Technical Report

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Funded by the University of Rhode Island Council for Research
Faculty Career Enhancement Program

Executive Summary

A growing body of evidence has demonstrated that place-based factors influence population health and contribute to health disparities. In essence, where one lives plays a substantial role in determining one's health status. Such factors, often referred to as "social determinants of health," have been widely studied in the population health literature, including, but not limited to cancer, chronic disease, and life expectancy. However, comparatively little research has examined more nuanced influences of these locally-based social determinants of health. Health disparities that occur at the neighborhood or community level may be overlooked by traditional research methods. Understanding and addressing potential local health disparities is critical to ensure that municipal services and programs be tailored to meet the needs of the populations they serve, and that all people have access to them.

Accordingly, life expectancy (LE) in Rhode Island has only previously been calculated on the state and county levels, and not on a more fine geographic scale, which may mask local disparities. Therefore, the study examined population health in Rhode Island on the local level through (1.) estimation of LE for each Rhode Island municipality, and (2.) determining the potential for social determinants of health, such as education, wealth, crime, environmental factors, and housing, to be associated with LE.

The study was conducted in three distinct, sequential phases.

Phase 1: We obtained exhaustive data on all deaths that occurred in Rhode Island for 2009-2011 from the Rhode Island Department of Health. Each death was geocoded to the municipality of residence and by 5-year age group. Using traditional life table methods, LE was calculated for each city and town both at birth and at age 65.

Phase 2: We created maps of all LE data obtained in Phase 1 and disseminate both calculated life expectancy and maps to interested parties, including the public.

Phase 3: We combined the LE data with an extensive array of social determinants of health. We used correlational models and generalized linear modeling to assess predictors of life expectancy in Rhode Island.

We then disseminated these findings through the website, abstracts to be presented at international conferences (e.g. the American Public Health Association), and manuscripts for potential publication in peer-reviewed public health journals.

Our research team consists of experts in public health demography, social determinants of health, epidemiology, and health promotion, as well as database experts with connections to the Rhode Island Department of Health and experts in web design. We anticipate that the deliverables of this project will be immediately useful to health researchers, and practitioners, policymakers as well as the general public.

Introduction

Place matters when describing population health. In the United States and many other nations across the globe, evidence suggests that one's place of residence plays a substantial role in determining one's health status. As a result, health disparities based on geography can and do occur. Among the multitude of studies that have demonstrated geographic health disparities, examples include, but are not limited to, cancer [1], physical activity and obesity [2], and health care quality and access [3-5].

Understanding and addressing the causes of place-based health disparities have focused primarily on social determinants of health on a large geographic level, such as the region, state, or county [6]. However, there has recently been a growing interest in drilling down to the local level and assessing smaller geographic areas to assess the influence of local place-based neighborhood and municipality characteristics of neighborhoods. Policies, demographics, and economic conditions on the local level may affect availability and quality of resources, community development, and economic opportunities [7]. A growing body of research [8-15] suggests that understanding how small-area social determinants, including education, wealth, crime, environmental factors, housing, and numerous others, influence population health is critical to reducing often sizeable health disparities that often occur within these small geographic areas.

To that end, life expectancy (LE) is a widely used summary measure of population health representing the average lifespan based on current death rates, and provides a global picture of population health. Differences in LE by place in the United States are substantial and have only worsened over time [16]. Consider, for example, the case of the US county with the lowest LE (Oglala Lakota County in South Dakota, 66.8 years) and the county with the highest LE (Summit County in Colorado, 86.8 years). That stark difference in LE in just a 400-mile stretch is nearly equivalent to the difference in LE between women in Ethiopia (66.7 years) and Japan (86.8)

There is growing research highlighting the utility of LE to summarize population health and highlight health disparities, as well as the understanding that health disparities occur at fine geographic levels, such as the municipality, census tract, and neighborhood levels [17-21]. These differences may be masked when LE and other health metrics are calculated on a larger scale, such as the county or state level. However, no studies to date that have (1) quantified LE in Rhode Island by city and town, and (2) systematically assessed potential associations between LE and social determinants on a fine geographic level. To that end, the study aims were to:

1. Estimate LE in all Rhode Island communities.
2. Create user-friendly maps and reports of LE
3. Assess associations between LE and social determinants of health and examine potential outliers in these associations.
    a. Compare and contrast life expectancy LE at birth with remaining LE at older ages to assess how health inequities among RI communities change over the lifespan.
4. Disseminate all study findings through reports, publications, and a web-based interface, and begin work on future proposals to scale the work nationally

Significance and novelty

We hope that the findings of this study will help inform policies, programs, and interventions designed to reduce health inequities in Rhode Island and promote population health for all Rhode Islanders, regardless of geographic location. Furthermore, the methodology used and study findings could be translatable to other geographic regions in the US and beyond.

This project is potentially **significant** because it advances our understanding of local effects on LE and utilizes a multidisciplinary approach (e.g. statistical, demographic, epidemiologic, and “big data”) to accomplish the study objectives. This project is also potentially **novel** because it Is the first study to integrate two growing areas of research (use of life expectancy at the local level and local, place-based social determinants) and provides new practical tools (maps and database download tools) for the Rhode Island state government as well as to the general public to use to gain insights in population health and potential upstream causes of health disparities.

Methods

Phase 1: Life Expectancy and Mortality Estimation

We obtained de-identified death records from the Rhode Island Department of Health (RI DoH) vital statistics geocoded to RI city/town ("municipality") for the years 2009-2011. We summed those deaths to create tables of total deaths for each Rhode Island municipality by 5-year age groups for the years 2009-2011. We then paired these data with detailed population counts for those corresponding 5-year age groups for each Rhode Island municipality to obtain age-specific death rates. From these, we calculated LE at birth and at age 65 and associated standard errors and 95% confidence intervals for each municipality. In the process, we created rules and documented methods for managing data anomalies such as zero death counts other aberrations, in accordance with past small-area LE projects the PI has managed [21]. In 13% of the cells, there were zero death counts. In those cases, we applied the state age-specific death rate to the calculation of LE. Therefore, the calculated LEs for those municipalities may be slightly biased toward the mean LE. We also calculated age-standardized mortality rates (ASMRs) for each RI municipality using those age-specific death rates.

Phase 2: Mapping Life Expectancy and Social Determinants

We obtained and downloaded shapefiles that are used in mapping. Using geographic information systems (GIS) software (i.e. ArcGIS version 10.1, Redlands, WA), we created detailed maps of LE at birth and at other ages (e.g. 65) for all Rhode Island cities and towns using a color gradient. Maps were made available via the project website and may be immediately usable by researchers, practitioners, and government officials to use as needed. We also obtained a set of over 50 social determinants of health for all Rhode Island cities and towns and made corresponding maps for the key social determinants for all RI municipalities.

Phase 3: Associations between Social Determinants and Life Expectancy

We conducted a detailed analysis designed to determine which small area factors are predictive of LE in Rhode Island municipalities. After obtaining a vast array of established social determinants of health from the latest (2010) US Census and American Community Survey, we obtained other related data on environmental factors, occupational factors, and other sociodemographic characteristics from other sources (e.g. RI Kids Count, Youth Risk Behavior Surveillance System, etc.) to create a large database of social determinants. These included, but were not limited to, education, income, poverty, green space, crime, etc. We used Pearson and Spearman correlation and linear regression to estimate associations and determine which factors are most predictive of LE. IBM SPSS version 24 (Armonk, NY) and SAS version 9.4 (Cary, NC) were used for all data management and analysis. SPSS and Microsoft Excel were used for graphing, where needed.

Key Results

Phase 1: Life Expectancy and Mortality Estimation (Table 1)

Life Expectancy

- The highest LE was found in Barrington (83.13 years).
- The lowest LE was found in Woonsocket (75.85 years).
- The median LE was found in North Providence (79.91 years).
- The highest remaining LE at age 65 was in New Shoreham (21.92 years).
- The lowest remaining LE at age 65 was in Richmond (17.59 years).

Age-Standardized Mortality Rate (ASMR)

- ASMR ranged from 722.01 per 100,000 in Barrington to 1127.58 per 100,000 in Woonsocket.
- Although New Shoreham had the second-lowest overall LE (76.76), it ranked 19th out of 39 cities and towns for ASMR (897.65 per 100,000)

Phase 2: Mapping Life Expectancy and Social Determinants

All maps for the three population health measures (LE at birth, LE at age 65, ASMR, and key social determinants can be found in the Maps section at the end of this document. (See Maps 1–56.)

Phase 3: Associations between Social Determinants and Life Expectancy

Table 2 shows the Pearson correlation coefficients of each social determinant and each of the three population health measures: LE at birth, LE at age 65, and ASMR. Social determinants are grouped by category (e.g. education, retirement, etc.). Within each category, the social determinants are sorted based on strength of the correlation (lowest to highest), and color-coded to represent the strength and direction of the association between the social determinant and LE at birth. Red and pink cells indicate negative correlations, while blue cells indicate positive correlations. Statistically significant associations ($p < 0.05$) are shown in boldface.

Education

- All education variables were significantly associated ($p < 0.05$) with LE at birth and ASMR.
- LE at age 65 was associated with both the percentage of adults with a bachelor's degree or higher ($r = 0.512$) and percentage with a graduate degree ($r = 0.467$).

Economic

- LE at birth was associated with all six economic variables, except for median home value.

- LE at age 65 was associated with median home value, median rent, and mean household income, and negatively associated with percentage on public assistance.
- ASMR was associated with percentage on public assistance, poverty rate, median rend, and mean household income, but not with unemployment or median home value.

Demographics

- None of the race/ethnicity variables were significantly correlated with any of the three population health outcomes (LE at birth, LE at age 65, and ASMR)
- Percent of the population age 65+ was associated with all three population health measures.

Crime

- All ten crime rates were significantly associated with LE at birth.
- Nine of ten crime rates were significantly associated with ASMR (all except murder).
- None of the crime rates were associated with LE at age 65.

Environment and Recreation

- Fast food and convenience stores per square mile was negatively associated with LE at birth (r = -0.348).
- No other environmental and recreational variables were associated with LE at birth, LE at age 65, or ASMR.

Housing

- Housing density was associated with LE at birth and ASMR, but not with LE at age 65. LE at birth was higher in areas of lower housing density.
- People per housing unit was negatively associated with LE at age 65 (r = -0.439).
- Increasing index of dissimilarity was associated with higher LE at birth (r = 0.575), higher LE at age 65 (r = 0.432), and lower ASMR (r = -0.574).

Retirement

- None of the five retirement variables examined were associated with any of the three population health measures.

Discussion

Within the 39 cities and towns in Rhode Island, there were some fairly substantial differences in life expectancy, both at birth and at age 65, and mortality. It should be noted that although there is a nearly eight-year gap between the municipality with the lowest life expectancy (Woonsocket, 75.85 years) and the highest life expectancy (Barrington, 83.13 years), Rhode Island, in general, performs substantially better than most other states in the US. The City of Woonsocket, despite having the lowest LE at birth in Rhode Island, has a LE at birth that is higher than nearly a quarter (23%) of all US counties [22]. Rhode Island itself has one of the highest state LEs in the country (79.58 in 2010).

Overall, education and crime were two categories of social determinants that were the strongest predictors of LE and ASMR. All crime rates were associated with LE at birth and most were associated with ASMR. Other factors associated with LE at birth and ASMR included housing density, density of fast food outlets and convenience stores, income and poverty measures, and some household composition measures (e.g. percent of households with married couples and percent of female-headed households with female only). Generally speaking, for most of the associations observed, the magnitude of the associations were weaker and more attenuated for LE at age 65 compared to those for LE at birth and ASMR. It should be emphasized that none of the race/ethnicity variables, such as percent White, percent Black, etc. were associated with any of the three population health measures.

It is interesting to note that the index of dissimilarity, which measures racial segregation, was positively associated with LE at birth and age 65, and negatively associated with ASMR. This means, essentially, that the more segregated the community, the better the health outcomes were. Clearly this paradoxical finding requires further research, as it contradicts a substantial body of evidence demonstrating that higher segregation leads to worse population health outcomes [23-28]. That said, there is some suggestive findings of studies of income inequality that have suggested that in small geographic areas, higher income inequality is associated with better health and reduced mortality [29,30]. The potential mechanisms for this are largely unknown and require further investigation.

These findings highlight the potential for certain social determinants to be important predictors of population health on the municipality level. Furthermore, these findings, though exploratory, suggest that population health could be potentially improved and disparities reduced by improving the social, economic, and educational characteristics of communities. Public health programs can be tailored to local communities and neighborhoods, providing more effective care to the population. By looking at these factors on a smaller scale, discrepancies in social determinants of health can be attributed to life expectancy in targeted populations. This allows municipalities and neighborhoods to focus their policy strategies in areas where they will be most effective.

Limitations

The findings of this exploratory project should be interpreted with important limitations in mind. These include, but are not limited to:

- Small-area LE calculations are subject to substantial error [21,31,32].
- Many of the cells used to calculate LE contained a death count of zero. When this occurred, we used the state age-specific death rates as substitutes, which would bias the results toward the mean. Similar methods were used for calculation of ASMRs.
- Minor changes in the number of deaths, particularly for cities and towns with low death counts in the younger ages, can have a sizeable impact on the calculation of LE and ASMR.
- The LE and ASMR calculations and social determinants data are somewhat old. We estimated LE using death data from 2009 to 2011 and matched it with US Census data from the most recent decennial census, which was conducted in 2010.
- Likewise, the social determinants data were primarily from the years 2010-2014 in order to temporally match with the LE data. However, in some cases, the social determinants data may have been up to five years removed from the LE data.
- There is some missing data for some of the social determinants listed, particularly for crime rates (N = 37 out of 39).
- There are a number of other measurements obtainable through life table analyses that were not used in this study, such as LE at any other five-year age increment and survival to any of the five-year age increments. Such measures could be used in future analyses.
- Although we used a fairly extensive list of social determinants, the list is not exhaustive.
- Much of the analysis presented in this report is bivariate, not multivariate. We did conduct some multivariate analyses, as described in the Methods section (Phase 3). Those findings will be available upon request.
- Correlation is not causation. The analysis we conducted was correlational, and therefore we cannot state that, for example, low education levels "cause" poorer population health. Rather, such conditions may provide the environment and lead to distinct psychological, biological, and/or sociological pathways that promote poorer health outcomes.

Strengths

Despite these and potentially other limitations, this study has several notable strengths. These include, but are not limited to:

- This study is among the first to examine municipal-level social determinants of population health in Rhode Island.
- Although it was not possible to ascertain all desired social determinants of health on the city/town level, the list of determinants used in this study represents a wide breadth of topics and measures.

- As local governance is conducted on the municipal (city/town) level, rather than other levels (e.g. county) in Rhode Island, as well as in many other northeastern states, this geographic unit of analysis is potentially meaningful when creating policies and programs designed to reduce disparities across Rhode Island communities and improve population health.
- The analysis and corresponding website is among the first of its kind to provide comprehensive tools that can be used by policymakers, researchers, and the general public, to become informed about Rhode Island communities.

Data Sources

Data used in this study are drawn from the following sources:

- Rhode Island Department of Health
- Rhode Island DataHUB
- US Census Bureau
- US Federal Bureau of Investigation
- US Environmental Protection Agency
- US News and World Report

Acknowledgements

The research team gratefully acknowledges the following individuals and groups:

- **Karen Markin**- University of Rhode Island
- **Dami OniOrisan**- Rhode Island Department of Health
- **Lori Leonard**- Rhode Island Department of Health
- **Jim O'Neill**- Pixels for Humans
- **Ehi Aimiuwu**- Pixels for Humans

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Tables

Table 1: RI cities/towns, life expectancy (LE), and age-standardized mortality rates (ASMR)

City/Town Name	County	LE at birth	LE at 65	ASMR	Rank LE	Rank LE 65	Rank of ASMR
Barrington	Bristol	83.13	21.34	722.01	1	3	1
Bristol	Bristol	80.94	20.18	852.95	12	15	15
Burrillville	Providence	77.33	18.22	1052.02	37	37	37
Central Falls	Providence	78.26	20.06	970.74	35	19	33
Charlestown	Washington	80.75	20.41	844.02	14	14	13
Coventry	Kent	79.31	18.73	963.18	27	35	32
Cranston	Providence	81.32	20.64	819.72	8	10	9
Cumberland	Providence	81.50	20.79	799.52	5	8	4
East Greenwich	Kent	82.17	20.83	782.78	3	7	3
East Providence	Providence	79.61	19.72	920.91	22	25	25
Exeter	Washington	79.59	20.17	897.68	23	16	20
Foster	Providence	79.14	21.16	813.75	28	4	8
Glocester	Providence	80.09	20.02	848.50	18	22	14
Hopkinton	Washington	78.90	19.70	916.36	30	26	23
Jamestown	Newport	80.83	20.89	893.34	13	6	17
Johnston	Providence	79.40	19.53	939.39	25	30	28
Lincoln	Providence	81.26	20.15	835.33	10	17	12
Little Compton	Newport	81.32	21.02	812.48	8	5	7
Middletown	Newport	80.26	19.66	893.38	17	28	18
Narragansett	Washington	82.00	20.52	799.92	4	13	5
New Shoreham	Washington	76.76	21.92	897.65	38	1	19
Newport	Newport	79.52	19.97	917.56	24	23	24
North Kingstown	Washington	80.34	19.45	945.22	15	31	29
North Providence	Providence	79.91	20.58	872.42	20	12	16
North Smithfield	Providence	79.40	19.67	927.55	25	27	27
Pawtucket	Providence	78.94	19.75	946.90	29	24	30
Portsmouth	Newport	82.93	21.46	727.48	2	2	2
Providence	Providence	78.37	19.38	973.77	34	32	34
Richmond	Washington	78.43	17.59	1072.26	33	39	38
Scituate	Providence	81.43	20.64	807.14	6	10	6
Smithfield	Providence	80.34	19.25	923.54	15	34	26
South Kingstown	Washington	81.34	20.07	833.63	7	18	11
Tiverton	Newport	81.16	20.72	830.02	11	9	10
Warren	Bristol	79.94	20.05	906.42	19	21	22
Warwick	Kent	78.89	19.31	959.59	31	33	31
West Greenwich	Kent	78.65	18.44	1029.60	32	36	36
West Warwick	Kent	77.79	19.56	985.23	36	29	35
Westerly	Washington	79.64	20.06	901.35	21	19	21
Woonsocket	Providence	75.85	18.19	1127.58	39	38	39

Table 2: Pearson correlations between life expectancy (LE) at birth and age 65 and age-specific mortality rates (ASMR) with key social determinants

	Correlation coefficients		
Education	**LE birth**	**LE 65**	**ASMR**
School district ranking	**-0.635**	-0.283	**0.471**
Percent less than high school	**-0.430**	-0.270	**0.415**
Percent less than 9th grade	**-0.336**	-0.182	**0.322**
Percent with bachelor's degree or higher	**0.614**	**0.512**	**-0.582**
Percent with graduate degree or higher	**0.678**	**0.467**	**-0.596**
Economic	**LE birth**	**LE 65**	**ASMR**
Unemployment rate	**-0.572**	0.117	0.263
Percent on public assistance	**-0.489**	**-0.394**	**0.523**
Poverty rate	**-0.389**	-0.245	**0.418**
Median home value	0.080	**0.527**	-0.293
Median rent	**0.513**	**0.350**	**-0.403**
Mean household income	**0.553**	**0.427**	**-0.533**
Demographics	**LE birth**	**LE 65**	**ASMR**
Percent of female-headed households with female only	**-0.332**	-0.242	0.327
Percent Hispanic/Latino	-0.298	-0.101	0.260
Percent "Other"	-0.291	-0.142	0.264
Percent Black	-0.271	-0.073	0.233
Percent foreign born	-0.236	-0.065	0.221
Percent Asian	-0.167	-0.299	0.252
Percent Multiracial	-0.032	-0.042	0.064
Percent age 16+	0.056	0.254	-0.185
Percent White	0.276	0.156	-0.270
Percent age 65+	**0.330**	**0.493**	**-0.419**
Percent of households with married couples	**0.394**	0.185	-0.352
Crime rates	**LE birth**	**LE 65**	**ASMR**
Forcible rape	**-0.630**	-0.183	**0.498**
Aggravated assault	**-0.619**	-0.072	**0.434**
Violent crime (all)	**-0.598**	-0.117	**0.450**
Burglary	**-0.513**	-0.046	**0.348**
Property crime (all)	**-0.503**	-0.065	**0.387**
Arson	**-0.479**	-0.099	**0.342**
Robbery	**-0.476**	-0.167	**0.411**
Larceny	**-0.421**	-0.038	**0.332**
Murder and non-negligent manslaughter	**-0.411**	-0.102	0.309
Motor vehicle theft	**-0.367**	-0.150	**0.325**

Table 2 (continued)

Environment and recreation	LE birth	LE 65	ASMR
Fast food and convenience stores per sq mi	**-0.348**	-0.118	0.310
Percent of population living near farmers market	-0.086	-0.026	0.019
Number of Superfund sites in city/town	0.064	-0.122	0.001
Percent of land area for public recreation	0.117	0.069	-0.098
Percent of residents in a food desert	0.138	0.207	-0.145
Miles of bike lanes per road mile	0.235	-0.157	-0.065
Housing	**LE birth**	**LE 65**	**ASMR**
Housing density	**-0.395**	-0.159	**0.350**
Population density	-0.312	-0.099	0.281
Median age of houses	-0.238	-0.046	0.185
Percent rural	-0.175	0.056	-0.002
Miles from Providence	-0.073	0.122	-0.049
People per housing unit	0.088	**-0.439**	0.137
Mean commute time	0.207	-0.084	-0.123
Gini index	0.270	0.252	-0.208
Index of dissimilarity	**0.675**	**0.432**	**-0.574**
Retirement	**LE birth**	**LE 65**	**ASMR**
Percent of grandparents who live with grandchildren	-0.229	-0.302	0.233
Percenf of grandparents who are male	-0.106	-0.076	0.053
Percent of households with no parent	-0.046	0.090	0.006
Percent of grandparents in poverty	-0.025	0.038	0.006
Percent of grandparents responsible for their grandchildren	-0.024	0.128	-0.005

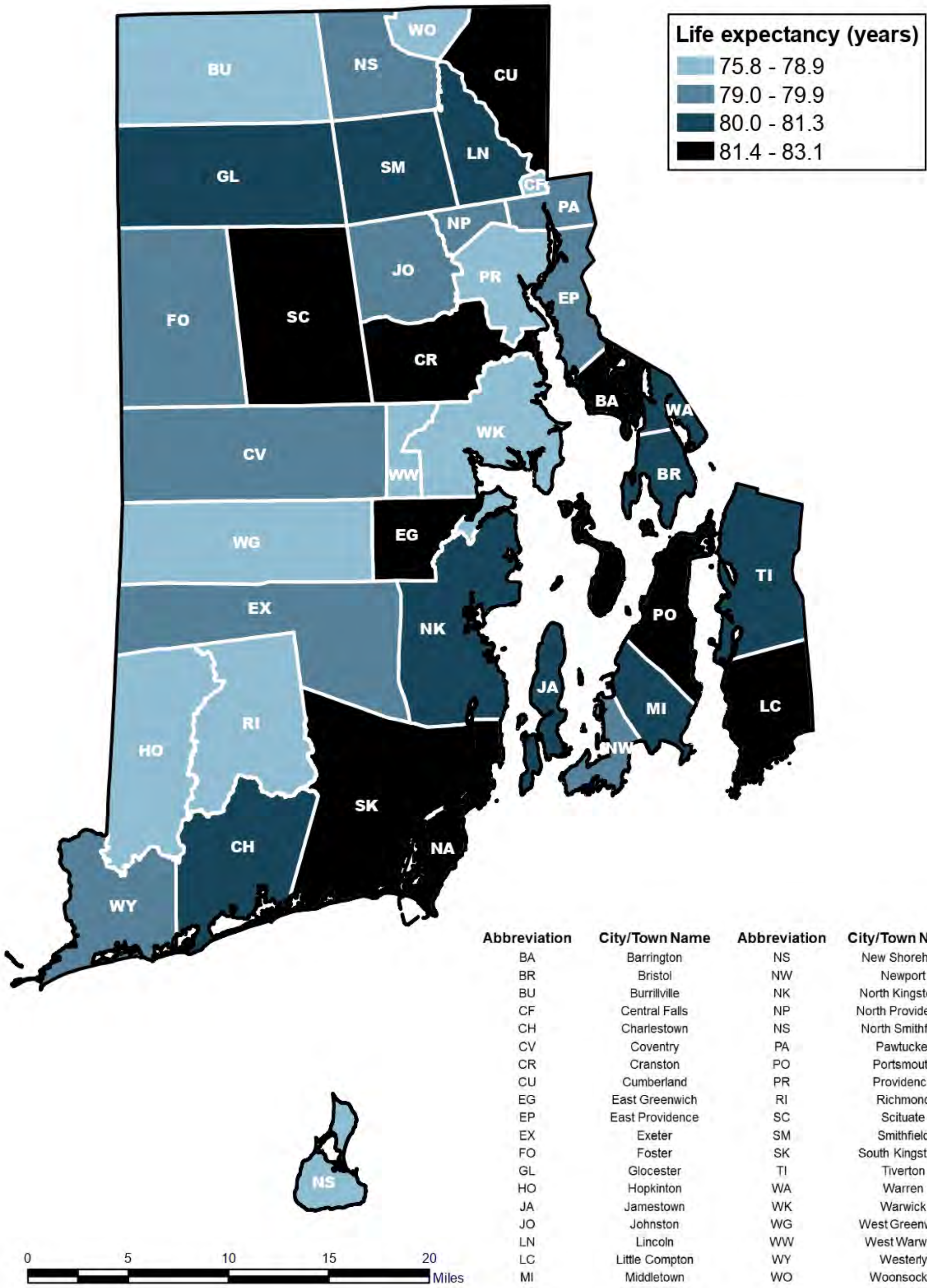
Boldface indicates significant associations ($p < 0.05$)

Red/pink = negative associations, blue = positive associations

Maps

Map 1: Reference map for Rhode Island cities and towns

Map 2: Life expectancy at birth (2011)



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LN	Lincoln	WW	West Warwick
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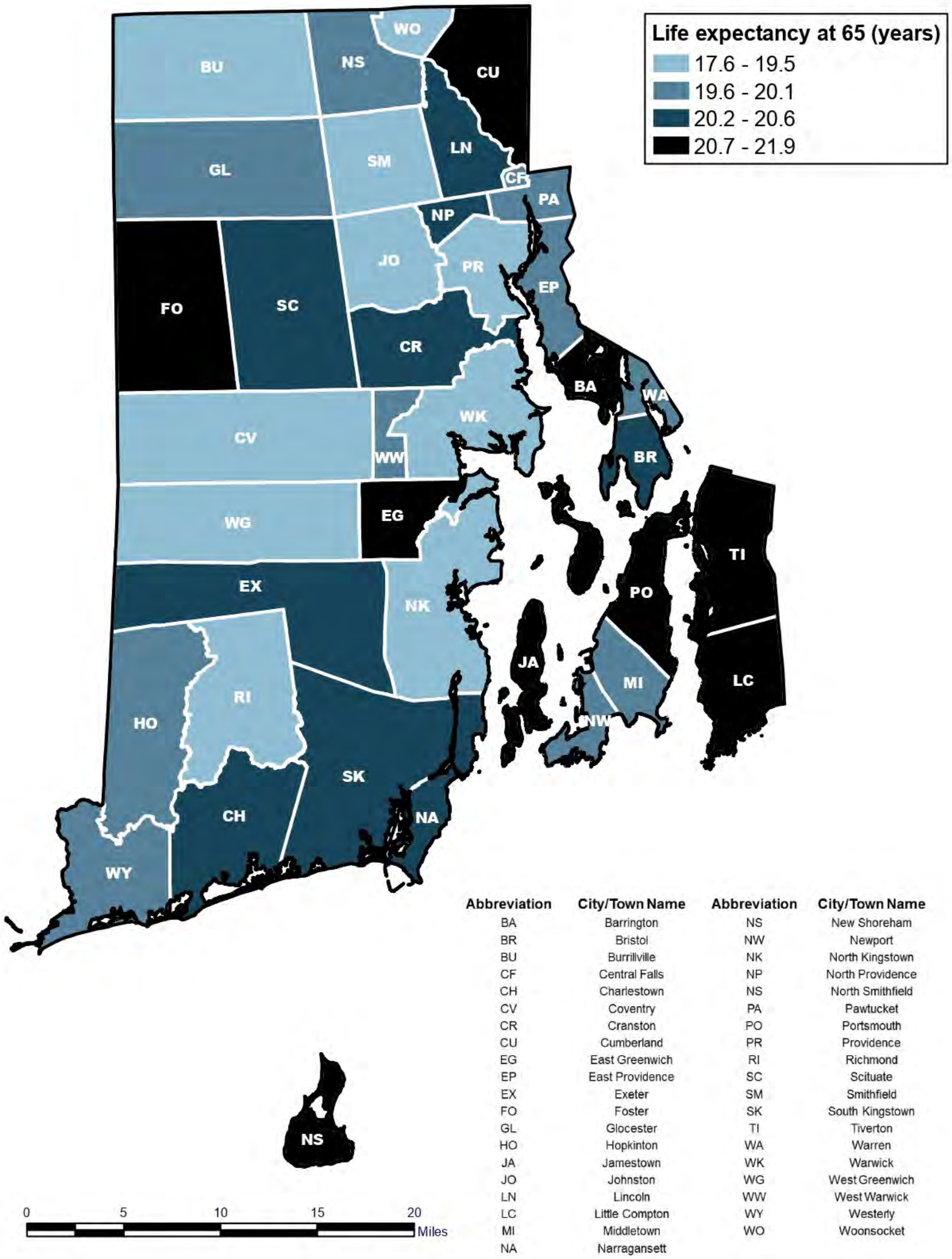
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 3: Life expectancy at age 65 (2011)



