ages



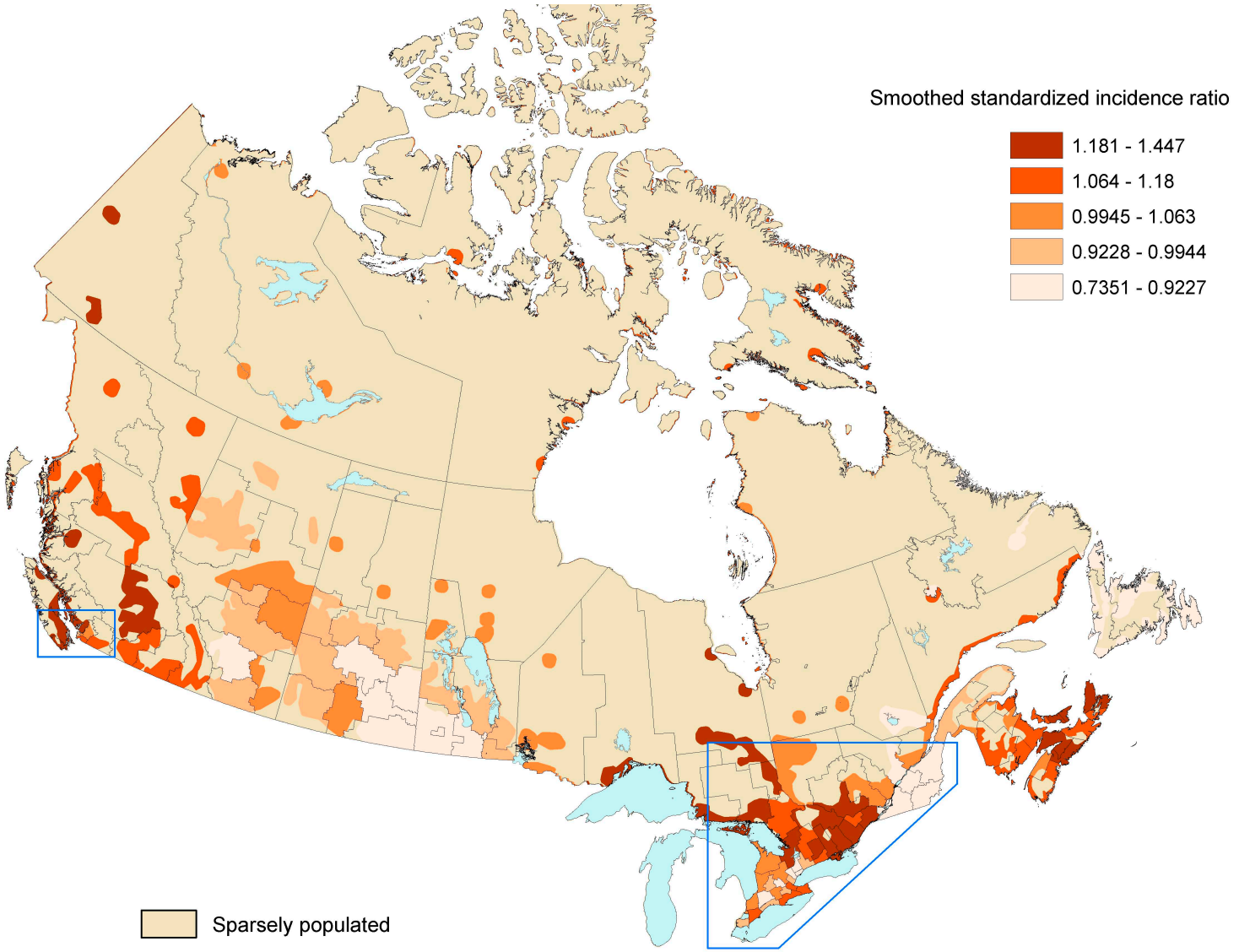
Data source: Canadian Cancer Registry database at Statistics Canada

Map 44-B. Buccal cavity and pharynx, males, 2000-2006, all ages



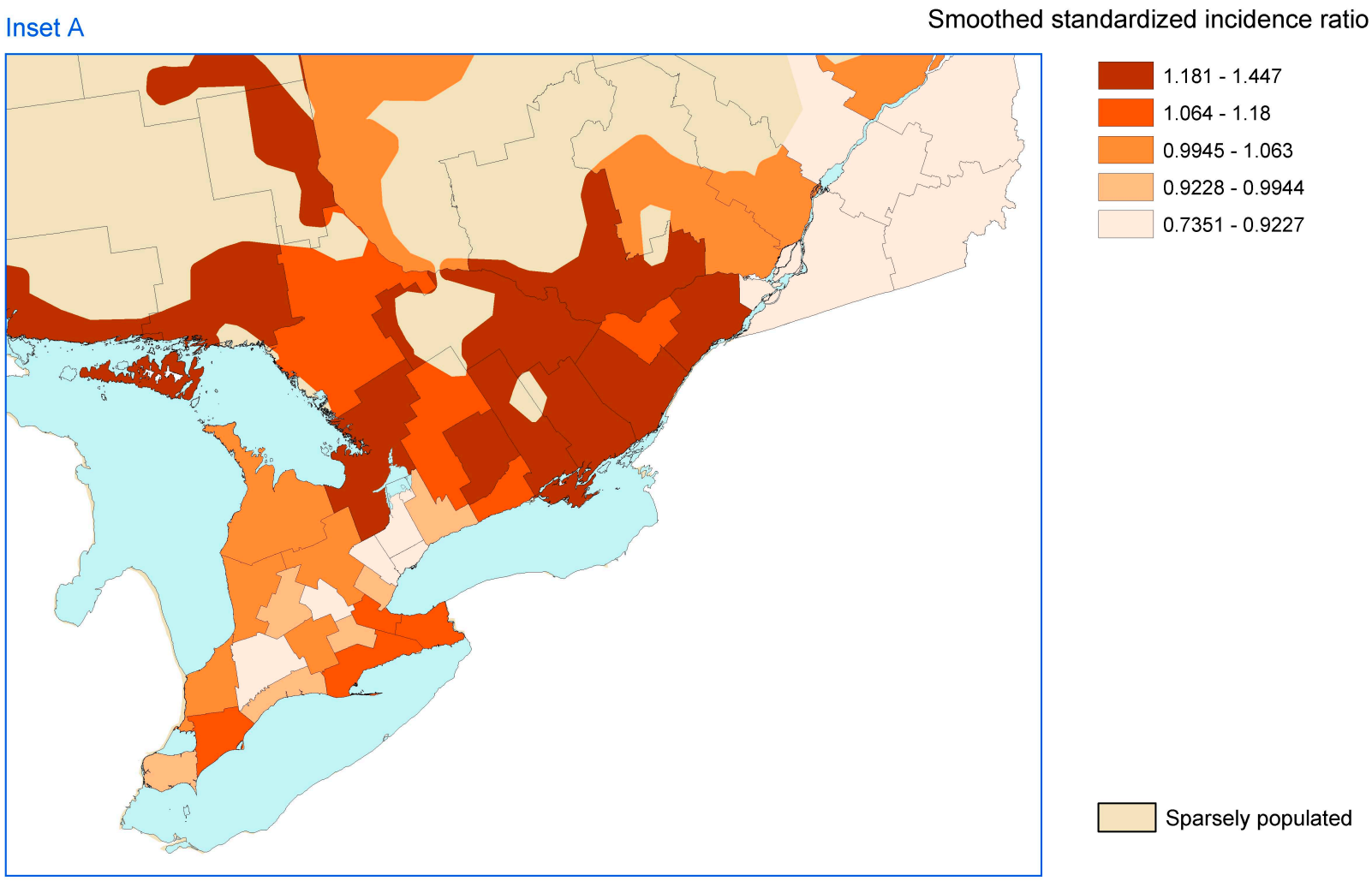
Data source: Canadian Cancer Registry database at Statistics Canada

Map 45. Esophagus, 2000-2006, all ages



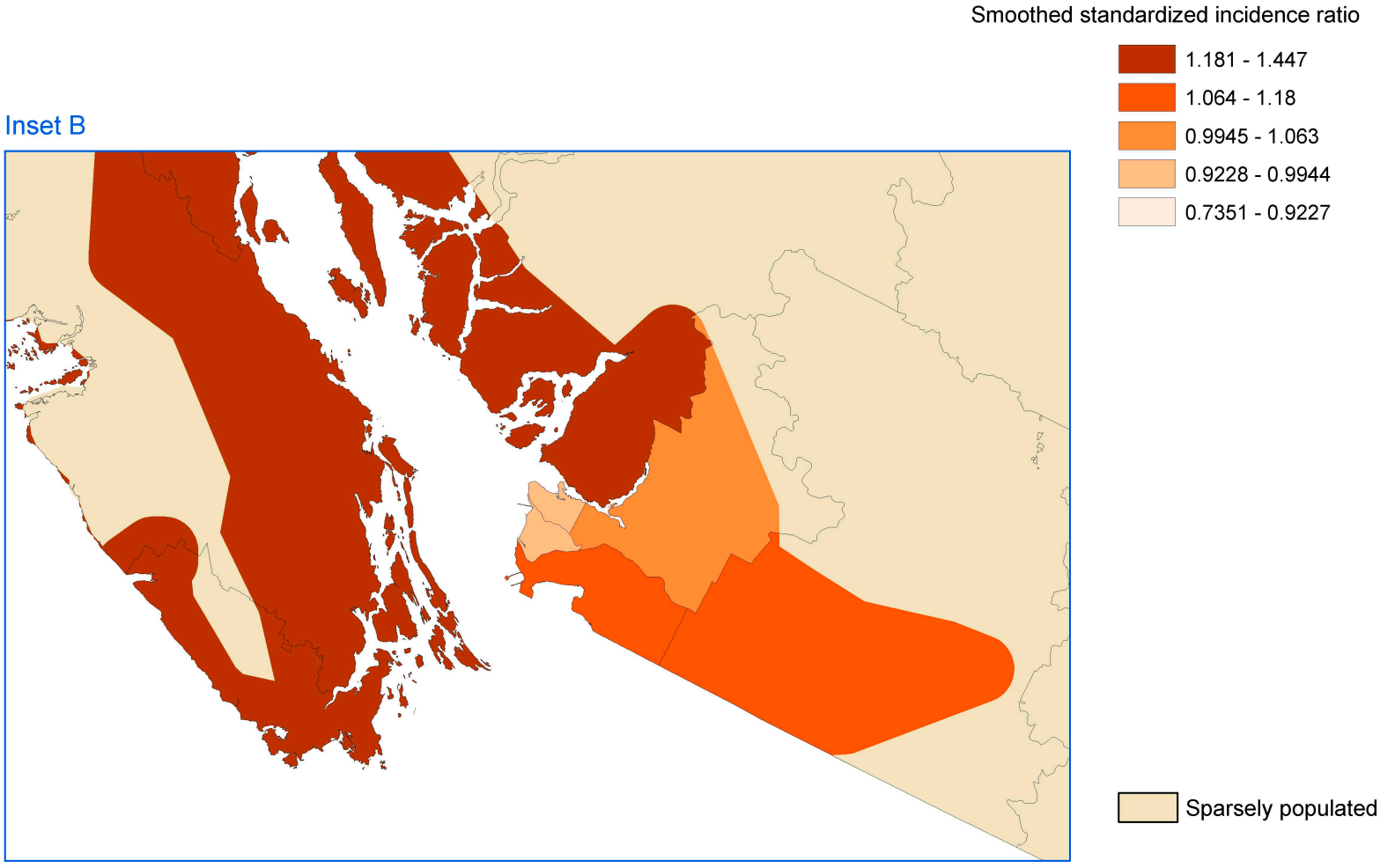
Data source: Canadian Cancer Registry database at Statistics Canada

Map 45-A. Esophagus, 2000-2006, all ages



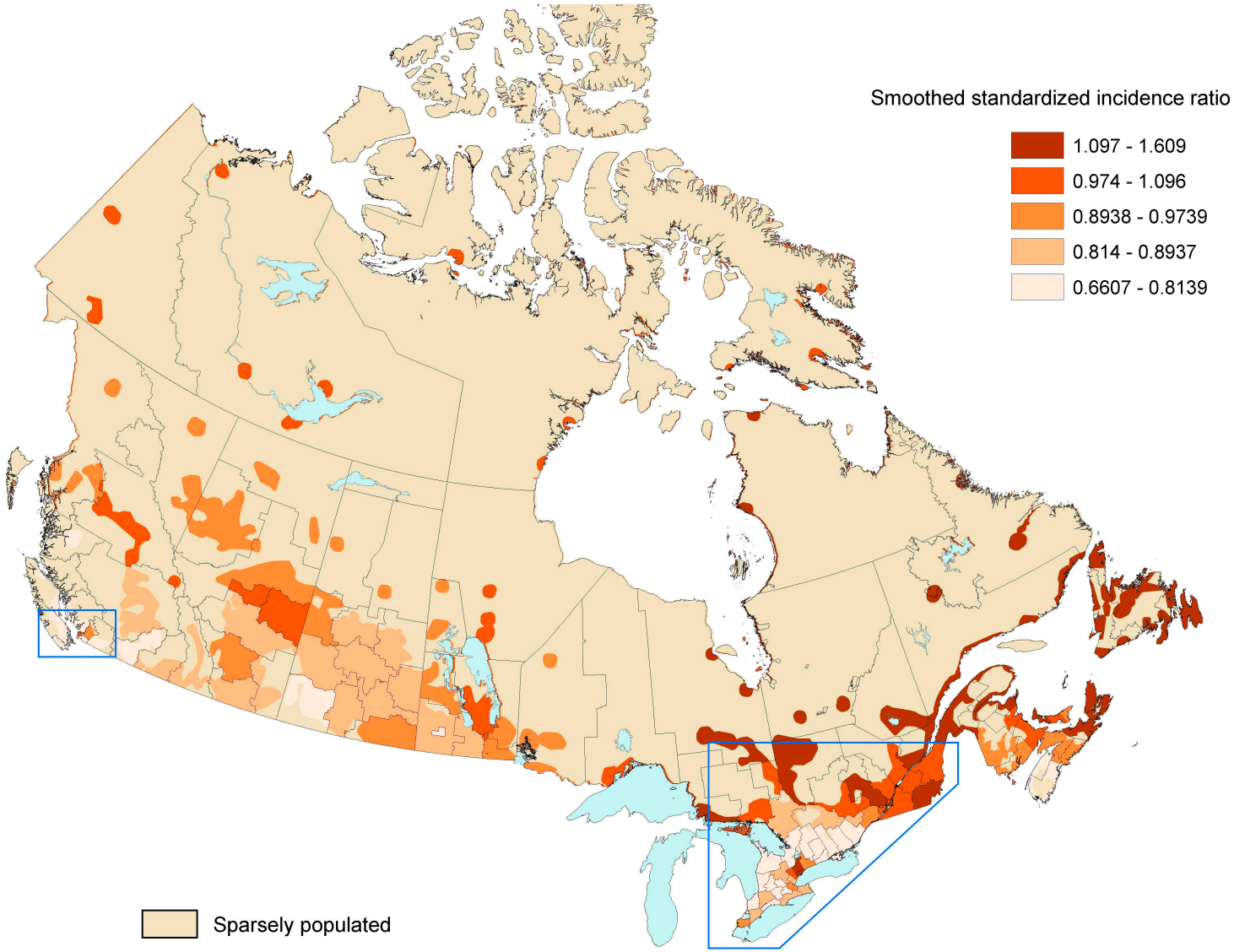
Data source: Canadian Cancer Registry database at Statistics Canada

Map 45-B. Esophagus, 2000-2006, all ages



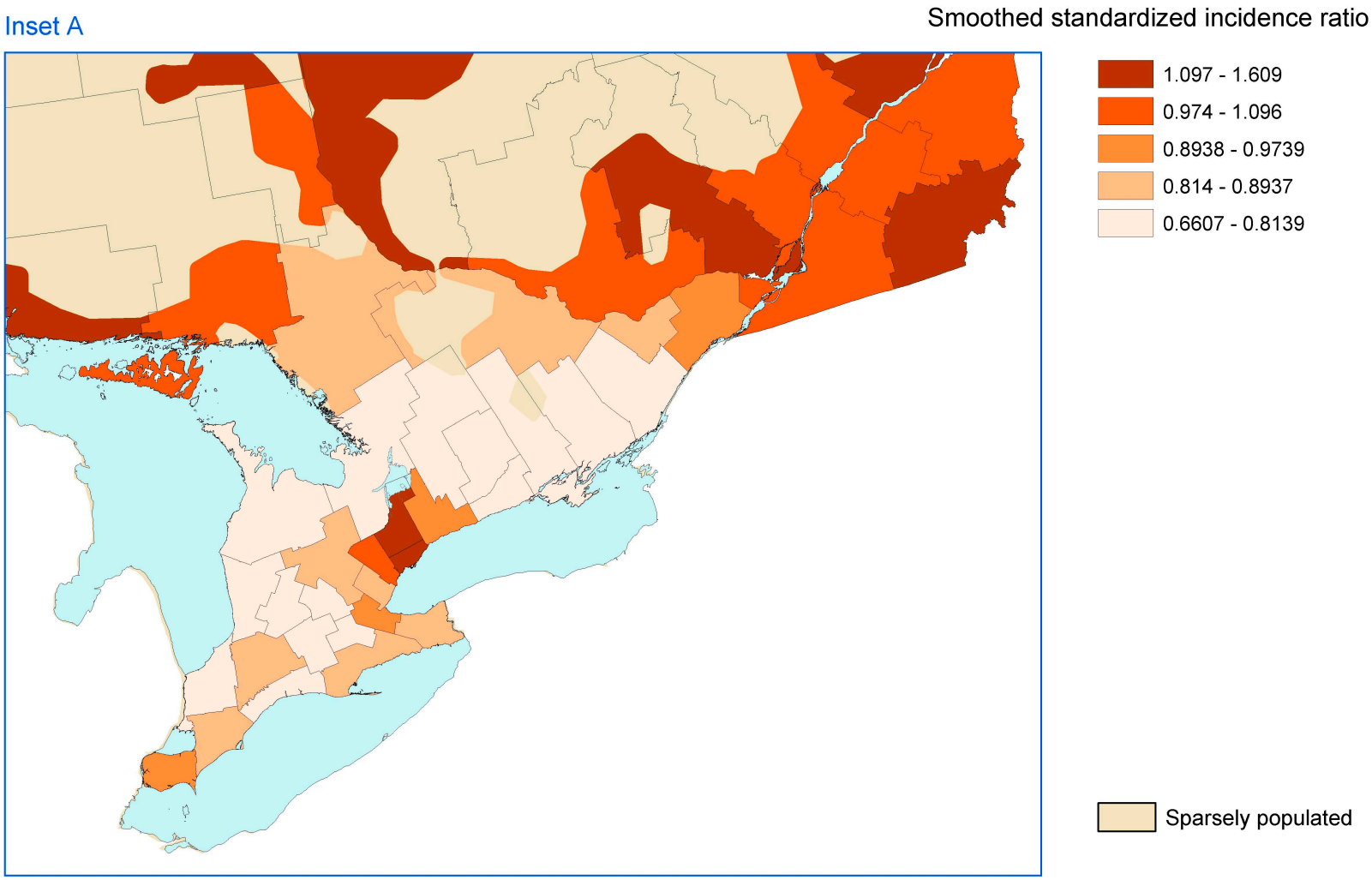
Data source: Canadian Cancer Registry database at Statistics Canada

Map 46. Stomach, females, 2000-2006, all ages



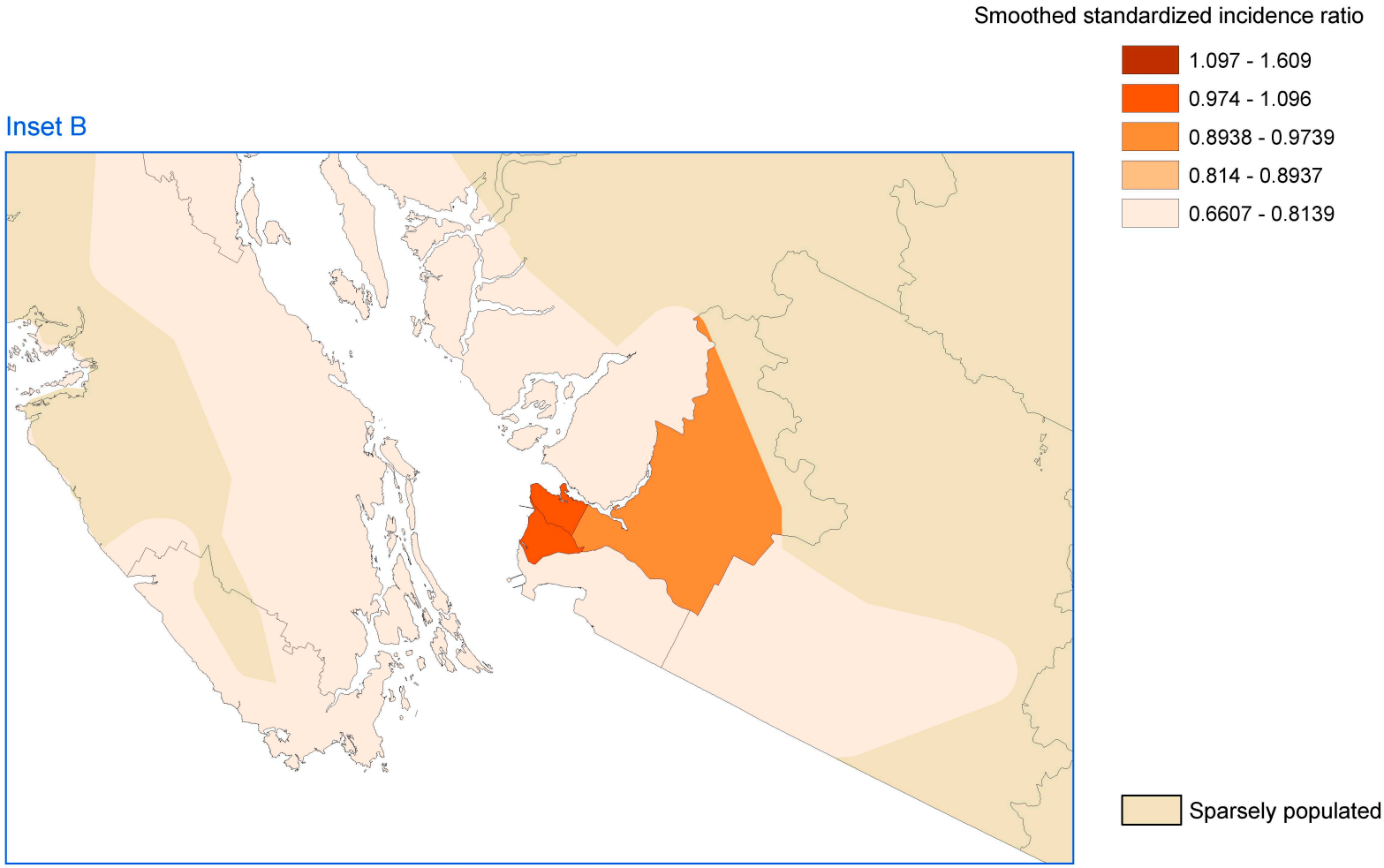
Data source: Canadian Cancer Registry database at Statistics Canada

Map 46-A. Stomach, females, 2000-2006, all ages



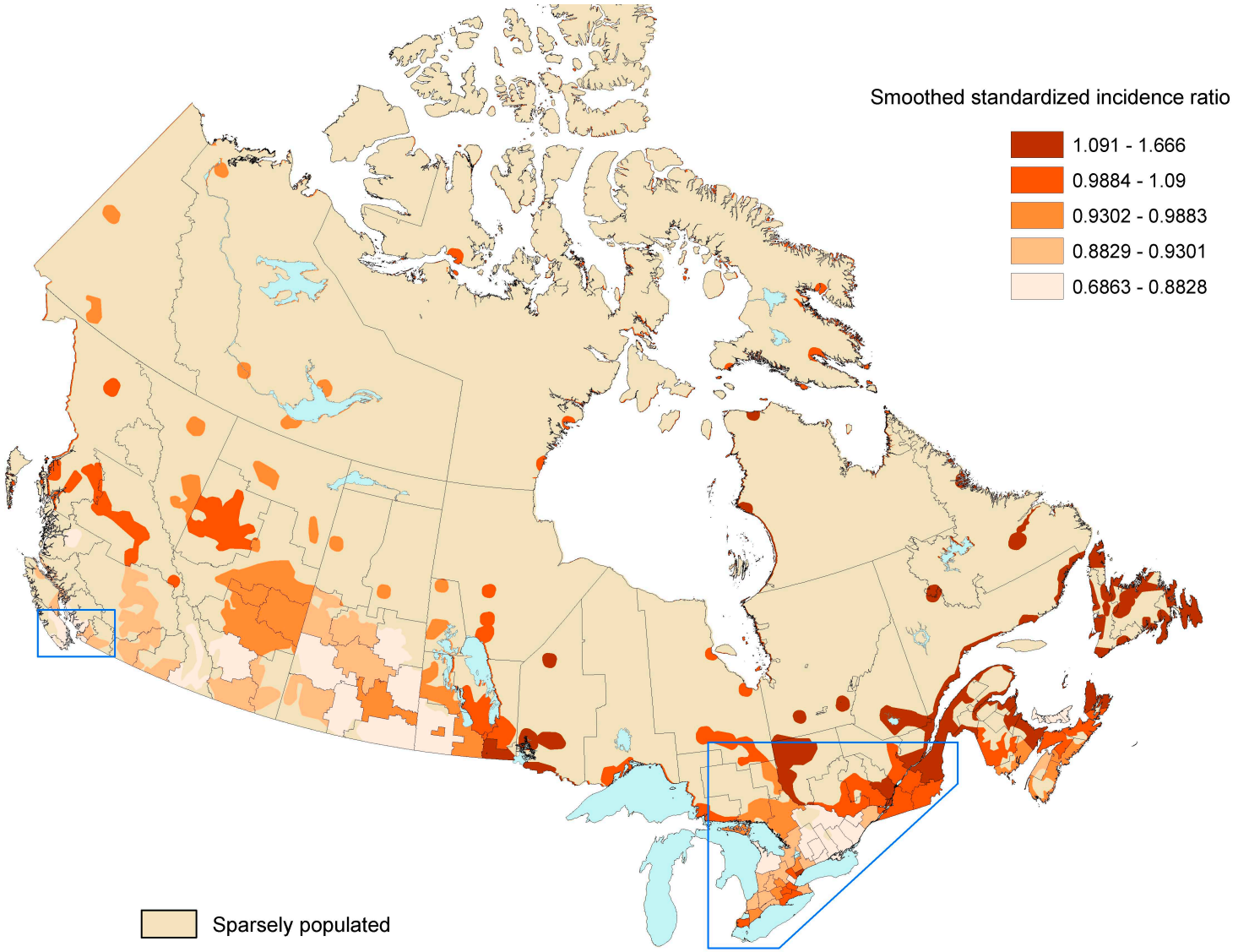
Data source: Canadian Cancer Registry database at Statistics Canada

Map 46-B. Stomach, females, 2000-2006, all ages



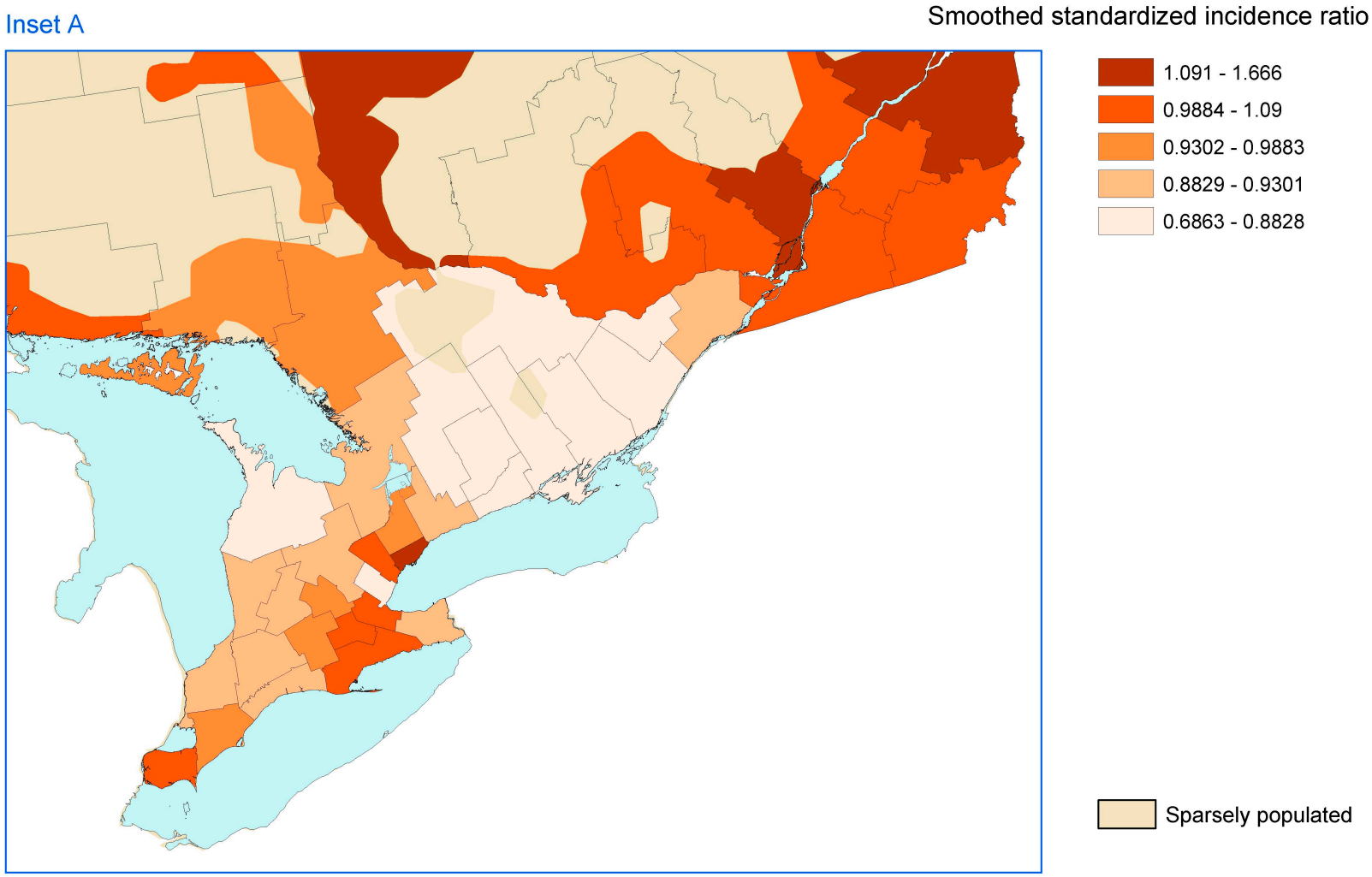
Data source: Canadian Cancer Registry database at Statistics Canada

Map 47. Stomach, males, 2000-2006, all ages



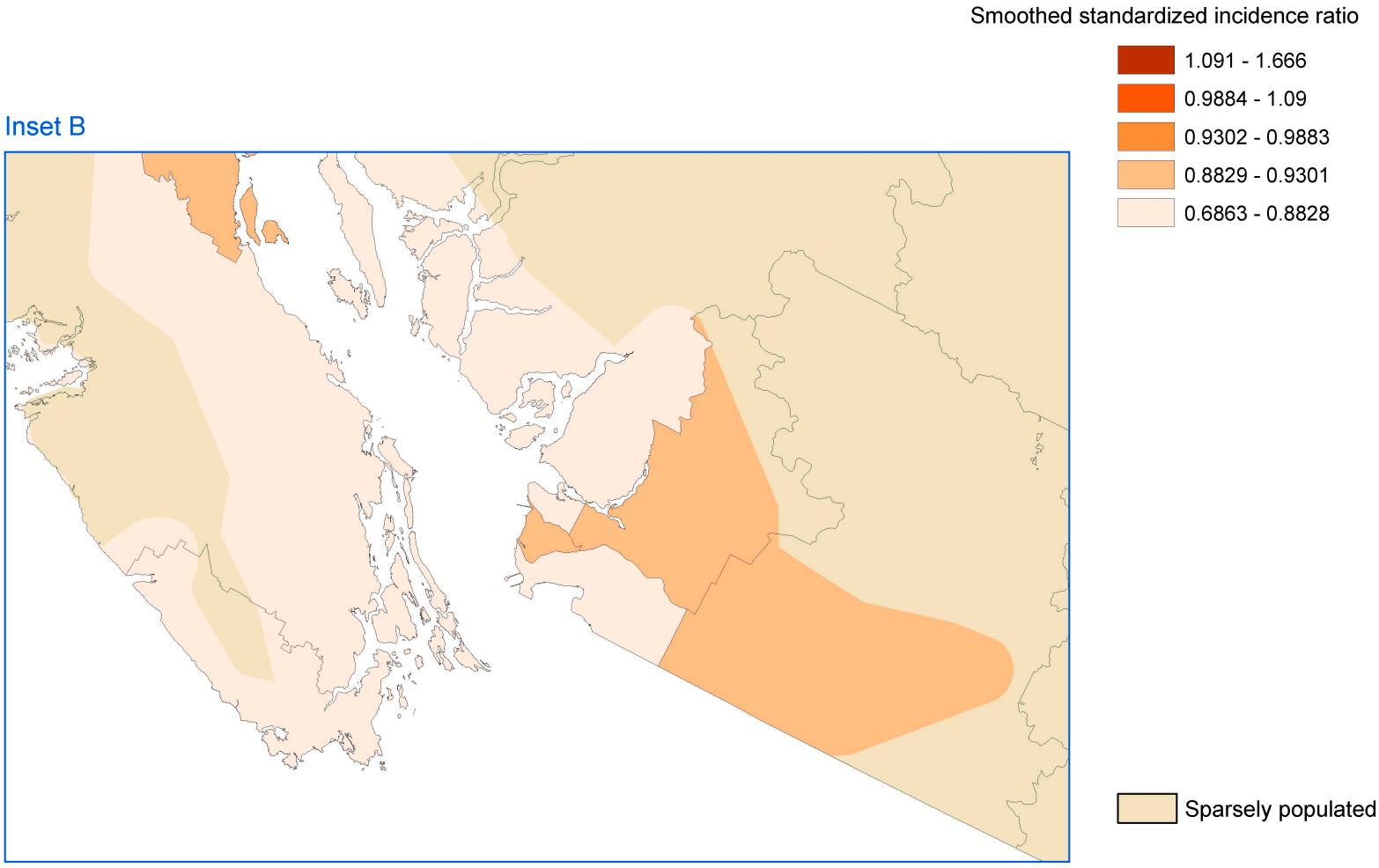
Data source: Canadian Cancer Registry database at Statistics Canada

Map 47-A. Stomach, males, 2000-2006, all ages



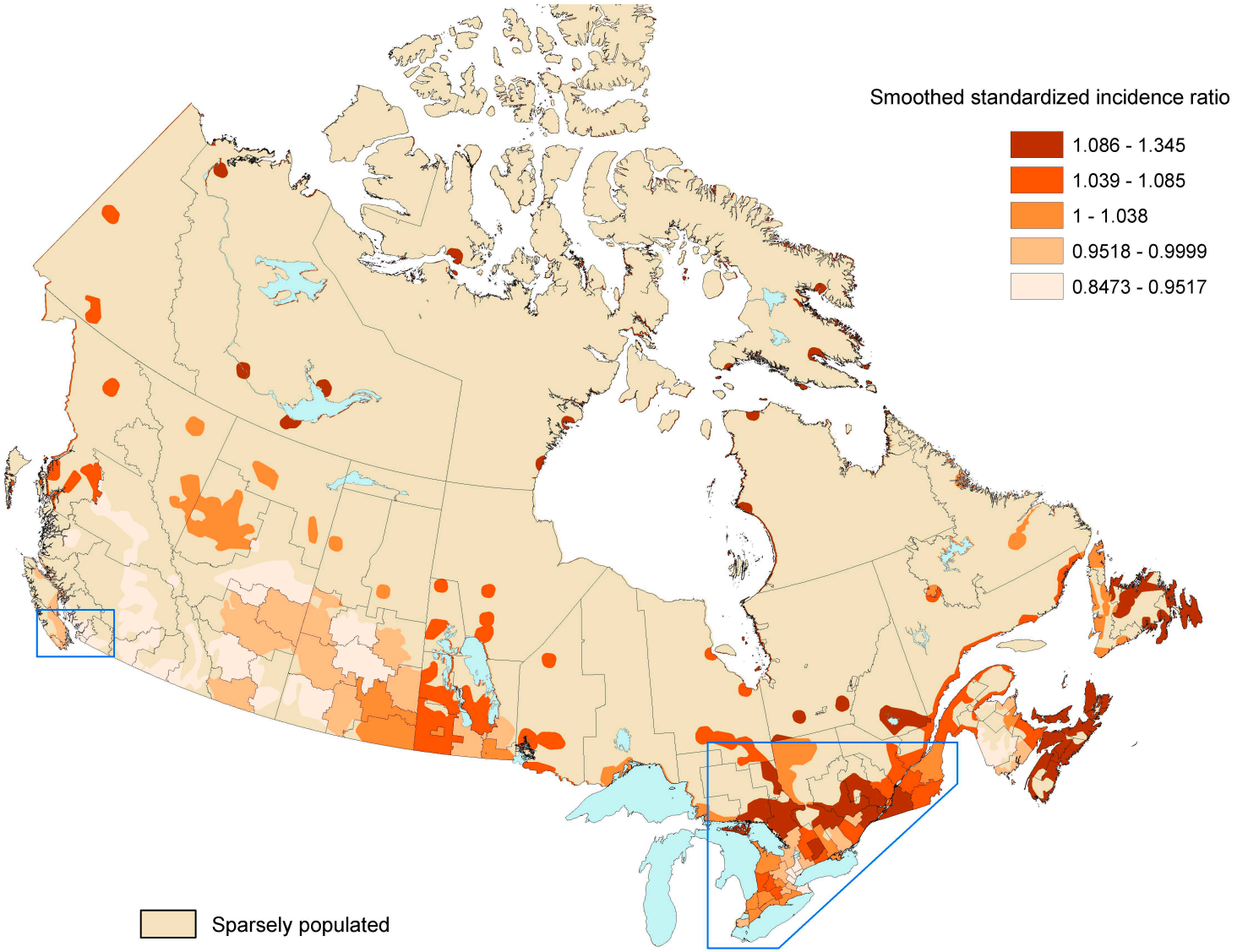
Data source: Canadian Cancer Registry database at Statistics Canada

Map 47-B. Stomach, males, 2000-2006, all ages



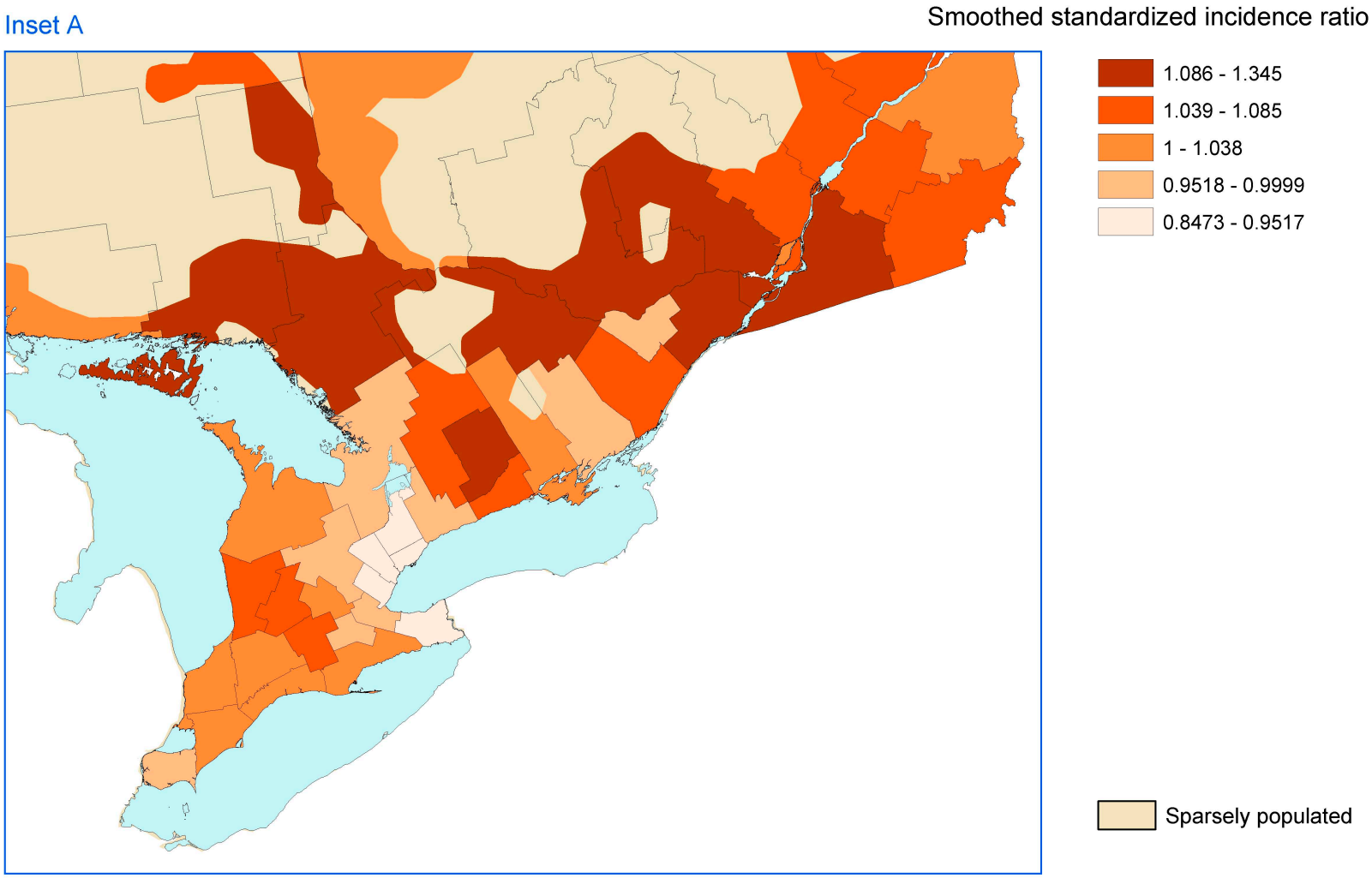
Data source: Canadian Cancer Registry database at Statistics Canada

Map 48. Colon and rectum, females, 2000-2006, all ages



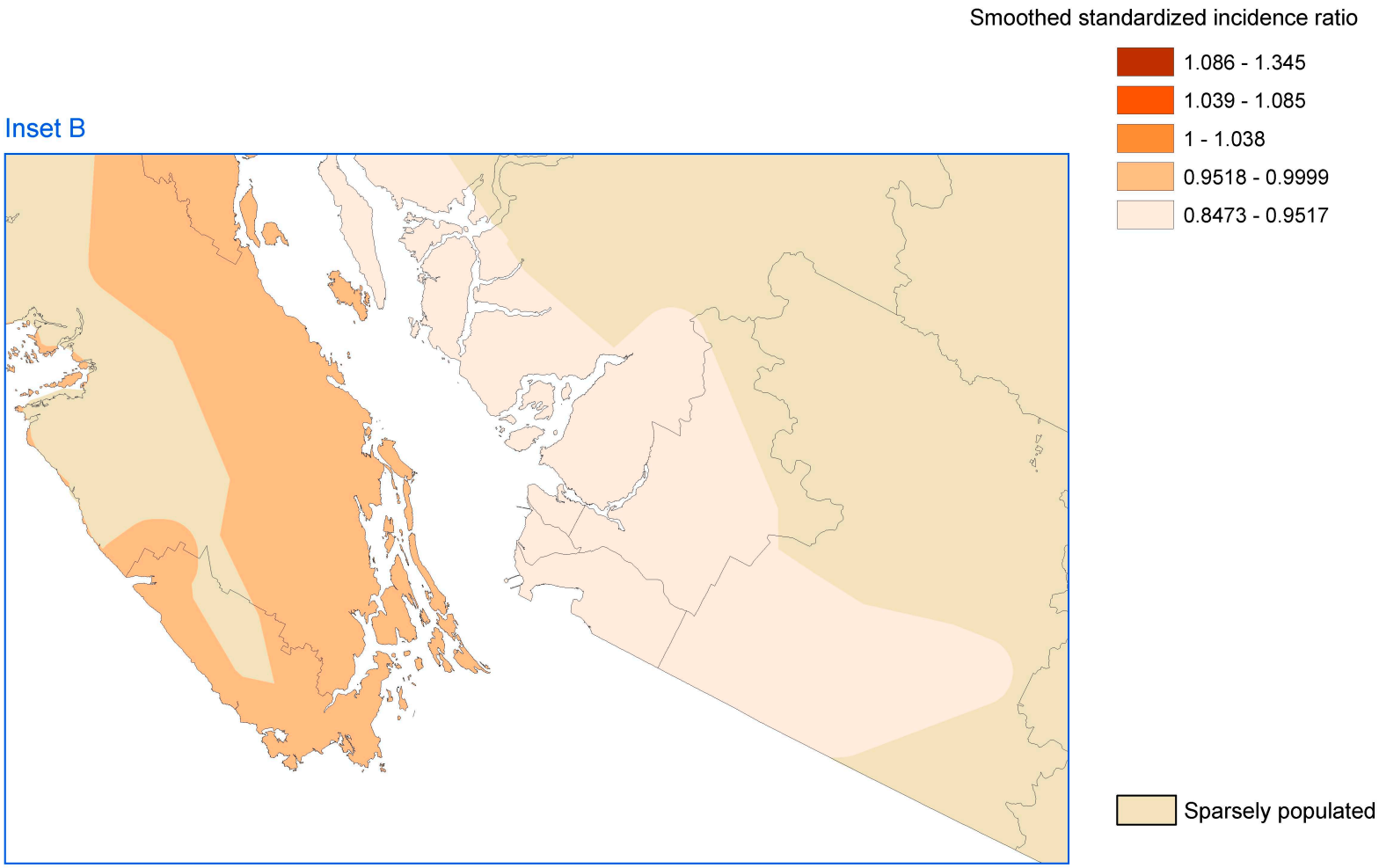
Data source: Canadian Cancer Registry database at Statistics Canada

Map 48-A. Colon and rectum, females, 2000-2006, all ages



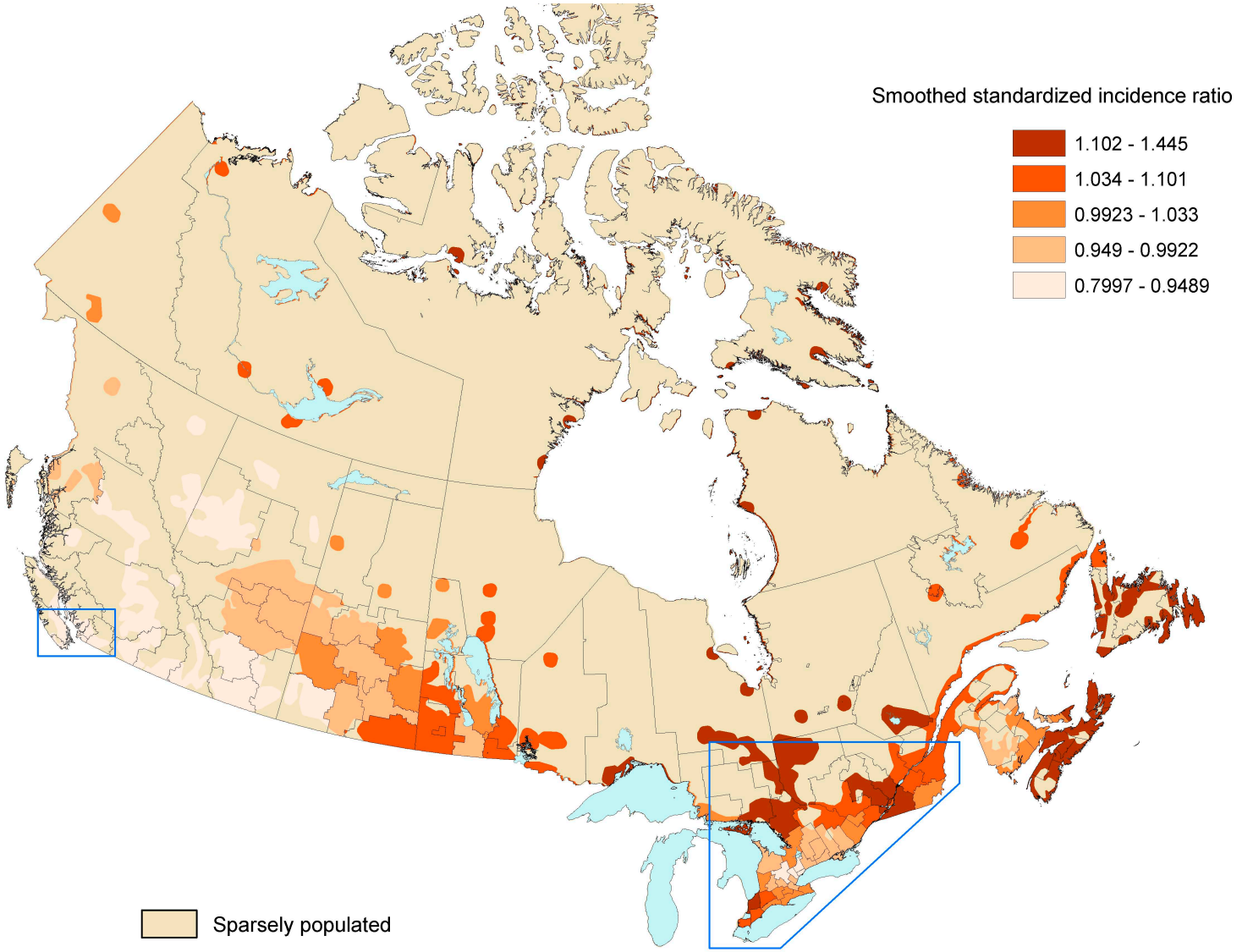
Data source: Canadian Cancer Registry database at Statistics Canada

