Comparative Food Pricing in Newfoundland and Labrador using Citizen Science, 2020-2021

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CLEAR, Memorial University

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The NL Food Pricing dataset and some figures tables are freely available online at: https://civiclaboratory.nl/nl-food-pricing-project/ & https://zenodo.org/record/7712681#.ZAoEOezMLnQ Dataset DOI: 10.5281/zenodo.7712681

This report is the result of a partnership between CLEAR (Memorial University), the Nunatsiavut Government, and the Social Justice Co-operative NL. It was funded by Memorial University's Public Engagement Fund, the Smallwood Foundation, Memorial Undergraduate Career Employment Program, and by a Social Science and Humanities Research Council Insight Grant.

Research design underwent ethics review by the Nunatsiavut Government Research Advisory Committee (NGRAC), as well as peer review by the Smallwood Foundation and Public Engagement Fund selection committees at Memorial University. We obtained permission from Miawpukek First Nation and NunatuKavut Community Council for citizen scientists to collect data in their areas (though this did not necessarily mean there is corresponding data for these locations).

We acknowledge that this analysis was conducted on the ancestral homelands of the Beothuk, and the island of Newfoundland as the ancestral homelands of the Mi'kmaq and Beothuk. We would also like to acknowledge the Inuit of Nunatsiavut and NunatuKavut and the Innu of Nitassinan, and their ancestors, as the original peoples of Labrador. This research was conducted on their homelands. Whenever data collection occurred within land claim or customary land use areas, permission and permits were sought from Indigenous governments.

We are grateful to the many volunteer contributors of data, review, and analysis, including (in alphabetical order): Alison Bennet, A.B., A.H., A.W., Barry Darby, B.L., Christine Knott, C.W., D.S., D.W., Emma Ford, E.P., F.D.S., J.D., Janine O'Reilly, J.O., Jill Wheaton, J.W., K.C.M., K.S., Lorna Knight, Lorraine Allen, Madison Acker, M.K., Melissa Samms, Nancy Penney, N.P., Nikki Wright, P.A., Riley Cotter, R.A.D., R.R., S.B., Sarah Ferber, Scott Neilsen, S.P.T., Tracey Galloway, as well as those who wish to remain anonymous.

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EXECUTIVE SUMMARY

This report presents a basic analysis of food prices collected across Newfoundland and Labrador (NL), Canada from October 2020 to December 2021. Our goal was to increase the temporal resolution of available data on food pricing by monitoring weekly or bi-weekly food prices in more than twelve communities across the province.

Unlike many other annual or "one-off" collections of consumer pricing information, this dataset reflects the complexity of price fluctuation in many regions from week to week, month to month, and season to season. Both data collection and analysis were driven by citizen science, which allows a nuanced, ground-up understanding of food pricing and the retail environment in different communities.

It is important that all levels of government, institutions, businesses, and organizations have access to community-driven information, so effective policies can be created to mitigate food insecurity and promote sustainability in rural and remote communities. An important preliminary finding of this report is that there is acute unevenness in food pricing and food availability across the province, with significant differences even between rural communities.

Across the study, locations and frequency of data collection were determined by where citizen science volunteers were located and their ability to collect data in that location. Data collection began shortly after the COVID pandemic began. Data was primarily collected in-person at local stores; however, in-person data collection was interrupted by a provincial lockdown that took place from mid-February through mid-March 2021. During this time, observations were primarily collected from online shopping sites when possible, but there are still gaps in the data. Further, more concentrated, local outbreaks during data collection caused some periodic data sparsity for affected areas. Volunteers indicated whether the food prices were retrieved in-store or online.

Evidence of the extent and impact of food insecurity in Canada is reported by PROOF, based on data collected by the Canadian Community Health Survey (Tarasuk 2020). Households experience food insecurity when members experience one or more of the following: running out of food or limiting their selection of food due to lack of funds, compromising the quality and/or quantity of food, or missing meals and reducing their food intake. The inability to afford food has a significant impact on one's physical and mental health and well-being.

The most current Canadian Community Health Survey information released for 2017-18 shows that 14.7% of households in Newfoundland and Labrador are food insecure (Tarasuk 2020). Among the 35 census metropolitan areas across Canada, food insecurity was most prevalent in St. John's, affecting more than 1 in 6 (17.3%) households in the city (Tarasuk 2020). In Nunatsiavut, food insecurity impacts 68.4% of residents (Inuit Tapiriit Kanatami 2021).

Key findings

While the main goal of this project was to create an open-source dataset for change-makers and others, we have also completed preliminary analysis using descriptive participatory statistics, where community members guided research questions and data queries. Key points include:

- Of the locations in this study, the most expensive food prices across the province are in Nain. In descending order, other locations with the highest prices for which there is significant data are: Rigolet, Hopedale, and Port aux Basques (Figure 3).
- Regionally, Nunatsiavut has the highest average prices of food, with Western and Labrador Grenfell next, then Eastern, then Central (Figure 4). This finding differs from the NL Food Basket data (Newfoundland and Labrador Statistics Agency n.d.), where Labrador Grenfell has the highest average price of food, followed by the Western region. We split the Labrador Grenfell region into smaller parts.
- Food pricing is characterized by high variability over time (large differences between highest and lowest pricing). Nain has the greatest variability of food pricing, followed by Port Hope Simpson, Rigolet, and Port aux Basques (Figure 9). These are the same places with the highest food costs. The foods with the highest variability in pricing by unit (to accommodate for different sizes and weights of the same food) are black tea, canned tuna, and cheddar cheese. The most stable prices are for fresh milk, fresh corn, Coca Cola (or Pepsi), and eggs (Figure 10).
- The food retailer (e.g., Dominion vs Frank's) has less impact on food pricing than locality, meaning that different retailers in the same place are more aligned in pricing than the same retailer in different places.
- The degree to which the Nutrition North Canada (NNC) food subsidy affects food prices in participating communities is unclear and unable to be determined in this analysis.
- Local prices are impacted by national and geopolitical trends such as the federal rise in inflation, and season has a complex relationship to local prices (it is not simply that some produce is least expensive when they are in season, as sometimes this is not the case).
- Consumers use a wide variety of strategies, such as shopping for sales, visiting multiple retailers, using phone applications ("apps"), subscribing to loyalty programs, and substituting goods to reduce food costs. However, on average, differences between sale and non-sale items were minimal when the size or weight of food items was considered. Given that consumers are already using various strategies to decrease food prices and given that the presence of more sale items in a grocery trip did not decrease the average grocery bill, interventions that focus on consumer thrift are not likely to significantly impact food security.

How to use this report

This report highlights basic trends in biweekly price data in Newfoundland and Labrador. The report is written for a general audience of policy makers, communities, NGOs, industry leaders, researchers, and the general public.

This is a pilot project, meaning it was designed to test the feasibility and results of a citizen science data collection project that could span the province over time. It has resulted in a dataset that any organization or individual is welcome to use and recommendations for designing future, similar studies are provided in the conclusion. This report is a small taste of what the dataset can show. If you are

pursuing the dataset for your own research, please consult the Appendix section on the limits and strengths of the dataset.

The NL Food Pricing dataset and all figures and tables are freely available online at https://civiclaboratory.nl/nl-food-pricing-project/

The NL Food Pricing dataset

Citizen scientists collected 4698 records. Each record is for the price and other variables for each food item. Data collection began in October 2020 and concluded at the end of December 2021. Volunteers were provided with a paper or digital form to collect data on 23 food items, including availability, price, unit size, and whether the item was on sale. Packaging type was also included after February 5, 2021. Data was cleaned and validated by CLEAR lab staff at Memorial University.

The dataset was first available in December 2021 in advance of participatory statistics meetings; the dataset was further cleaned and updated. The updated dataset used in this report. The dataset is available online at Zenodo.org (an initiative of OpenAIRE) and at civiclaboratory.nl.

Locations in the dataset are based on where volunteers shopped. Figure 1 shows how these data points are organized over time. See the Appendix for a summary of data points for each community.

For some locations continuous data is available throughout the course of collection. For others there is a single date, creating a snapshot of food prices (Figure 1). The gaps in data collection reflect the availability of individual volunteers to collect data as well as restrictions due to COVID-19 public health measures, particularly during lockdowns in February and March 2021. See the Appendix for other notable dates that may impact data collection and food pricing.

Place (city/town)	October-2020	November-2020	December-2020	January-2021	February-2021	March-2021	April-2021	May-2021	June-2021	July-2021	August-2021	September-2021	October-2021	November-2021	December-2021
Nain						11	128	182	111	120	117			13	
Clarenville	211	85	85		38	106	81	43	80	123	43	37			
Happy Valley Goose Bay	171	128	127	42	42		127		44	64	43	22	108		
St. John's				1	42	94	65	89	56	115	12	21			
Corner Brook				11	42	14	37			111	71	83	56	9	
Carbonear										43	88	44	44		
Baie Verte										31	16	48	58	12	
Rigolet							12		19	17	15		17	20	
Gander					16		29	16	18	19	20			19	
Hopedale											37		30		
Port aux Basques								33		15	15				
Conception Bay South		22			22		21								
Grand Falls Windsor							13	26	24	1					
Bay Roberts				6	21			14	20						
Lewisporte					13	25	25								
Port Hope Simpson															38
Deer Lake						22									
Stephenville						22									
Burgeo									7						
L'Anse au Loup									4						
Charlottetown Labrador									1						
Mount Pearl									1						

Figure 1: Number of data points (prices of individual food items) collected in each place, per month. Due to low numbers, some locations were excluded from analyses (e.g. Mount Pearl), although they remained in the dataset

Price information for food items is available in two formats: either as a **unit price**, a cost per standard unit of volume, weight, or each (usually the price divided by the weight or volume), or as the **item price** as sold in store (what would be on your grocery bill). For example, in Figure 2 below, the top line is the **unit price** of 2L of fresh milk, compared with the item price of a single can of evaporated milk. For these items, the item price is divided by millilitres. The bottom line shows the average **item price**, or the cost of buying the item outright. Both offer different types of insight and are appropriate for different types of comparison and analysis. All graphs and analyses note which type of price is being used.