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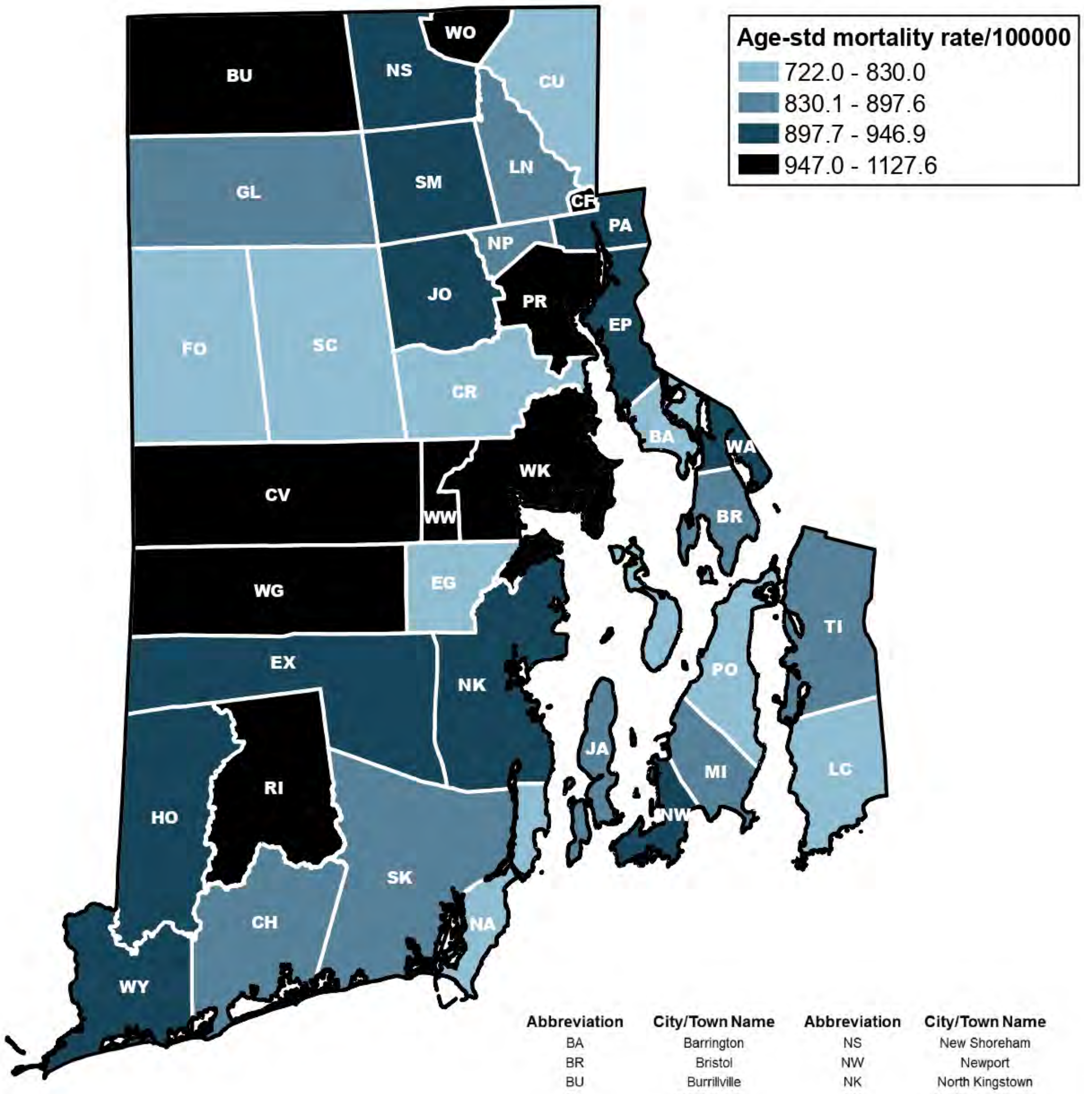
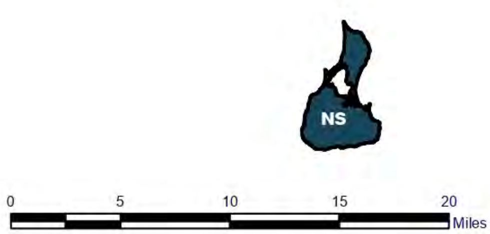
Map 4: Age-standardized mortality rate (ASMR) (2011)





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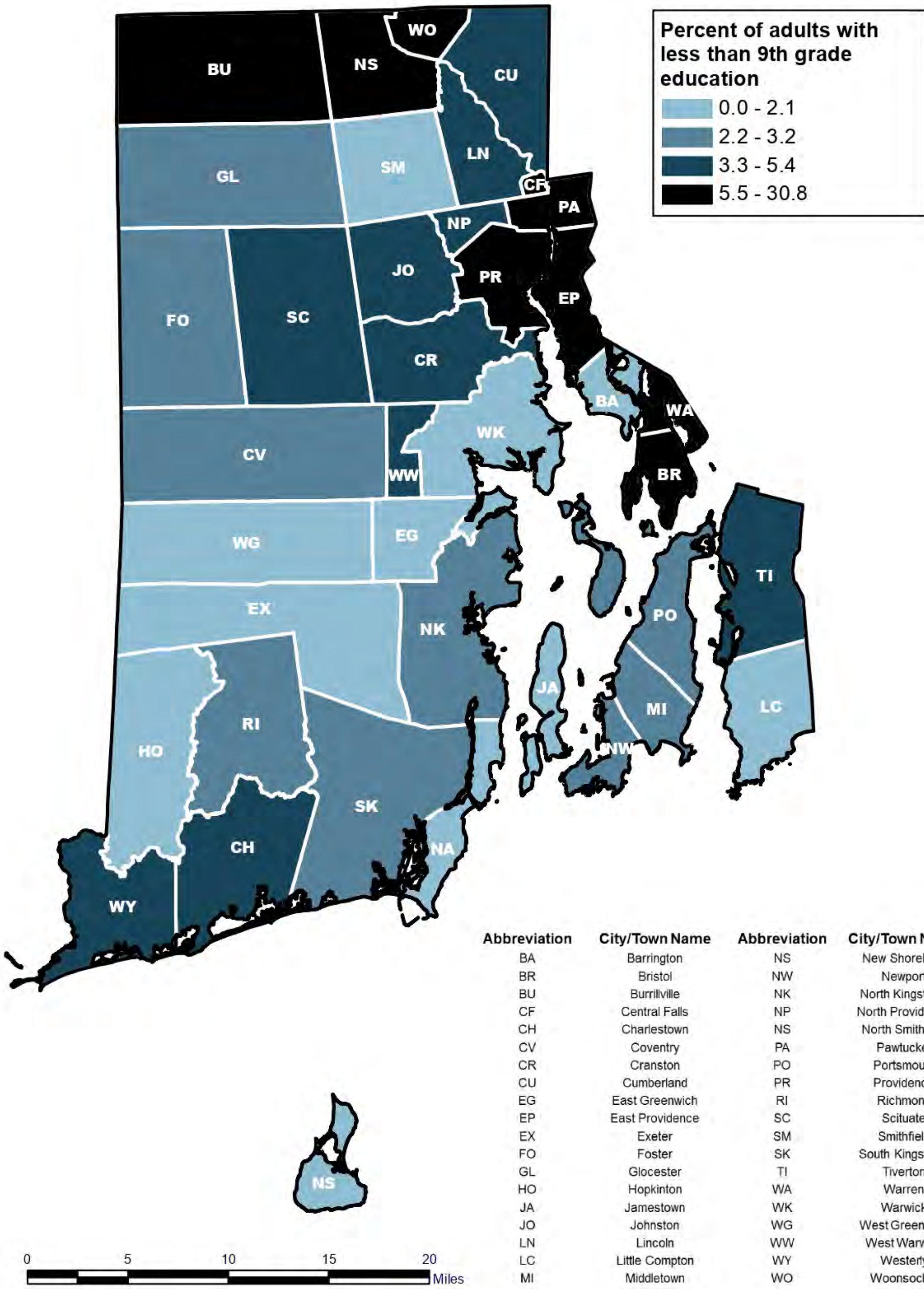
Map 5: Percent of adults with less than a 9th grade education



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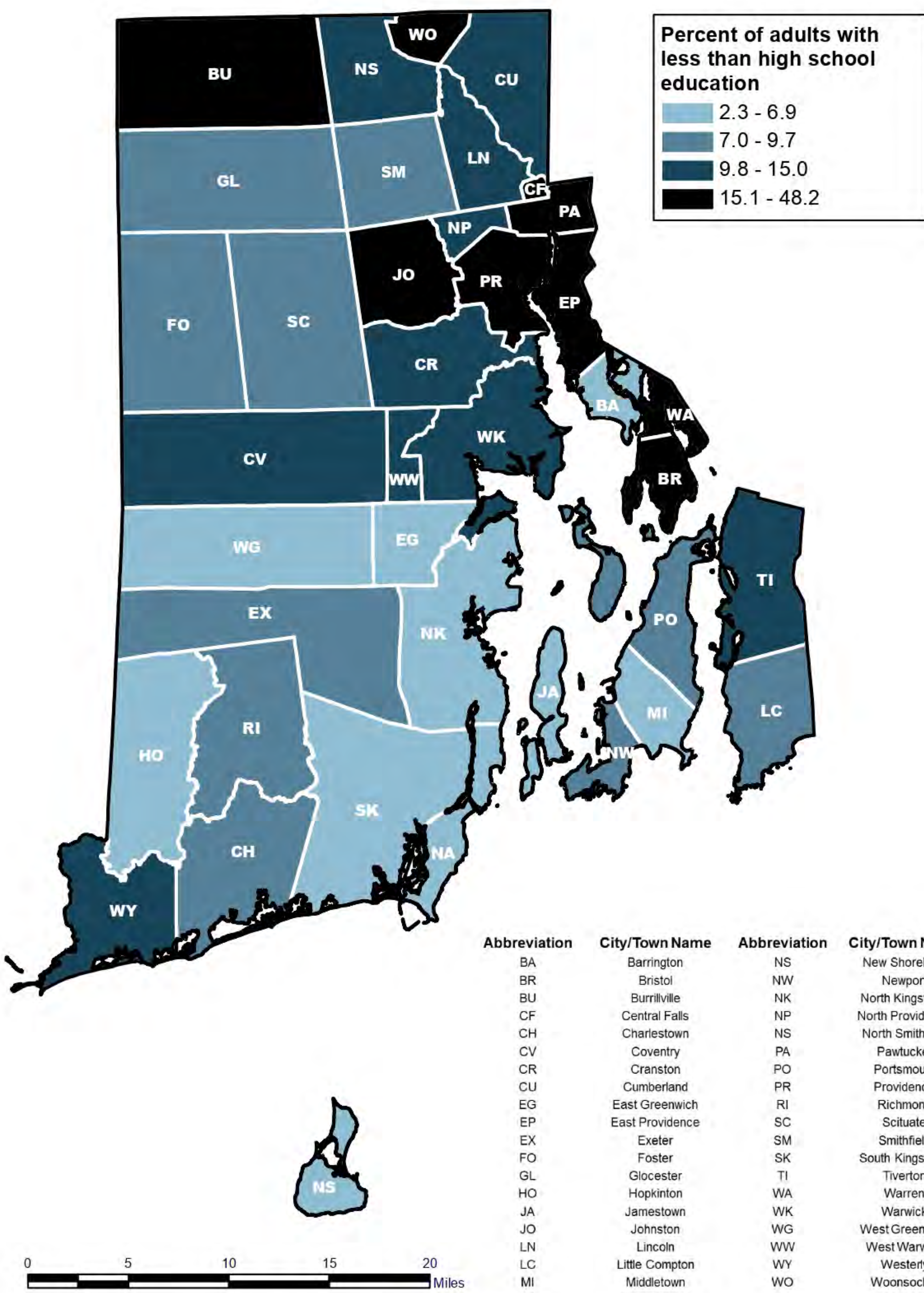
Map 6: Percent of adults with less than a high school education



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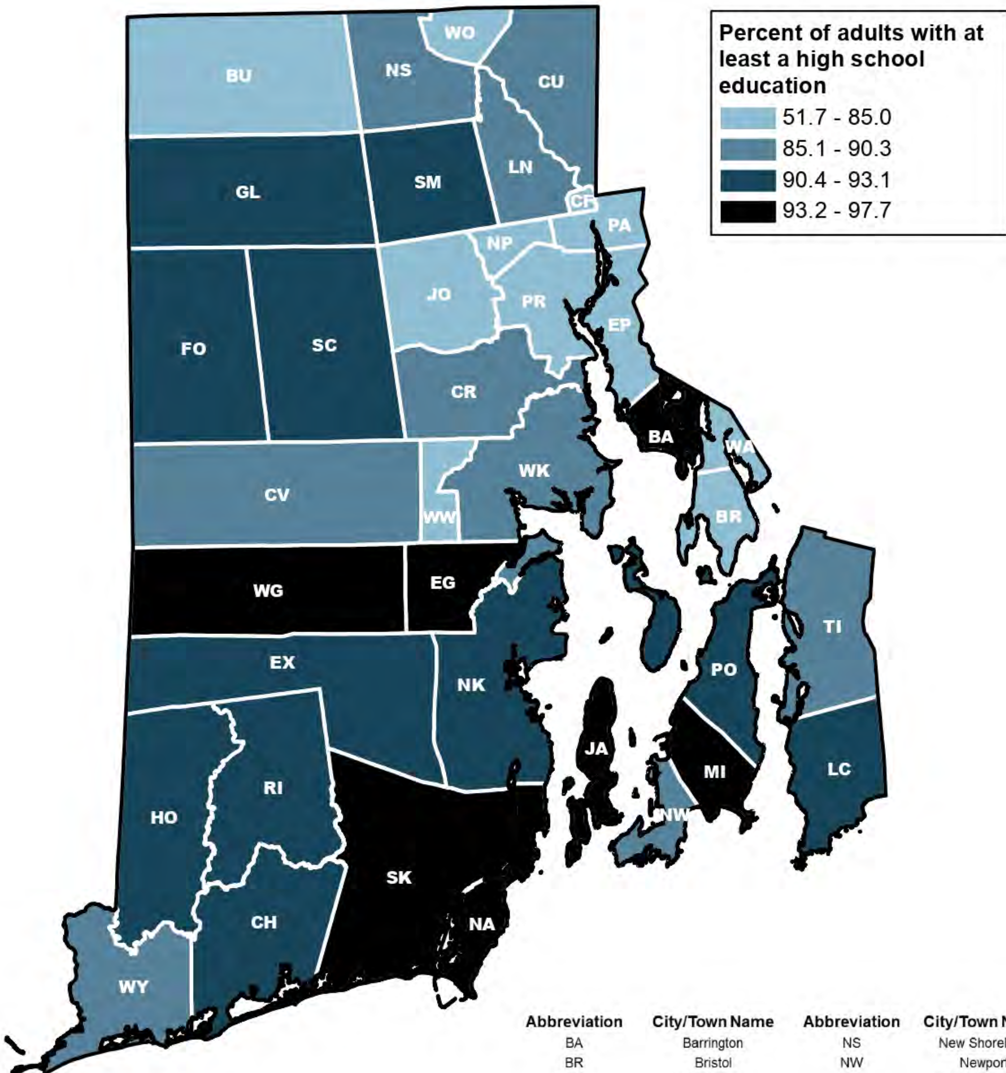
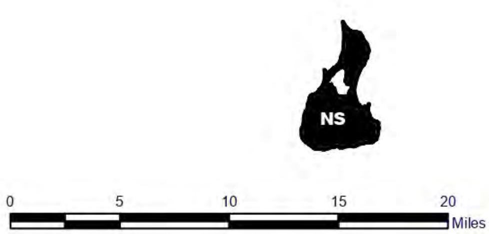
Map 7: Percent of adults with at least a high school education





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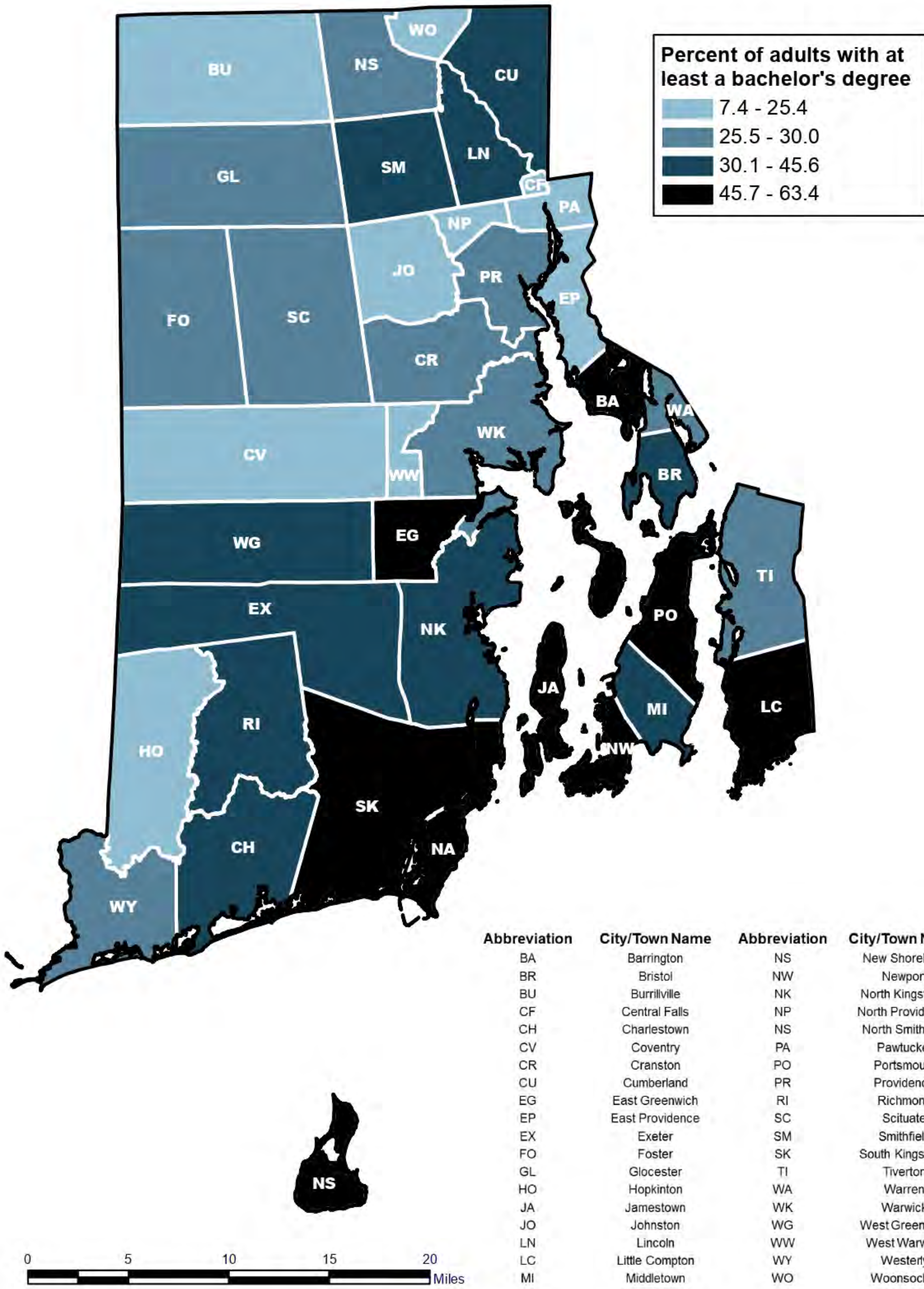
Map 8: Percent of adults with at least a bachelor's degree



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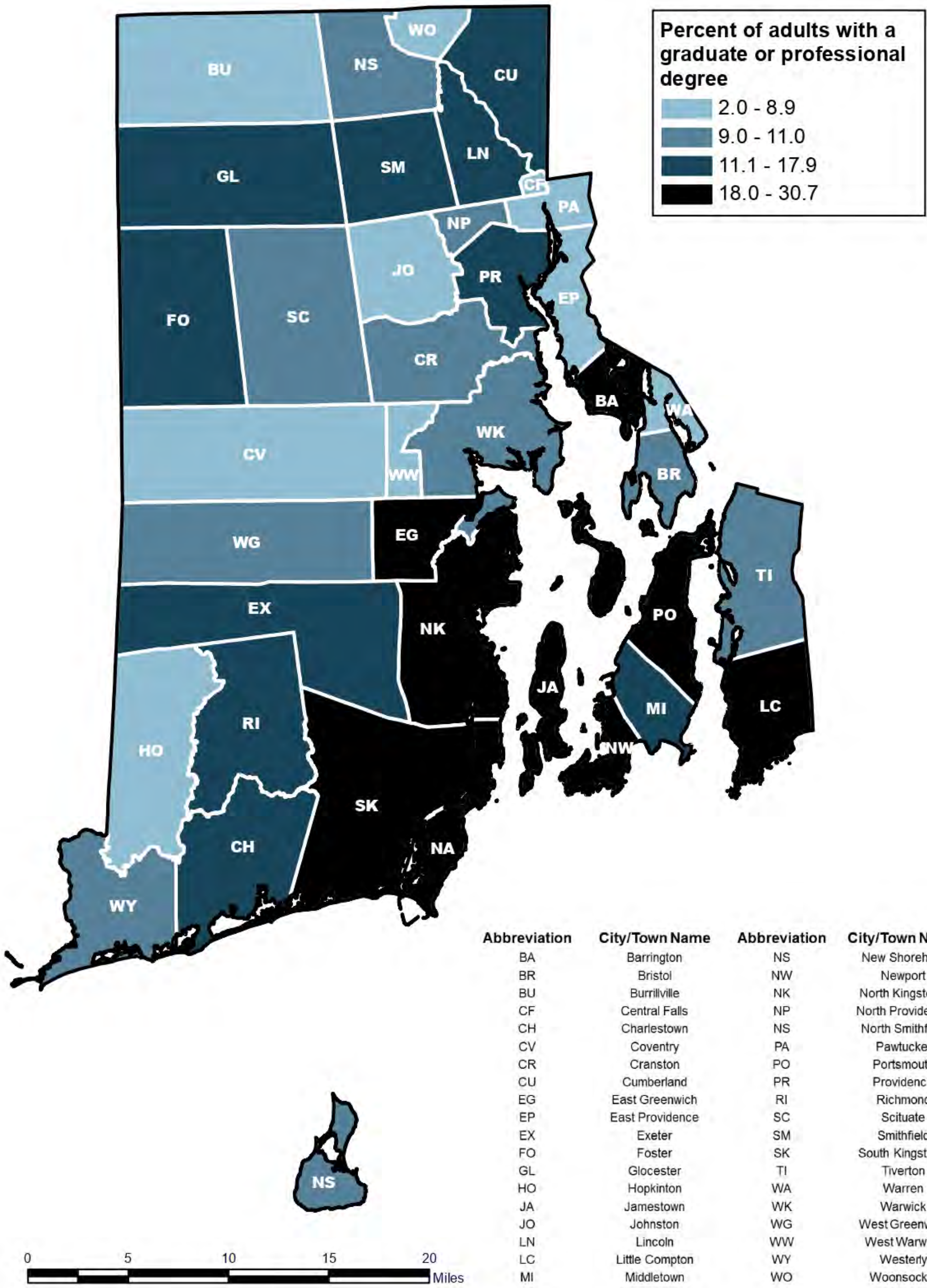
Map 9: Percent of adults with a graduate or professional degree



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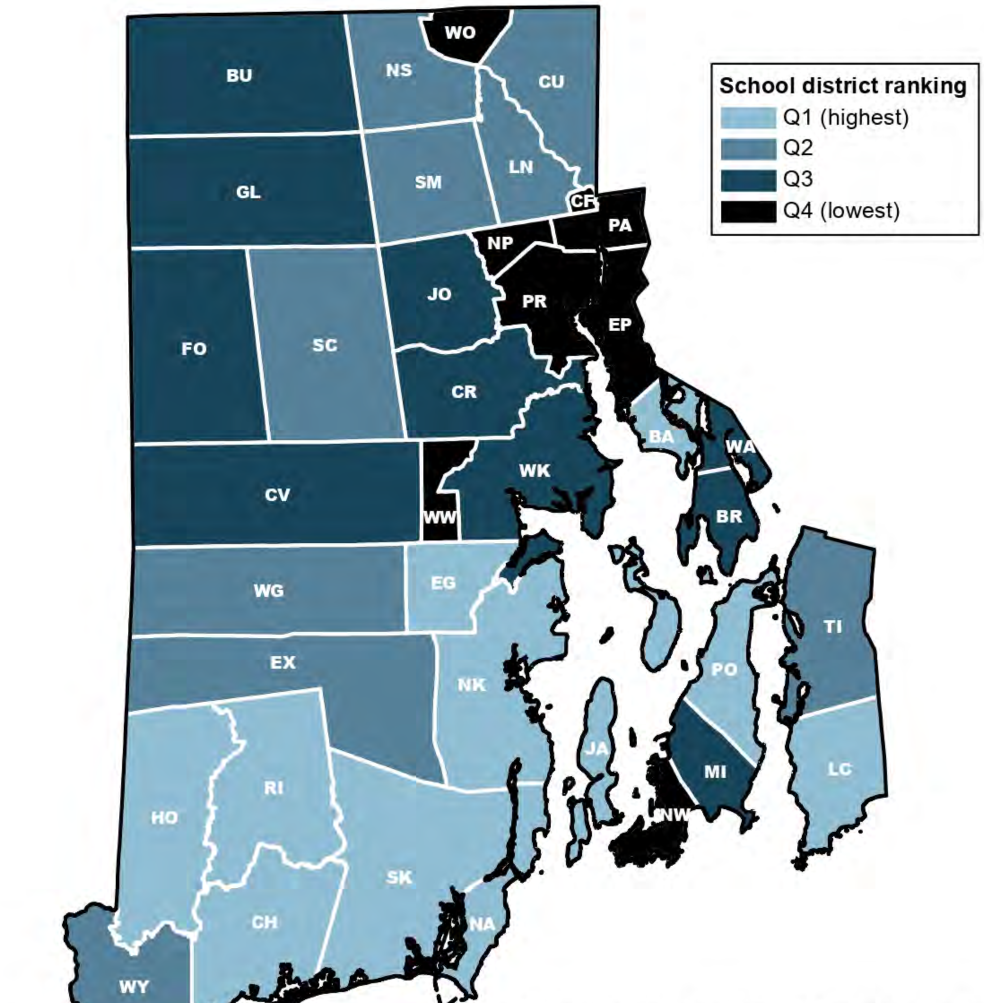
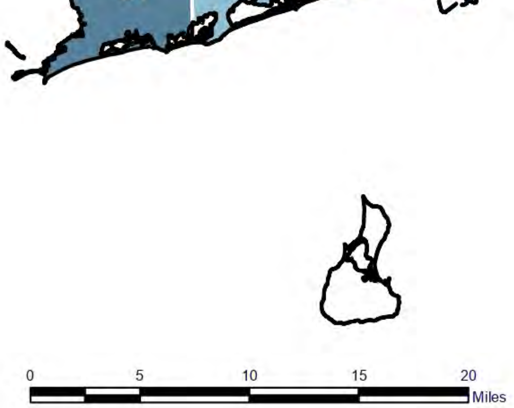
Map 10: School district ranking (quartile)





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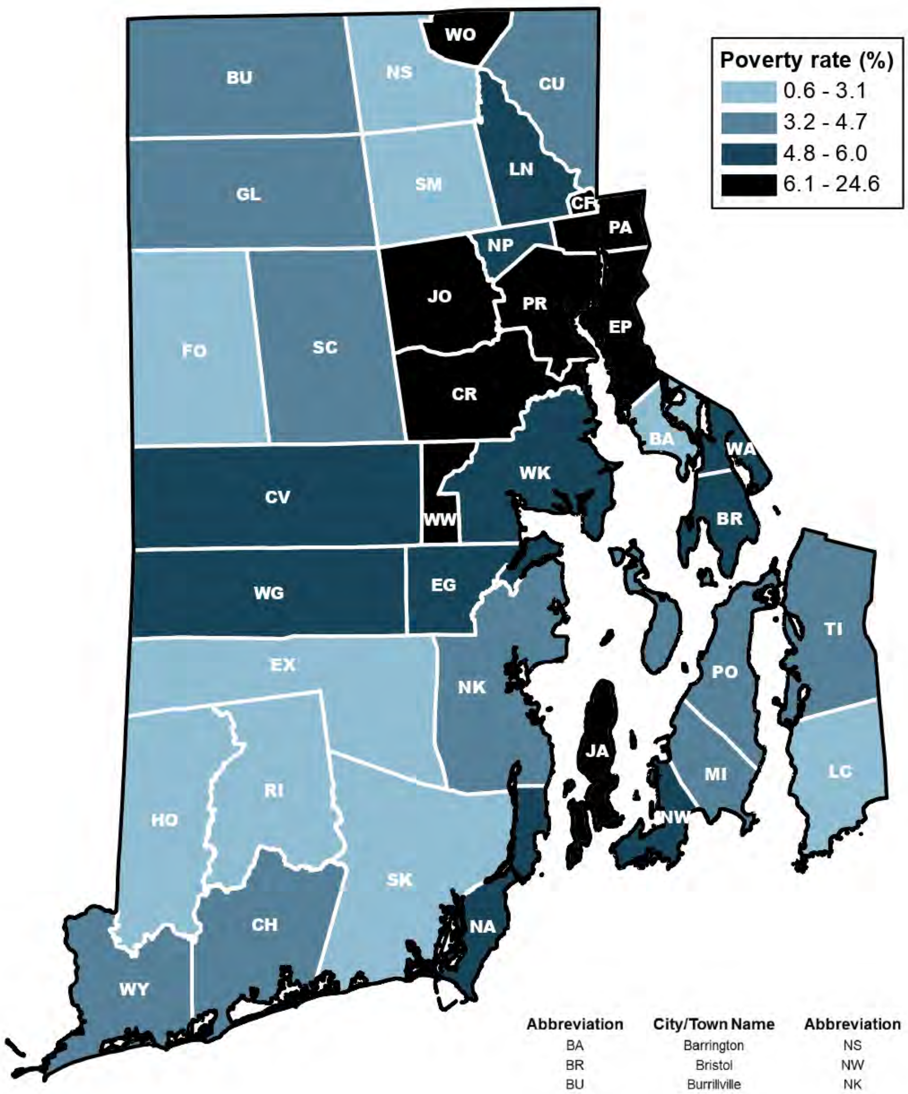
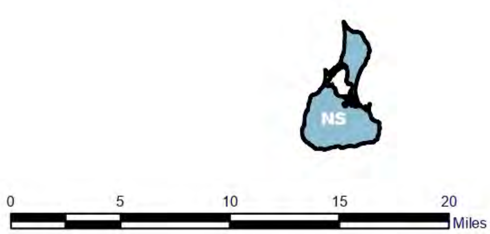
Map 11: Poverty rate