Map 48-B. Colon and rectum, females, 2000-2006, all ages



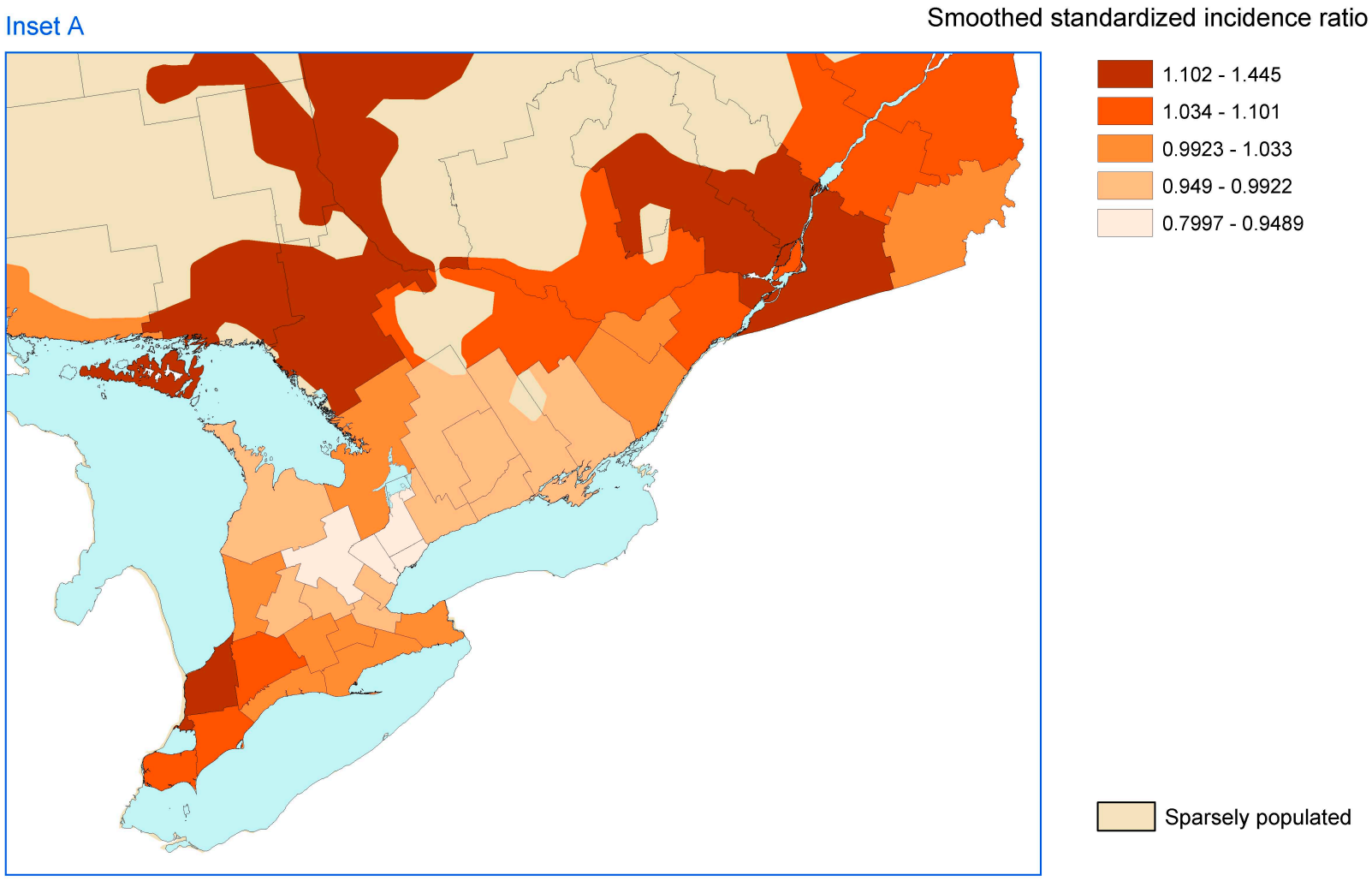
Data source: Canadian Cancer Registry database at Statistics Canada

Map 49. Colon and rectum, males, 2000-2006, all ages



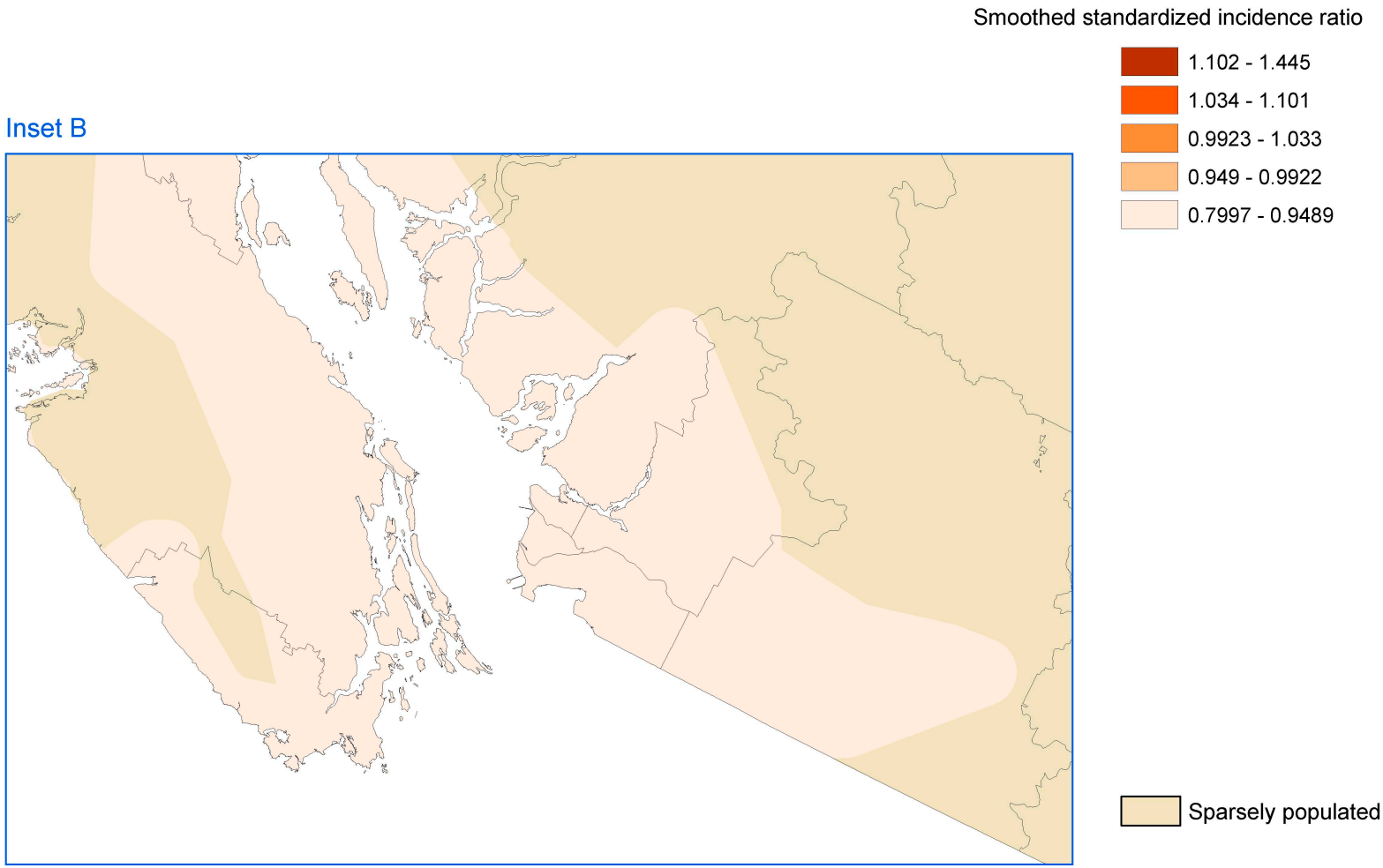
Data source: Canadian Cancer Registry database at Statistics Canada

Map 49-A. Colon and rectum, males, 2000-2006, all ages



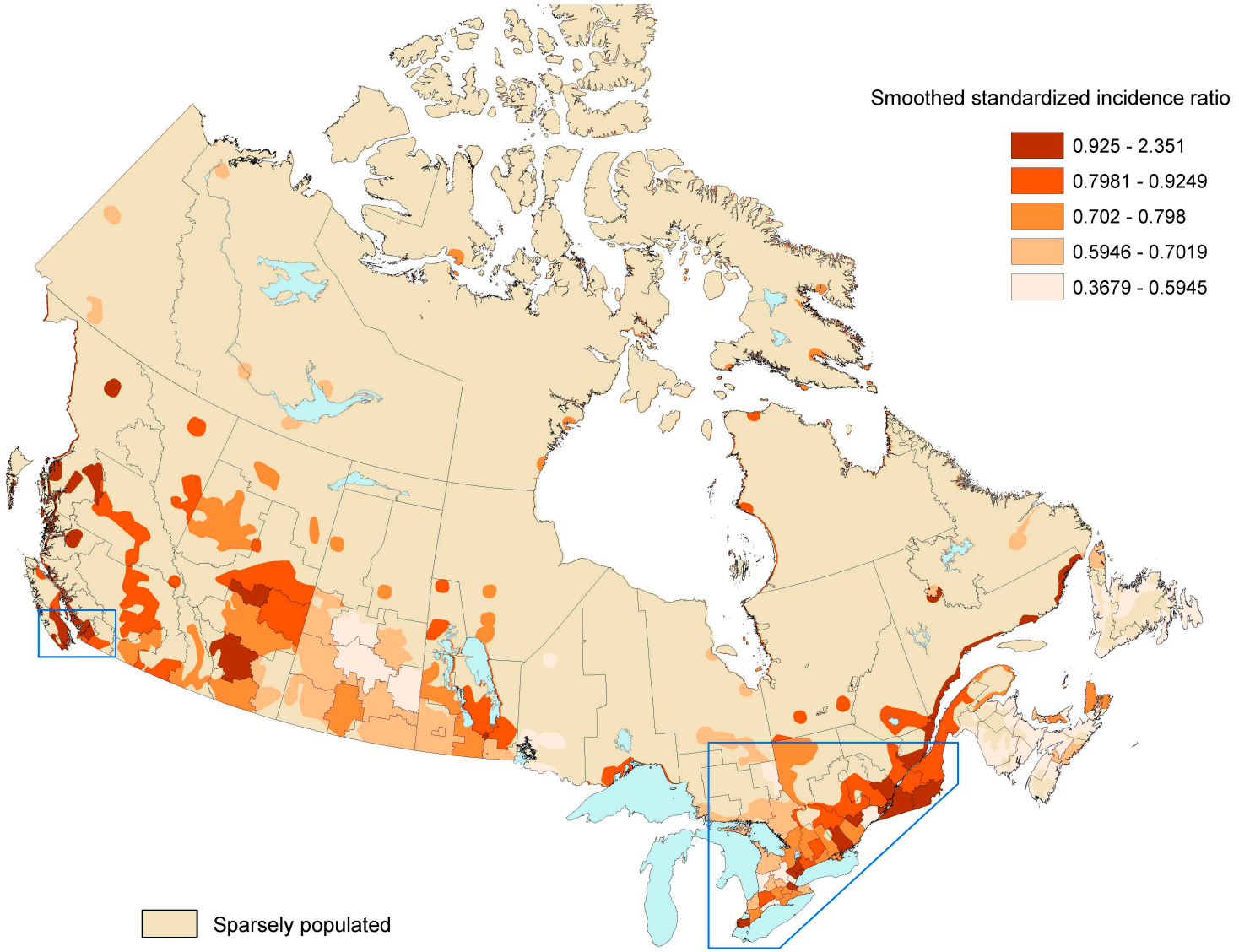
Data source: Canadian Cancer Registry database at Statistics Canada

Map 49-B. Colon and rectum, males, 2000-2006, all ages



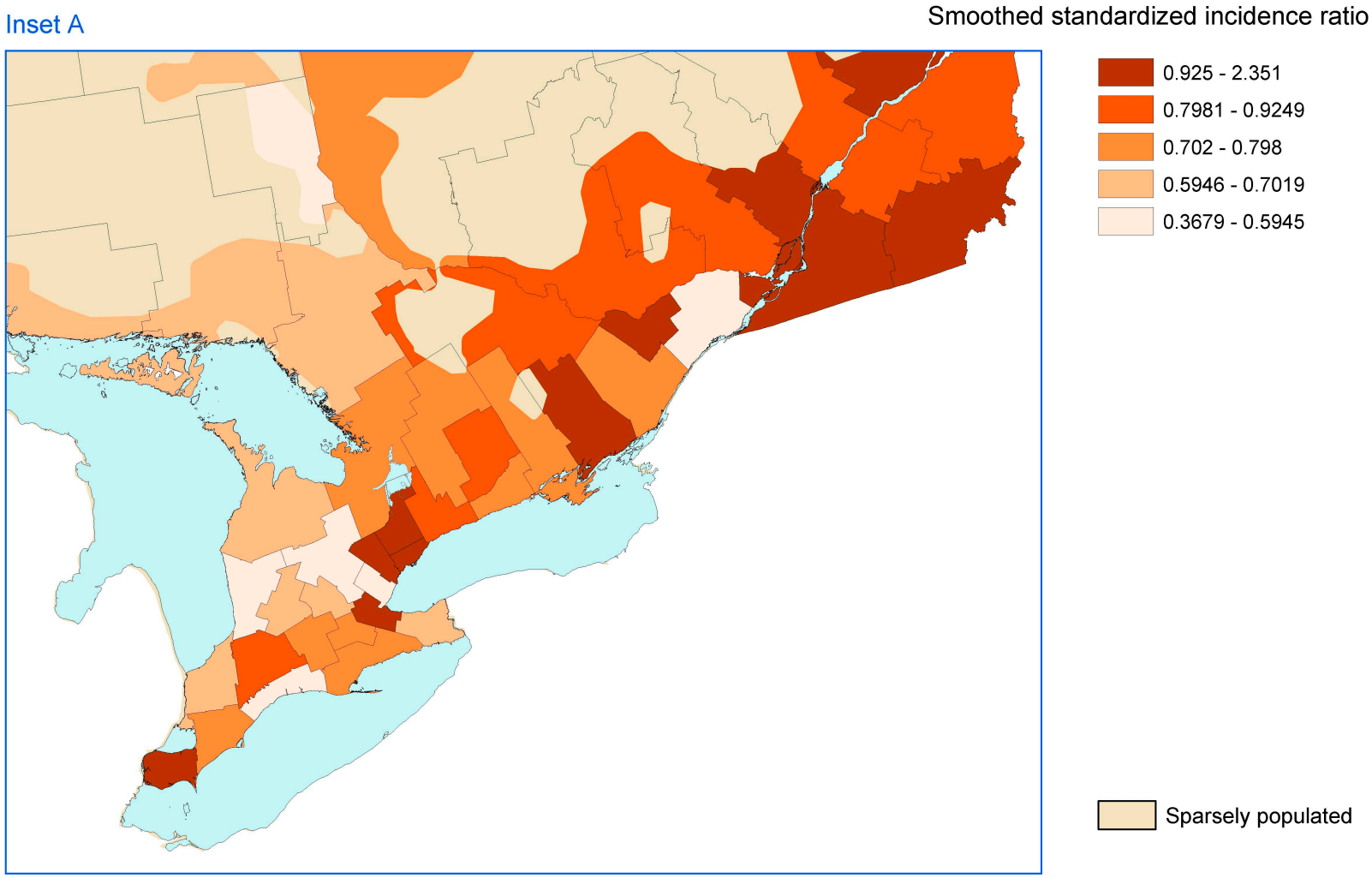
Data source: Canadian Cancer Registry database at Statistics Canada

Map 50. Liver, 2000-2006, all ages



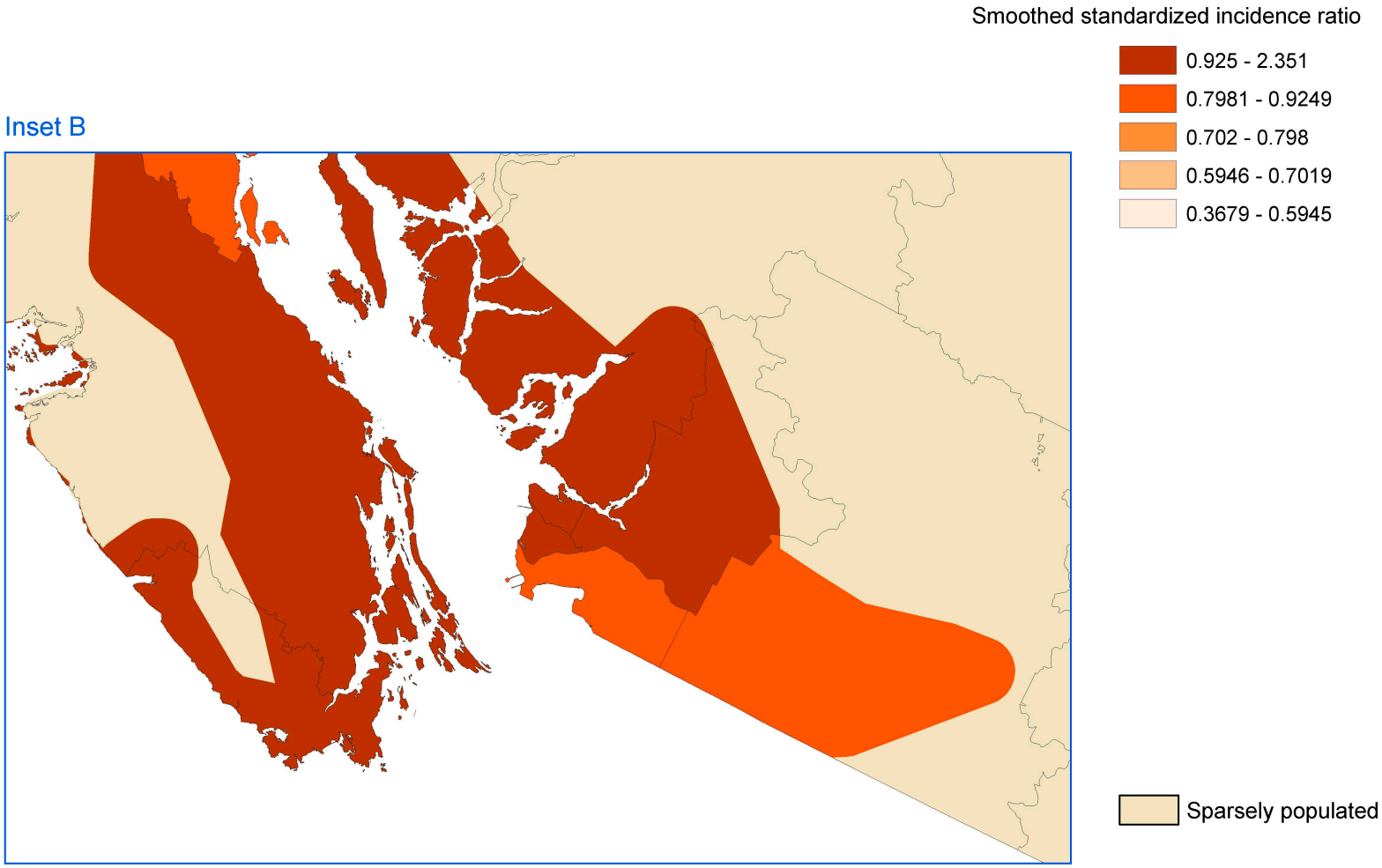
Data source: Canadian Cancer Registry database at Statistics Canada

Map 50-A. Liver, 2000-2006, all ages



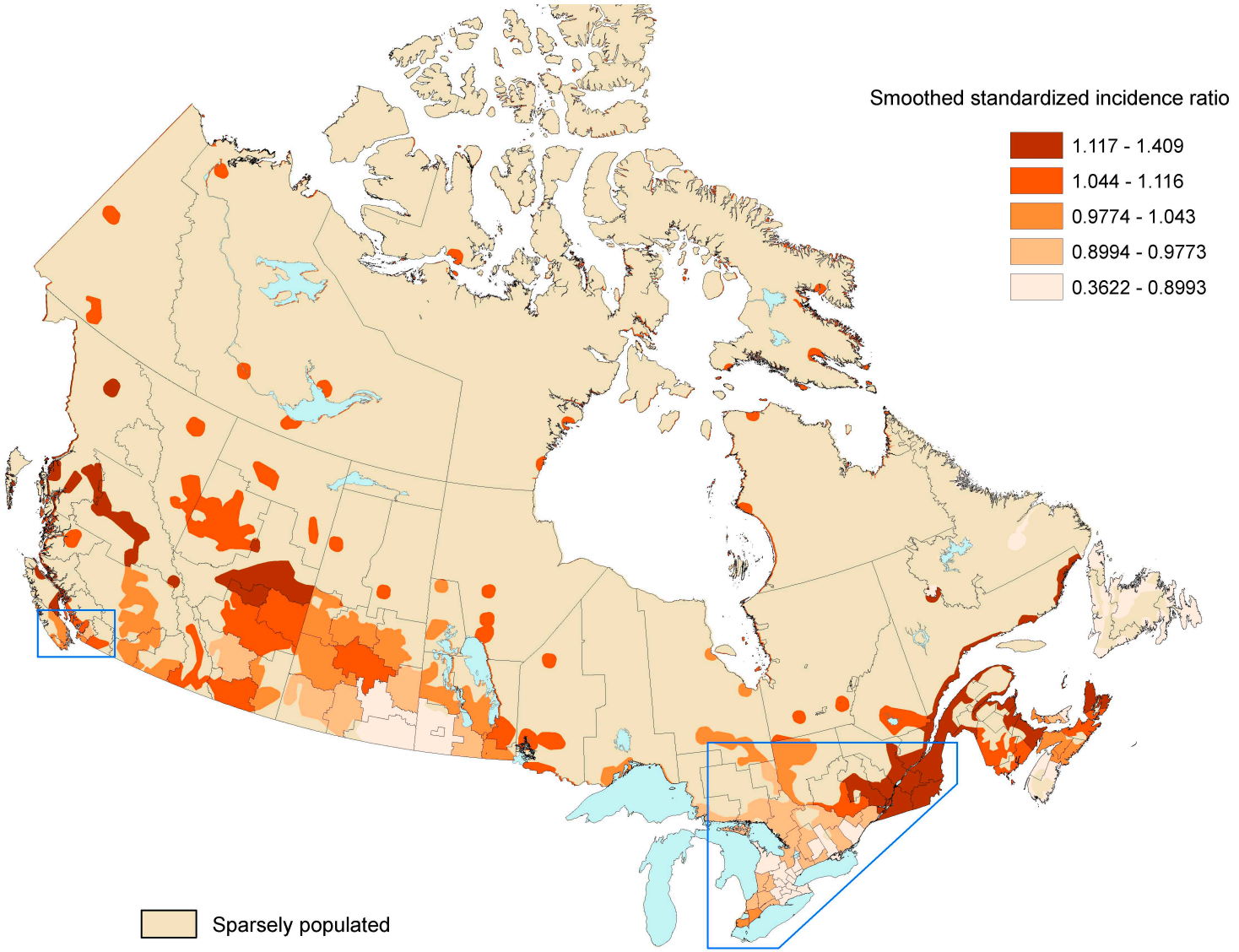
Data source: Canadian Cancer Registry database at Statistics Canada

Map 50-B. Liver, 2000-2006, all ages



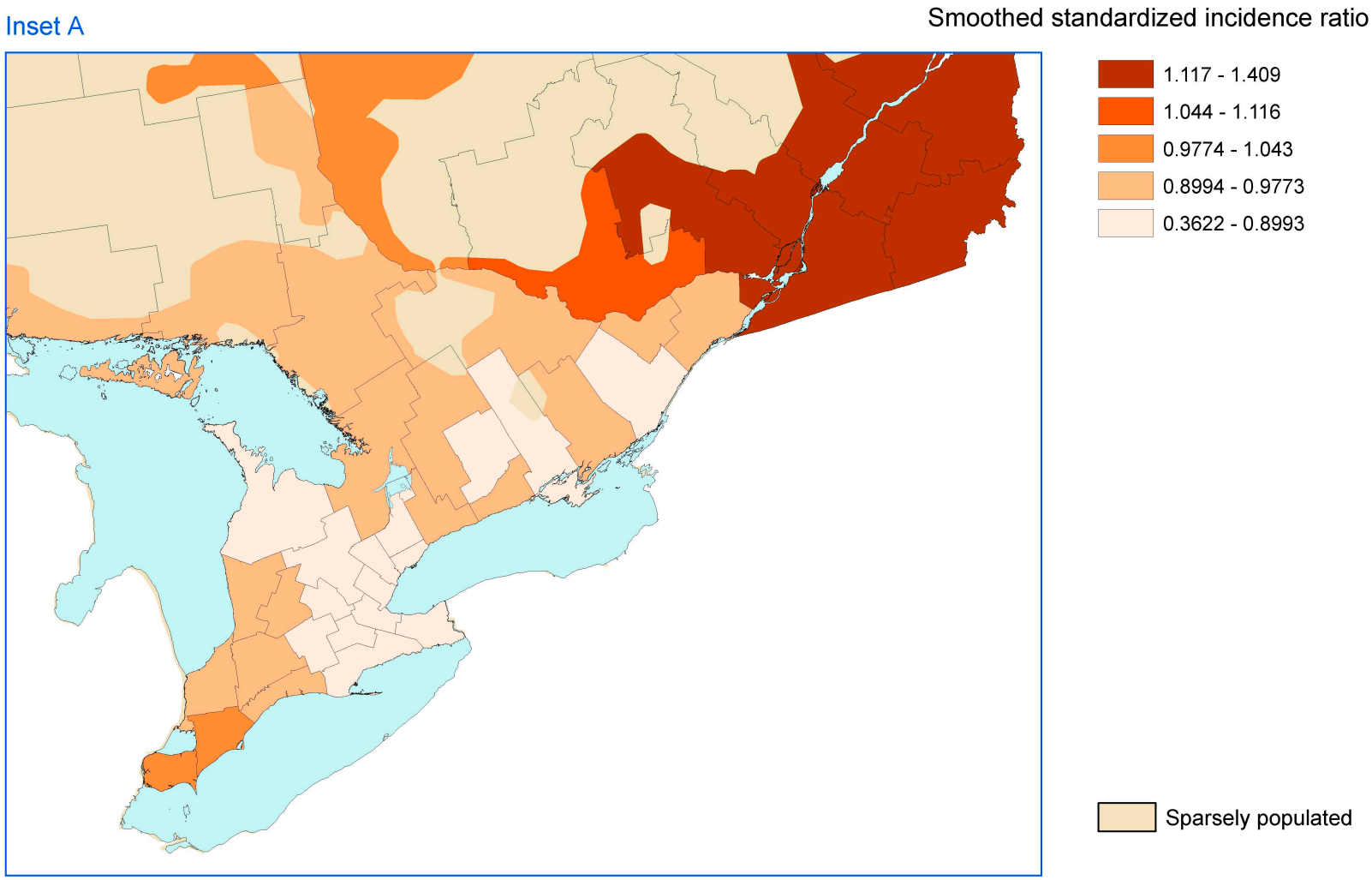
Data source: Canadian Cancer Registry database at Statistics Canada

Map 51. Pancreas, females, 2000-2006, all ages



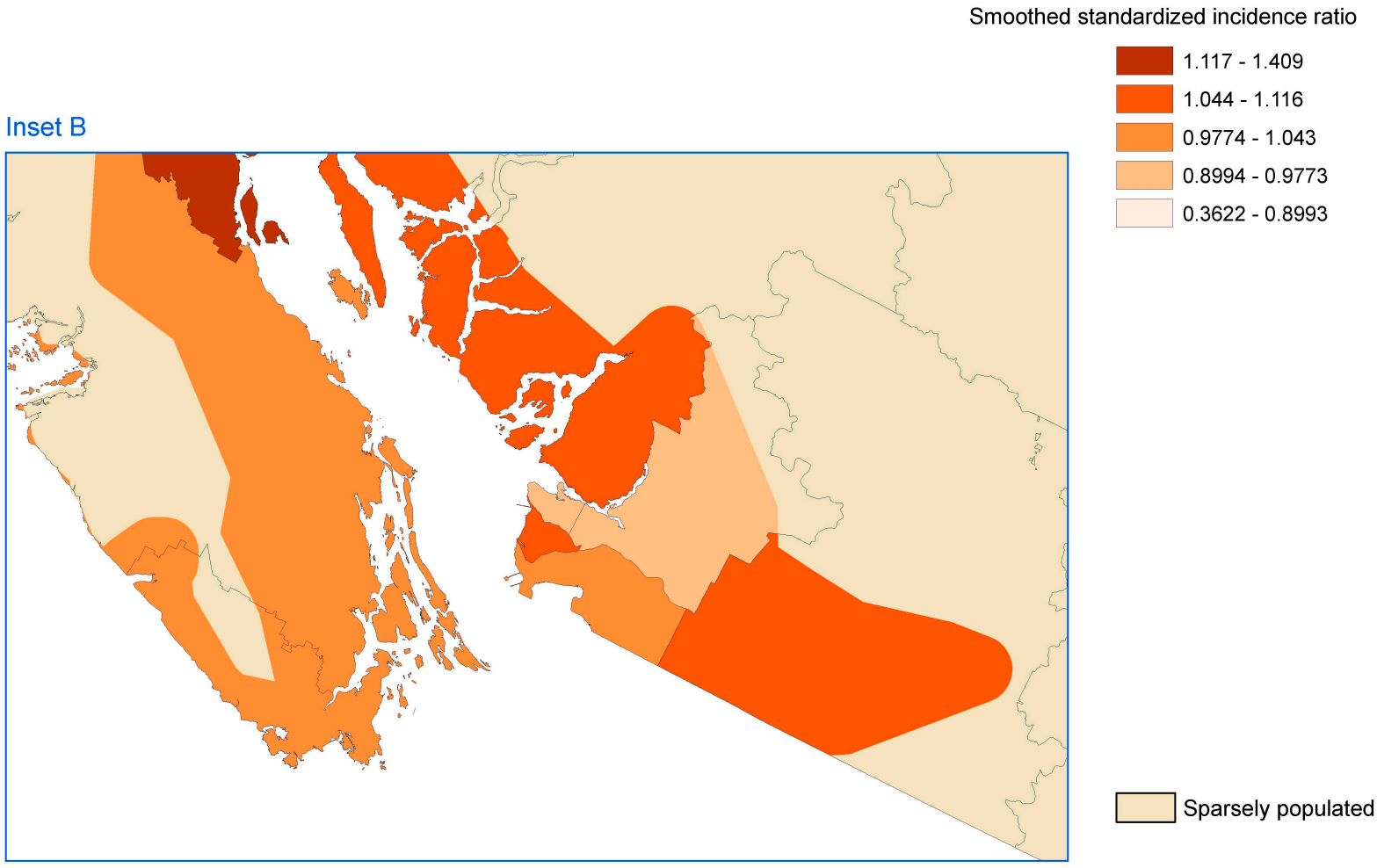
Data source: Canadian Cancer Registry database at Statistics Canada

Map 51-A. Pancreas, females, 2000-2006, all ages



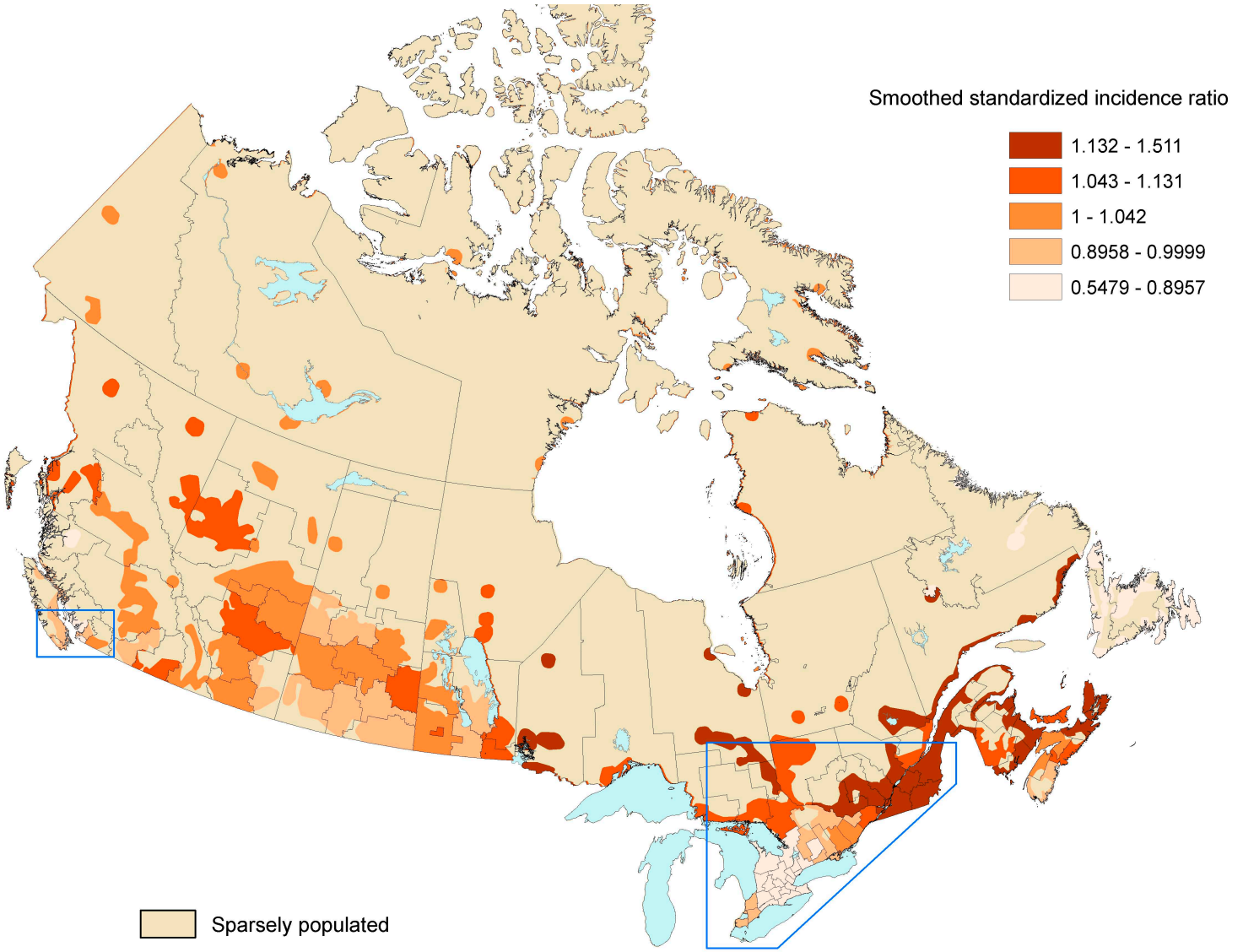
Data source: Canadian Cancer Registry database at Statistics Canada

Map 51-B. Pancreas, females, 2000-2006, all ages



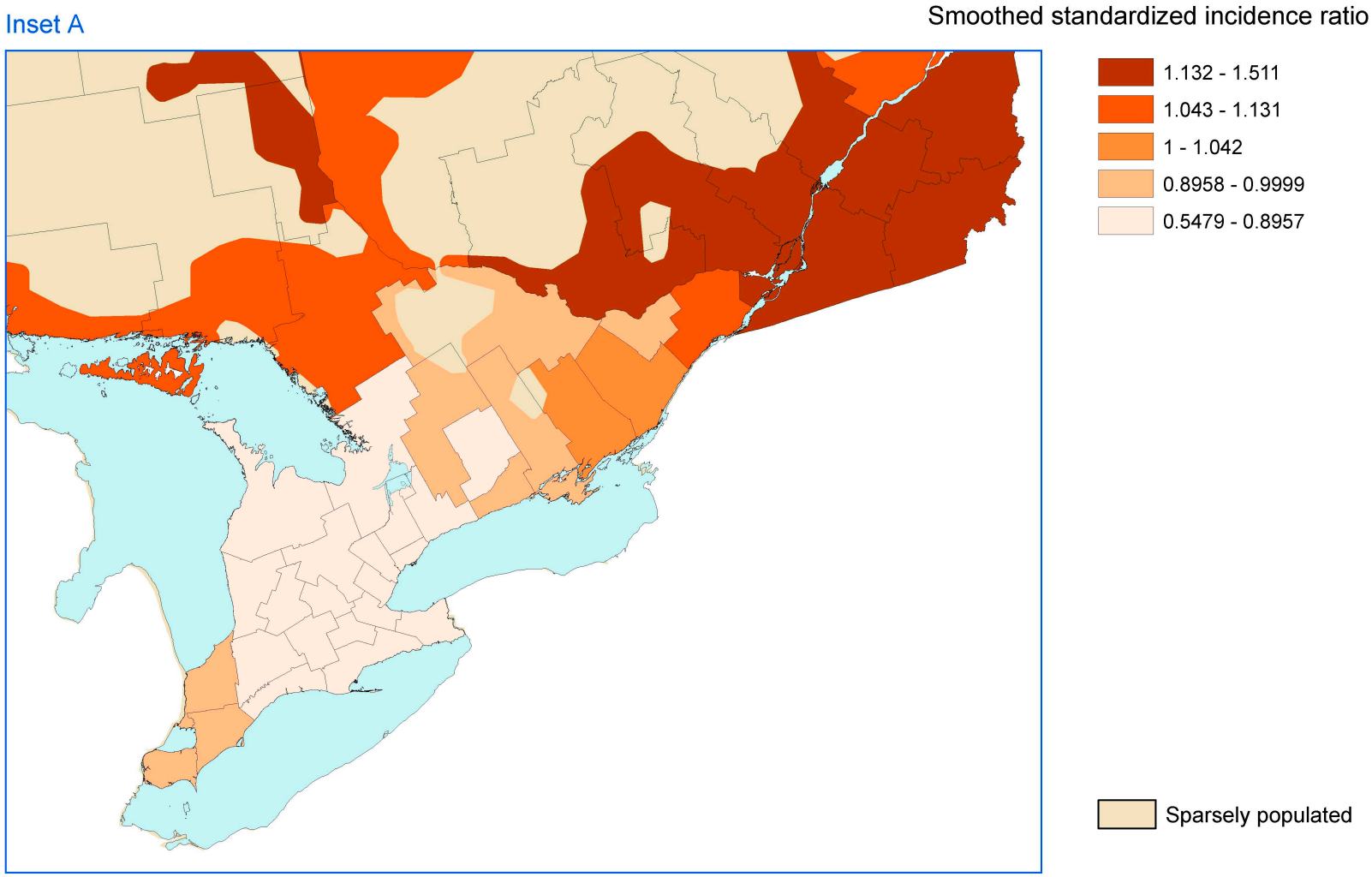
Data source: Canadian Cancer Registry database at Statistics Canada

Map 52. Pancreas, males, 2000-2006, all ages



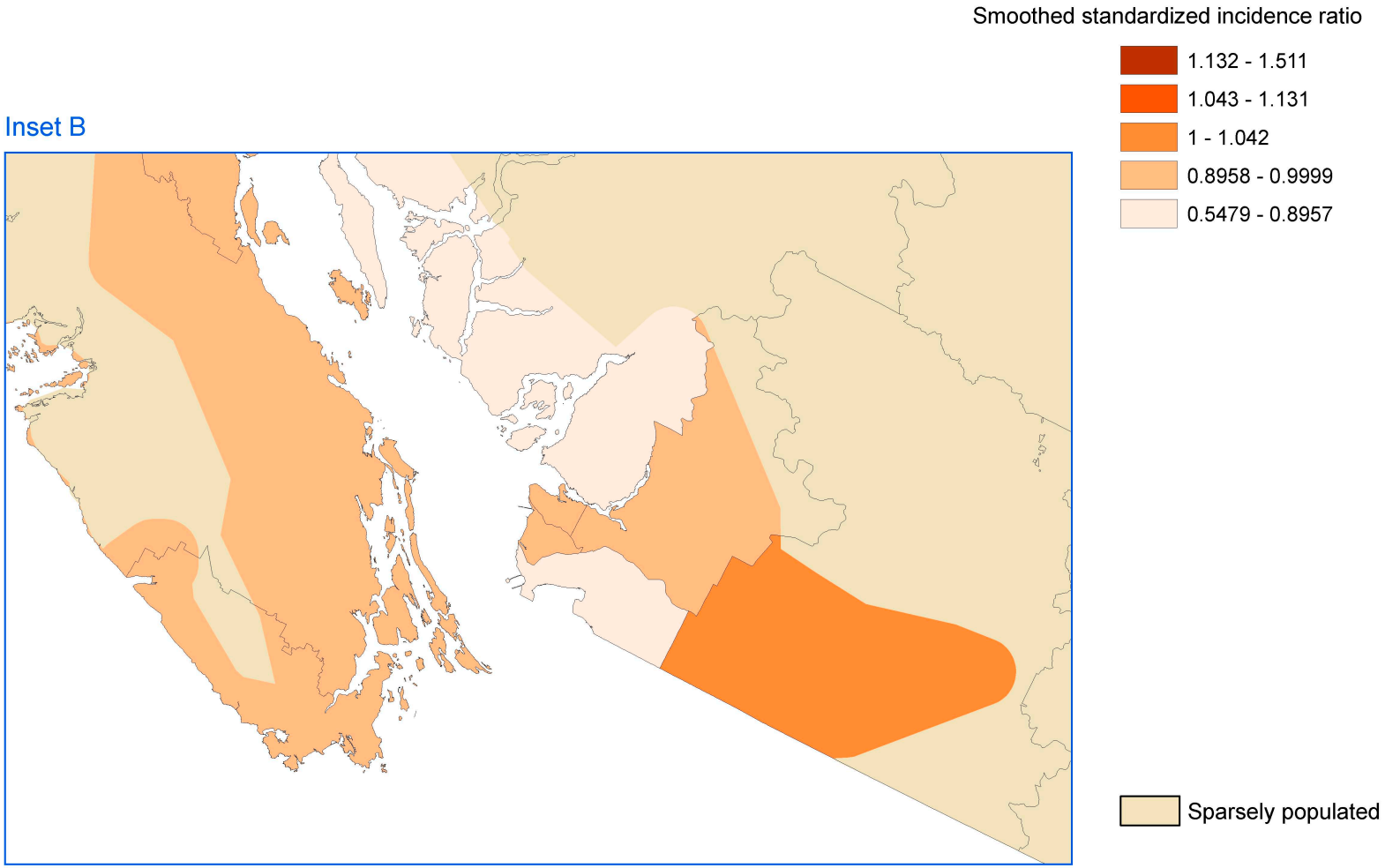
Data source: Canadian Cancer Registry database at Statistics Canada

Map 52-A. Pancreas, males, 2000-2006, all ages



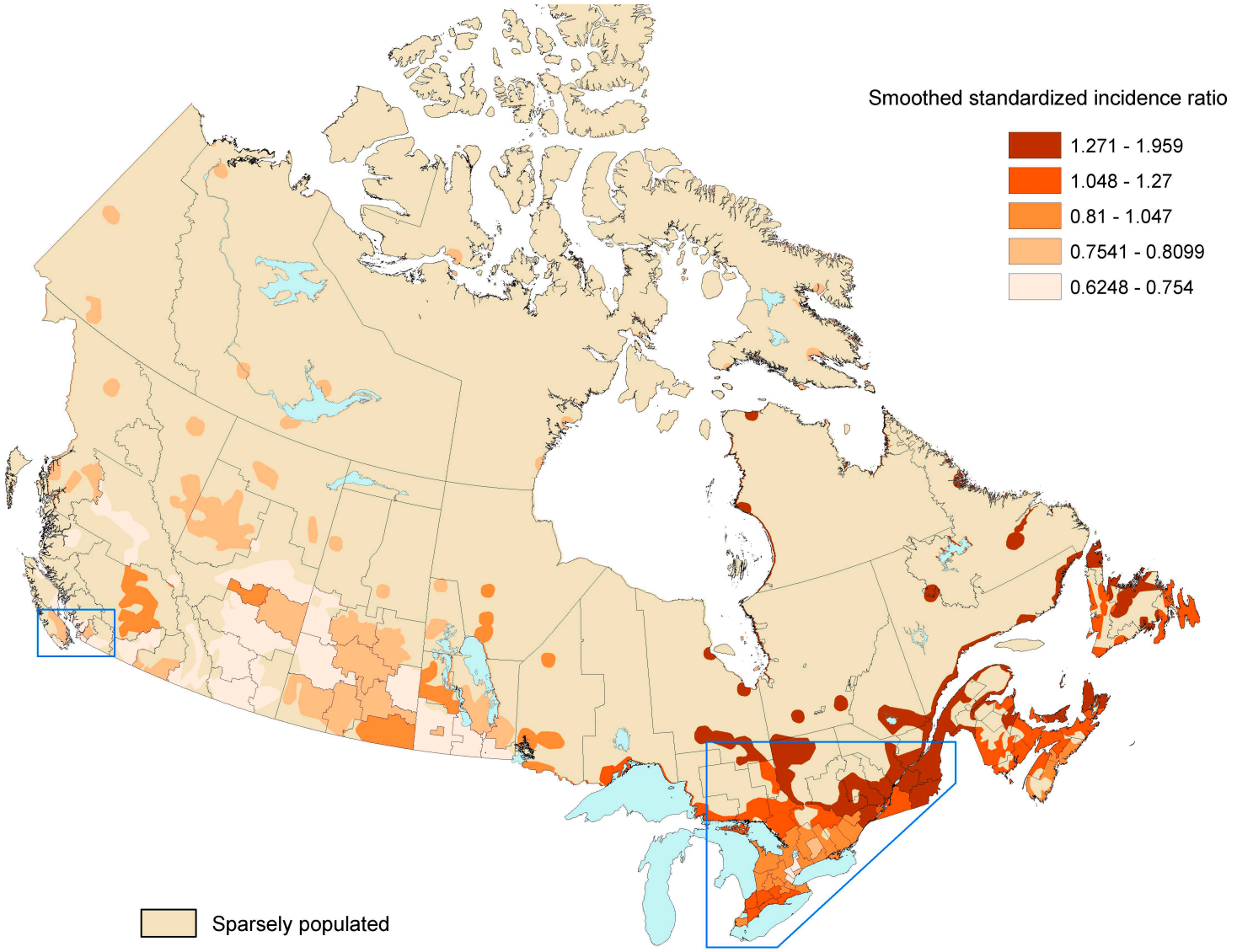
Data source: Canadian Cancer Registry database at Statistics Canada

Map 52-B. Pancreas, males, 2000-2006, all ages



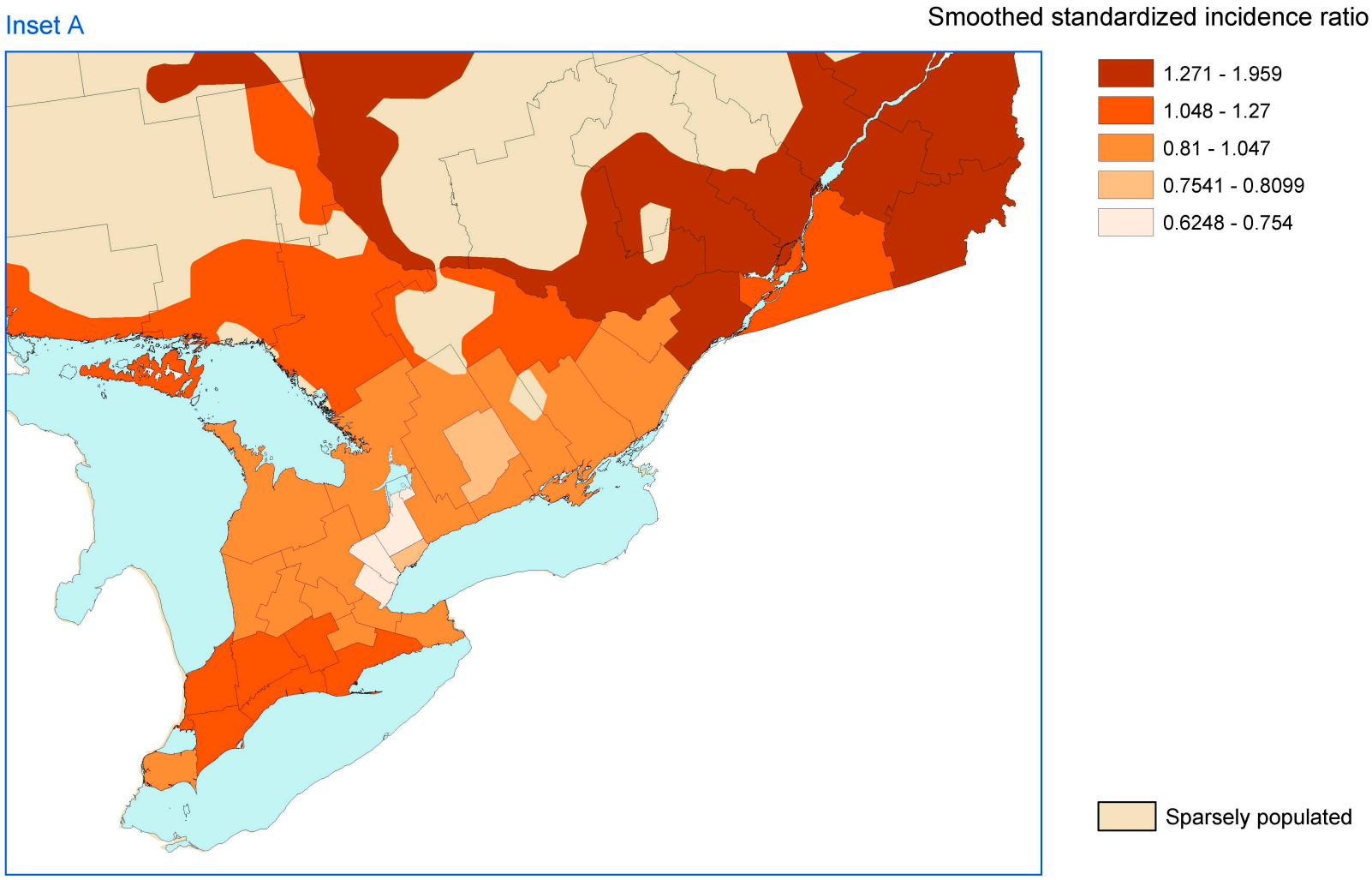
Data source: Canadian Cancer Registry database at Statistics Canada

