



Exploring the Impact of the COVID-19 Pandemic on Food Production and Waste Sustainability within Boston College Dining Services

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ABSTRACT

In order to open its campus during the global coronavirus pandemic (COVID-19), Boston College was faced with the challenge of protecting the health and safety of all students, faculty, and staff. Boston College Dining Services (BCDS) is an integral campus facility that previously provided upwards of 23,000 daily meals to students as well as employed over 200 individuals. Because BCDS is such a necessary part of campus operation, it was imperative that new safety precautions be administered in order to maintain food service while protecting the community it serves. This study intends to determine the impact of COVID-19 and subsequent safety protocols on sustainability within Boston College Dining Services in three key areas: sources of food, waste and recycling, and economics.

Our research targets how food and waste production has been affected, and we took a comprehensive approach in order to assess multiple elements. First, we investigated where the food is coming from, how this supply-chain process has shifted since the beginning of the pandemic; we aim to understand how the amount of food and patterns of food distribution have changed, beginning in March 2020 and stretching throughout the Fall 2020 and Spring 2021 semesters. We observed how the pandemic has altered the output of BC Dining's waste, specifically as this relates to food packaging. We collected data regarding the economic implications of such changes from BC Dining faculty. Finally, we surveyed Boston College students to gather data to best analyze and answer these questions.

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INTRODUCTION

The global outbreak of the coronavirus disease in the beginning of 2020 challenged many previously established aspects of our society, affecting everything from healthcare to food systems. In order to prioritize human health and safety during the pandemic, many sectors were forced to reevaluate their operations. Because of this massive global focus on protection against the virus at all costs, the environmental impacts of the pandemic were not immediately considered, and became overshadowed (Klemeš: 2020). In the year since its onset, COVID-19 has caused a massive disruption, not only in waste management practices (Klemeš: 2020), but also in the overall food supply chain (Aday: 2020). One area where the impacts of these disruptions have become increasingly apparent is within the college dining environment.

During a typical year, Boston College Dining Services (BCDS) serves more than 23,000 meals per day to the 85% of its 9,370 undergraduate student population who enroll in a university meal plan (BCDS Sustainability Report: 2019). In a typical year, this equates to approximately 4,041,630 meals served per school year across fourteen dining locations, which are open to both students and the public. The three main dining locations for undergraduates are Corcoran Commons, McElroy, and Stuart Hall; here, large expanses of seating are provided and are typically abuzz with students eating and conversing with each other. Whether the meal is breakfast, lunch, or dinner, each of these three locations, in a typical year, offers numerous options to students. Serve-yourself cereal and bakery items are options in the morning as well as speciality omelettes, potatoes, and breakfast protein options. Lunch often offered a wrap station where students could specialize order wraps to their preference; in addition, a buffet-style salad bar was always an option. Dinner offered around three or four different specific meal options while also providing serve-yourself stations such as sticky rice and soup in addition to the salad bar. To-go containers for food were offered, as 60% of students take food to-go, but reusable, washable dishware and cutlery were commonly used. In a typical year, BC Dining offers many options for dining at each of the three meals of the day and equally was gaining momentum with their sustainability efforts (BCDS Sustainability Report: 2019).

However, while originally designed and organized to operate at a high capacity and deliver a surplus of different food options, college dining halls have been forced to alter their practices and reimagine a new system that protects the health and safety of their students (Wiener-Bronner: 2020). Similar to the changes restaurants have had to undergo, college dining

halls have had to reduce capacity and alter menus to cater to take-out rather than indoor dining experiences. This shift comes with a change in how the food is served; food distribution is now designed for take-out, or a grab-and-go, and it comes packaged in single-use disposable materials rather than reusable materials such as dishware. This pivot from salad bars, self-serve buffets, and other typical food stations has been replaced by pre-packaged meals, in which the packaging both functions to make food more accessible to students and ensures a level of sanitation and safety of the food preparation and delivery. BCDS remarks that, although the Food and Drug Administration (FDA) and the Centers for Disease Control and Prevention (CDC) have deemed reusable servicewear safe to use during COVID if properly cleaned, they have decided to strictly use take-out and to-go containers in order to provide the utmost safety (Spring Reopening Plans: 2021). While the added packaging is recommended for food safety during the pandemic, these to-go containers pose a potential environmental risk with their added increase in plastic waste (Carpenter: 2021).

Because this new pattern of student dining is such a recent development, research on the long-term effects of COVID-19 on the waste stream of restaurants and dining services is still evolving (Writer: 2020). Necol Dunson, of Sodexo Food Services, Marketplace, and Catering at West Liberty University, expresses that where there were once self-serve pizza lines and a buffet-style serving station, the meals now offered to students, following the outbreak of COVID, are pre-prepared and self-contained in packaging (Writer: 2020). On a global scale, an increase of the use of single-use plastic has similarly occurred, specifically as this plastic waste originates from medical waste produced by healthcare facilities (Silva: 2021). Catalonia, Spain has increased their medical waste by 350% and China has increased theirs by 370% (Silva: 2021). This dramatic increase has overloaded these country's capacity to manage and treat this waste adequately. Increased use and disposal of other single-use plastics accompanied this increase of medical waste, and it is predicted the demand on plastics will continue to rise by 40% in packaging and 17% in other applications, such as plastics for masks and other medical use (Silva: 2021).

An increase in plastic waste across many sectors due to COVID-19 poses an environmental threat and is sufficient cause for concern. Post-consumer plastic waste is becoming an increasingly apparent issue, particularly in the United States, as only a fraction of this waste is disposed of properly or recycled. The EPA reports that as of 2017, although 73% of

Americans had access to curbside recycling programs, only 8.4% of total plastic waste was actually recycled (Moore: 2021). If plastic is not recycled, it often ends up in landfills or throughout ecosystems. When left in the environment untreated, plastic does not break down, rather, it breaks up into microplastics, which end up in the water, eaten by wildlife, or inside our bodies (Lindwall). This is damaging to the health of humans, wildlife, and ecosystems. The National Institute of Environmental Health Sciences classifies the chemicals that exist within microplastics as endocrine disruptors and are classified as carcinogens by the Environmental Protection Agency (National Institute for Environmental Health Sciences). In addition to adverse health effects for the biosphere, plastic waste is also a contributor to greenhouse gas (GHG) emissions, because plastic waste is almost entirely composed of fossil-based carbon (Moore: 2021). A recent study found that plastic emits GHGs at each stage in its life cycle--from extracting fossil fuels to manufacture to waste management (Hamilton: 2019). By acknowledging the dangerous effects of increased plastic waste, it becomes imperative that we address the proper management of waste. On the global scale, there has been a decline in waste recycling and an increase in waste mismanagement (Hamilton: 2019).

Beyond the problem of waste created by the increase of packaging, the pandemic has also affected the supply chain responsible for providing and distributing food (Aday: 2020). While the health of employees remains a primary concern, it is equally imperative to keep disruptions in the food supply chain at a minimum to ensure food security across the globe (Aday: 2020). In addition to evaluating the short-term changes in dining and food systems that arose in response to the pandemic, this paper also analyzes the possible extent of the permanency of these changes as we look towards a “post-pandemic life.” We discuss the financial impact of COVID-19 policies on food serving facilities (namely BC dining facilities), how BC Dining’s food supply chain shifted, and the general impact on the consumer. Our specific research questions are broken up into three topic-specific sections relating to sources of food, waste and recycling, and economics, and are the following:

I. Sources of Food:

- A. Has the amount of food being distributed changed; do the same amount of students rely on dining halls for their meals?
- B. Has there been a change in the types of meals being offered?

- C. Has there been a change in Boston College Dining Services' food sourcing; what are the ramifications of this change?
- II. Waste and recycling:
- A. To what extent were disposables used in BC Dining before the pandemic; to what extent are disposables currently being used?
 - B. How has BC Dining's use of food packaging changed since the pandemic started (i.e. type of packaging material, amount of food packaged)?
 - C. How has the overall waste production and management (including both trash and recycling) changed since the start of the COVID-19 pandemic?
- III. Economics and Operations:
- A. Were there any sustainability initiatives that had to be put on hold due to the pandemic?
 - B. Has there been a change in cost as it relates to food processing and packaging; is BC Dining spending more on packaging and disposable products than before?
 - C. Has the cost structure/cash flows of BC Dining changed as a direct result from the pandemic?
- IV. Student Survey
- A. How have BC student dining habits changed as a result of the COVID-19 pandemic?
 - B. What is the dining culture among Boston College undergraduates?

Due to the nature of our research, the methods, results, and discussion for each topic will be addressed individually. Our final recommendations will combine all three sections, as we look at how COVID-19 has currently impacted the entirety of Boston College dining experience for both producers and consumers in current and future environments.

PRESENTATION OF RESEARCH

I. SOURCES OF FOOD

A. METHODS

We used three primary methods when gathering information regarding BC Dining Services' sources of food, and these involved collaborating with various members of the BC Dining faculty, consulting the BC Dining website, and referring to the 2019 Boston College

Dining Sustainability Report. Collaborations with members of BC Dining involved informational interviews as well as email and data exchanges.

Our initial point of contact was Molly Funk, one of BC Dining's Sustainability Interns; over a thread of emails, we introduced the premise of this project, and then specifically outlined our focus on the ways in which BC Dining's food sources have shifted since the beginning of the Coronavirus pandemic last March, during the Fall 2020 semester. Molly put me in touch with another of BC Dining's Sustainability Interns, Jane Fulton, who worked with Molly to gather information. To most efficiently convey the data gathered, we then set up an informational interview with Molly and Jane where we spoke about local and non-local sources from which BC Dining purchases their food, and how the current output of meals by BC Dining is at 70% of their usual capacity; however, Jane noted that there has been a slight increase in overall purchases this semester, Spring 2021, as compared to last semester, Fall 2020. Jane wrote up a brief report of her and Molly's informational findings that she then shared with us.

From our informational interview with Molly and Jane, we gathered that there is a decrease of students choosing to utilize BC Dining services and gleaned that the distribution of this food has also shifted with the introduction of the Green2Go program. When the conversation shifted to my inquiring if there has been a change in the origins of BC Dining's purchased food, Molly directed us to an additional intern at BC Dining, Rudy Bradley.

Rudy and I exchanged a number of emails, and I asked him about the suppliers of BC Dining, both locally and non-locally. He provided me with large spreadsheets of raw data which showed all of the recorded purchases BC Dining made during the specific semesters of Fall 2019, Spring 2020, and Fall 2020 both from producers operating within the New England region and from producers based outside of New England. As a means of assisting with the paring down of the masses of this raw data, I emphasized to Rudy the specifications of this project's interest on how overall purchasing habits shifted, and he sent additional datasets reflecting the specific quantities, in gallons and pounds, of how much food BC Dining purchased from regions both locally in the New England region and non-locally outside of the New England region. This data breakdown also included the purchasing totals spent by different campus dining locations during different months of the Fall 2019, Spring 2020, and Fall 2020 semesters. Having the quantity as well as the price breakdown allowed me to analyze different data sets to find how the data related and discover a trend in the changes in BC Dining's food sourcing since the outset of COVID-19.

We consulted the 2019 Boston College Dining Sustainability Report as a means of understanding the past trends and outputs of BC Dining to compare with the data provided by Rudy. We then analyzed and extrapolated this data to better understand how the food sourcing and food outputs have shifted in response to COVID-19.

B. RESULTS

The results from the graphing and analysis of the raw data acquired demonstrate that the purchasing habits and trends of BC Dining were most affected by the pandemic during the Spring 2020 semester. The largest decrease in purchasing occurred during the months of March, April, and May 2020; this timing lines up directly with when the students of Boston College received notice on March 11, 2020 that they were to leave campus in the following days due to Coronavirus. In the Fall 2020 Semester, the amount of food purchased monthly by BC Dining has increased; however, the amount of food being purchased is significantly less than the amount purchased in the Fall 2019 semester.

In the Fall 2019 semester, the majority of gallons of food purchased per month originated from sources in the New England region (Figure 1). Across the five months, this totaled 27,522 gallons of food purchased. The second largest amount of food was purchased from regions throughout the United States (USA), and across the five months, this totaled 16,093 gallons of food purchased. The total number of gallons purchased from Europe across the five months was 4,067. The total number of gallons purchased from Asia/Pacific across the five months was 52. To better understand how purchasing patterns varied throughout the five months comprising the Fall 2019 semester, Figure 2 shows the trends of purchasing according to the sum of the pounds of food purchased totaled across all four principal purchasing regions; Figure 2 shows that in September and October, the highest volume of gallons of food were purchased, 12,677 and 12,439 gallons, respectively. November followed with a total of 10,102 gallons; August had 6,668 gallons of food purchased; December had 5,848 gallons.

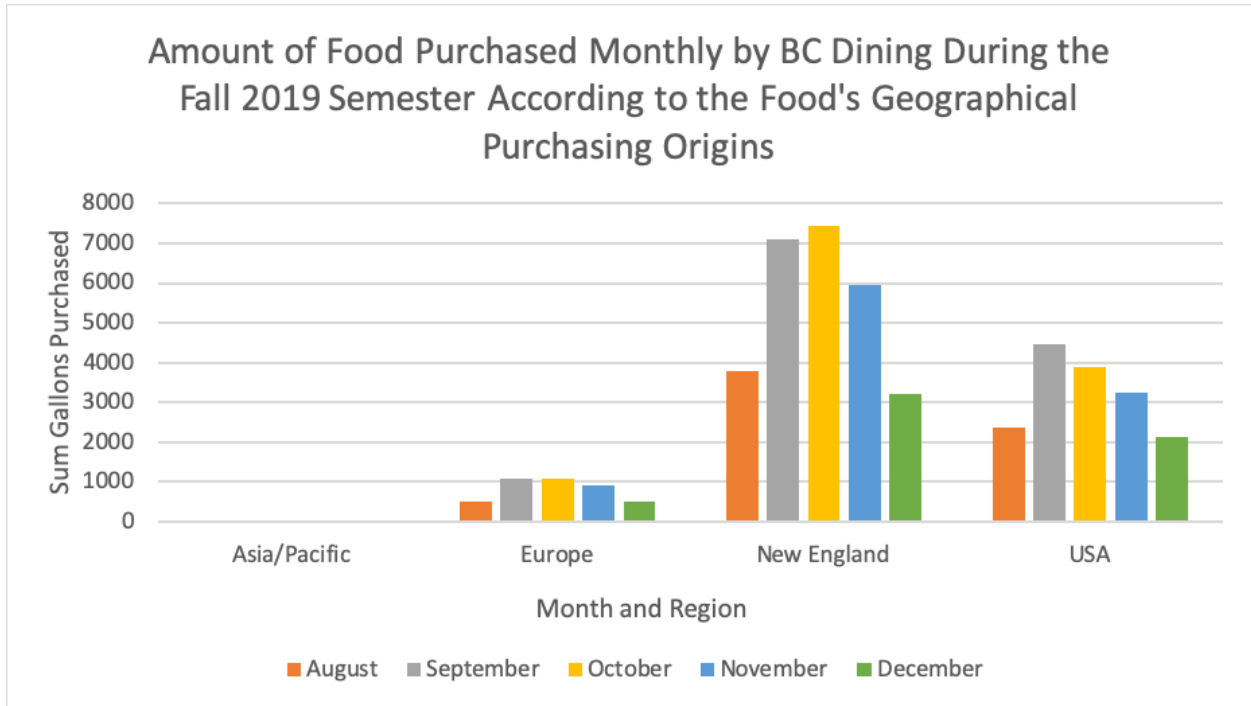


Figure 1: Distribution of the amount of food, in sum gallons, purchased monthly by BC Dining during the Fall 2019 Semester, according to the food’s geographical purchasing origins

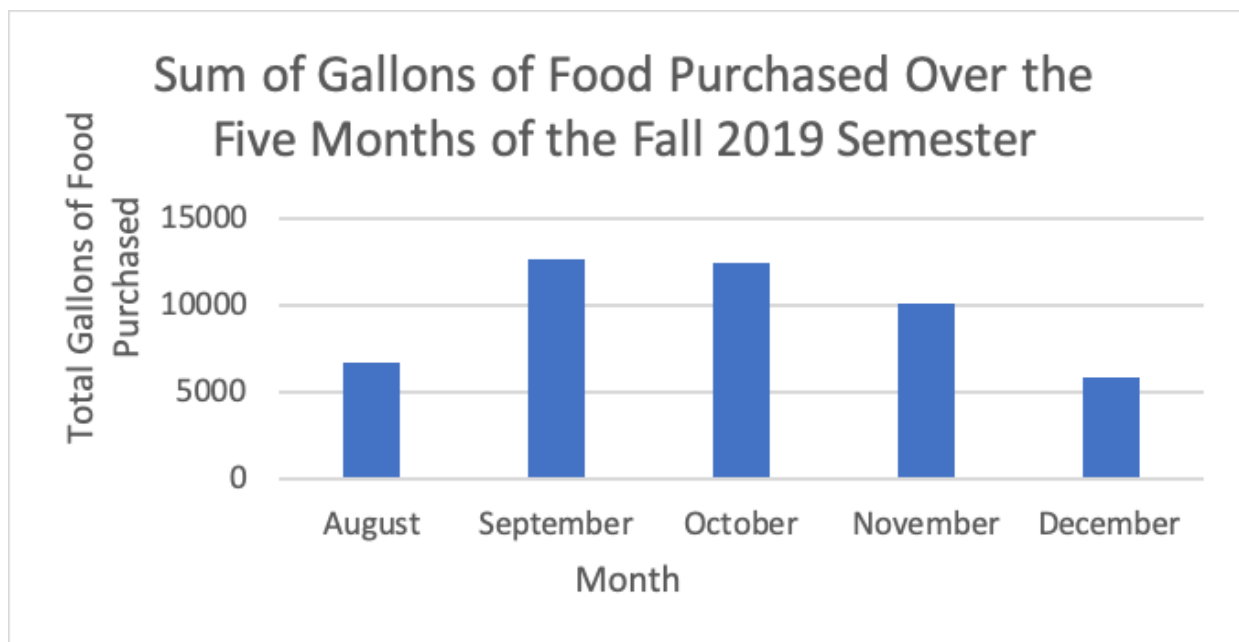


Figure 2: Distribution of the total sum of gallons of food purchased over the five months of the Fall 2019 semester

In the Fall 2019 semester, the majority of pounds of food purchased per month originated from sources in the United States region (Figure 3). Across the five months, this totaled 1,248,217 pounds of food purchased. The second largest amount of food was purchased from the

New England region, and across the five months, this totaled 555,307 pounds of food. The total number of pounds purchased from Europe across the five months was 5,884. The total number of pounds from Latin America was 5,826; Canada totaled 3,011 pounds; the Asia/Pacific region totaled 2,652 pounds.