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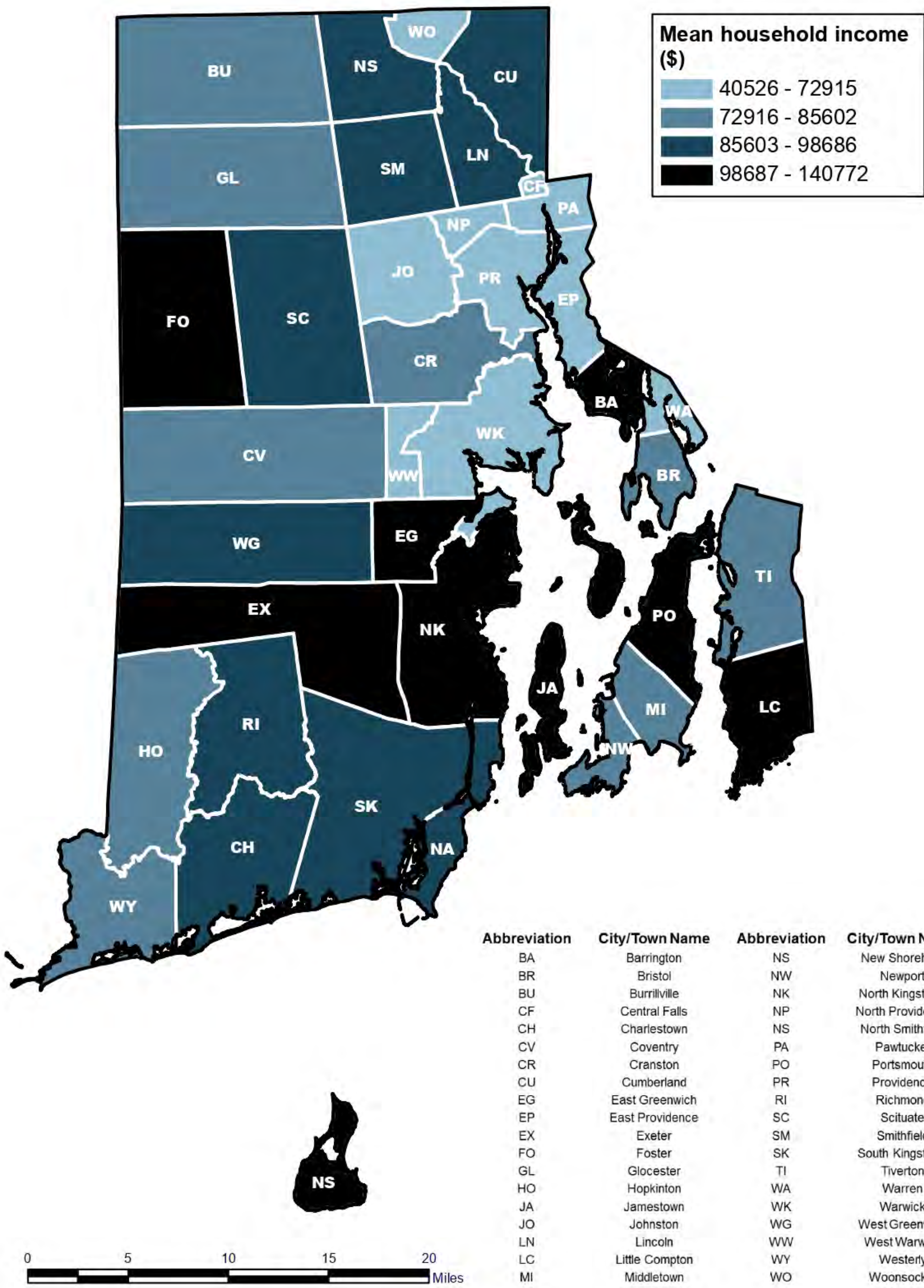
Map 12: Mean household income ($) (2012)



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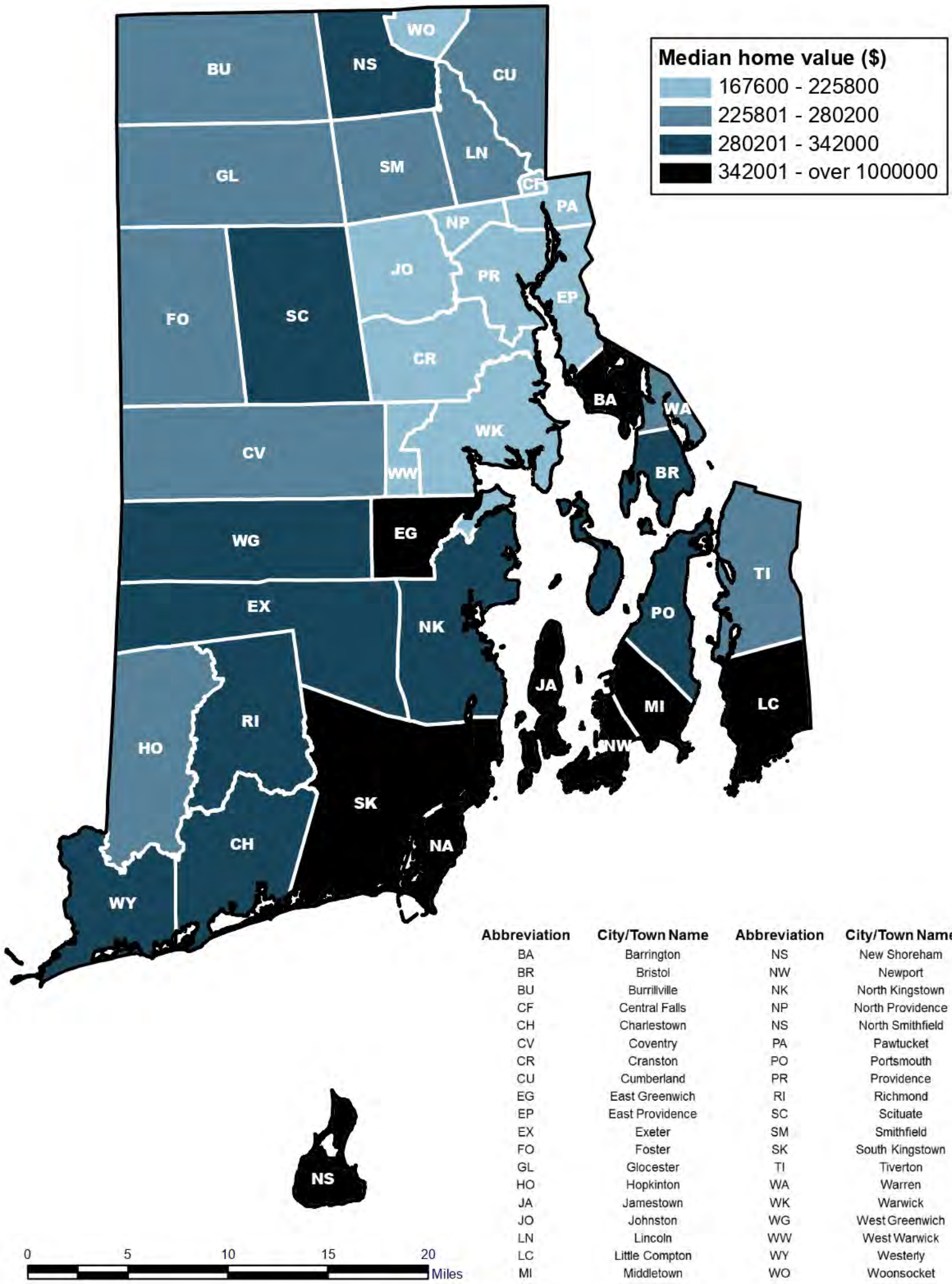
Map 13: Median home value ($) (2012)



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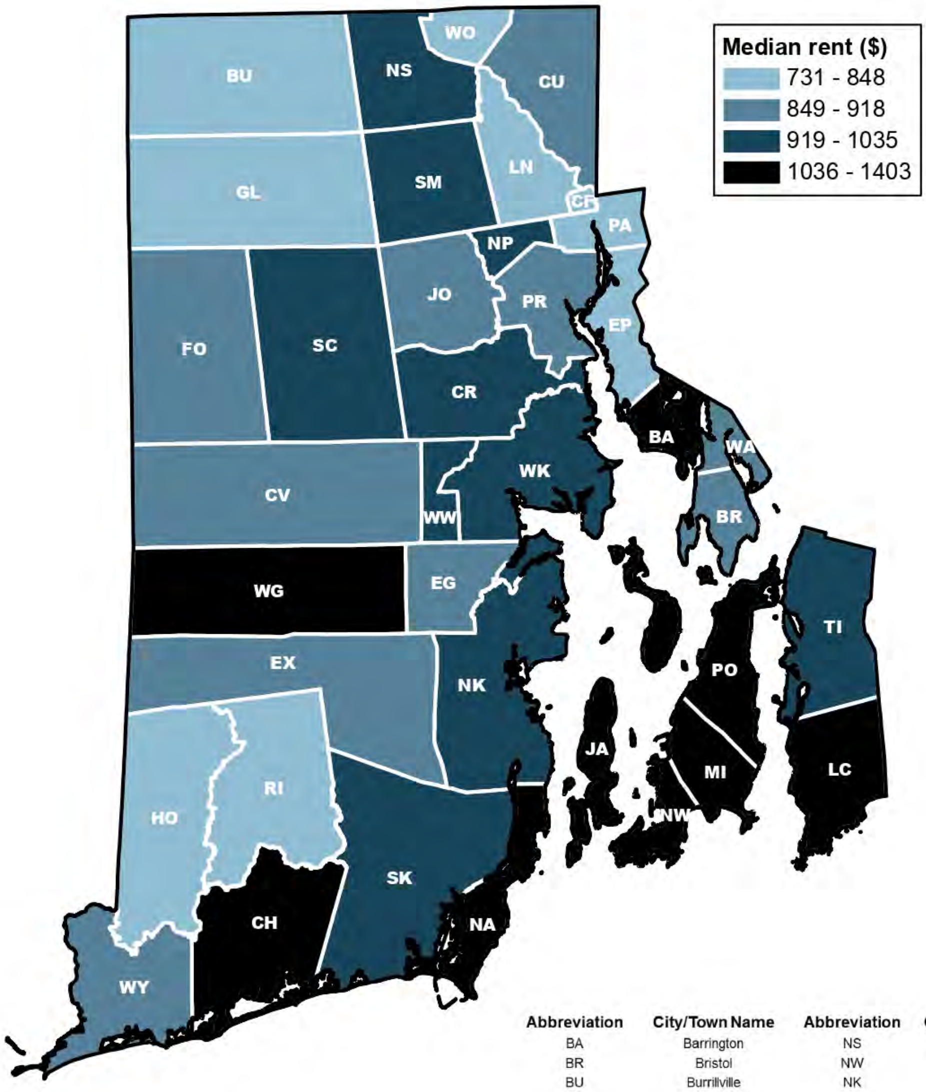
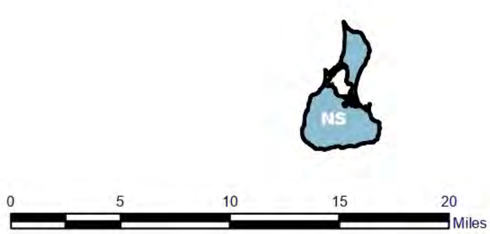
Map 14: Median rent ($) (2012)





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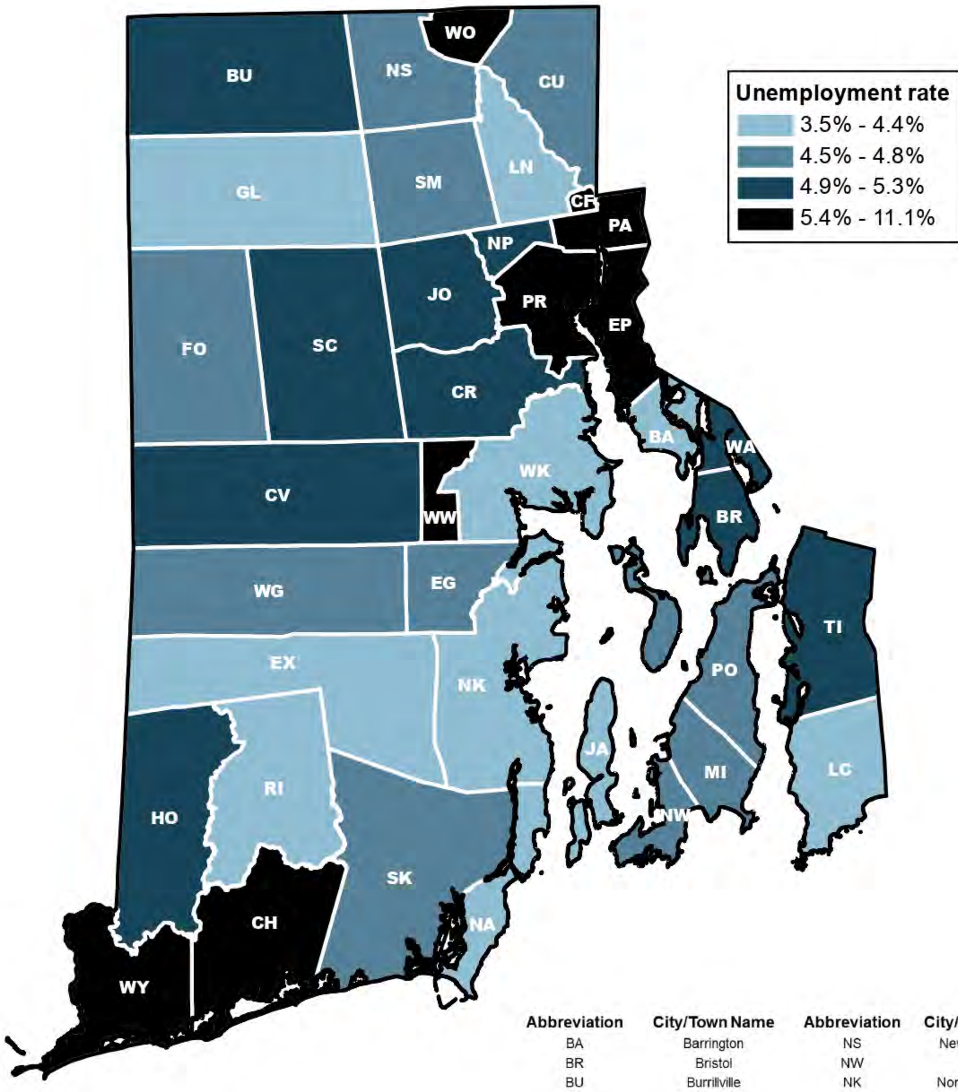
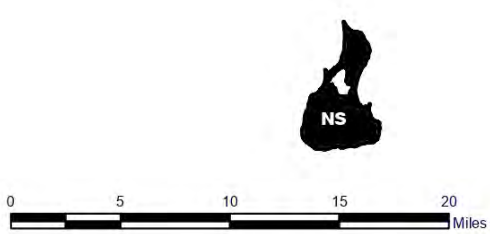
Map 15: Unemployment rate (2013)





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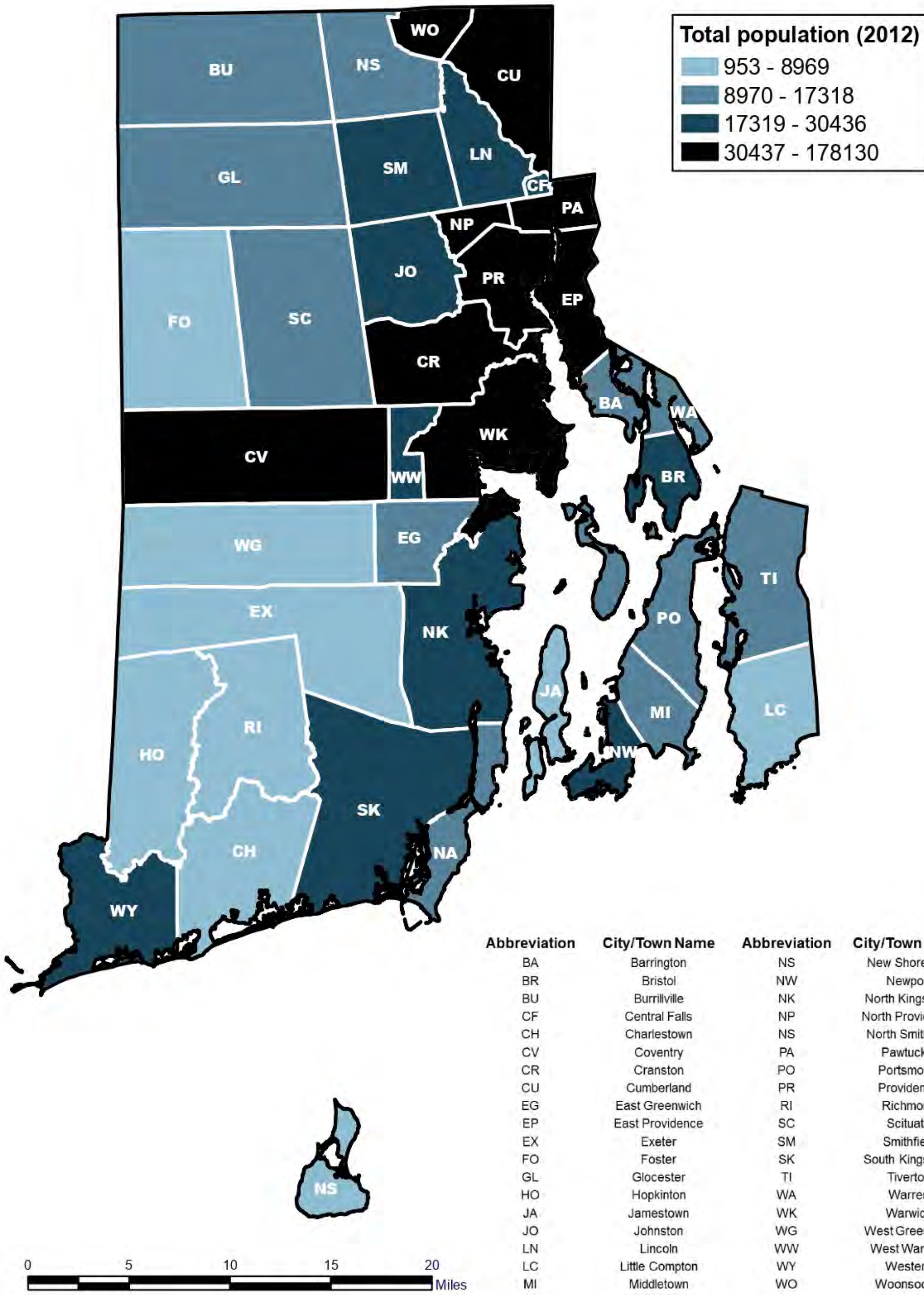
Map 16: Total population (2012)



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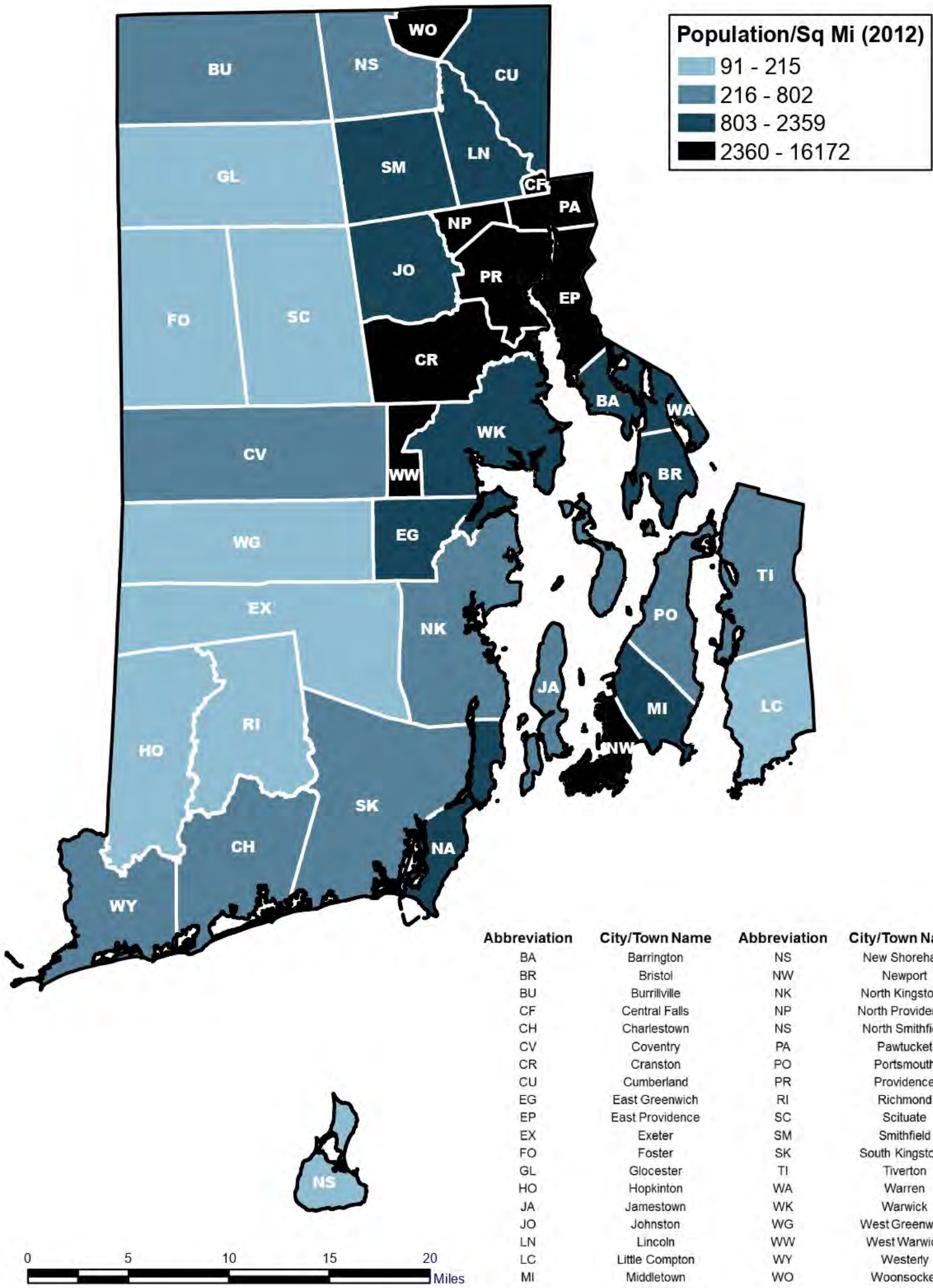
Map 17: Population density (population per square mile) (2012)



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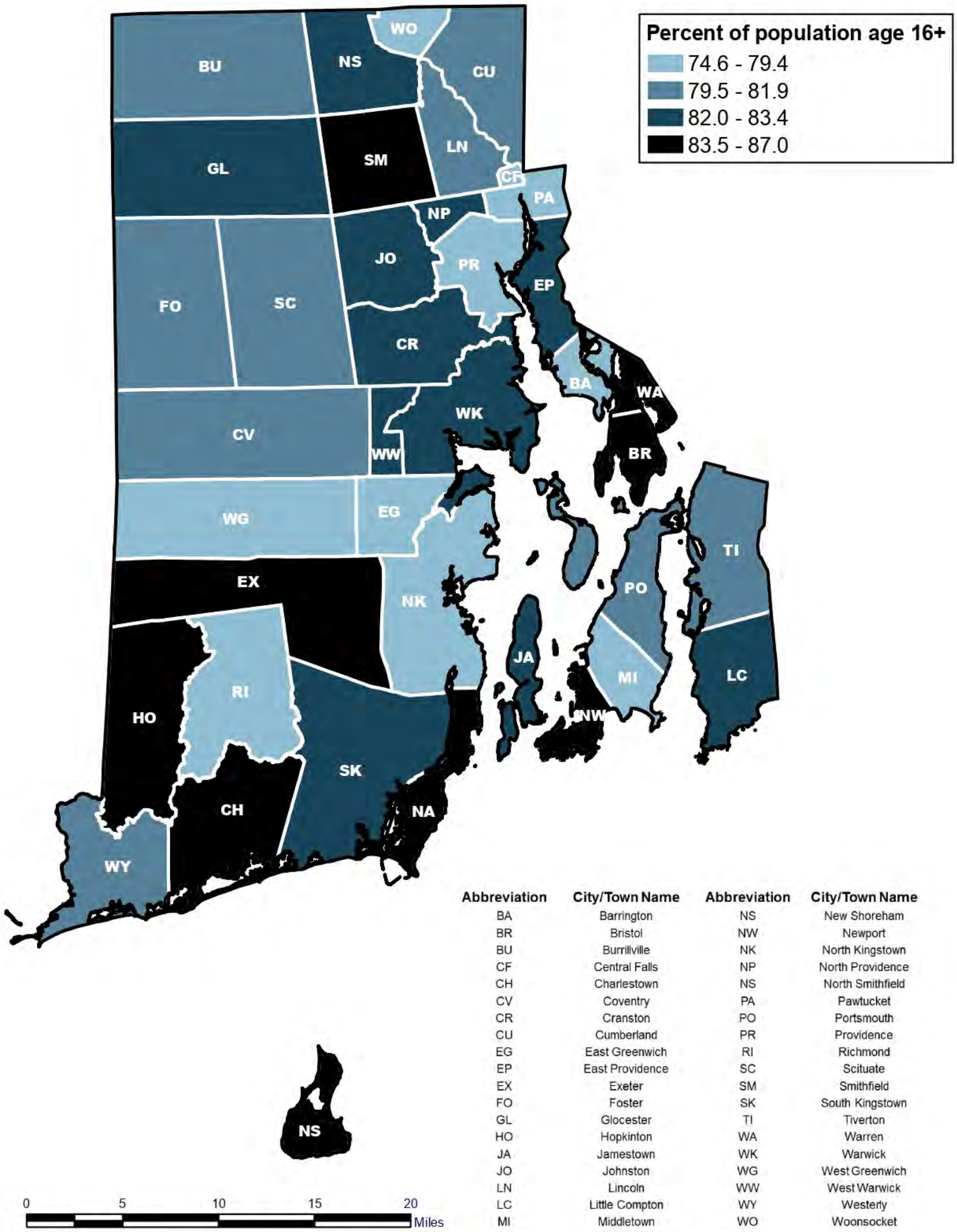
Map 18: Percent of population age 16+



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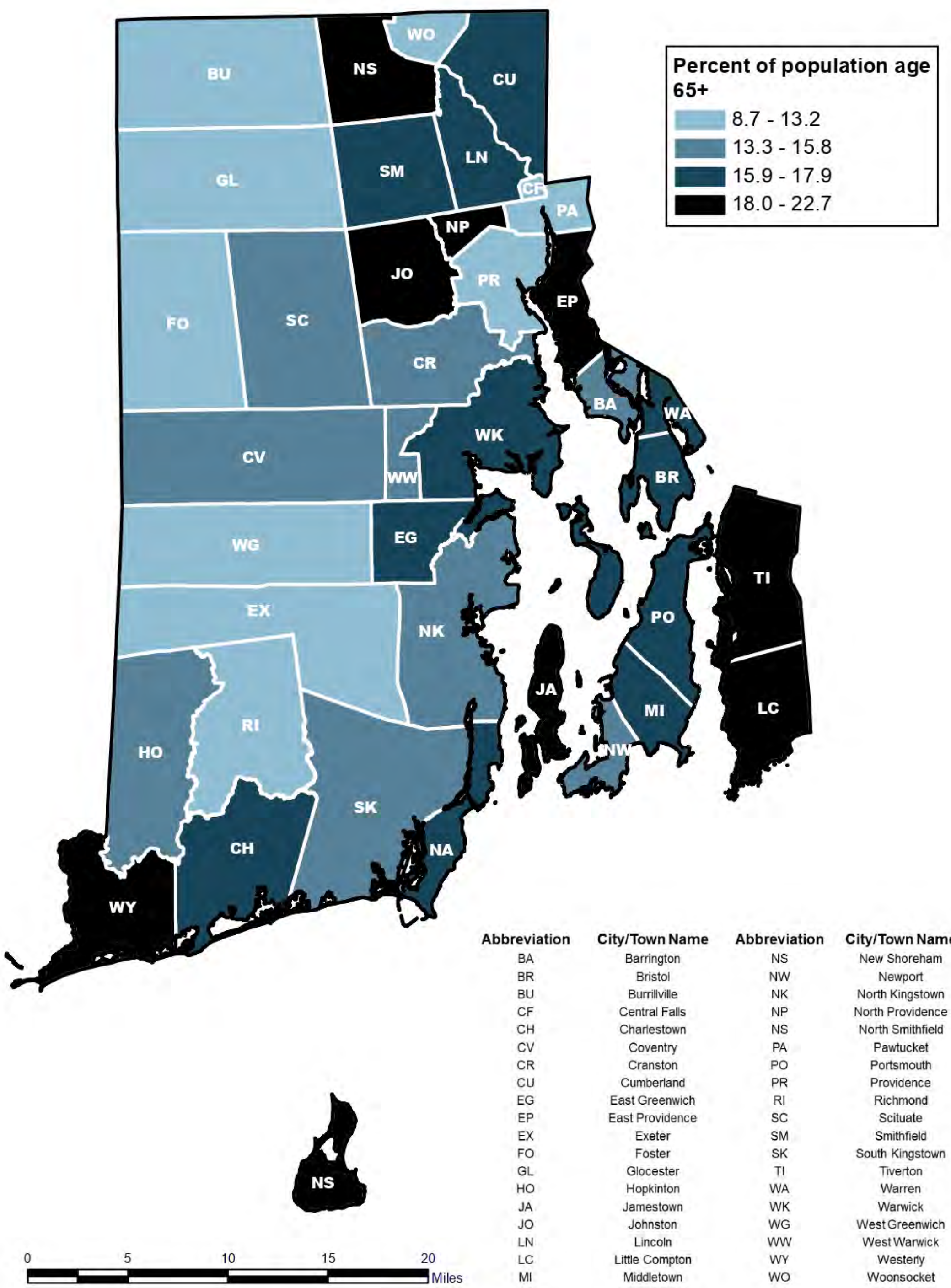
Map 19: Percent of population age 65+