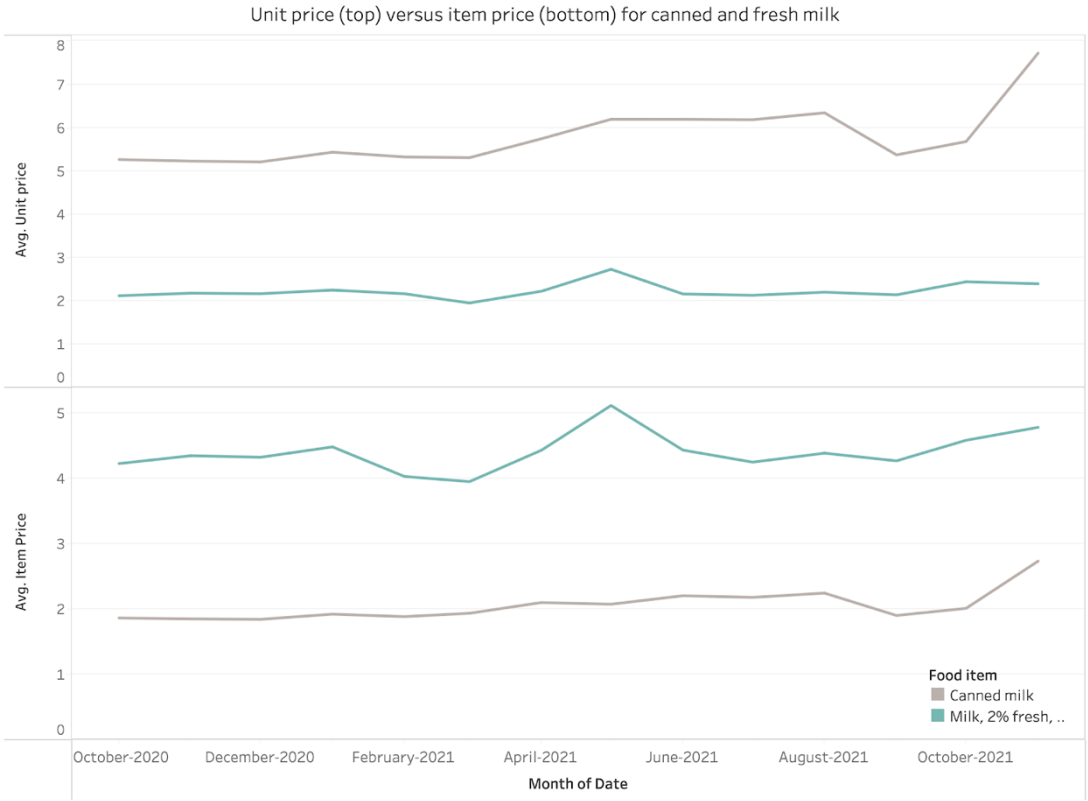

Figure 2: Unit price (top) versus item price (bottom) for canned and fresh milk. This shows that while buying a can of milk is less expensive than buying a carton of fresh milk, litre by litre the canned milk is more expensive. This report often uses unit price (item price divided by the weight or volume of the item) for comparison.

Citizen scientists used a set list of food items for which to collect data. Sometimes food items were not available or the full list was not collected. This has an impact on the interpretation of some analyses, such as average prices. For example, if a limited number of food items from the full list were recorded, the average price per community, region, or at a point in time would be less reliable for comparison.

Data has been cleaned and validated.

DATA COLLECTED

Each line in the dataset contains 19 fields of information about the date, place, and price of food item recorded (see the Appendix for an example of the data collection sheet). Column headings for location include the community name, latitude and longitude in decimal degrees, and region. Region is identified as the NL Health region (Eastern, Central, Western, and Labrador Grenfell) or Nunatsiavut. Additional information about the food item includes:

- Whether the food item was advertised as a sale or reduced in price (Yes/No, blank if not recorded)
- Whether or not the food product was available in the store at the time (Yes/No)
- Brand of the item
- Whether data was collected in person (at the physical store) or using an online or flyer option
- Packaging type, selecting from categories of plastic, none, can, cardboard/paper, cardboard/plastic mix, "other and specify", or blank if not recorded (Note: Inclusion of packaging type began after February 5, 2021.)
- Whether the item qualifies for any Nutrition North Canada retail subsidy program (Yes/ No) (Note: This was added by CLEAR staff after data collection and prior to analyses.)

Forms had space for notes or observations as reported by volunteers. These are typically notes on business of the store, stock of food, promotional prices, quality of food, and issues with weather that may have impacted transportation. See the Appendix for an image of the full form.

LIST OF FOODS

Twenty-three (23) food items were selected for data collection based on many conversations with research partners, end-users of data, and the project team. Food items were selected for cultural relevance (foods that are important and meaningful in the province) and the ability to compare subsidized and unsubsidized foods, nutrition of similar food (e.g. fresh vs canned), and to compare wild-caught versus store-bought meats. Some items were selected on the basis of comparison with food items in other food pricing research lists created by Nutrition North, Statistics Canada's Nutritional Food Basket, New Brunswick's Good Cost Survey, the Nunavut Food Price Survey, and the Canadian Consumer Price Index. A complete description of traits and rationale for item inclusion is available in the Appendix. The list of food items, with recommended size and brands to record, includes:

- Apple, fresh
- Tomato, fresh
- Celery, fresh
- Milk, 2% fresh, 2L
- Eggs, dozen, fresh
- Ground beef
- Tuna, canned
- Tomatoes, canned
- Canned milk (Carnation if possible)
- Peanut butter
- Black tea (orange pekoe)
- Coca cola (2L if possible)
- Ammunition (shotgun)

When volunteers had additional time, they were also asked to collect:

- Orange, fresh
- Carrot, fresh
- Lettuce (iceberg), fresh
- Corn, fresh
- Peas, frozen
- Corn, frozen

- Corn, canned
- Bread, whole wheat
- White flour (Robin Hood if possible)
- Cheddar cheese

METHODS

Collaboration

Citizen science, where members of the public collect and analyze data, has informed each aspect of the NL Food Pricing Project. Arising from the original community research question—"Why is food so expensive here?"—a collaborative partnership grew between CLEAR, the Nunatsiavut Government, and the Social Justice Co-operative NL to design and carry out a research project that could include participants from both science and nonscience backgrounds.

Project partners met many times to decide on the principles of the project. We invited experts in food pricing research to advise us. Together, we developed the food list and data collection tool, which we tested with members of CLEAR to ensure usability.

CITIZEN SCIENTIST RECRUITMENT

Volunteer citizen scientists were recruited through targeted individual emails (people known to the project team who were in locations that were important to project partners, particularly in Nunatsiavut), social media, and media interviews. Whenever a citizen scientist who was based in a land claim or Indigenous traditional use area offered to join the project, the project team reached out to the research advisory board of each Nation/Council for permission and permits. All citizen scientists took part in virtual orientation meetings and check-ins with the project team.

Twenty-seven volunteers were involved in data collection; two paid CLEAR staff members collected data biweekly.

PARTICIPATORY STATISTICS

Given the geographical differences within this project and the hypothesis that location greatly influences food pricing, local knowledge is crucial for successful analysis (Barahona 2002, Holland 2013, Lee 2018). In participatory statistics, community members analyze the data together using local knowledge and research priorities to refine research questions, query relationships, and test hypothesized correlations. A trained researcher used a data visualization tool (Tableau) to input these queries into the dataset, and participants discussed results. Many of these data visualizations are part of this report. Participants in analysis included the citizen scientists who were part of data collection, members of the Nunatsiavut Government, Social Justice Co-operative NL, Food First NL, and members of the interested public (these meetings were advertised on social media and were open to all). Three virtual meetings for participatory statistics were conducted in all.

This report reflects the research questions of the group who participated in these collaborative analysis meetings.

EXISTING DATASETS AND RESEARCH ON FOOD PRICING

Information on food price is collected by governments, researchers, and community groups for a variety of purposes. There is considerable study of food pricing and food insecurity in the province (Loopstra et al 2015, Mah et al 2018, Reza 2019, Tarasuk et al 2019) and in particular areas such as Nunatsiavut (McTavish et al 2017, Nunatsiavut Government 2017, Bowers et al 2019) and even Memorial University (Blundell et al 2018), with some work on food sovereignty in terms of hunting and fishing for both settlers and Indigenous communities (Montevecchi et al 2007, Organ 2012, Lowitt 2013, Foley & Mather 2017). We build on many of the insights of this research, particularly in terms of the complex economic geography of the province and its wild food distribution systems (e.g. Foley & Mather 2017).

But as the partners in this project have noted, most of the data on food security and sovereignty in the province relies on low resolution data where entire regions are averaged together (which can find that food security in the province as a whole is dropping even though it is rising in Nunatsiavut, e.g. Loopstra et al 2015 vs McTavish et al 2017), and where temporal trends are likewise averaged over years so they cannot distinguish temporal impacts of weather, seasons, and paycheck cycles. Indeed, the goal of this project is to see how existing research holds up to high-resolution geographical and temporal data. For instance, what happened to food security during Snowmageddon 2020 (weather state of emergency) or the start of COVID-19 lockdowns? We anticipate that it suffered, but where, how, and to what degree did food pricing play a role in different areas, and did these areas recover? If so, how quickly? Was the recovery even across different types of food? Existing average data collection design cannot answer these questions.

Nationally, **the Consumer Price Index (CPI)** measures a fixed list of consumer goods and services collected monthly in Canada. This information is used to guide economic policies made by institutions (such as the interest rate set by the Bank of Canada) and governments (for example, the minimum wage in NL). The CPI is made of up 299 items across 8 categories and is used to show trends in the percent change from year to year, whereby retail food items are disaggregated and available monthly across all provinces. It is not clear which retailers are included for which items.

The Market Basket Measure is designed to capture information on how people living on a low income can maintain a "modest, basic standard of living." It includes a specific set of qualities and quantities of food, clothing, footwear, transportation, shelter, and other expenses for a reference family of two adults and two children developed by Employment and Social Development Canada (ESDC). It is used by the Canadian Census to reflect the cost of purchasing specific items, including a nutritious diet as specified in Health Canada's 2008 National Nutritious Food Basket.

The province of Newfoundland and Labrador developed its own **NL Nutritious Food Basket** and collected data yearly until 2017. The measure was revised to reflect changes in Canada's Food Guide in 2019 and more recent data is not yet available.

Nutrition North Canada (NNC) is a federal program that provides a subsidy for some foods in the North directly to retailers and suppliers. There is important third-party research on NNC (e.g. Galloway 2014, Galloway 2017, St-Germain et al 2019).

Nunatsiavut Government has conducted several studies and surveys about food security and food sovereignty in Nunatsiavut (Nunatsiavut Government 2017), as well as community-based food assessments in partnership with FoodFirstNL (Flowers et al 2010, Airhart et al 2011). In alignment, the **Inuit Nunangat Food Security Strategy** is an Inuit-specific strategy for ending hunger in Inuit Nunangat,

including Nunatsiavut (Inuit Tapiriit Kanatami 2021). This research and these efforts are ongoing and are the origin of this research project.

Food Secure Canada (FSC) has conducted research on food costs in the North, particularly for First Nations communities (e.g., Veeraraghavan et al 2016).