Map 53. Larynx, 2000-2006, all ages



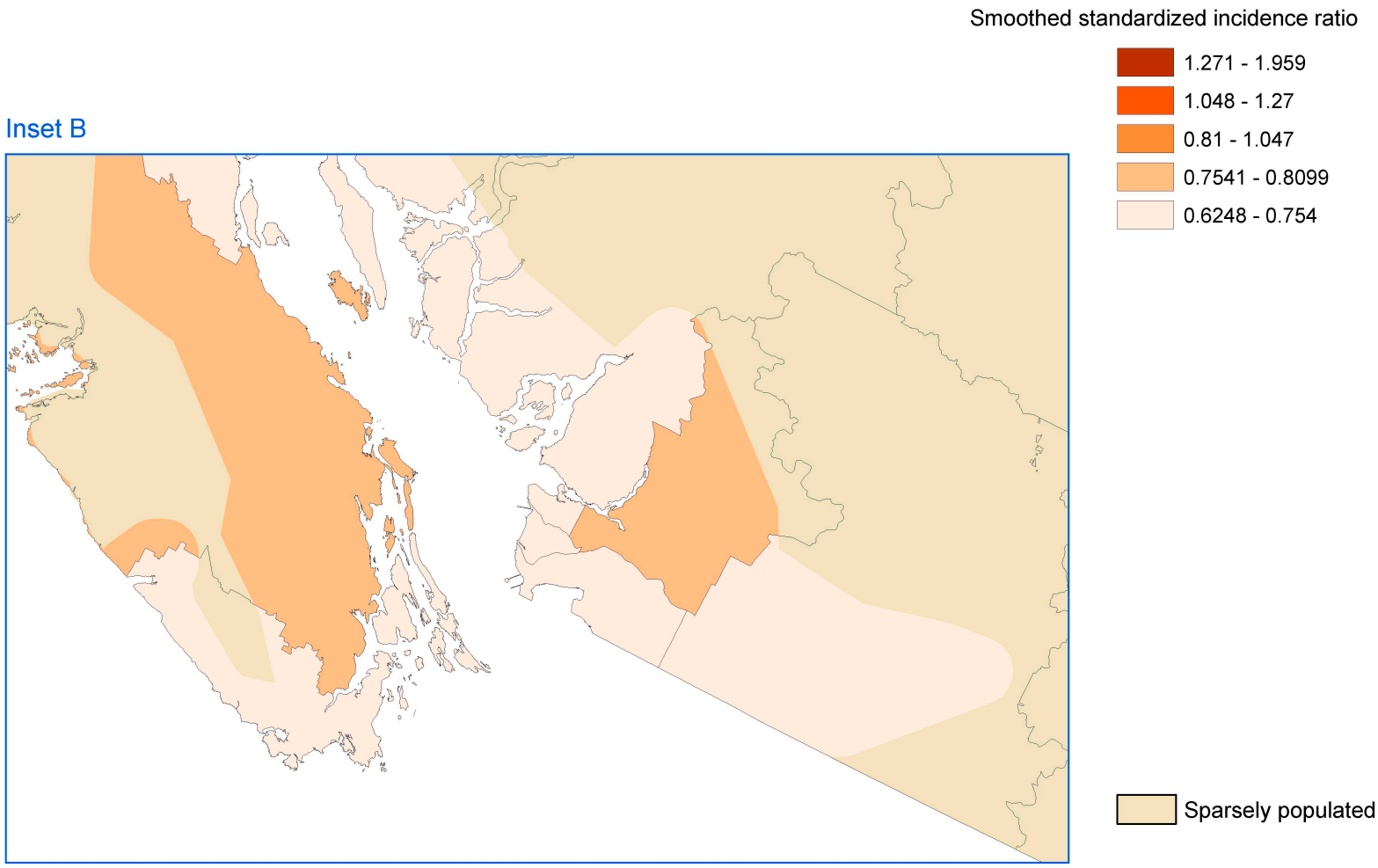
Data source: Canadian Cancer Registry database at Statistics Canada

Map 53-A. Larynx, 2000-2006, all ages



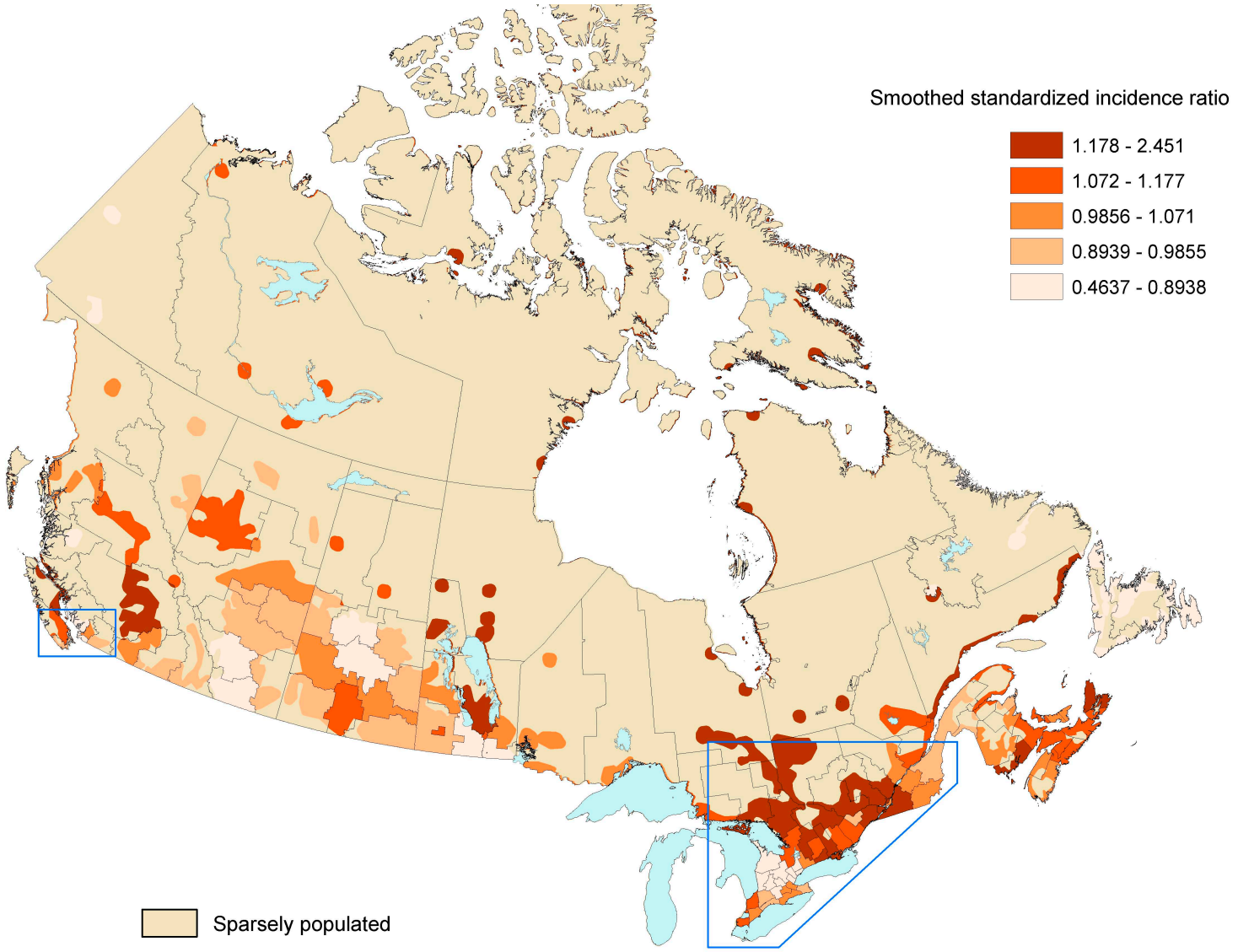
Data source: Canadian Cancer Registry database at Statistics Canada

Map 53-B. Larynx, 2000-2006, all ages



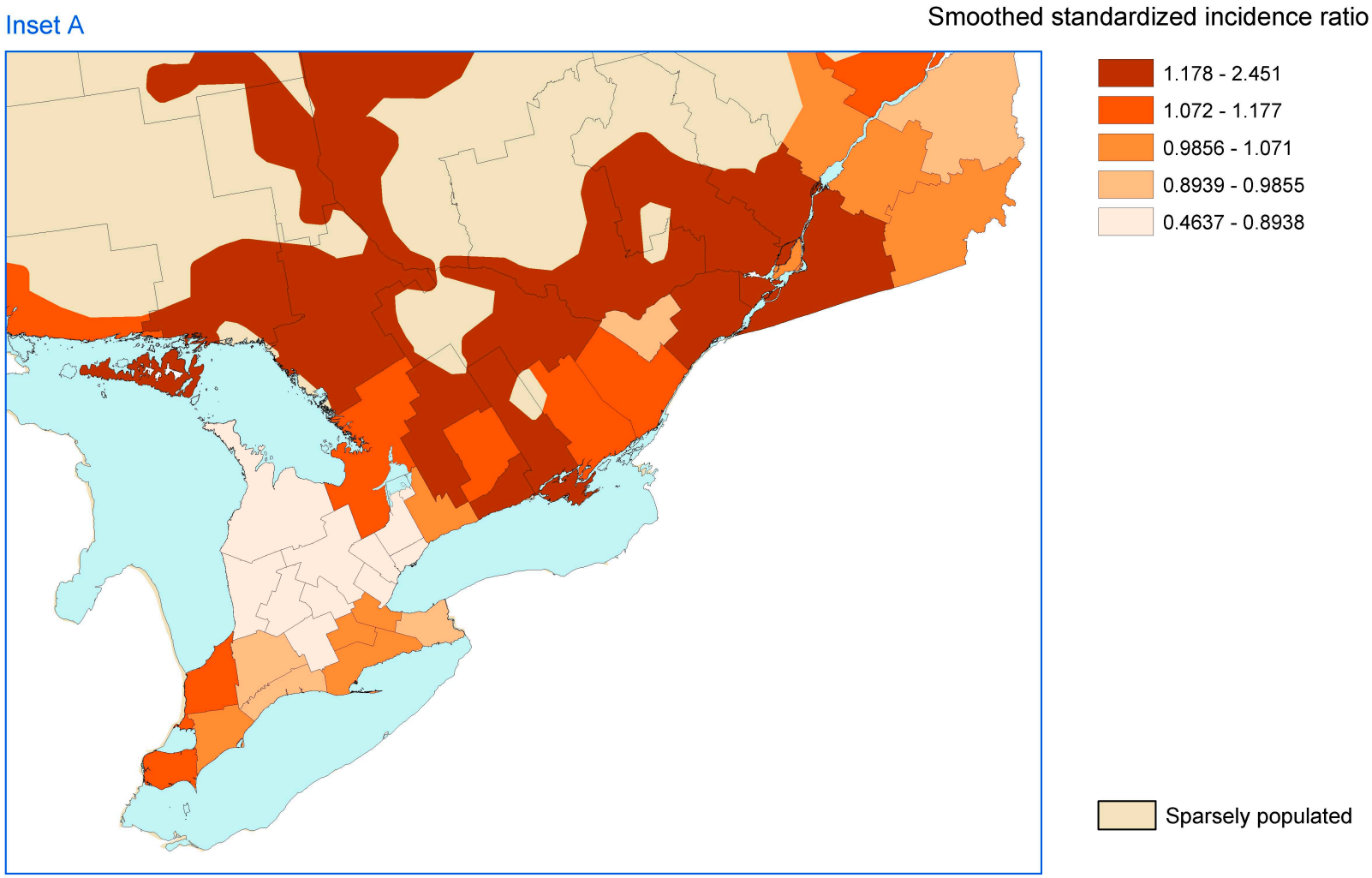
Data source: Canadian Cancer Registry database at Statistics Canada

Map 54. Lung and bronchus, females, 2000-2006, all ages



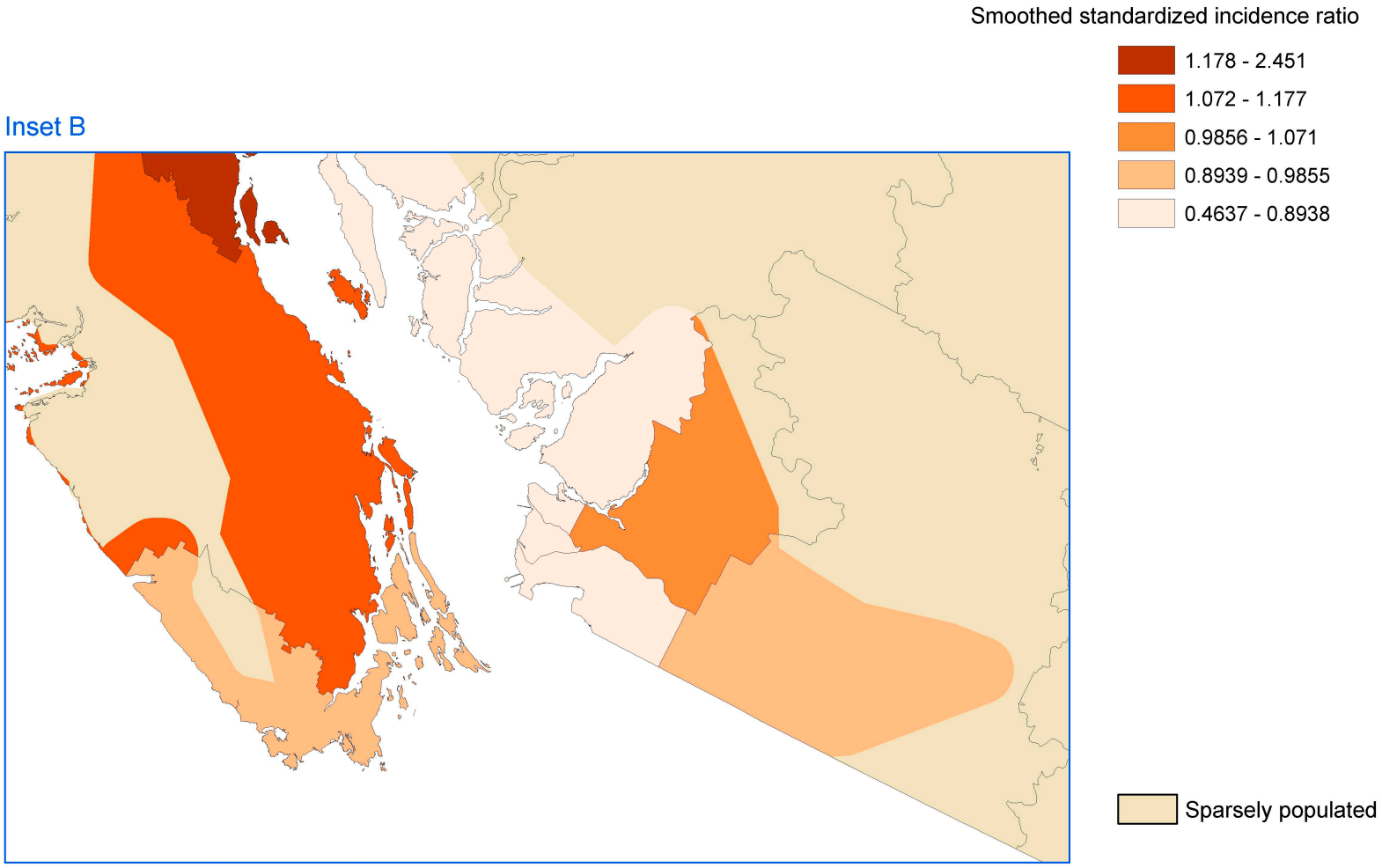
Data source: Canadian Cancer Registry database at Statistics Canada

Map 54-A. Lung and bronchus, females, 2000-2006, all ages



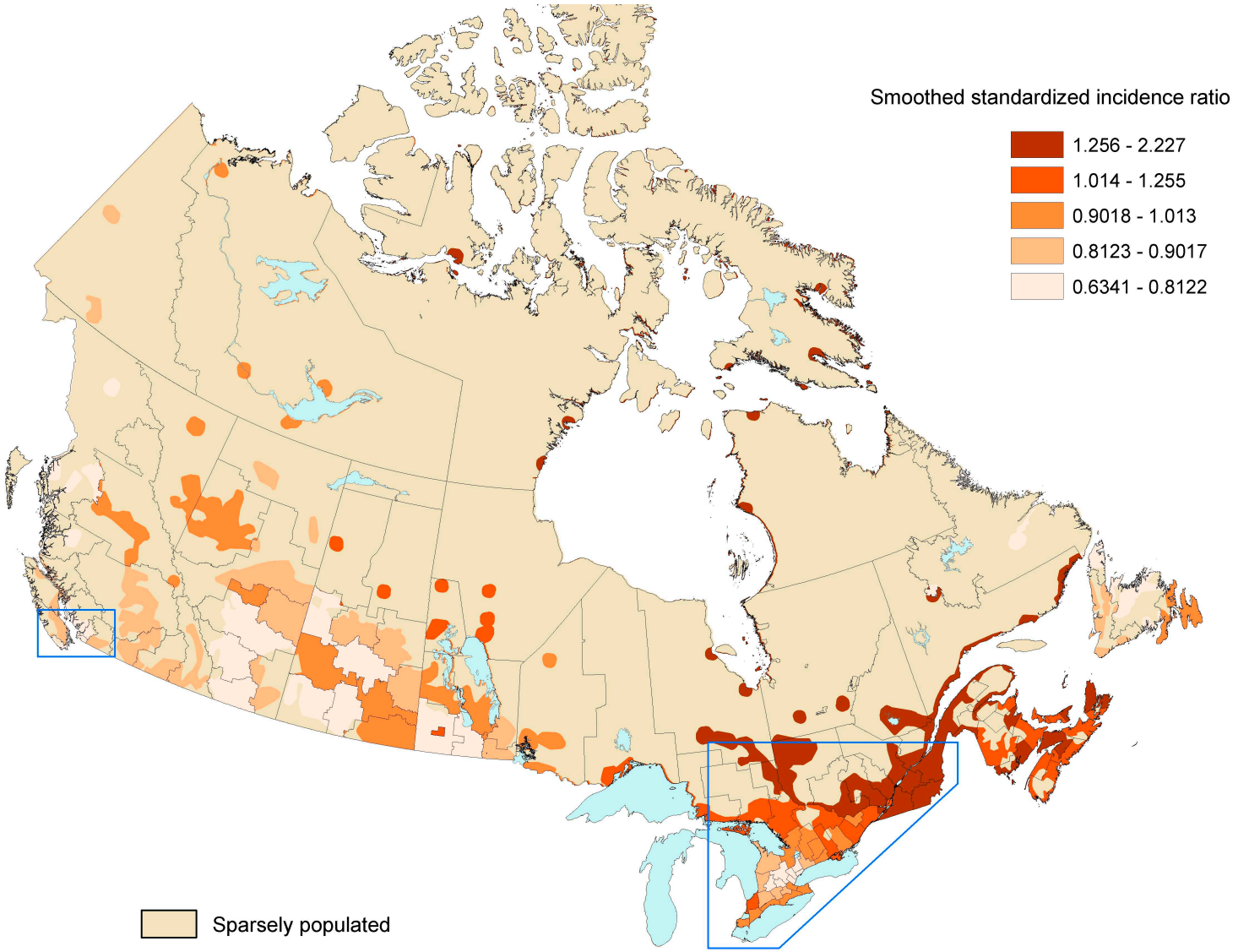
Data source: Canadian Cancer Registry database at Statistics Canada

Map 54-B. Lung and bronchus, females, 2000-2006, all ages



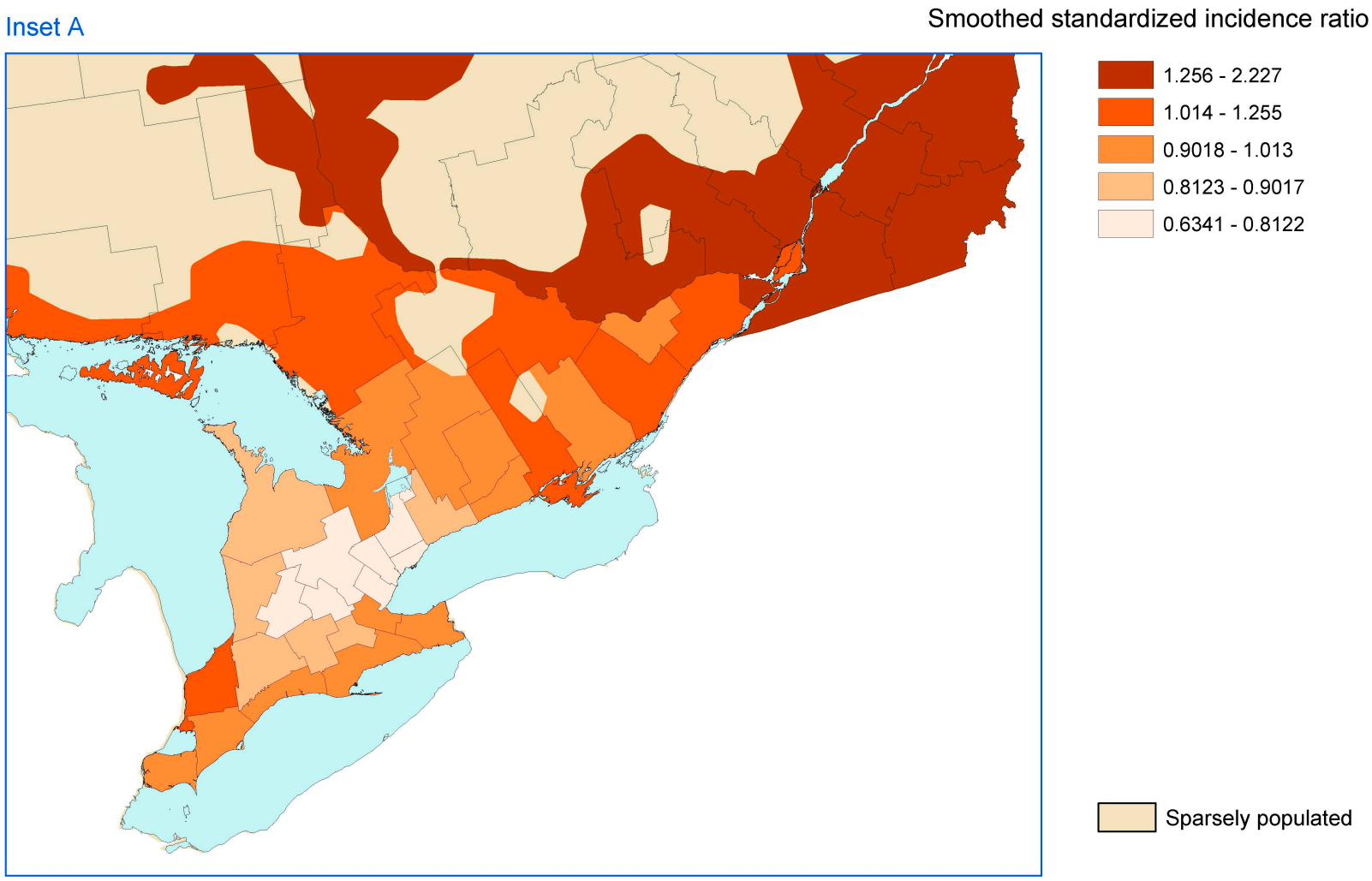
Data source: Canadian Cancer Registry database at Statistics Canada

Map 55. Lung and bronchus, males, 2000-2006, all ages



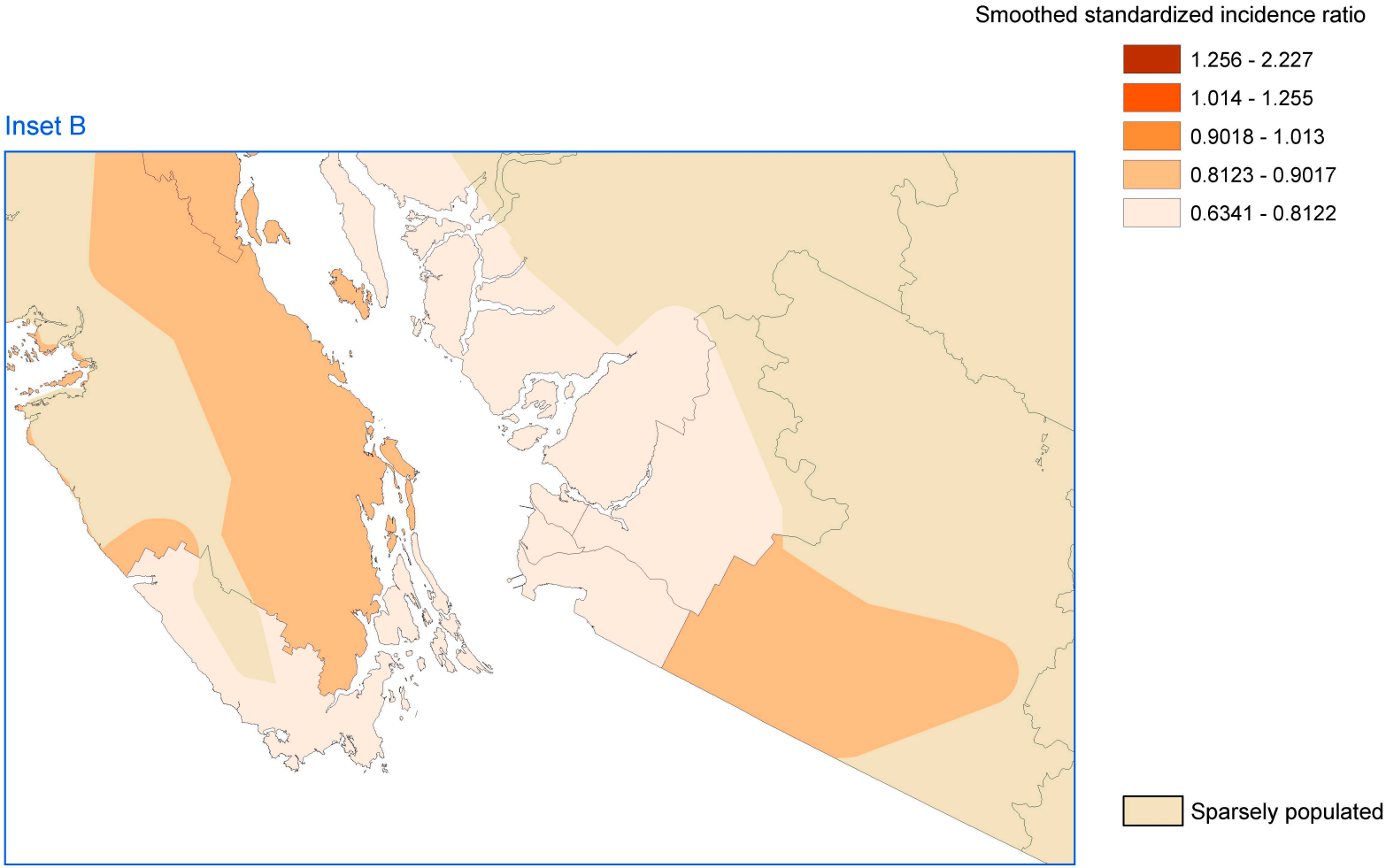
Data source: Canadian Cancer Registry database at Statistics Canada

Map 55-A. Lung and bronchus, males, 2000-2006, all ages



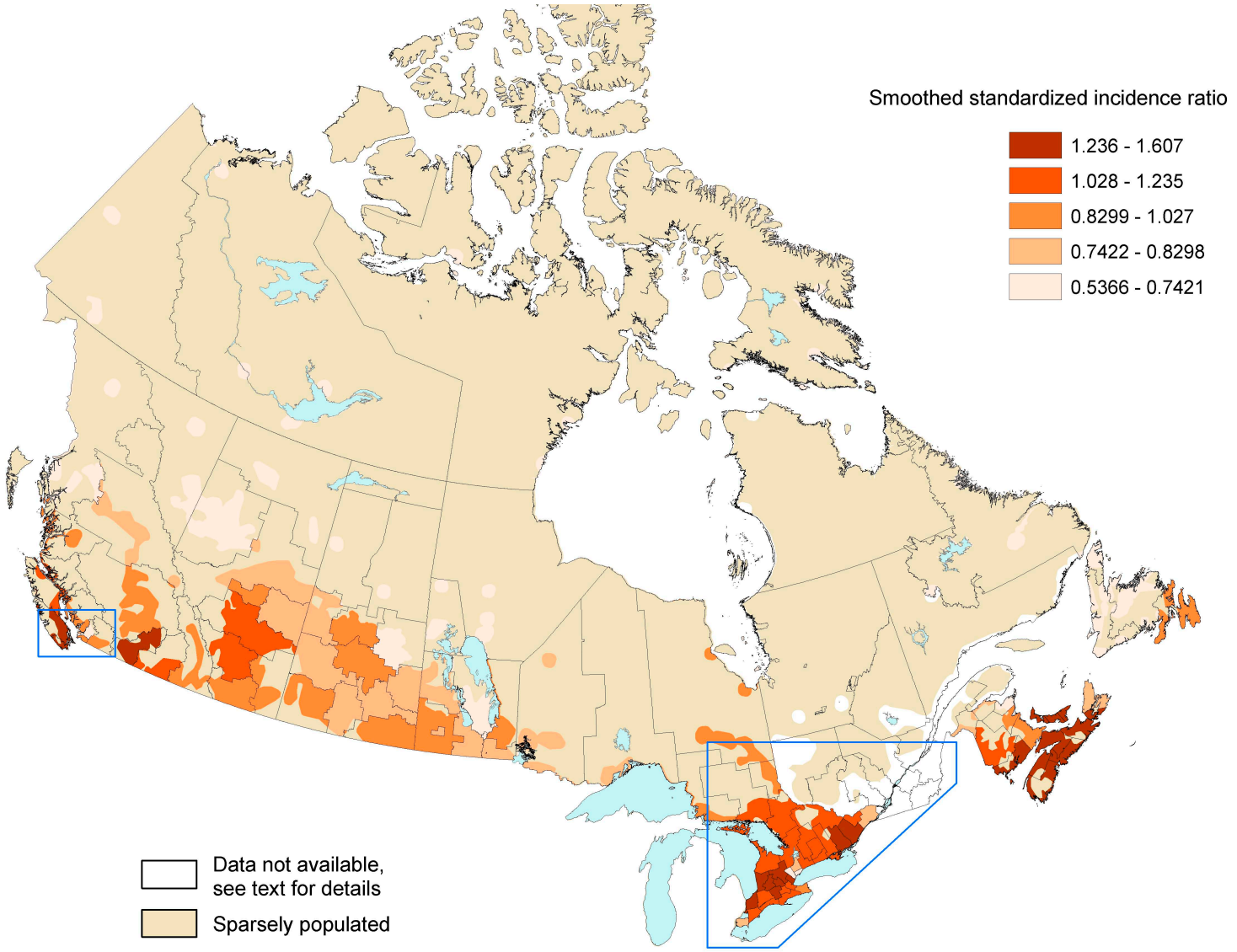
Data source: Canadian Cancer Registry database at Statistics Canada

Map 55-B. Lung and bronchus, males, 2000-2006, all ages



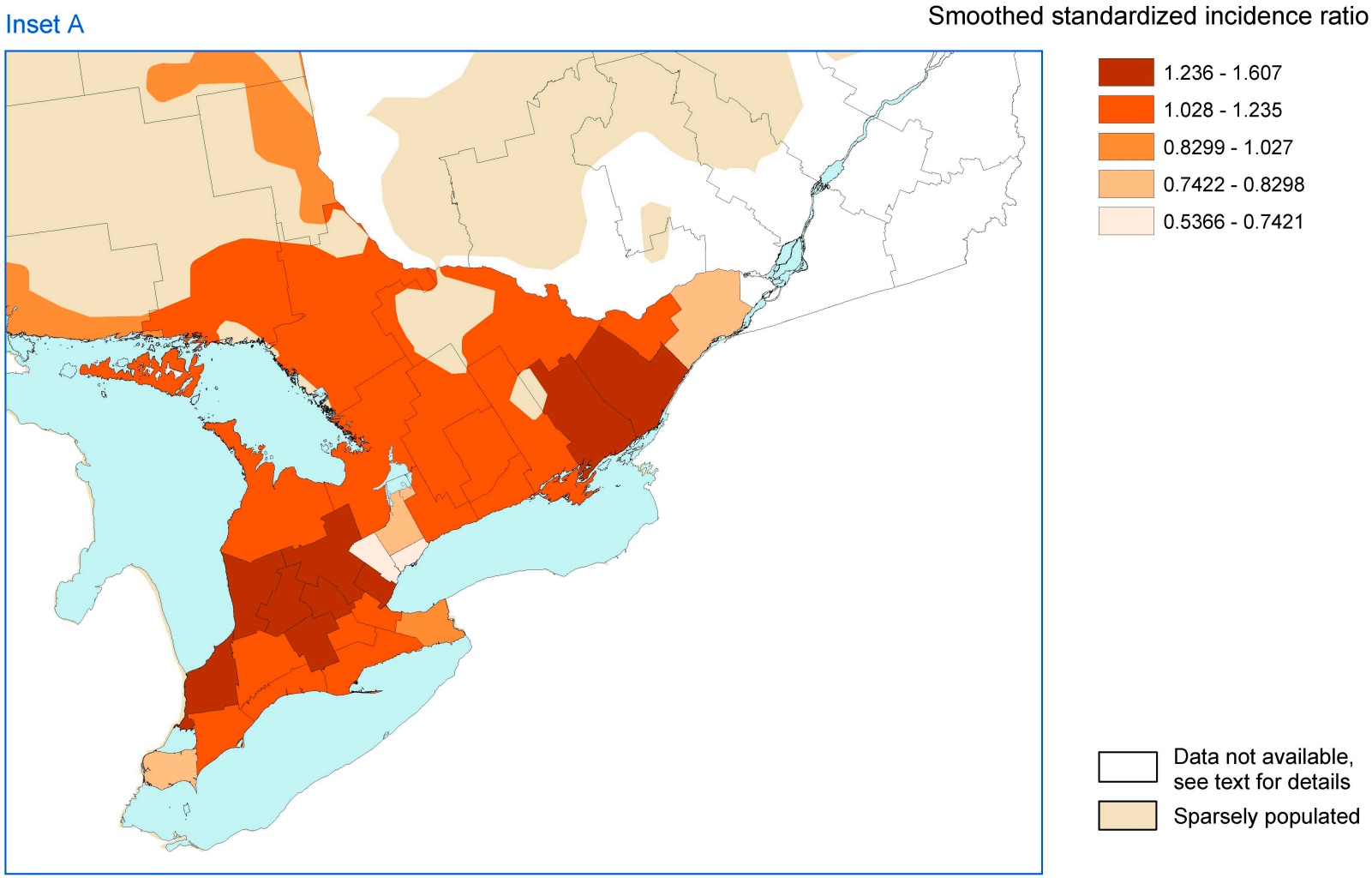
Data source: Canadian Cancer Registry database at Statistics Canada

Map 56. Melanoma of the skin, females, 2000-2006, all ages



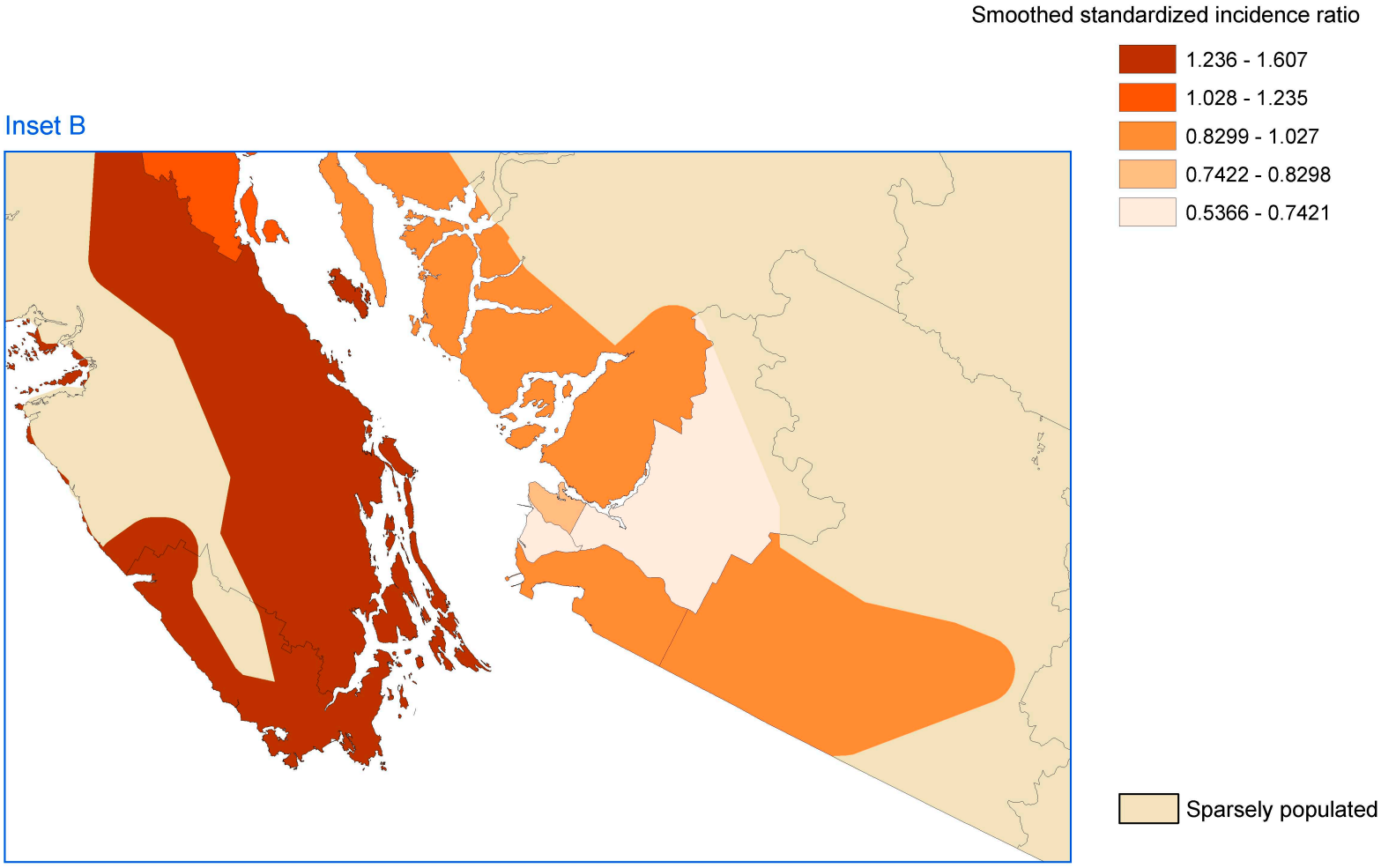
Data source: Canadian Cancer Registry database at Statistics Canada

Map 56-A. Melanoma of the skin, females, 2000-2006, all ages



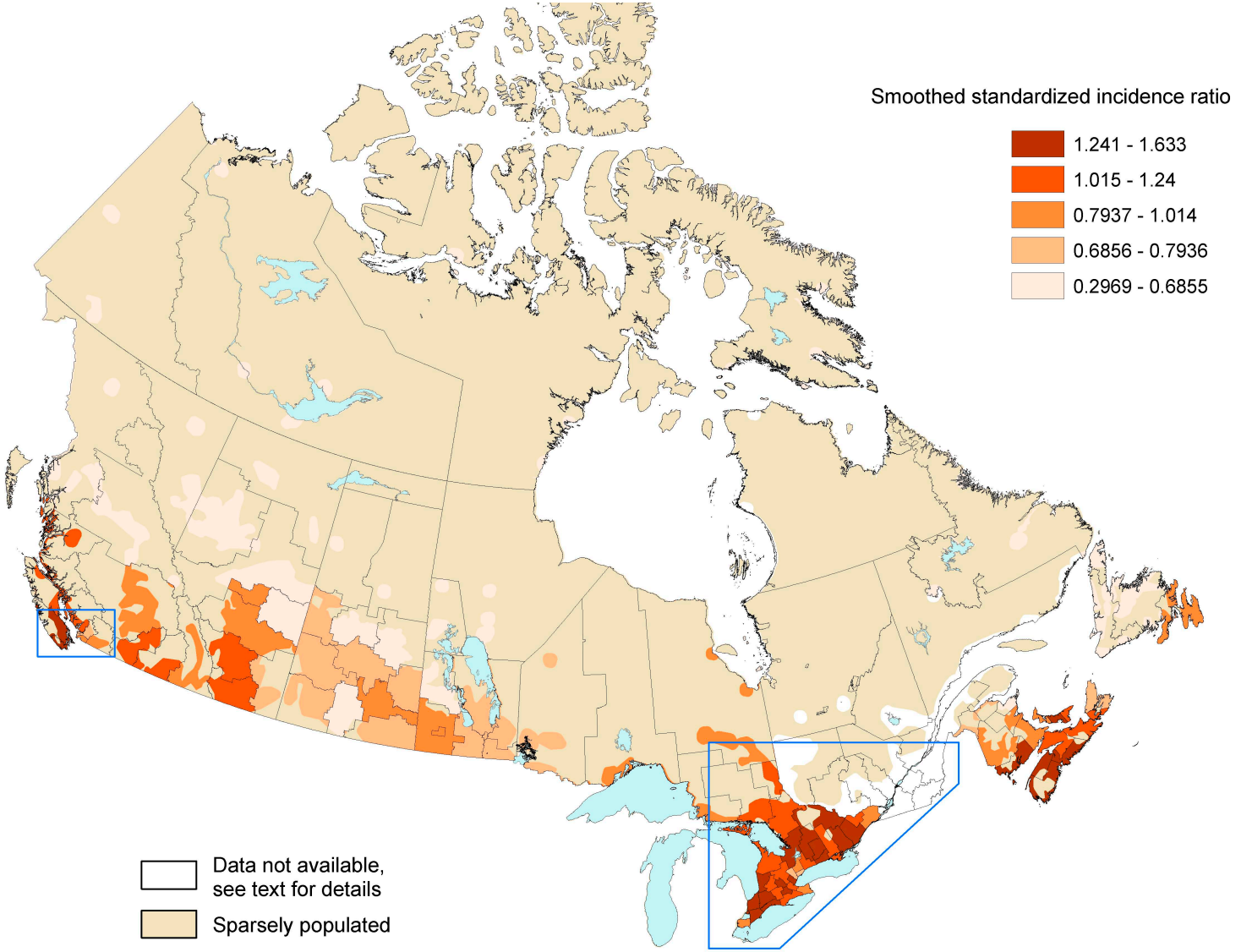
Data source: Canadian Cancer Registry database at Statistics Canada

Map 56-B. Melanoma of the skin, females, 2000-2006, all ages



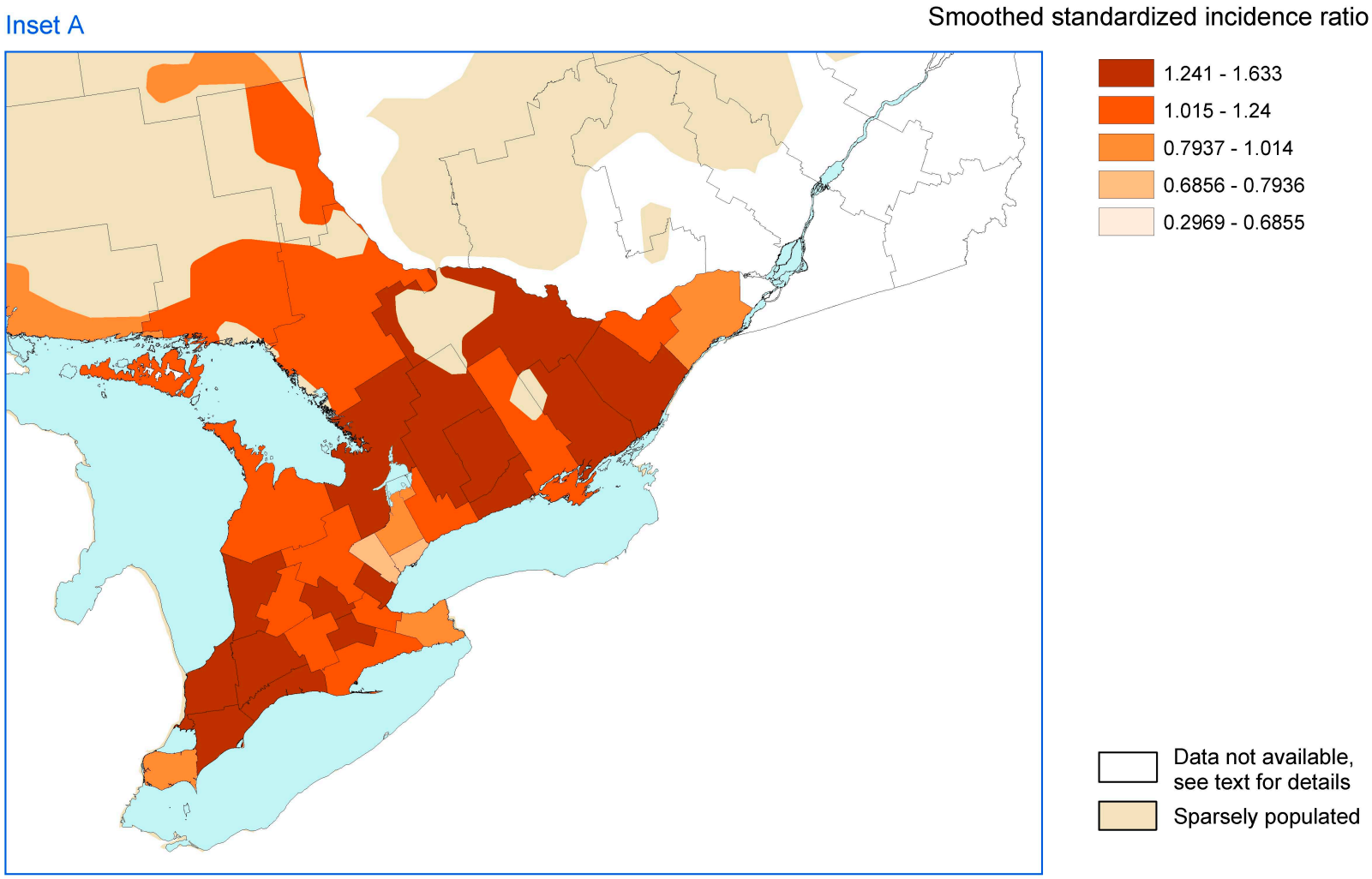
Data source: Canadian Cancer Registry database at Statistics Canada