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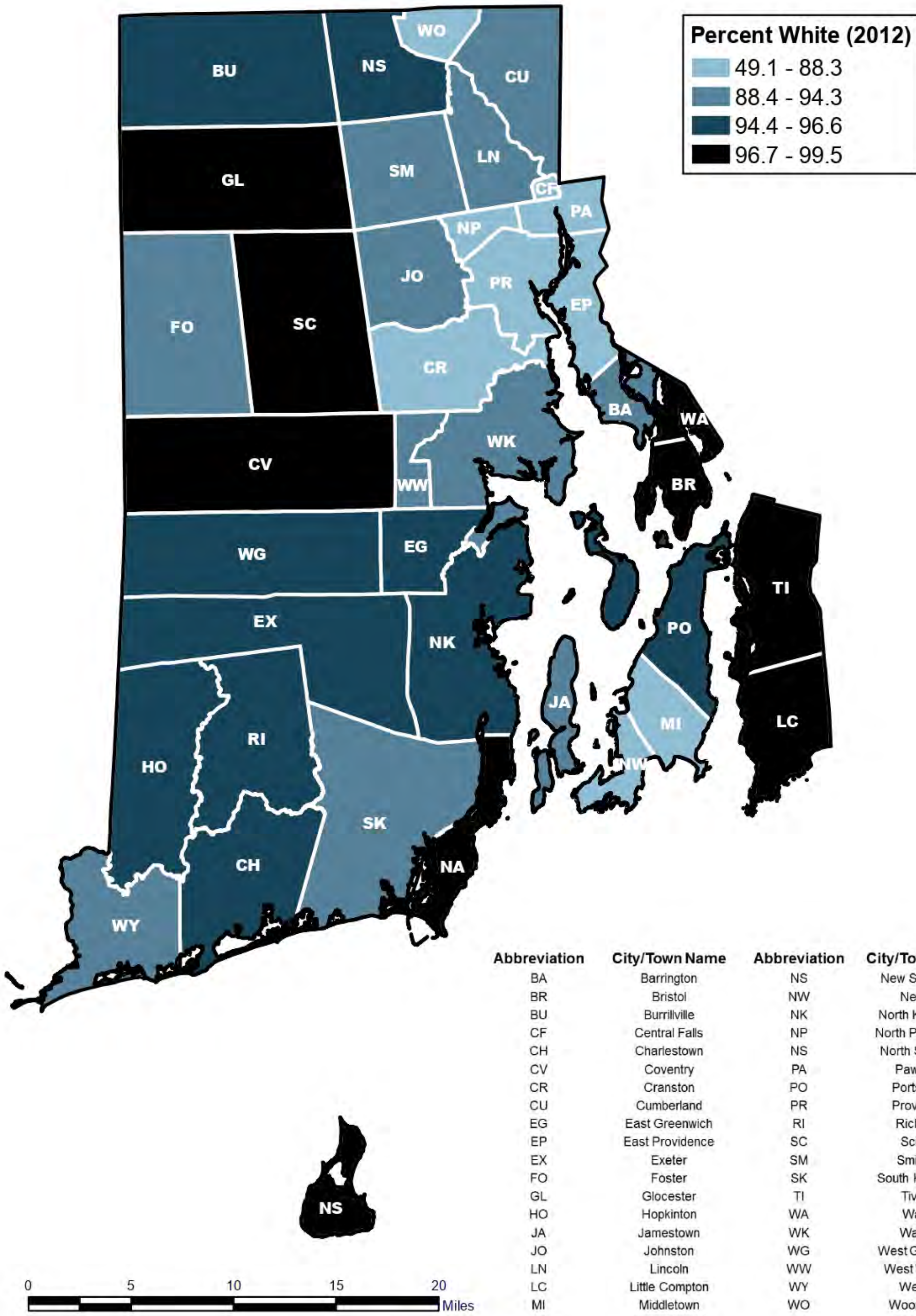
Map 20: Percent of the population that is White



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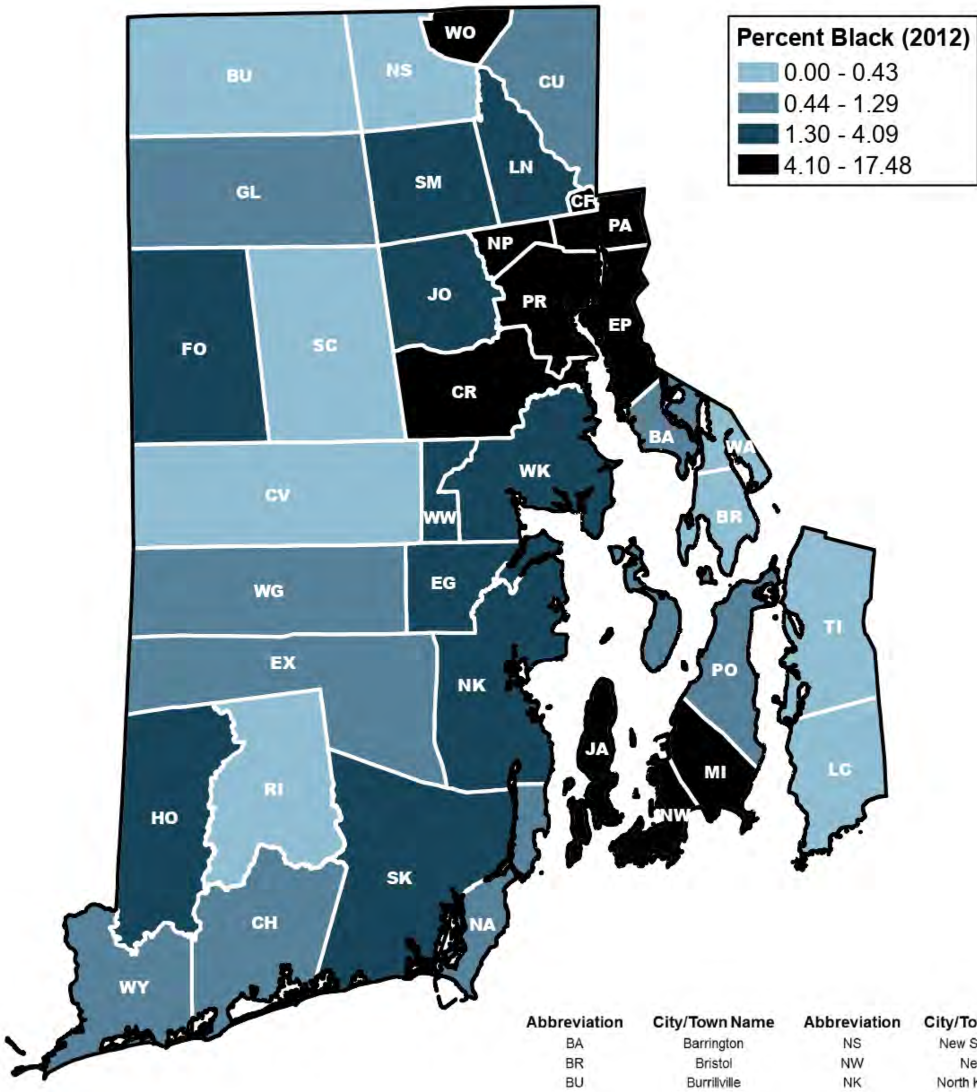
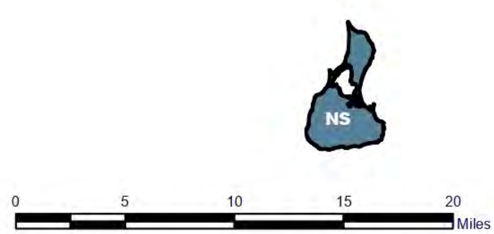
FO	Foster	SK	South Kingstown
GL	Glocester	TI	Tiverton
HO	Hopkinton	WA	Warren
JA	Jamestown	WK	Warwick
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 21: Percent of the population that is Black or African-American





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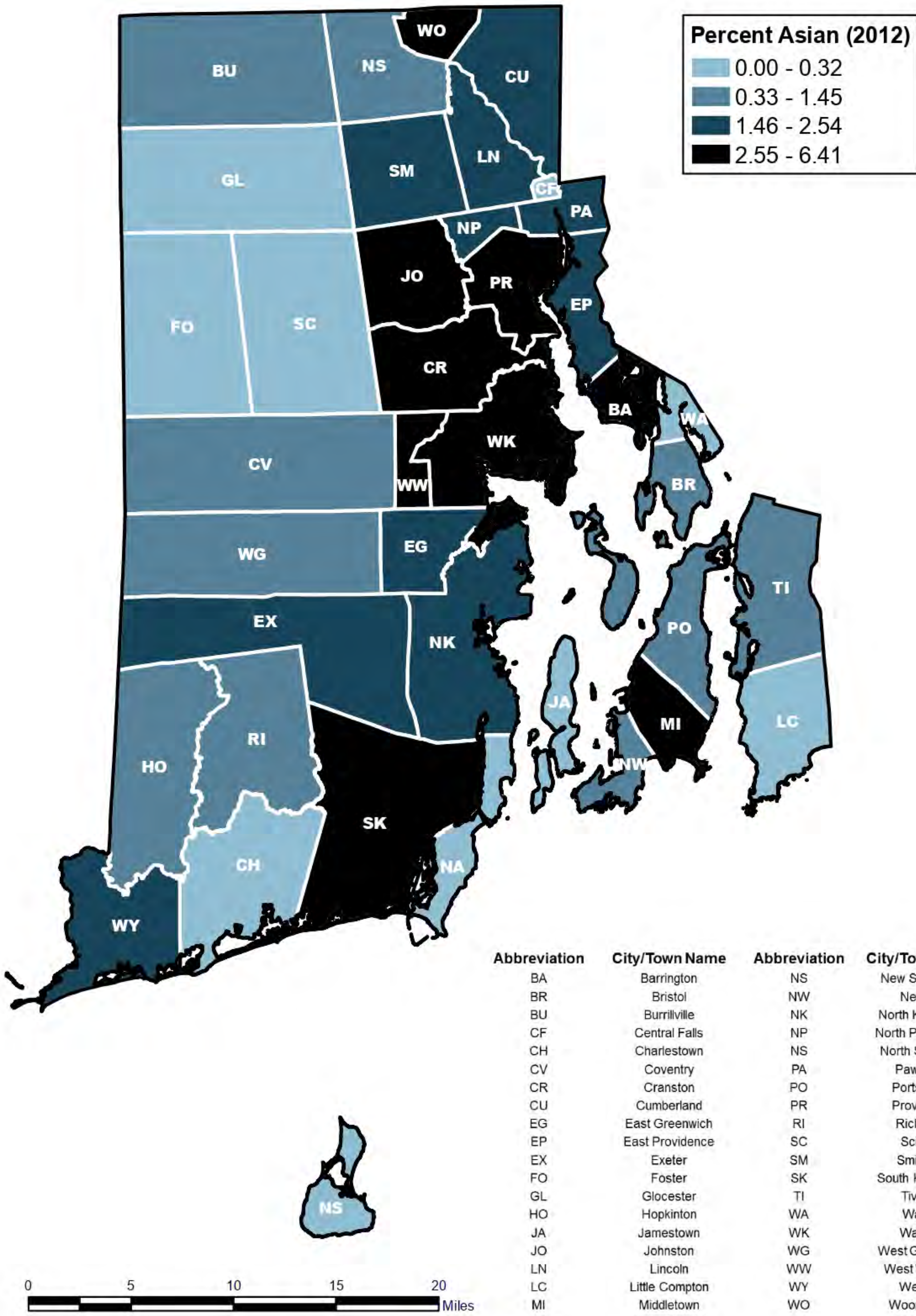
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 22: Percent of the population that is Asian



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GL	Glocester	TI	Tiverton
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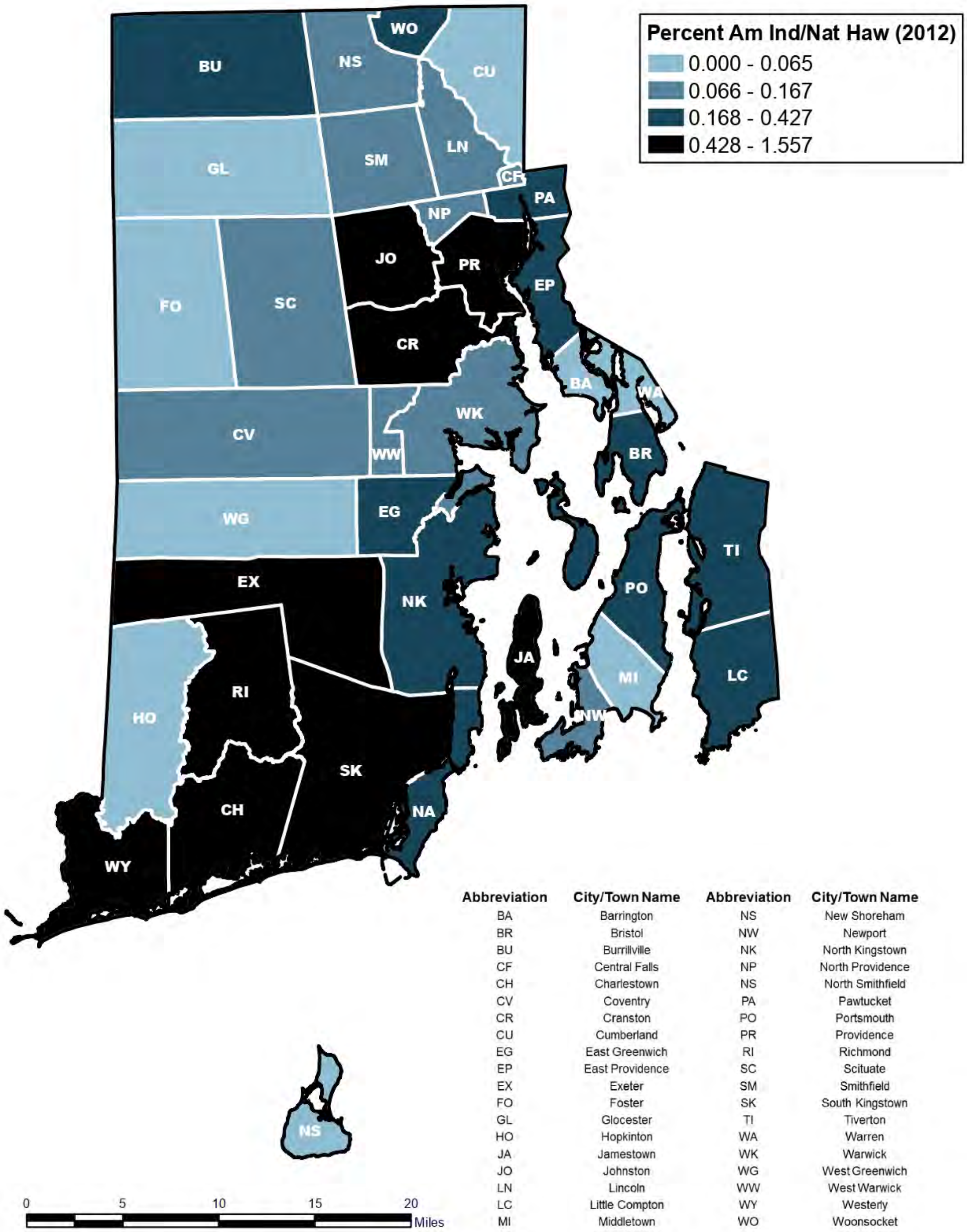
JA	Jamestown	WK	Warwick
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 23: Percent of the population that is American Indian/Native Hawaiian



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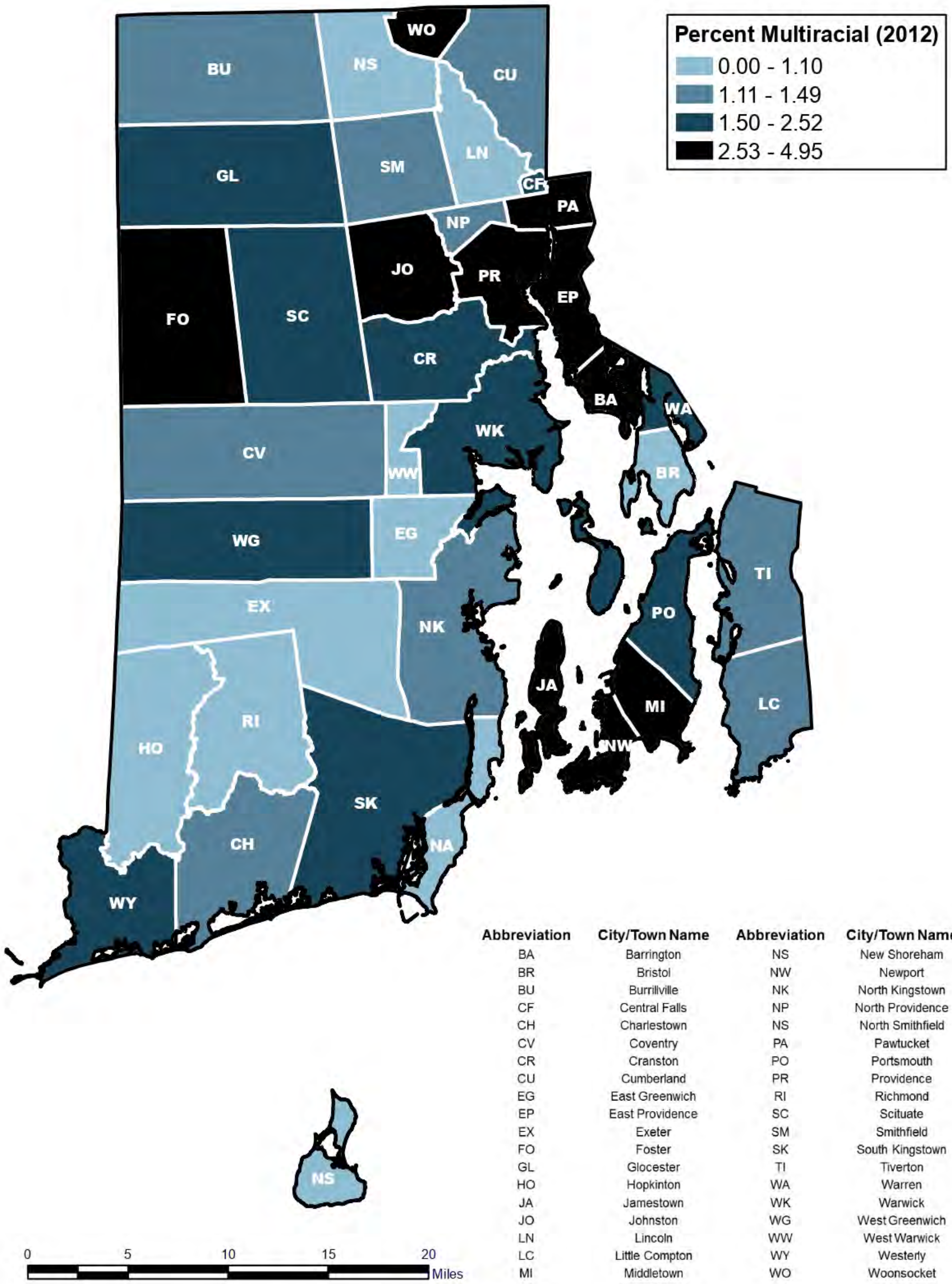
JA	Jamestown	WK	Warwick
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 24: Percent of the population that is multiracial



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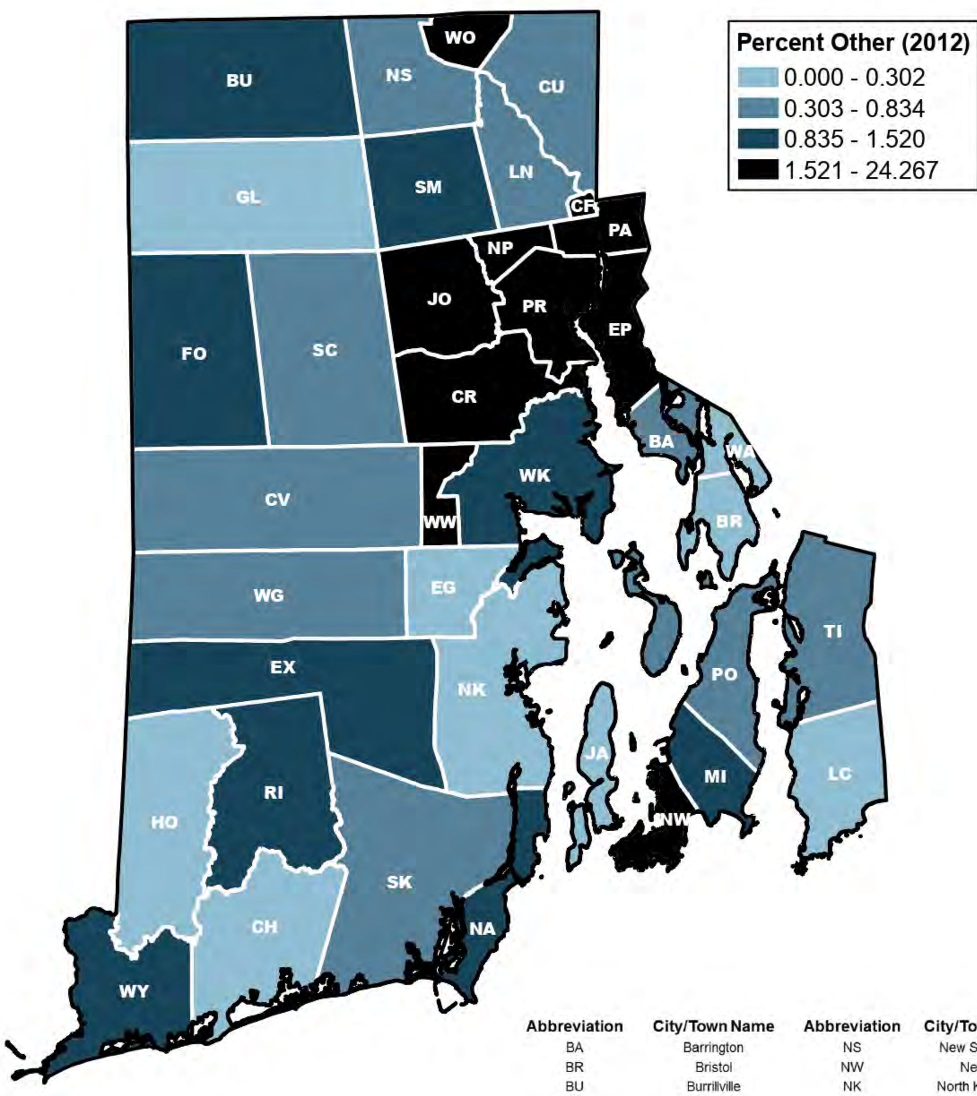
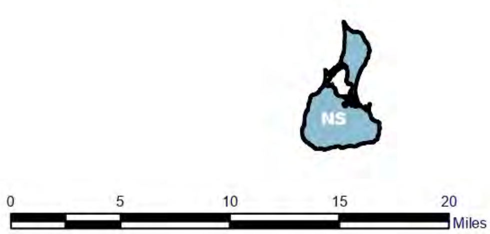
JA	Jamestown	WK	Warwick
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 25: Percent of the population that is of "other" race(s)





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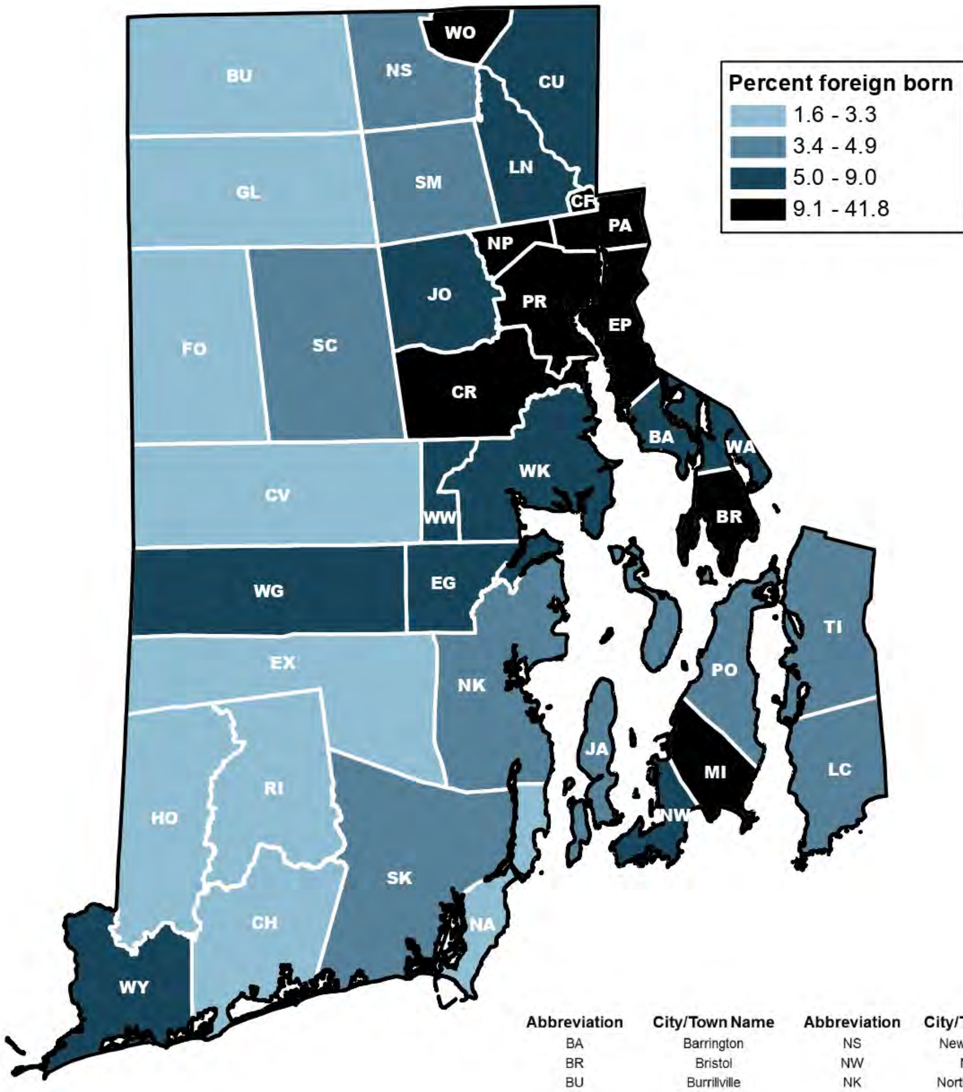
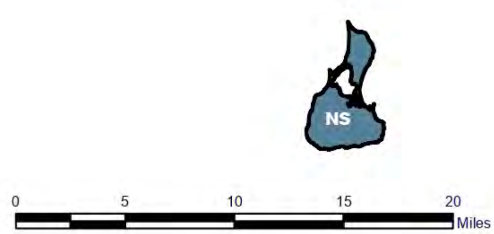
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 26: Percent of the population that is foreign born