To better understand how purchasing patterns varied throughout the five months comprising the Fall 2019 semester, Figure 4 shows the trends of purchasing according to the sum of the pounds of food purchased totaled across all four principal purchasing regions; Figure 4, similar to Figure 2, shows that in September and October, the highest volume of pounds of food were purchased, 488,009 and 459,193 pounds, respectively. November followed with a total of 384,121 pounds; August had 251,382 pounds of food purchased; December had 238,192 pounds.

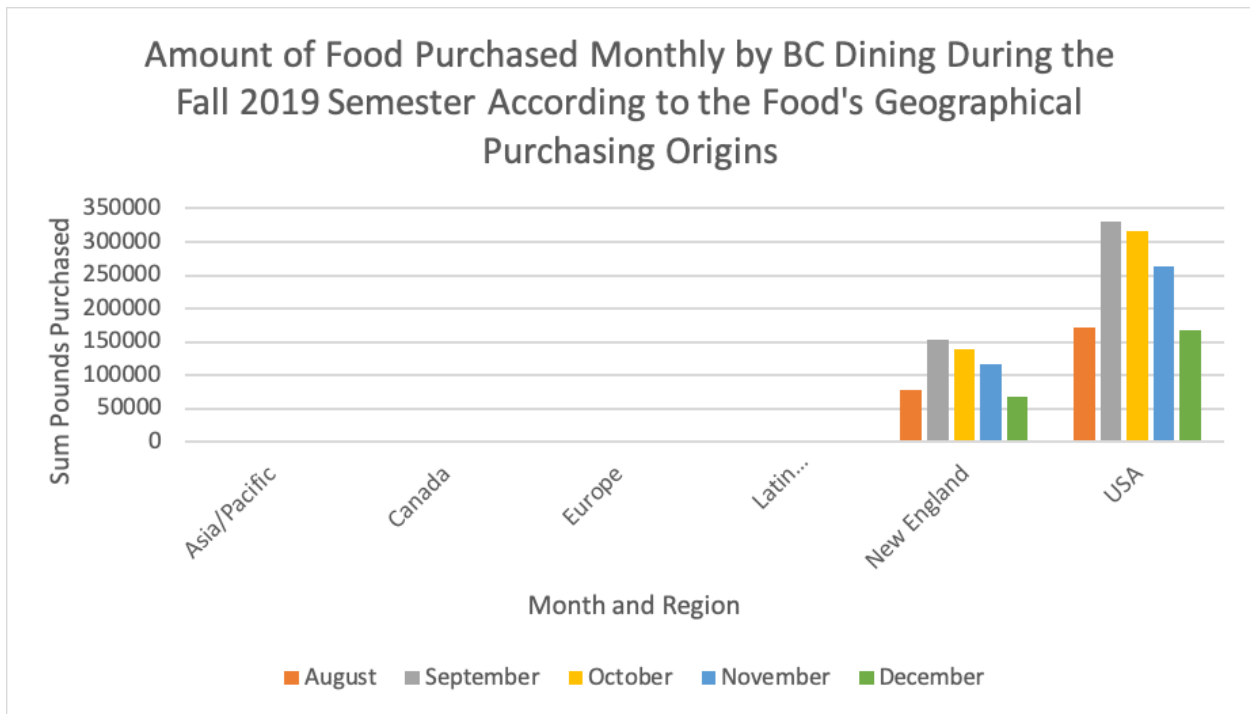


Figure 3: Distribution of the amount of food, in sum pounds, purchased monthly by BC Dining during the Fall 2019 Semester, according to the food's geographical purchasing origins

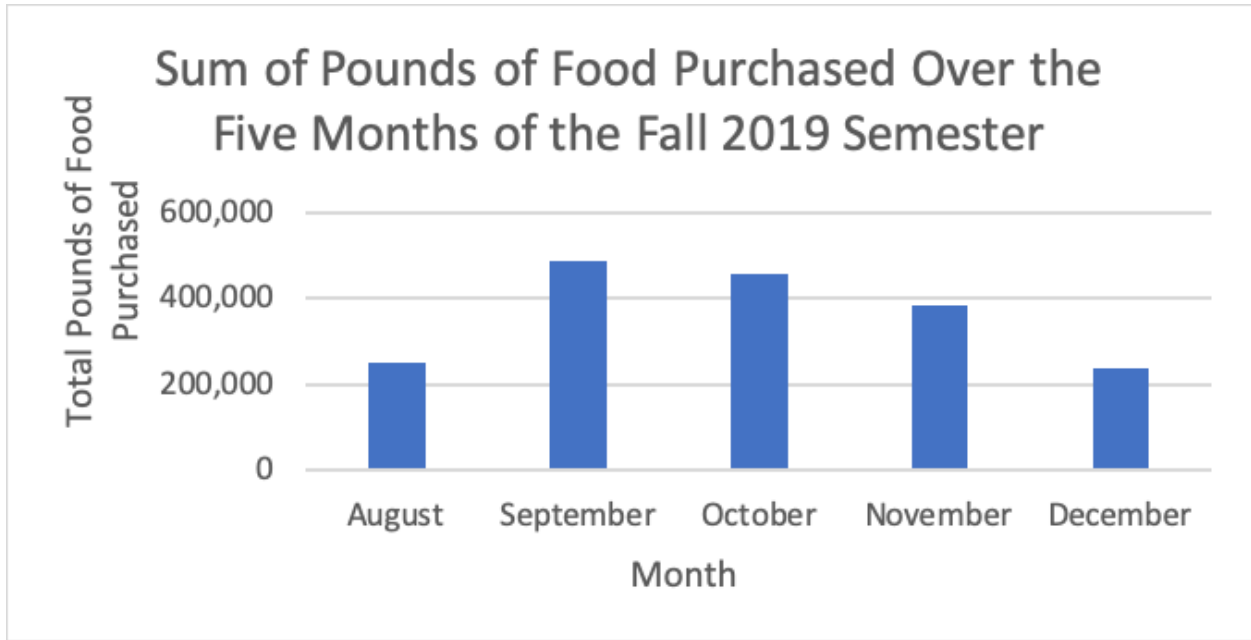


Figure 4: Distribution of the total sum of pounds of food purchased over the five months of the Fall 2019 semester

In the Spring 2020 semester, the semester when the Coronavirus pandemic snowballed and was officially declared as a pandemic by the World Health Organization (WHO) on March 11, 2020 (Aday: 2020), the majority of gallons of food purchased per month originated from sources in the New England region (Figure 5). Across the five months, this totaled 12,722 gallons of food purchased. The second largest amount of food was purchased from regions throughout the United States (USA), and across the five months, this totaled 5,914 gallons of food purchased. The total number of gallons purchased from Europe across the five months was 1,438; the Asia/Pacific region totaled 86 gallons.

To better understand how purchasing patterns varied throughout the five months comprising the Spring 2020 semester, Figure 6 shows the trends of purchasing according to the sum of the gallons of food purchased totaled across all four principal purchasing regions; Figure 6 shows that in January and February the highest volume of gallons of food were purchased, 9,622 and 10,321 gallons, respectively. March follows with a total of 3,141 gallons, but, as dining trends shifted immensely and immediately on March 11, 2020, it cannot be assumed this number is representative of the entire month. April and May had a mere 195 and 199 gallons of food purchased during their respective months.

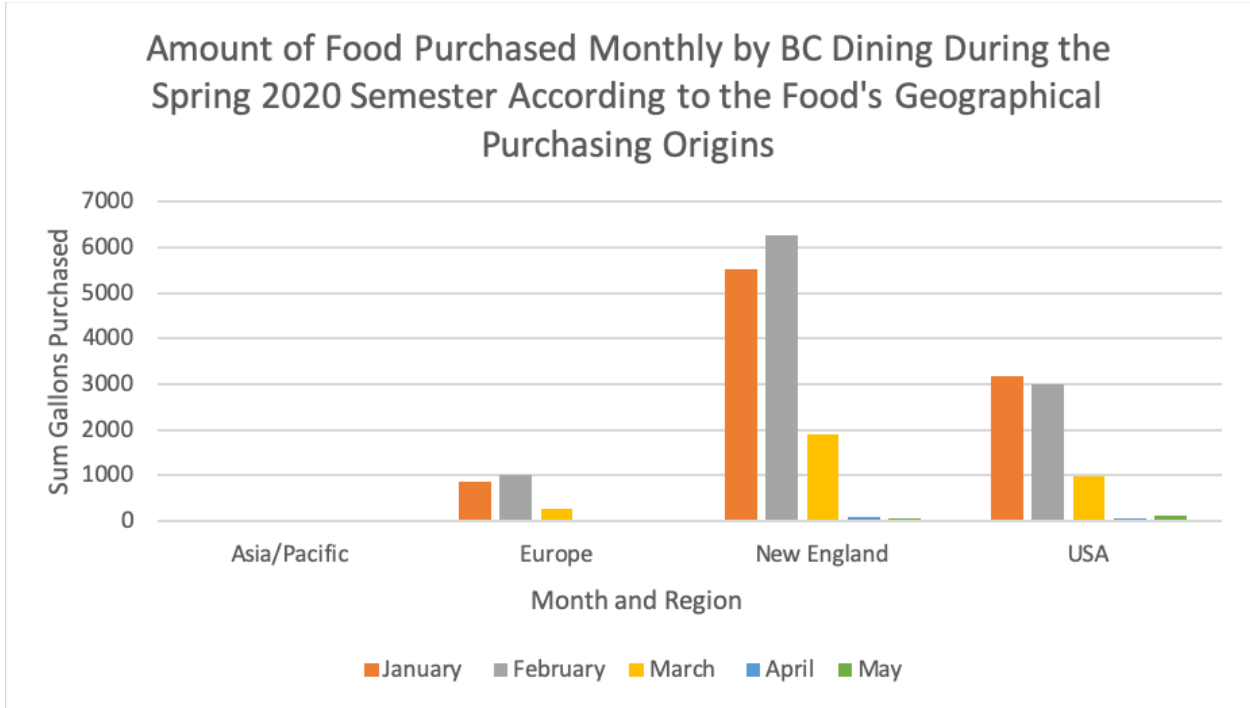


Figure 5: Distribution of the amount of food, in sum gallons, purchased monthly by BC Dining during the Spring 2020 Semester, according to the food's geographical purchasing origins

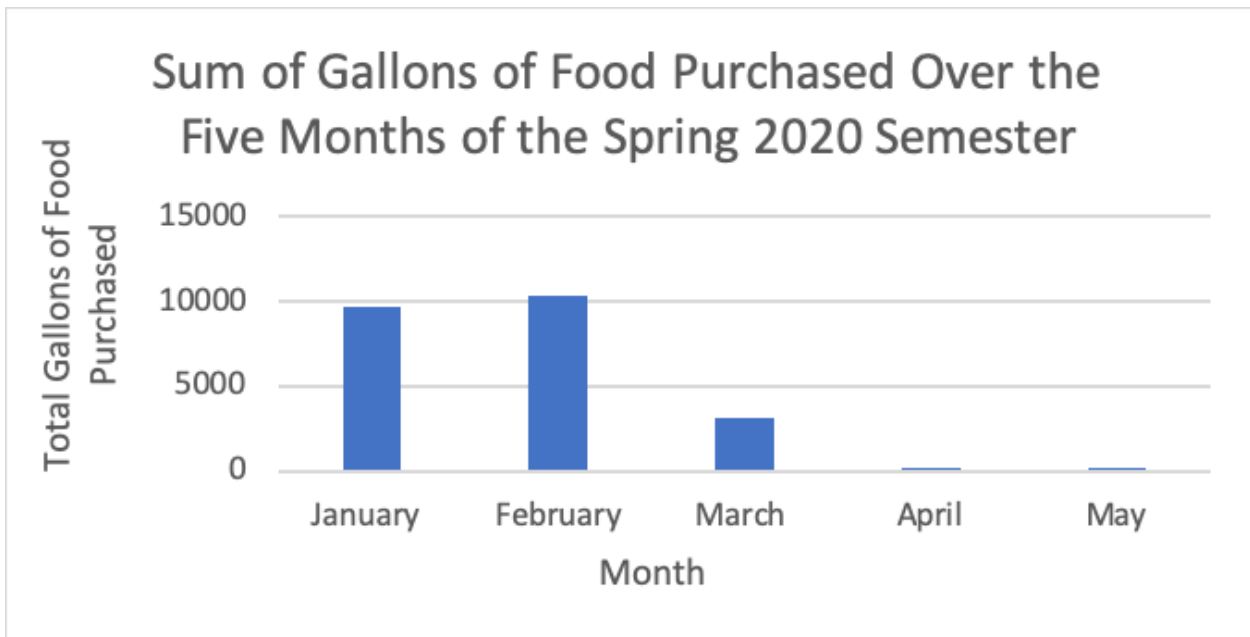


Figure 6: Distribution of the total sum of gallons of food purchased over the five months of the Spring 2020 semester

The trends of the number of pounds of food purchased in the Spring 2020 semester similarly resemble the trends of the gallons of food purchased during the same semester. The

majority of pounds of food purchased per month originated from sources in the United States region (Figure 7). Across the five months, this totaled 614,849 pounds of food purchased. The second largest amount of food was purchased from the New England region, and across the five months, this totaled 272,635 pounds of food purchased. The total number of pounds purchased from Latin America across the five months totaled 7,440; Europe totaled 2,672 pounds; Canada totaled 2,290 pounds; the Asia/Pacific totaled 1,634.

To better understand how purchasing patterns varied throughout the five months comprising the Spring 2020 semester, Figure 8 shows the trends of purchasing according to the sum of the pounds of food purchased totaled across all four principal purchasing regions; Figure 8 shows that in January and February, the highest volume of pounds of food were purchased, 361,421 and 398,948 pounds, respectively. March followed with a total of 120,090 pounds; April and May saw a great decrease in pounds of food purchased, 10,938 and 10,123 pounds, respectively.