Map 57. Melanoma of the skin, males, 2000-2006, all ages



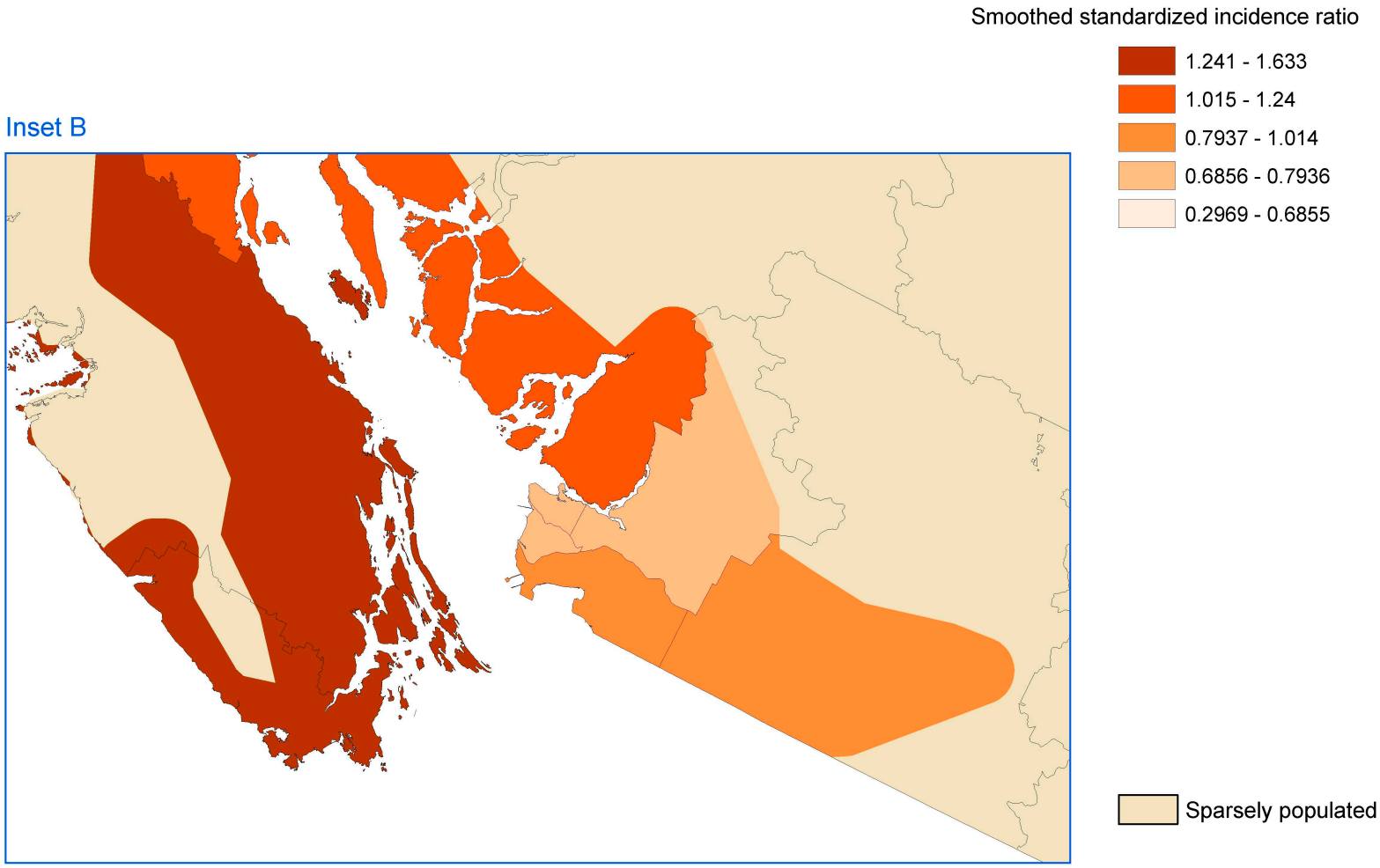
Data source: Canadian Cancer Registry database at Statistics Canada

Map 57-A. Melanoma of the skin, males, 2000-2006, all ages



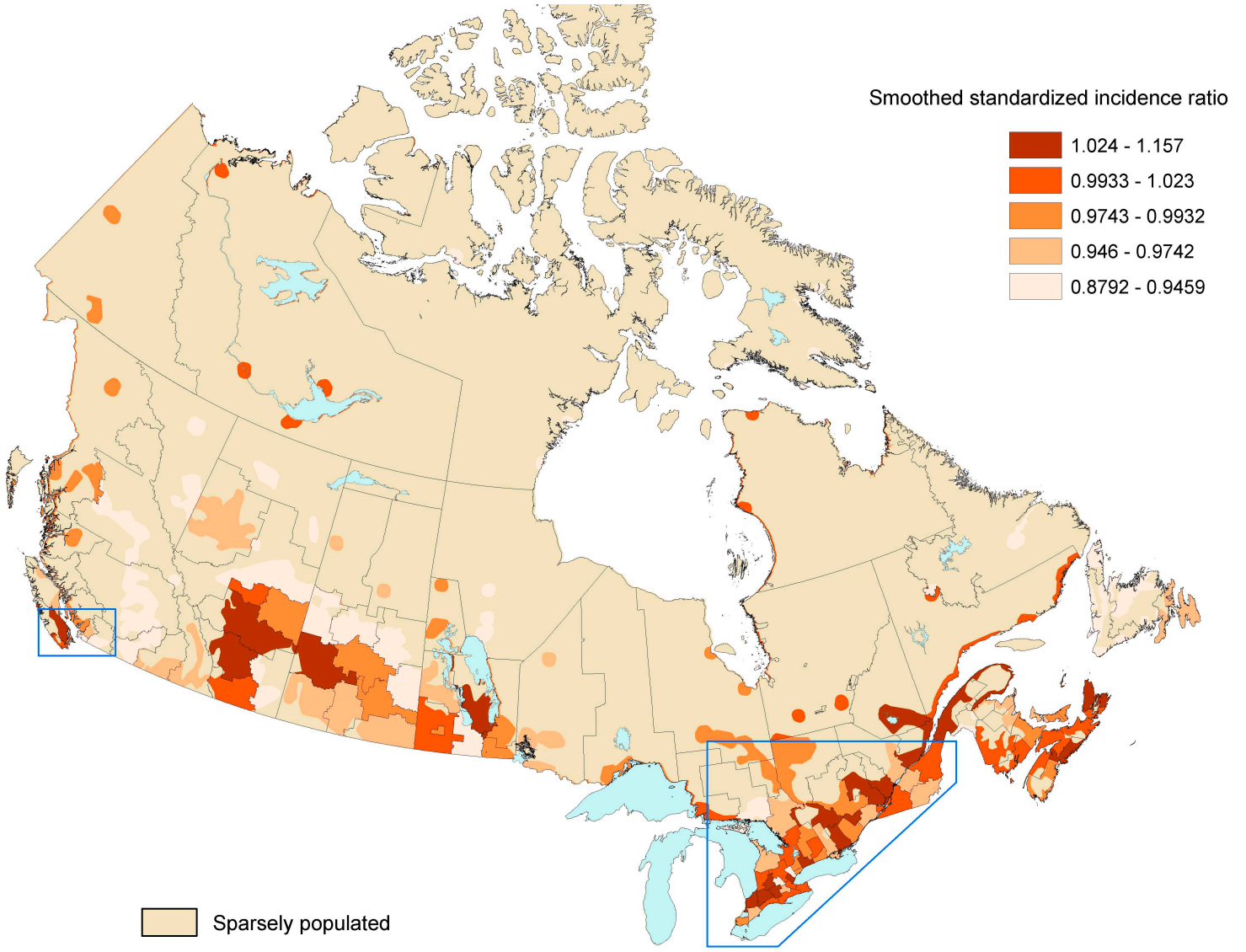
Data source: Canadian Cancer Registry database at Statistics Canada

Map 57-B. Melanoma of the skin, males, 2000-2006, all ages



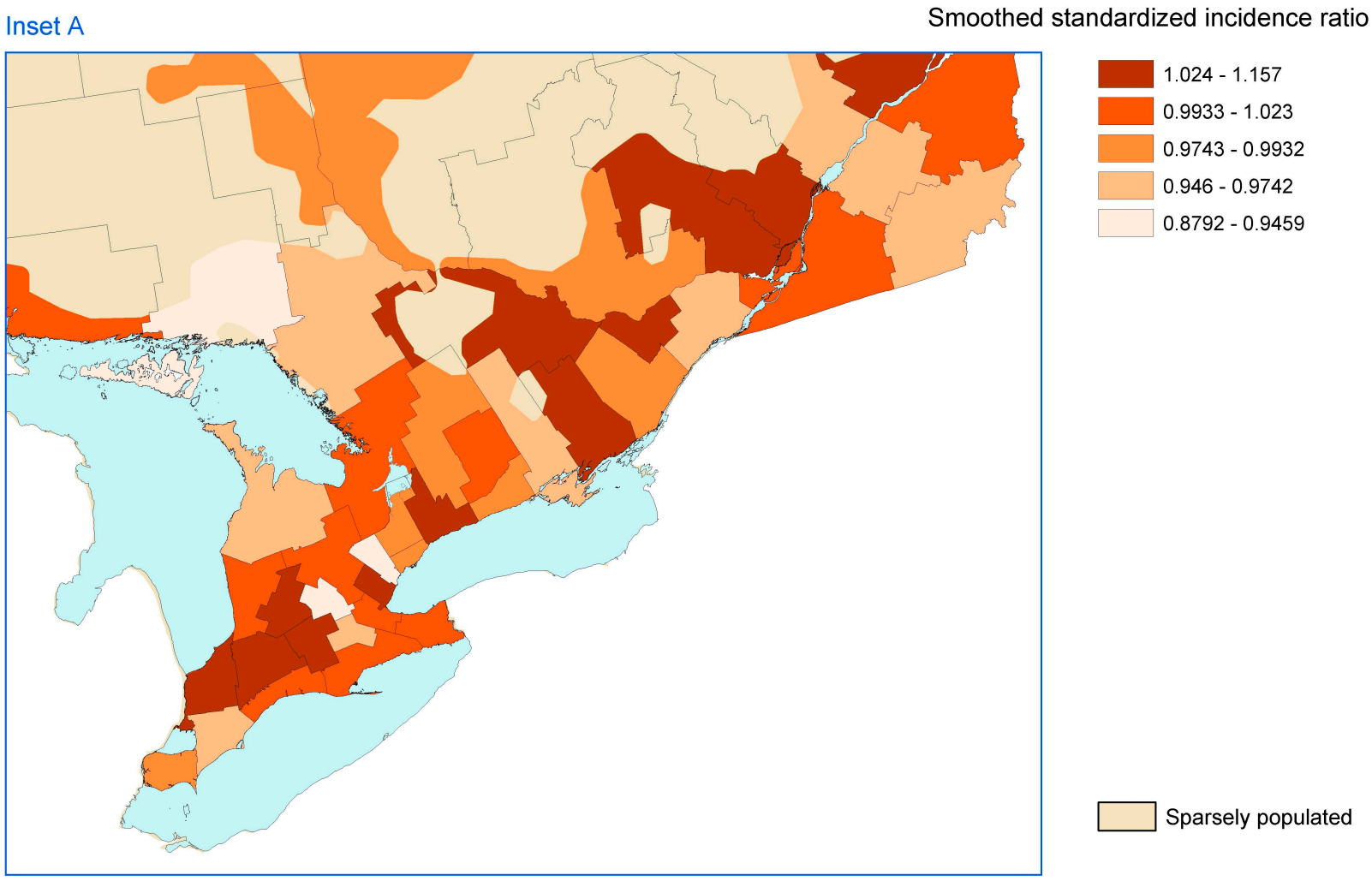
Data source: Canadian Cancer Registry database at Statistics Canada

Map 58. Female breast, 2000-2006, all ages



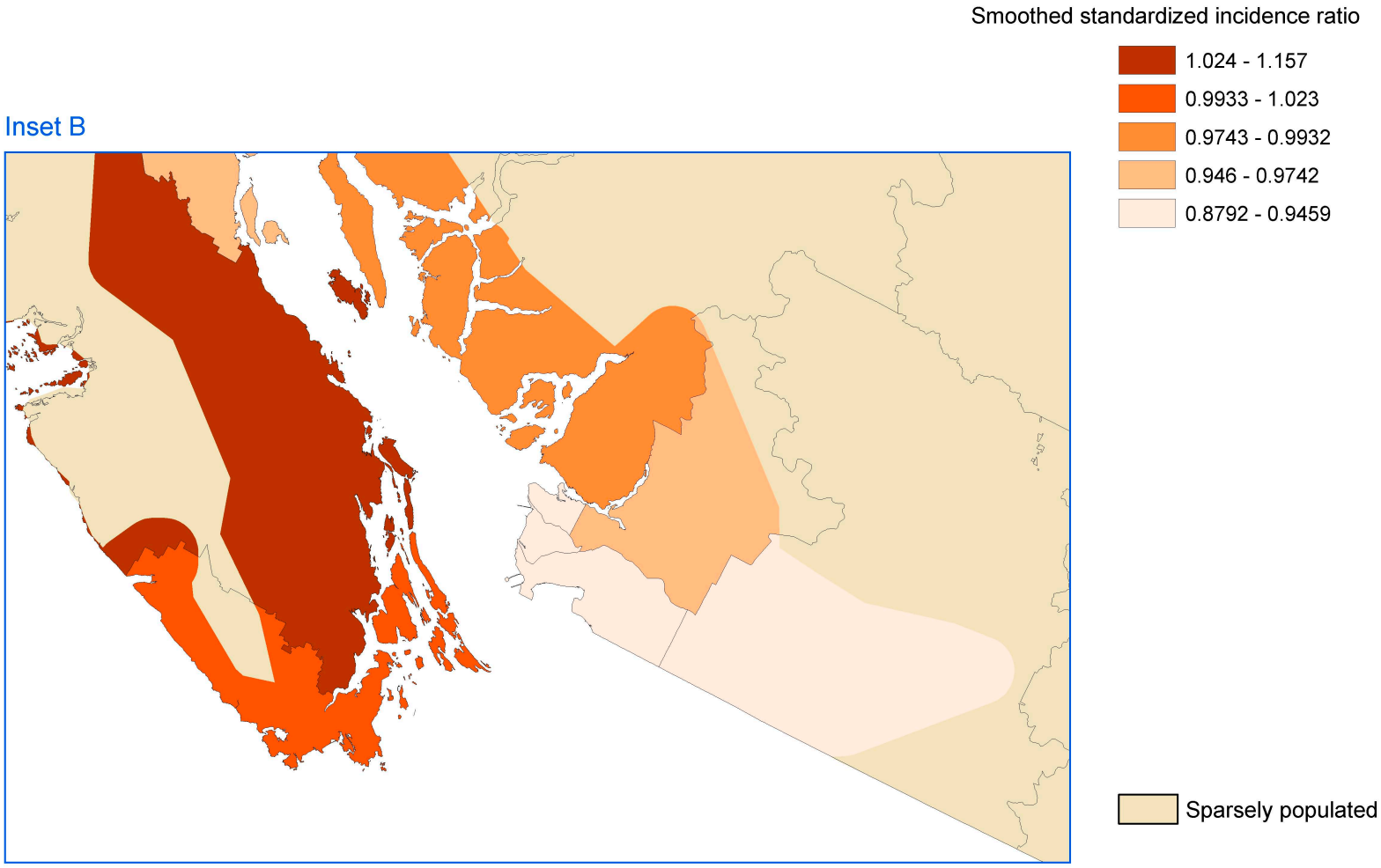
Data source: Canadian Cancer Registry database at Statistics Canada

Map 58-A. Female breast, 2000-2006, all ages



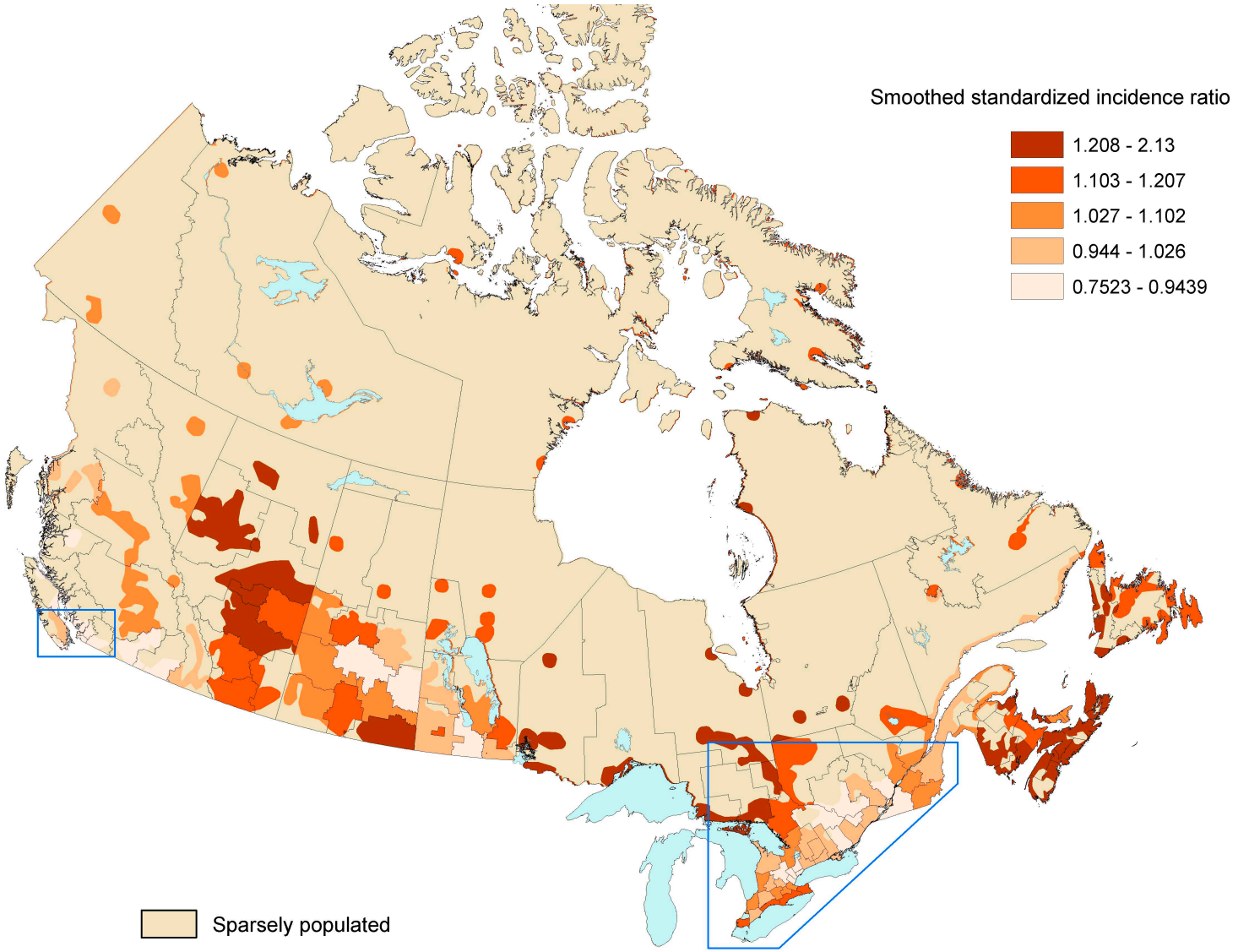
Data source: Canadian Cancer Registry database at Statistics Canada

Map 58-B. Female breast, 2000-2006, all ages



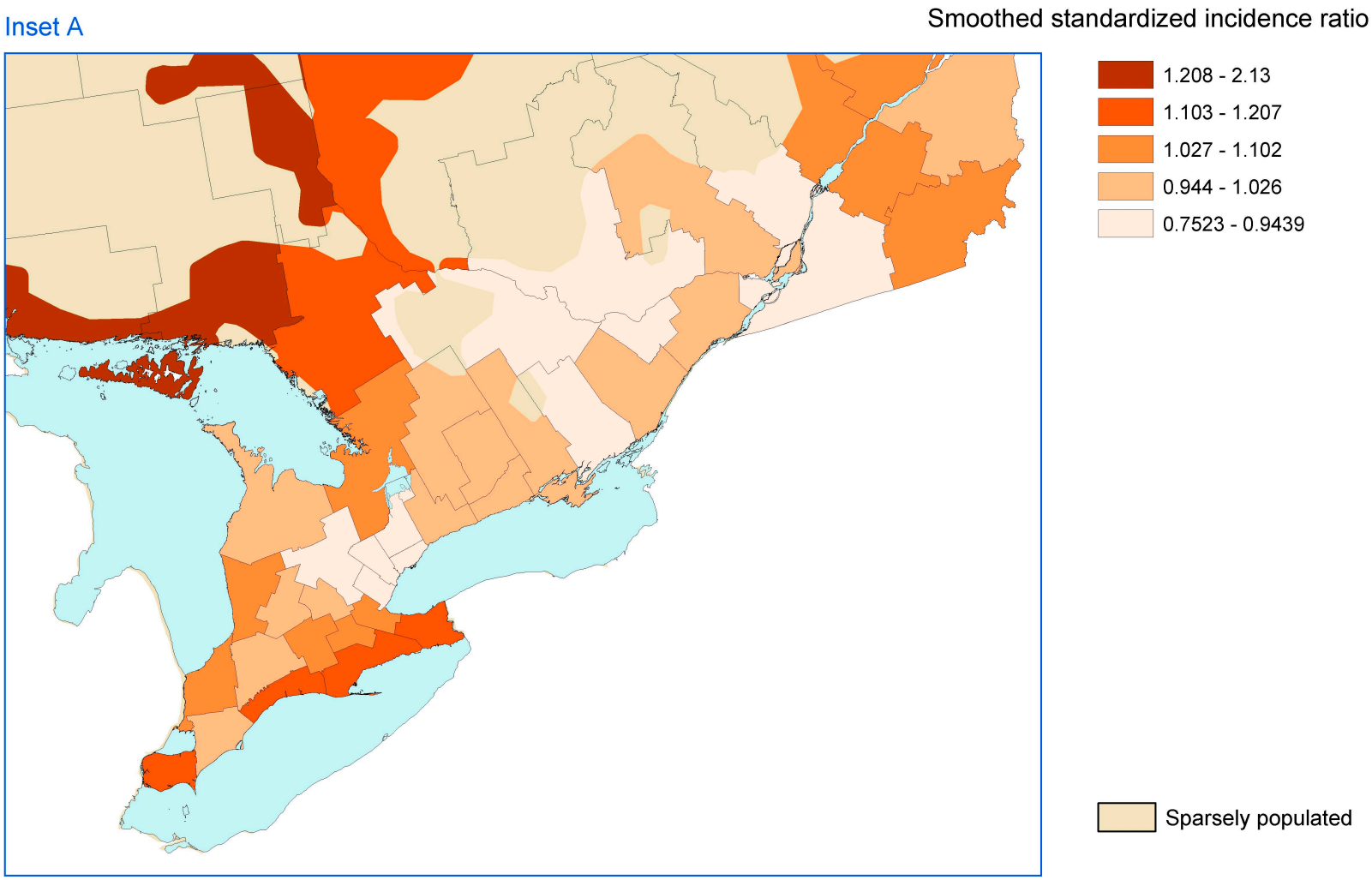
Data source: Canadian Cancer Registry database at Statistics Canada

Map 59. Cervix uteri, females, 2000-2006, all ages



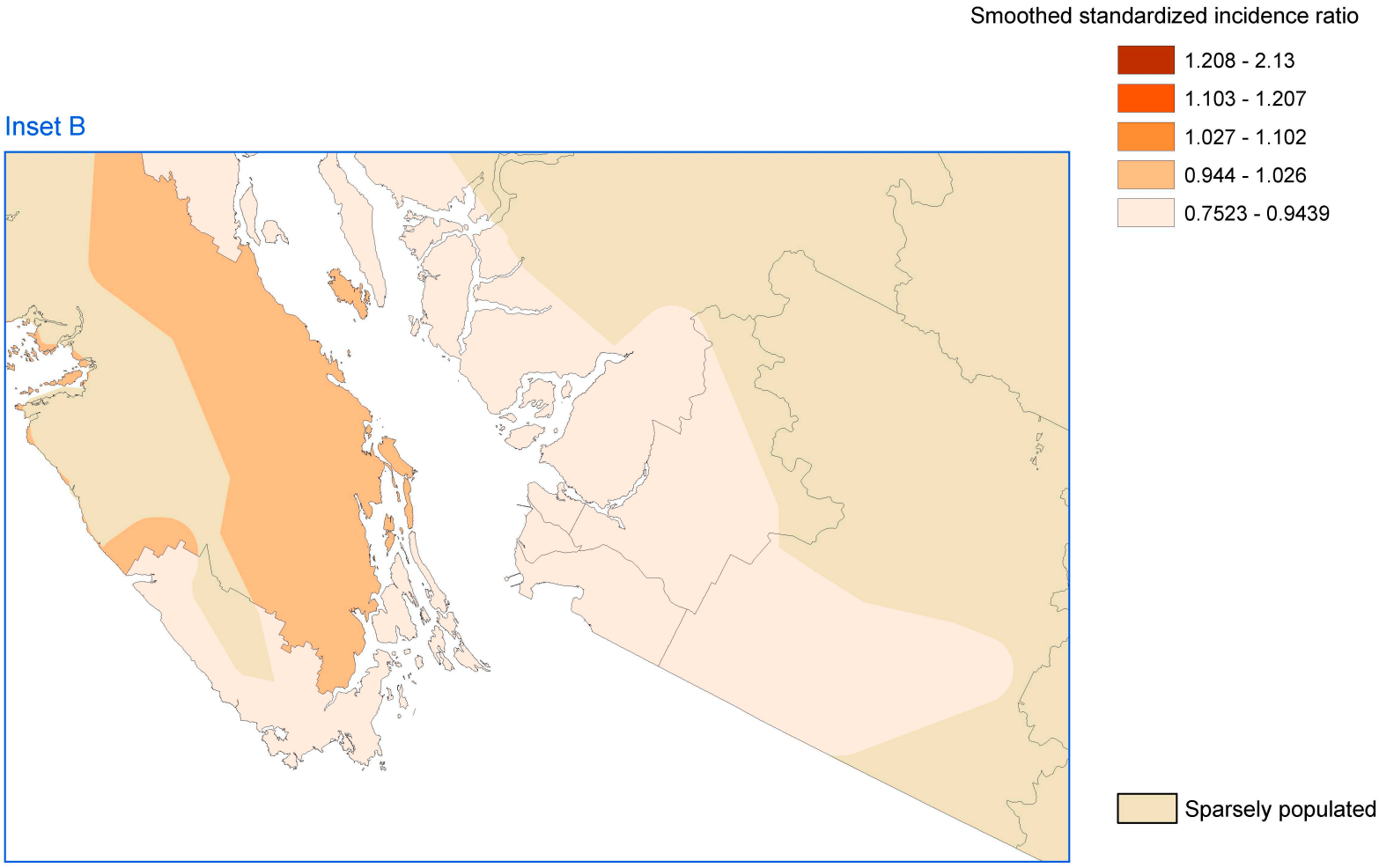
Data source: Canadian Cancer Registry database at Statistics Canada

Map 59-A. Cervix uteri, females, 2000-2006, all ages



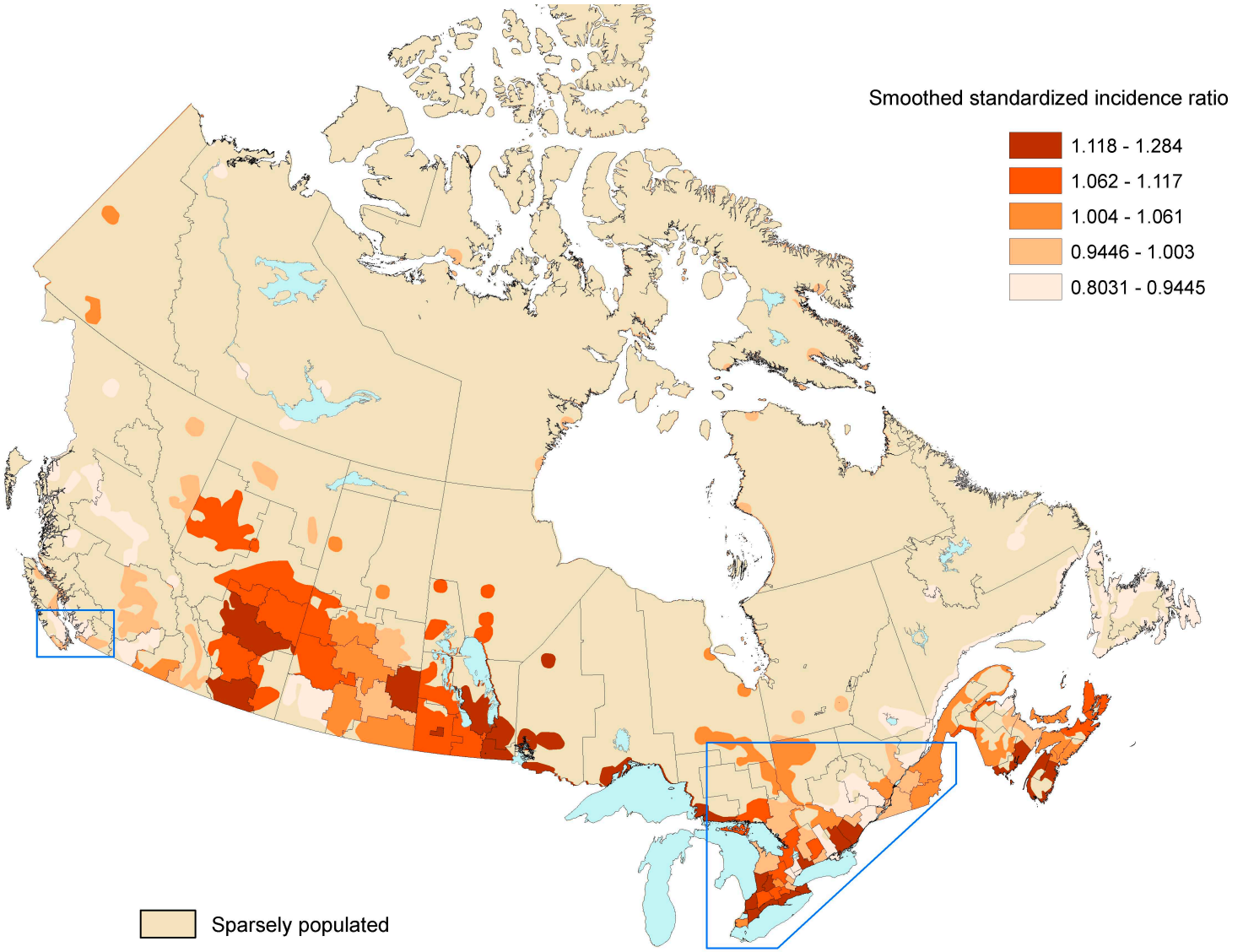
Data source: Canadian Cancer Registry database at Statistics Canada

Map 59-B. Cervix uteri, females, 2000-2006, all ages



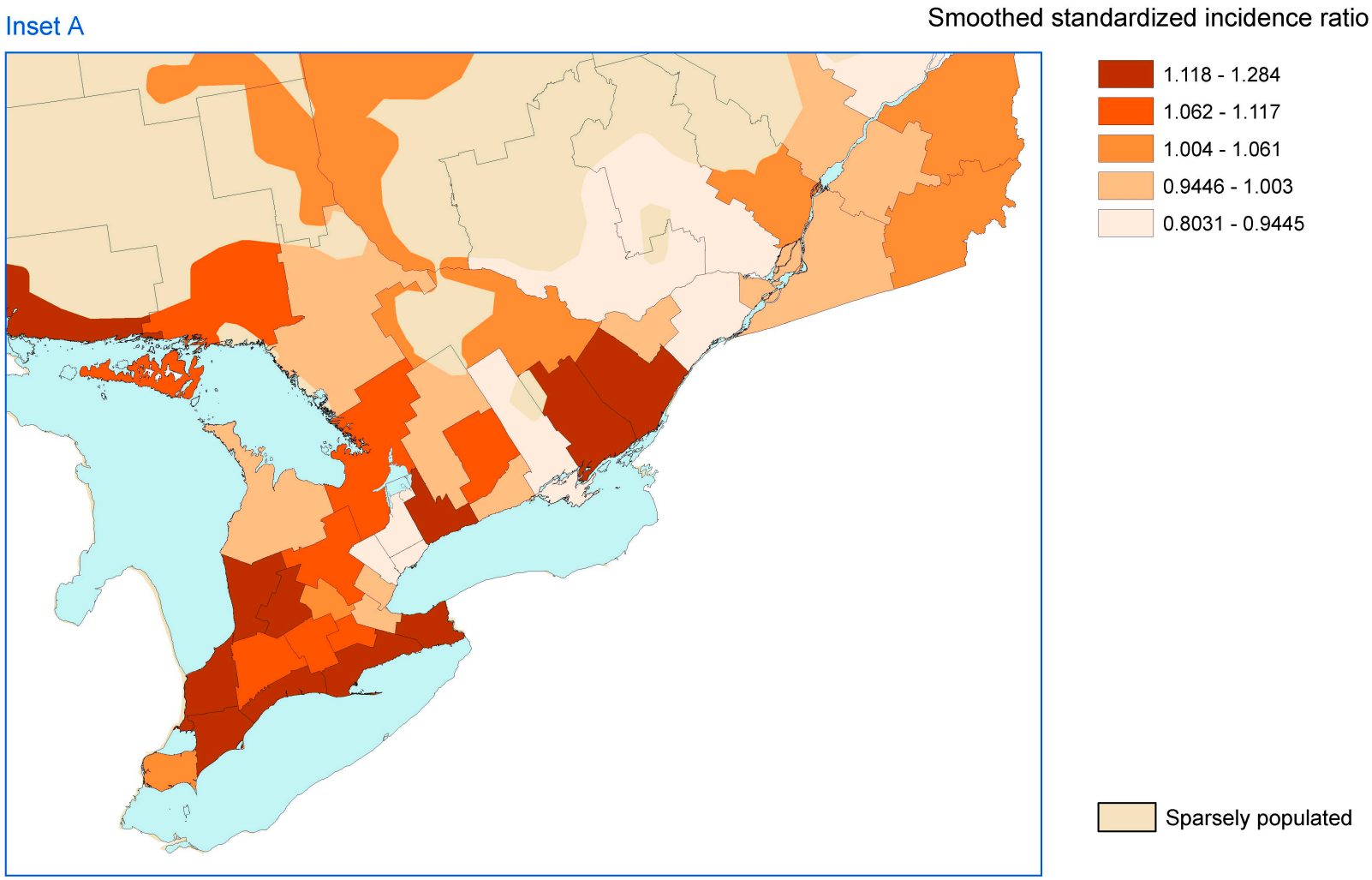
Data source: Canadian Cancer Registry database at Statistics Canada

Map 60. Uterus excluding cervix, females, 2000-2006, all ages



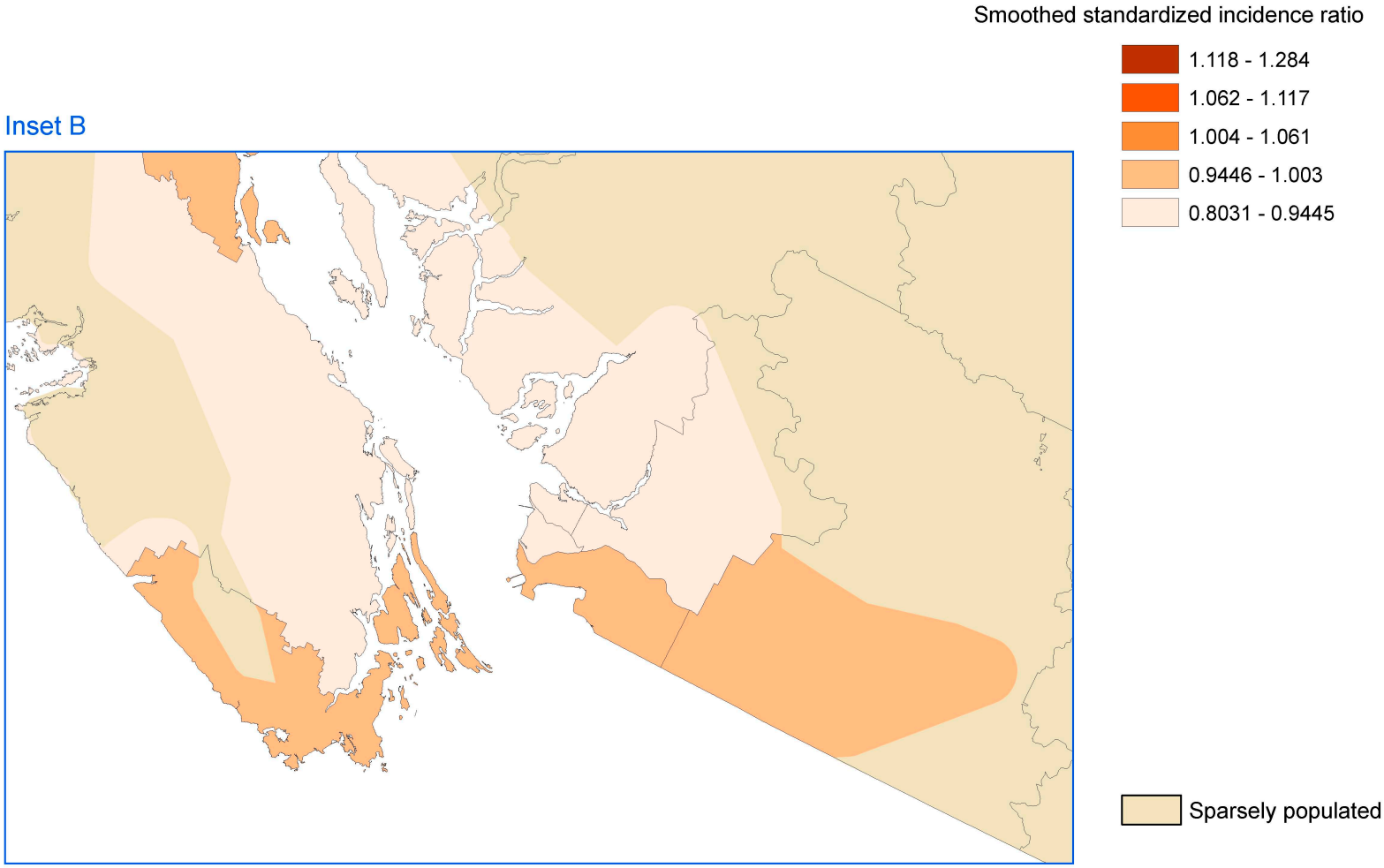
Data source: Canadian Cancer Registry database at Statistics Canada

Map 60-A. Uterus excluding cervix, females, 2000-2006, all ages



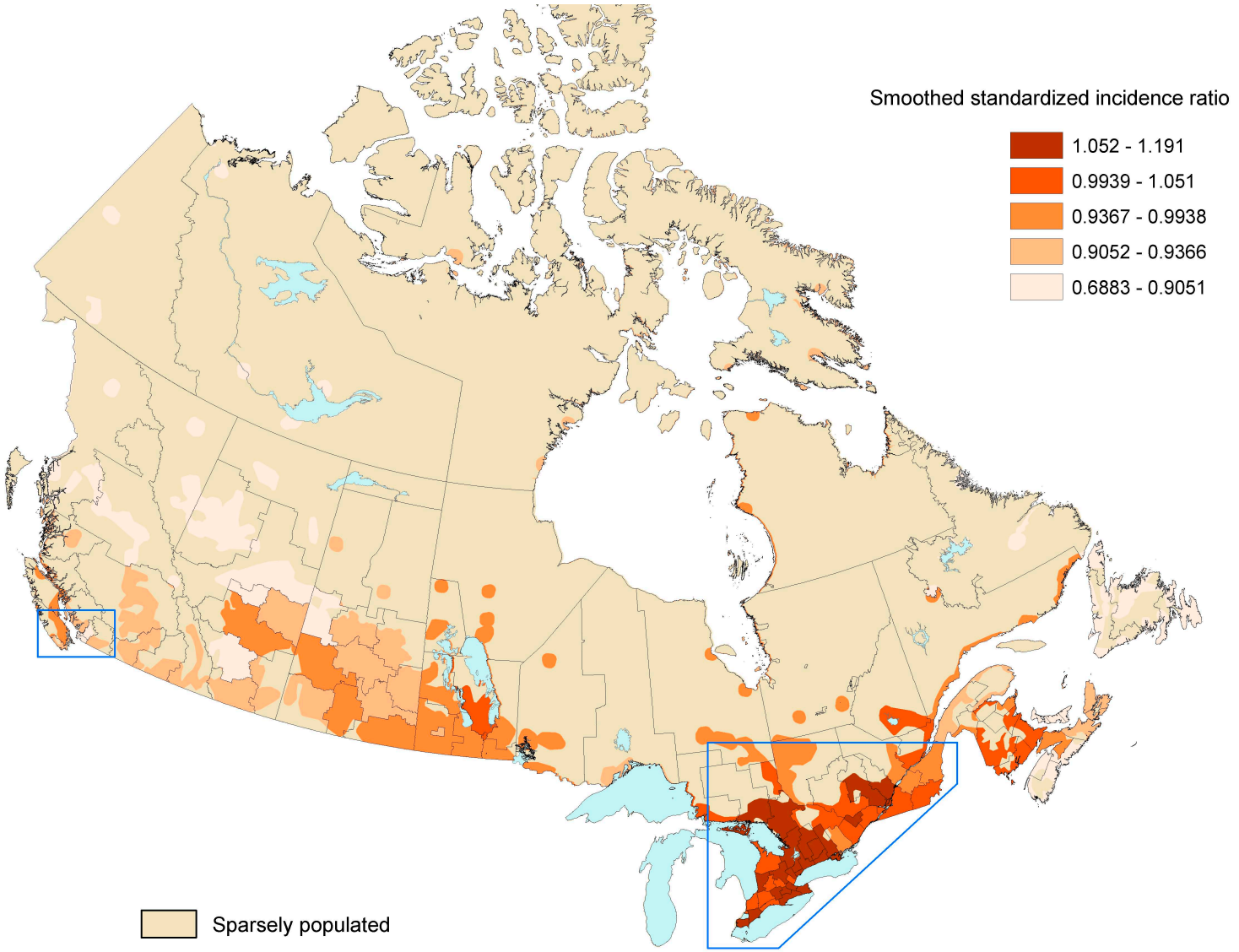
Data source: Canadian Cancer Registry database at Statistics Canada

Map 60-B. Uterus excluding cervix, females, 2000-2006, all ages



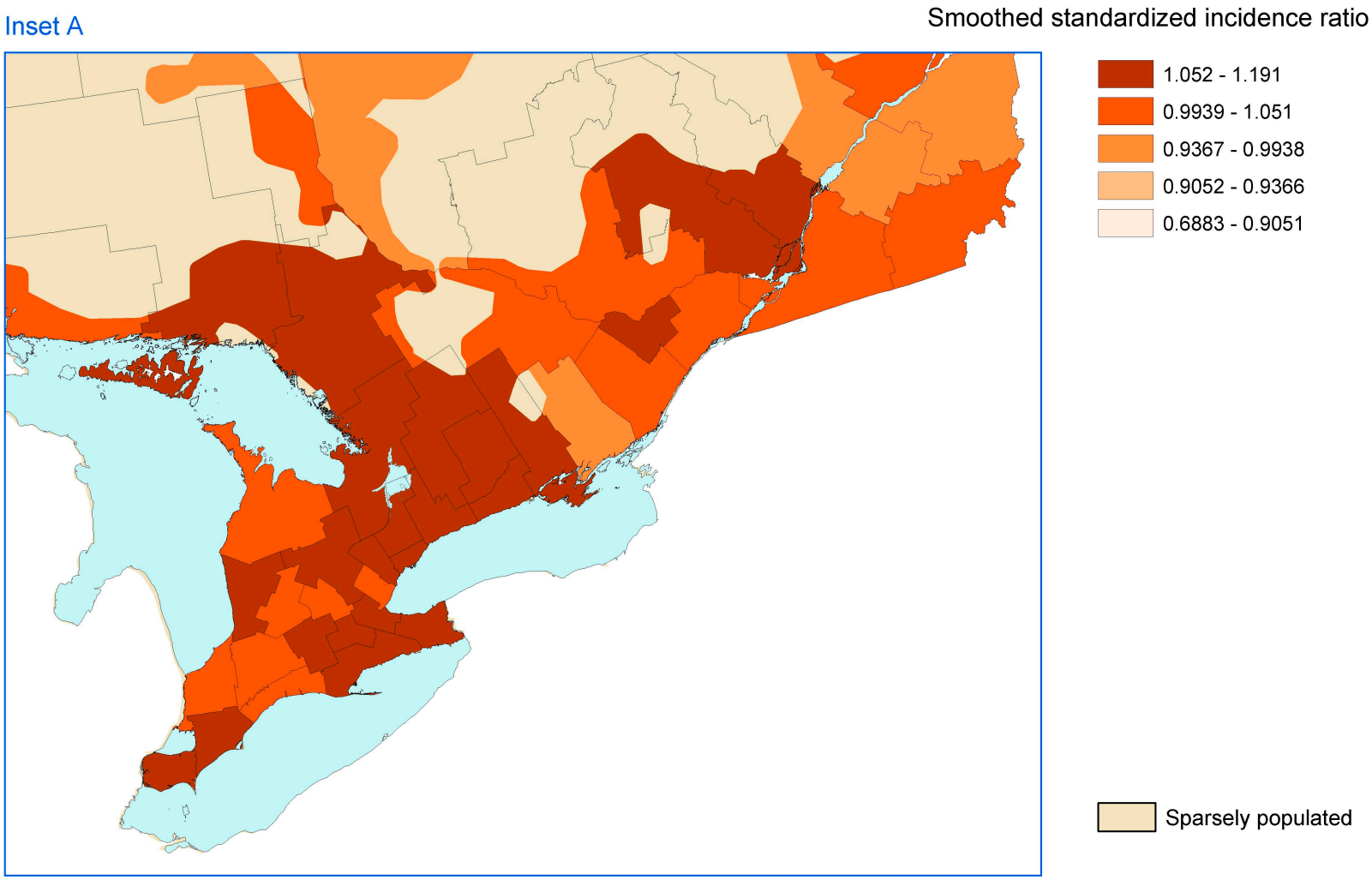
Data source: Canadian Cancer Registry database at Statistics Canada

Map 61. Ovary, females, 2000-2006, all ages



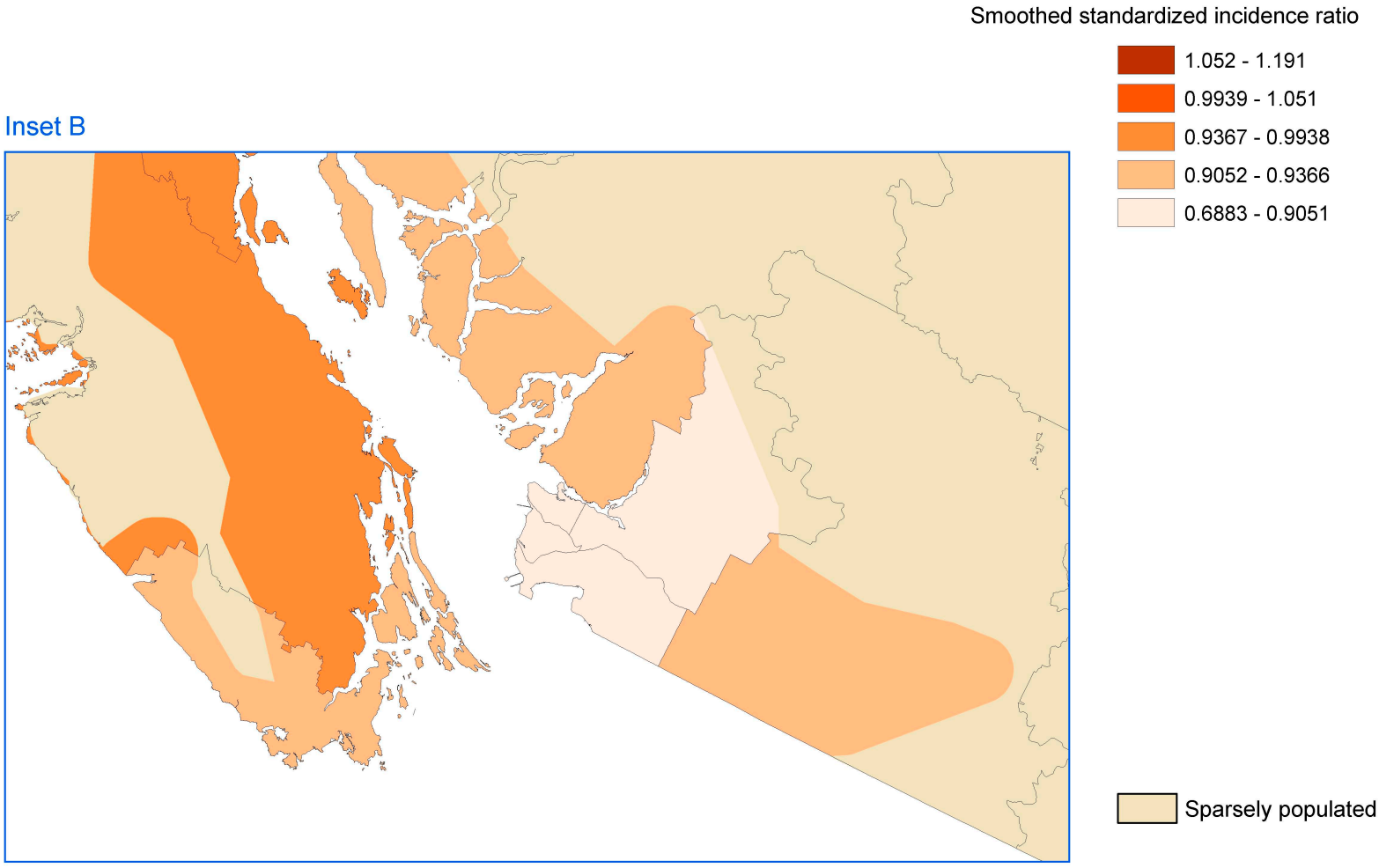
Data source: Canadian Cancer Registry database at Statistics Canada