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JA	Jamestown	WK	Warwick
JO	Johnston	WG	West Greenwich
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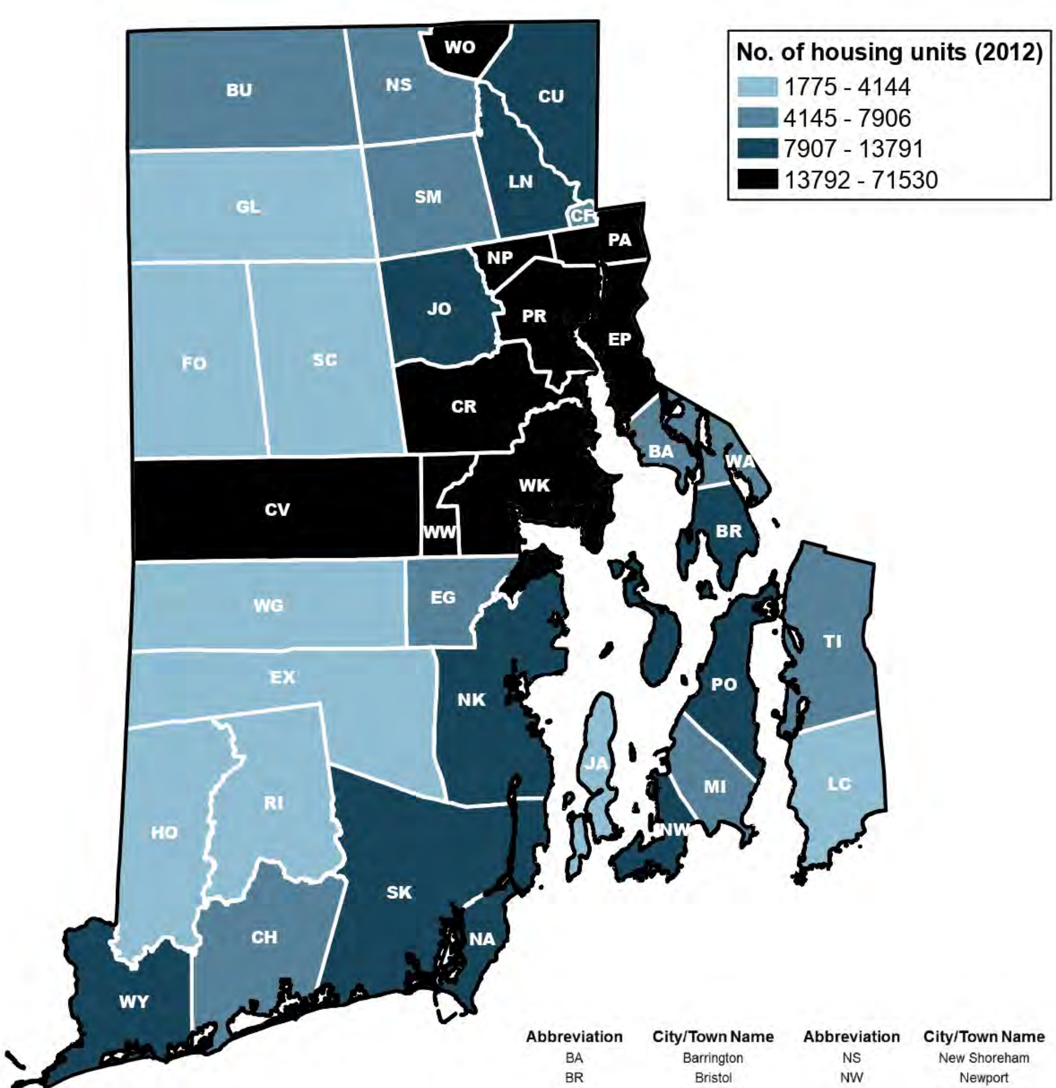
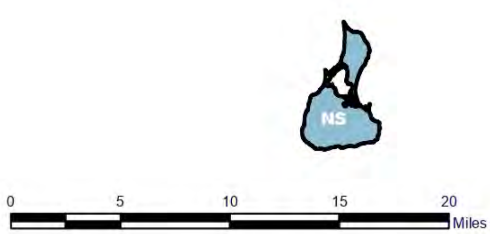
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 27: Number of housing units





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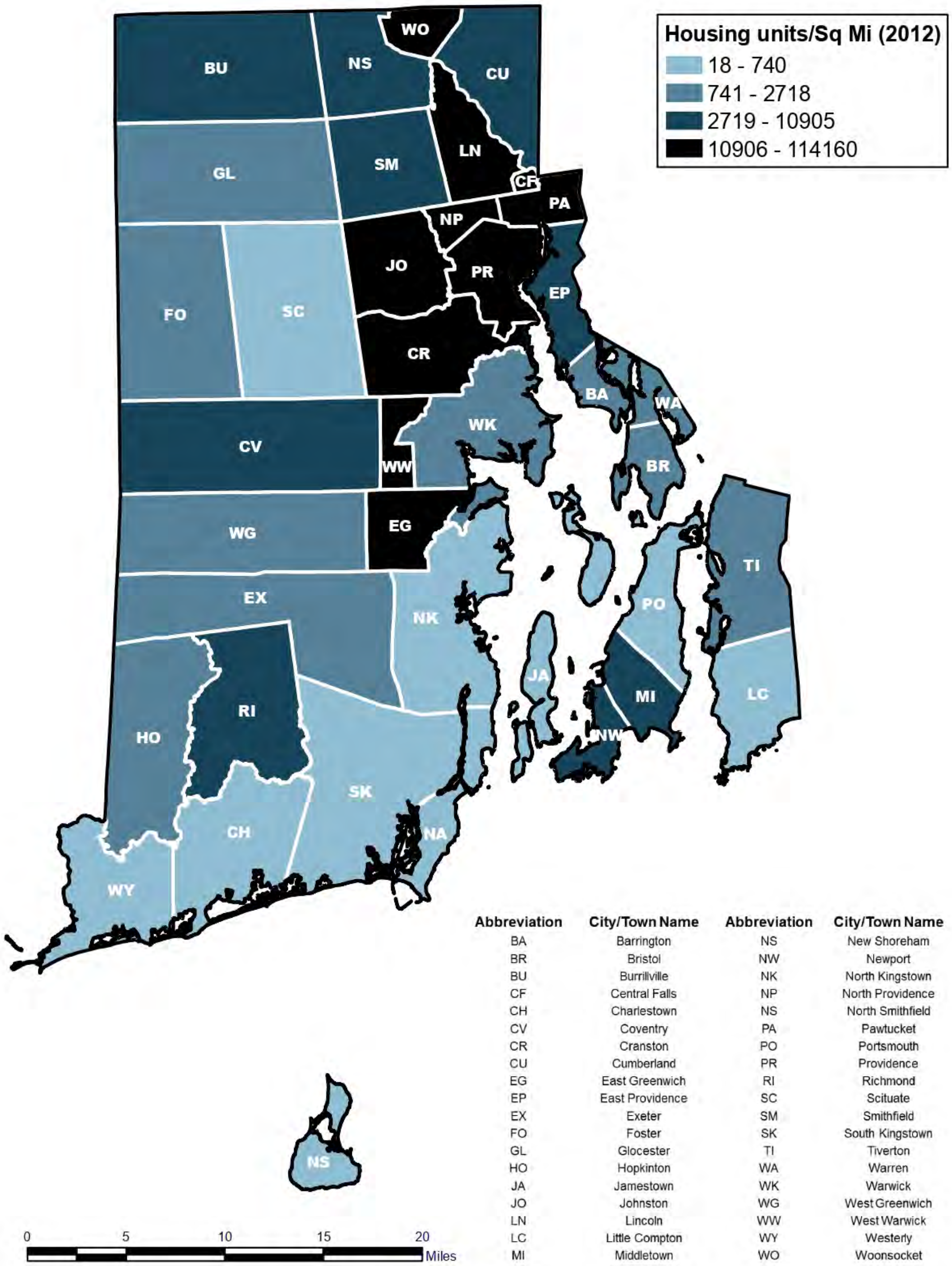
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 28: Housing unit density



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LN	Lincoln	WW	West Warwick
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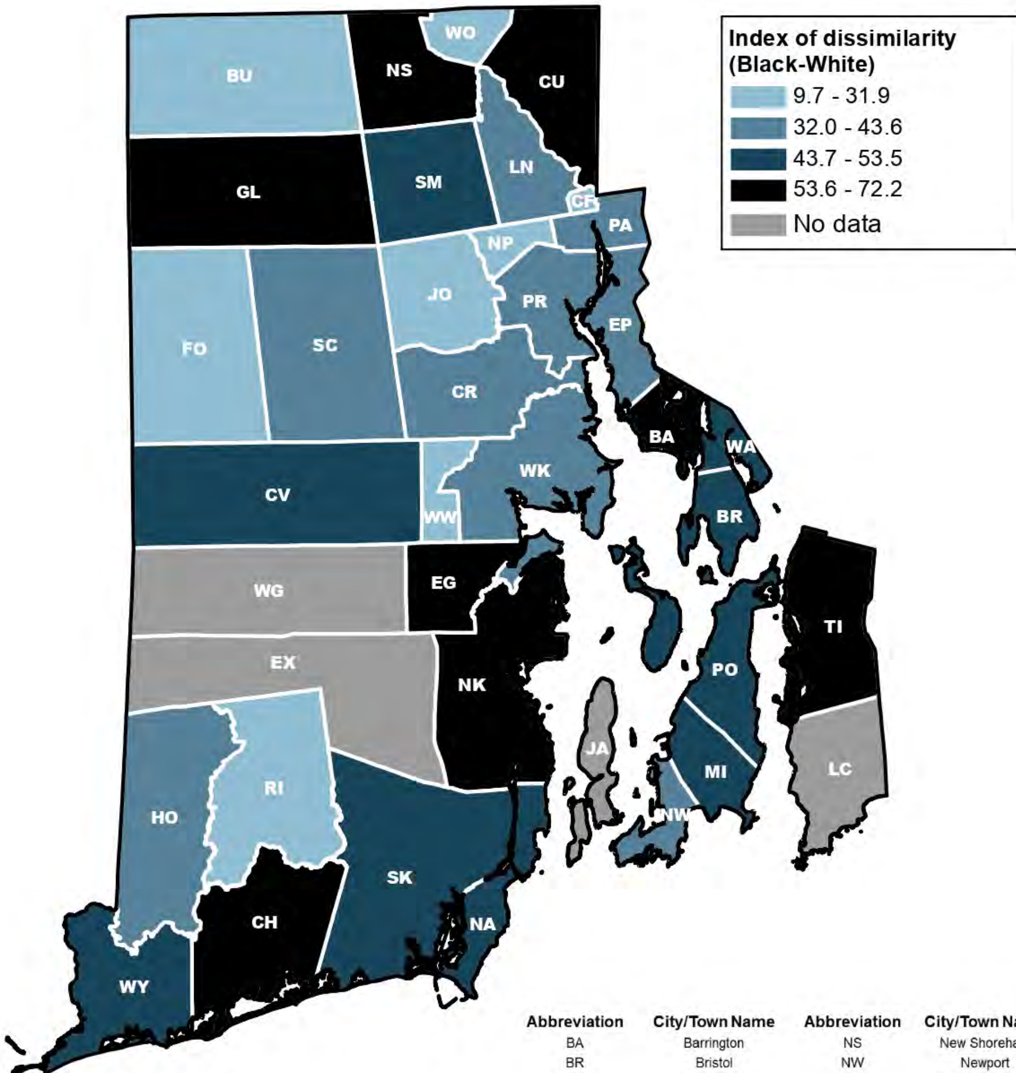
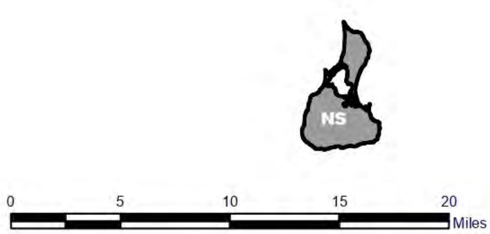
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 29: Index of dissimilarity





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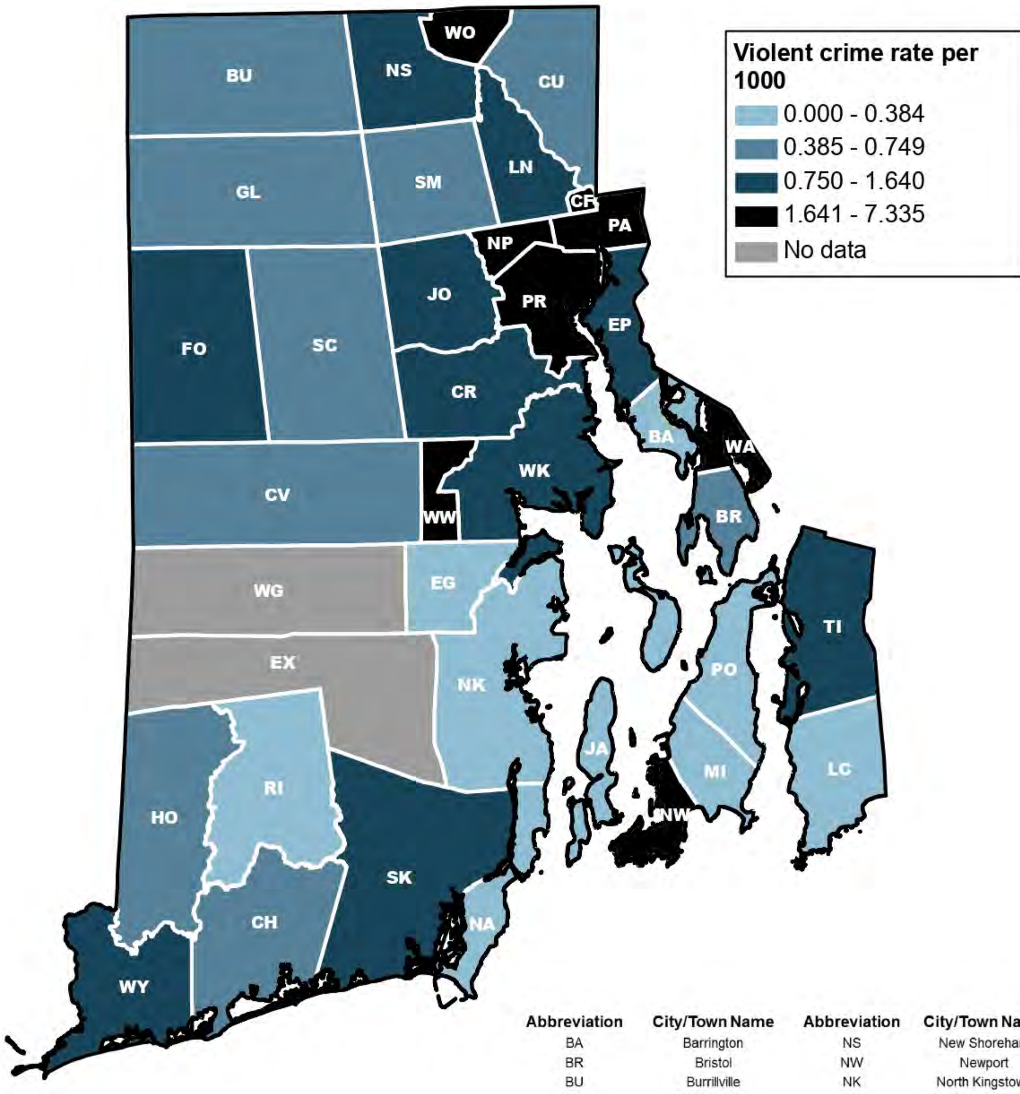
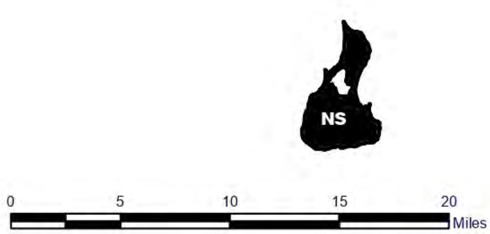
Map 30: Total violent crime rate (2013)





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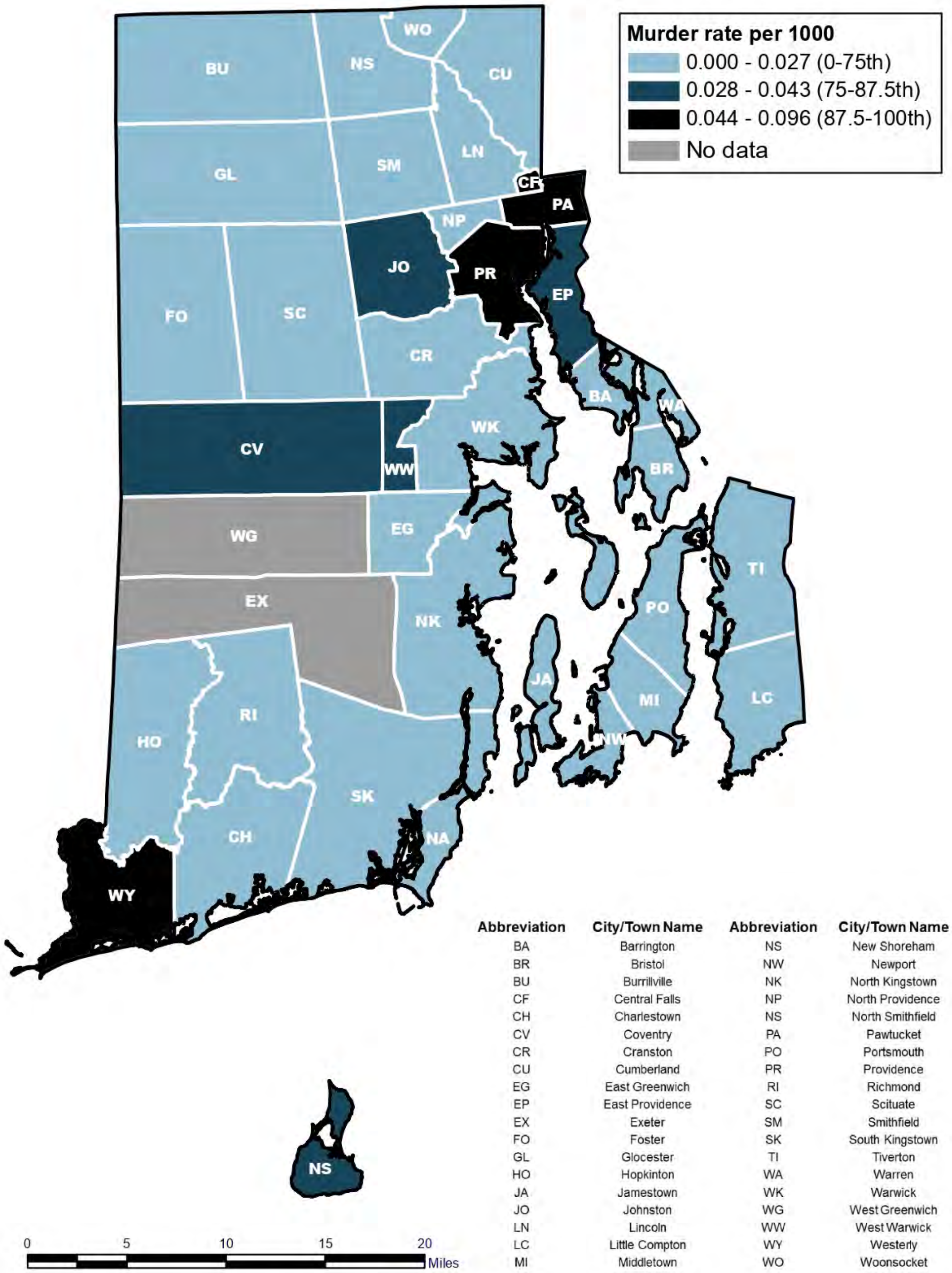
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 31: Murder rate (2013)



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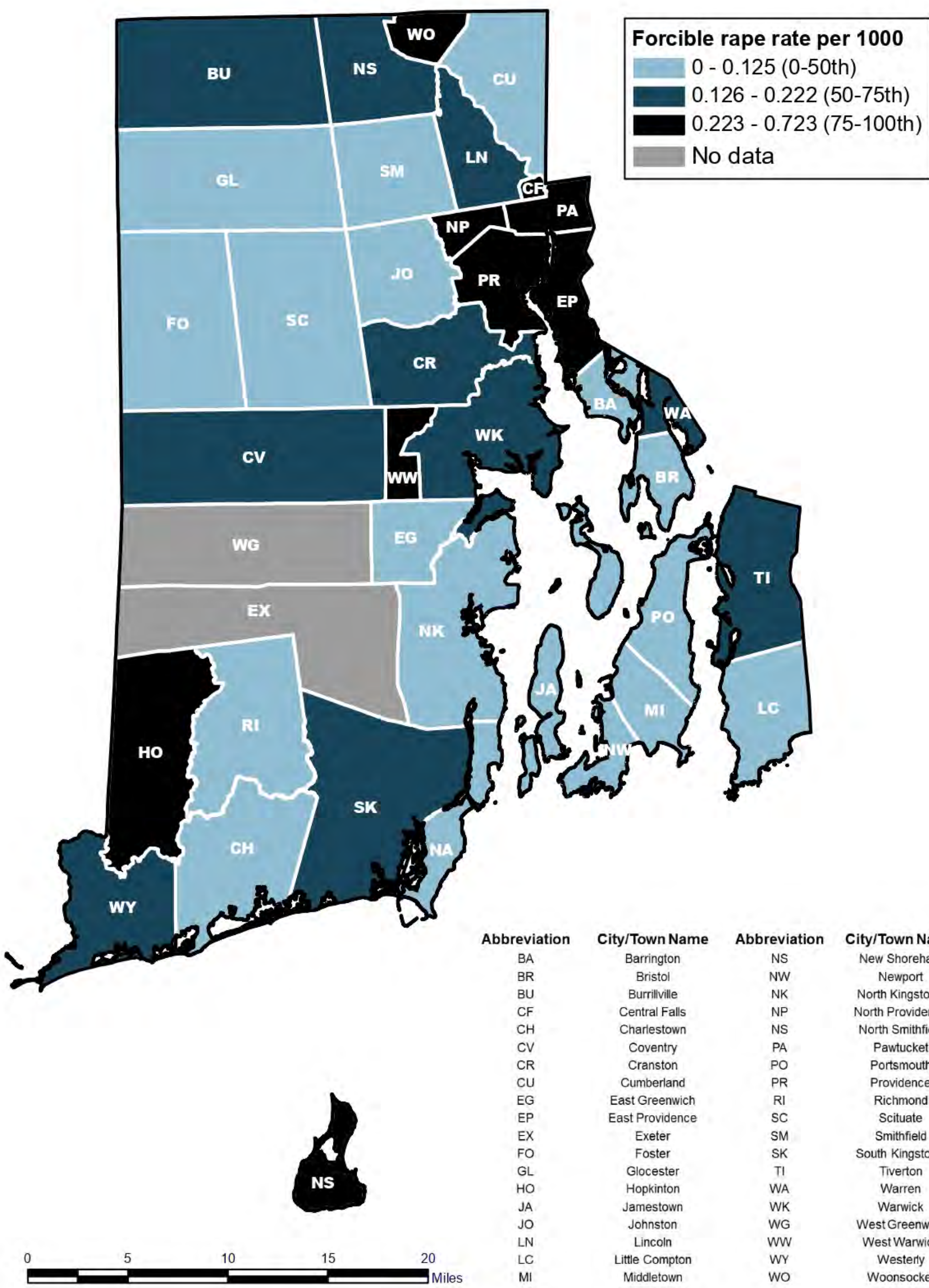
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 32: Rape rate (2013)



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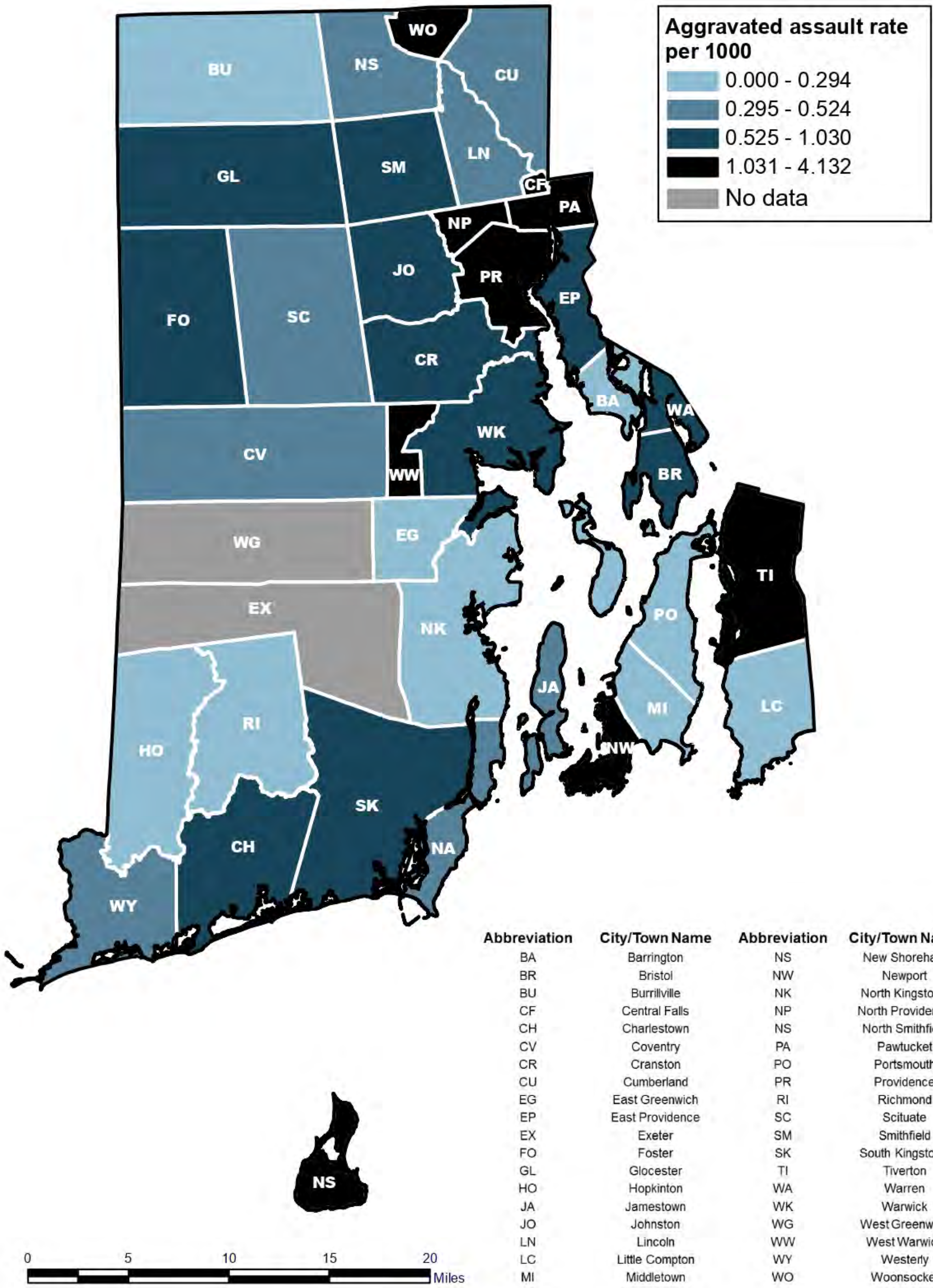
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 33: Assault rate (2013)



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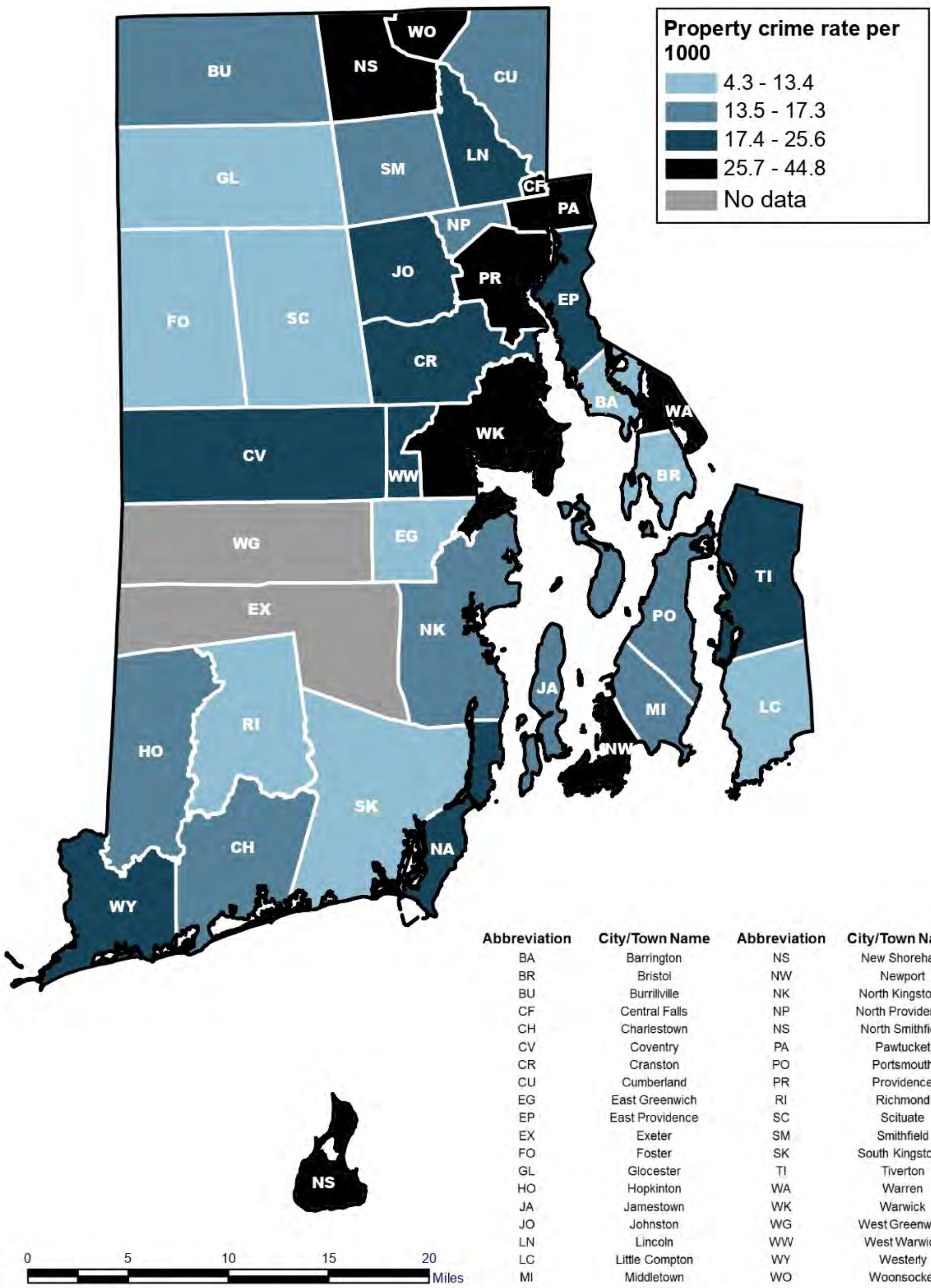
Map 34: Total property crime rate (2013)