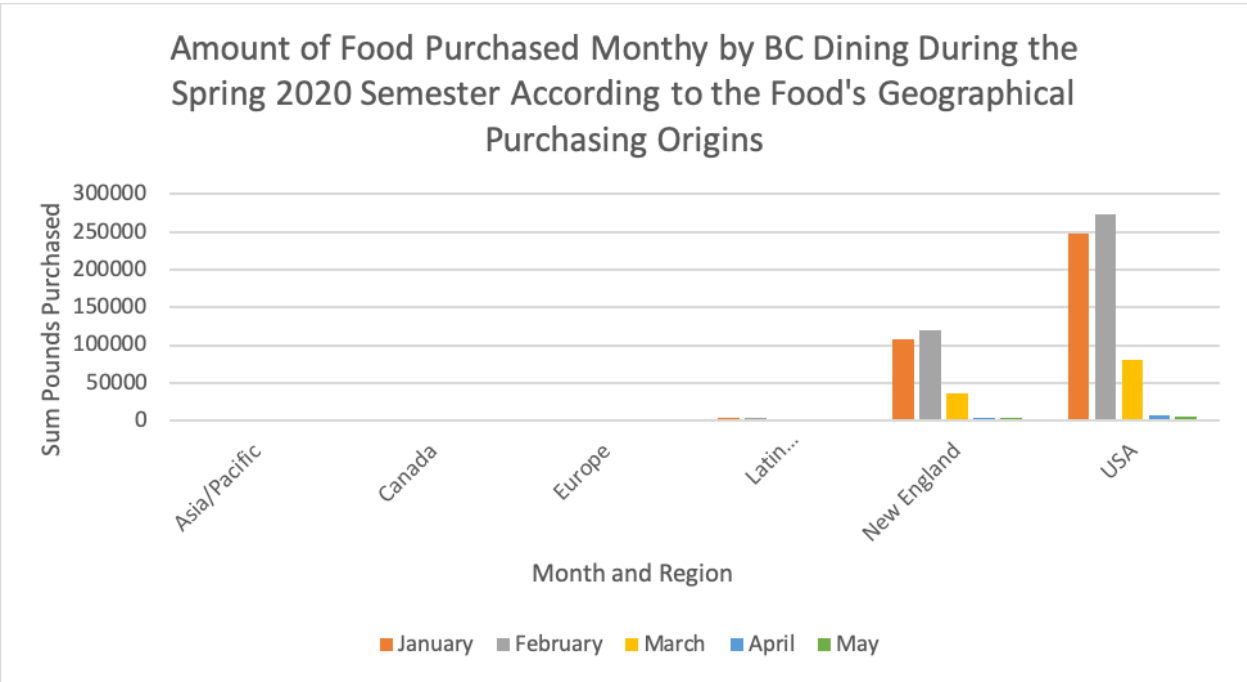


Figure 7: Distribution of the amount of food, in sum pounds, purchased monthly by BC Dining during the Spring 2020 Semester, according to the food’s geographical purchasing origins

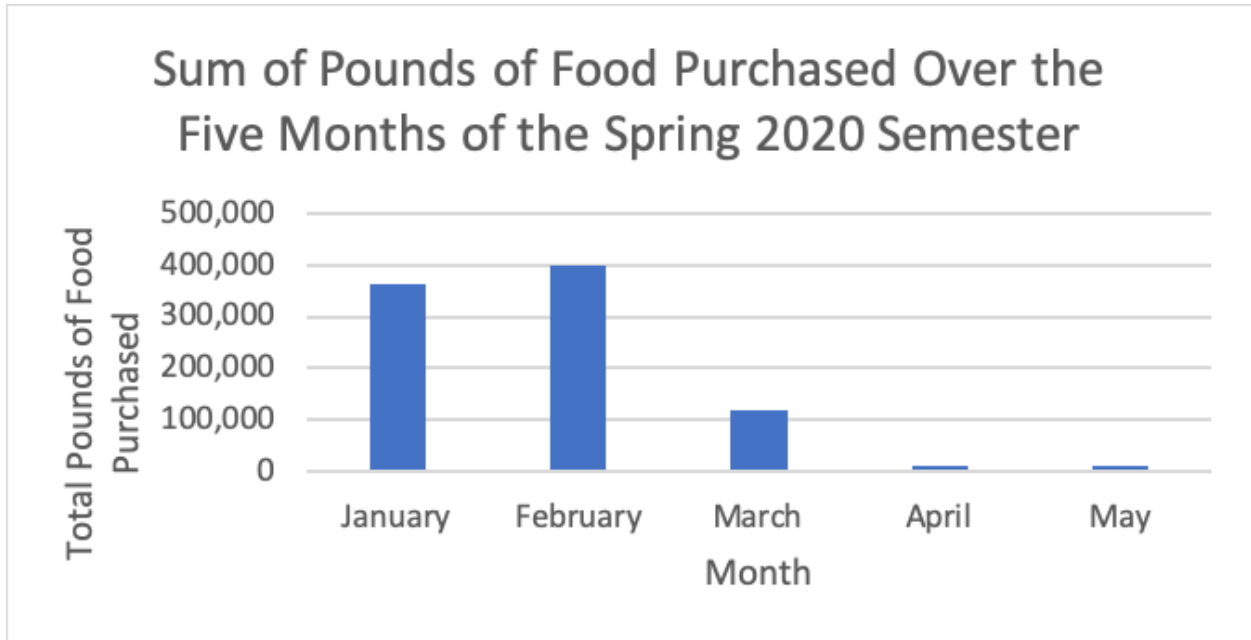


Figure 8: Distribution of the total sum of pounds of food purchased over the five months of the Spring 2020 semester

The data from the Fall 2020 semester indicates an upwards trend from the low of the purchasing habits during the months of March, April, and May of the Spring 2020 semester. The majority of gallons of food purchased per month originated from sources in the New England region (Figure 9). Across the five months, this totaled 12,722 gallons of food purchased. The second largest amount of food was purchased from regions throughout the USA, and across the five months, this totaled 5,914 gallons of food. The total number of gallons purchased from Europe across the five months totaled 1,438; the Asia/Pacific region totaled 86 gallons.

To better understand how purchasing patterns varied throughout the five months comprising the Fall 2020 semester, Figure 10 shows the trends of purchasing according to the sum of the gallons of food purchased totaled across all four principal purchasing regions; Figure 10 shows that in September and November, the highest volume of gallons of food were purchased, 5,822 and 4,806 gallons, respectively. August followed with a total of 4,487 gallons; October had 2,951 gallons of food purchased; December had 2,094 gallons.

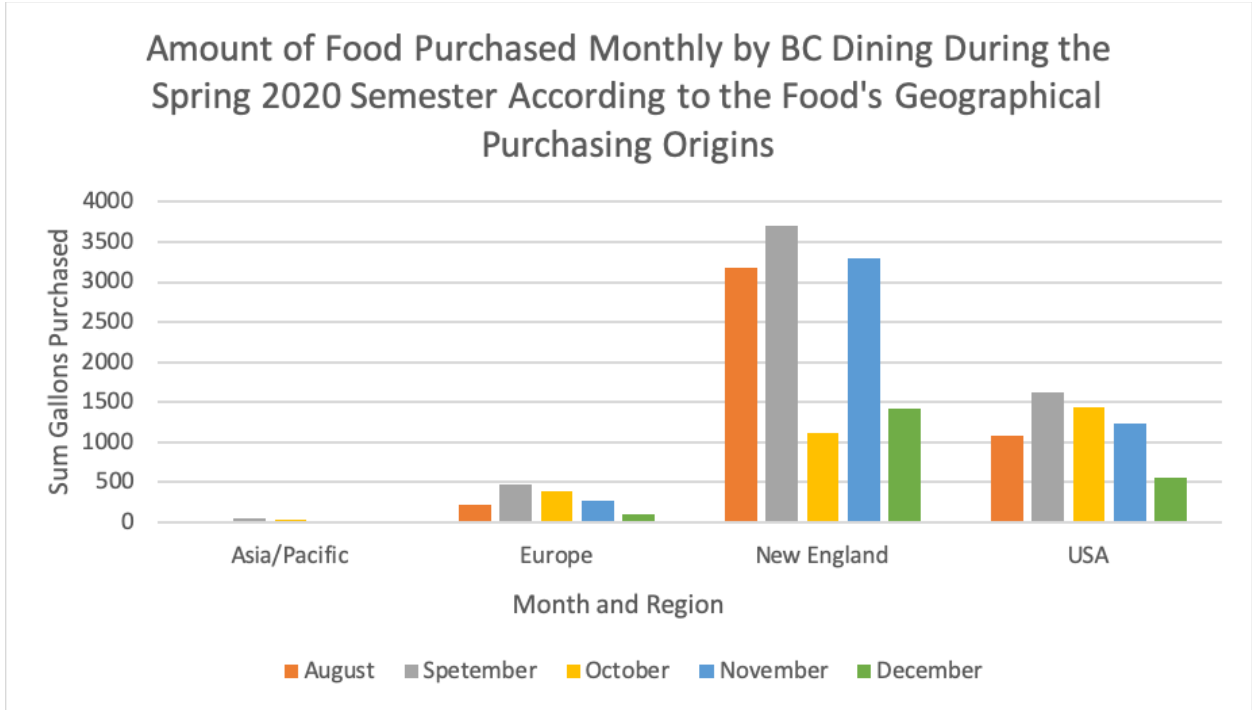


Figure 9: Distribution of the amount of food, in sum gallons, purchased monthly by BC Dining during the Fall 2020 Semester, according to the food’s geographical purchasing origins

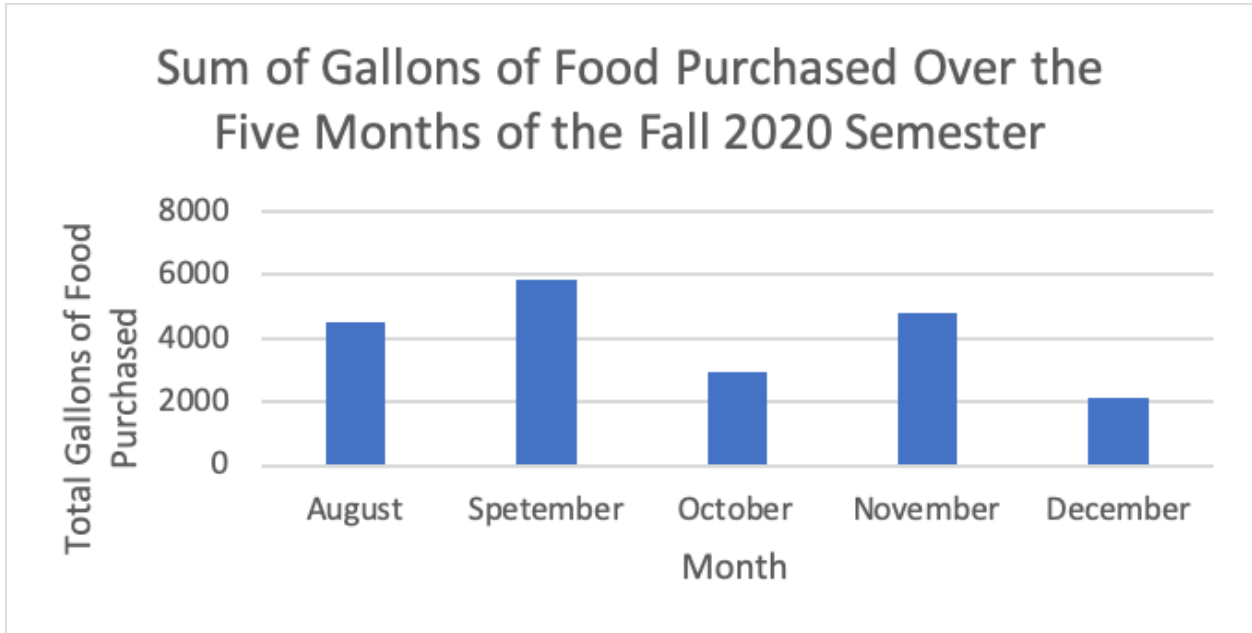


Figure 10: Distribution of the total sum of gallons of food purchased over the five months of the Fall 2020 semester

In the Spring 2020 semester, the majority of pounds of food purchased per month originated from sources in the United States region, though this amount was not much greater than the amount of pounds of food purchased from the New England region (Figure 11). Across

the five months, the number of pounds of food purchased from the USA totaled 676,443. The amount of food purchased from the New England region totaled 647,191 pounds; Latin America totaled 11,088 pounds; Canada totaled 4,500 pounds; Europe totaled 2,582 pounds; the Asia/Pacific region totaled 441 pounds.

To better understand how purchasing patterns varied throughout the five months comprising the Fall 2020 semester, Figure 12 shows the trends of purchasing according to the sum of the pounds of food purchased totaled across all four principal purchasing regions; Figure 12 shows that in September and October, the highest volume of pounds of food were purchased, 187,655 and 162,395 pounds, respectively. November followed with a total of 151,650 pounds; August had 122,441 pounds of food purchased; December had 101,284 pounds.

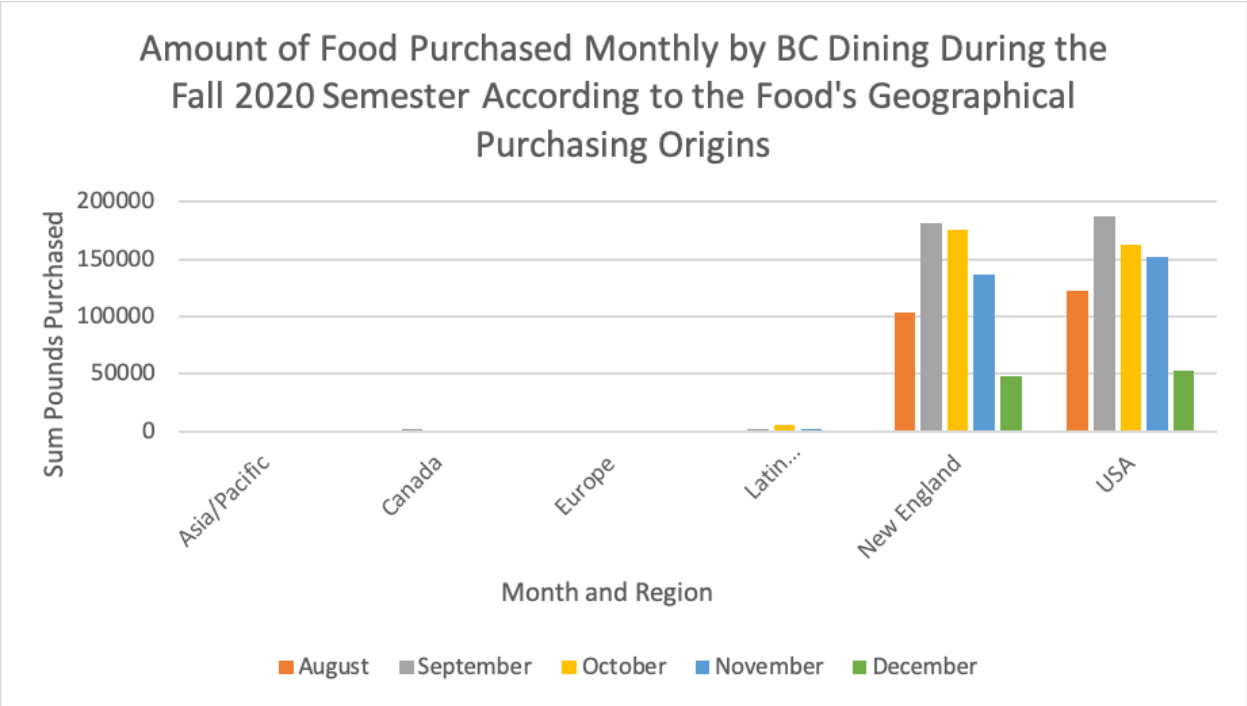


Figure 11: Distribution of the amount of food, in sum pounds, purchased monthly by BC Dining during the Spring 2020 Semester, according to the food’s geographical purchasing origins

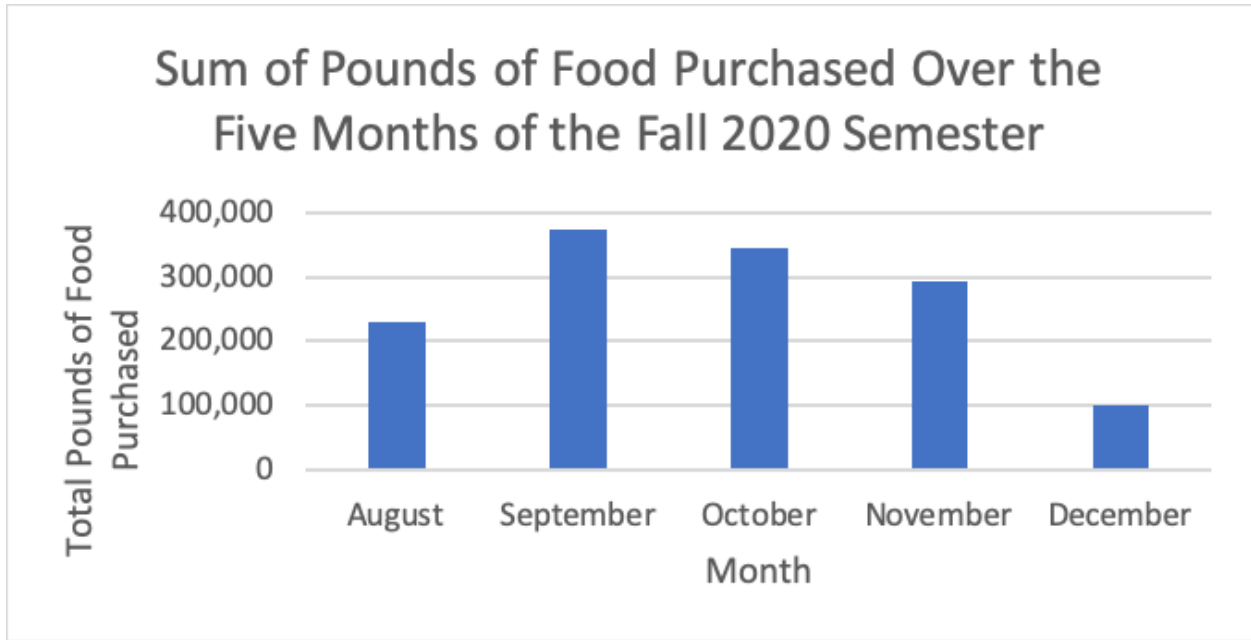


Figure 12: Distribution of the total sum of pounds of food purchased over the five months of the Spring 2020 semester

As a means of putting this quantitative data of food purchased into perspective, I also analyzed the financial data, provided by Rudy, that shows how much each of the respective dining locations around campus spent each month during the Fall 2019, Spring 2020, and Fall 2020 semesters, when purchasing food from various geographical sources. Figures 13-15, when regarded in subsequent order, provide a visual of how, in addition to a great decrease in the amount of foodstuffs bought, the impact on the amount spent can equally represent the effects of the Coronavirus on the shifts in how much food was being purchased.