Map 61-A. Ovary, females, 2000-2006, all ages



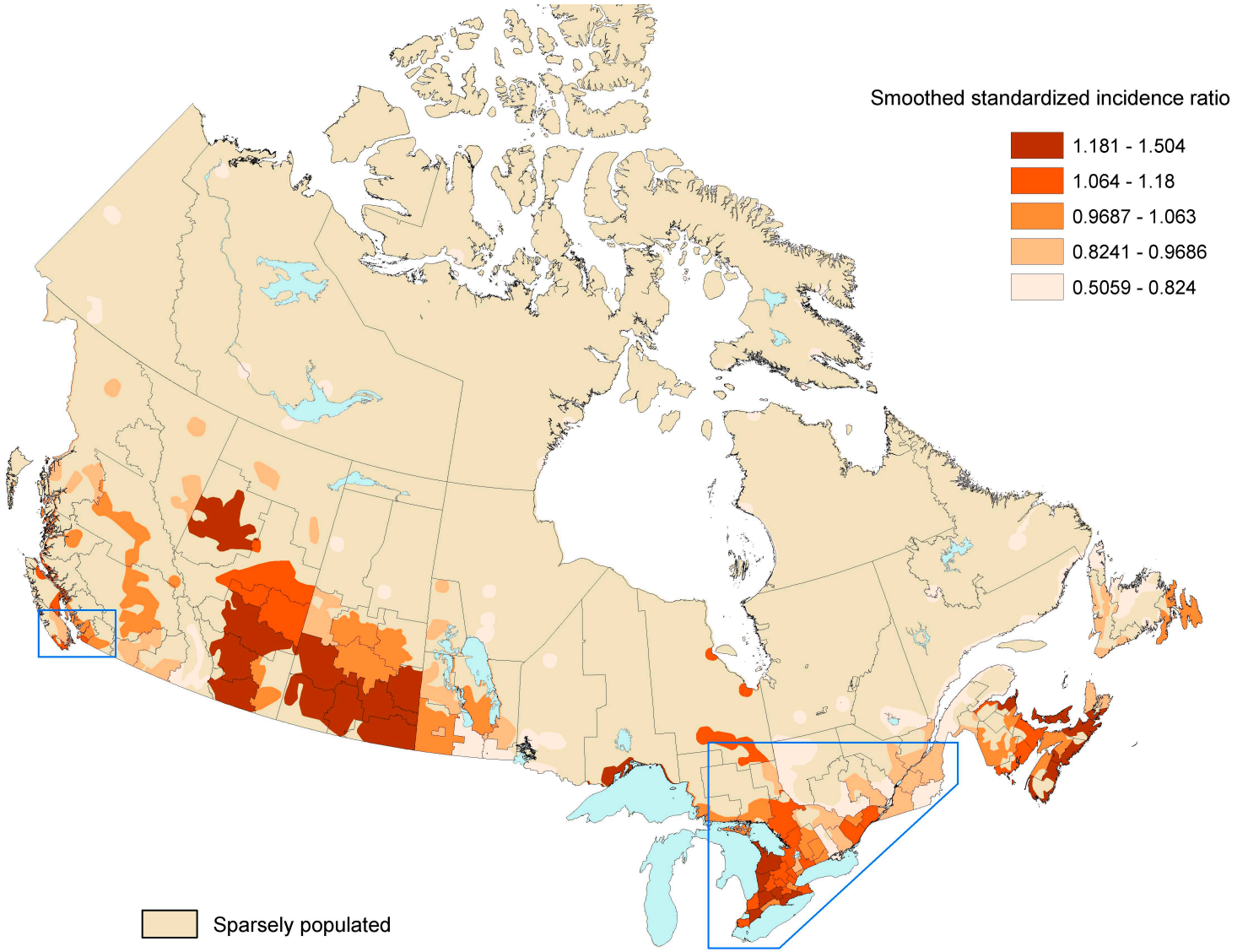
Data source: Canadian Cancer Registry database at Statistics Canada

Map 61-B. Ovary, females, 2000-2006, all ages



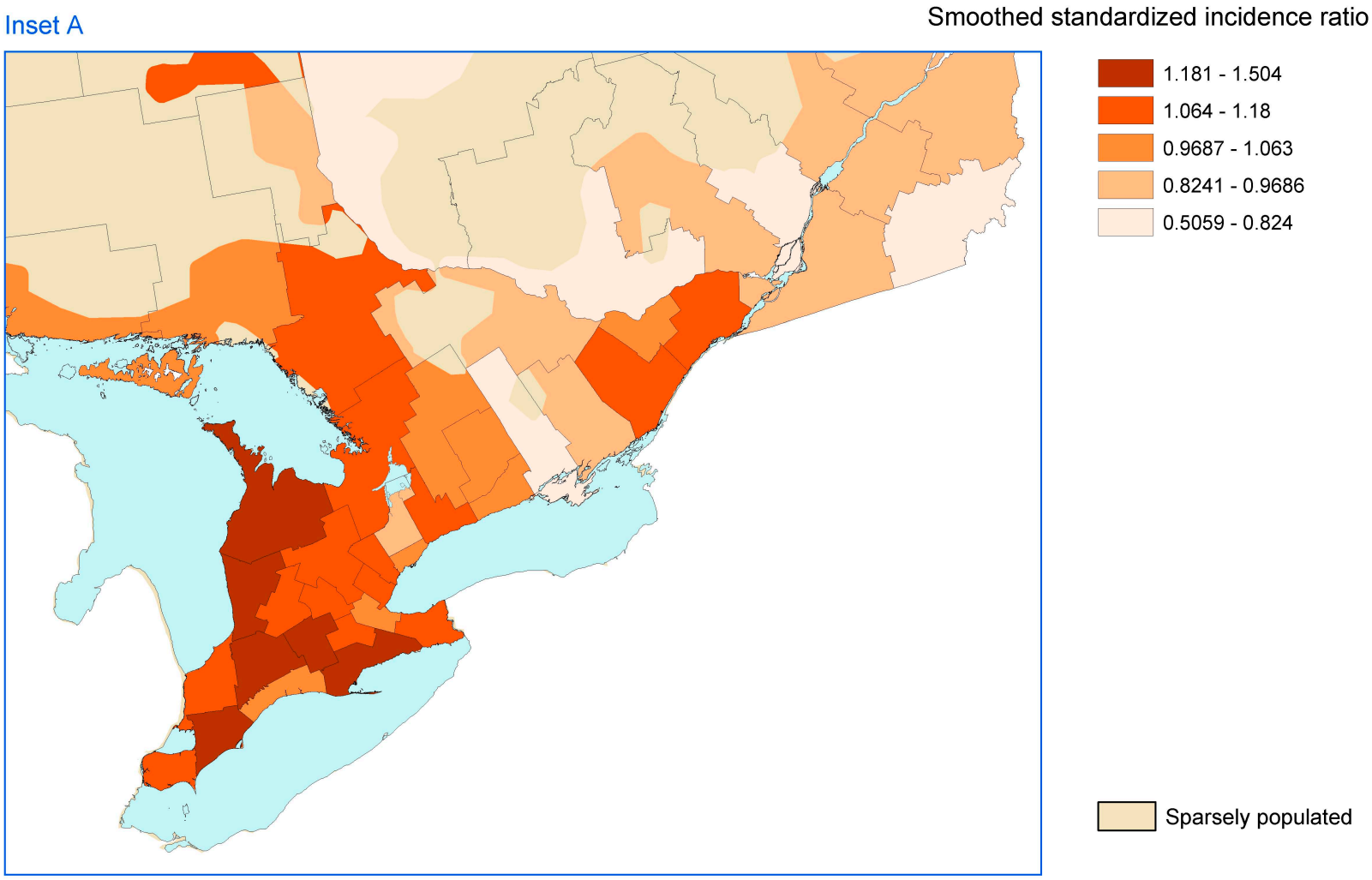
Data source: Canadian Cancer Registry database at Statistics Canada

Map 62. Prostate, males, 2000-2006, all ages



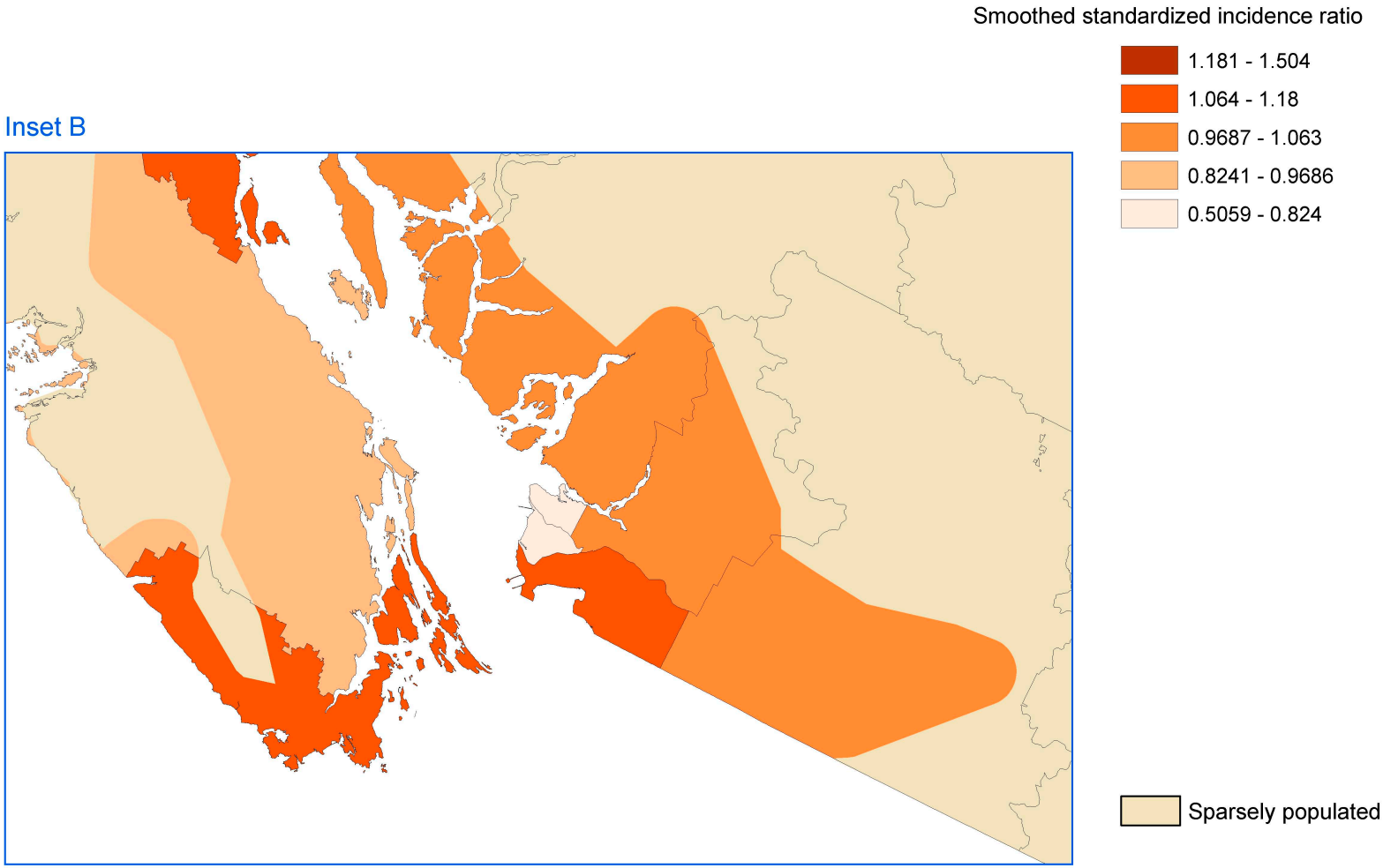
Data source: Canadian Cancer Registry database at Statistics Canada

Map 62-A. Prostate, males, 2000-2006, all ages



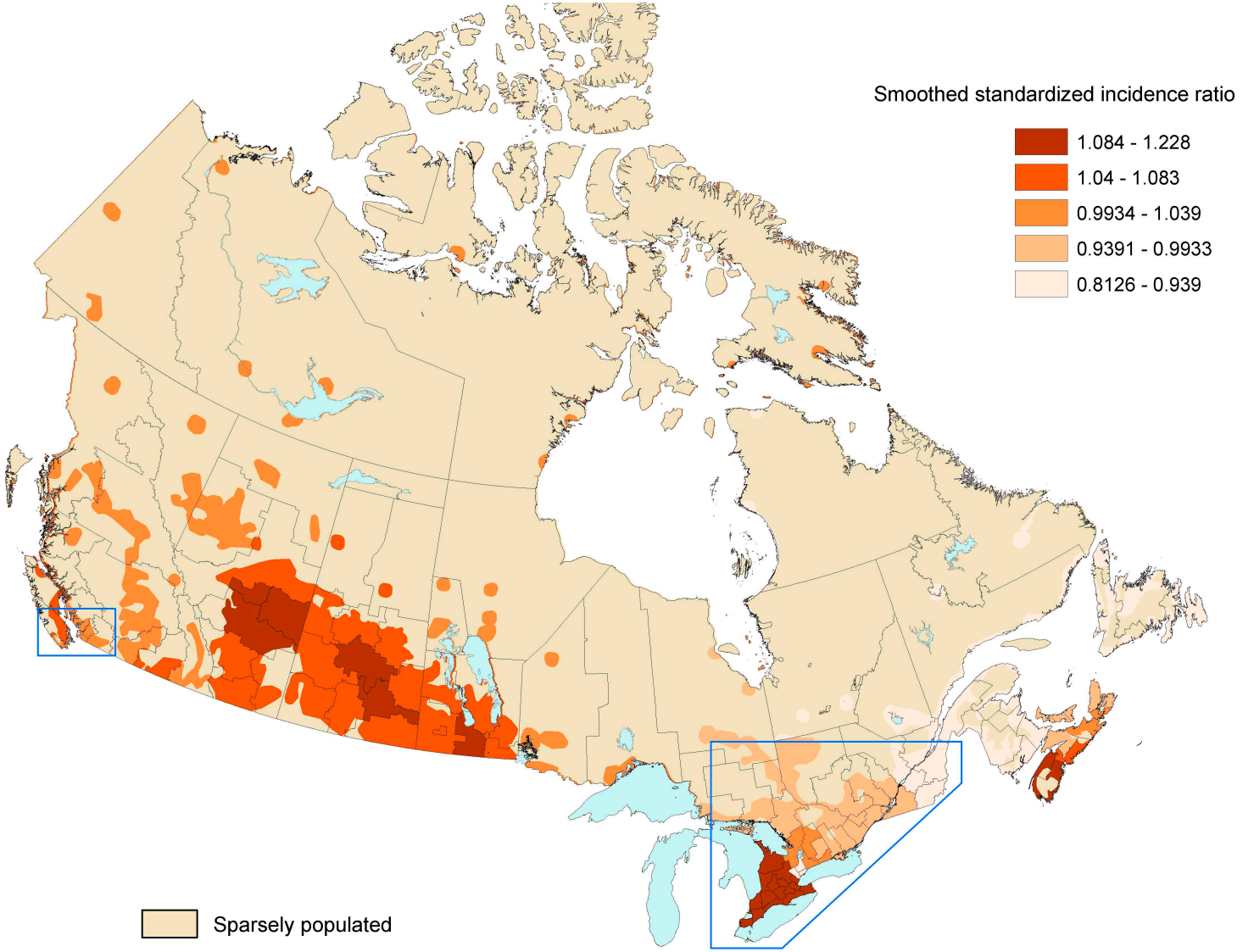
Data source: Canadian Cancer Registry database at Statistics Canada

Map 62-B. Prostate, males, 2000-2006, all ages



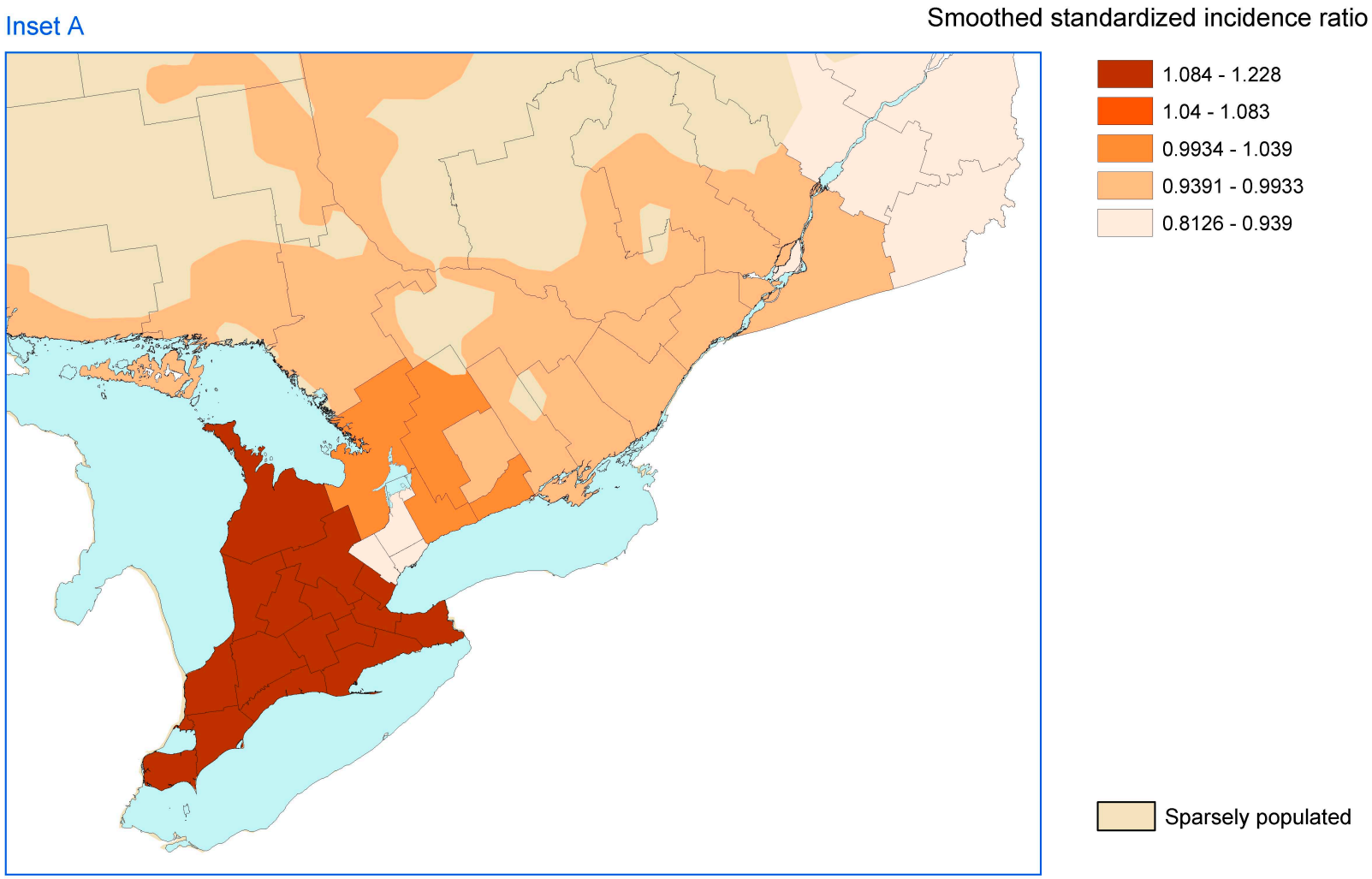
Data source: Canadian Cancer Registry database at Statistics Canada

Map 63. Testis, males, 2000-2006, all ages



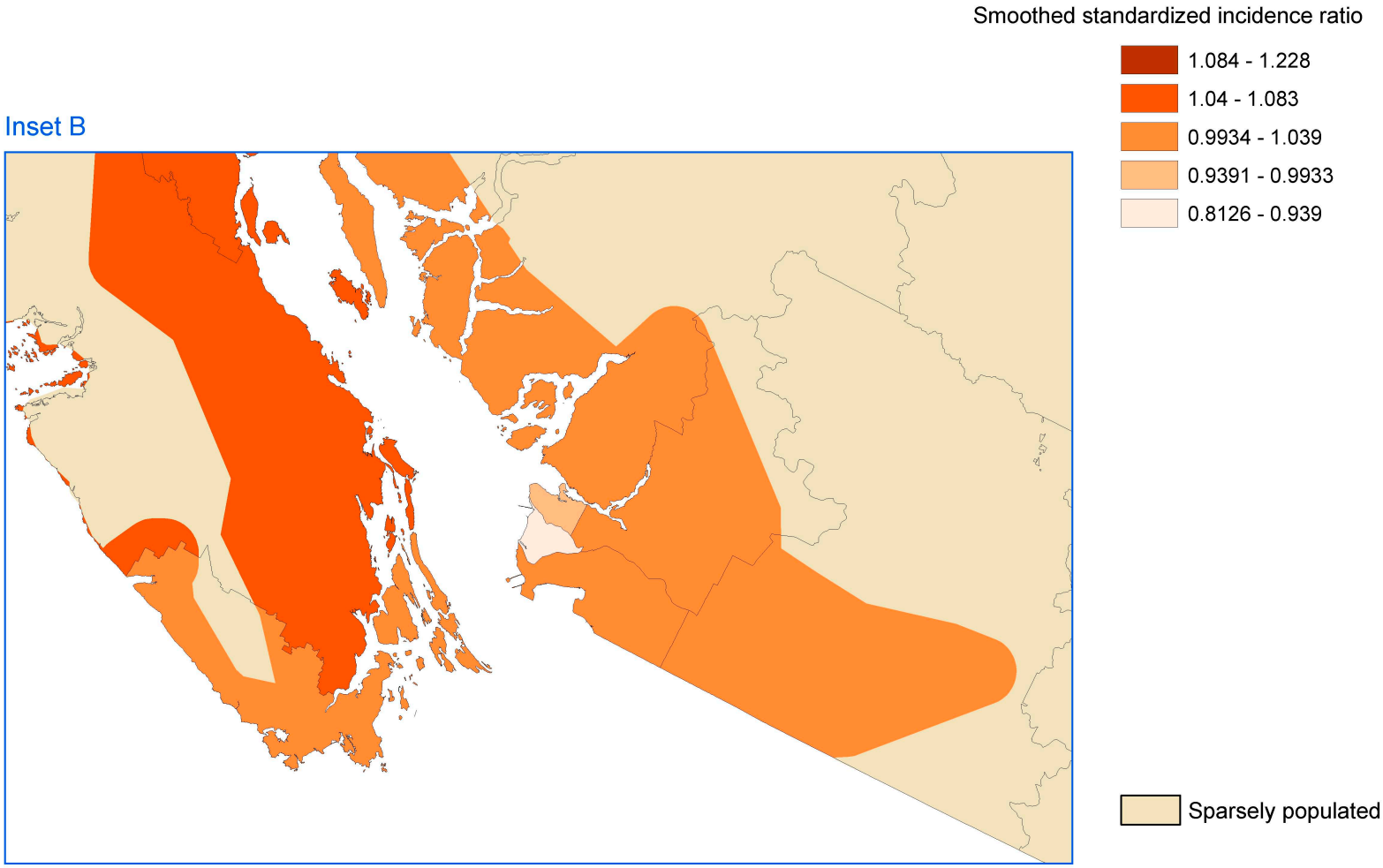
Data source: Canadian Cancer Registry database at Statistics Canada

Map 63-A. Testis, males, 2000-2006, all ages



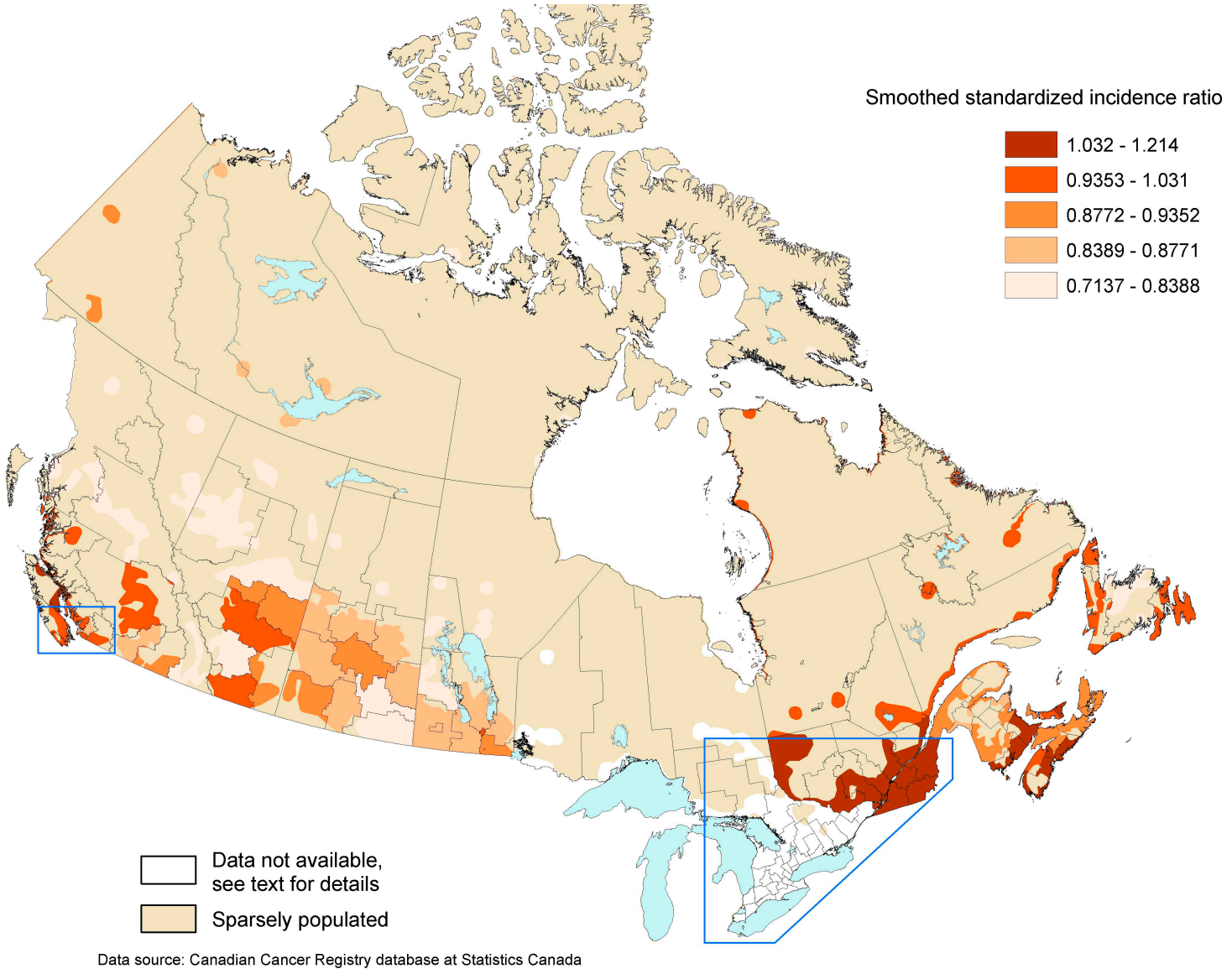
Data source: Canadian Cancer Registry database at Statistics Canada

Map 63-B. Testis, males, 2000-2006, all ages



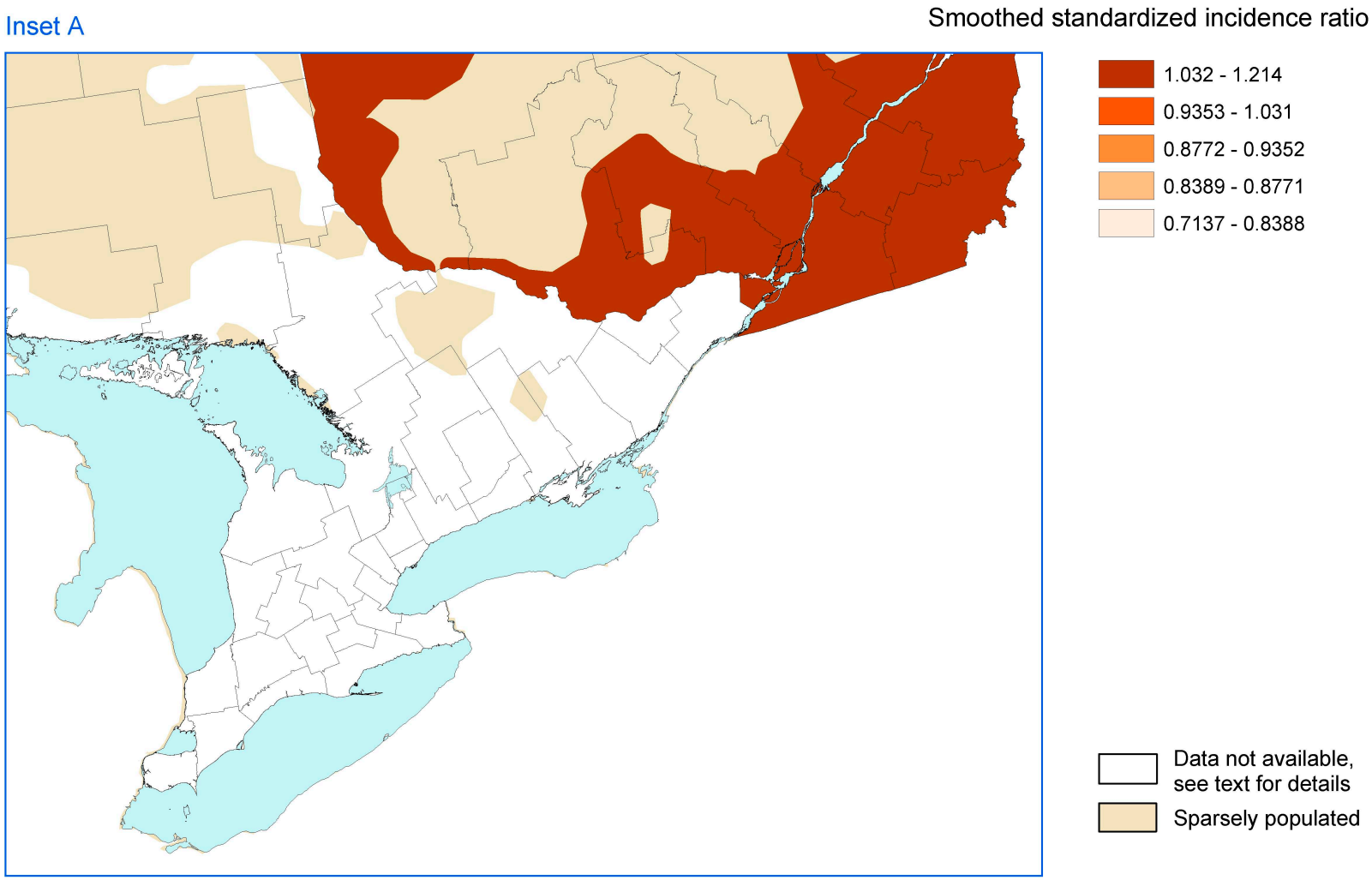
Data source: Canadian Cancer Registry database at Statistics Canada

Map 64. Bladder, females, 2000-2006, all ages



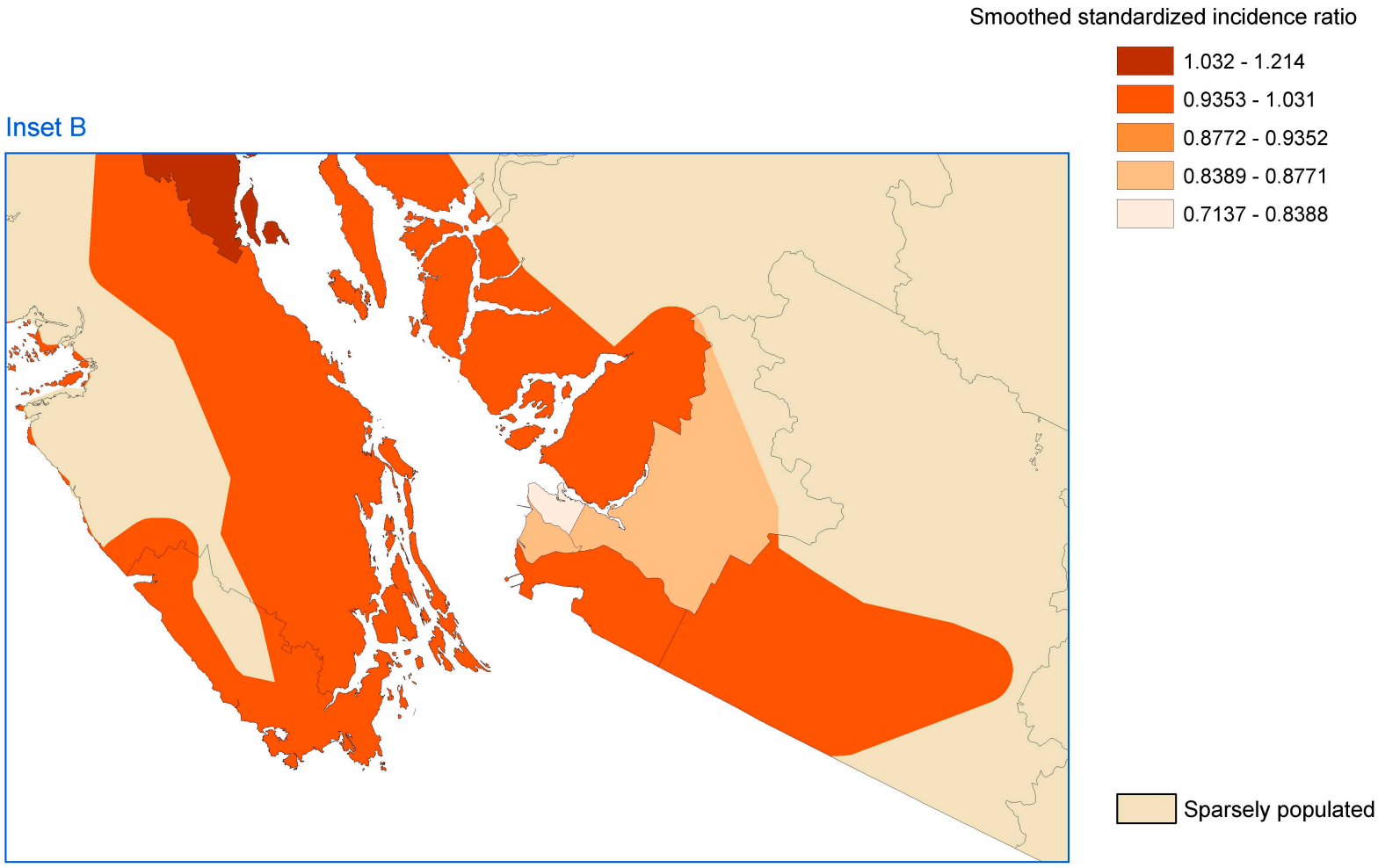
Data source: Canadian Cancer Registry database at Statistics Canada

Map 64-A. Bladder, females, 2000-2006, all ages



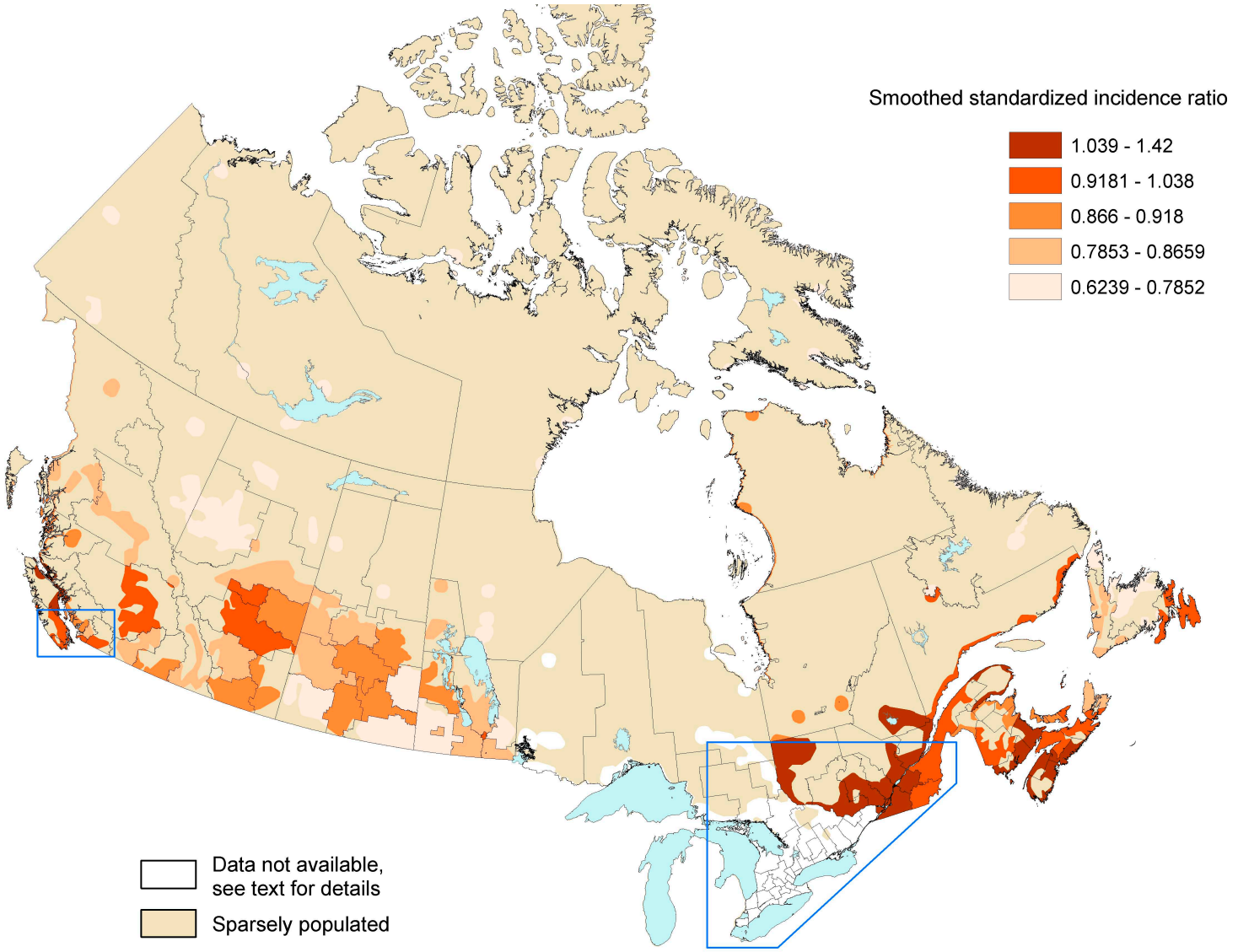
Data source: Canadian Cancer Registry database at Statistics Canada

Map 64-B. Bladder, females, 2000-2006, all ages



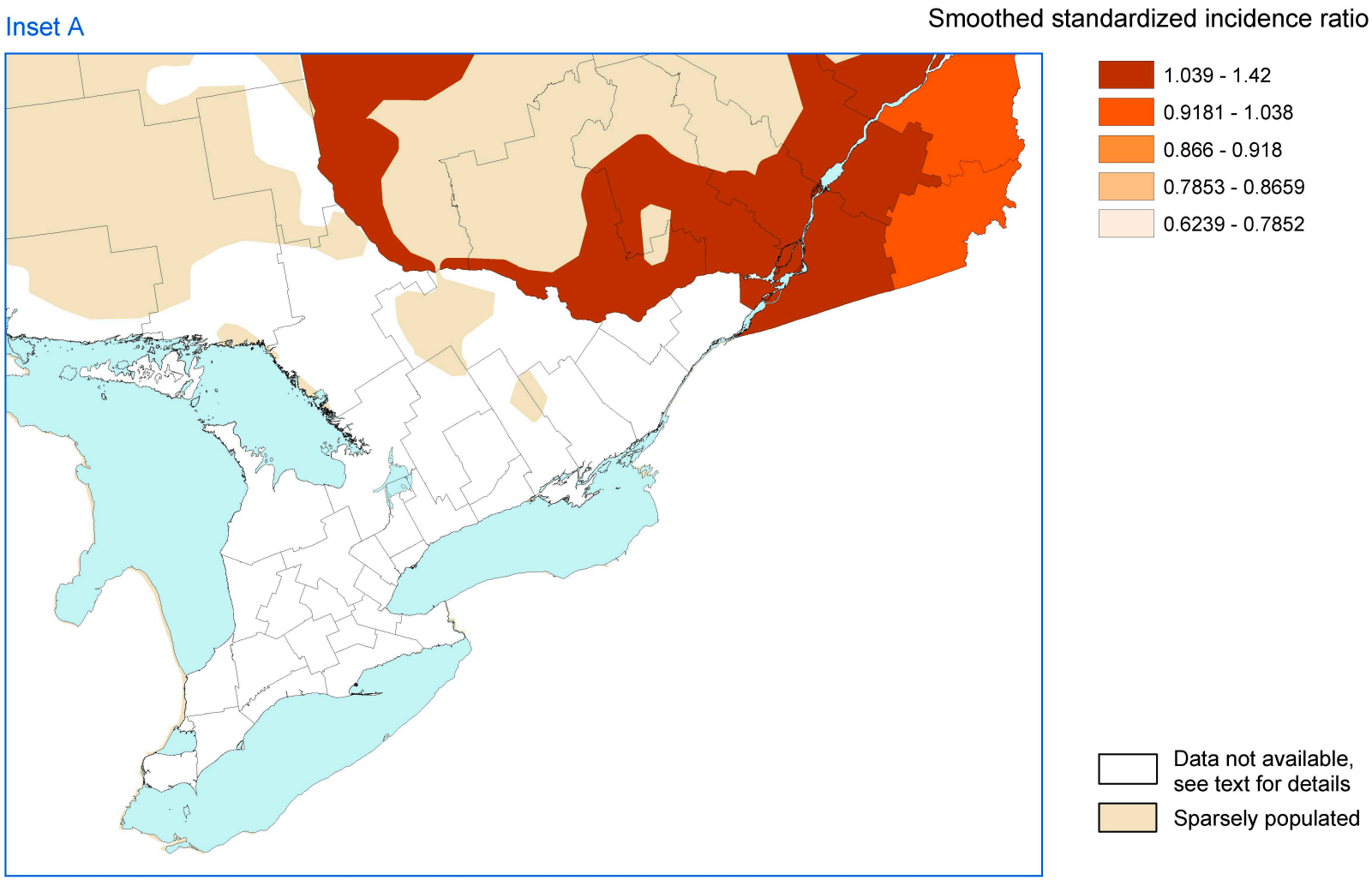
Data source: Canadian Cancer Registry database at Statistics Canada

Map 65. Bladder, males, 2000-2006, all ages



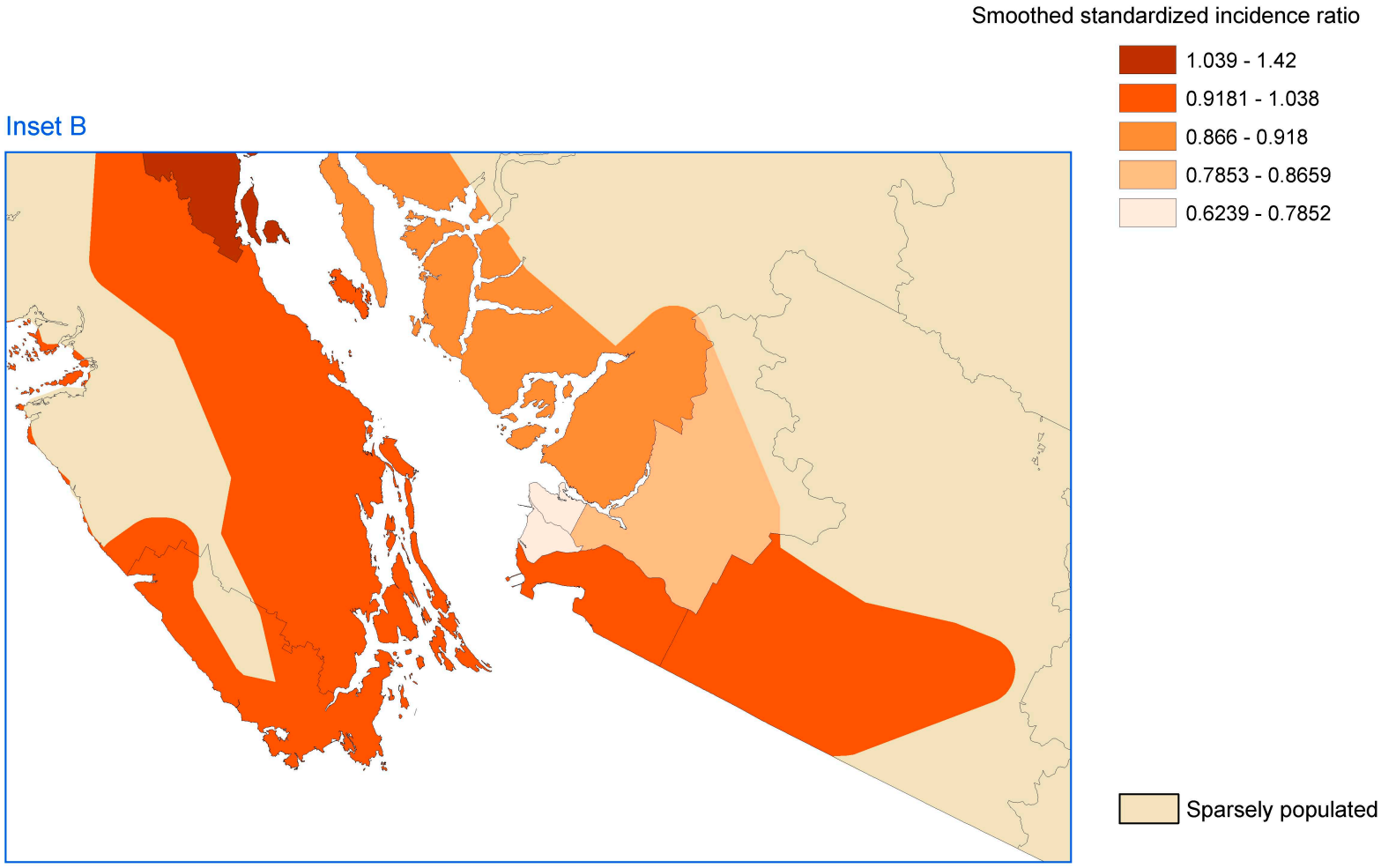
Data source: Canadian Cancer Registry database at Statistics Canada

Map 65-A. Bladder, males, 2000-2006, all ages



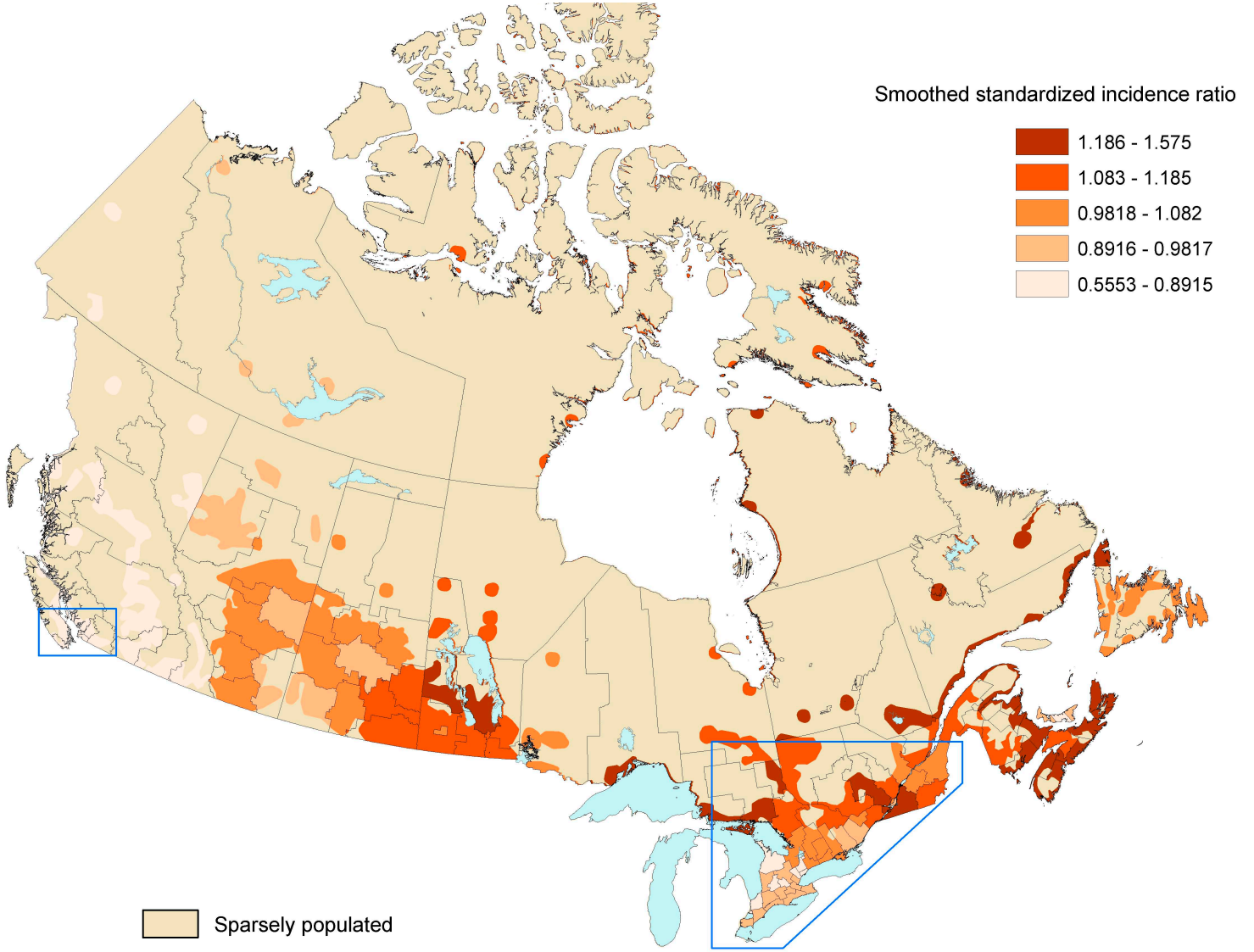
Data source: Canadian Cancer Registry database at Statistics Canada