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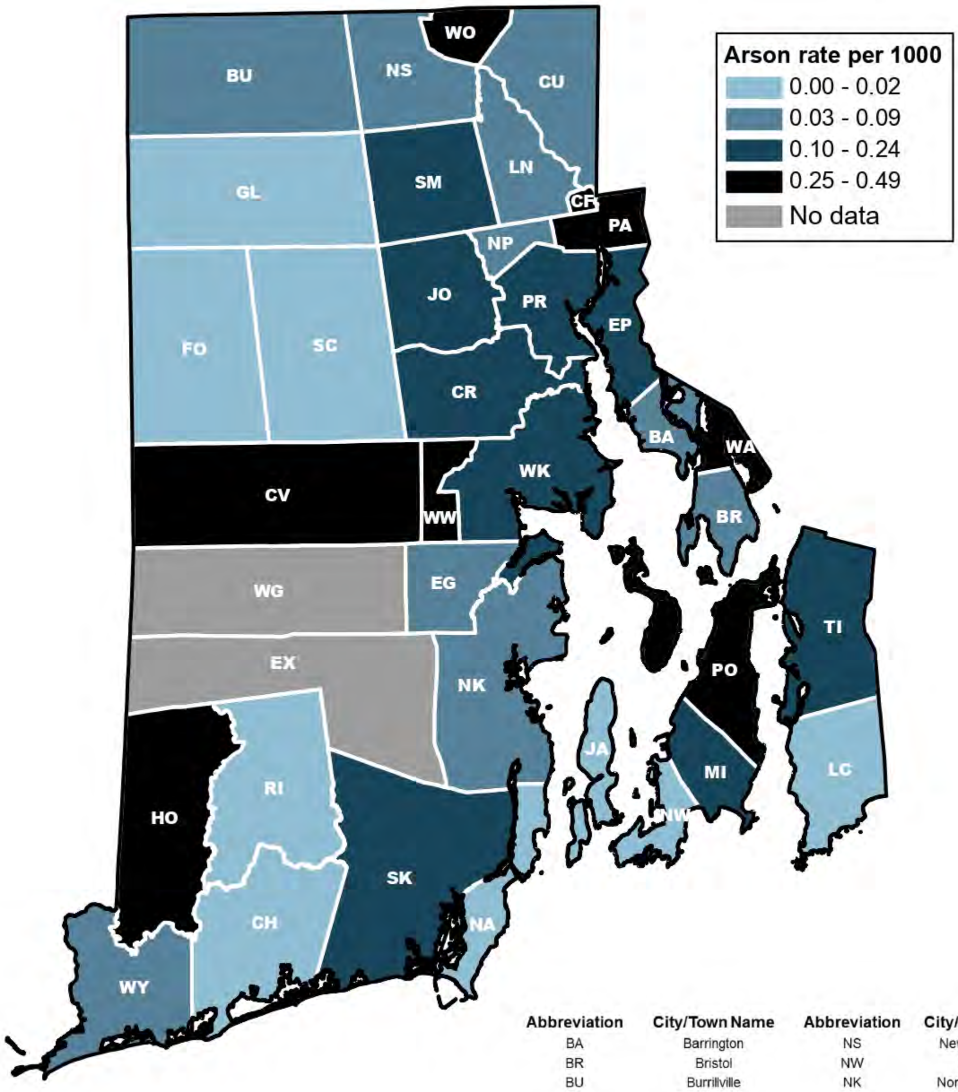
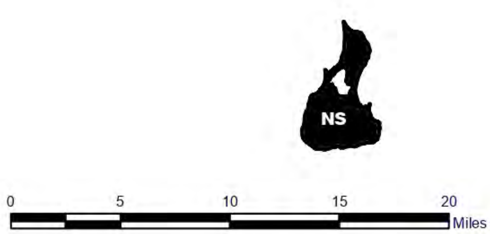
Map 35: Arson rate (2013)





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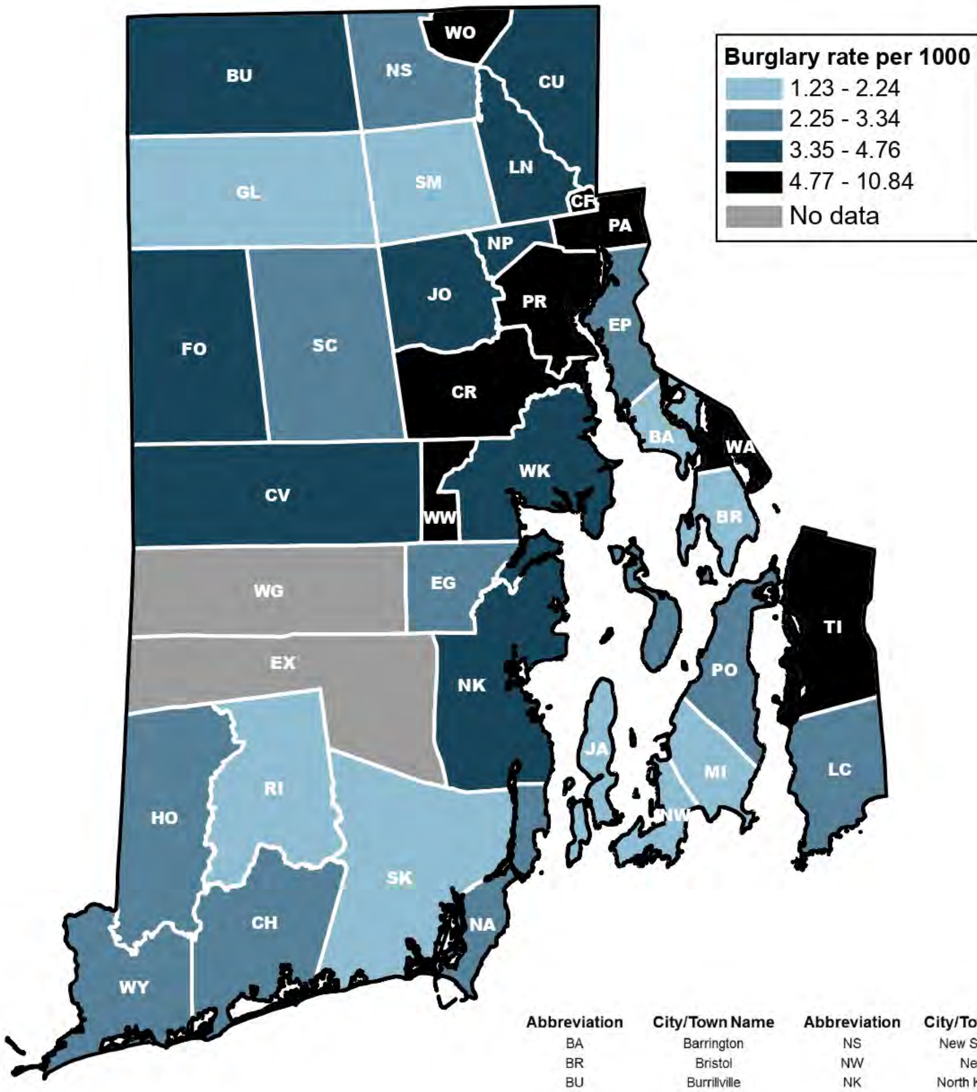
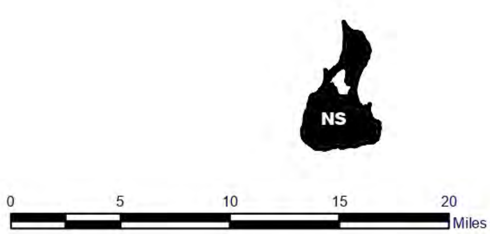
Map 36: Burglary rate (2013)





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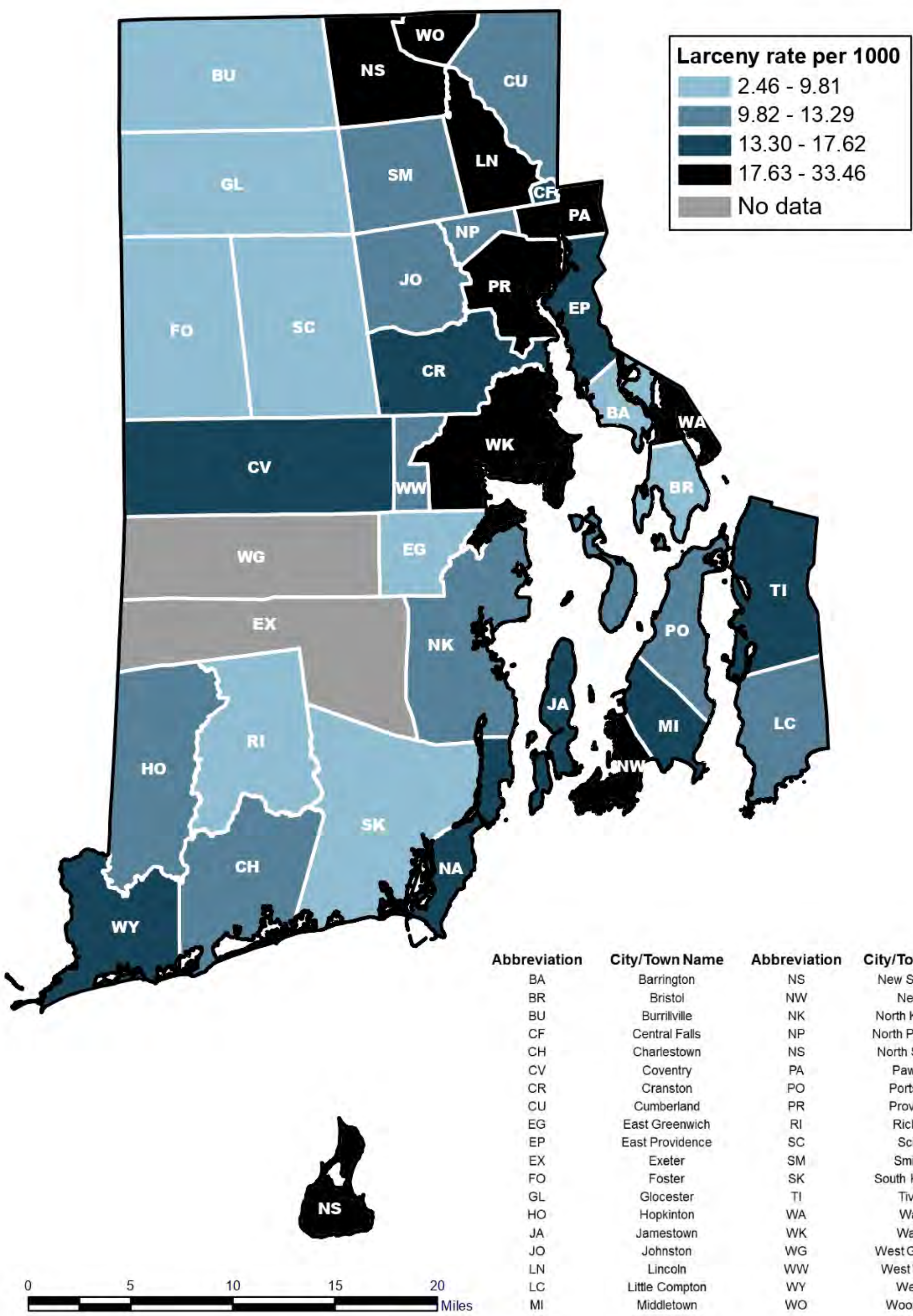
NA	Narragansett		

Map 37: Larceny rate (2013)



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LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
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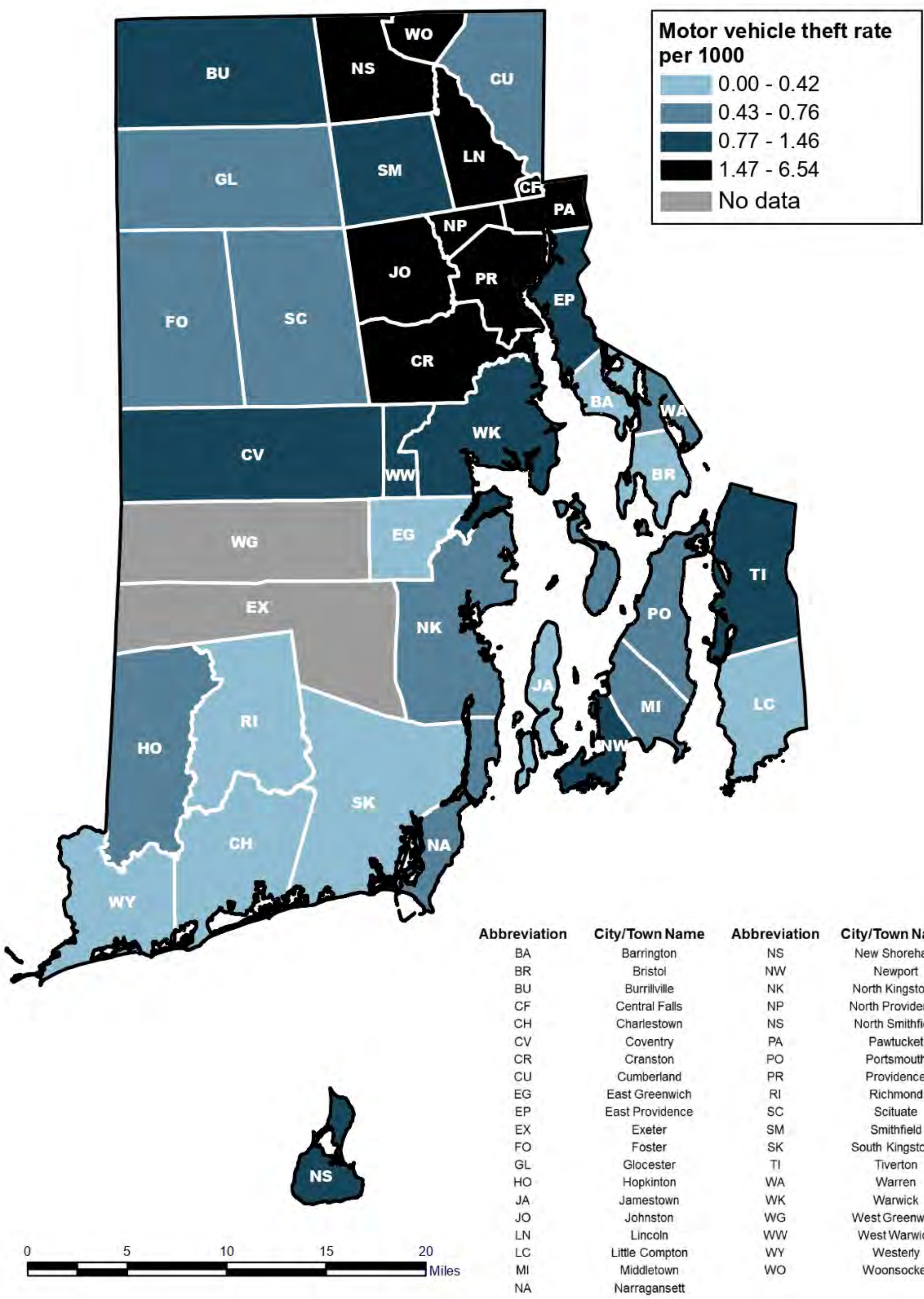
Map 38: Motor vehicle theft rate (2013)



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MI	Middletown	WO	Woonsocket
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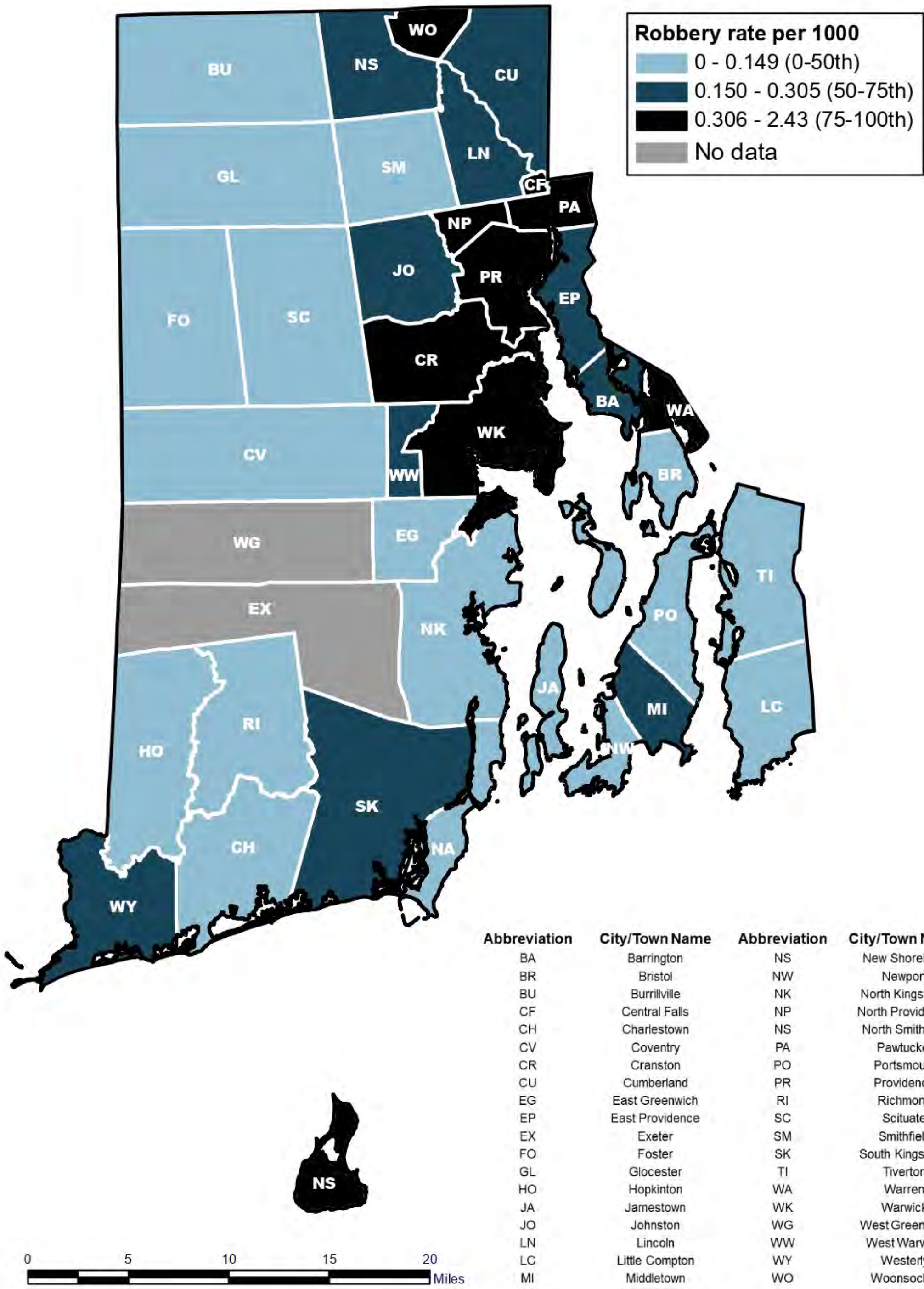
Map 39: Robbery rate (2013)



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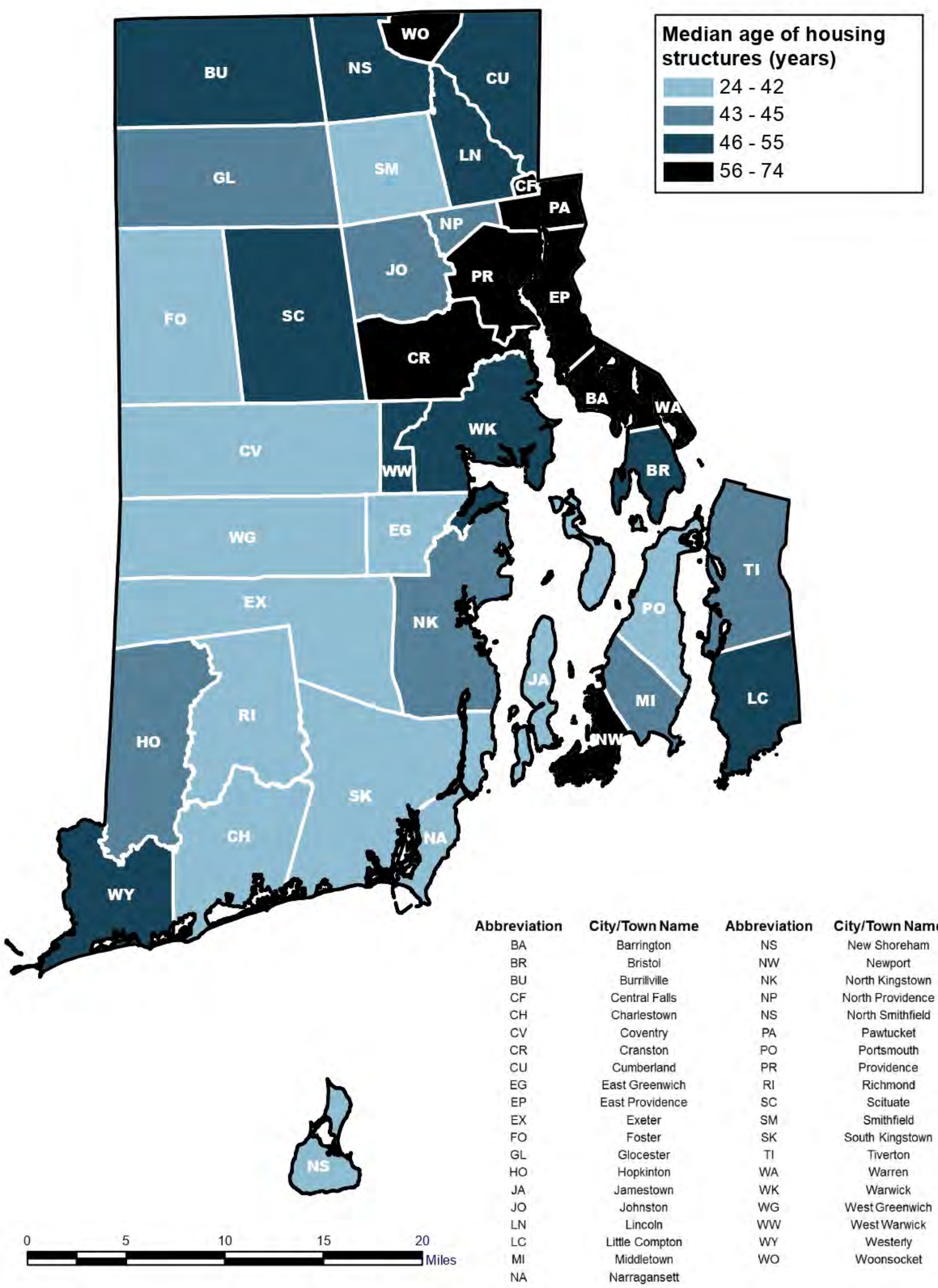
HO	Hopkinton	WA	Warren
JA	Jamestown	WK	Warwick
JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
NA	Narragansett		

Map 40: Median age of houses (2012)



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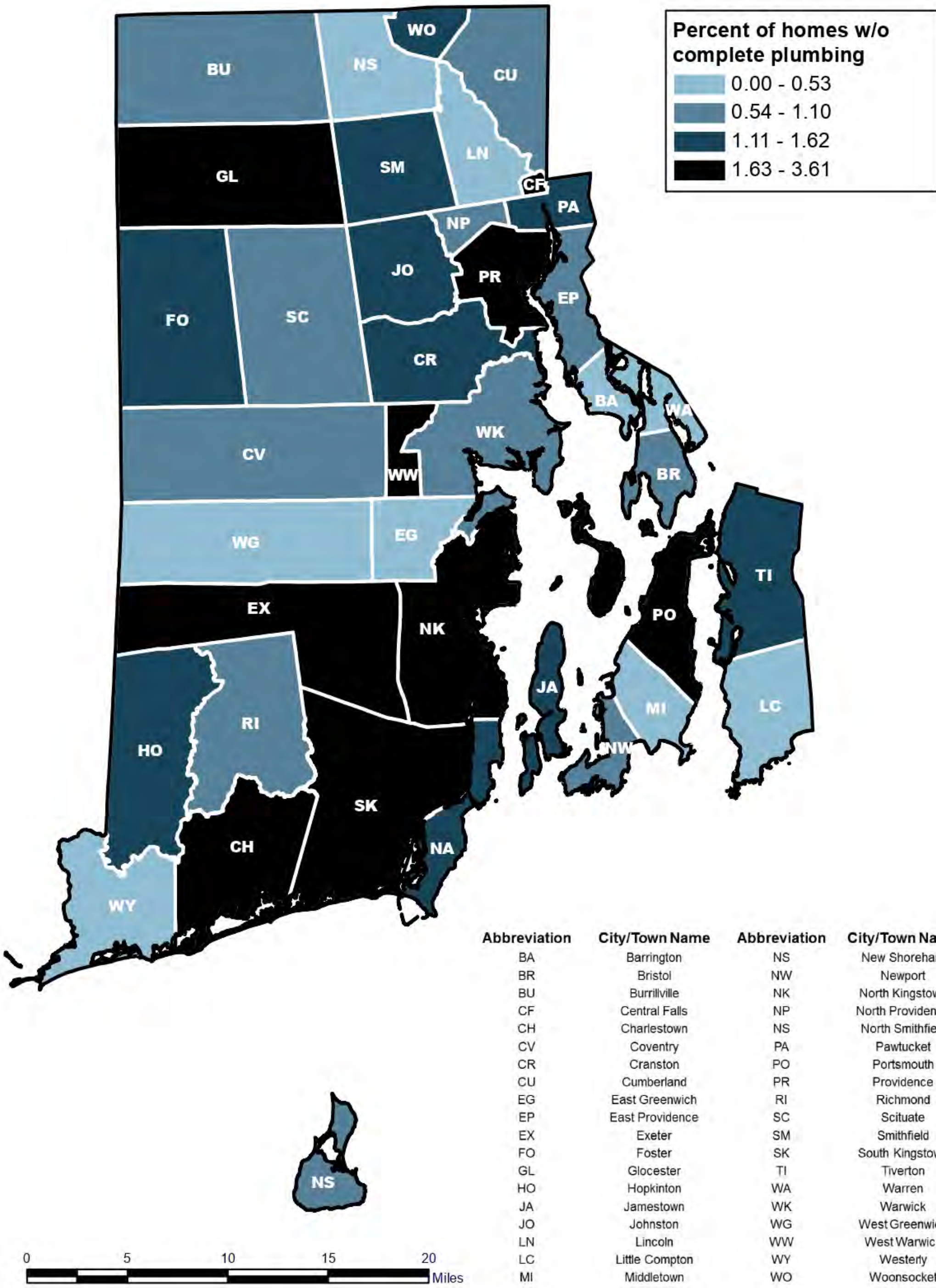
NA	Narragansett		

Map 41: Percent of housing structures without complete plumbing



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JO	Johnston	WG	West Greenwich
LN	Lincoln	WW	West Warwick
LC	Little Compton	WY	Westerly
MI	Middletown	WO	Woonsocket
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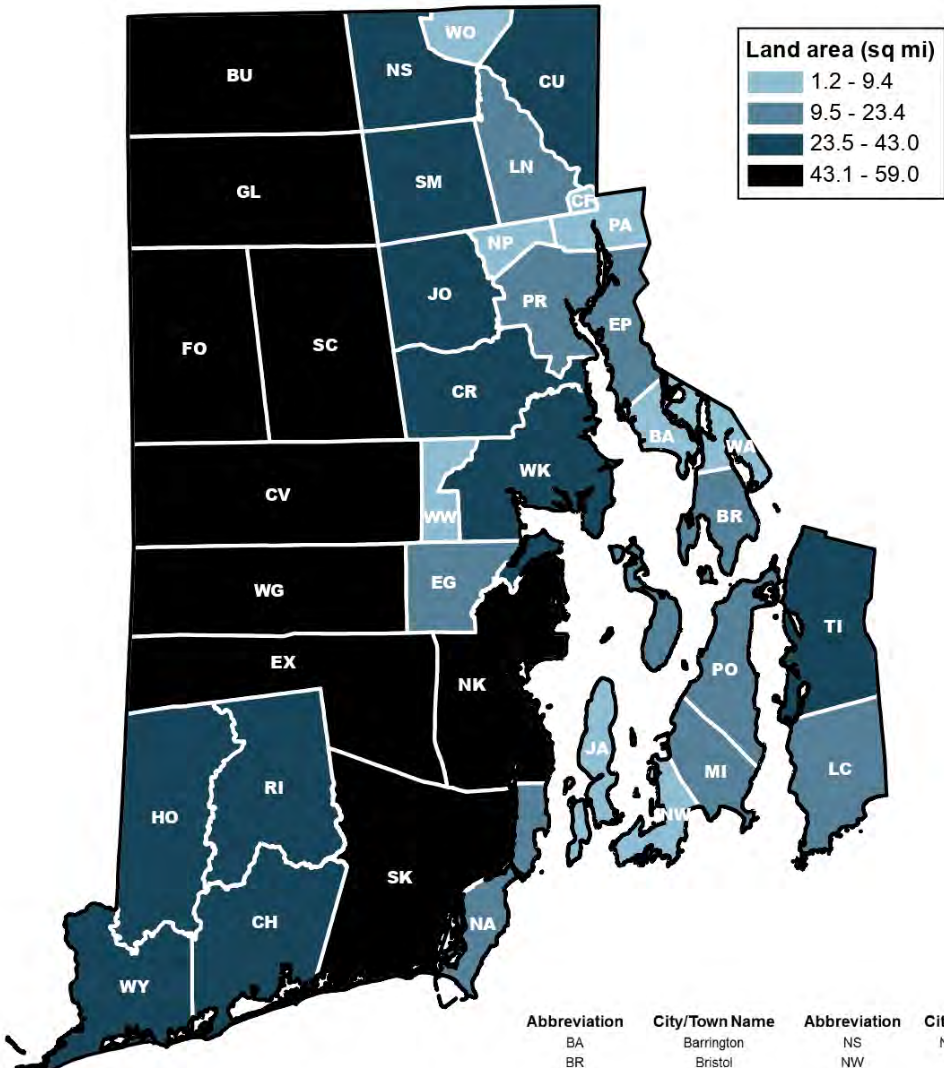
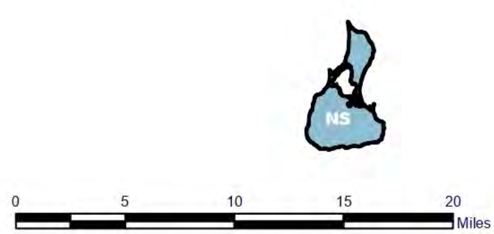
Map 42: Total land area (square miles)