FINDINGS

Food prices between places

AVERAGE FOOD PRICES BY PLACE

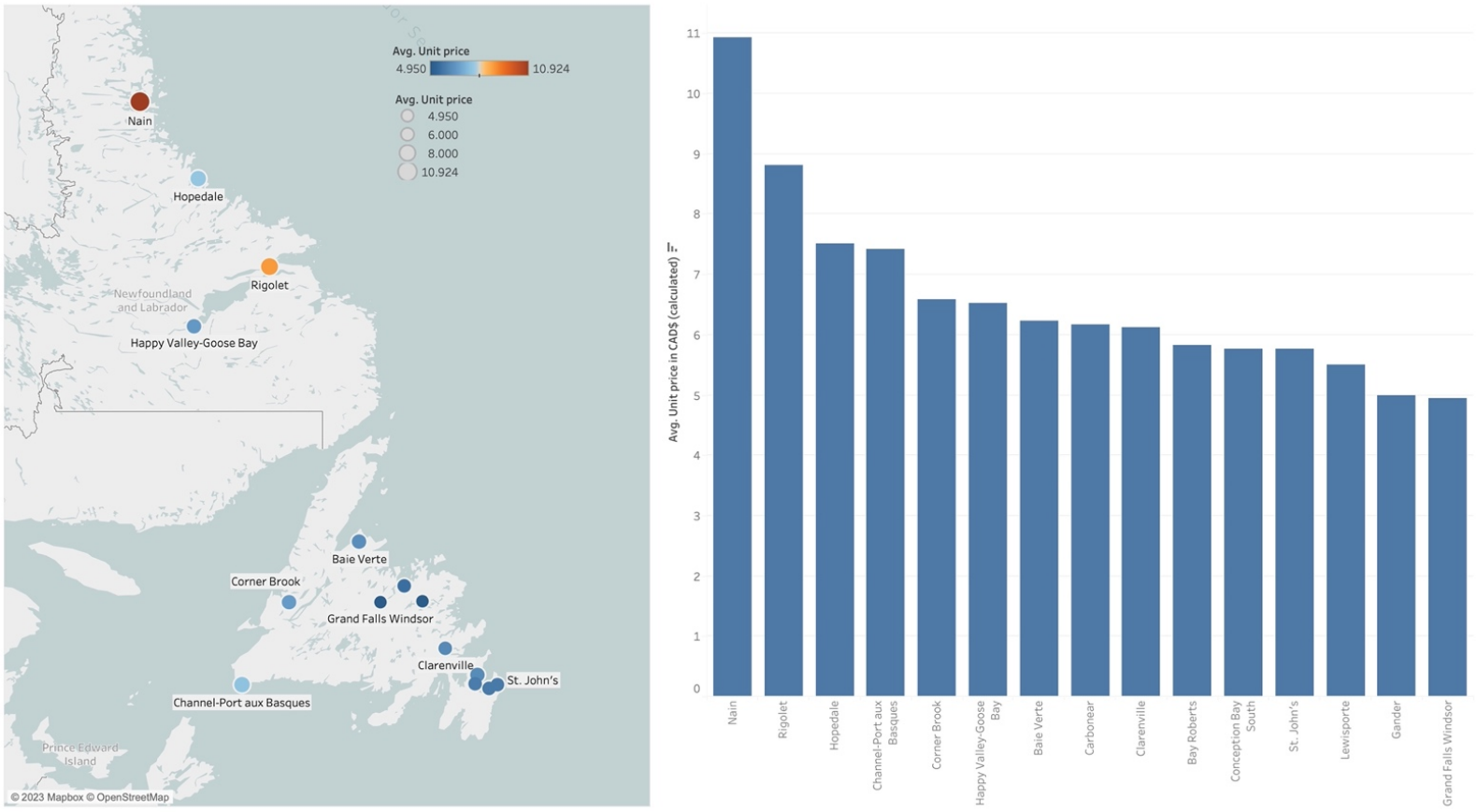

Figure 3: Average food prices by place (by unit). Only places with at least three dates of data were used to ensure comparability.

Regardless of the season, Nain consistently had the highest priced food by both unit and item prices. The next two highest priced places were also in Nunatsiavut: Rigolet and Hopedale. Port Hope Simpson was also comparable to Rigolet and Hopedale, but the data for Port Hope Simpson is not included in Figure 3 because data was collected for only one month (December 2021) and temporal variability is an issue in

the province (see section below). On the island of Newfoundland, Port aux Basques has the highest average food prices, even though it is the port of entry for much of the island's food supply.

HEALTH REGIONS

To compare regions, the data was coded to coincide with four health authorities, plus Nunatsiavut communities (Figure 4). Health services in Nain, Hopedale, and Rigolet are administered by Nunatsiavut Government Department of Health and Social Development, with an agreement for services with Labrador Grenfell Health.

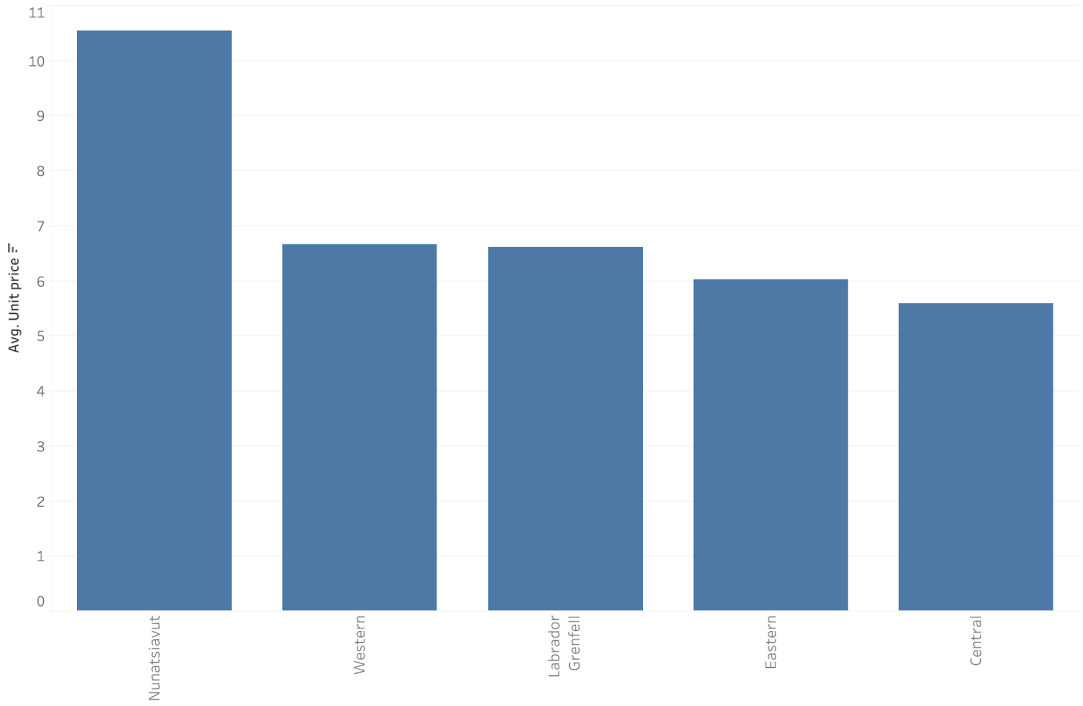

Figure 4: Average food prices by unit according to region. The ranking does not change when item price is considered instead of unit price, or when ammunition is included or excluded (as a high-priced, occasionally recorded item). Including or excluding locations with few data points does not significantly change the trend. This graph only includes locations with three or more dates of data.

The average unit price ranged from the lowest in Central and the highest in Nunatsiavut. In our dataset, the Central Region includes both Grand Falls-Windsor and Gander, which had the lowest average prices in the region. Depending on how data was arranged, Western and Labrador Grenfell were either tied or Western was slightly higher. When locations with more than one major grocery store were removed, the order shifted somewhat. Nunatsiavut stayed the same, then Western was the next highest, followed by Labrador Grenfell, Central, then Eastern. Thus, rural and urban prices impact regions in particular.

These overall trends have some overlap with those produced by the Newfoundland and Labrador food basket data for 2017 (NL Statistics Agency n.d.). They also found that the North Coast of Labrador had significantly higher food prices than other regions, including other regions in Labrador. Of the island regions, they found that Western was the highest (concurring with our data), then Central, then Eastern.

However, the order of Central and Eastern were reversed for the 2016 data. They also found that urban prices could be half of what rural prices were, especially in Central NL. The gap between urban and rural was less in Western NL (NL Statistics Agency n.d.).

RETAILER VERSUS LOCALITY

A primary research question in community analysis was the role that retailers played in food pricing. People consistently cited going to certain stores for specific items because of the relative price differences between retailers. However, when we compare the data there is a higher agreement in average prices between stores in a locality than between the same retailer in different localities. Figure 5 (next page) shows the average unit price of food by location, broken out by retailer. In Nain, while Frank's is less expensive on average than Northern (which aligns with lived experience of shoppers in Nain), both are still much higher than the Frank's in Hopedale or the Northern in Rigolet, though both are still in Nunatsiavut. Likewise, the Dominion, Sobeys, and Coleman stores in one region will be closer to one another in prices than the same retailer in another region.

AVAILABILITY

Access to food includes its affordability as well as availability. A lack of key items on the shelf is keenly felt in some communities when foods may simply not be in stock when you want to buy them. Table 1 summarizes the percentage of items on our grocery list that were not available by location. The highest figures are in Labrador, with Nain, Hopedale, and Rigolet having the highest rates of empty shelves for items. These are also locations with some of the highest food prices and highest price variability in the province.

Table 1: The percentage of times a food item was not on the shelf when a volunteer went to record it. Percentages allow comparability between locations with different amounts of data.

Location	% of time items unavailable
Corner Brook	0.47%
Gander	0.72%
Carbonear	1.38%
St. John's	1.82%
Happy Valley Goose Bay	3.85%
Clarenville	3.88%
Rigolet	4.85%
Hopedale	5.63%
Nain	9.24%