Map 65-B. Bladder, males, 2000-2006, all ages



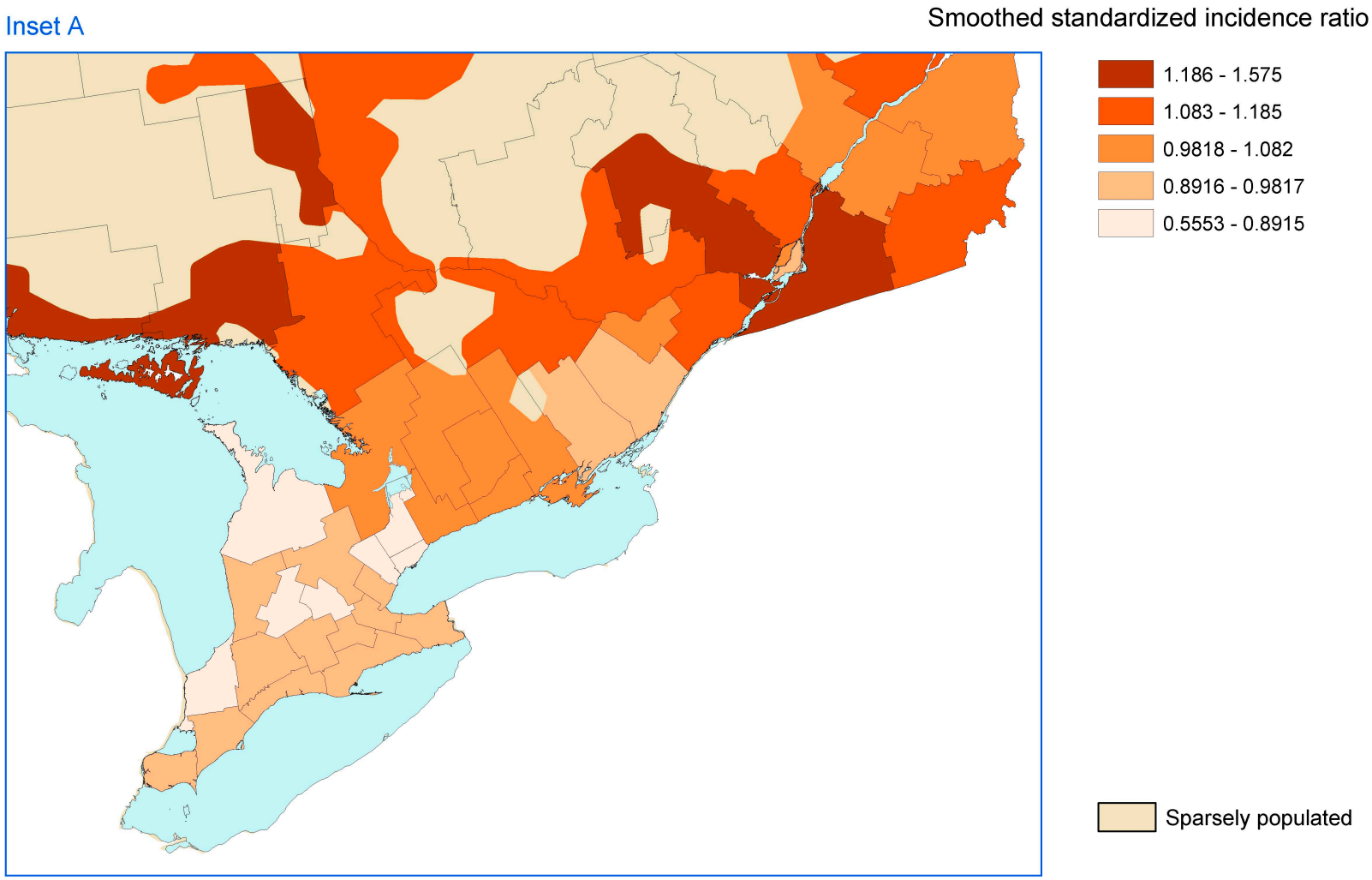
Data source: Canadian Cancer Registry database at Statistics Canada

Map 66. Kidney and renal pelvis, females, 2000-2006, all ages



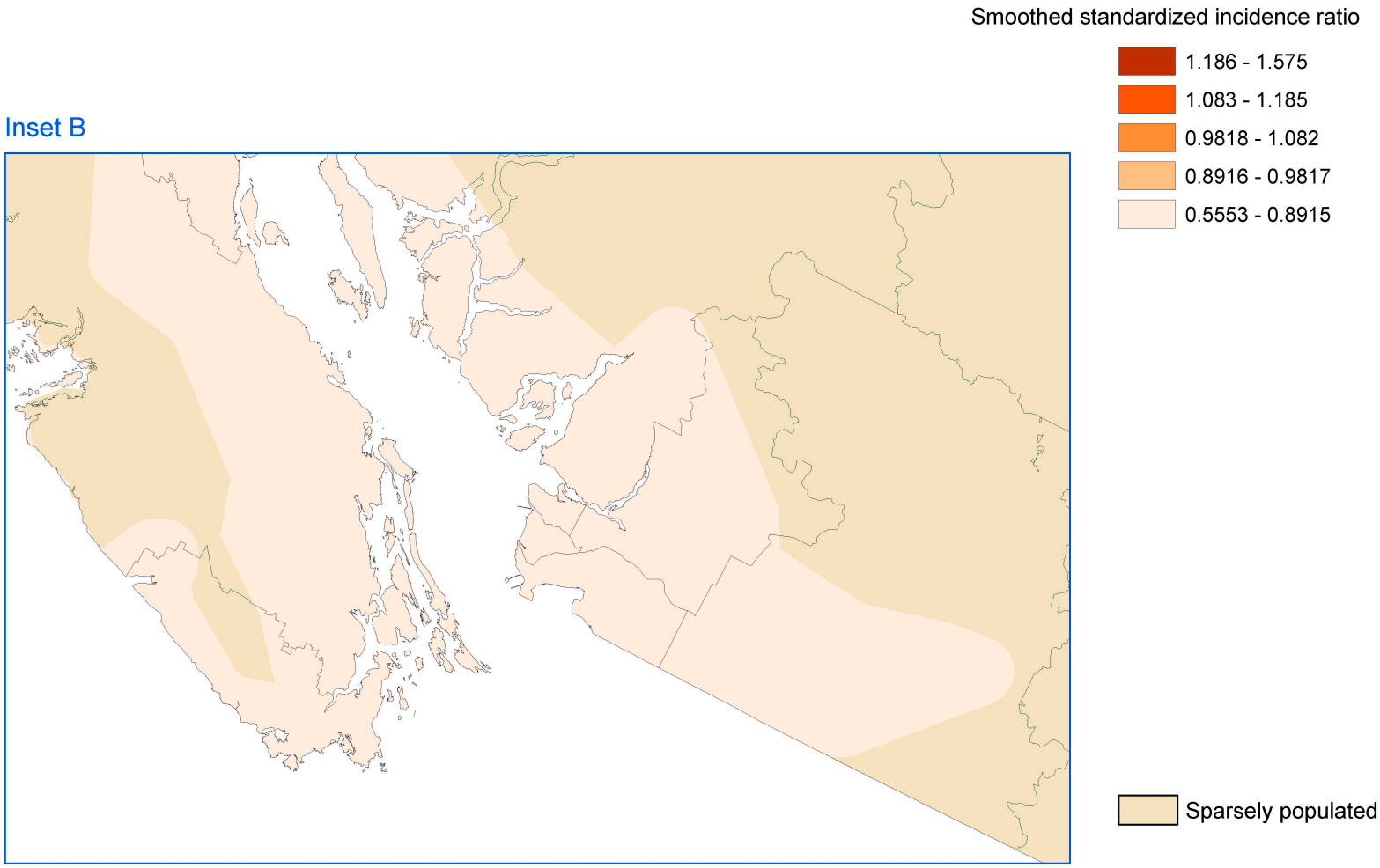
Data source: Canadian Cancer Registry database at Statistics Canada

Map 66-A. Kidney and renal pelvis, females, 2000-2006, all ages



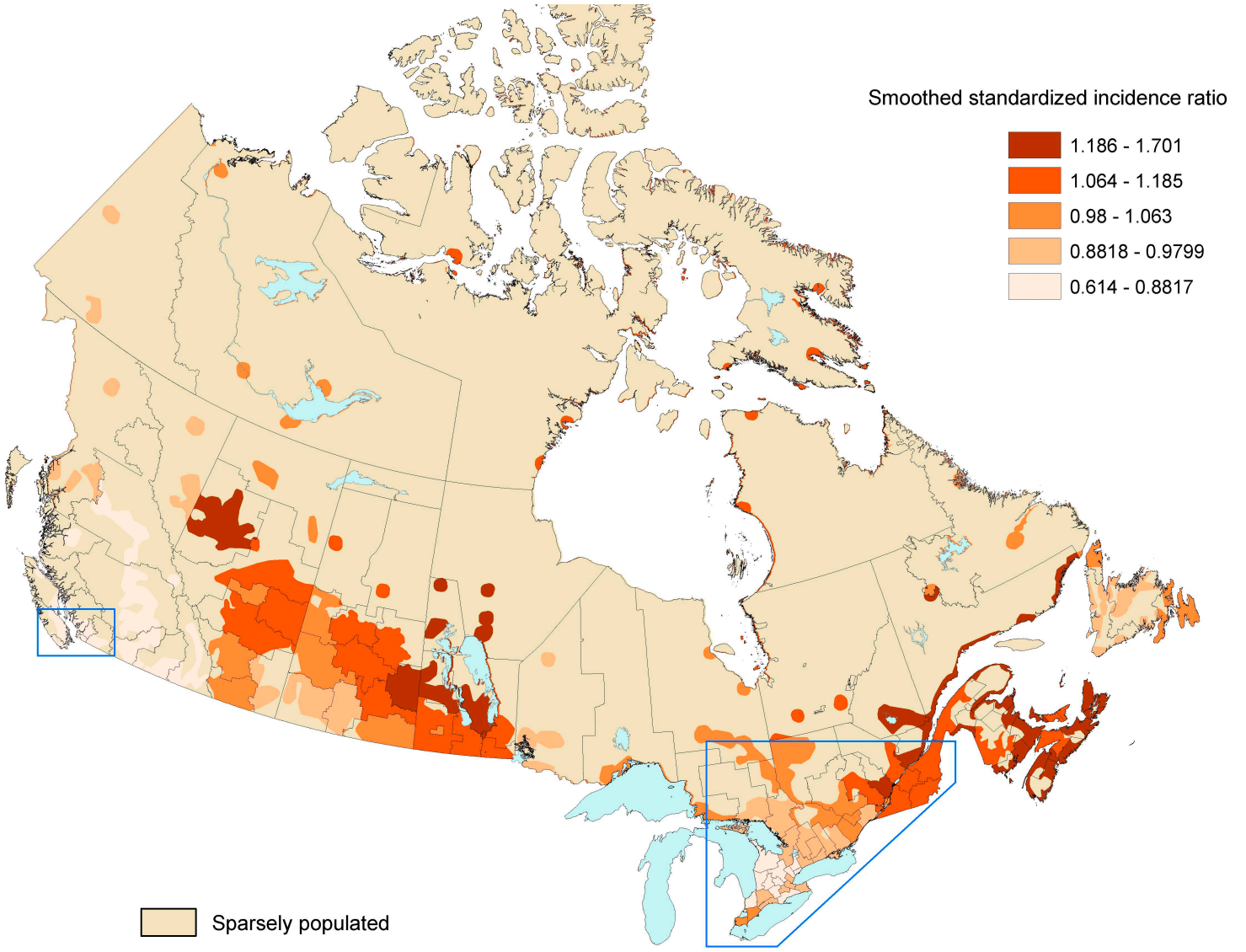
Data source: Canadian Cancer Registry database at Statistics Canada

Map 66-B. Kidney and renal pelvis, females, 2000-2006, all ages



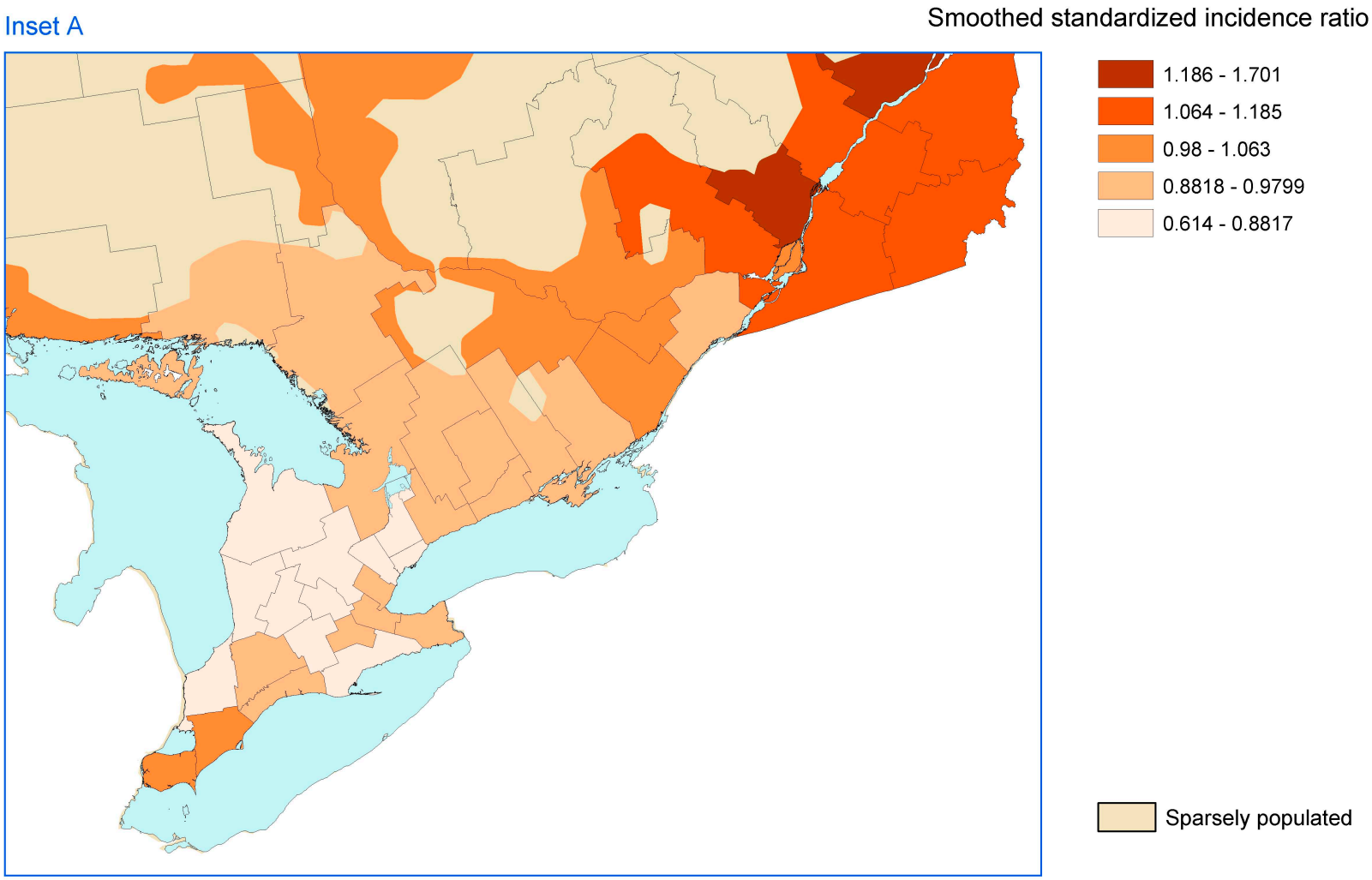
Data source: Canadian Cancer Registry database at Statistics Canada

Map 67. Kidney and renal pelvis, males, 2000-2006, all ages



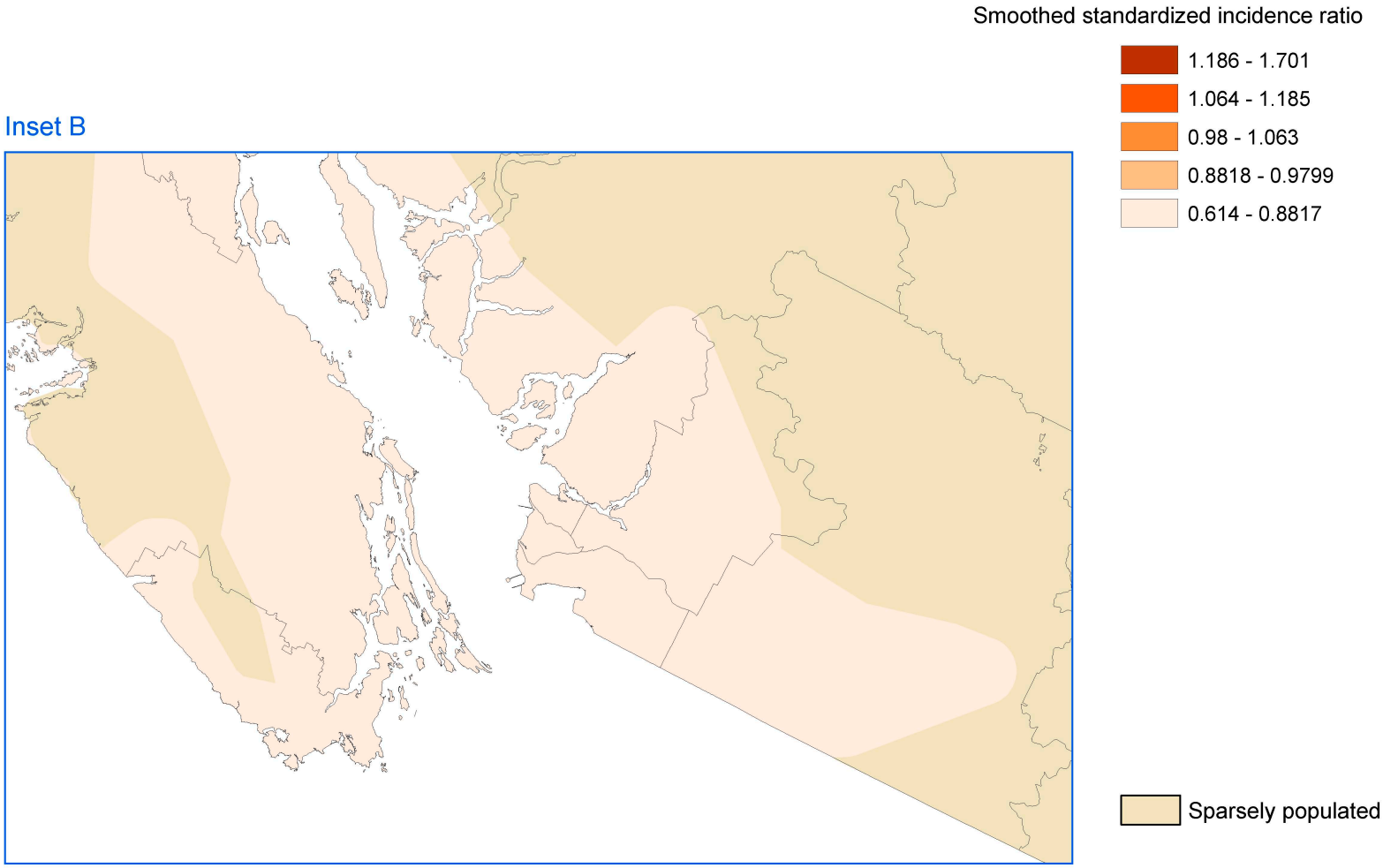
Data source: Canadian Cancer Registry database at Statistics Canada

Map 67-A. Kidney and renal pelvis, males, 2000-2006, all ages



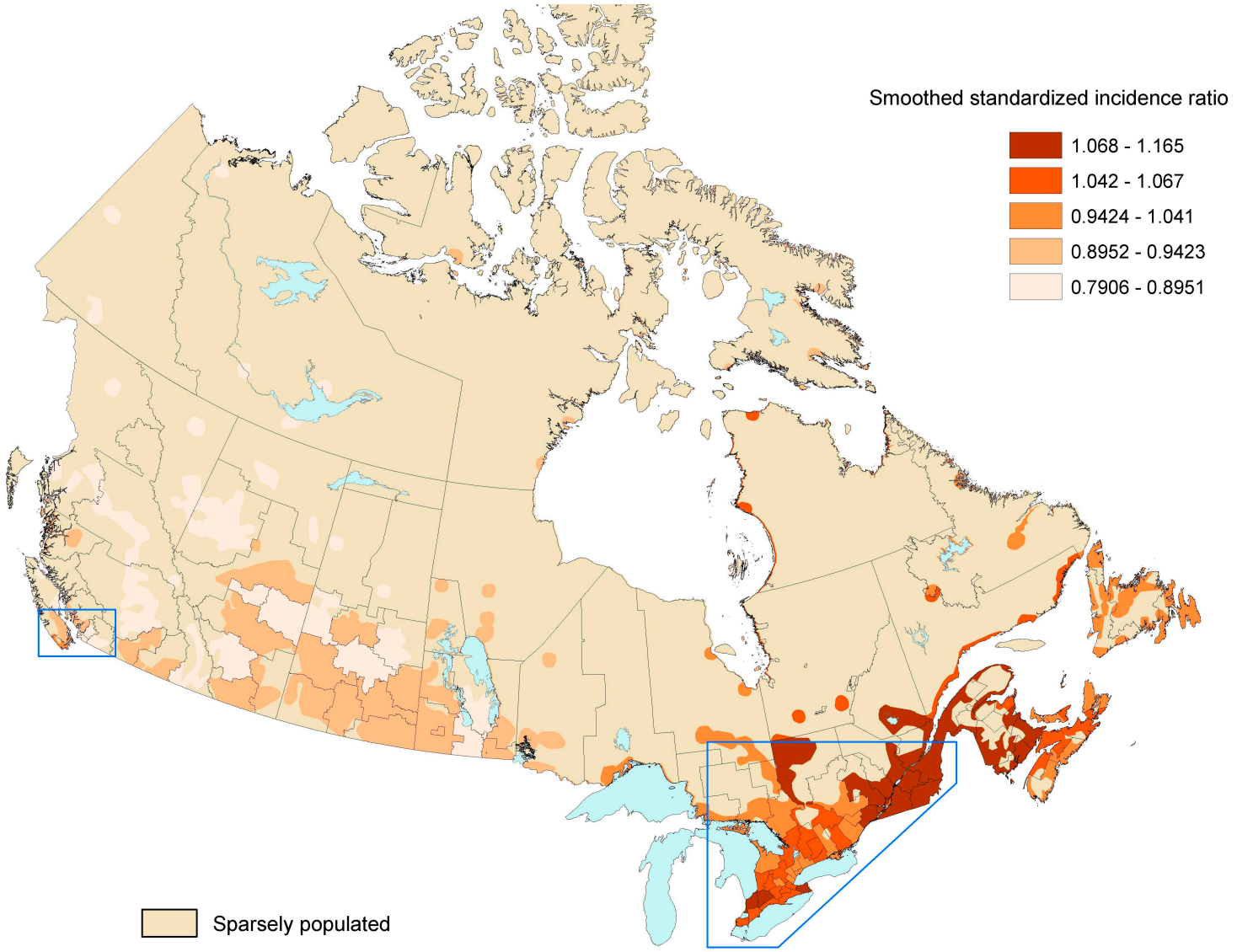
Data source: Canadian Cancer Registry database at Statistics Canada

Map 67-B. Kidney and renal pelvis, males, 2000-2006, all ages



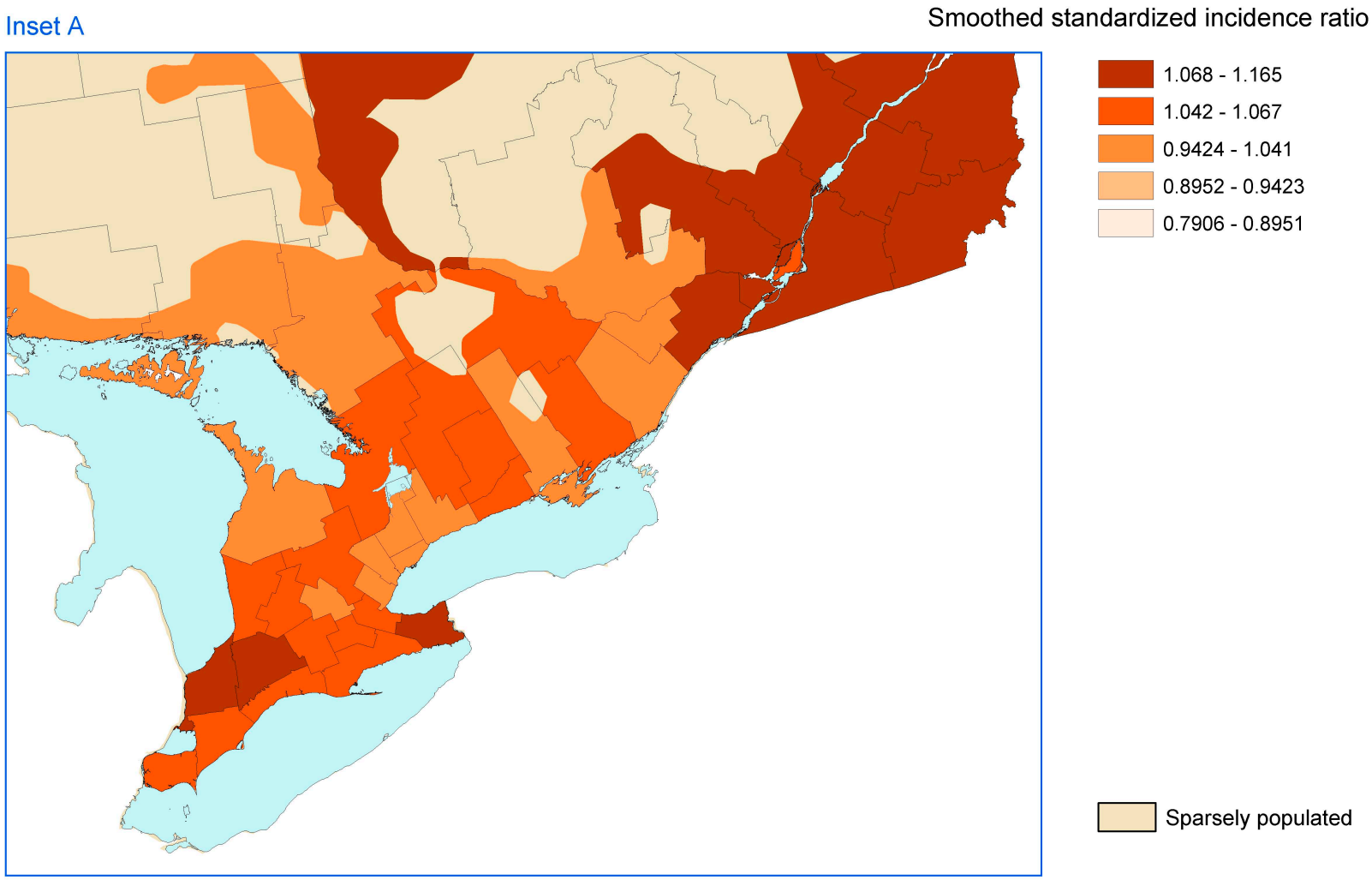
Data source: Canadian Cancer Registry database at Statistics Canada

Map 68. Brain and other nervous system, females, 2000-2006, all ages



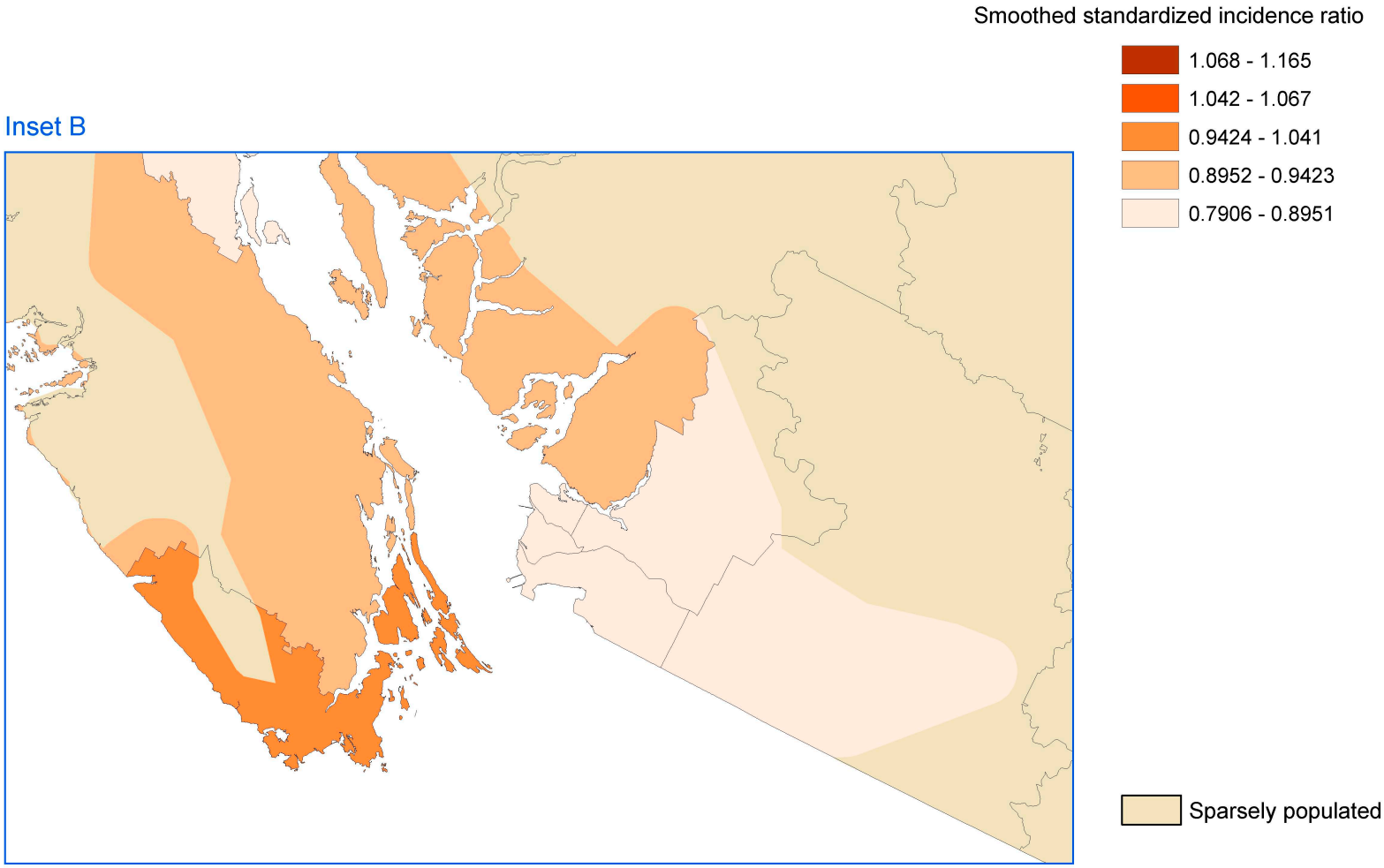
Data source: Canadian Cancer Registry database at Statistics Canada

Map 68-A. Brain and other nervous system, females, 2000-2006, all ages



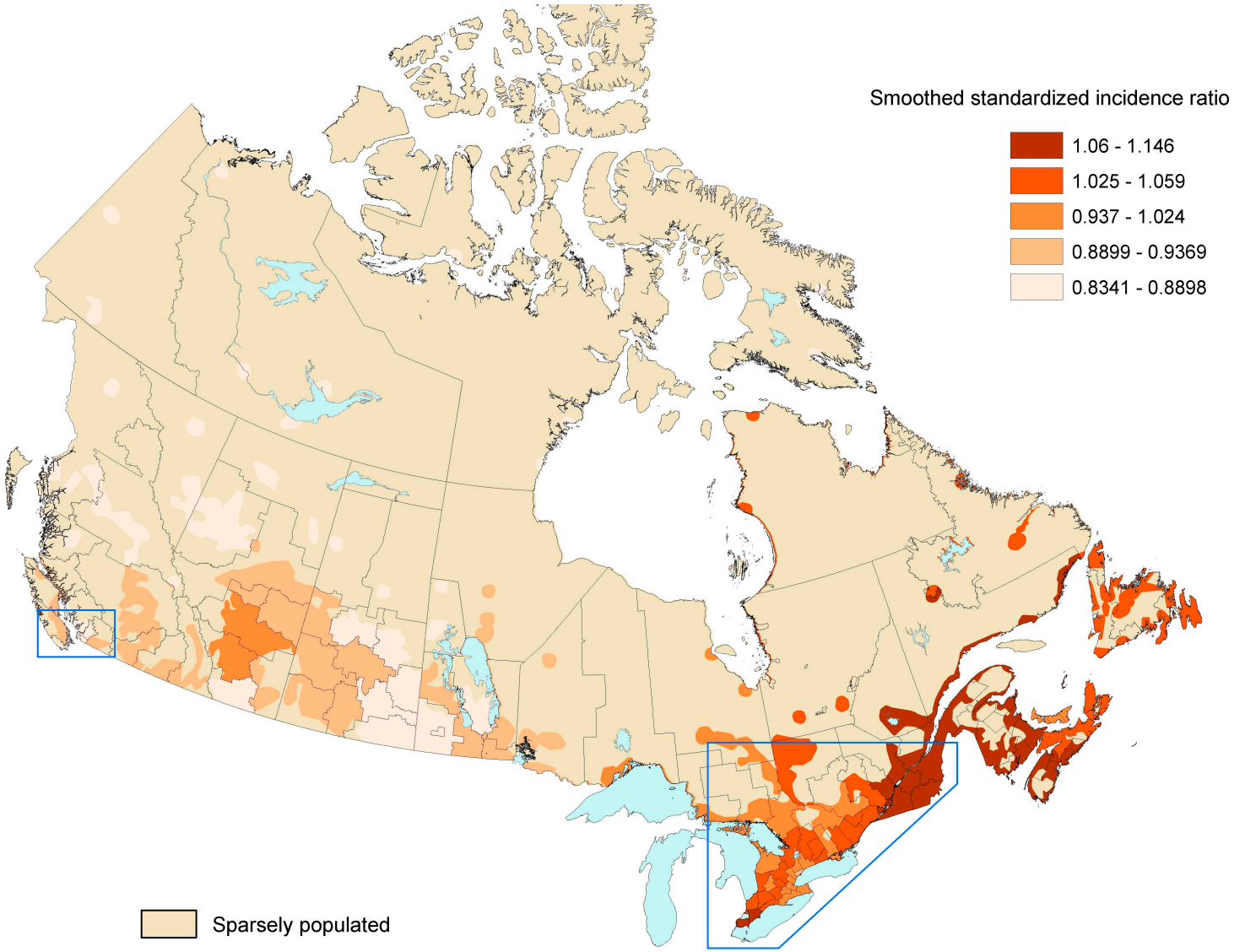
Data source: Canadian Cancer Registry database at Statistics Canada

Map 68-B. Brain and other nervous system, females, 2000-2006, all ages



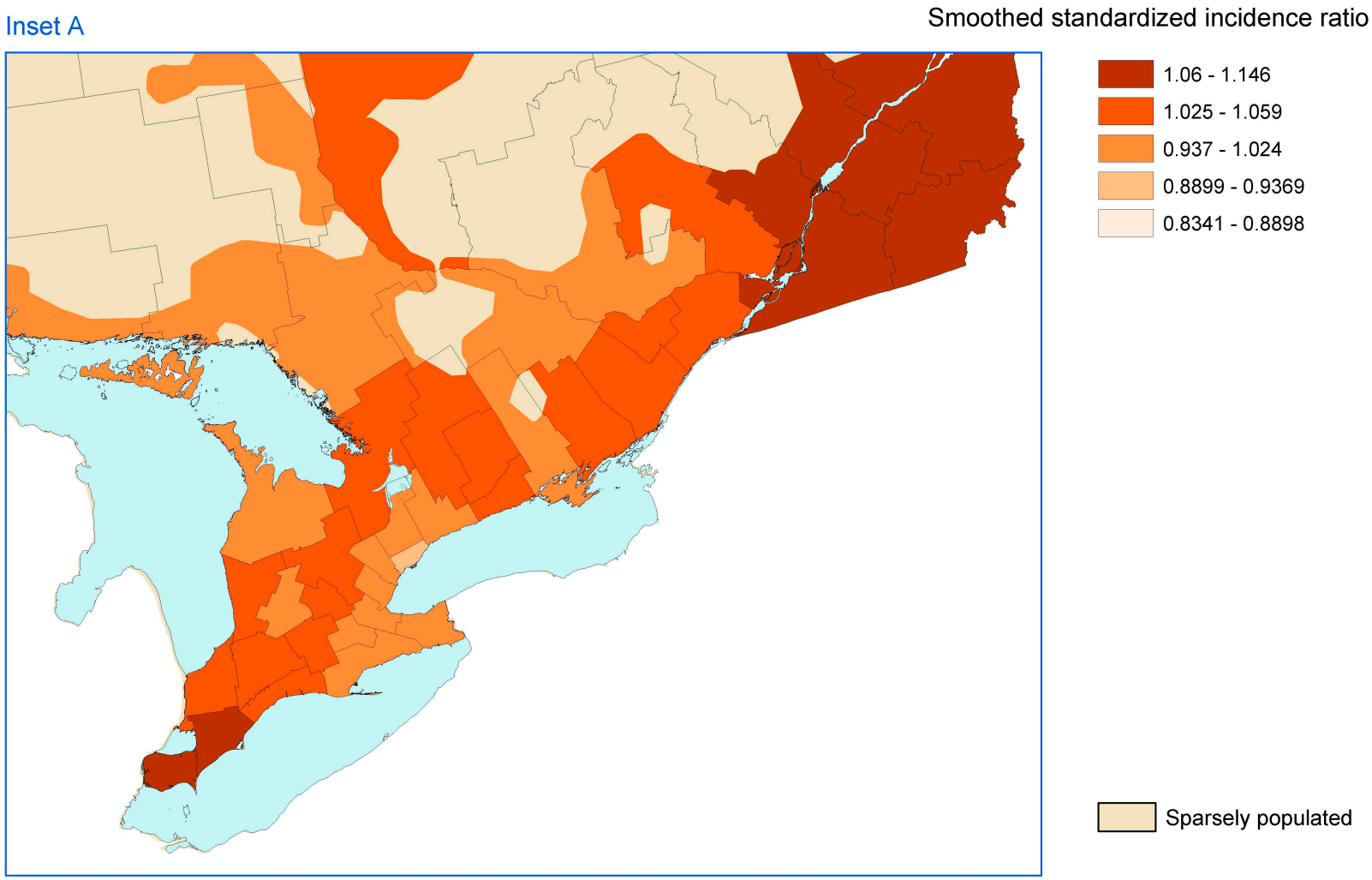
Data source: Canadian Cancer Registry database at Statistics Canada

Map 69. Brain and other nervous system, males, 2000-2006, all ages



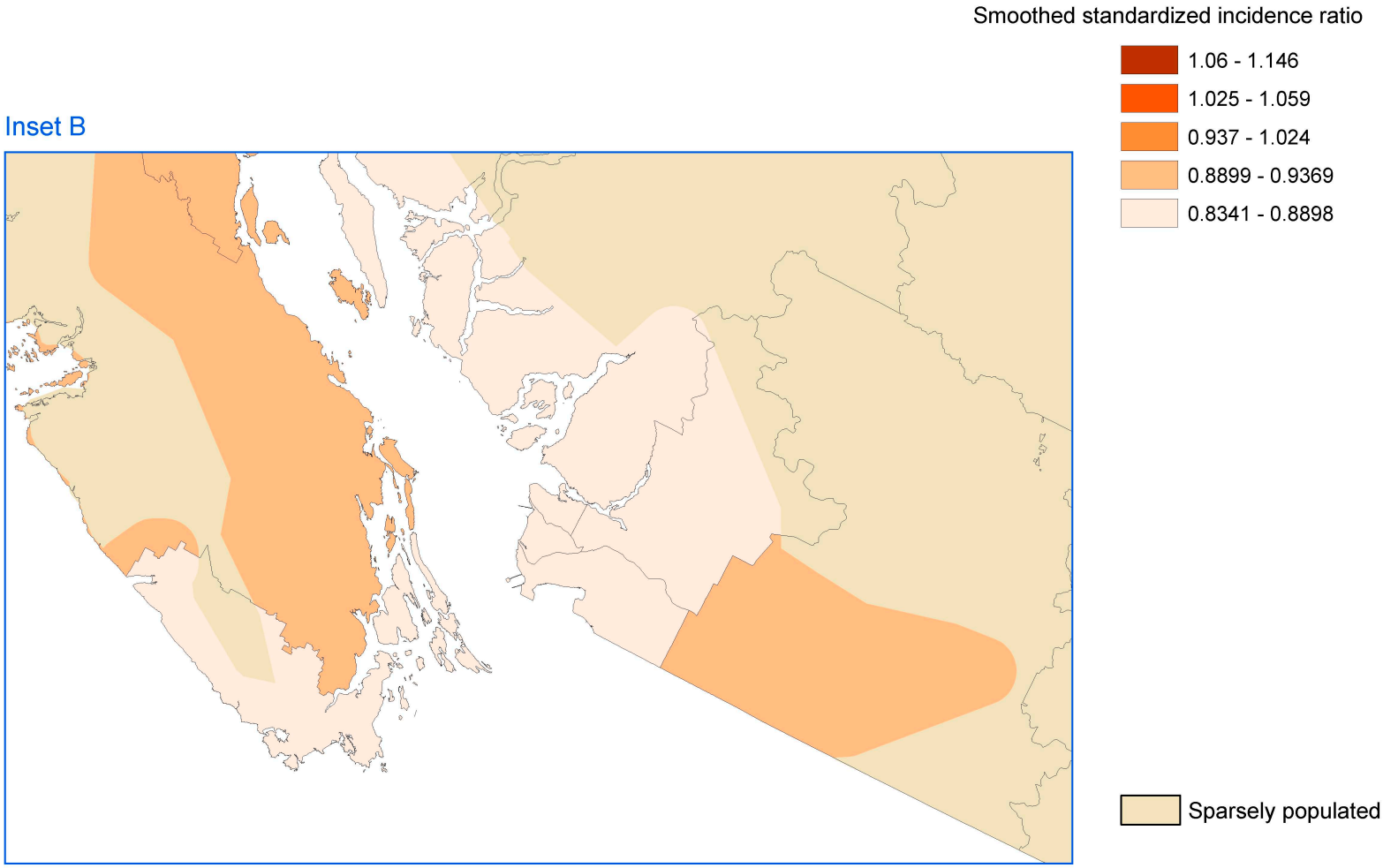
Data source: Canadian Cancer Registry database at Statistics Canada

Map 69-A. Brain and other nervous system, males, 2000-2006, all ages



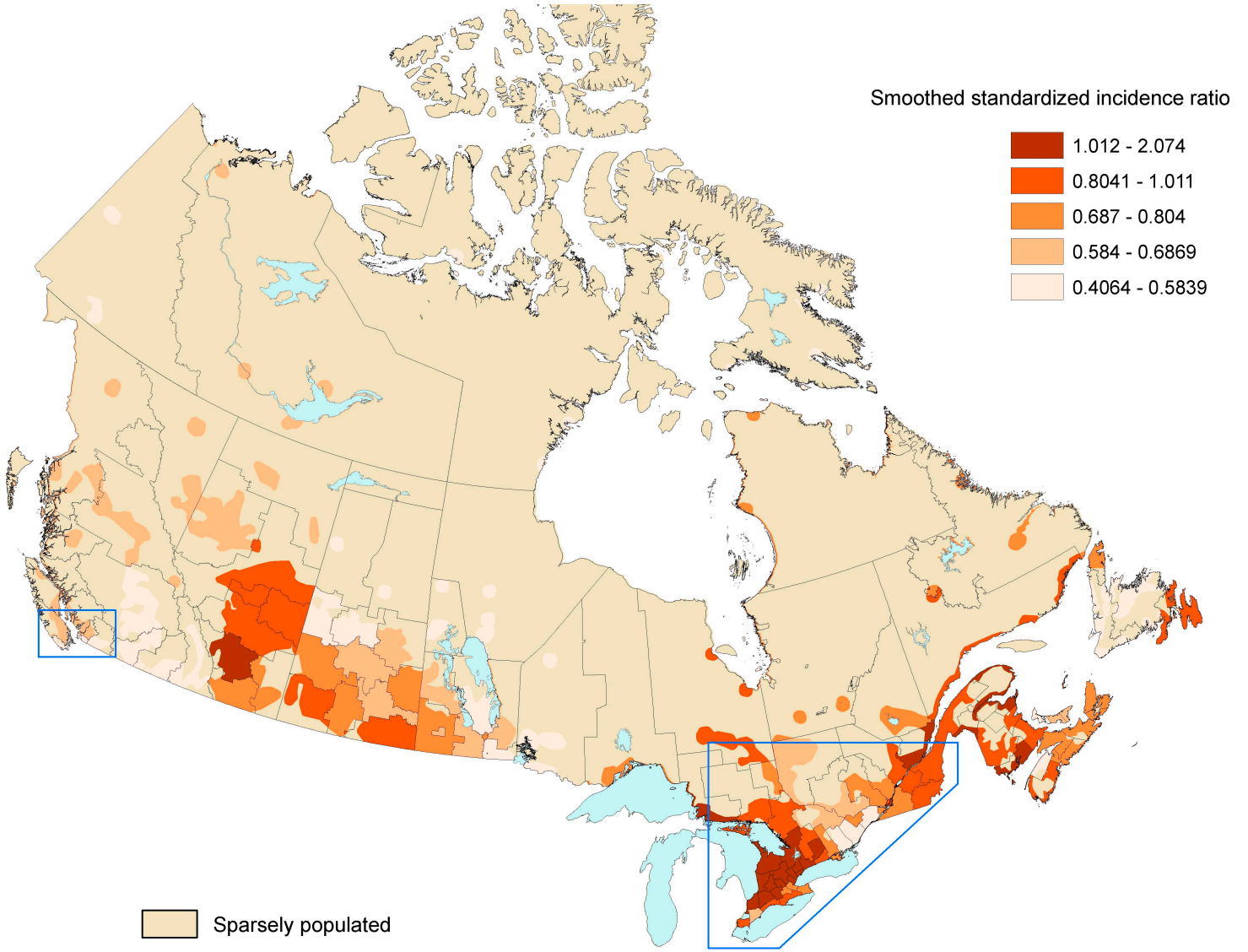
Data source: Canadian Cancer Registry database at Statistics Canada

Map 69-B. Brain and other nervous system, males, 2000-2006, all ages



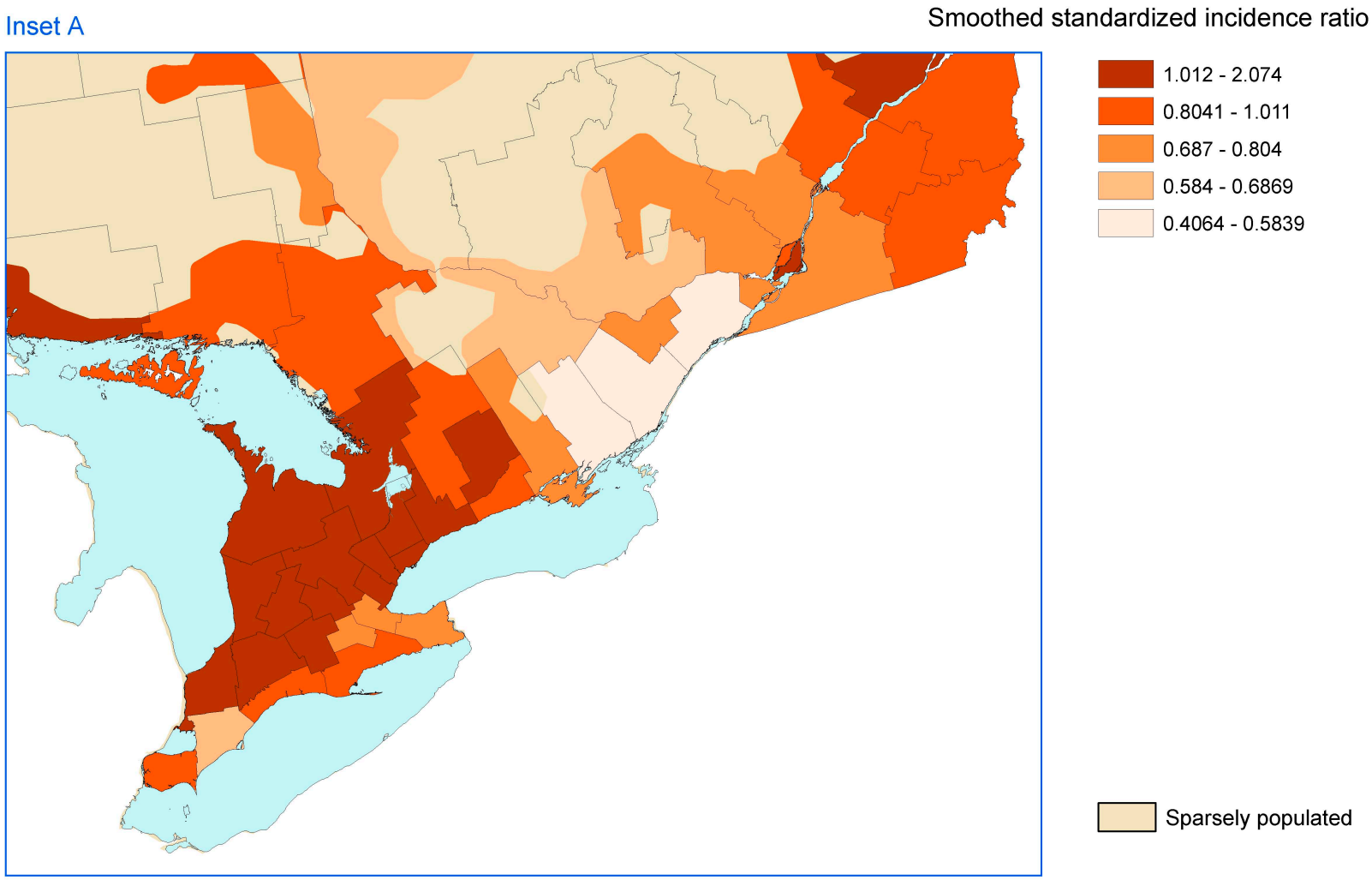
Data source: Canadian Cancer Registry database at Statistics Canada