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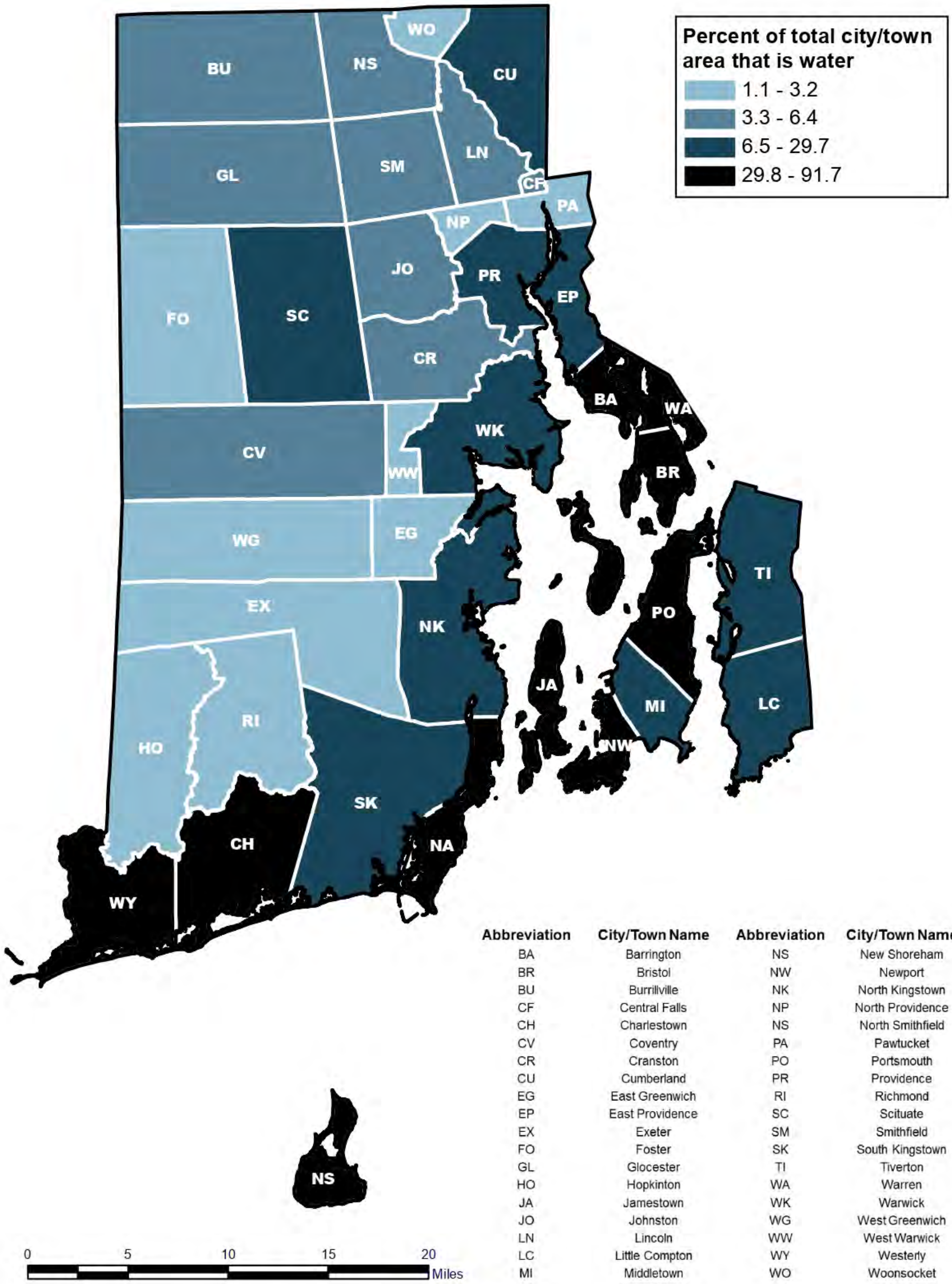
Map 43: Percent of total land area comprised of water



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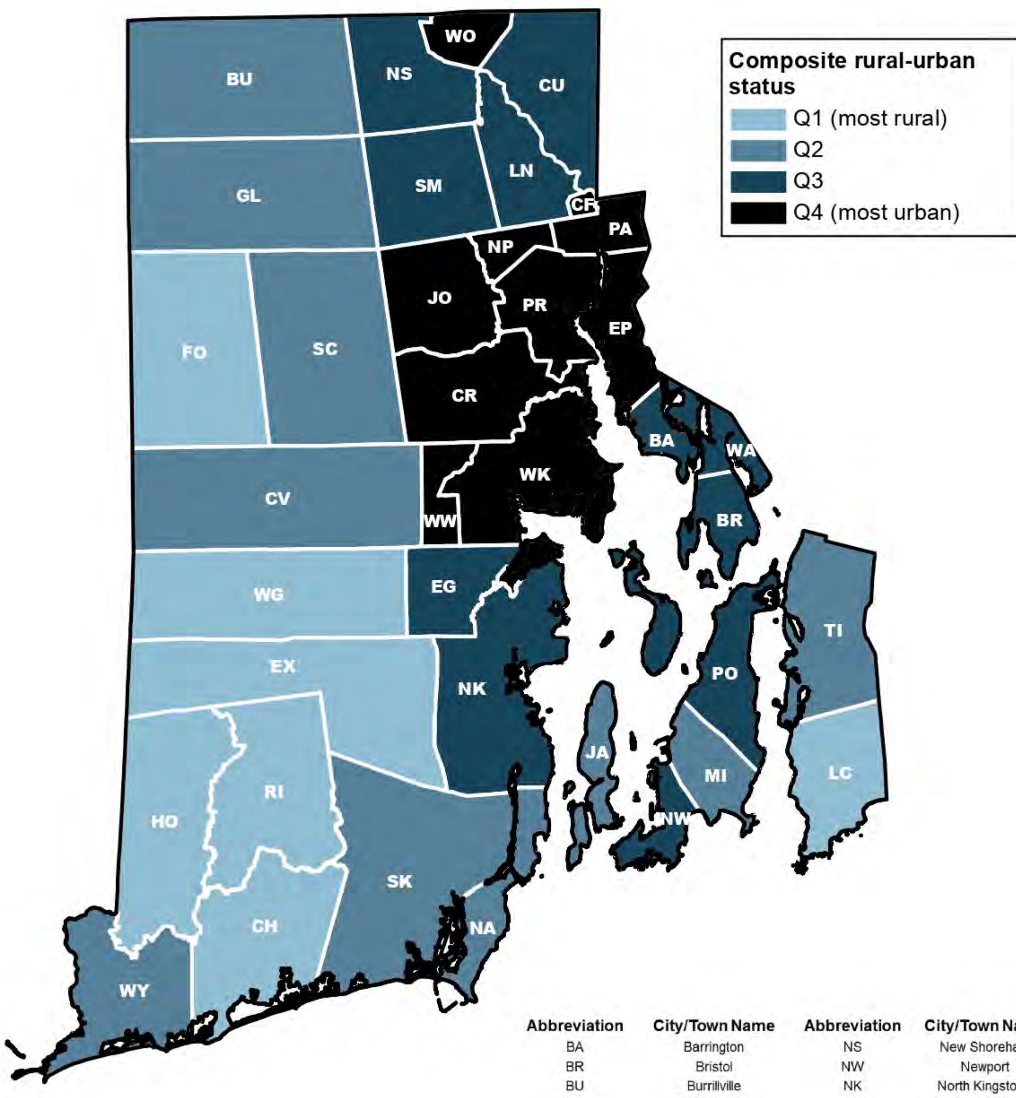
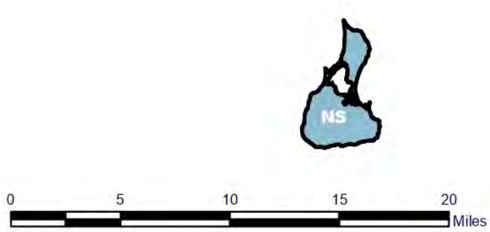
Map 44: Composite rural/urban index





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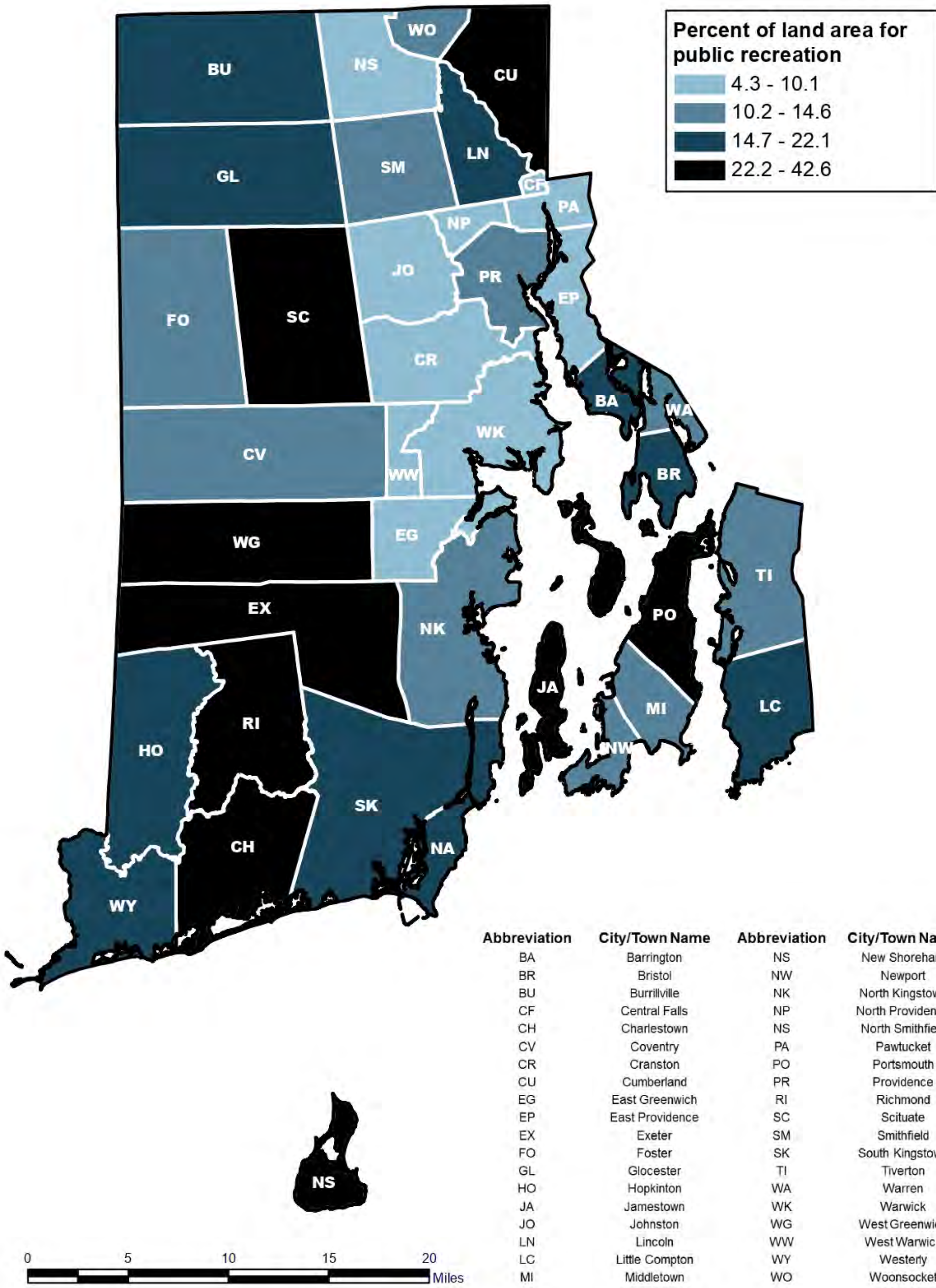
Map 45: Percent of land area used for public recreation



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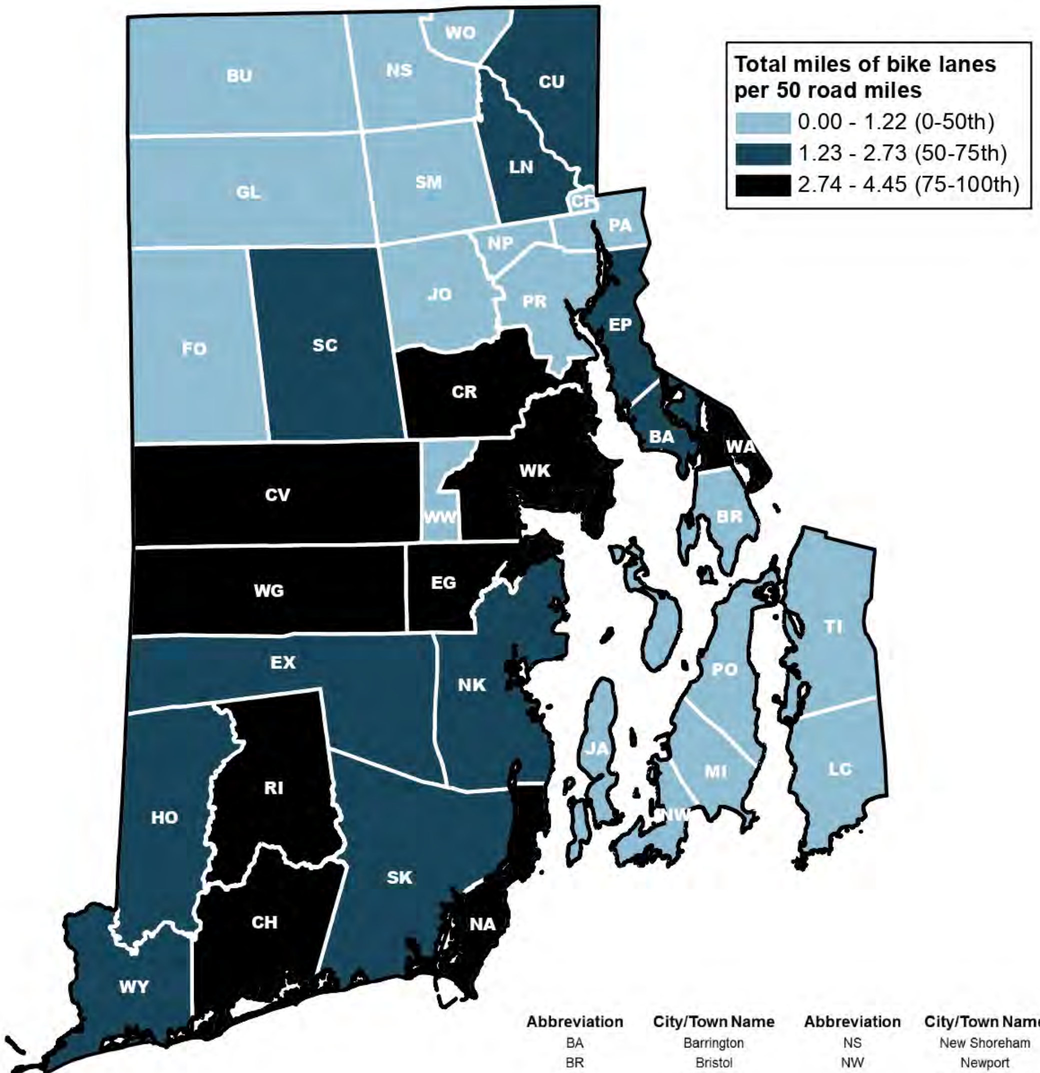
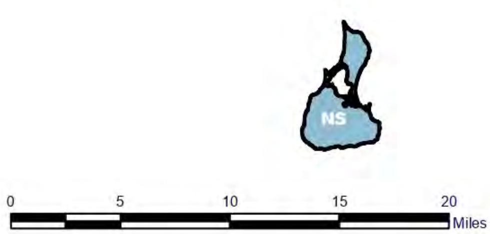
Map 46: Total miles of bike lanes per 50 road miles





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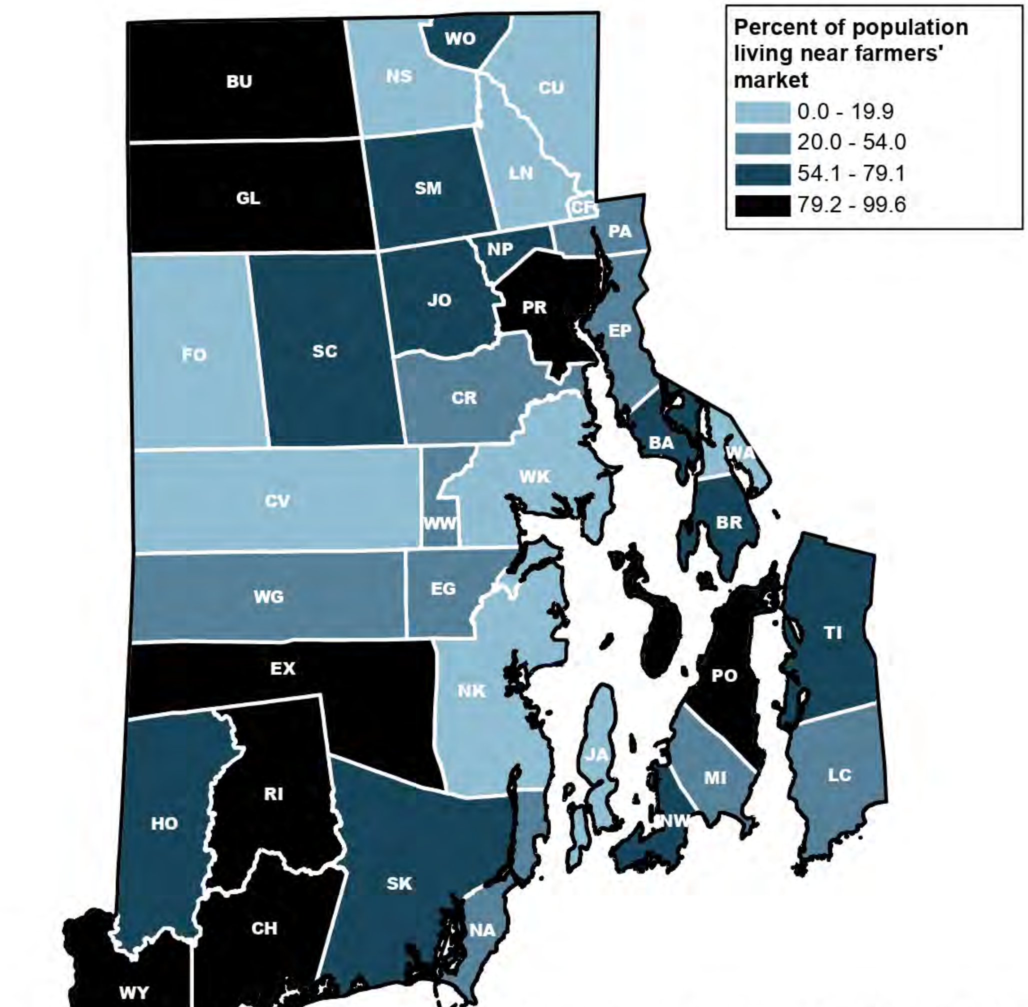
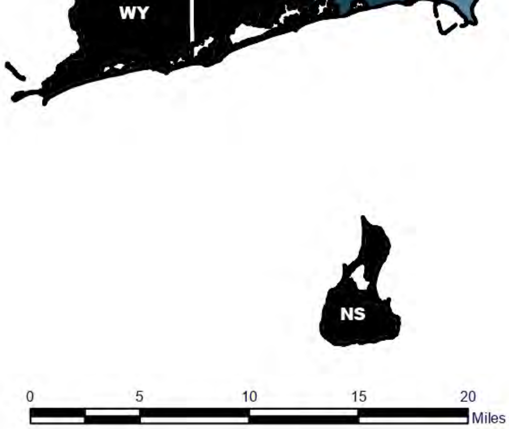
Map 47: Percent of population living near farmer's market





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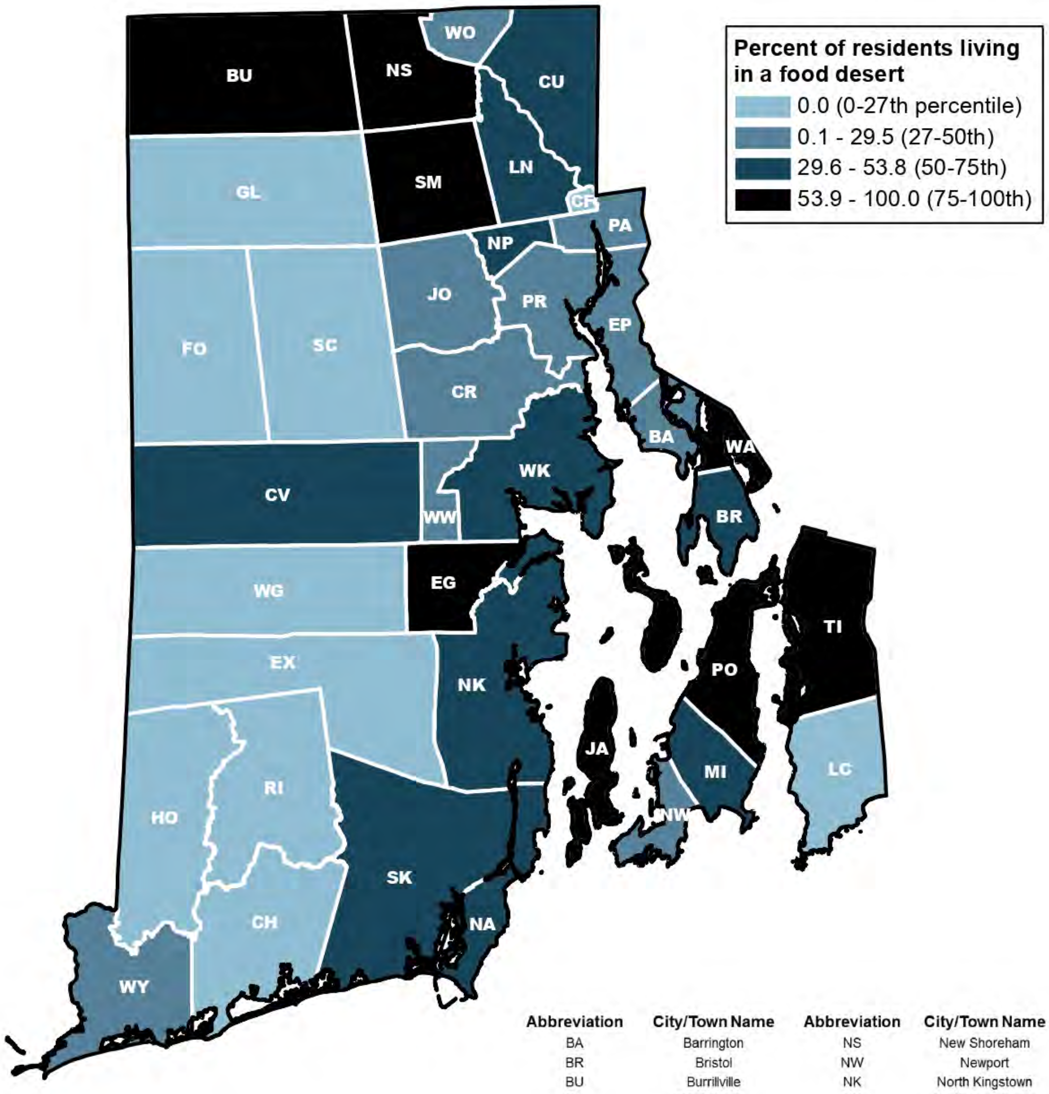
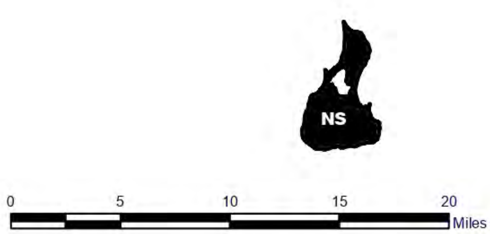
Map 48: Percent of population living in “food desert”





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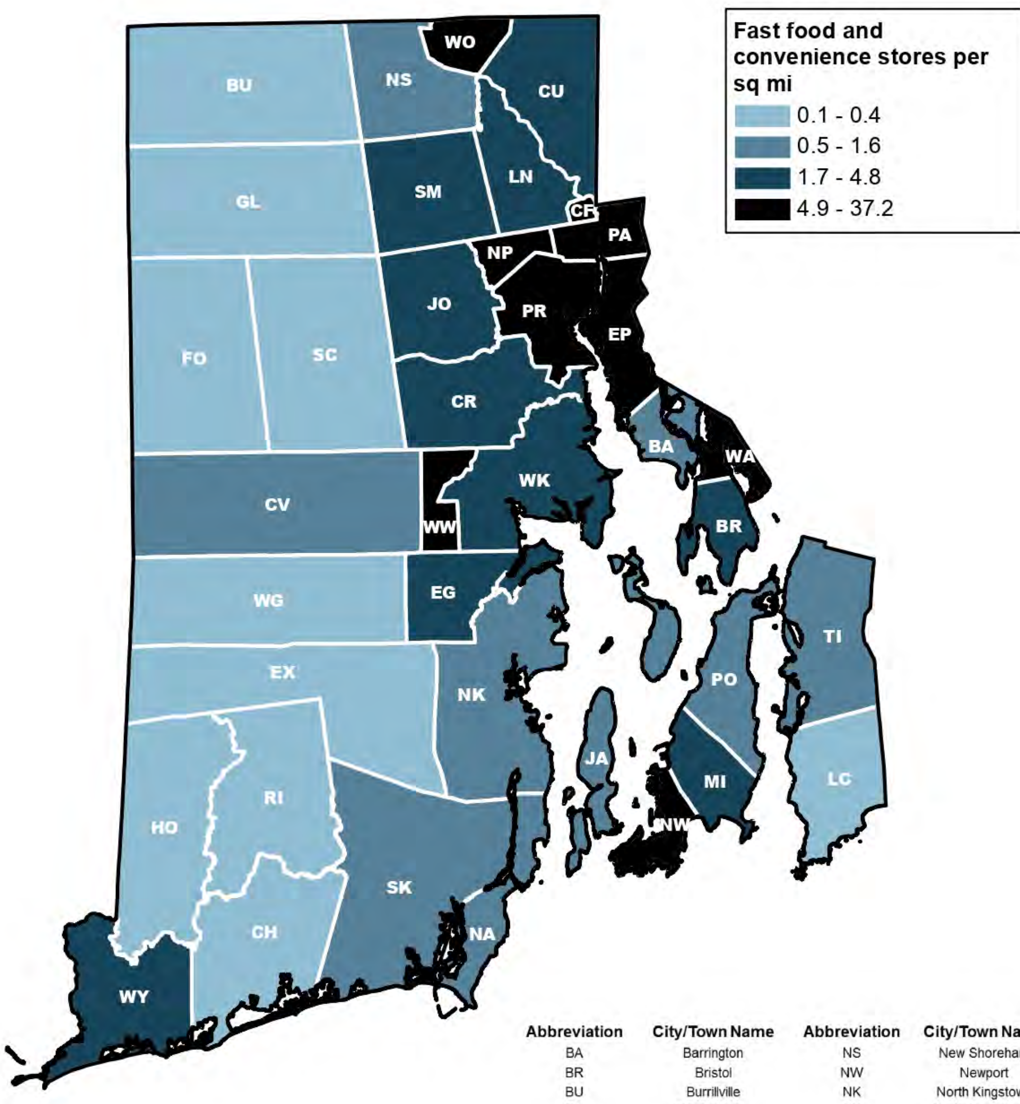
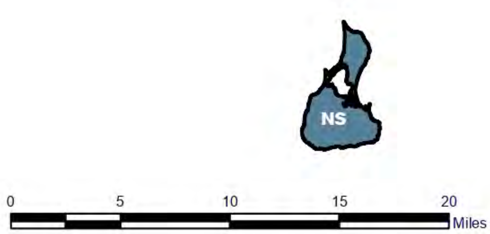
Map 49: Fast food and convenience stores per square mile