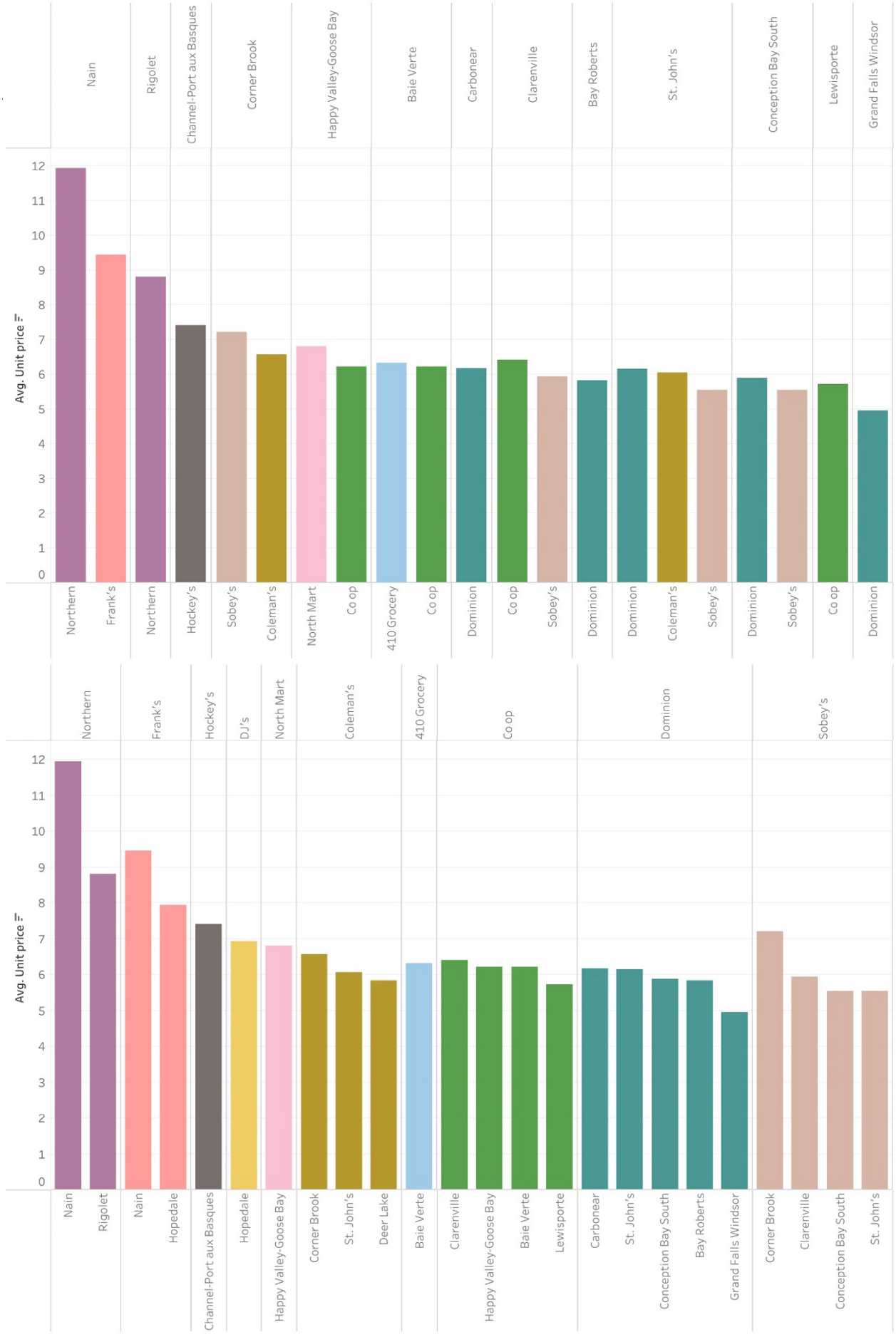

Figure 5: Top: The average unit price for each place, broken down by grocery store. Bottom: Grocery store chains grouped by average prices in different locations. Both: Colour indicates the grocery chain. Locations with too few data points that were excluded are: Burgeo, Charlottetown (Labrador), L'Anse au Loup, Port Hope Simpson, and Stephenville.

SUBSTITUTION

The lack of certain foods on grocery shelves is a widely acknowledged issue in Newfoundland and Labrador. "Fresh. Frozen. Canned. All Good Options." was a health promotion campaign that began in 2017, funded by the provincial government and delivered by regional dietitians in each Health Authority (Government of Newfoundland and Labrador 2022). Regional health authorities used the campaign to encourage fruit and vegetable consumption by informing the public that frozen and canned options are cheaper, more convenient, and nutritious substitutes for fresh produce (Central Health NL n.d.). substituting minimally processed produce in meals when specific items are not available or affordable (Government of Newfoundland and Labrador 2022). Nutrition North Canada (NNC) has parameters that allow the subsidy to be applied to make substitutions more affordable when fresh food is not available.

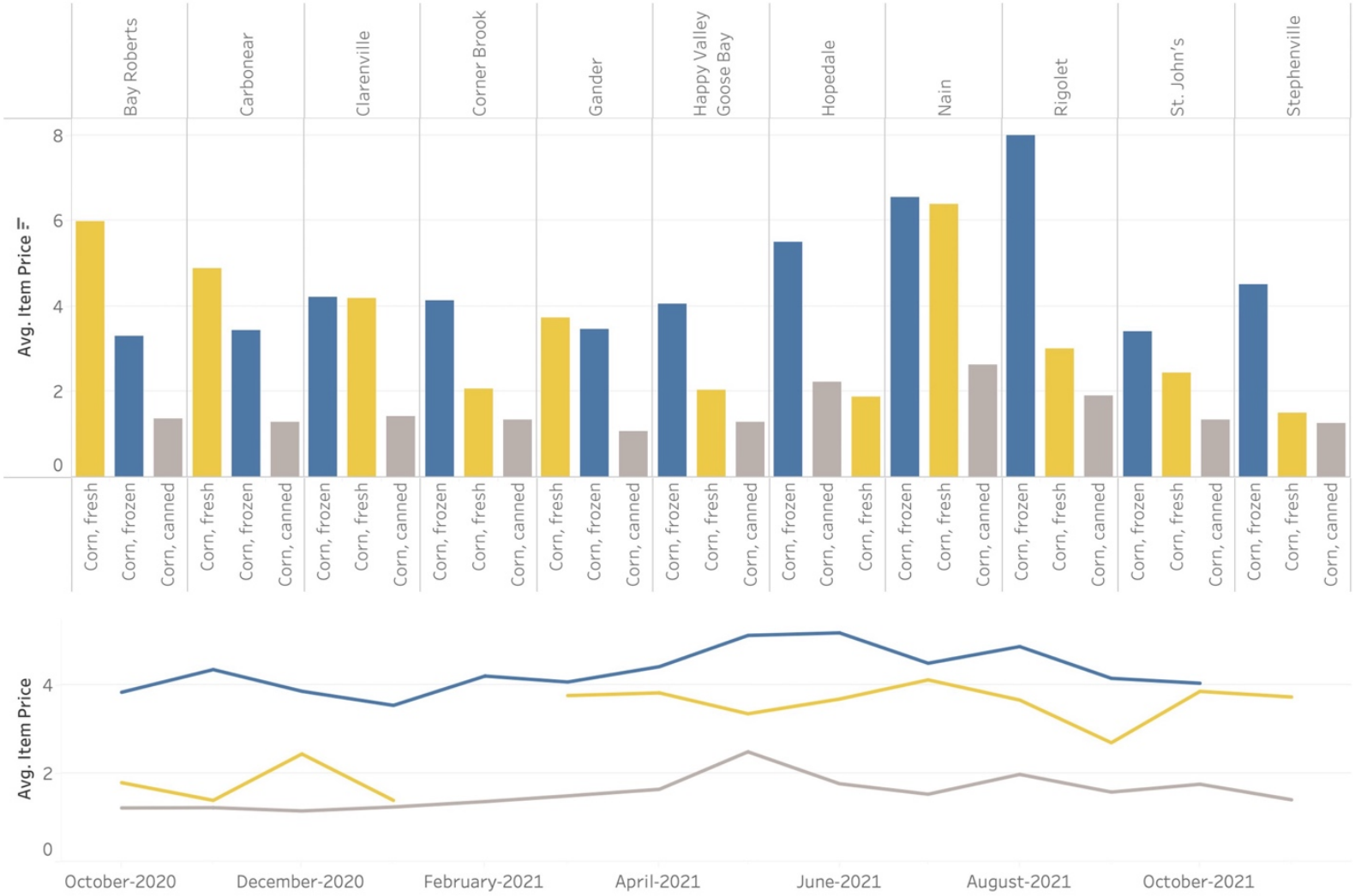

Figure 6: Comparison of item prices for fresh (yellow), frozen (blue), and canned (grey) corn. The top graph shows average item prices by location over the entire data collection period, while the bottom graph shows the average item price for all locations over time. Though frozen corn is less expensive than fresh corn on average in some locations, such as Bay Roberts, Carbonear, and Gander (top graph), more often it is more expensive (indicated on the time series graph at the bottom). Seasonality of fresh corn (summer and fall) does not necessarily impact the prices of canned or frozen corn. Nor does the lack of available fresh corn in February and March 2021 appear to impact the price of fresh or frozen corn. Rather, location is the greater indicator of price trends. This aligns with other data that finds place to be the greatest determinant of food pricing.

Yet, according to our data, these efforts make the relative price of substitutions unpredictable in certain places. The food item with the largest number of possible substitutions (forms in which to buy the food) on our list is corn. We recorded fresh, frozen, and canned corn year-round. Here, we used item price instead of unit price to mimic a situation where a shopper required corn and needed to buy an item (Figure 6). The data also shows a gap when there was no fresh corn available in many locations during February and March 2021.

One item of substitution that we included on our food price list was Coca-Cola, which has one of the lowest variabilities in unit price of all foods recorded (Table 2). In September 2022, the provincial government introduced a "sugar tax" on sugar-sweetened beverages (Department of Finance 2022). We wanted to see if this tax might impact the base price of beverages or their availability. However, we did not look at the cost or non-availability of local water and the only other beverage on the list is milk, which is unlikely to be a substitute for Coca-Cola. In participatory analysis, community members did not think the price of Coca-Cola or sugar-sweetened beverages was important for answering their research questions or priorities.

SALES

The timing of sales is variable. And as one volunteer observed in Port aux Basques, "All of the tomatoes were gone due to sale (went on sale Thursday and were gone on Friday)," which indicates that advice to 'shop sales' is not an effective way to address the affordability of food. Moreover, sales may negatively impact availability of some food items. When we compared sale item average costs to non-sale average costs, sale items were notably less expensive on average. But when we compared the same items by unit cost, the savings were minor. Thus, while sales may make certain items more affordable to put in the cart, gram-by-gram, and millilitre-by-millilitre they represent a more modest gain.

THE NNC SUBSIDY

One intervention to address the high food cost in Northern and remote communities is Nutrition North Canada (NNC). NNC is a program administered by the federal government to subsidize certain staple and healthy food items (Government of Canada 2022). The value of the subsidy is a flat rate dollar value kilogram of food shipped by air or freight, depending on the transportation access available. It is up to the retailer to apply for the program, and not all stores do.

Three communities within the dataset are considered "Northern" and retailers are eligible to receive the NNC subsidy: Nain, Hopedale, and Rigolet. Five items on the food list qualify for a 'high' rate of NNC subsidy: milk (2% fresh), whole wheat bread, white flour, corn (frozen), and peas (frozen) (Figure 7, next page).

In the public meeting, the NNC subsidy attracted the most attention of any topic. Participants discussed in detail the lack of transparency to consumers and researchers and whether the NNC subsidy achieves the goal of making healthy food more affordable. Researchers concur, reporting that, "The current structure and regulatory framework of NNC are insufficient to ensure the program meets its goal. Both the volume and cost of nutritious food delivered to communities is highly variable and dependent on factors such as retailers' pricing practices, over which the program has no control. It may be necessary to consider alternative forms of policy in order to produce sustainable improvements to food security in remote, northern communities" (Galloway 2017: 1).