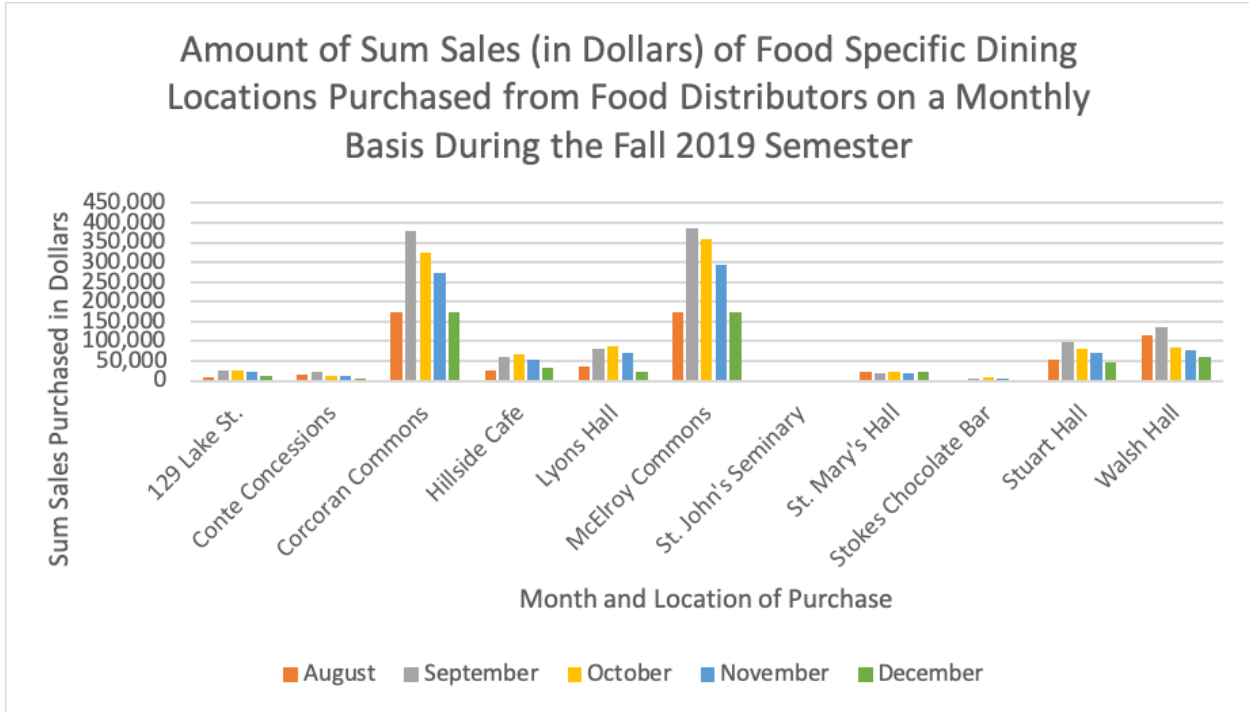


Figure 13: Amount of sum sales, in dollars, of food specific Boston College dining locations purchased from food distributors on a monthly basis during the Fall 2019 semester

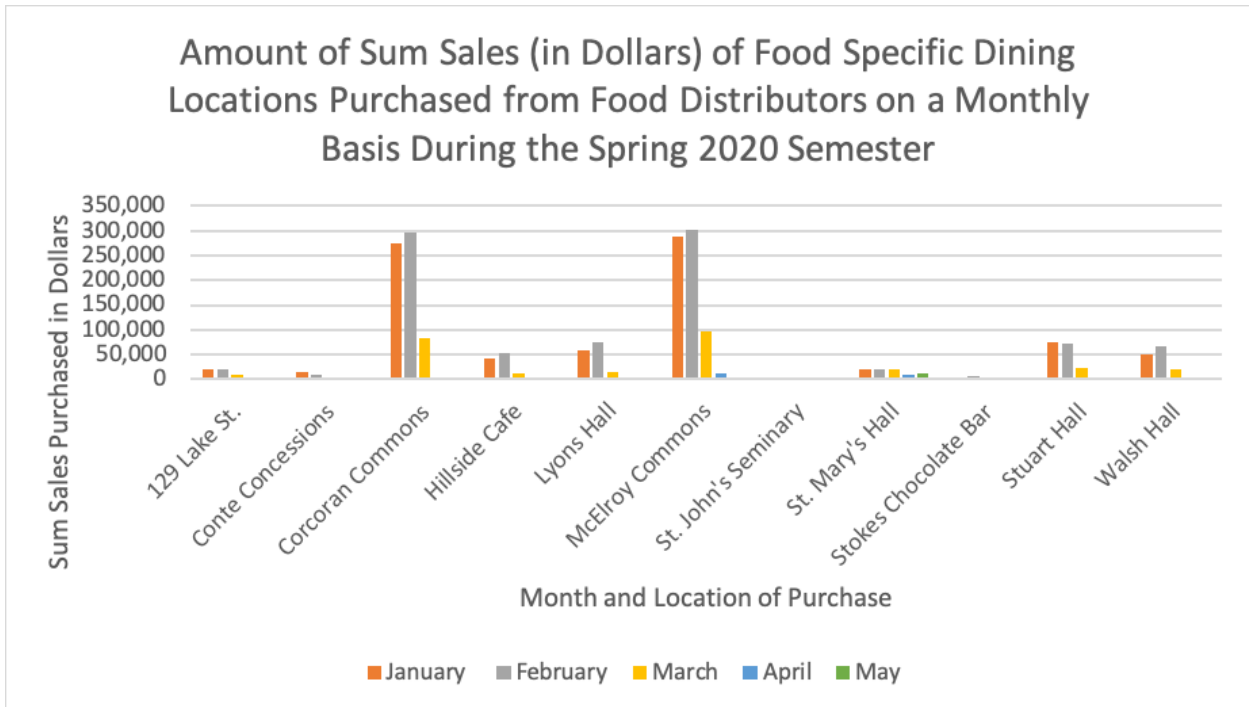


Figure 14: Amount of sum sales, in dollars, of food specific Boston College dining locations purchased from food distributors on a monthly basis during the Spring 2020 semester

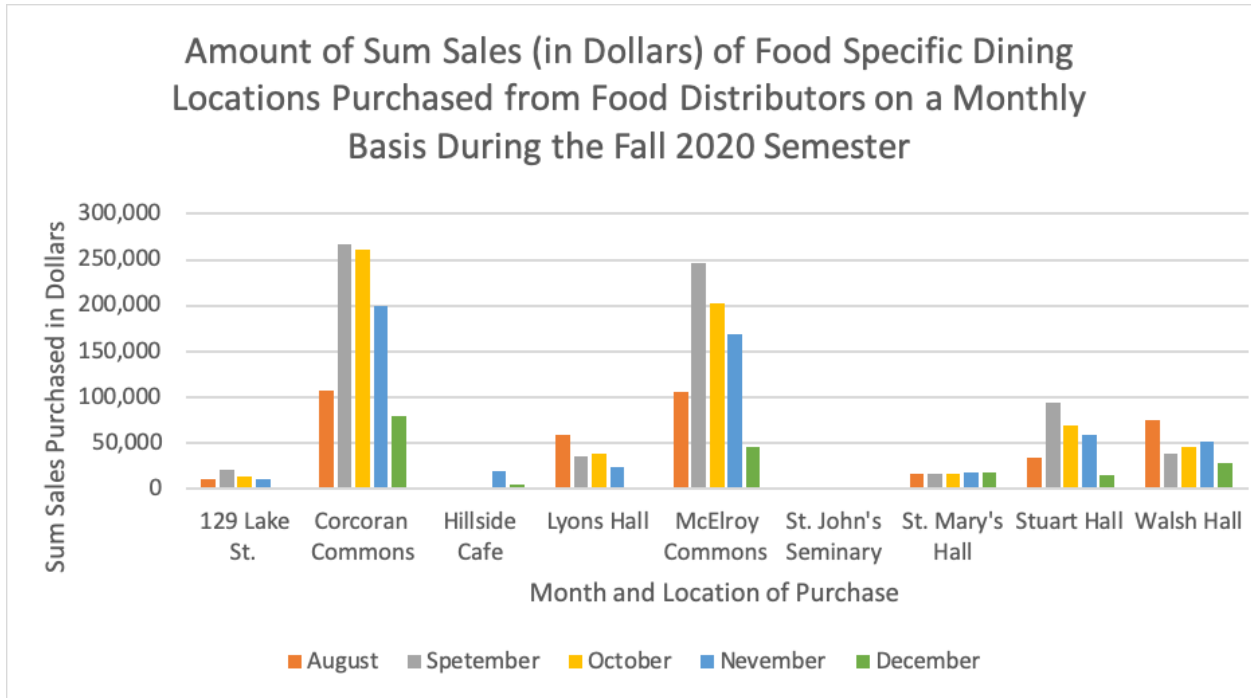


Figure 15: Amount of sum sales, in dollars, of food specific Boston College dining locations purchased from food distributors on a monthly basis during the Fall 2020 semester

C. DISCUSSION:

Based on the data, we identified that Boston College Dining Services' food sourcing experienced a decrease, not only consisting of an immediate decrease at the outset of the COVID-19 pandemic, but also a decrease that persisted throughout the Fall 2020 semester. This lasting decrease of the amount of food sourced and purchased aligns with Molly Funk's estimation that current BC Dining Services are operating at 70% of their usual production, and is highlighted in the comparison of the amount of food sourced and purchased during the Spring 2020 and Fall 2020 semesters. Three main sections will be further discussed as they relate to a decrease in food sourcing and include the following: sourcing of gallons of food, sourcing of pounds of food, and sourcing according to the amount of dollars spent on food purchases. This discussion will end with an overall summary of the results.

Sourcing of Gallons of Food:

The Fall 2019 data received assumes a typical dining year for Boston College, and from this, we compared the sum gallons of purchased food of the Spring 2020 and Fall 2020 semesters. As indicated in Figures 1, 5, and 9, the amount of gallons of food purchased declined heavily during the Spring 2020 semester following the outset of COVID-19, but has increased in

the Fall 2020 semester with students returning to campus, albeit nowhere close to pre-pandemic levels.

When comparing the number of gallons of food purchased between the five months of the Spring 2020 and Fall 2020 semesters, the first month, comparing the amount of gallons purchased in August 2019 to those purchased in January 2020, saw a 44.3% increase. The second month, comparing the amount of gallons purchased in September 2019 to those purchased in February 2020, saw a 18.58% decrease in the amount of gallons of food purchased. The third month, comparing the amount of gallons purchased in October 2019 to those purchased in March 2020, saw a 74.75% decrease. The fourth month, comparing the amount of gallons purchased in November 2019 to those purchased in April 2020, saw a 98.07% decrease, and the fifth month, comparing the amount of gallons purchased in December 2019 to those purchased in May 2020, saw a 96.9% decrease. Understandably, the largest percent decreases occurred during the months of April and May. Overall, this data shows a mean 48.74% decrease in the number of gallons of food purchased between the Fall 2019 and Spring 2020 semester.

However, while this conclusion about the great decrease in the amount of gallons of food purchased between the Fall 2019 and Spring 2020 semester highlights that the sourcing of food was indeed altered and lessened according to changes wrought by the pandemic, it is also necessary to understand how food sourcing has been affected once students returned to campus in the semester of Fall 2020.

When comparing the number of gallons of food purchased between the five months of the Fall 2019 and Fall 2020 semesters, the first month, comparing the amount of gallons purchased in August 2019 to those purchased in August 2020, saw a 32.71% decrease. The second month, September, saw a 54.07% decrease. The third month, October, saw a 76.28% decrease. The fourth month, November, saw a 52.43% decrease, and the fifth month, December, saw a 64.19% decrease. Overall, this data shows a mean 55.94% decrease in the number of gallons of food purchased between the Fall 2019 and Fall 2020 semester. While the percent decreases for the Fall 2020 semester vary, this average highlights how much less food BC Dining sourced this past fall semester in comparison to a typical fall semester when dining services are operating normally. It must be noted that the particularly high percent decreases of the months of November and December might be explained in part by the fact that students had the choice to opt to leave

campus following Thanksgiving Break and not return until the beginning of the Spring 2021 semester.

Sourcing of Pounds of Food:

As indicated in Figures 3, 7, and 11, the amount of pounds of food purchased similarly declined heavily during the Spring 2020 semester, but has increased somewhat in the Fall 2020 semester.

When comparing the number of pounds of food purchased between the five months of the Spring 2020 and Fall 2020 semesters, the first month, comparing the amount of gallons purchased in August 2019 to those purchased in January 2020, saw a 43.77% increase. The second month, comparing the amount of gallons purchased in September 2019 to those purchased in February 2020, saw a 18.25% decrease in the amount of gallons of food purchased. The third month, comparing the amount of gallons purchased in October 2019 to those purchased in March 2020, saw a 73.85% decrease. The fourth month, comparing the amount of gallons purchased in November 2019 to those purchased in April 2020, saw a 97.15% decrease, and the fifth month, comparing the amount of gallons purchased in December 2019 to those purchased in May 2020, saw a 95.75% decrease.

As was found of gallons of food purchased, the largest percent decreases occurred during the months of April and May. Overall, this data shows a mean 48.25% decrease in the number of gallons of food purchased between the Fall 2019 and Spring 2020 semester.

Worth noting is that the percent changes reflected in the number of pounds of purchased do not differ by more than a single percent when compared to the percent changes of the number of gallons of food purchased during this same time frame.

When comparing the number of pounds of food purchased between the five months of the Fall 2019 and Fall 2020 semesters, the first month, comparing the amount of gallons purchased in August 2019 to those purchased in August 2020, saw a 8.94% decrease. The second month, September, saw a 23.3% decrease. The third month, October, saw a 29.21% decrease. The fourth month, November, saw a 23.9% decrease, and the fifth month, December, saw a 57.48% decrease. Overall, this data shows a mean 28.57% decrease in the number of pounds of food purchased between the Fall 2019 and Fall 2020 semester.

Sourcing According to the Amount of Dollars Spent on Food Purchases:

Figures 13, 14, and 15 capture how the amount of sum sales in dollars spent by various dining locations when purchasing food experienced a similar stark in spending decrease during the Spring 2020 semester and a gradual increase during the Fall 2020 semester. There was a 51.42% decrease in spending between the Fall 2019 and Spring 2020 semesters and a 44.15% decrease in spending between the Fall 2019 and Fall 2020 semesters.

Results Summary:

Across all the data sets analyzed, the found percent decreases during the Fall 2020 semester are less steep than the Spring 2020 semester furthering the conclusion that, while a huge decrease in food purchasing occurred during the months of March, April, and May of the Spring 2020 semester, the Fall 2020 semester is increasing its food purchasing, though at a slower rate that reflects the estimation that BC Dining Services are currently operating at 70% of their usual capacity. Overall, these trends suggest that there has been an understandable decrease in Boston College Dining Services' food sourcing, and therefore, the amount of food being distributed has decreased as well.

II. WASTE AND RECYCLING

A. METHODS

In order to conduct our research on the impact of COVID-19 and develop a well-rounded understanding of the waste and recycling operations at Boston College and Boston College Dining Services, we used both qualitative and quantitative mechanisms. We contacted representatives from BCDS, including student sustainability manager, Molly Funk, for interviews and data collection through discussions and e-mail correspondence. We sought to obtain data regarding the amount and type of waste produced before and during the pandemic, if there were any changes in disposable container and plastic use for food distribution, and if there were any new sustainability plans implemented. From these representatives we obtained information including a statement titled "Impact of COVID-19 on BC Dining Sustainability" as well as quantitative data in the form of waste and recycling audits from January 2017 to December 2020. This information and data served as the primary source material for our observations and research.