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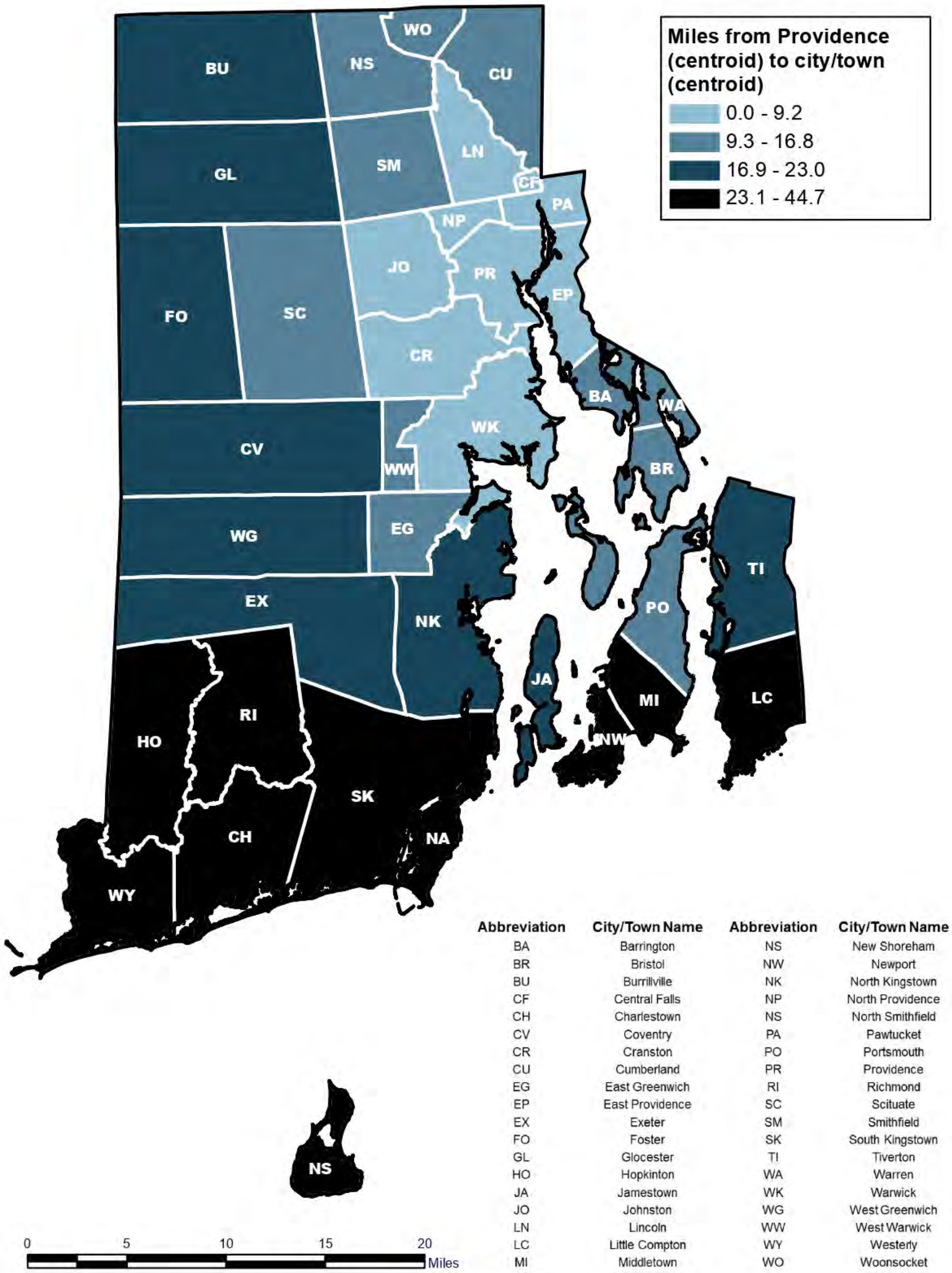
Map 50: Average miles to nearest metropolitan area (Providence)



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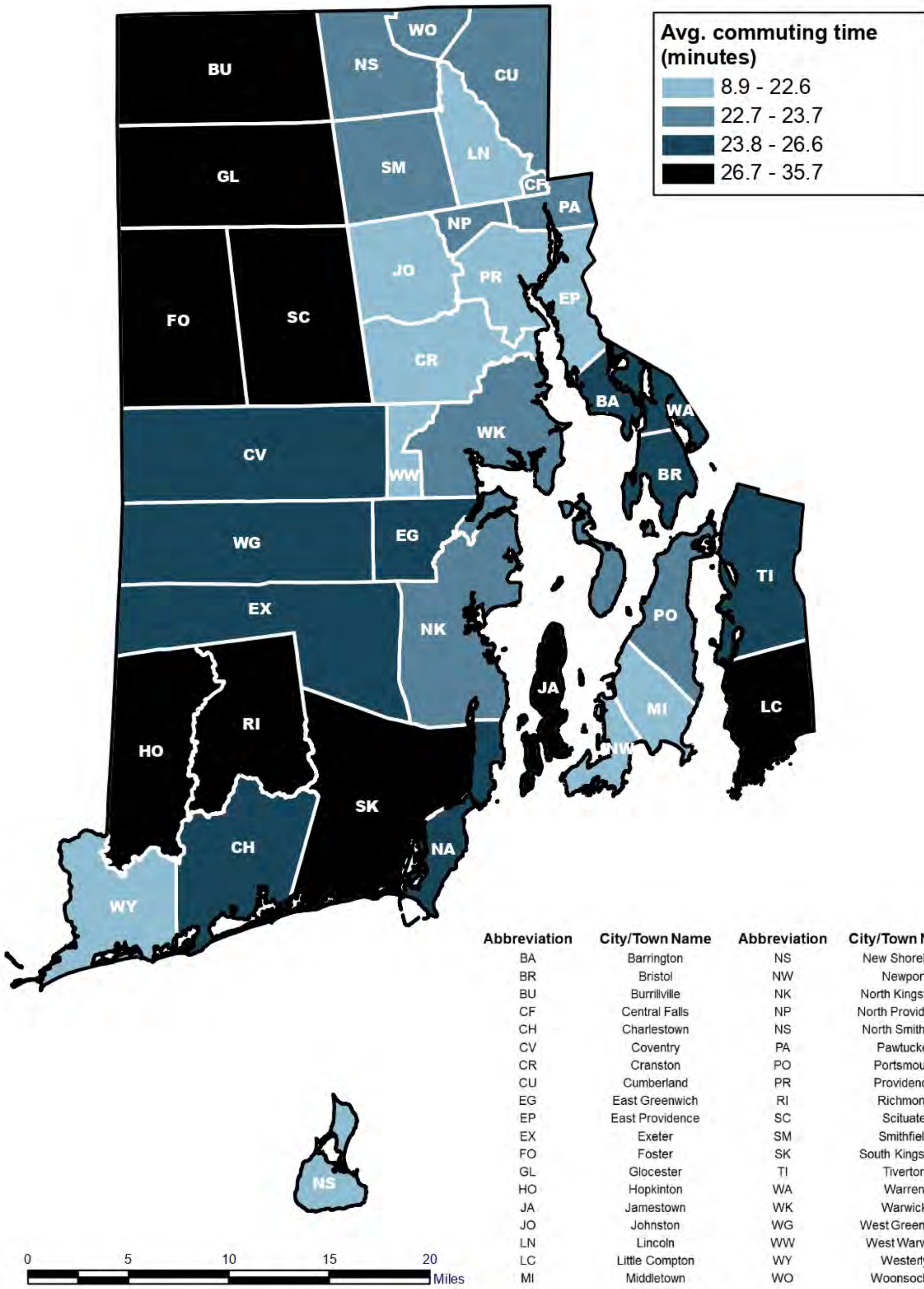
Map 51: Average commute time (minutes)



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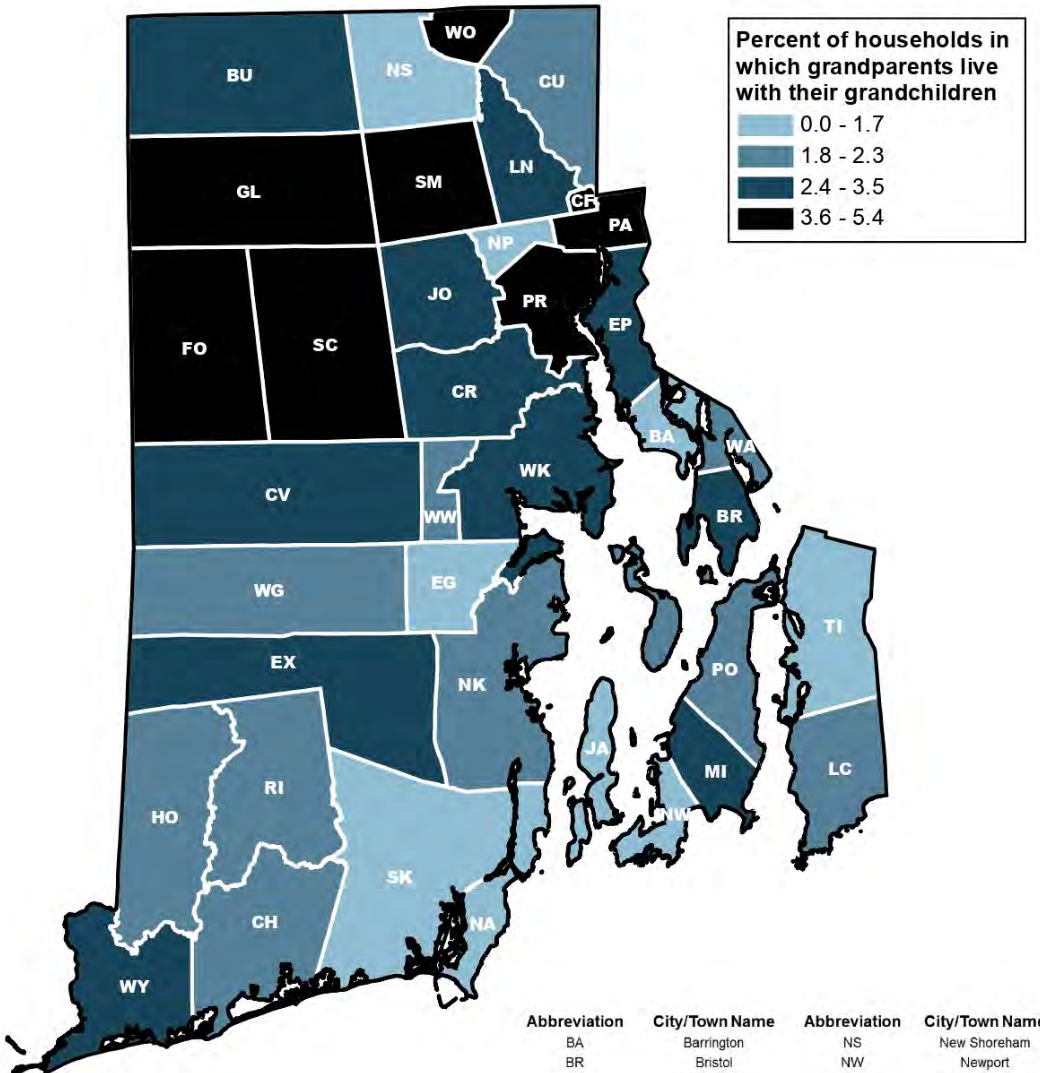
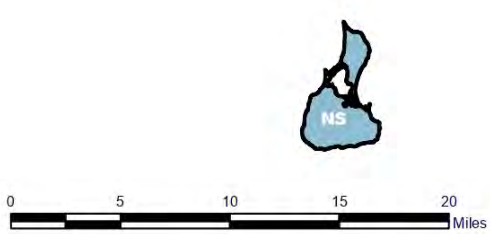
Map 52: Percent of grandparents that live with grandchildren





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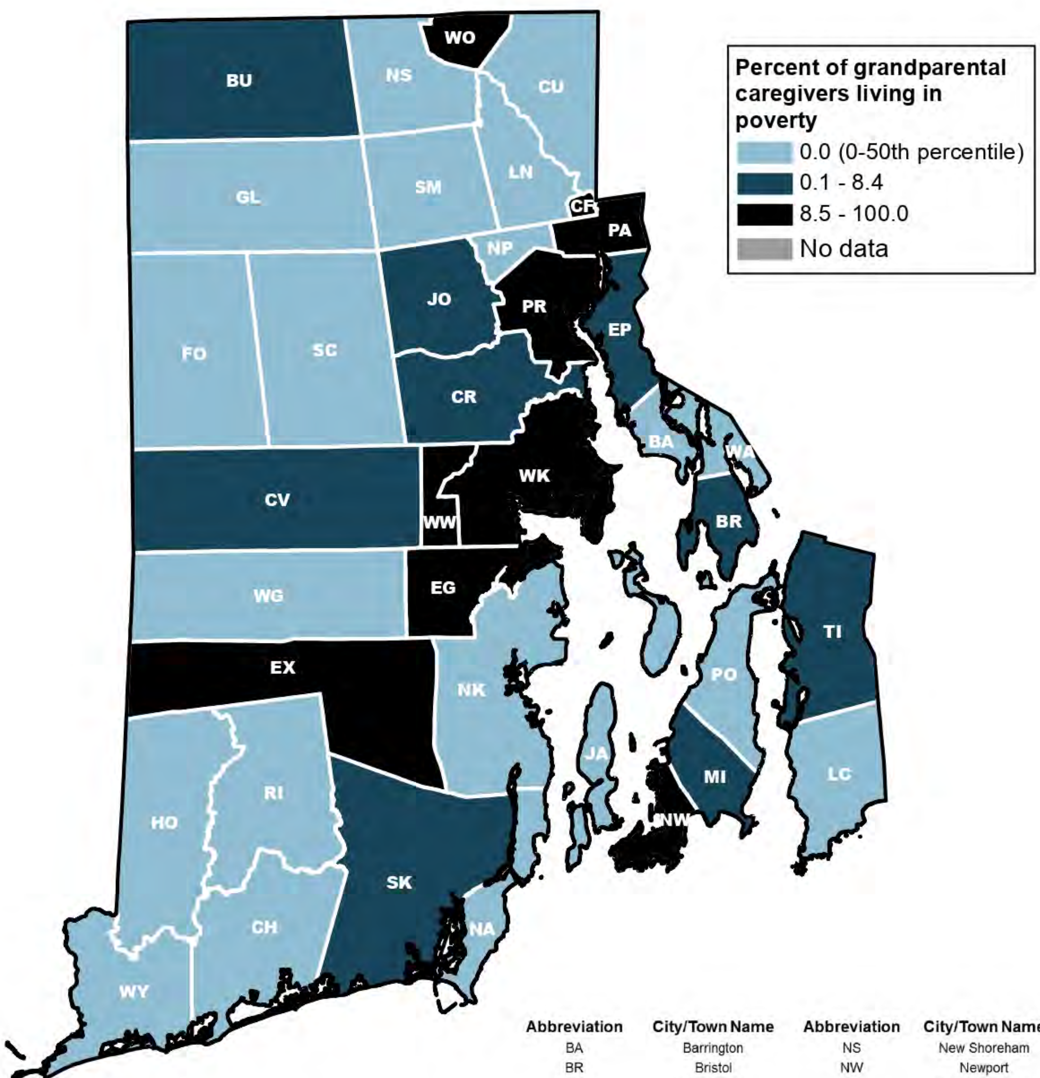
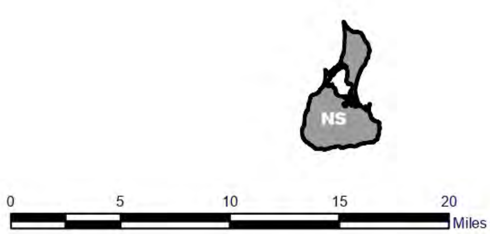
Map 53: Percent of grandparental caregivers living in poverty





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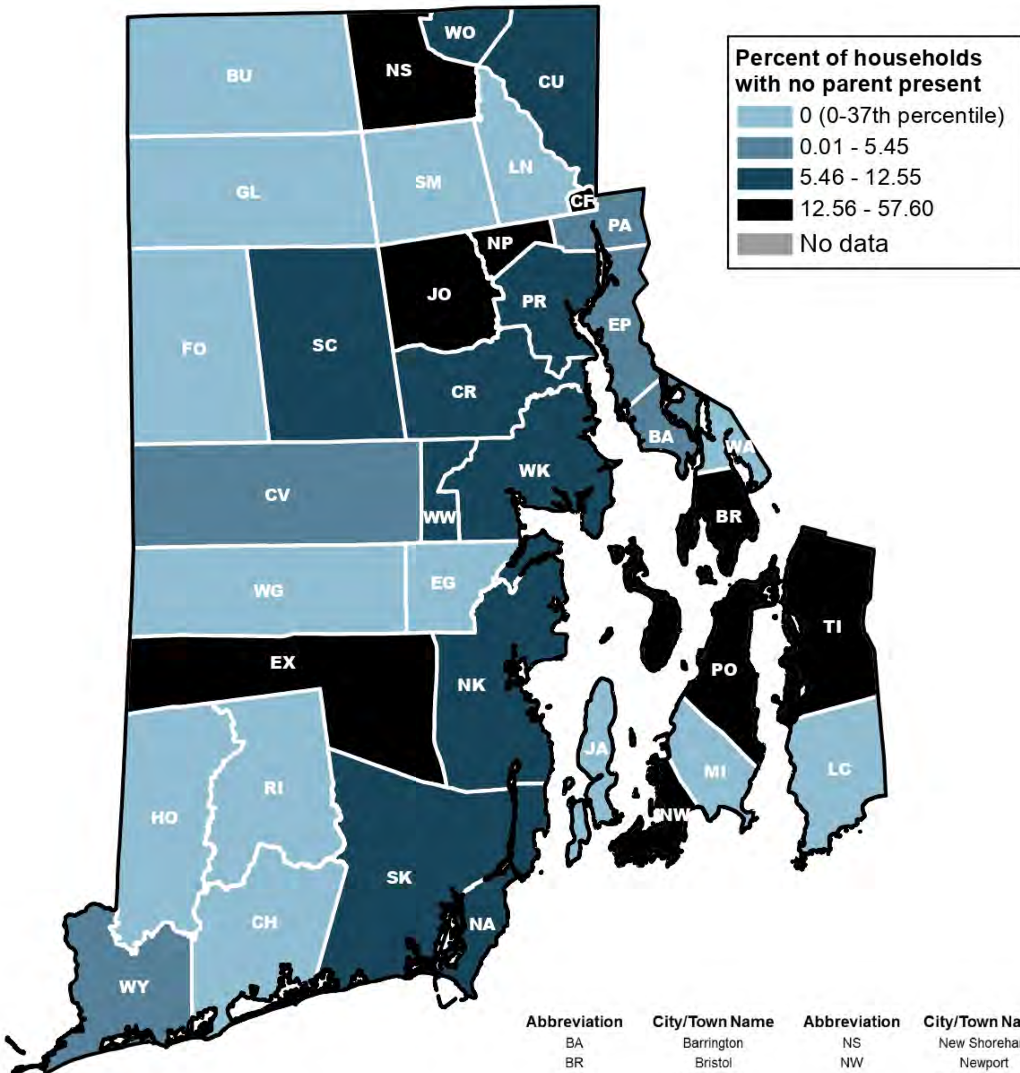
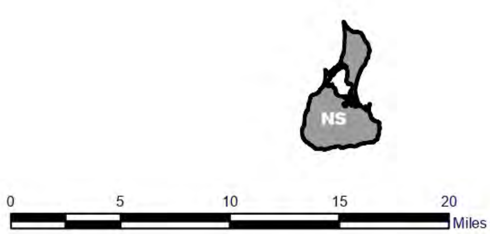
Map 54: Percent of family households with children but without parent present





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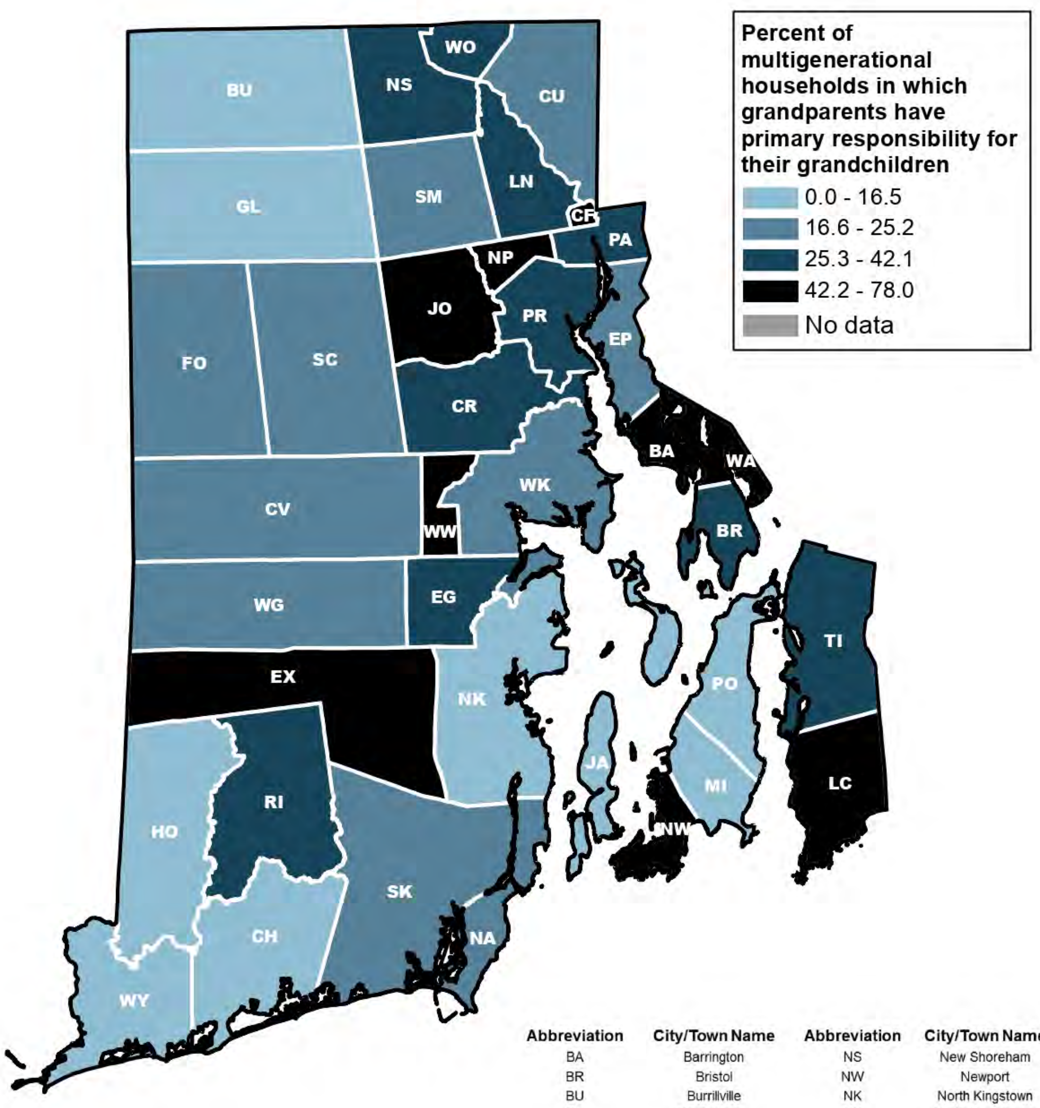
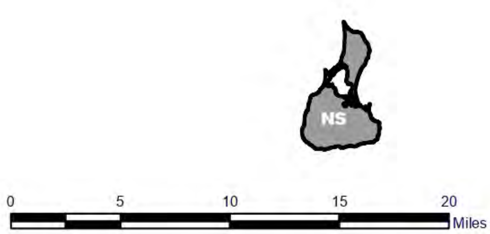
Map 55: Percent of grandparental caregivers w/ primary responsibility for grandchildren





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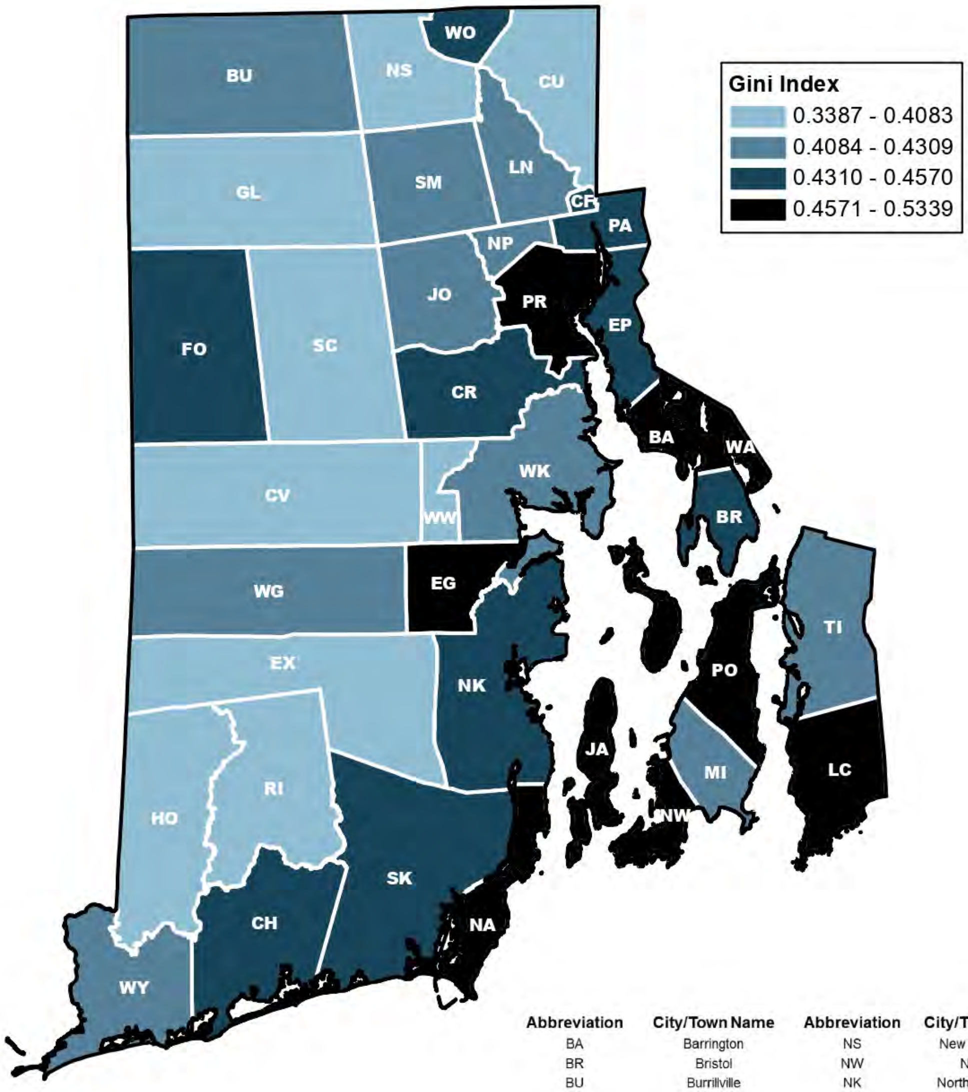
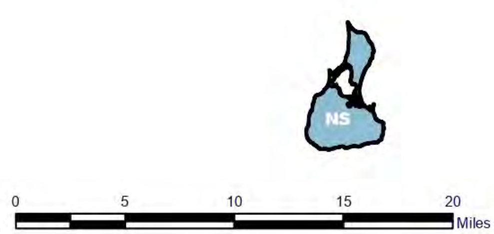
Map 56: Gini index of income inequality (higher = greater income inequality)





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Appendices

Appendix A: Accepted abstracts at the American Public Health Association Annual Meeting, November 2-6, 2019, Philadelphia, PA.

Abstract # 444771

Introduction: Understanding and addressing the causes of place-based health disparities have focused primarily on understanding social determinants of health on a large geographic level, such as the region, state, or county. However, there is a growing need to assess and understand how place-based characteristics at smaller geographic areas relate to of local place-based neighborhood characteristics on population health.
Objective: The objective of this study was to evaluate the magnitude of the associations between a variety of social determinants and life expectancy (LE) and related measures on the community or municipality level.
Methods: LE at birth (LE0), remaining LE at age 65 (LE65), and age-specific mortality rates (ASMR) were calculated from mortality data (2009-2011) from the Rhode Island Department of Health (RIDoH) using abridged life table methods for each RI city/town. City/town-specific LE and ASMR were linked to the US Census, RIDoH, the Federal Bureau of Investigation, and other databases that include information on multiple social, environmental, and demographic determinants of health. Bivariate and partial correlations were examined between city/town-level LE0, LE65, and ASMR and the examined social determinants: demographics, household size and composition, income and poverty, education, environment, food insecurity, crime, transportation, and rural-urban status.
Results: LE0 (range: 75.9-83.3 years) was most strongly associated with the percent of the population with a graduate/professional degree ($r=0.687$, $p<0.001$), violent crime rate ($r=-0.598$, $p < 0.001$), and per capita income ($r=0.553$, $p<0.001$). Similar results were observed for ASMR: ASMR was associated with the percent of the population with a graduate/professional degree ($r=-0.596$, $p<0.001$), violent crime rate ($r=0.450$, $p=0.005$), and per capita income ($r=-0.533$, $p<0.001$). The associations between LE65 and social determinants were more attenuated, however. Of note, none of the three mortality measures (LE0, LE65, or ASMR) were associated with any of the race/ethnicity variables.
Conclusions: There are several important place-based characteristics associated with mortality (LE and ASMR) among RI cities/towns. Additionally, some communities had unexpectedly high LE and low ASMR, despite poor social indicators.
Public Health Implications: These results highlight substantial place-based disparities in mortality and potentially addressable social determinants that could improve population health and reduce place-based disparities among neighboring communities.

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Abstract # 440381

Introduction: Life expectancy (LE) is a widely used measure of population health that represents the average lifespan based on current death rates. LE can be used to detect place-based health disparities at fine geographic levels, such as the municipality and neighborhood. This study's primary objective was to compare three measures of mortality--city/town-level LE at birth (LE0) and age 65 (LE65)--and age-standardized mortality rates (ASMR) and examine outliers. A secondary objective was to identify methodological challenges in estimating LE on the city/town level.
Methods: LE0, LE65, and ASMR for all Rhode Island (RI) cities/towns were estimated based on population data and all deaths occurring in 2009-2011 in five-year age groups using life tables. Correlational and regression analyses were used to estimate the associations among the measures and obtain outlier cities/towns.
Results: Of all five-year age groups in RI cities/towns, 9.8% had death counts of zero, necessitating the substitution of state-level age-specific mortality rates to estimate LE. ASMR was strongly correlated with LE0 (r=-0.872, p<0.001) and LE65 (r=-0.863, p<0.001). The association between LE0 and LE65 was weaker (r=0.578, p<0.001). Two communities were outliers for the LE0-L65 association: Community 1 (standardized residual -2.46, high LE0, low LE65) and Community 2 (standardized residual +3.86, low LE0, high LE65).
Conclusions: LE estimation on the city/town level carries important methodological challenges (e.g. zero death counts, heterogeneity of city/town population size). Although LE0 and LE65 were highly correlated with ASMR, there were notable discrepancies in some communities between LE0 and L65 that merit further study.

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