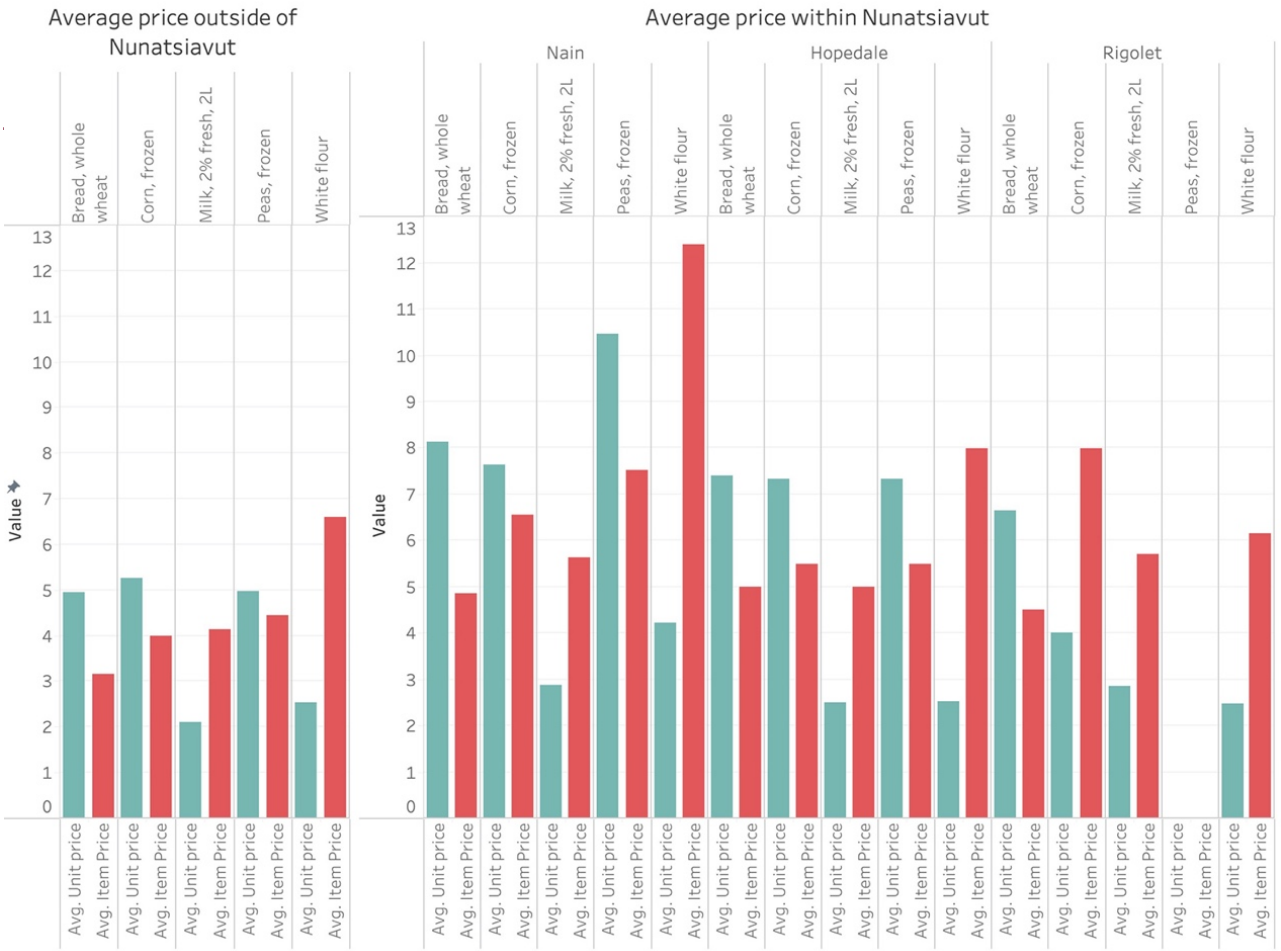

Figure 7: Average unit (blue) and item (red) prices for NNC subsidized items in the province over all minus Nunatsiavut (left hand side) and in the three communities in Nunatsiavut with food pricing data (right hand side).

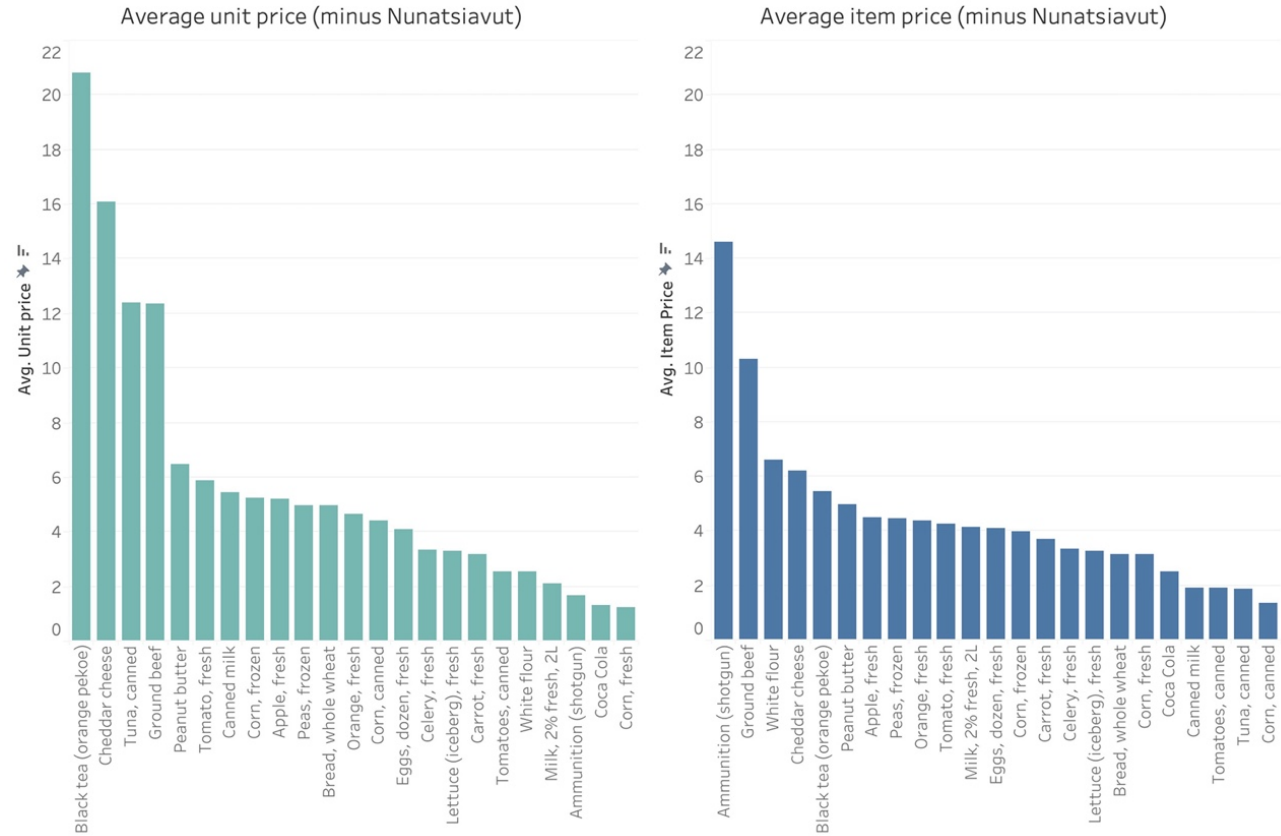

Figure 8: Comparison of the prices of food items by unit (green, left hand side) and by item (blue, right hand side). These figures do not include the communities of Nain, Hopedale, or Rigolet in Nunatsiavut because the food prices there are disproportionately high.

EXTREME VARIABILITY

Food pricing changes over time, but we found that the differences between high and low food prices (variability) were remarkably different for different foods and in different places (see the time scale in Figure 9, and variability in food items in Table 2, below). Such variability presents complex issues for food and finance planning that directly impacts food security. High variability means high fluctuations in food prices, both for individual food items and for items overall (averages). High variability negatively impacts planning and budgeting. When considering food security and stability, both high prices and high variability are justice issues.

Food pricing changes over time, but we found that the differences between high and low food prices (variability) varied remarkably for different foods and in different places (Figure 9). Such variability presents complex issues for food and finance planning that directly impacts food security.

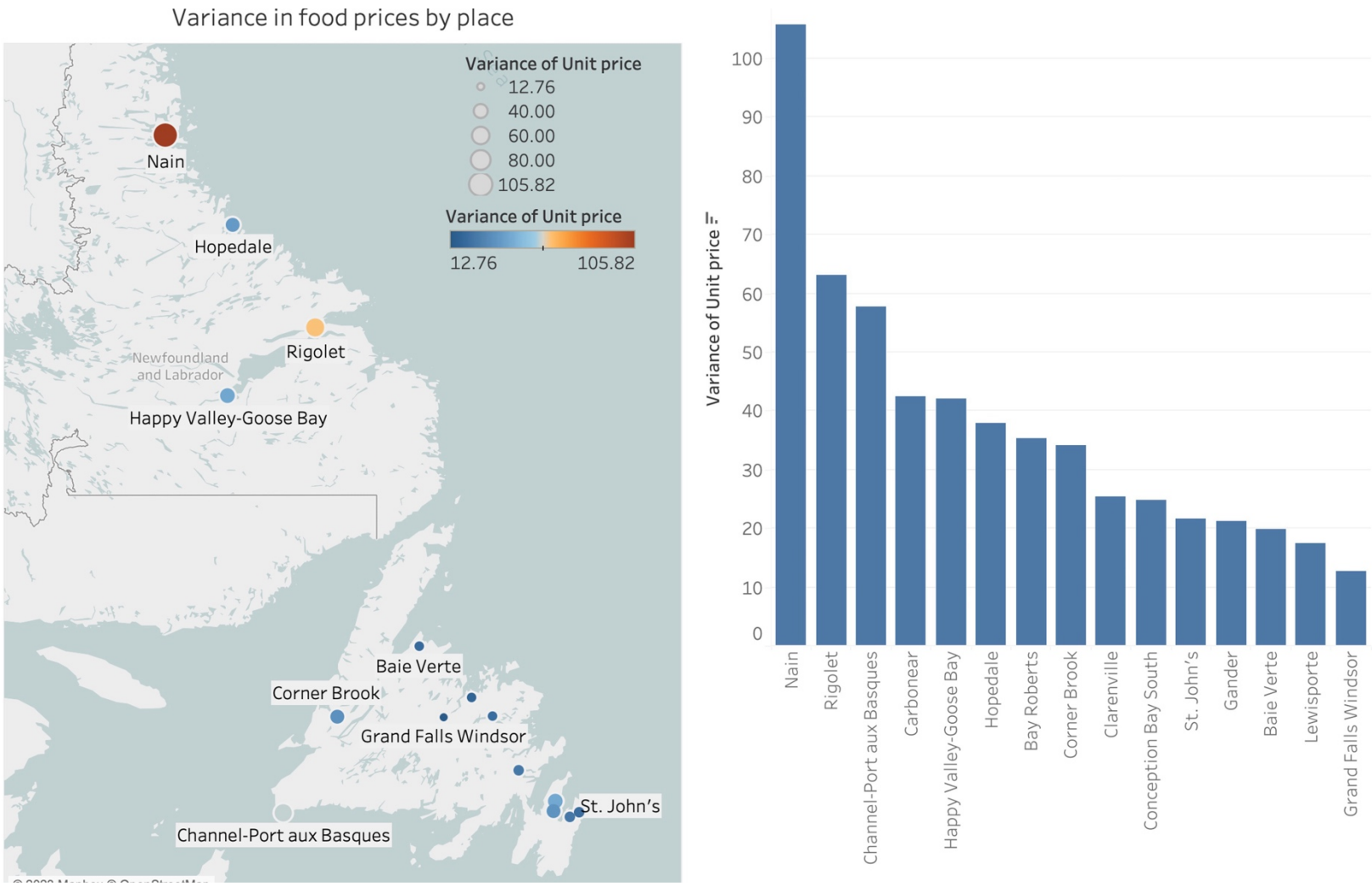

Figure 9: The average unit prices of food items by place. The left image shows the data in map form, where both the colour and size of the dot indicate the degree of variance. The bar graph on the right shows the data in a way that allows easier comparison of the relative magnitude of variance between locations.