The impact statement explains the shifts that took place in the operation of Boston College dining halls in order to meet new health and safety standards, including the complete

switch to disposable containers and restrictions placed on in-person dining, as well as maintaining sustainability measures through the reintroduction and expansion of the Green2Go program and inclusion of more compost bins across campus. In order to build sufficient context for the waste and recycling changes at BCDS, we observed campus-wide, local, and national guidelines. By looking at the impact statement in connection with external protocols established by Boston College administration, the local government restrictions on restaurants, and pandemic-specific recommendations from the CDC, we were able to better understand the decisions made by BCDS in order to open dining halls during the pandemic.

The data sheets we have received from the aforementioned representatives document the different types of waste produced from various Boston College facilities (i.e. municipal solid waste, food waste, and single stream recycling), the amount of each type of waste as well as total waste production, and the locations where campus waste was produced at Boston College from January 2017 to December 2020. By comparing the trends in waste and recycling during pre-pandemic operations (January 2017-February 2020) with numbers during the pandemic (March 2020-present), we can observe particular trends that have occurred as a result of new behaviors and protocols listed in the impact summary. We created graphs of the three types of waste that were most relevant to our research and one graph for the total waste across campus. Each graph shows the amount of each type of waste (municipal solid waste, single stream recycling, and food waste) measured in tons per month, with a separate line for each year (2017, 2018, 2019, 2020) in order to compare yearly outputs.

It is also necessary to acknowledge the limitations of our research and findings so that results can be interpreted with the utmost accuracy. The data sheets we obtained demonstrate campus-wide waste and recycling numbers by building. Because some campus dining spaces like Lyon's Hall (a.k.a. "the Rat") exist within buildings with other functions, such as Student Services and many classrooms, dining-specific waste collection numbers were not available for such locations. Similarly to the reduced dining hall capacity restrictions, it is necessary to point out that many dining areas that were fully-functioning prior to the pandemic, have suspended operations, which could potentially skew the waste and recycling output calculations. According to the BC Dining website, these include: the Faculty Dining Room, the Bean Counter in Fulton Hall, Café 129 on the Brighton campus, and the Chocolate Bar in Stokes Hall (*Locations and Menus*: 2021). Furthermore, compositional waste analysis numbers from September and October

2020 were not included in the 2020 report, and according to the sustainability representative, data from 2021 was not yet available to be passed on to our research group.

B. RESULTS AND DISCUSSION

According to the “CDC considerations for restaurant and bar operation during the coronavirus pandemic,” it is acceptable to use non-disposable food service items as long as they are handled with gloves and washed, rinsed, and sanitized properly. However, it is *recommended* that shared objects are limited, and it is preferable to use disposable food service items for increased safety. In regards to restaurant capacity, the lowest risk is defined as switching entirely to drive-through, take-out, or curbside pick-up; indoor service with reduced capacity is defined as “higher risk” (*Considerations for restaurant and bar operators*: 2020). The Massachusetts State Government affirms these recommendations in their guidelines. Dishware is allowed with proper cleaning, single-use disposables are preferred, and dining capacity is limited to 6 people per table and tables must be at least 6 feet apart from each other (*Safety Standards and Checklist: Restaurants*: 2021). In order to reopen its services safely, Boston College Dining is following all CDC and Massachusetts State Government site capacity and shared object recommendations. BCDS remarks that they “have determined that the safest and most efficient way to serve meals will be on take-out and to-go containers only” (*Spring Reopening Plans*: 2021). With this decision, sustainability questions arise.

Part 1: “Impact of COVID-19 on BC Dining Sustainability” Statement

- *To what extent were disposables used in BC Dining before the pandemic; to what extent are disposables currently being used?*
- *How has BC Dining’s use of food packaging changed since the pandemic started (i.e. type of packaging material, amount of food packaged)?*

Prior to the pandemic, it is estimated that around 40% of all meals were served on reusable dishware with metal cutlery. From that, we can then infer that the remaining 60% of meals were served using disposables of some sort. The statement details that the main impact of COVID-19 on Boston College’s sustainability was the need to switch to serving 100% of meals on disposables. This decision was implemented due to increased safety and sanitation precautions, limited staffing capacity (which will be discussed in further sections), as well as the need to accommodate and encourage an increase in grab-and-go and take-out meals.

Despite having to entirely use single-use disposable containers and cutlery, BCDS explains that the majority of food is served on disposable World Centric containers, including: plant fiber burrito bowls, salad bowls, and soup cups. This company's containers have been used at BC since 2019 to accommodate students who preferred to take their meals to-go. All World Centric items are fully compostable with Save that Stuff, Boston College's waste provider (*Sustainability Programs and Initiatives*). From further investigation into this brand of disposables, we have found that these containers and other materials are: made from annually renewable plants (i.e. bamboo and corn), 100% compostable, non-polluting and non-toxic, and produced in a zero carbon emissions facility. Additionally the company donates 25% of its revenue to social and environmental organizations (*About our products*).



Figure 16. Graphic depicting the World Centric containers used in BC dining halls across campus.

Despite the majority of food being served in compostable containers, BCDS remarks they have noticed an increase in the use of plastic bags, clamshell containers, and cutlery due to the new pandemic precautionary measures. Similarly, all baked goods and salad bar items are no longer freely available at self-serve stations, but are now wrapped in plastic. Dining Services also only offers bottled drink options as opposed to providing fountain drinks, which has led to an increase in students purchasing bottled beverages. Additionally, refillable water fountains across campus and the bring-your-own-mug-discount programs have been suspended.

To combat the switch to disposables and the increase in take-out meals, several new programs have been implemented. RealFood BC, a club on campus, has partnered with the Office of Sustainability to place compost bins outside of all residence halls. In previous years, even though containers were made from compostable materials, students were not always

placing them in compost bins. Now, with added bins in more convenient locations, students are able to compost items outside of dining halls. This is especially important because so many students rely on take-out instead of eating meals inside dining halls, which have appropriate waste bins readily available.



Figures 17 and 18. Pictures of compost bin and instructions placed outside of 2150 St. Thomas More Apartments. Bin is conveniently located just around the corner of the building's entrance.

Additionally, BCDS has restarted its Green2Go program, which began in Lower Live and Corcoran Commons during the Spring 2020 semester, but was suspended during the initial coronavirus campus closures. This program was reintroduced on March 1, 2021 across Lower, McElory, and Stuart dining halls. Green2Go allows students to opt-into a reusable container program with a one-time \$9 fee taken out of their mandatory meal plan. The Green2Go containers can be used just as the other disposable containers. Once returned, students will receive a carabiner, which serves as a token that can then be exchanged for a reusable container. Green2Go containers are made in collaboration with Preserve, a local Massachusetts company. Containers are made from 50% #5 recyclable materials (Murphy: 2020). During its reintroduction earlier this year, the Undergraduate Government of Boston College (UGBC)

subsidized the program for 230 students so that they would be able to opt-in for free. BCDS estimates that each student who participates in the program cuts down on their disposable consumption by around 60 containers per month. They are looking into expanding this program and making it an integral part of the dining experience.

Overall, it is evident that sufficient changes have been made to the operations of the Boston College dining halls. The switch from 40% of meals being served on reusable dishware to 100% being served in disposable containers or wrapped in plastic is an important sustainability concern that has arisen due to the new healthy and safety procedures. However, it is also apparent that BCDS is aware of the environmental impact and has attempted to make the switch as sustainable as possible with the various new options available, from using compostable containers to encouraging students to engage in environmentally conscious programs like Green2Go.

Part 2: Waste and Recycling Output Analysis

- *How has the overall waste production and management (including both trash and recycling) changed since the start of the COVID-19 pandemic?*



Figure 19. Graph depicting total waste (including: MSW, construction and demolition, food waste, yard waste, cardboard, metal, single stream recycling and paper) trends across campus from January 2017 to December 2020.

All raw data tables from BCDS used to create graphs are available in the Appendix

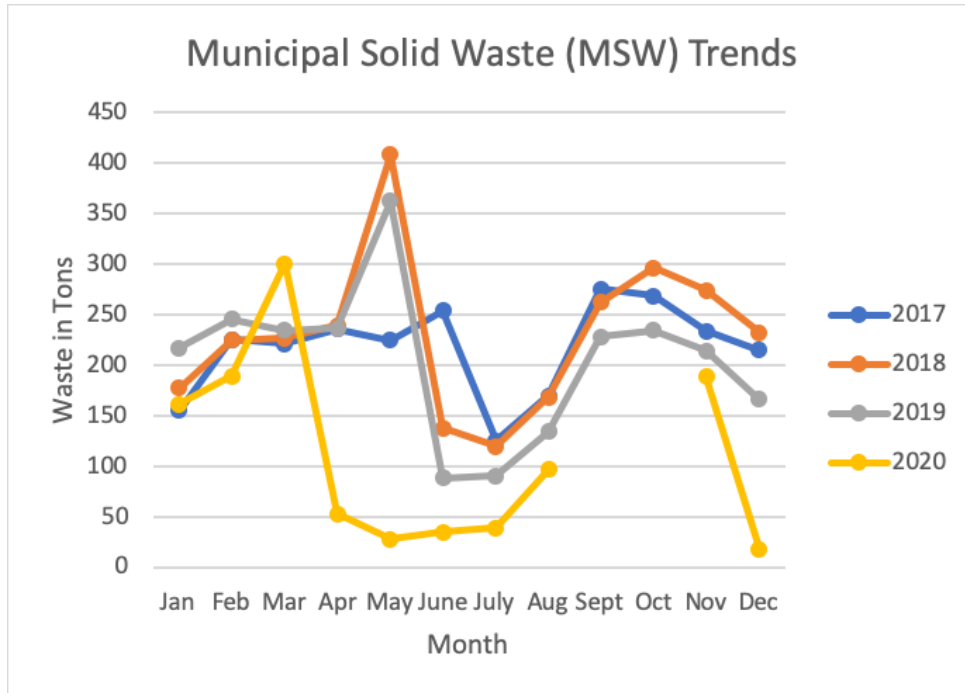


Figure 20. Graph depicting MSW trends across campus from January 2017 to December 2020.

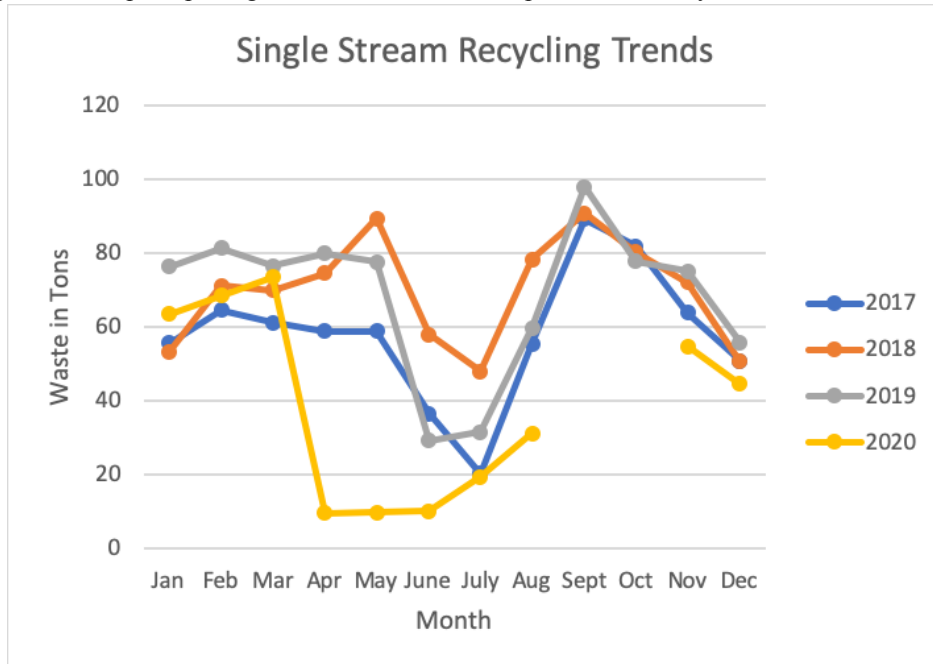


Figure 21. Graph depicting single stream recycling trends across campus from January 2017 to December 2020.

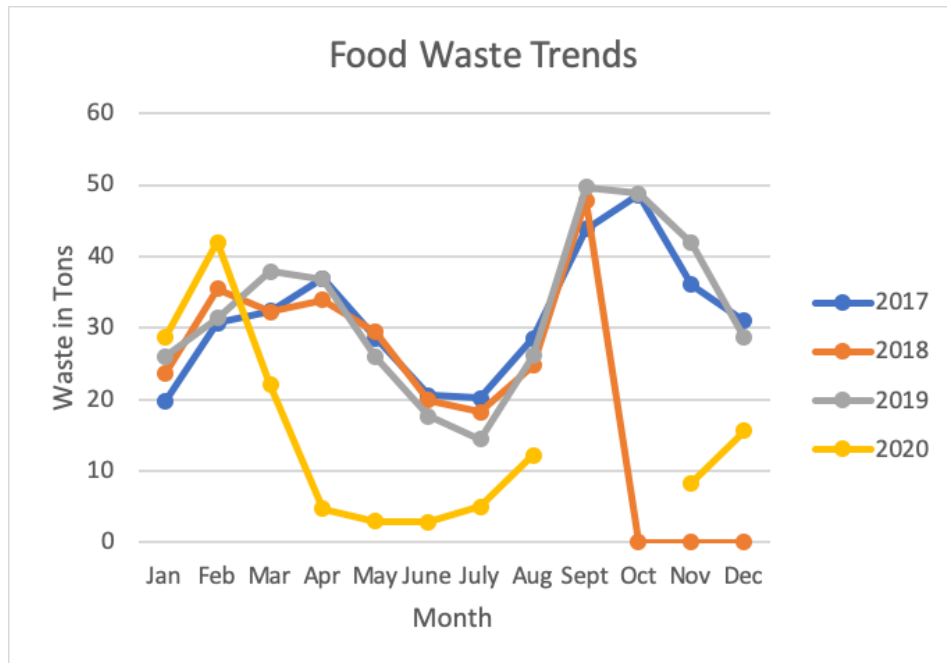


Figure 22. Graph depicting food waste trends across campus from January 2017 to December 2020.

By looking at the various waste outputs over a four year span, we can observe the impact of COVID-19 on waste and recycling. The years 2017-2019 appear to have somewhat similar cycles of waste outputs, wherein outputs are steady from January to April and reach a spike in May. This correlates with the cycle of the Spring academic semester, where students return to campus in January and depart in May. It makes sense that waste would increase in May, because all students must evacuate their dormitories and apartments and must remove all belongings. This results in an abnormally high amount of waste and recycling. From June to August we see a dip in the waste output, because most of the student and staff population is not on campus during the summer months. It follows that in August and September, we see another increase in waste output, as this is when the Fall academic semester begins. The waste output remains somewhat consistent from September to November during the Fall semester, but then falls again in December when campus is closed for winter break.

The year 2020 marks a significant change in the output cycle. After the national declaration of the coronavirus pandemic, Boston College made the decision to evacuate all students from campus by March 15, 2020 (University Communications: 2020). Because of this, we see waste spikes in March rather than May, because students had to evacuate their dormitories and apartments. Similarly, we see drastic dips in waste outputs from April until

August, when campus remained close for the remainder of the Spring 2020 semester and into the summer. Again, we see waste outputs increase in August during the reopening of campus for the Fall 2020 semester. Although compositional waste analysis data from September and October 2020 were not included in the audits we received, we can infer that they might also represent a gradual increase because the total waste output increases during those months (Figure 19). Also, that trend appears to have been consistent for the past three years. It is also evident that waste outputs during the Fall 2020 semester were somewhat lower than the previous years.

Food waste has a drastically lower output in 2020 (Figure 22). This data corresponds with the information we have received from BCDS; although there has been a switch from 40% reusable dishware to 100% disposable containers throughout the dining halls, BCDS also reports that they are serving around 70% less meals than usual. Sustainability representative, Molly Funk, commented on this number and explained that she believes this is due to the fact that there are fewer students living on campus and fewer upperclassmen choosing to eat on campus.

Waste output cycles have been affected by the abnormal semester system of the 2020 year, with campus closing to the majority of the campus' population from March to August 2020. With less people on campus, waste output levels dropped significantly. This is predictable due to data from the previous three years that shows significantly lower waste outputs during the summer months and winter break when campus is closed. However, the total waste trends data demonstrates that the cycle appears to have gotten back on track when the Fall 2020 semester began at the end of August (Figure 19). The single stream recycling and MSW output trends also appear to have returned to the typical cycle, barring the excluded information (Figures 20, 21).