Map 70. Thyroid, 2000-2006, all ages



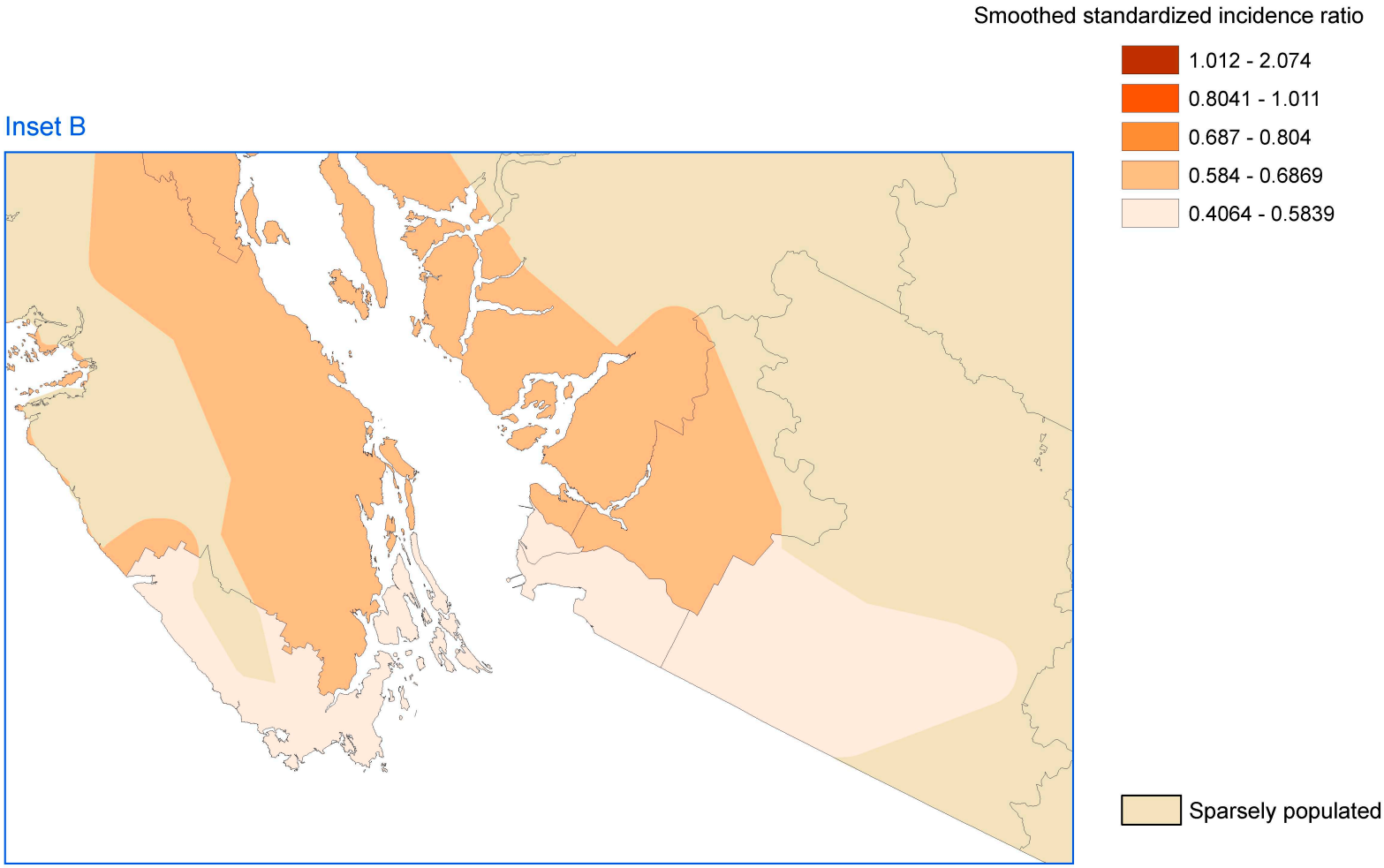
Data source: Canadian Cancer Registry database at Statistics Canada

Map 70-A. Thyroid, 2000-2006, all ages



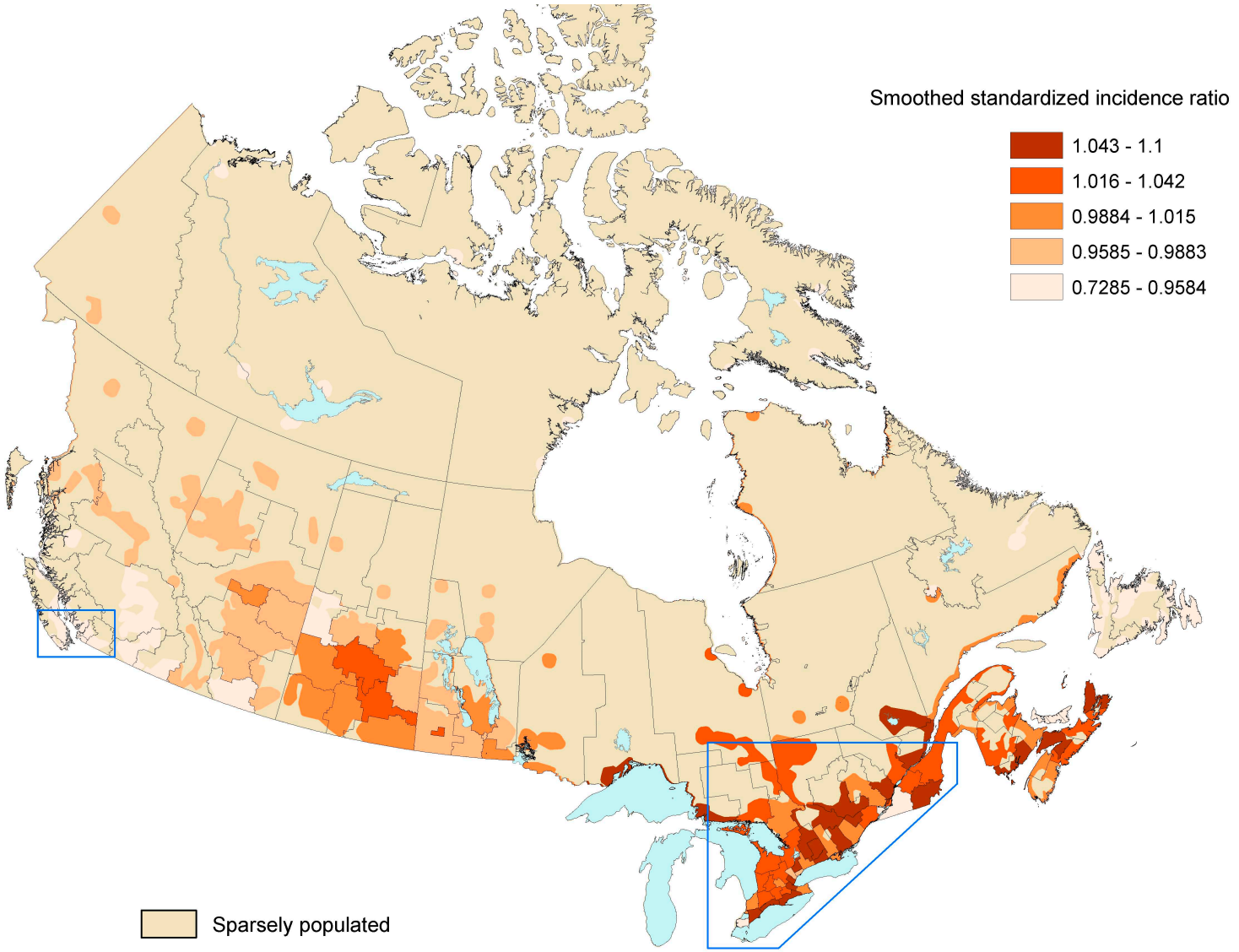
Data source: Canadian Cancer Registry database at Statistics Canada

Map 70-B. Thyroid, 2000-2006, all ages



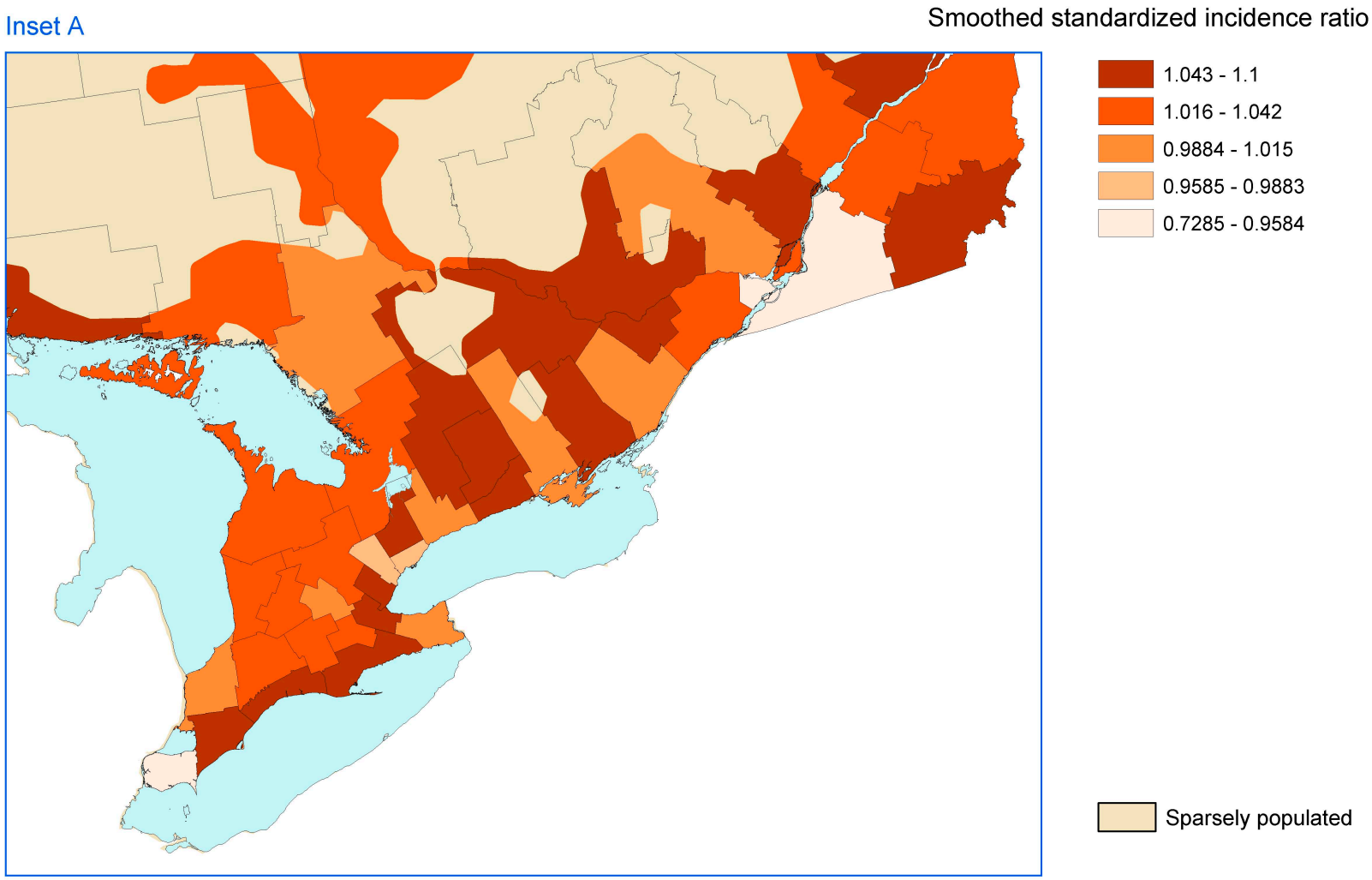
Data source: Canadian Cancer Registry database at Statistics Canada

Map 71. Hodgkin lymphoma, 2000-2006, all ages



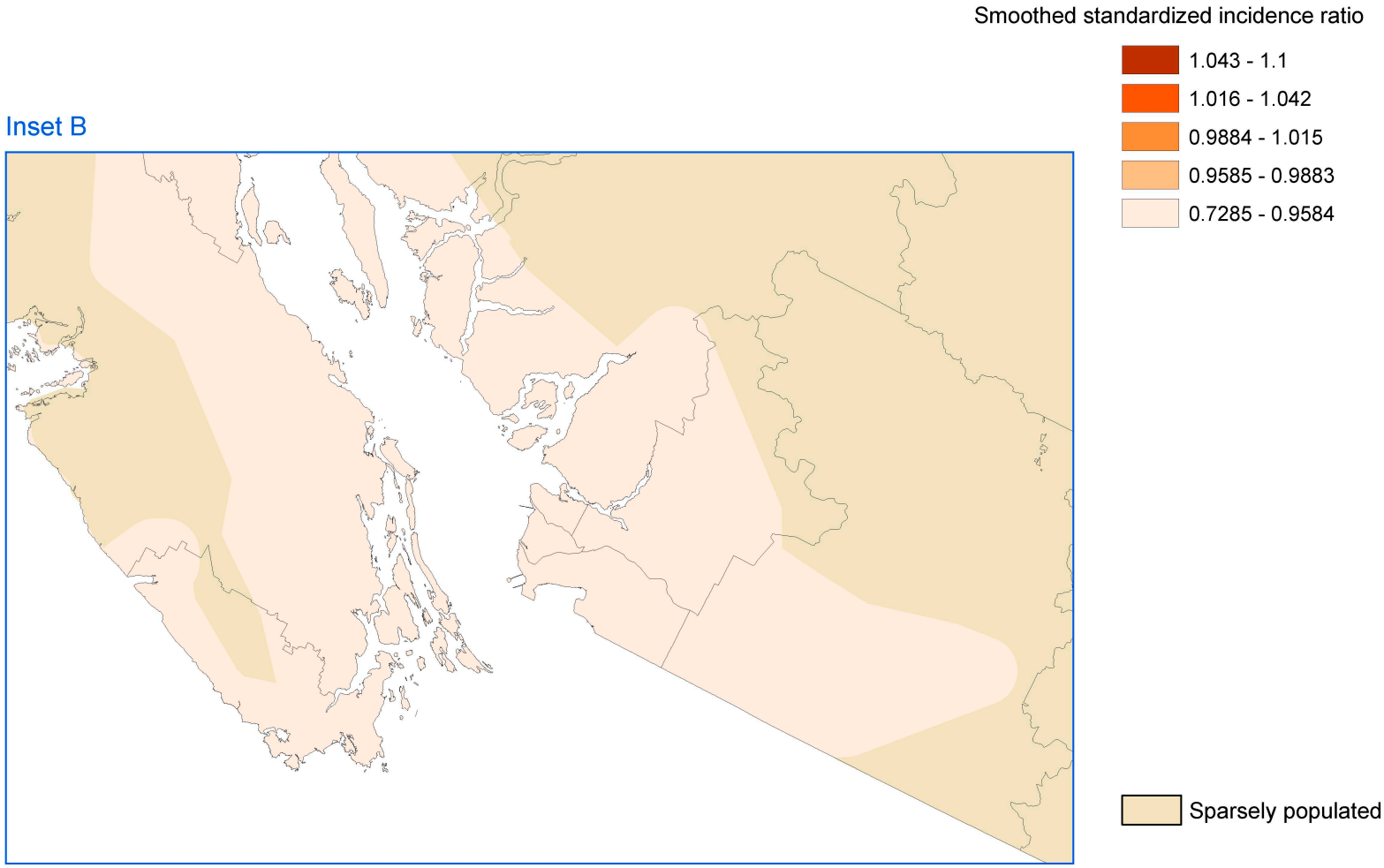
Data source: Canadian Cancer Registry database at Statistics Canada

Map 71-A. Hodgkin lymphoma, 2000-2006, all ages



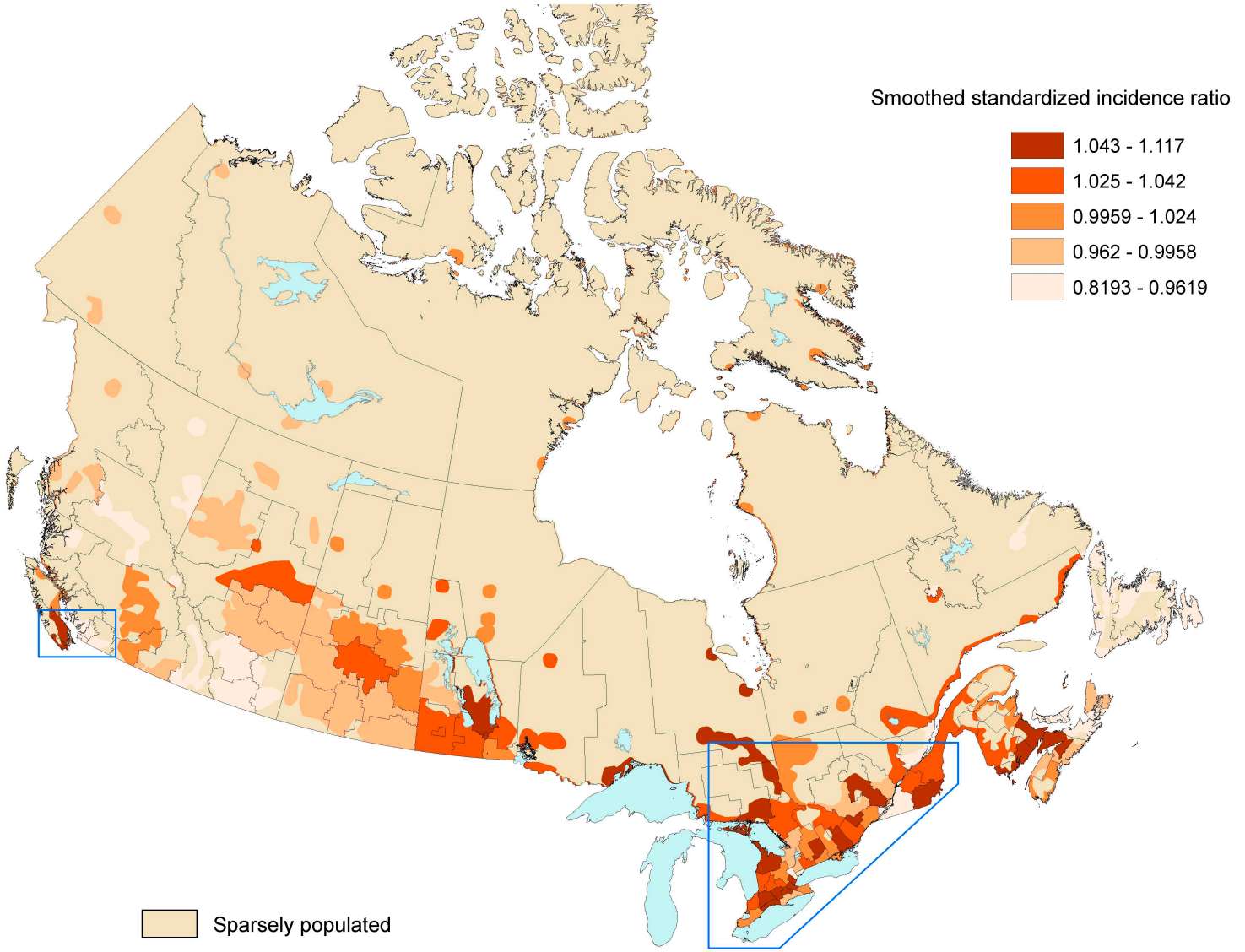
Data source: Canadian Cancer Registry database at Statistics Canada

Map 71-B. Hodgkin lymphoma, 2000-2006, all ages



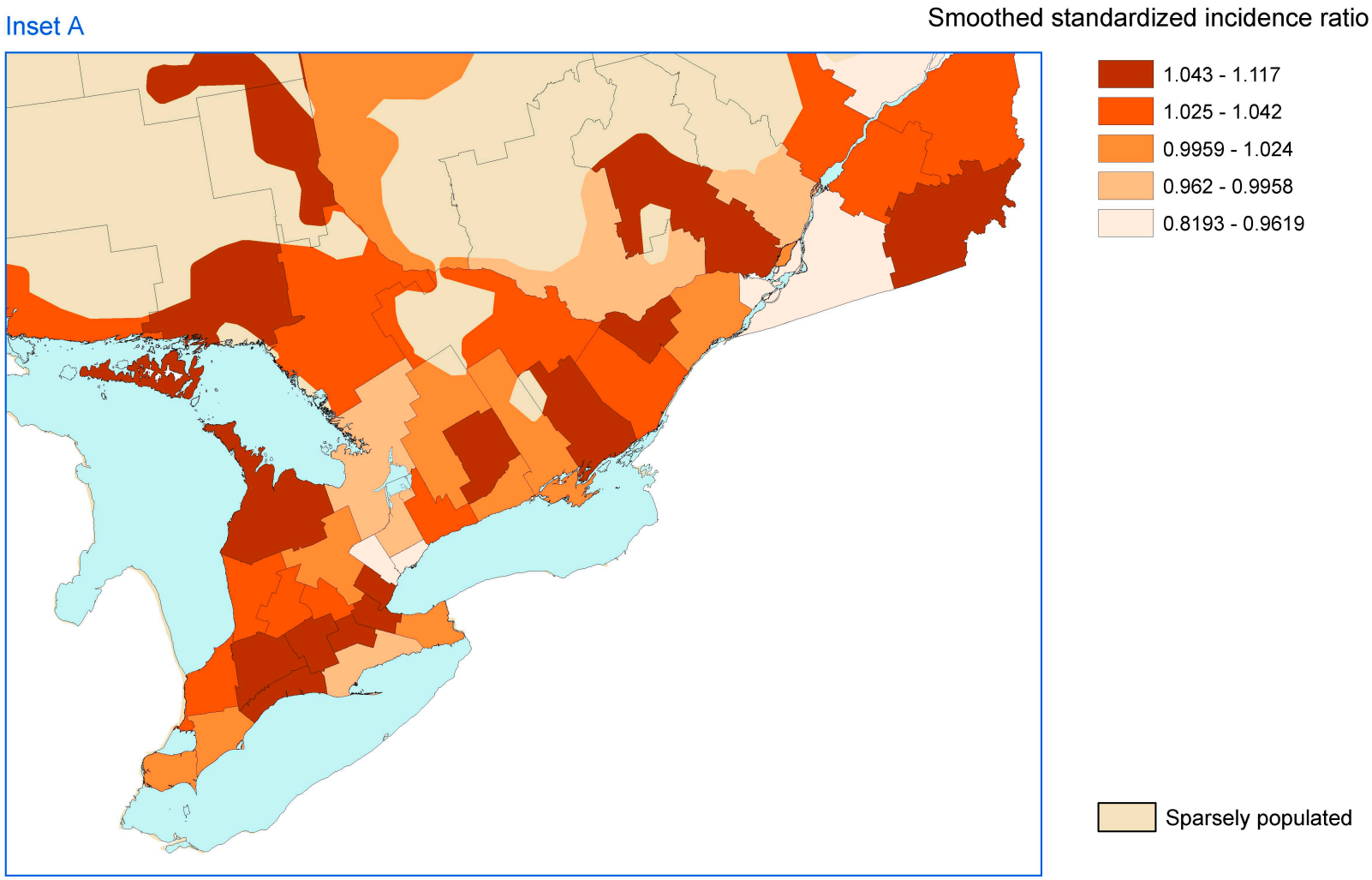
Data source: Canadian Cancer Registry database at Statistics Canada

Map 72. Non-Hodgkin lymphoma, females, 2000-2006, all ages



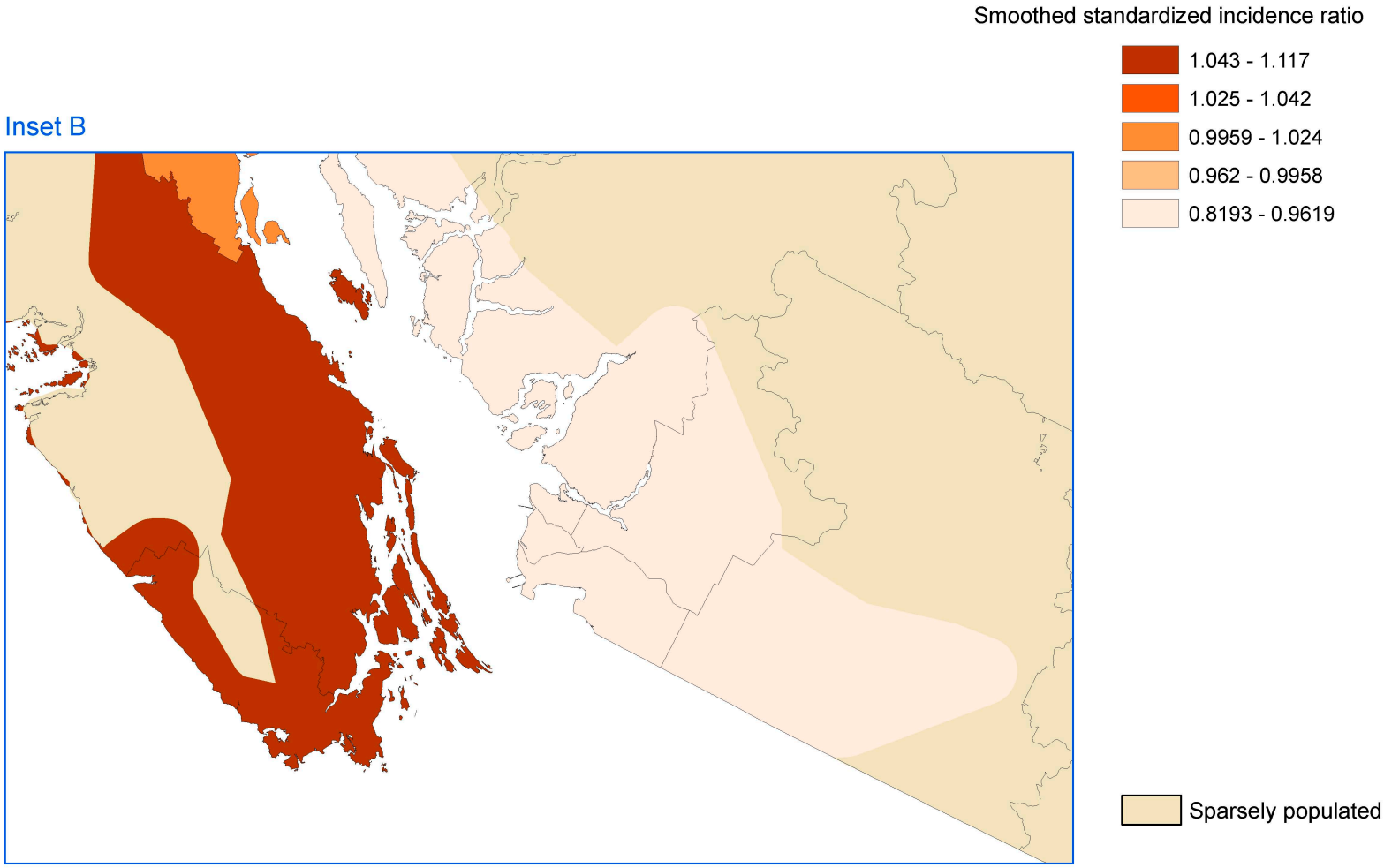
Data source: Canadian Cancer Registry database at Statistics Canada

Map 72-A. Non-Hodgkin lymphoma, females, 2000-2006, all ages



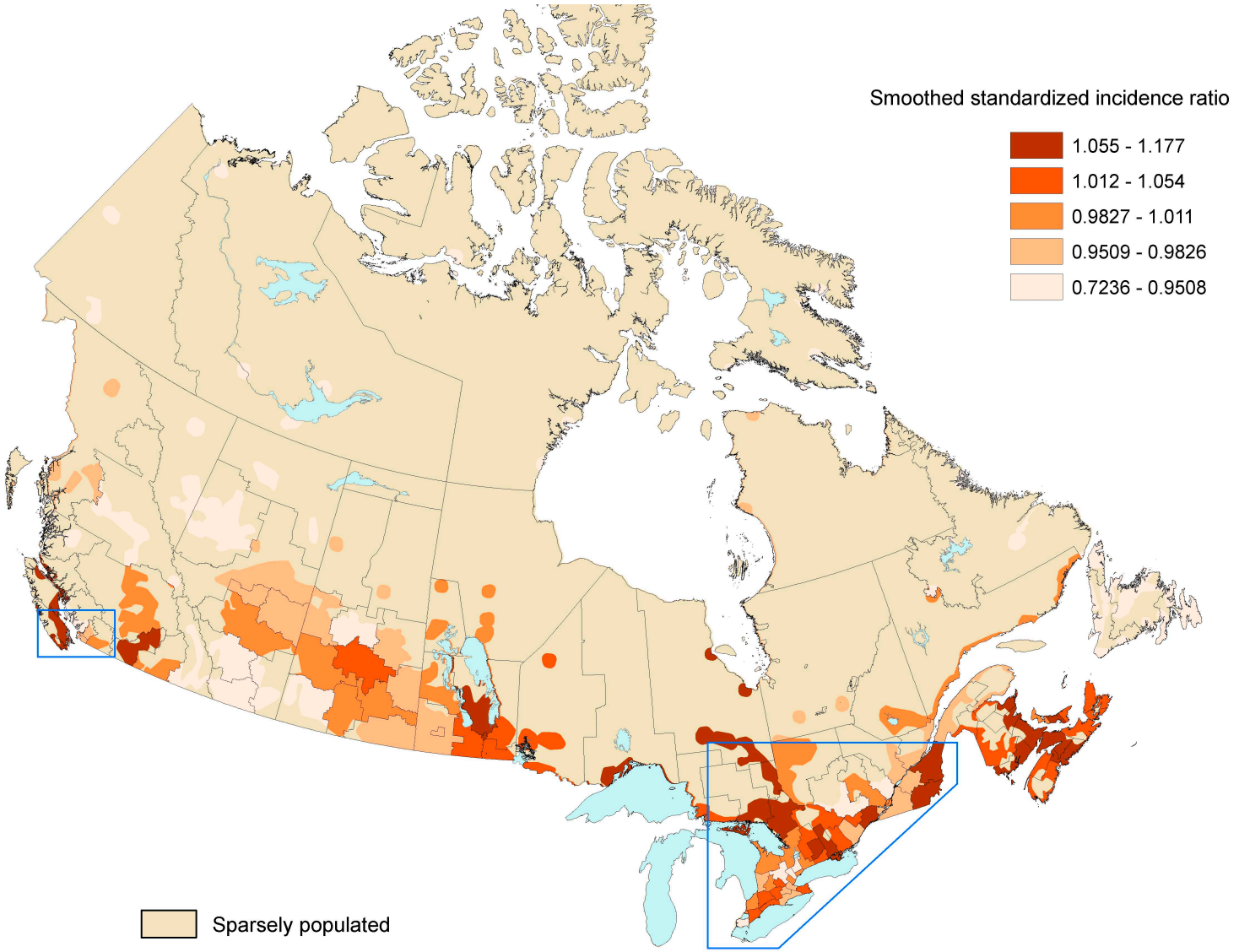
Data source: Canadian Cancer Registry database at Statistics Canada

Map 72-B. Non-Hodgkin lymphoma, females, 2000-2006, all ages



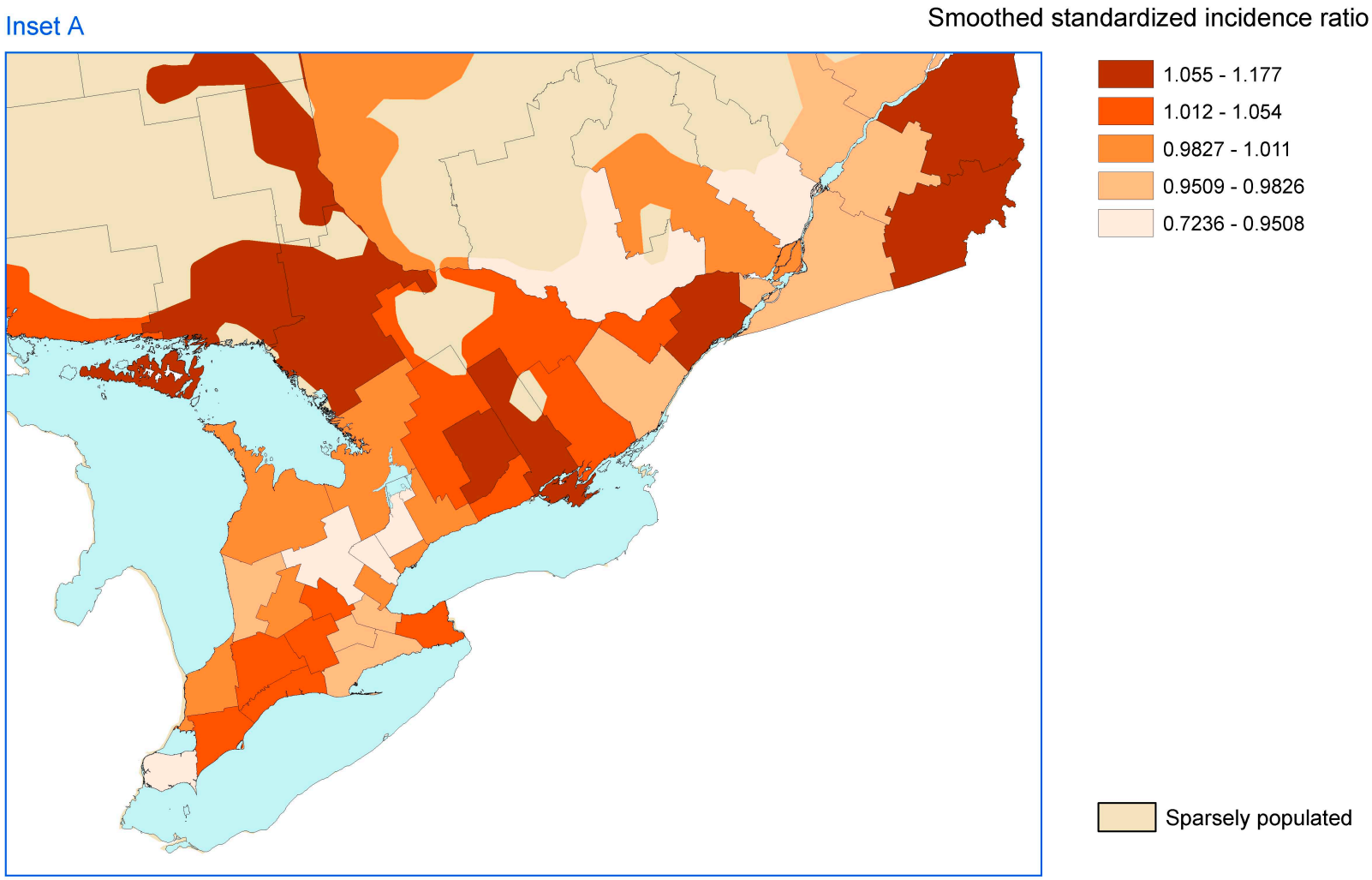
Data source: Canadian Cancer Registry database at Statistics Canada

Map 73. Non-Hodgkin lymphoma, males, 2000-2006, all ages



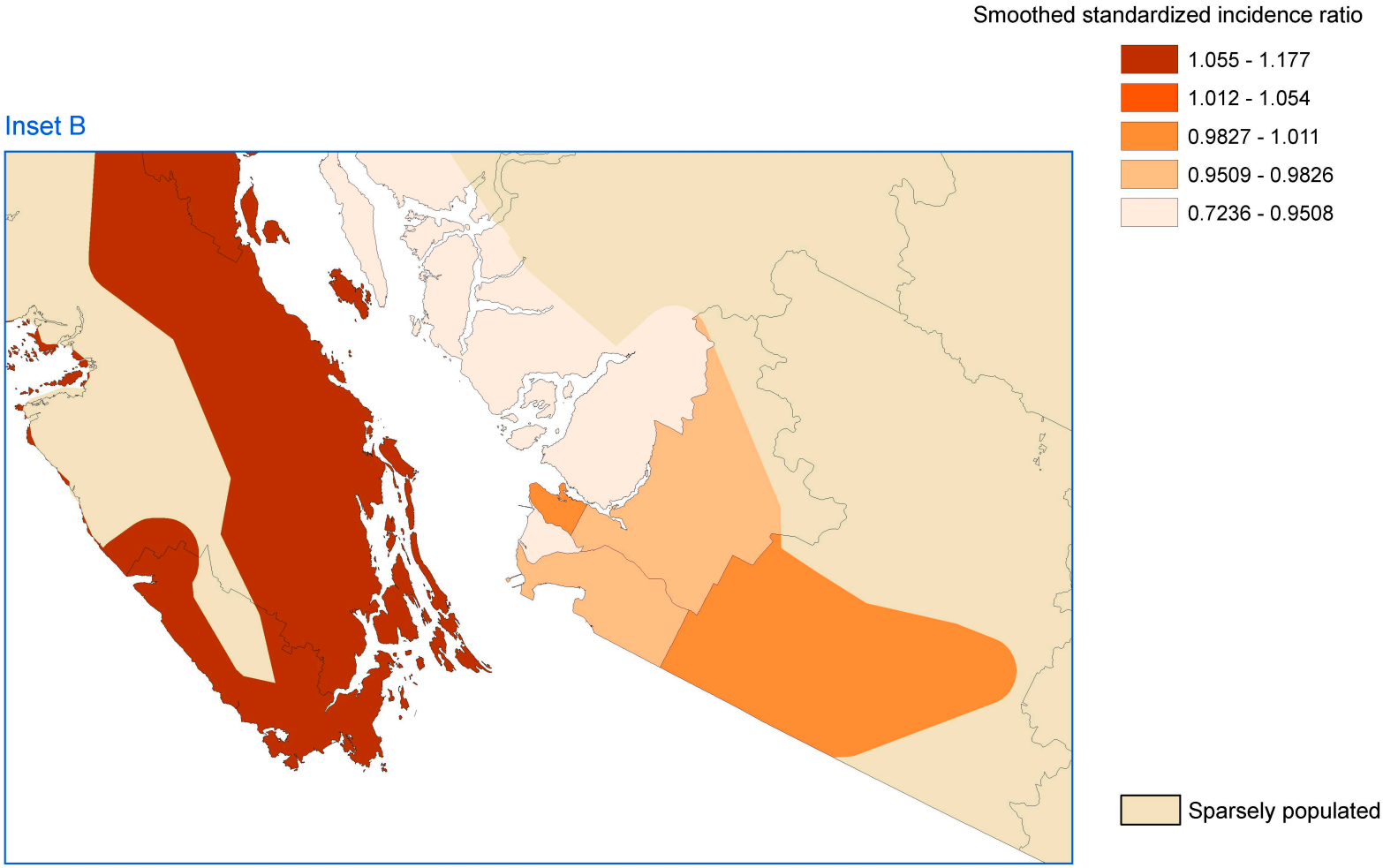
Data source: Canadian Cancer Registry database at Statistics Canada

Map 73-A. Non-Hodgkin lymphoma, males, 2000-2006, all ages



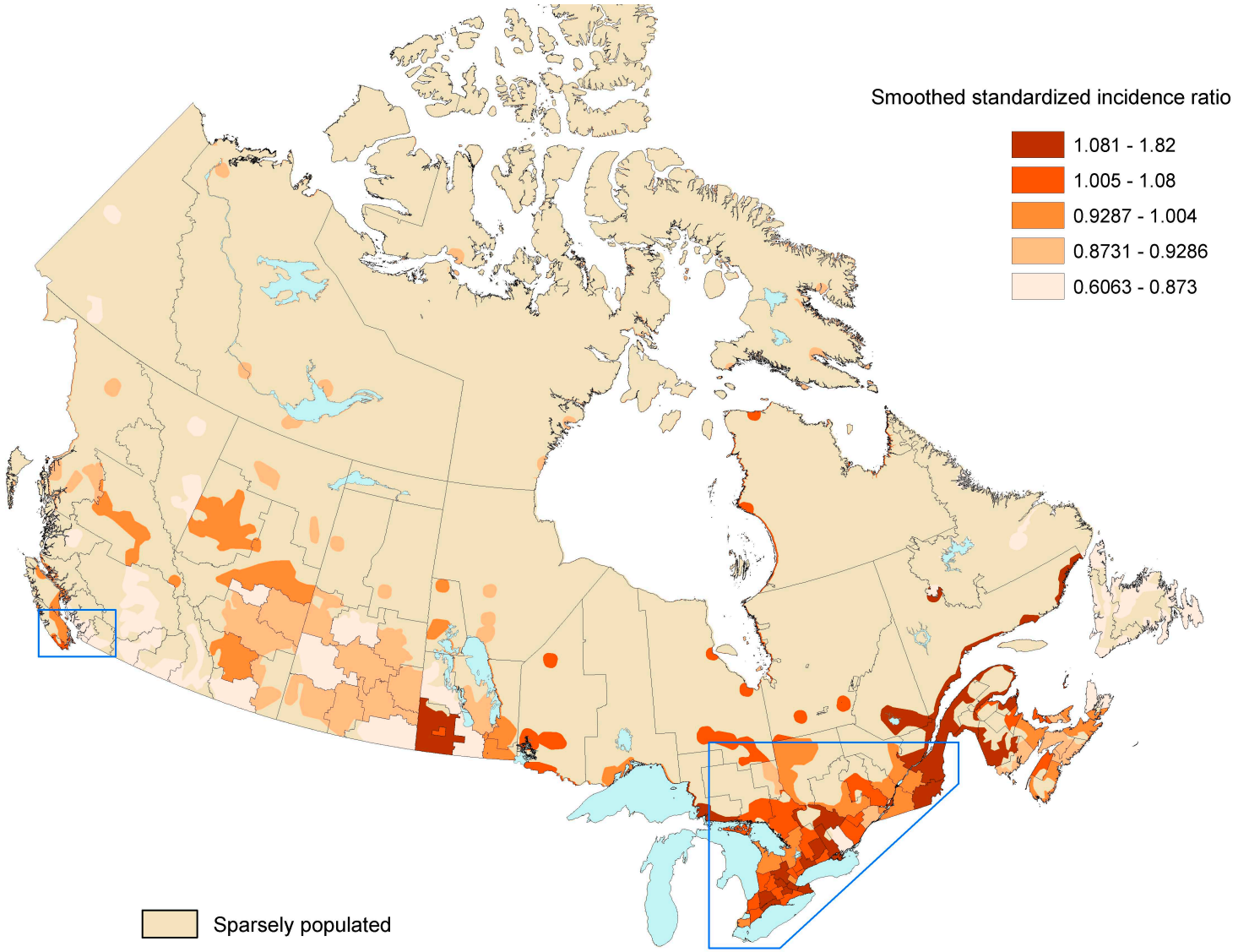
Data source: Canadian Cancer Registry database at Statistics Canada

Map 73-B. Non-Hodgkin lymphoma, males, 2000-2006, all ages



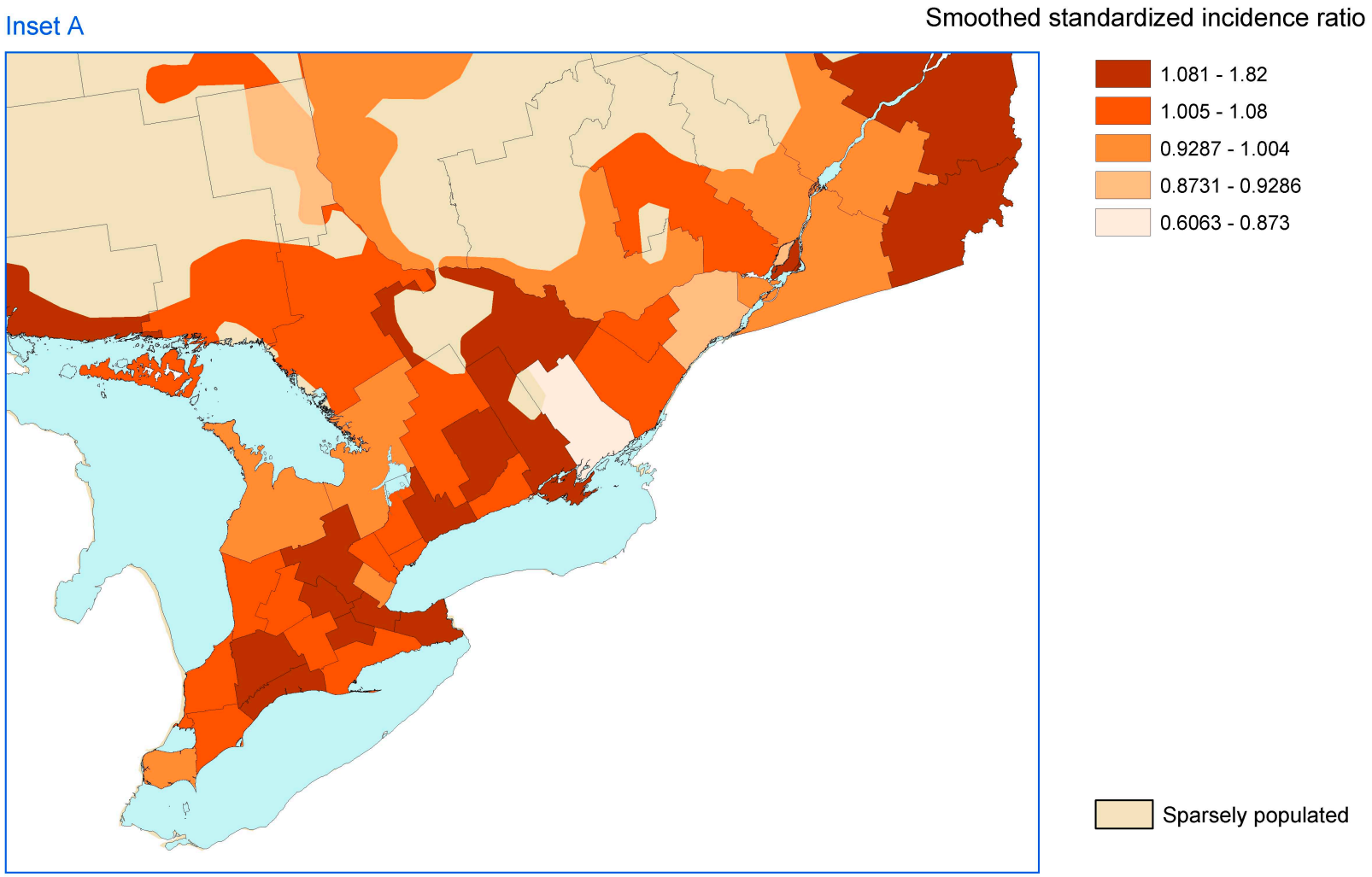
Data source: Canadian Cancer Registry database at Statistics Canada