Table 2: Variance in unit price by food item, arranged from least to most variation (locations selected for regular data collection)

Food item	Unit size	VAR of Unit price	MIN of Unit price	MAX of Unit price
Ammunition, shotgun	Per cartridge	0.23	0.32	1.99
Milk, 2% fresh	L	0.32	1.30	5.06
Corn, fresh	Per cob	0.35	0.25	4.99
Soda	L	0.41	0.35	3.75
Eggs, dozen	dozen	0.48	2.09	6.99
Celery, fresh	Per bag	0.65	1.50	5.99
Flour, white	kg	1.66	0.94	10.13
Canned milk	L	1.86	1.02	10.71
Lettuce, fresh	Per head	2.02	1.99	17.99
Tomato, fresh	kg	2.52	2.14	12.10
Apple, fresh	kg	2.68	2.50	15.39
Orange, fresh	kg	2.68	0.45	12.09
Tomatoes, canned	L	2.77	0.99	8.07
Carrot, fresh	kg	2.91	1.76	13.19
Bread, whole wheat	kg	3.16	2.94	10.99
Corn, canned	L	5.05	2.58	11.70
Peas, frozen	kg	5.79	2.49	20.33
Corn, frozen	kg	6.59	2.75	29.96
Peanut butter	kg	8.85	1.98	15.98
Beef, ground	kg	12.19	1.32	24.00
Cheese, cheddar	kg	32.80	8.82	55.50
Tuna, canned	kg	67.43	5.12	39.90
Tea, black	kg	95.00	2.57	55.10

THE IMPACT OF MAJOR LOCAL AND NATIONAL EVENTS ON FOOD PRICING AND SECURITY

In January 2020, St. John's metro areas experienced an 8-day State of Emergency due to a winter storm ("Snowmageddon"). In a local event to debrief, people shared the impact of this disruption on their food needs:

> *"People that you wouldn't expect," Sylvia White, member of the Choices for Youth Leadership Council said, "Young people that are working and they're living cheque to cheque.…They didn't get paid in time before the stores were shut down, so when they did get paid, they had no food" (Kennedy 2020).*

The effects of COVID-19-related disruptions to the food supply chain, labour force challenges, inflation, and food transportation challenges, alongside climate change and adverse weather effects, during this data collection period are ongoing. When averaged over the entire span of the project, average unit food prices show both some variability as well as an upward trend (see Figure 10). For a list of events that may have impacted food pricing, food availability, and data collection, see the Appendix.

At the high point, May 2021, we note that at this time the rate of inflation in Canada passed the upper bound of 3% targeted by the Bank of Canada. According to the Consumer Price Index, within Newfoundland and Labrador over the project timeline from October 2020 to 2021, the percent change of all "food" shows an increase of 5%, from 150.2 to 157.5 overall within Newfoundland and Labrador over the project timeline from October 2020 to 2021. However, the price of fresh fruits and vegetables decreased 2%, from 122.6 to 119.7 (CPI 2020–21).

Throughout the spring, local and international governments began to relax their COVID-19 restrictions. Price is influenced not just by local provincial lockdowns, but the national and international economy. Many businesses opened their doors to consumers, including restaurants, which required large quantities of food from a complex supply chain. Uneven restrictions and reopenings, the cost of commodities, low rates of employment, and other factors impacted the increased cost of consumer goods (Bank of Canada 2021)

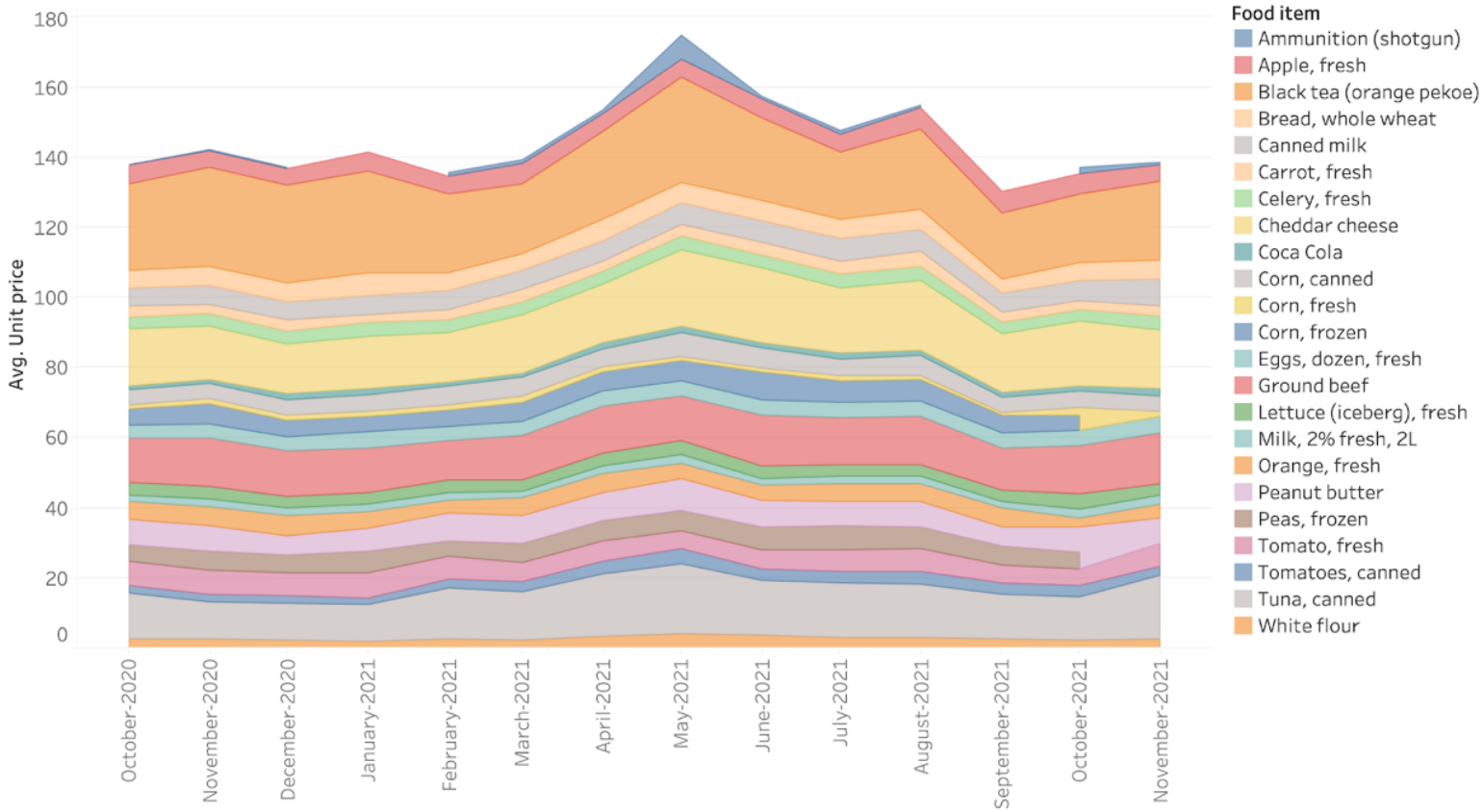

Figure 10: The average unit price of food items in Newfoundland and Labrador during the entire study period (October 2019–December 2021). In February 2021, the province went on COVID lockdown and data is more sparse. For other significant dates that impact data collection and prices, see the Appendix.

THE IMPACT OF SEASONS

In analysis meetings, participants expected that prices reflected seasonal availability of both sources of food (e.g., apples in the fall) and use of those foods (e.g., apples for back to school in September). Figure 11 shows the average item and unit costs for produce in the province, excluding Nunatsiavut where high and highly variable prices can skew provincial averages and there is no data for winter months (see Figure 14 in the Appendix for Nunatsiavut version of Figure 12). Based on the 14 months of data collection, the following trends are likely:

- Item prices are impacted by variability more than unit pricing, regardless of season
- Different produce items are impacted differently by season or other temporal trends
- It is difficult to identify seasonal trends that hold across years in this dataset, since only fall is sampled twice and the prices of some items are quite different in the 2020 and 2021 seasons (particularly tomato, oranges, and fresh corn)
- Unit prices are lowest in the summer and most variable in the winter
- Lettuce and celery are fairly stable produce in terms of both unit and item pricing

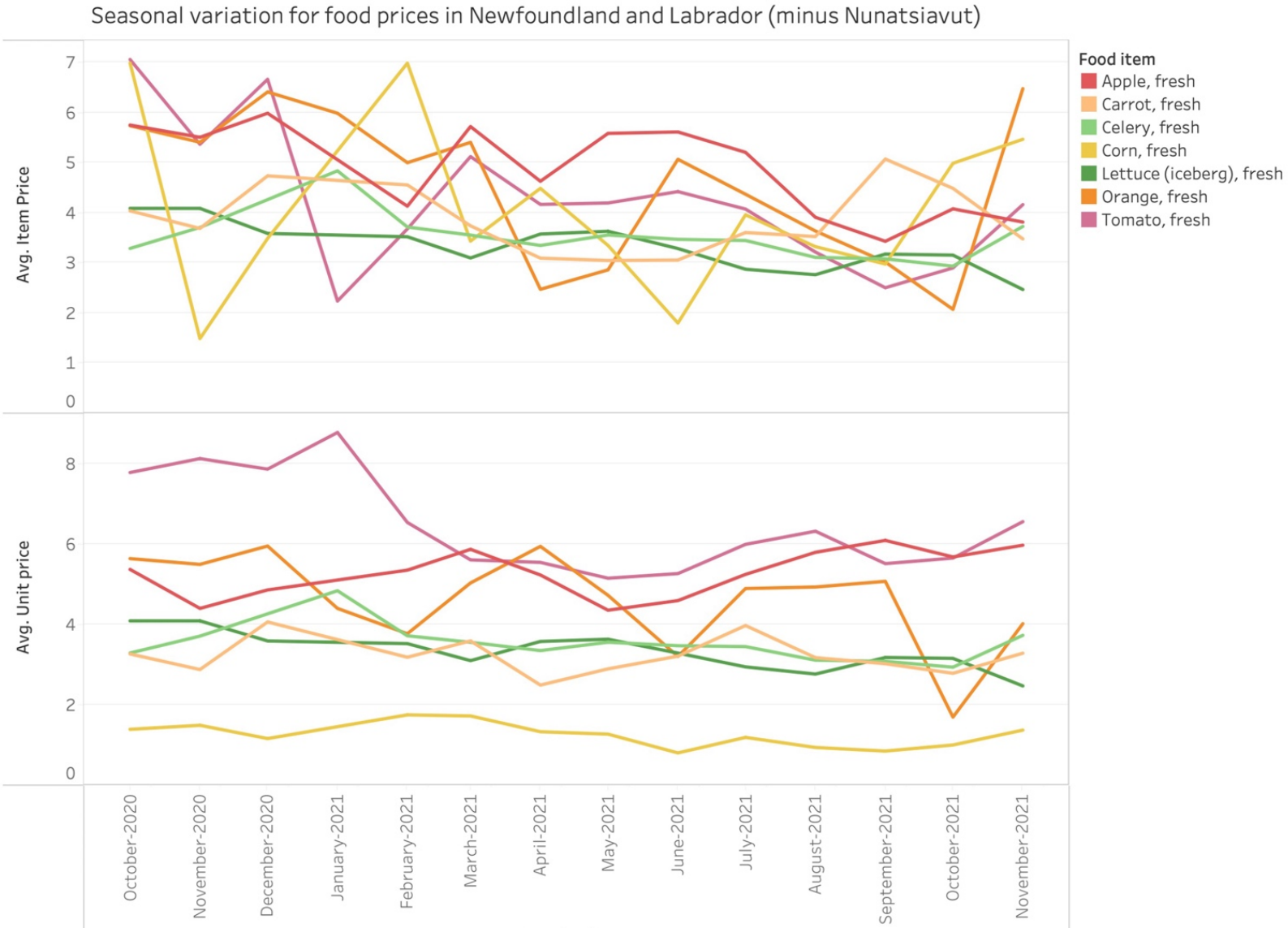

Figure 11: The average item (top) and unit (bottom) prices of fresh produce. This graph includes regions in the province except Nunatsiavut because the region skewed the data. (See Appendix for the Nunatsiavut version of this figure.)