Overall, the data does not show that the COVID-19 pandemic has drastically increased the waste output at Boston College and subsequently, at Boston College Dining Services, as would be expected. In fact, all waste output numbers are lower from March 2020 onwards than previous years. This could be due to a number of influencing factors, including less students, staff, and visitors on campus due to coronavirus restrictions or to personal choice. Again, it is important to remember that this data represents waste outputs from the Boston College campus as a whole. It is not specific to the dining halls, as waste output data at Boston College is measured building-by-building and then calculated in its entirety. Furthermore, this data represents an isolated community and does not reflect the waste output on any national or international scale.

III. ECONOMICS AND OPERATIONS

The COVID-19 pandemic has fundamentally changed just about everything, and changes in dining services are one of the most visible. In response to the rapidly spreading coronavirus in the United States, the CDC has maintained an updated set of guidelines for a number of industries, such as the manufacturing, restaurant, and education industries (*Guidance documents: 2021*). One such guideline recommends refraining from using reusable dishware in restaurant settings (*Considerations for restaurant and bar operators: 2020*). This decision was based on early evidence supporting the spread of COVID-19 through food packaging; one study found that “food packaging is a key factor that needs attention in order to stop spreading COVID-19 in the human population” (Duda-Chodak: 2020). Industry researchers at Mckinsey & Co. found that the \$900 billion packaging industry (with food packaging being the largest area of the packaging industry) was unable to meet the rapid increase in demand for consumer food packaging products; this points to a rapid surge in demand for disposable packaging that occurred as a result of the pandemic and has been maintained since the start (Feber: 2020). Further industry analysis conducted by Morgan Stanley found that the food delivery sector of the economy advanced so rapidly in the first months of the pandemic that 2020 delivery capabilities surpassed predictions for 2025 (*COVID-19 era serves up big changes for U.S. Restaurants*). Previous research has established the utter chaos the dining industry was thrown into as a result of the COVID-19 pandemic.

Boston College dining facilities and students had to adopt unprecedented changes in their operations and dining habits, respectively, in order to prevent the spread of the coronavirus. In addition to adhering to CDC guidelines, BC dining facilities must also adhere to the Restaurant Safety Standards and Checklist published by the state of Massachusetts, which include strict guidelines on staffing (*Safety Standards and Checklist: Restaurants: 2021*). Procedures were put in place, such as mandatory use of disposable packaging and social distancing, that forced students to change their dining habits. This paper expands on the already established research by looking at how the pandemic-inspired changes have affected the cost structure and operations of BC dining facilities.

A. METHODS

The primary research mechanism for this inquiry was to procure data from Boston College dining facilities, interview BC dining staff (in a range of positions within the

organization), and review research on macroeconomic factors that both resulted from COVID-19 protocols and affected the dining industry. Boston College was unwilling to provide us with data relating to their expenses, revenues, payroll, water usage, and much more; in fact, almost every request or data was denied by Boston College dining. Our team reached out to 4 individuals in the organization who all denied our requests. This severely limited our ability to analyze any changes in BC dining's expenses resulting from the pandemic.

In order to gain insight into the changes in cost and operations in the absence of numerical data, we met with a number of staff from BC dining facilities. The staff included the top managers of Corcoran Dining Hall and McElroy Dining Hall, as well as two students in the sustainability department of BC dining's broader operations. Two of these meetings were set up beforehand via email, while the other two were spontaneously initiated by us simply walking into the manager's office and requesting a meeting at that moment. We felt we had to initiate these meetings in person due to the unwillingness of BC dining to share data and information with us. These meetings provided us with several important insights into the changes in operations as a result of the pandemic, several important cost figures, the future vision of BC dining, and much more.

In order to strengthen the data obtained from BC dining facilities we also reviewed industry research on the macroeconomic effects COVID-19 has had on dining facilities and food systems. We then apply and extrapolate this data to gain insight into the specific effects of BC dining's COVID-19 response protocols.

The purpose of this research undertaking is to establish COVID as either an economic asset or liability in order to determine if there is an incentive to indefinitely continue the current protocols in place.

B. RESULTS AND DISCUSSION

As indicated in the methods section, our analysis of the financial impact COVID-19 has had on BC dining was severely limited due to BC's unwillingness to share financial data. However, we conducted extensive interviews with four members of the Boston College staff who provided insights into our research questions. We will not identify the interviewees by name in order to maintain confidentiality and encourage a culture of mutual trust for future research. The insights gained from these conversations are described in detail below.

Staffing

The implementation of state and national COVID-19 protocols in dining facilities greatly impacted the staffing decisions of BC dining establishments. Each worker had to be at least 6 feet apart from another worker and maintain a “work area” that more or less keeps employees in a stationary position for the entirety of their shift. COVID protocols also increased the workload in the dining halls which increased costs; There must be staff members in the “dining lobby” directing traffic and ensuring everyone is socially distant. Additionally, all foods previously served in the buffet or “open serve” style must now be packaged in individual packages; this has increased the overall cost of labor as staff now must individually prepare items that students had previously prepared themselves. BC dining had trouble filling these positions at the start of the year due to COVID concerns among potential employees. With a reduced working space (thus lower staff capacity), increased labor requirement to serve food, and an inability to find new hires, BC made the decision to shift to using exclusively disposable containers; they simply did not have the staff or the space to continue dishwashing. Before COVID 70% of meals were served on reusable dishware; that number has fallen to 0% as a result of the pandemic protocols; this has had significant implications for the sustainability of BC dining facilities.

Sustainability

The sustainability of BC dining was negatively impacted with the onset of the COVID pandemic. The COVID pandemic forced BC to serve all food in disposable containers which has increased the environmental footprint of a BC dining meal. Most hot meals are served in a fully compostable container made out of plant fiber with a carbon production footprint of zero; if disposed of properly these compostable containers go to a company called “Save that Stuff” where the waste is composted and put into an anaerobic digester for energy production.

Many BC dining sustainability initiatives were put on hold during the pandemic. One such program called Green2Go was paused last March when it was in its initial trial phase. This program allows students to use reusable containers for takeout that can be returned and cleaned by dining facilities. The initial goal of the programs was to make disposable containers obsolete in BC dining, but COVID prevented this from becoming a reality. Despite setbacks the Green2Go initiative was relaunched on March 1st in Lower, McElroy, and Stuart dining halls. So far the program has gained 400 student members accounting for over 1100 meals. BC dining hopes to expand the program going forward.

BC dining's FRESH to table program was entirely put on hold during the pandemic. Fresh stands for fairly traded, regional, equitable, sustainable, and healthy food. The program brought socially just, sustainable, and healthy meals to BC students; once a week a "kitchen" was set up in Corcoran Commons and samples were handed out to students. Each menu item had to meet at least two of the five FRESH requirements. This program links BC sustainability with economic and social justice within New England. The program did not resume the fall semester of 2020 because BC dining felt handing out samples to students did not meet COVID safety protocols.

BC dining has implemented several new programs to fill in the gaps left by the discontinuance of the FRESH to table program. One of which is a community supported agriculture (CSA) program. For a price of \$340 (meal plan money accepted) students can buy into the program at the beginning of the semester. This money goes to local farms as an upfront investment into that season's crop production costs. In return students receive \$40 worth of locally grown produce on a weekly basis. This program brings fresh and local food to students and provides farmers with money in their off season to continue their operations. Participation in the program increased by 300% (from 40 participants to 120) this semester, presumably because students can now use their meal plan money. This change did not occur because of COVID and BC dining hopes to continue offering this payment option in the future. Additionally, BC dining began offering virtual cooking classes for students once a week, outdoor weekly farmer's markets, and occasional "pop-up" food trucks which were also outdoors. This allowed BC dining to continue community engagement and pursue sustainability in a COVID-friendly way.

Revenues and Expenses

COVID had a significant impact on the cash flows of BC dining by lowering revenues while also increasing costs. As a whole, BC dining is serving meals at 70% normal capacity compared with previous academic years. According to a source at McElroy Commons, revenues have decreased even further, to around 50% of what is considered a "normal year." This is attributed to several COVID protocols which have increased expenditures. One such protocol instructs workers to dispose of all food after it has left the kitchen; previously a majority of the food leftover at the end of the meal period would be repurposed and served the following day/meal period. Now, however, that food is thrown out and BC must buy more food to manage this inefficiency. This also has significant implications on the sustainability of BC dining's

operations. The increased workload has resulted in an increase in staffing expenses, according to a source at McElroy. This same source cited a 15% increase in packaging expenses resulting from the exclusive use of disposable containers. All of these factors have led to a diminished net profit for BC dining.

Food prices have also increased as a result of the pandemic. The price of beef increased by about 12% and the price of chicken increased by 9% according to a source at McElroy Commons. To gain a deeper insight into the effects of COVID on the food supply we conducted further research on the macroeconomic conditions of the food economy resulting from COVID. The US Bureau of Labor Statistics (BLS) published a study which describes how COVID has caused incredible volatility in the price of food commodities, with meat, fish, dairy, and eggs affected the most (*The impact of the COVID-19 pandemic on food price indexes and data Collection: 2020*). The table below shows the percent change in the consumer price index for food items in the United States during the pandemic:

Table 4. Consumer price indexes for select food at home categories, 12-month and 3-month percent change

Category	12-month percent change, March 2019–March 2020	3-month percent change (SA), March–June 2020
Food at home	1.1	4.3
Cereals and bakery products	0.1	3.1
Meats, poultry, fish, and eggs	2.3	10.3
Beef and veal	3.8	20.4
Dairy and related products	3.7	2.1
Fruits and vegetables	-1.9	2.5
Nonalcoholic beverages	1.4	3.6
Other food at home	1.4	2.1

Note: SA = seasonally adjusted.

Source: U.S. Bureau of Labor Statistics.

Table 4 shows a relatively large increase in the consumer price indexes for animal products from March 2020 to March 2021. These price increases have been attributed to the industry’s slow response to the virus, COVID outbreaks in US meatpacking facilities, global supply shocks in animal products and a subsequent decrease in meat imports. BC dining was immune to the macroeconomic shocks when they were at their worst (March - June 2020), but has had to grapple with these effects this academic year. While the prices of many of the food

commodities that BC dining centers their menu around increased during this period, other food prices decreased considerably; lobster, for example, saw its consumer price index decrease by over 50%. The intense volatility in these food prices has made BC dining's costs unpredictable and has had real implications on their margins. BC dining continues to offer dishes primarily centered around the foods that saw the largest price increases (beef and chicken, i.e.) which has forced them to increase the amount they are spending on food.

IV. STUDENT SURVEY

A. METHODS

We conducted a survey amongst current Boston College undergraduate students to gain insight into their experiences at BC dining facilities. The google form survey consisted of 39 questions separated into 3 sections: dining habits, sustainability, and general impressions. The dining habits section was the longest section and asked questions which gauge the students' dining habits before, during, and after the pandemic. The second section asked students to provide information on the sustainability of dining on BC's campus. The third and final section allowed students to voice their general impressions of BC dining facilities. The survey was conducted through google forms and in order for a student to take the survey they had to log in via their BC email address

Due to COVID-19 protocols and social distancing guidelines we limited our survey solicitation to online forms which most likely limited the response rate. We digitally sent the survey to all online BC groups we could access (i.e. facebook class groups, friend group messages, student club groups), friends/peers that could access additional BC students (i.e. resident assistants, club leaders), and class rosters. The survey disproportionately represents the senior class since this is the subset of the BC community we have the most access to. Additionally, the freshmen respondents were not on campus prior to the pandemic which prevented them from comparing their current dining experience at BC with the pre-pandemic experience.

Respondents were made aware that their participation in the survey was completely voluntary and they could stop at any time. They were also made aware that all responses were anonymous and no information which could identify someone personally were recorded. Respondents were made aware of the purpose of the study and who would view the results.

B. RESULTS AND DISCUSSION

Of the 54 survey respondents around 48% are seniors, 15% are juniors, 13% are sophomores, and 23% are freshmen. Ideally each class would be split evenly but we were limited in our access to students due to reasons outlined in the methods section. About 54% of respondents are in the Morrissey School of Arts and Sciences, 30% are in the Carroll School of Management, 9% are in the Lynch School of Education, and 7% are in the Connell School of Nursing. Ideally the distributions between schools would be 65%, 25%, 6% and 5%, respectively; these figures are fairly close, meaning each school is well represented in the pool of respondents. Lastly, about 83% of respondents live on campus and 17% live off campus.

The dining culture among Boston College undergraduates

We asked our survey participants several questions to understand what they value in a dining experience to inform BC dining’s covid protocols and reopening plans; the results are below:

On a scale of 1 to 5, how important is the social aspect of on campus dining facilities to you?
54 responses

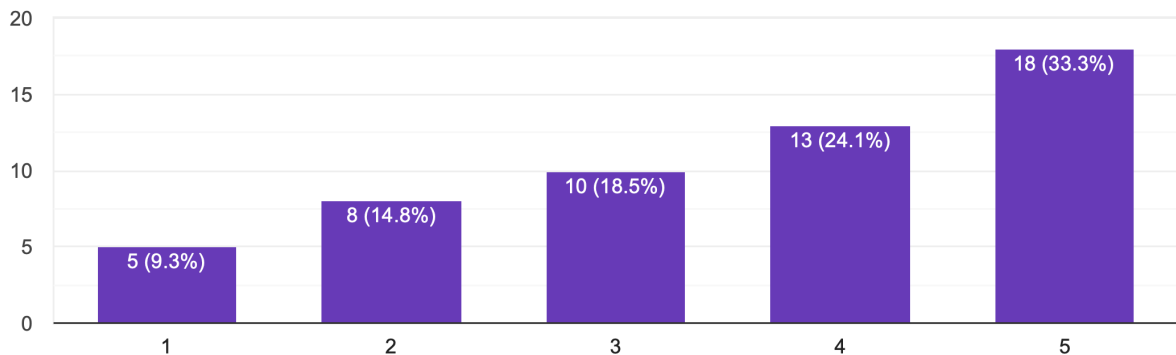


Figure 23

Figure 23 shows us that 57.4% of students value the social aspect of on campus dining as important or very important, while only 24.1% of respondents say it is very unimportant or unimportant. This indicates that BC students place a high value on the social aspect of dining on campus and this should be prioritized in a post-COVID reopening plan. The social aspect of dining has been limited during COVID due to limited seating capacity and social distancing, but students still crave these social interactions.

What do you currently value MOST when evaluating your dining options (on or off campus)?

54 responses

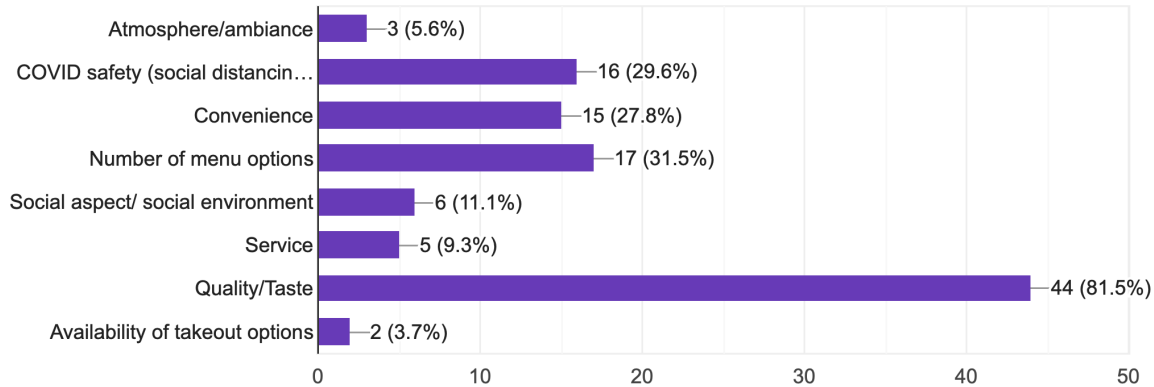


Figure 24

What do you currently value LEAST when evaluating your dining options (on or off campus)?