Map 74. Multiple myeloma, females, 2000-2006, all ages



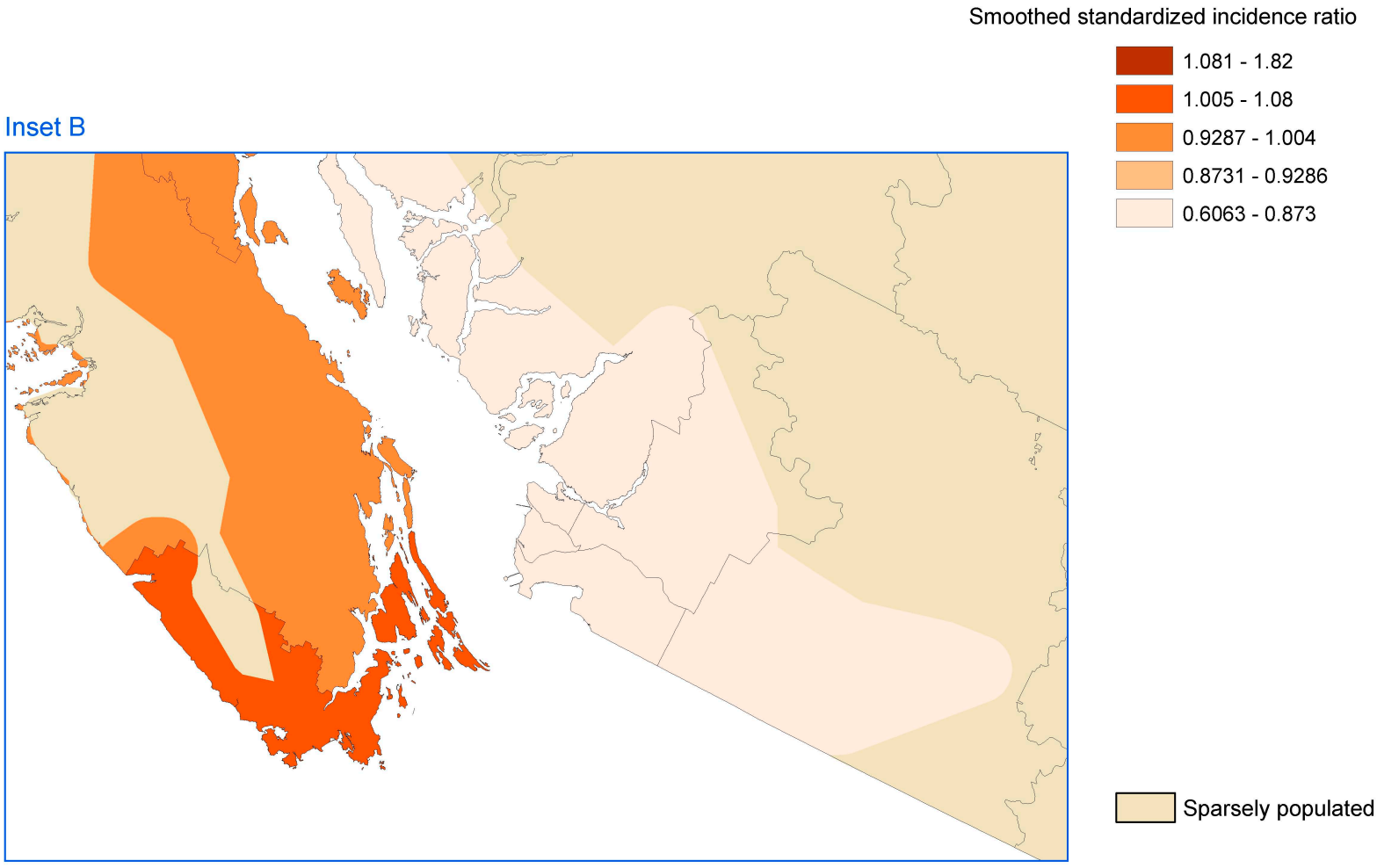
Data source: Canadian Cancer Registry database at Statistics Canada

Map 74-A. Multiple myeloma, females, 2000-2006, all ages



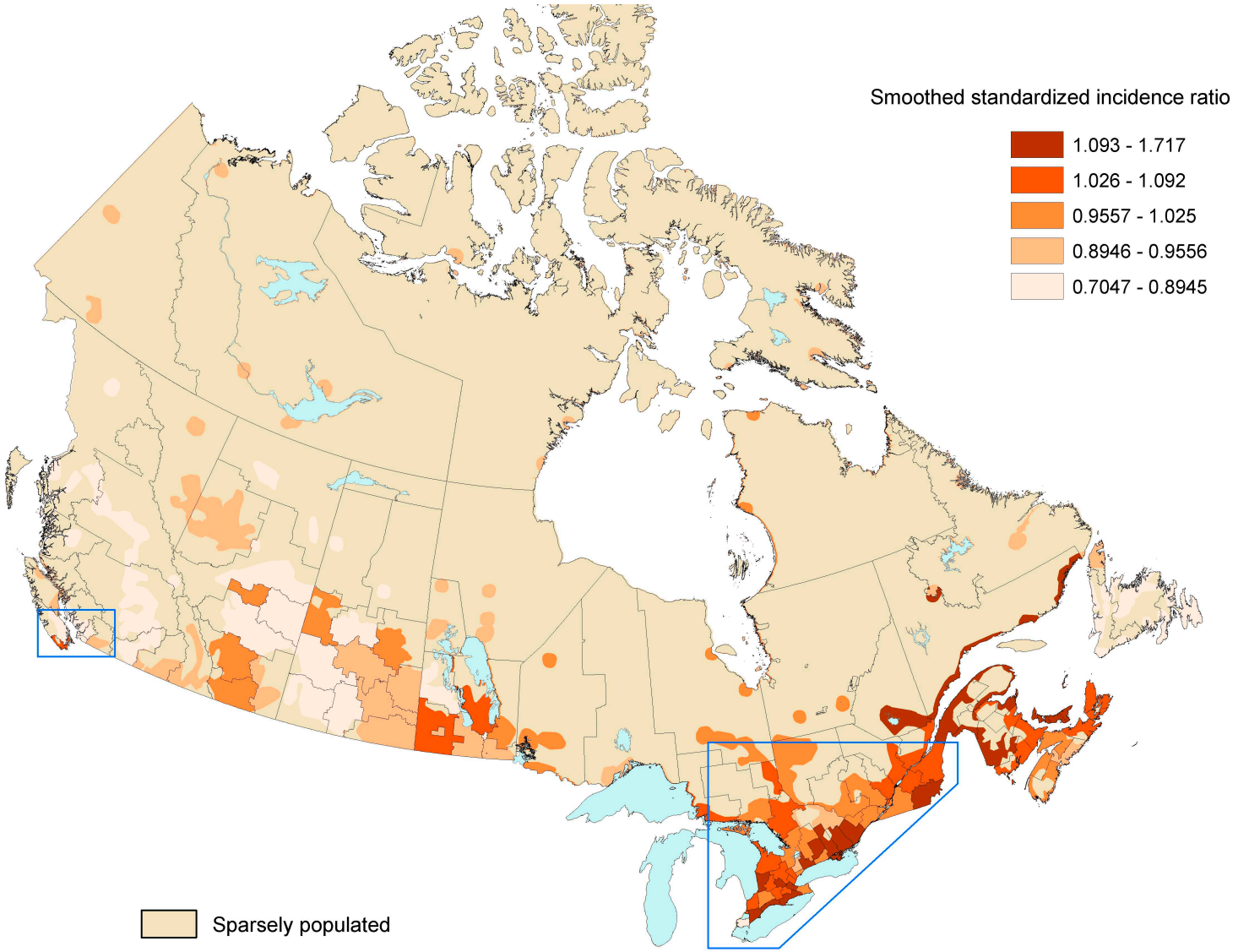
Data source: Canadian Cancer Registry database at Statistics Canada

Map 74-B. Multiple myeloma, females, 2000-2006, all ages



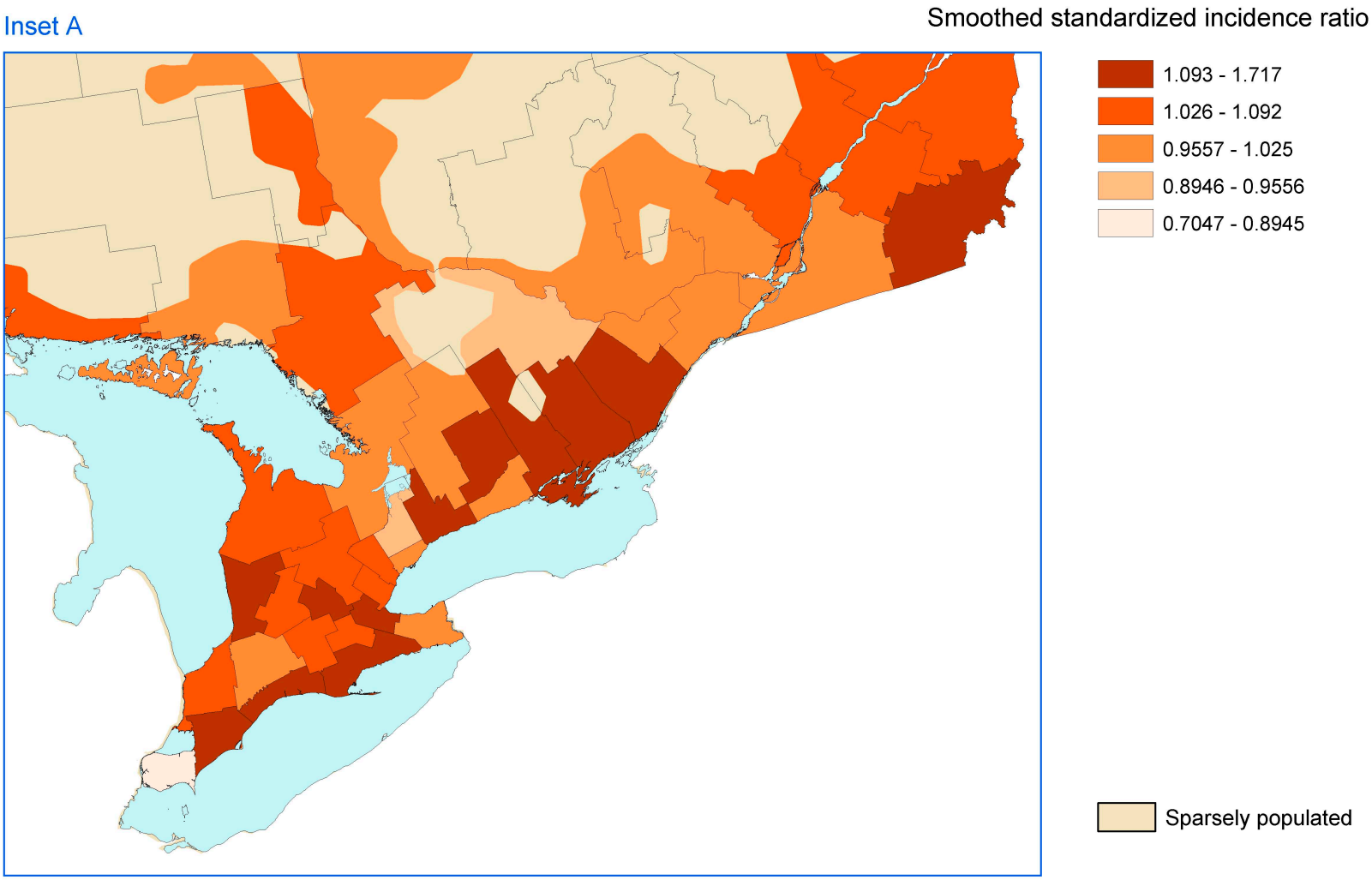
Data source: Canadian Cancer Registry database at Statistics Canada

Map 75. Multiple myeloma, males, 2000-2006, all ages



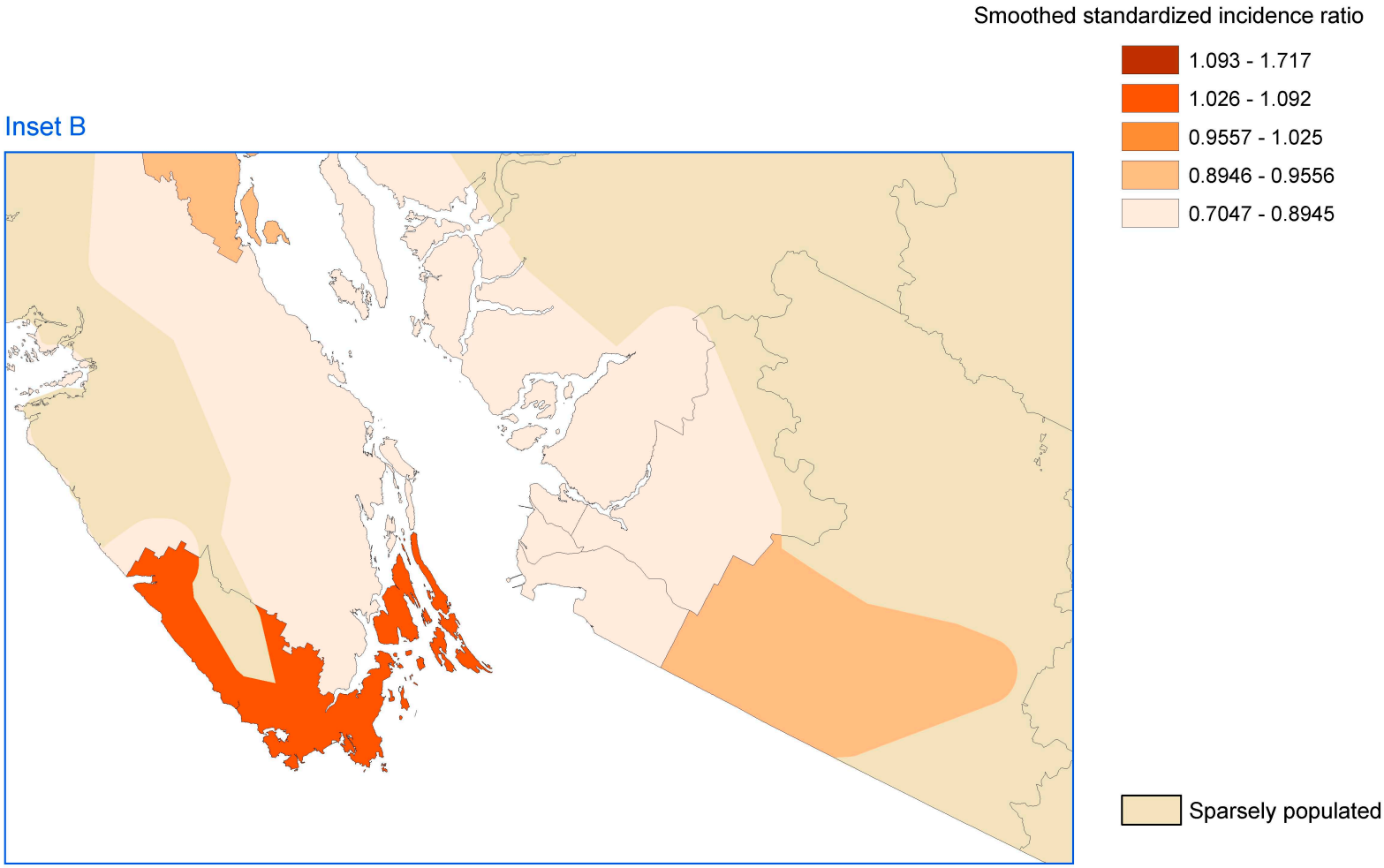
Data source: Canadian Cancer Registry database at Statistics Canada

Map 75-A. Multiple myeloma, males, 2000-2006, all ages



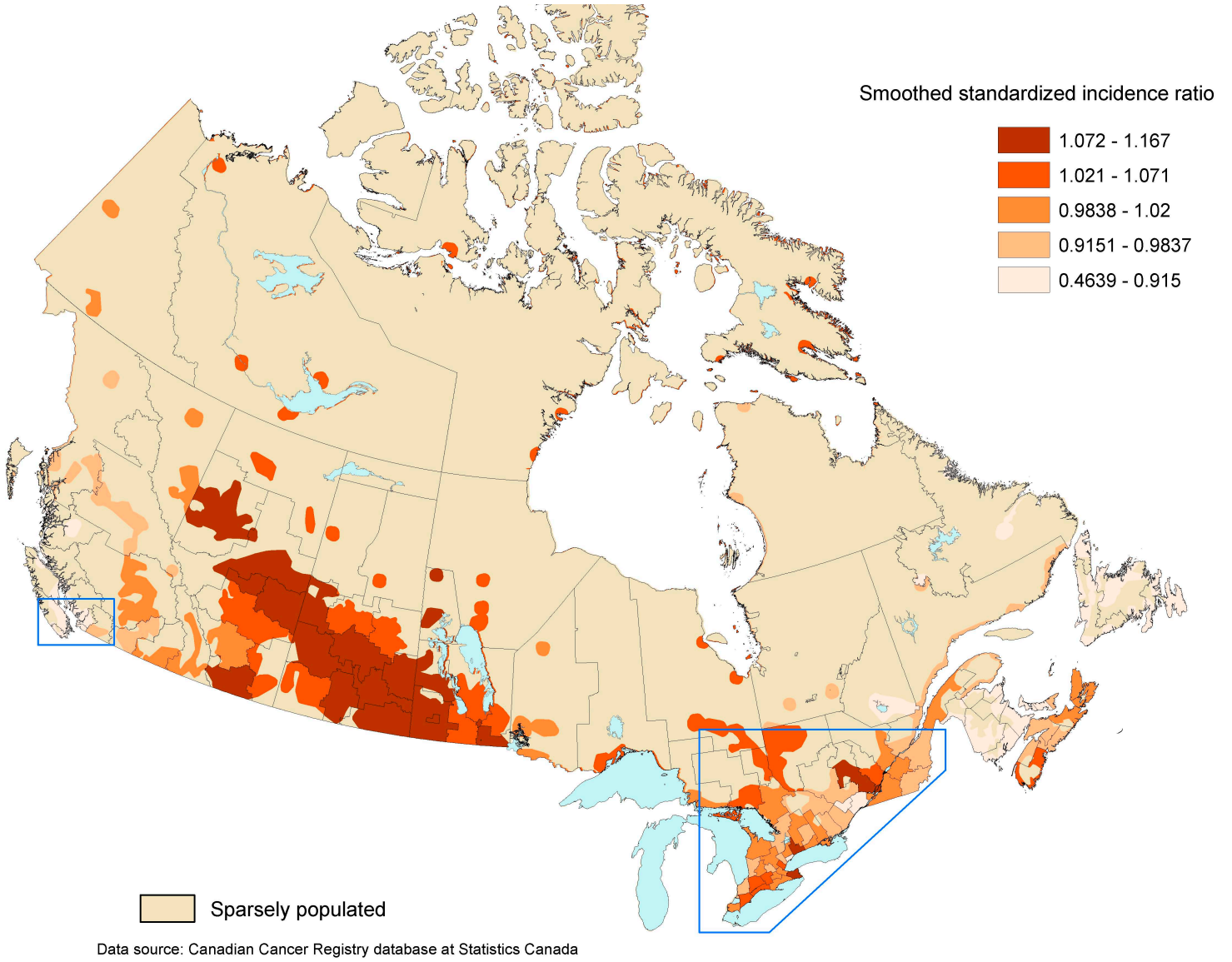
Data source: Canadian Cancer Registry database at Statistics Canada

Map 75-B. Multiple myeloma, males, 2000-2006, all ages



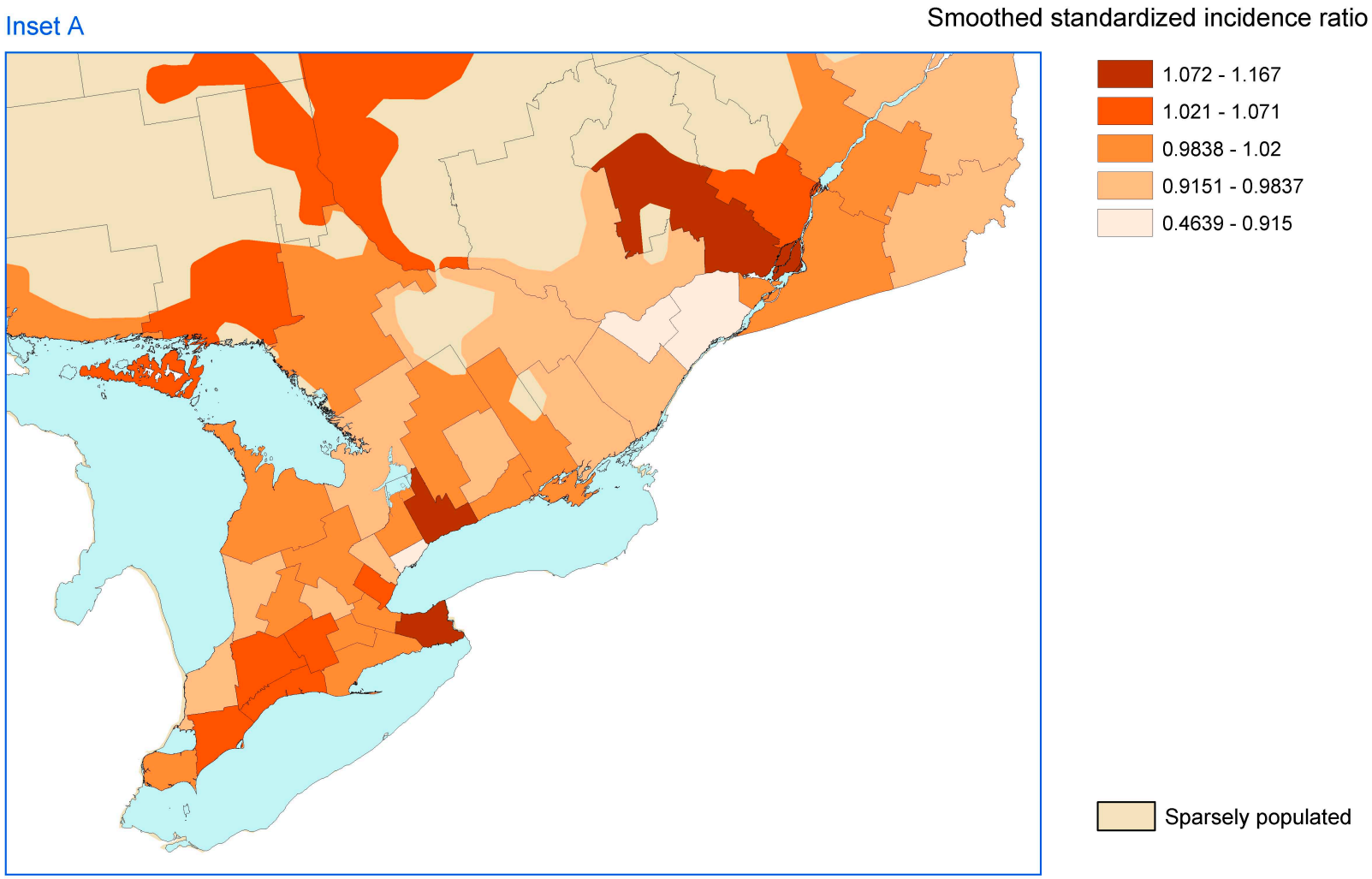
Data source: Canadian Cancer Registry database at Statistics Canada

Map 76. Leukemia, females, 2000-2006, all ages



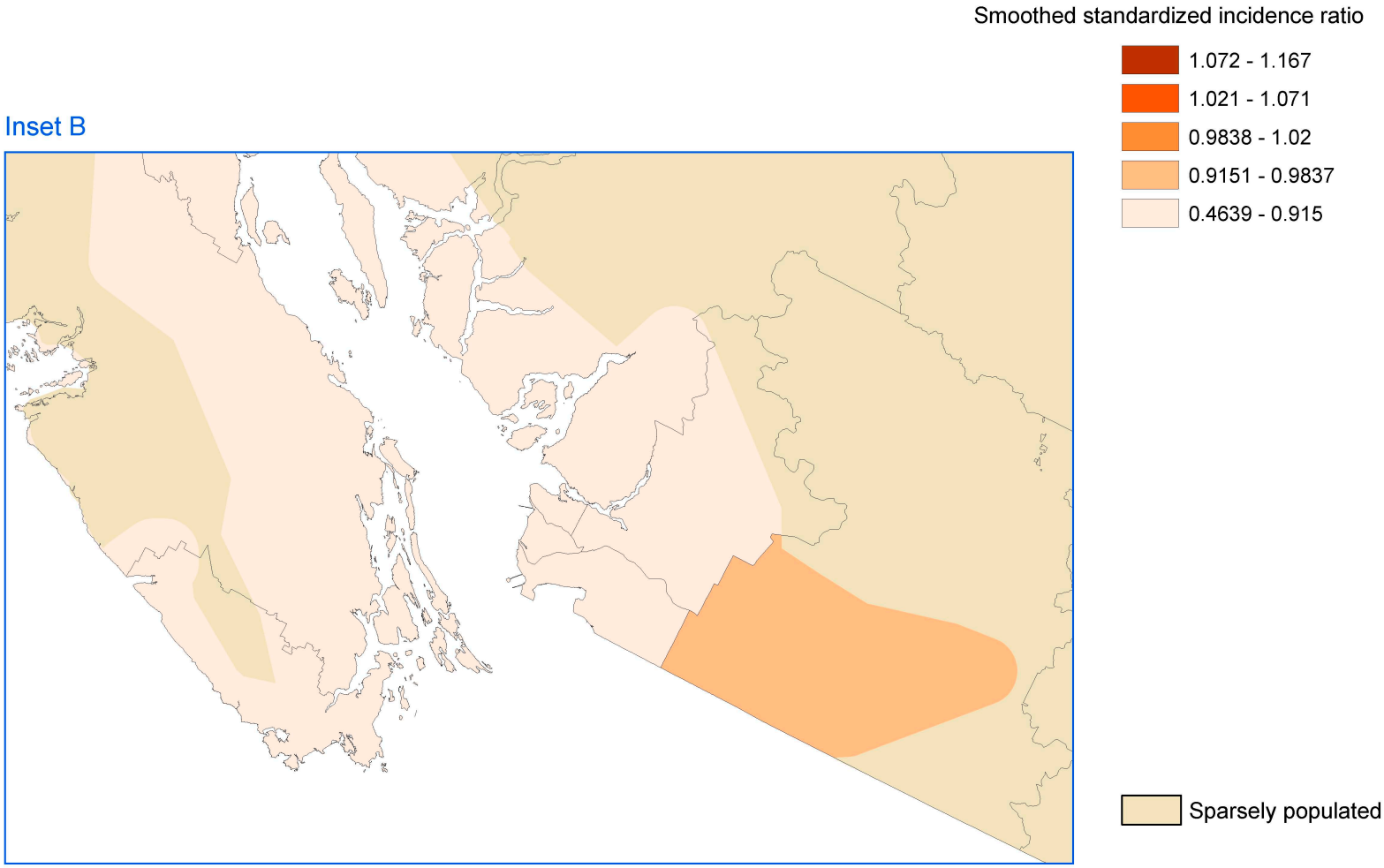
Data source: Canadian Cancer Registry database at Statistics Canada

Map 76-A. Leukemia, females, 2000-2006, all ages



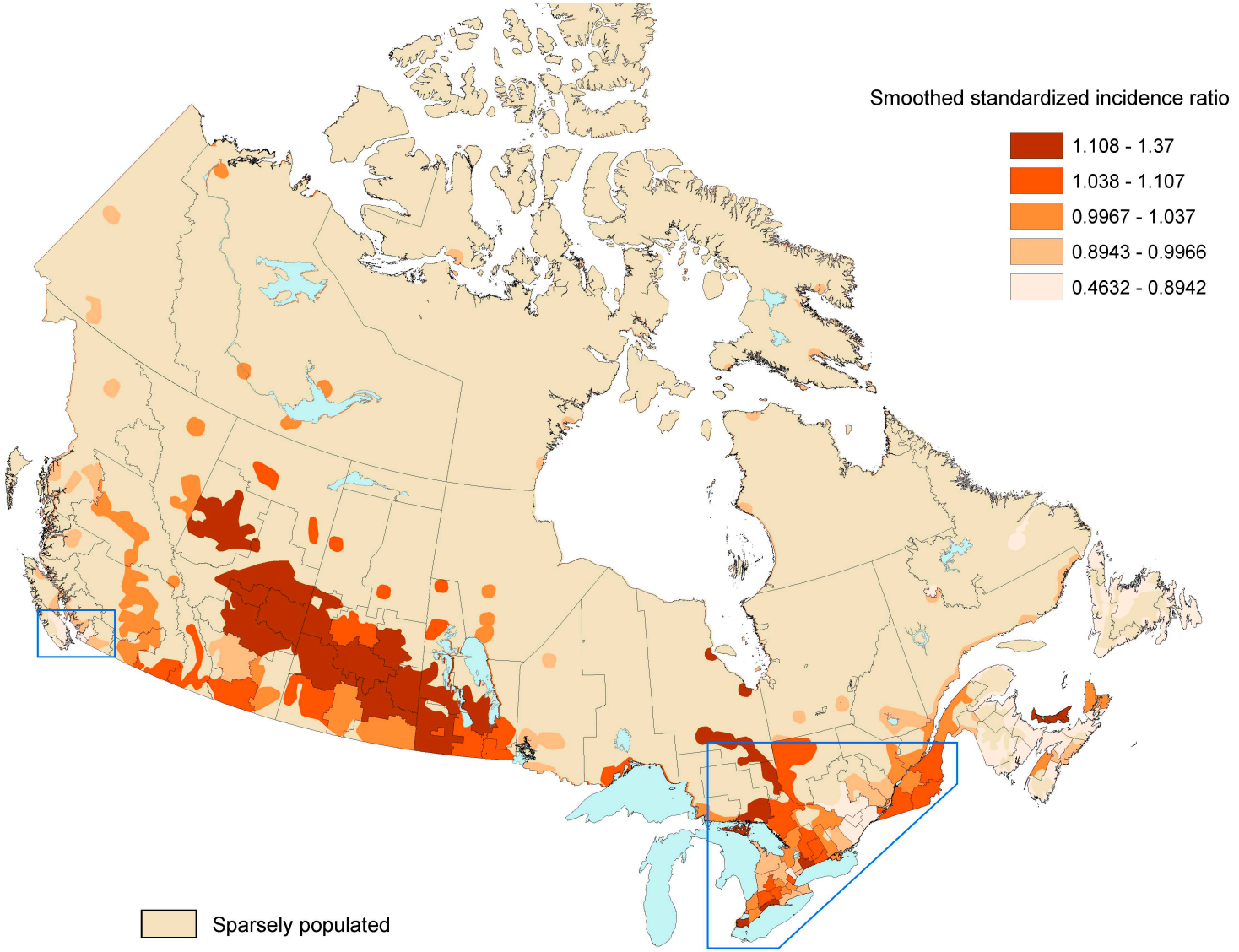
Data source: Canadian Cancer Registry database at Statistics Canada

Map 76-B. Leukemia, females, 2000-2006, all ages



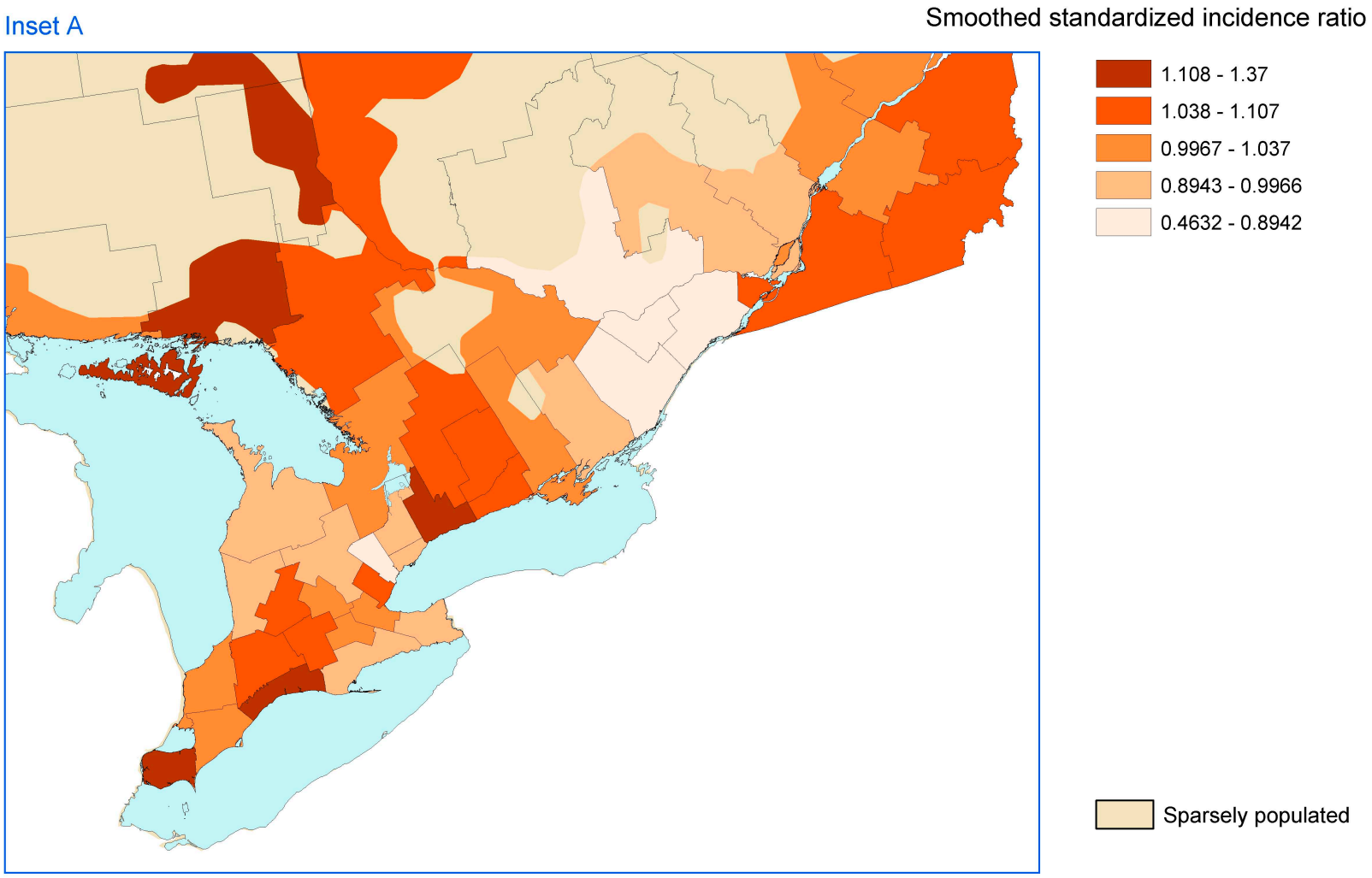
Data source: Canadian Cancer Registry database at Statistics Canada

Map 77. Leukemia, males, 2000-2006, all ages



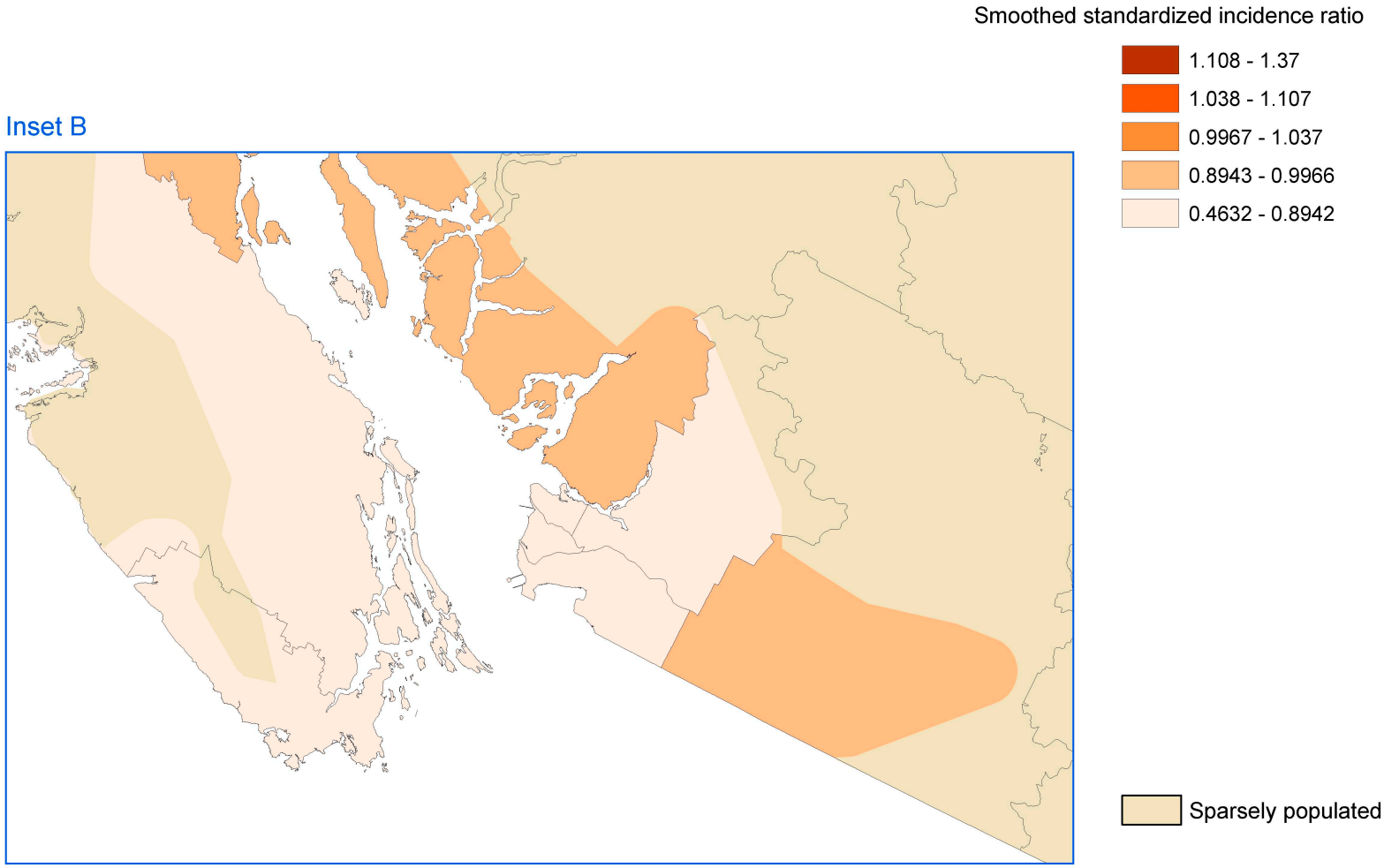
Data source: Canadian Cancer Registry database at Statistics Canada

Map 77-A. Leukemia, males, 2000-2006, all ages



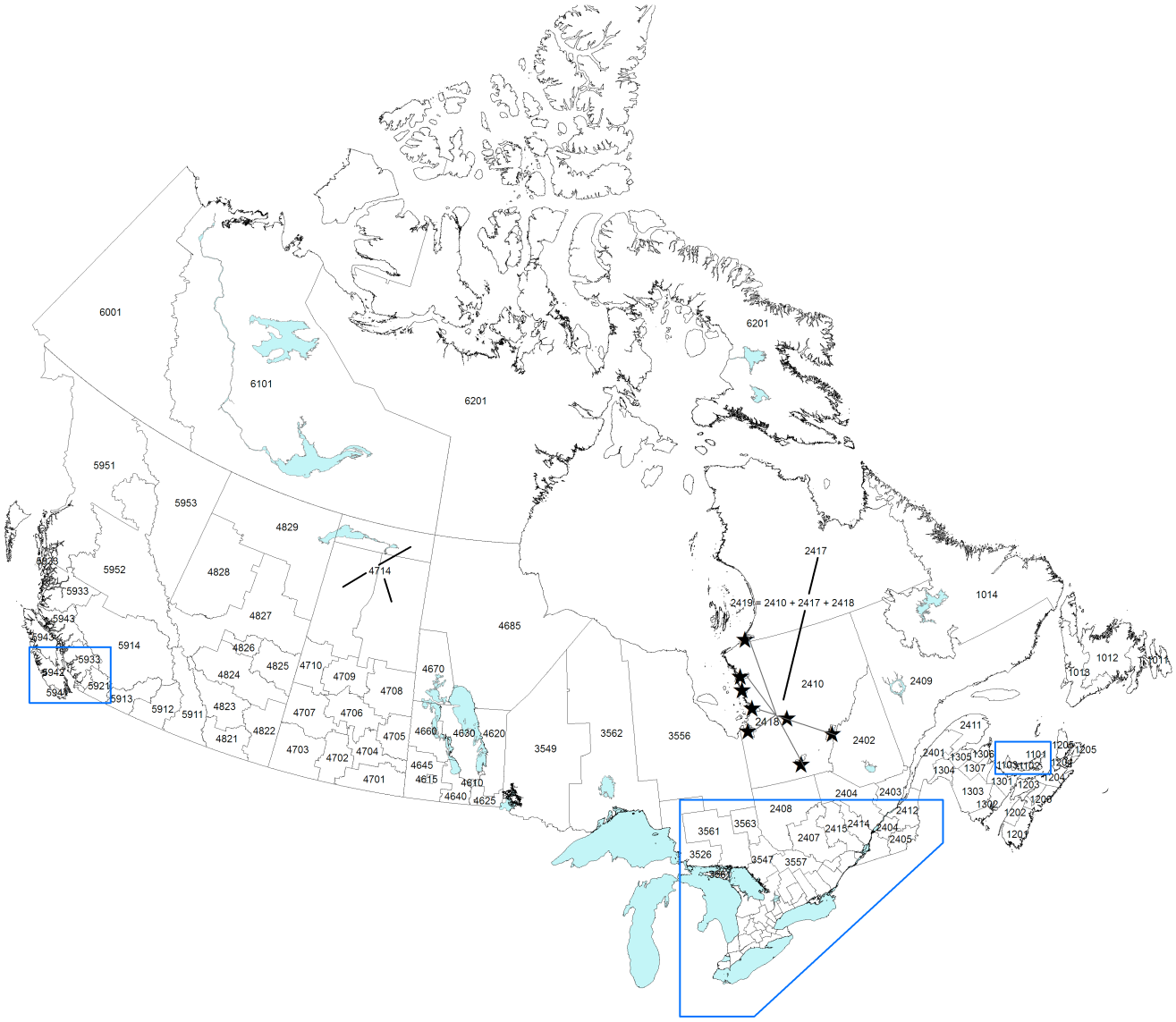
Data source: Canadian Cancer Registry database at Statistics Canada

Map 77-B. Leukemia, males, 2000-2006, all ages



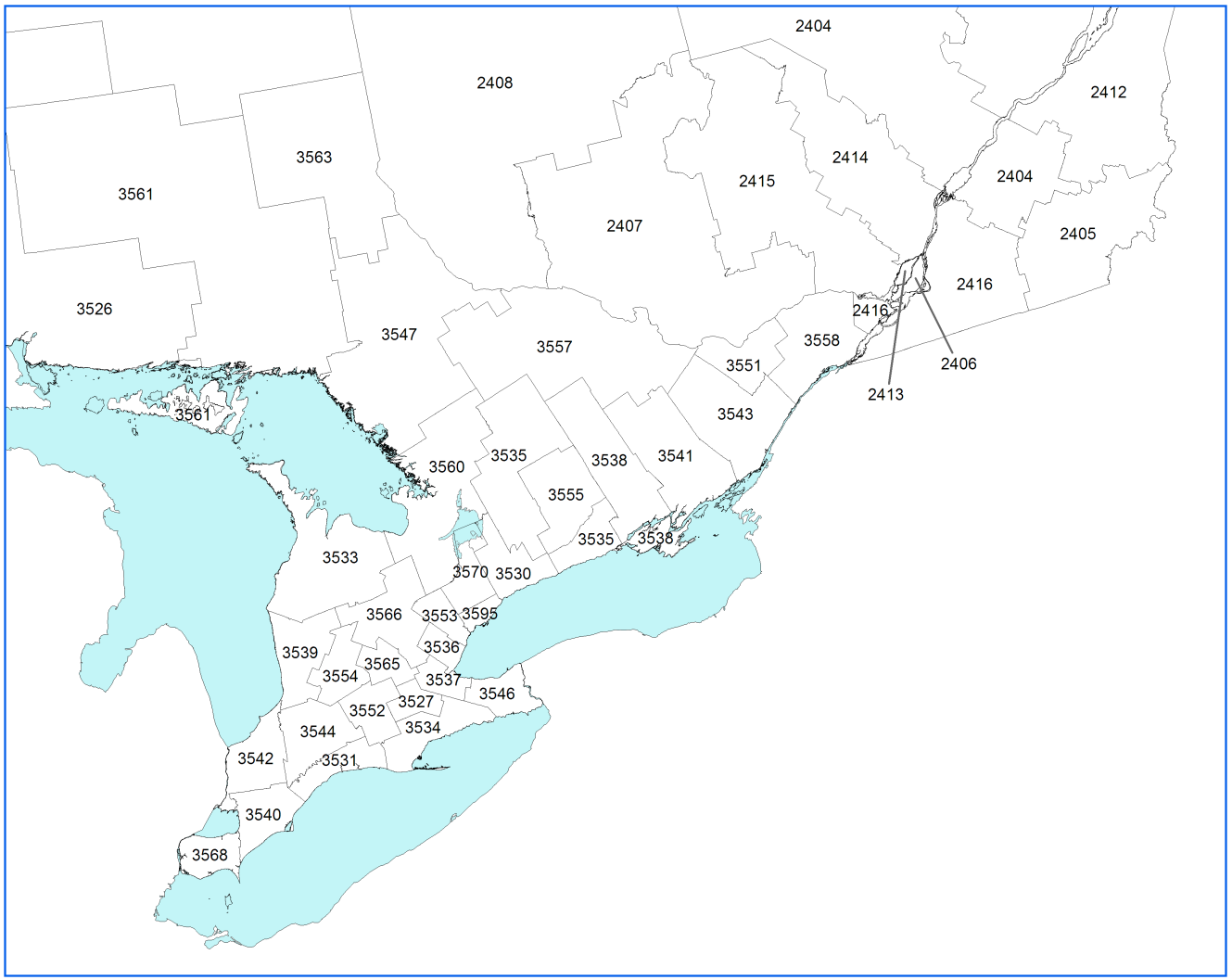
Data source: Canadian Cancer Registry database at Statistics Canada

Map A1. 2007 Health region reference map



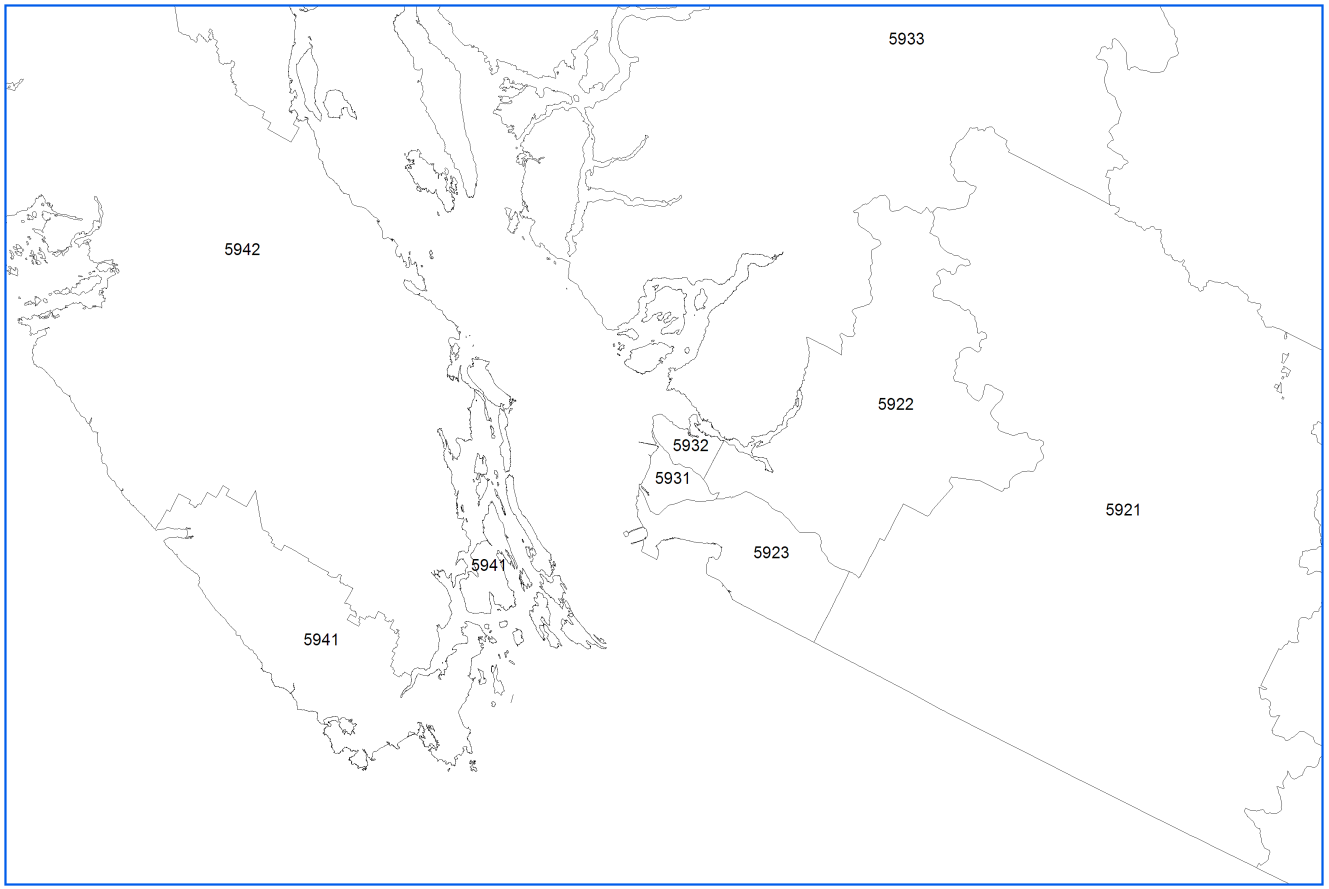
Map A1-A. 2007 Health region reference map southern Ontario and southwestern Quebec

Inset A



Map A1-B. 2007 Health region reference map southern British Columbia

Inset B



Map A1-C. 2007 Health region reference map Prince Edward Island

Inset C