Another seasonal food group of importance in Newfoundland and Labrador is proteins. The number of people who harvest wild and country foods in the province are the highest of any province in Canada; the percentage of people who fished in 2016 is 44.2%, which is 21.9% above the national average, and the percentage of people who hunted and trapped in 2016 is 20.2%, which is 14.3% above the national average (Statistics Canada 2020). Moreover, hunting and fishing relate food security (the ability to access healthy and affordable food) to food sovereignty (the ability to access culturally relevant and meaningful foods, particularly for Indigenous peoples).

The spike in prices for ammunition and canned tuna from April–June 2021 coincides with the jump in prices for most food items in the province due to inflation (see Figure 12). Overall, all proteins show an average overall increase in pricing over time, and no fluctuations appear to be tied to fishing or hunting seasons.

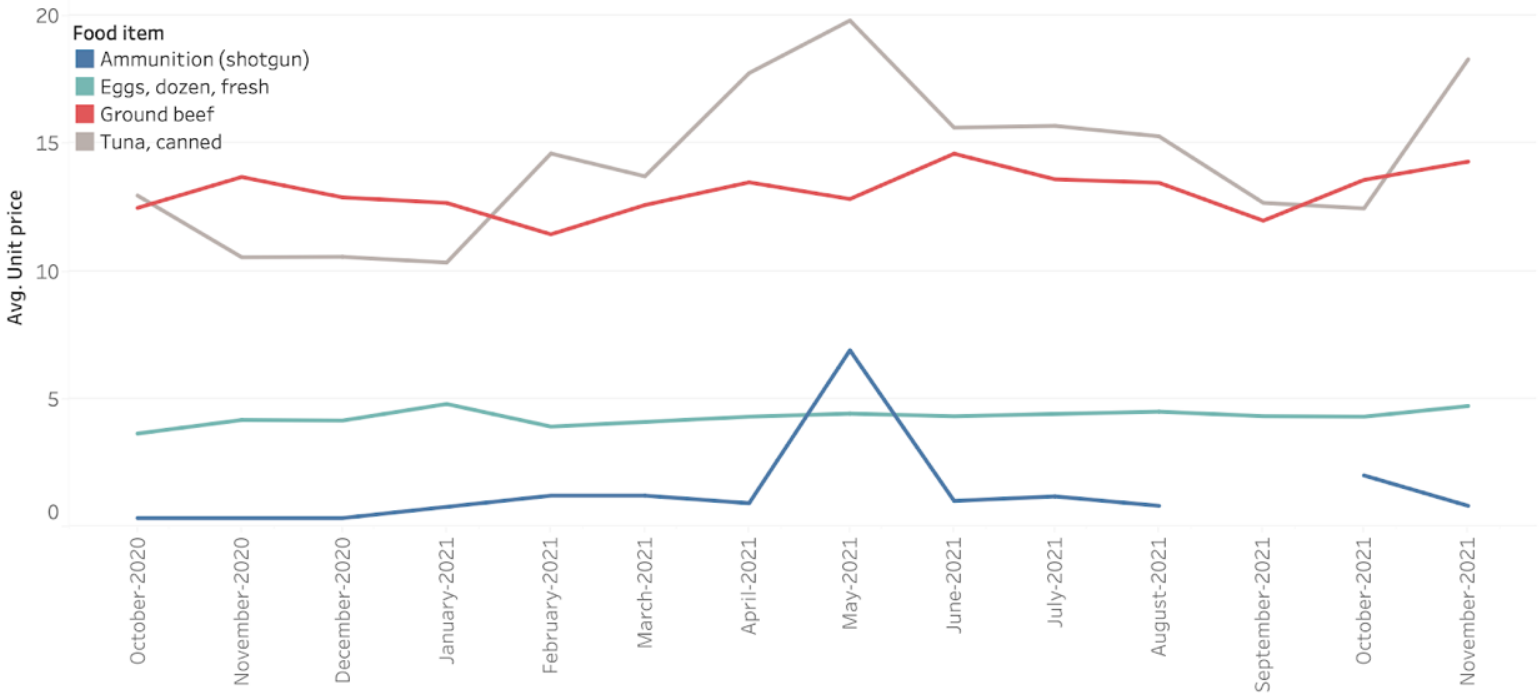

Figure 12: Four unit prices associated with proteins over time: shotgun ammunition (blue), eggs (light blue), ground beef (red), and canned tuna (grey). This data includes the entire province of Newfoundland and Labrador. Moose hunting season is usually early September to the last day in December. The food fishery is usually on the weekends in July, August, and early September. The break in data for ammunition reflects that either it was not available or no data was collected for that item for those dates.

FUTURE DIRECTIONS AND RECOMMENDATIONS

USE OF NL FOOD PRICING DATASET

This citizen science pilot project produced a useable, open-source dataset. **We hope that other researchers use the data to move toward goals of food security and sovereignty**. In particular, we **recommend more inferential statistical analysis** in addition to the descriptive participatory statistics approach used here. We also hope the results are shared widely with community leaders and policy makers. To this end, the Appendix includes information about the way the dataset was cleaned and how it works.

DESIGN OF FUTURE CITIZEN SCIENCE PROJECTS

Citizen science data collection has advantages: it allows wide geographic coverage, enables local knowledge to be incorporated at the data collection stage (and with participatory statistics, also at the analysis stage), and it is less expensive to carry out. But there are also limitations: the data is uneven and the geographic locations are opportunistic and unpredictable. Like other data collection, citizen science data requires quality control and there is a cost to cleaning the data. Most of the limitations were eliminated when we paid staff to collect data. Indeed, our most reliable data come from two paid CLEAR members. **We recommend a *paid* citizen science approach**.

The participatory statistics analysis based on real-time data visualizations worked well. This approach could be expanded to **include inferential statistics in participatory analysis**.

Weekly or bi-weekly data collection allowed us to see some of our most important findings about variability. We recommend **future projects collect food price data weekly or biweekly**.

In future studies, the **selection of food items should be done with the research needs of end users in mind**. This project was accountable to multiple stakeholders and rightsholders and our list is a reflection of many parties' involvement. Other lists will differ based on who will use the data and for what purpose, including which points of comparison within lists and to third-party lists are most meaningful.

Several research questions arose during participatory analysis that remain outstanding. Future studies can address:

- What are the reasons behind high variability of food prices in all places, with the assumption that the drivers of variability will differ between regions?
- What are the drivers behind provincial or regional trends, which will be different than local ones?
- How can future studies capture issues of quality since it is a key factor in choosing to buy some food instead of others? One participant noted, "As a consumer, I am less interested in where the prices differ (to a certain extent, where you live is where you live) and more on availability, quality, brand names, and sales that influence my bottom household budget."
- What are the impacts of the NCC subsidies in Northern communities? How do they actually work?
    - Does the conflation of food security with food sovereignty contribute to the colonization of Northern diets and/or detract from efforts to strengthen Northern foodways?
- How does food pricing fit into larger pictures of financial insecurity as they relate to medications, homelessness, and other necessities?

- How might a study like this address wild food more directly, including the ability to indicate the impact of locals selling fish or wild food?
- What agency do stores have in setting prices, particularly in relation to their operating costs? What role do local monopolies play in food pricing?

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APPENDIX

LIMITATIONS AND MITIGATIONS IN THE DATASET

One of the core limitations in the dataset is its temporal patchiness, meaning that for some places, data was collected rarely and sometimes only once. For example, there are a few places for which we have a single date or date cluster logged: Mount Pearl, L'Anse au Loup, Burgeo, Stephenville, and Charlottetown (see Figure 1). Likewise, there are significant data points from Port Hope Simpson, but they all occur in December 2021, when data collection in all other locations had stopped, meaning any data for that month is exclusively from that location. While these points remain in the dataset, we often removed them for analysis because they are not representative of a true average.

Note that some items that are rarely recorded but have high item costs, such as ammunition, may skew averages. We often removed ammunition from analyses that relied on item pricing.

This report uses unit pricing for most comparisons because it is the more comparable of the two pricing methods (per item or per unit), but this is not to say that a can of milk and fresh milk are comparable on cultural, nutritional, or other grounds. It is merely a way to compare apples to milk, and a 1L jug of milk to a 2L carton of milk. Sometimes per item prices are better for analysis, since they more accurately reflect a grocery bill.

NUMBER OF DATA POINTS PER COMMUNITY

The number of data points (price of a food item on a specific day) that were collected in each community are recorded below in Table 3.

Table 3: Total number of data points per community

COMMUNITY	# DATA PTS
Baie Verte	167
Bay Roberts	63
Burgeo	7
Carbonear	222
Clarenville	966
Conception Bay South	66
Corner Brook	429
Deer Lake	22
Gander	138
Grand Falls Windsor	64
Happy Valley Goose Bay	955
Hopedale	71
L'Anse au Loup	3
Lewisporte	63
Nain	737
Port aux Basques	59

Port Hope Simpson	40
Rigolet	104
St. John's	499
Stephenville	23
Total	**4698**

DATASET CLEANING

All locations, food items, and other text have been standardized in spelling, punctuation, and capitalization. Some data has been removed from the original dataset completely; this includes:

- Any locations that had a single item logged on a single day. This would heavily skew the averages that this and similar reports rely on
- When prices for a particular item were notably different from similar items in similar locations on similar dates, we first consulted the original data collector to clear up errors, and if this did not work or they could not be reached, the result was removed
- When size/weight data was missing, we often consulted the brand website or online shopping to identify the size/weight for unit pricing calculations (for example, how many mL in a standard can of Carnation condensed milk?)
- When line items had a retailer-place combination that was impossible (e.g., the Walmart in Nain), we first consulted the original data collector to clear up errors, and if this did not work or they could not be reached, the result was removed
- Unit price data was calculated by dividing the price by the weight/volume of the item. When items were bought as an object without a weight/volume, they are listed as "per each"

MAJOR EVENTS THAT MAY IMPACT FOOD PRICING

During data collection the following events may impact food pricing and/or data collection in some areas:

Ferry freight, first and last days accepting cargo in Nunatsiavut: This normally starts in May depending on ice. During the data collection period, the first ferry was June 7, 2021. The last day was November 12, 2021.