54 responses

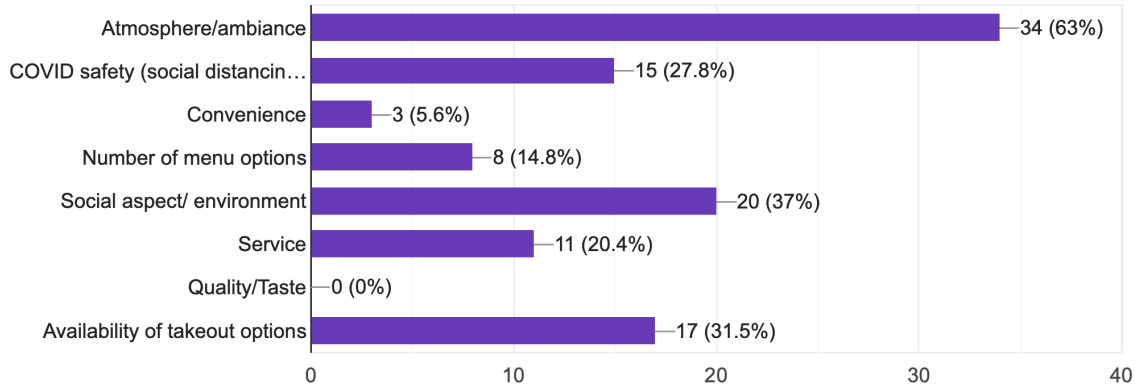


Figure 25

Figure 24 and Figure 25 display student responses in which they ranked their top two most and least important factors when determining where to eat during COVID-19. What stands out in these two figures is how about 30% of students said COVID safety was a top priority when deciding where to eat while another 28% of students said this was the least important factor. This indicates a wide gap between BC students level of risk tolerance when it comes to the pandemic. This poses challenges to BC dining because they cannot force students to care

about the disease and take protocols seriously. This division in priorities was also seen when we asked students which they would like BC dining to prioritize: COVID safety or sustainability initiatives; 37% of respondents said they wanted COVID safety to be prioritized over sustainability, while 33% said they would like sustainability to be prioritized over COVID safety. This again highlights a wide discrepancy in BC students' values which can hinder BC dining's ability to satisfy all of its students.

We also asked students whether they have heard of the Green2Go initiative and, if yes, have they participated in it. 66% of respondents said they had heard of the initiative; this indicates that BC dining has done a relatively effective job raising awareness for the Green2Go initiative, but there is more work to be done. However, of those who had heard of the initiative, only 9% have participated in it. This indicates that either BC dining hasn't been effective in incentivizing students to participate in the Green2Go initiative or BC students are not motivated enough to participate.

How have BC students' dining habits changed as a result of the pandemic?

We asked students several questions regarding changes in their dining habits as a result of the COVID-19 pandemic. Some of these questions, and results, are laid out below:

Do you rely more on takeout options because of the COVID-19 pandemic?

54 responses

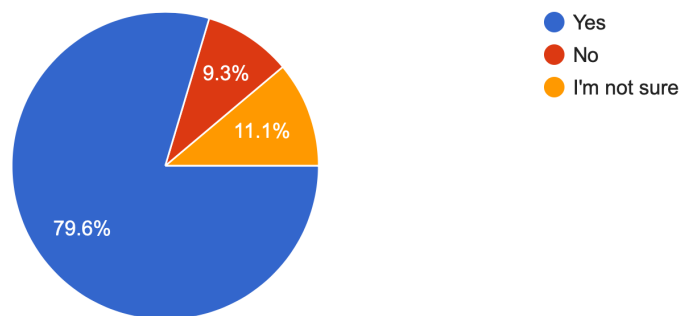


Figure 26

Figure 26 shows that 80% of students have turned to relying on takeout options during the COVID-19 pandemic. Relying on takeout options more than din-in options increases the amount of food waste per meal, as takeout options are packaged in disposable containers. We can

conclude that BC students waste output has increased as a result of a heavier reliance on takeout options.

We asked our survey participants how comfortable they feel eating in on campus dining halls during the pandemic and how comfortable they feel going out to eat off campus; the results are as follows:

How comfortable do you feel going out to eat (off campus) during the COVID-19 pandemic?

54 responses

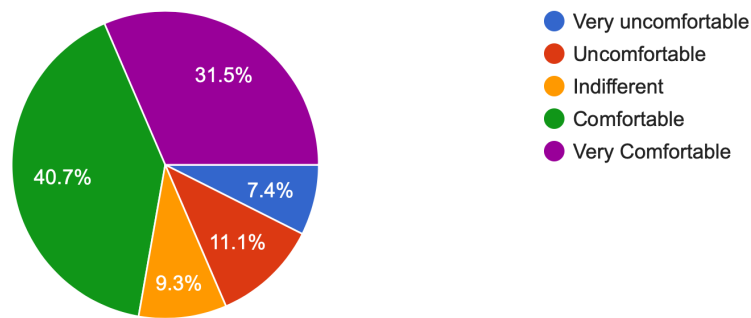


Figure 27

How comfortable do you feel eating at BC dining halls during the COVID-19 pandemic?

54 responses

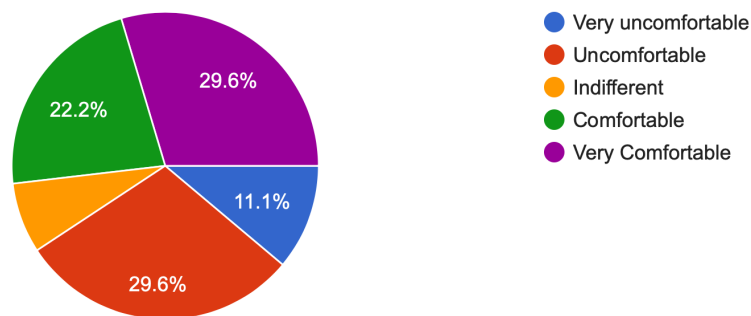


Figure 28

As figure 27 shows, only 18.5% of respondents (10) reported feeling uncomfortable or very uncomfortable dining in off campus establishments during the pandemic while figure 28 shows that 40.7% of respondents (22) reported feeling uncomfortable/very uncomfortable eating

in BC dining facilities. This indicates a general perception among undergraduates that BC dining has maintained a lower level of COVID-19 safety than the surrounding dining establishments have. Additionally, while only 16 students listed COVID safety protocols as a primary motivator on where to eat, 22 students said they do not feel comfortable eating at BC dining halls because of the pandemic. This indicates that even the students that are not extremely concerned about COVID-19 safety while dining find Boston College's dining protocols insufficient in making them feel comfortable.

We also asked students how frequent they eat at the dining halls and how frequently they order food from the dining halls compared with before the pandemic. The results are below:

Relative to before COVID protocols were put in place, how much do you eat at the dining halls now?

54 responses



Figure 29

Relative to before the COVID-19 pandemic, how frequently do you order food from BC dining halls now?

54 responses

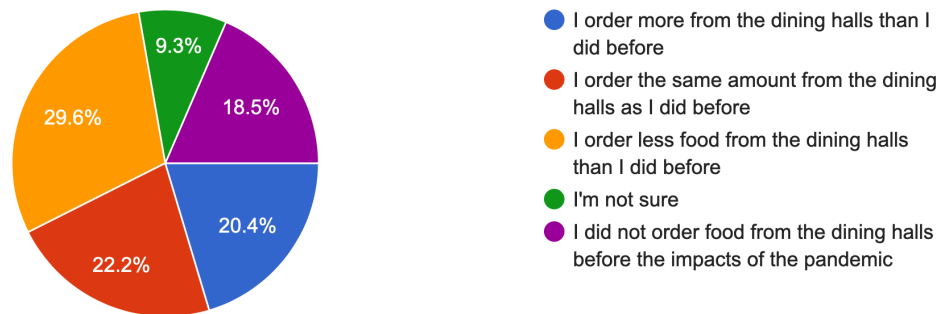


Figure 30

These two figures indicate that while a large majority of students (63%) are physically dining in the dining halls less frequently than before the pandemic only a small minority (30%) of students are ordering from the dining halls less frequently. This has implications for sustainable waste disposal (outlined in more detail below). Figure A shows us that students are more likely to eat their meals somewhere else, while figure B shows us that we cannot assume a trend in the amount of food ordered.

Waste Disposal during COVID

All dining facilities offer composting bins, recycling bins, and trash bins; each bin is placed under a picture of the items that should go in each bin. In theory it works very well, but poorly managed waste bins can become an impediment to sustainable waste disposal. We have taken photos which illustrate the limitations of this food waste disposal system:



Image 1. Taken April 12th, 2021 at McElroy Commons



Image 2: Taken February 10th, 2021 at Eagle's Nest.



Image 3: Taken February 10th, 2021 at Eagle's Nest.

Image 1 shows the bins placed in a different order than the disposal guidelines posted on the wall above, which can confuse students who are trying to properly dispose of their waste. Images 2 and 3 show overflowing waste bins. The images show that the compostable food waste and packaging were thrown in the trash and recycling presumably because the compost bin is overflowing. We observed the area for over two hours and no one came to empty the bins. A fourth bin was added during this time and students used it to dispose of all their waste--composting, recycling, or trash. By allowing these bins to pile up beyond their capacity BC dining prevents students from disposing of their waste in a sustainable way.

The availability of composting on Boston College's campus is essentially limited to the dining halls (although there are a few outdoor composting bins in select locations across

campus). With limited seating capacity, social distancing guidelines, and the convenience of defaulting to disposable containers, we were compelled to research where students are eating and, as a result, disposing of their waste. Some of the questions we asked, and the results, are laid out below:

When you purchase food from BC dining facilities, are you more likely to eat it there or eat it at another location?

54 responses

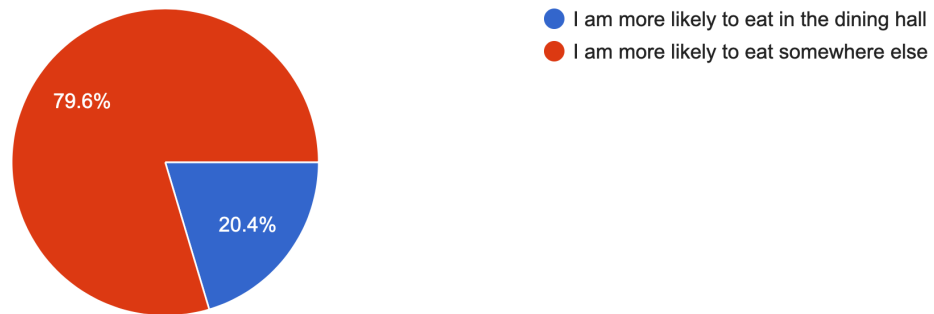


Figure 31

Where do you primarily dispose of your food waste/packaging (from BC dining)?

54 responses

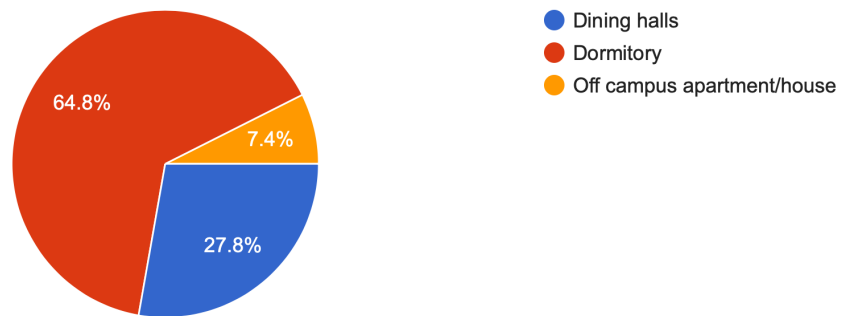


Figure 32

Does your living space (i.e. dorm, off campus apartment) offer composting?
52 responses

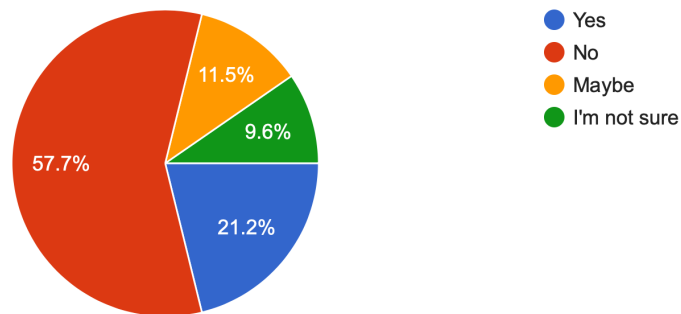


Figure 33

Does your living space (i.e. dorm, off campus apartment) offer recycling?
52 responses

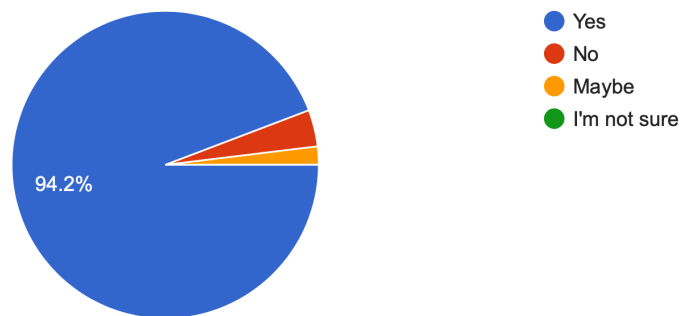


Figure 34

How comfortable do you anticipate you will feel eating at BC dining halls after the COVID pandemic is over?

54 responses

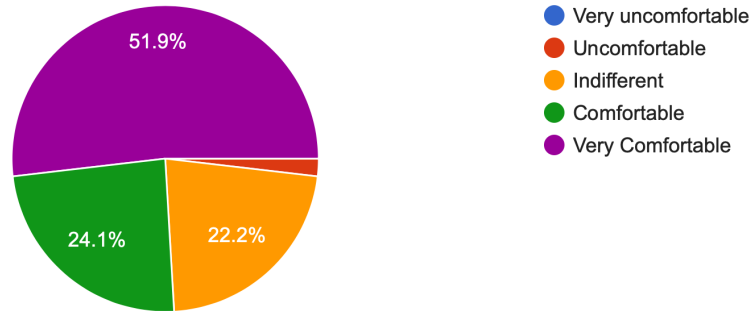


Figure 35

Which of the following BC dining options do you anticipate relying on more once COVID-19 is no longer a concern?

54 responses

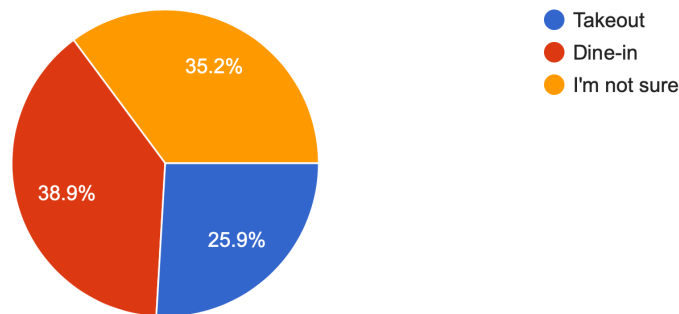


Figure 36

Figure 31 shows us that about 80% of respondents are more likely to eat their food outside of the dining halls, where composting bins are hard to find. Figure 32 further shows that students are less likely to dispose of their food waste at BC dining facilities, with about 72% of respondents reporting disposing their food waste in their on campus dorm or off campus apartment. This is concerning when we look at figure 33 which shows that only about 21% of respondents were aware of composting in their living space. What we gather from these data is that BC undergraduates are limited in their ability to compost due to a lack of availability in the dorms and off campus apartments. Figure 34 shows that recycling is still widely available

outside of BC dining facilities. Figure 35 shows us that all but 1 respondent will feel comfortable, very comfortable, or indifferent eating at BC dining halls after the pandemic is over. Figure 8 shows us that about 40% of respondents will rely on dine-in services while only about 26% will rely on take out once the pandemic is over. Synthesizing these data together shows us that the COVID-19 pandemic has made dining at BC dining halls less appealing to students, which has led them to eat at other locations which do not offer composting; with reasonable certainty we can say that the COVID-19 pandemic has made composting less frequent among BC students.

We also asked students how frequently they dispose of their waste “properly” (i.e. separate into composting, trash, recycling); about 72% of respondents said they only do it if it is convenient for them. This places the burden on BC to prioritize proper waste disposal for its students. Images 1, 2 and 3, and figure 33 show us that there is much work to be done to enhance the convenience of proper waste disposal, especially in the dorms. There is a similar perception among BC students, as evidenced below:

On a scale of 1 to 5, how would you rate the convenience of proper waste disposal (i.e. availability of compost/recycling/trash bins) in BC dining facilities?

54 responses

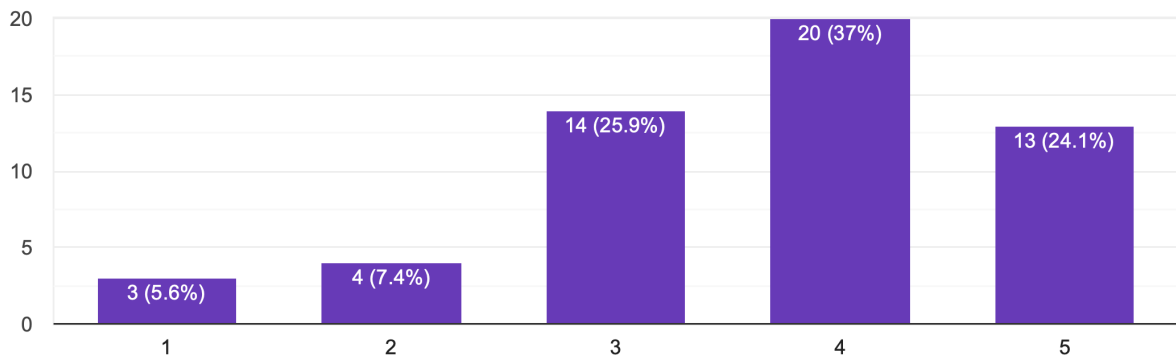


Figure 37

On a scale of 1 to 5, how would you rate the convenience of proper waste disposal (i.e. availability of compost/recycling/trash bins) in your living space (i.e. dorm, off campus house, etc.)?