Weather:

- Hurricane Larry, September 10–11, 2021, affected east coast of NL
- Hurricane Sam, October 9, 2021, affected east coast of NL
- Heavy rain, wind and flooding, November 23, 2021, southwest coast of island and southeast coast of Labrador
- The shipping freight season to the North Coast of Labrador where food and other goods can be shipped by ferry as well as flights started June 7, 2021 and ended November 12, 2021

COVID lockdown dates:

- Second lockdown of the pandemic during study period: entire province to alert level 5 on February 12, 2021
- Areas outside the Avalon peninsula returned to level 4 on February 24, 2021

- Areas outside the Avalon back to level 3 and Avalon back to level 4 on March 13, 2021
- Entire province returns to alert level 2 on March 24, 2021

Modification of collection sheets:

- The data collection sheet was updated to include packaging type on November 26, 2020. However, we did not start recording this data until February 2021 when the project launched
- Started collected online data sites during lockdown; beginning on February 18, 2021

SELECTION OF THE FOOD LIST

The food price list (including both essential items to collect and optional items to collect) was compiled for the ability to compare subsidized and unsubsidized food, nutrition, wild-caught versus store-bought meats, and comparison of food items to other datasets (such as the Nunavut food price list, which breaks data down by food item but uses yearly averages from Statistics Canada). Table 4 charts the food list items based on these inclusion factors.

The lists were created with multiple factors in mind:

- Since data collection was to be done by volunteers, we decided data collection had to take 30 minutes or less. After timing this activity, we found that each item takes an average of 1 minute and 30 seconds to log. This led to an essential list of 13 items (19.5 minutes) and 10 optional items (another 10.5 minutes). The length of the list and the minimizing the burden of data collection on volunteers was one of our core priorities.
- We chose foods that are always or almost always available in Nain, as one of the most remote locations in the province and because the project is co-sponsored by the Nunatsiavut Government
- We wanted a comparison of fresh and non-fresh alternatives (e.g., fresh and canned tomatoes).
- We wanted foods that are culturally important (e.g., black tea) and used widely (e.g., ground beef)
- We wanted a range of food groups with an emphasis on produce and protein
- We wanted to include some foods that are commonly subsidized as well as those that are not
- We wanted to compare nutritious and less nutritious sources of food
- We needed to have foods that are already part of common food pricing research lists created by Nutrition North, Statistics Canada's Nutritional Food Basket, New Brunswick's Good Cost Survey, the Nunavut Food Price Survey, and the Canadian Consumer Price Index
- We included shotgun shells to include analysis related to food sovereignty and wild food

Final items had two or more of the above traits. We selected the lists based on many conversations with research partners, end users of data, and the project team.

Table 4: Food list items and inclusion factors

	Milk	Canned milk	Ground beef	Peanut butter	Celery	Tomatoes, canned	Tomatoes, fresh	Apple, fresh	Eggs	Black tea	Coca-Cola	Ammunition	White flour	Bread	Lettuce	Orange. Fresh	Peas, frozen	Corn, fresh	Corn, frozen	Corn, canned	Cheddar cheese
Listed on nutritional food basket list (2019)	X			X	X	X	X	X	X						X	X	X	X	X		
Listed on food cost survey in NB (2012)	X		X	X	X	X	X	X	X				X	X	X	X	X			X	
Listed on Nunavut Food Price Survey (2017)	X	X	X	X	X	X		X	X	X			X	X		X					
Luxury and non-nutritious										X	X										
Nutrition/ substitution comparison	X	X	X	X		X	X		X			X						X	X	X	
Subsidized but not monitored					X																X

DATA COLLECTION SHEET

NL food prices project

Name:_____ Date:_____ Grocery Store:_____ Location:_____

Thank you for volunteering to gather data for a comparison of key foods around Newfoundland and Labrador!
Instructions for gathering data:

- Record prices *regularly*: either weekly or bi-weekly.
- Always record the **13 essential food items** (in bold), and the optional 10 are just that: optional.
- If there is more than one brand or type of the food, always record the least expensive.
- "Unit" means the measurement unit the food comes in, usually its weight or volume. For example, a 2L container of milk's unit is 2 litres, a 3.2 lb. pack of meat's unit is 3.2 lbs, a 250 mL can of milk's unit is 250 mL, a bag of apples sold at $0.80/lb that costs $1.60 because it weighs 2 lbs has a unit of 2 lbs, a dozen eggs has a unit of a dozen.
- If something isn't available but the prices are there, please record them. Sometimes we know something will not be available and there will be no pricing information. Just mark as N under availability.
- If the packaging type falls under the "other" category (6), please specify what type of packaging it is in the space provided under the packaging column of this form.
- When you are done with this paper from, please take a well-lit photo and email it to foodpricesNL@gmail.com
- If you have questions or issues, you can email foodpricesNL@gmail.com
- Data from this project will be posted at civiclaboratory.nl

Packing types: (1)Plastic (2)Cardboard/paper (3)Plastic/Cardboard mix (4)Can (5)None (6) Other

Food item	Unit	Price	Brand	Packaging	On sale	Available
Essential (always record these):						
Apple, fresh					Y / N	Y / N
Tomato, fresh					Y / N	Y / N
Celery, fresh					Y / N	Y / N
Milk, 2% fresh, 2L					Y / N	Y / N
Eggs, dozen, fresh					Y / N	Y / N
Ground beef					Y / N	Y / N
Tuna, canned					Y / N	Y / N
Tomatoes, canned					Y / N	Y / N
Canned milk (Carnation if possible)					Y / N	Y / N
Peanut butter					Y / N	Y / N
Black tea (orange pekoe)					Y / N	Y / N
Coca cola (2L if poss)					Y / N	Y / N
Ammunition (shotgun)					Y / N	Y / N
Optional:						
Orange, fresh					Y / N	Y / N
Carrot, fresh					Y / N	Y / N
Lettuce (iceberg), fresh					Y / N	Y / N
Corn, fresh					Y / N	Y / N
Peas, frozen					Y / N	Y / N
Corn, frozen					Y / N	Y / N
Corn, canned					Y / N	Y / N
Bread, whole wheat					Y / N	Y / N
White flour (Robin Hood if possible)					Y / N	Y / N
Cheddar cheese					Y / N	Y / N

Notes (weather, ferry interruption, etc.):

Figure 13: Copy of the physical version of the data collection sheet used by participants.

While data collection could be done online via Google Forms or via paper form, the vast majority of regular citizen scientists used paper forms (see Figure 13) that were emailed to the CLEAR team, who

then entered the information into the dataset manually. This allowed greater quality control of data, and also was easier to use for citizen scientists.

SEASONAL PRODUCE PRICES IN NUNATSIAVUT

There are two reasons this graph of unit and item average prices for produce (Figure 14) is separate from the rest of the provincial data in Figure 12. First, the high prices and high variability of food prices in Nunatsiavut influences provincial averages. Second, these high prices were only collected in fall (orange shading) and spring/summer (green shading) months and are missing for the winter, giving us an incomplete seasonal picture.

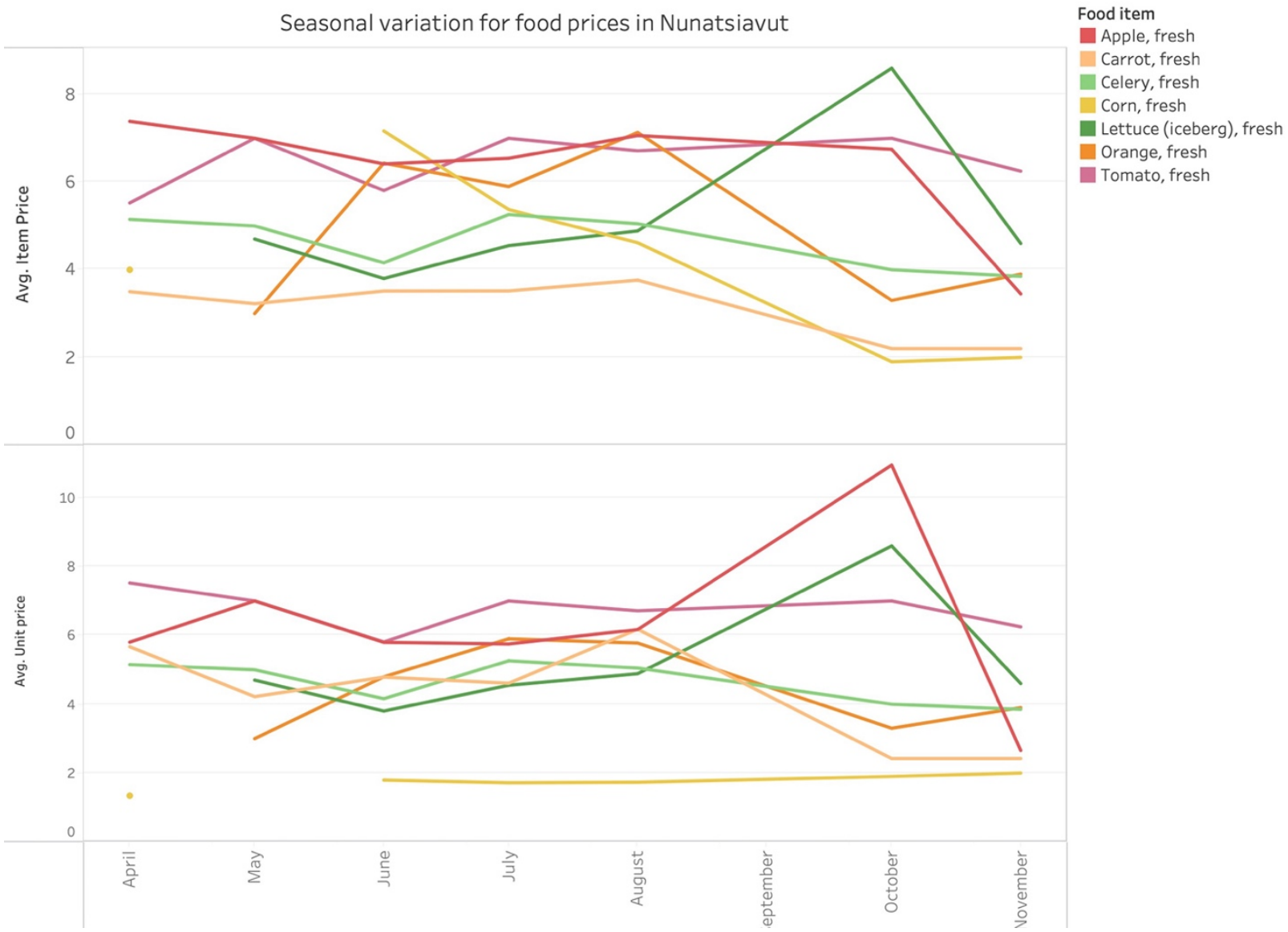

Figure 14: Average and unit prices for produce in Nunatsiavut. Dots and broken lines indicate the absence of produce during data collection (e.g., corn in May).