54 responses

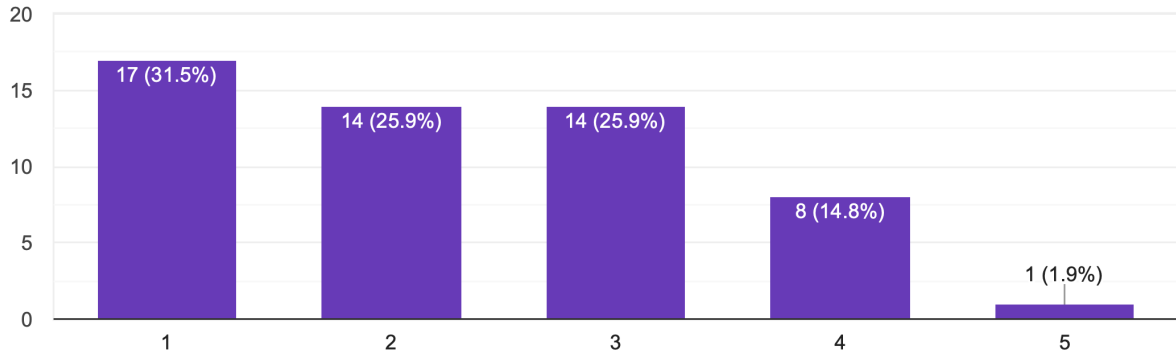


Figure 38

Figure 37 shows us that about 61% of students say proper waste disposal is convenient or very convenient in the dining halls while figure 38 shows us that only about 16% find it convenient in on campus dorms. Conversely, only about 12% of students find proper waste disposal inconvenient or very inconvenient in the dining halls, while about 57% of respondents find proper waste disposal inconvenient or very inconvenient in their dorms.

What is around to stay?

During the pandemic BC dining has only served food in covered, disposable containers. Prior to the pandemic the default when serving food at BC was to use reusable dishware (unless the customers asked for a disposable); in fact 70% of meals served at BC dining facilities were served on reusable dishware before the pandemic CITE CONVO. We asked students how comfortable they anticipate feeling eating off of reusable dishware in public dining facilities once the COVID-19 pandemic is over. About 44% of respondents (24) said they would feel uncomfortable or very uncomfortable eating on reusables in common dining facilities after the pandemic is over. This indicates that BC dining will have to find a way to incentivize students to use reusable dishware in the future and encourage faith in BC dining's sanitation process.

We also asked our survey participants which COVID-19 protocols they wish will remain even after the pandemic. The results are below:

Which BC dining COVID protocols do you hope will continue post-pandemic? (We will assume the options that remain unchecked are protocols you hope will NOT remain in the post-pandemic world)
54 responses

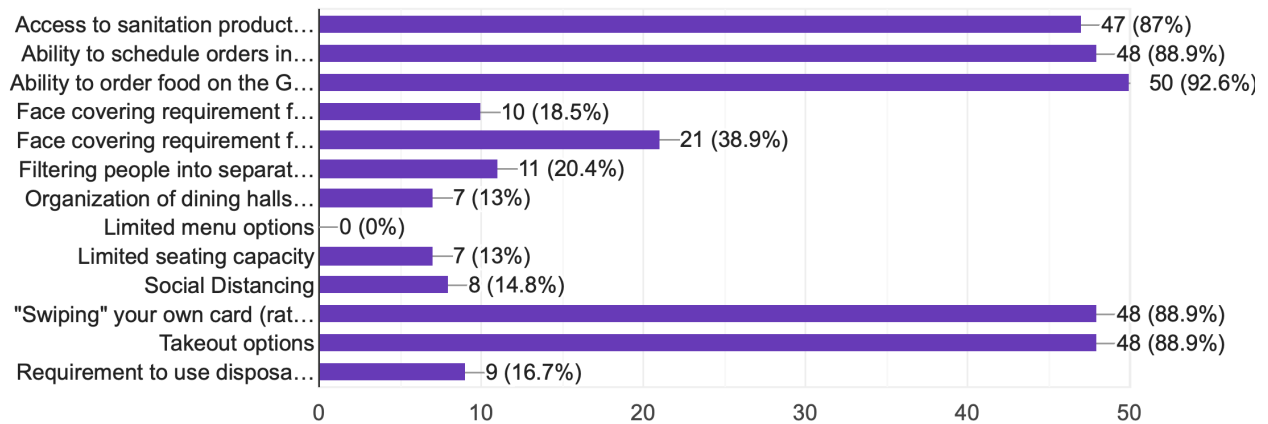


Figure 39

Figure 39 shows us that many of the changes in dining that resulted from the pandemic have enhanced the dining experience at BC dining facilities. For example, the GET mobile app is very popular, with about 93% of students saying they hope GET mobile ordering continues in the future and about 89% of students hope the app continues to support scheduling orders in advance. 89% of students hope to continue to “swipe” their own cards at the cashier stand. 89% of students hope that takeout options remain in the future. Lastly, 87% of students want to continue having expanded access to sanitation products (cleaning spray and hand sanitizer) in their dining facilities. We can conclude based on these survey results that these five COVID policies have enhanced the dining experience of BC students, as a large majority wish to see them continue in the post- pandemic world. BC dining should also take note that about 89% of students want takeout options to continue in the future; this conflicts with BC’s goal of increasing the usage of reusable dishware and it should be considered in future decision making.

The remaining COVID protocols have garnered support among only a minority of students. These include: a requirement to use disposable containers, social distancing, limited seating capacity, limited menu options, organization of dining halls, organizing the flow of students, and face covering requirements for students and staff. These protocols tend to restrict

the experience of students rather than enhancing it; they are the most intrusive into the student's dining experience. While all the protocols have assisted in our fight against COVID, these were the ones that came at a cost, rather than a benefit, to the students. We also see from this figure that about 19% of students hope that the face covering requirement *for students* continue after the pandemic while about 39% hope that *staff* are required to wear face coverings after the pandemic. This discrepancy indicates that a minority of students will feel relatively comfortable not wearing masks but may feel a certain discomfort if staff do not wear them.

We also asked students whether they believe their eating habits have permanently changed as a result of the pandemic, the results are below:

Do you think your dining habits in general (on or off campus) have permanently changed as a result of the pandemic?

54 responses

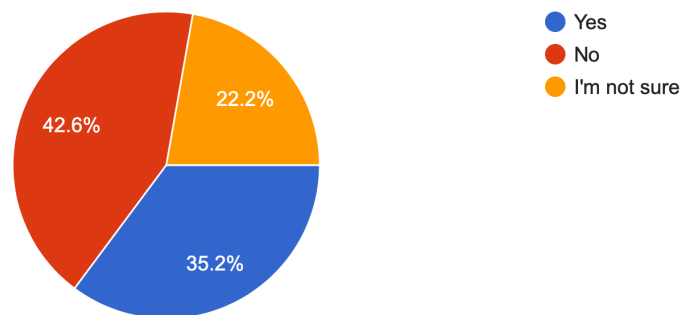


Figure 40

A large minority of students (about 35%) believe their dining habits have changed permanently as a result of the pandemic. The previous figures attempt to discern what exactly this means, but figure 40 shows us that it is more complicated; about 22% of students are not sure if they will go back to their pre-pandemic dining habits. This indicates the general uncertainty surrounding life after the pandemic; it is hard to predict how comfortable we will feel resuming normal dining practices when the pandemic continues to rage on.

RECOMMENDATIONS

Based on the findings of our research, this paper proposes several recommendations that could serve to improve the culture of sustainability at Boston College Dining Services both during and after the coronavirus pandemic. The student survey provides us with a reliable metric

of the dining culture at Boston College that should inform BC dining's reopening plan. COVID-19 has drastically changed the student dining experience and provided us with a valuable learning opportunity. Some measures implemented in response to COVID-19 have been supported by 87% of respondents who said the following measures should continue after the pandemic: the GET mobile ordering system, providing sanitation products for students (hand sanitizer and disinfectant spray), and offering takeout options; it is our recommendation that these measures continue in a post-pandemic Boston College in order to enhance the dining experience of students. All other COVID-19 measures should be slowly phased out according to CDC/MA state guidelines because the survey indicates that these are inhibiting the dining experience of students.

Encouraging the use of reusable dishes should be prioritized in the reopening plan. In order to continue limiting the use of disposables, we believe there should be an expansion of the Green2Go program and a reintroduction of discounts for students who use reusables, such as mugs. Hillside Cafe gives discounts to those who use a reusable coffee cup, so there is a precedent for this. Reusable dishware should be placed in prominent, easily accessible locations, so students instinctually grab them instead of disposables. Eventually, the Green2Go initiative should be the only choice for those who opt for takeout, which could completely eliminate food packaging waste at BC dining halls.

BC dining should increase their transparency and publish the reasoning behind their COVID protocols so students know that the transition to disposable containers was not entirely because of hygiene concerns. This would also allow students to feel more safe dining during COVID and combat the perception that BC dining has maintained a lower level of COVID safety than surrounding restaurants. BC dining should also become more transparent regarding their dishwashing process; one way to achieve this is by publishing a video of the process and sending it to students. If BC adopts these measures it could encourage all students to use reusable dishware and would allow BC students to live a more sustainable lifestyle.

BC dining has a responsibility to make waste disposal more sustainable for its students. Trash, recycling and composting bins in the dining facilities should be monitored more frequently so that they may be emptied once they are full; the person monitoring this should also ensure that each bin is placed under the correct poster so as to prevent confusion among students. Composting bins should be placed in every trash room in every dorm so that students have the

option to compost in their homes. The outdoor composting bins should be more apparently advertised so that students are aware of them and know where they are located. Students should also be educated on the importance of proper waste disposal and made aware of where there composted waste ends up. BC dining can become more sustainable if they adopt these waste disposal measures.

BC dining should once again prioritize sustainability once the pandemic is over. They should continue the food truck events, community based agriculture, and farmer's market programs since they have been very popular among students. FRESH to Table should be resumed when it is safe to do so in order to engage with students on menu options. These programs should be expanded as much as the budget allows since sustainability had to take a backseat during the pandemic. BC dining will have the opportunity to expand these sustainability initiatives once the pandemic has come to an end.

Although the decrease in revenues and increase in costs were largely unavoidable, there are some possible solutions to combat the effects. BC dining should look into "atypical" menu options in order to avoid paying the higher prices for food commodities. This would expand menu options for students and reduce costs for BC dining. The expanded menu options could also potentially draw in more students to the dining halls and increase revenues. Staffing levels should be maintained despite higher costs in order to continue adhering to COVID guidelines. In a reopening plan BC dining should expand their cleaning staff in order to encourage trust amongst students.

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APPENDIX

Raw waste and recycling data audits at Boston College collected and measured monthly in tons by type from January 2017-December 2020. This raw data was used to create trend graphs across 2017-2020. Separate trend graphs were created with the MSW, Food Waste, and Single Stream recycling quantities.

2017	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTALS
MSW	154.9	225.3	221.0	235.4	224.8	253.6	125.4	169.5	275.5	268.7	233.7	214.8	2,602.50
C&D	9.4	8.7	10.6	5.6	15.2	12.2	32.0	38.2	12.7	15.1	14.2	14.6	188.50
Food Waste	19.8	30.7	32.4	36.9	28.6	20.6	20.2	28.6	43.8	48.6	36.1	31.0	377.20
Yard Waste	14.0	6.1	29.4	17.5	12.0	11.4	20.1	25.0	8.0	18.1	54.2	32.5	248.17
Cardboard	7.3	14.4	12.3	12.0	7.2	1.6	0.7	7.3	11.9	9.8	10.0	4.4	98.69
Metal	4.4	2.3	5.6	2.9	4.7	2.4	2.4	5.1	4.1	2.5	4.1	0.0	40.55
Single Stream	55.8	64.6	61.3	58.9	59.0	36.6	20.3	55.6	89.3	81.9	63.9	51.0	697.99
TOTALS	265.6	352.0	372.4	369.2	351.4	338.4	220.9	329.3	445.3	444.6	416.3	348.2	4,253.60

2018	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTALS
MSW	177.4	224.8	226.9	239.2	408.1	137.7	119.2	168.3	262.1	296.2	274.0	232.3	2,766.28
C&D	10.6	10.7	46.4	22.5	24.4	24.7	19.4	53.9	21.0	21.0	10.0	13.0	277.48
Food Waste	23.7	35.5	32.3	33.9	29.4	19.9	18.2	24.8	47.8	0.0	0.0	0.0	265.47
Yard Waste	14.0	16.0	28.7	27.4	24.6	8.0	33.3	5.4	12.1	12.0	26.7	44.1	252.43
Cardboard	7.1	11.7	7.1	12.5	6.9	1.7	1.5	3.0	6.1	78.9	71.1	56.1	263.67
Metal	0.0	4.1	3.6	4.2	1.4	4.5	1.9	3.3	2.3	1.2	2.2	0.0	28.74
Single Stream	53.4	71.3	70.1	74.6	89.5	58.0	48.0	78.4	90.9	80.3	72.2	50.7	837.39
Paper	0.00	0.09	0.21	0.14	0.12	0.34	0.08	0.35	0.17	0.09	0.27	0.0	1.86
TOTALS	286.2	374.2	415.4	414.3	584.5	254.8	241.6	337.4	442.5	489.8	456.6	396.1	4,693.31

2019	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTALS
MSW	216.8	245.4	234.2	236.2	362.7	88.2	90.3	133.9	228.0	234.1	214.0	166.3	2,450.00
C&D	12.3	7.3	10.3	21.9	15.9	22.1	20.3	19.5	25.0	28.2	13.4	9.4	205.58
Food Waste	26.0	31.4	37.9	36.8	25.9	17.7	14.4	26.1	49.7	48.8	41.9	28.7	385.18
Yard Waste	24.1	8.0	12.0	24.1	4.0	12.0	24.1	16.0	16.0	12.0	64.2	4.0	220.55
Cardboard	6.2	6.0	5.6	5.9	5.1	1.2	0.9	10.7	8.2	9.9	10.2	13.0	82.99
Metal	4.3	2.5	1.5	1.8	5.8	5.1	8.3	4.4	8.0	2.8	3.8	5.9	54.28
Single Stream	76.4	81.4	76.7	80.1	77.7	29.3	31.7	59.8	98.0	77.9	75.2	55.9	819.95
Paper	0.06	0.15	0.38	0.18	0.11	0.41	0.05	0.09	0.03	0.00	0.00	0.0	1.48
TOTALS	366.1	382.1	378.6	407.0	497.1	176.1	189.9	270.6	433.0	413.8	422.6	283.2	4,220.00

2020	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTALS
MSW	161.2	189.4	300.1	53.0	27.5	34.9	38.5	96.9					901.46
C&D	9.9	9.5	11.0	23.9	7.2	16.6	13.9	9.1					101.02
Food Waste	28.8	42.0	22.0	4.7	3.0	2.9	5.0	12.2					120.71
Yard Waste	32.1	13.4	20.0	36.1	12.0	32.1	40.1	8.0					193.75
Cardboard	7.9	10.8	3.9	0.0	0.0	0.1	0.7	3.8					27.10
Metal	4.6	4.5	4.1	3.0	3.3	5.8	3.3	3.6					32.11
Single Stream	63.5	68.5	73.6	9.7	9.9	10.2	19.4	31.2					286.02
Paper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					-
TOTALS	307.9	338.1	434.8	130.3	63.0	102.5	120.8	164.7	0.0	0.0	0.0	0.0	1,662.17

FY 2021	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	TOTALS	FY 2020
MSW	188.57	145.2											334	1,702
C&D	8.34	17.3											26	158
Food Waste	17.61	15.6											33	264
Yard Waste	52.13	40.1											92	306
Cardboard	7.41	3.7											11	71
Metal	2.15	2.6											5	47
Single Stream	54.79	44.7											100	587
Paper	0.00	0.00											-	0
TOTALS	331.00	269.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	600.18	
FY 2020	422.64	283.175	307.89	338.08	434.79	130.34	62.98	102.51	120.84	164.74	392.51	373.77		3,134