



# Arboricultural Journal

The International Journal of Urban Forestry



ISSN: (Print) (Online) Journal homepage: [www.tandfonline.com/journals/tarb20](http://www.tandfonline.com/journals/tarb20)


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To cite this article: Richard W. Harper & Daniel A. Lass (08 Sep 2024): The economic impacts associated with COVID-19 on the arboriculture & commercial urban forestry sector in New England, U.S.A, Arboricultural Journal, DOI: [10.1080/03071375.2024.2394362](https://doi.org/10.1080/03071375.2024.2394362)

To link to this article: <https://doi.org/10.1080/03071375.2024.2394362>

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# The economic impacts associated with COVID-19 on the arboriculture & commercial urban forestry sector in New England, U.S.A

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## ABSTRACT

This research investigated the economic impacts resulting from the effects of the COVID-19 pandemic in relation to the arboriculture/commercial urban forestry (ACUF) industry through a survey that was administered to practitioners – arborists and commercial urban foresters – throughout the New England states (Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, Maine) of the United States of America (USA). The responses by this sample of ACUF firms indicate that the COVID-19 pandemic period was one of strong income and employment growth for the industry fuelled in part by increased demand by private homeowners. This period saw growth for the ACUF industry, but firms from this sample also faced many of the same difficulties that other industries faced in relation to securing the labour they needed, as well as increases in costs related to wages, salaries, and health insurance. Whether these increases are short-term phenomena or longer-term shifts for the ACUF industry remains an important research question. Analysis of this segment of the broader “green industry” enables stakeholders and interested parties to educate legislators, regulatory decision-makers, and others about the importance of the COVID-19 pandemic in relation to the ACUF sector.

## ARTICLE HISTORY

Received 3 April 2024

Accepted 16 August 2024


## KEYWORDS

Arboriculture; urban forestry;  
COVID-19; business;  
commercial

## Introduction

Understanding related to the economic contributions of industries, including agriculture and traditional forestry, has been greatly aided through the longstanding application of contribution analysis frameworks. With strong ties to the agriculture community and often considered a subset of the forest industry, recent systematic efforts have been undertaken to better understand the economic contributions of the arboriculture/commercial urban forestry (ACUF) sector (Hoy et al., 2022; Lass & Harper, 2023; Parajuli et al., 2022). Addressing critical knowledge gaps, these works have provided important information related to industry output, gross income, employment, payroll, and taxes to local, state and federal economies. This has facilitated a growing understanding among legislators, economic development analysts, university extension specialists and the general public (Hoy et al., 2022; Lass & Harper, 2023;

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 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/03071375.2024.2394362>

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Parajuli et al., 2022). Understanding may be somewhat complicated, however, by discrepancies as to how this sector of the economy – often referred to as the “green industry” – is actually defined. Many governments, associations and organisations relate these terms directly to environmentally sustainable growth and development of the economy (United Nations Industrial Development Organization, 2022). Others use “green industry” more broadly to include sectors like landscape contracting and design, the golf industry, the horticultural nursery industry and garden retail (Parajuli et al., 2022; Perry & Stack, 2009). Understanding sector-specific economic contributions may be further confounded by vacillations in spending trends, geopolitical uncertainty, shortages and excess related to supply and demand, and unprecedented anomalies like the international lockdown associated with the COVID-19 pandemic (Behe, Huddleston, et al., 2022; Behe, Knuth, et al., 2022).

Recent findings indicate that well over half (55%–75%) of U.S.A. households engage in outdoor activities, including beautification through gardening and landscaping (Behe, Knuth, et al., 2022; Whiting & Cohen, 2022). With spending levels related to lawn and gardening equipment already at \$48 billion USD annually, trends during the COVID-19 shutdown continued to markedly increase, with 65% of consumers indicating spending at or above levels of previous years (Whiting & Cohen, 2022; Behe, Huddleston, et al., 2022). Speculation as to the motivations for this unprecedented demand, which has been keenly noted at garden supply centres (Beytes, 2020), has included recreation/leisure, health (both mental and physical well-being), immersion in nature, nutrition, and food security (Behe, Huddleston, et al., 2022; McFarland et al., 2018). This aligns with other studies that include positive findings regarding the emotional, social, and physiological benefits derived from spending time in and among greenery, plants and trees (Elton et al., 2022; Hall & Knuth, 2019; Mei et al., 2021)

This study is part of a broader initiative focused on specifically understanding the economic contribution of the arboriculture/commercial urban forestry (ACUF) sector of the green industry. For purposes of this study, arboriculture is regarded as the individualised care of a single tree (Miller et al., 2015; O’Herrin et al., 2020), or a small number of trees, by an arborist – a specialist with discipline-specific training, education and experience in tree care (Harper et al., 2016; O’Herrin et al., 2023). And though urban forestry includes a host of technical professionals, decision-makers, and private business principals, it is broadly defined as the management of the totality of the urban trees in a community (Campbell et al., 2022; Harper et al., 2017; Miller et al., 2015).

## Methods

### *Survey design*

An electronic survey was composed and disseminated to arboriculture/commercial urban forestry (ACUF) firms throughout the states comprising the New England region of the United States of America (USA) using Qualtrics (Qualtrics, Provo, UT). The survey consisted of a series of 21 closed and open-ended questions designed following methods outlined by Dillman et al. (2014). Questions were formulated in relation to business-related impacts associated with the COVID-19 pandemic. In this study, we report descriptive statistics pertaining to these sample firms in 2021. Before formal distribution, the survey was piloted with subject-matter experts, including principals of ACUF firms.

## Survey distribution

In accordance with methods outlined by Dillman et al. (2014), the survey was initially disseminated on 15 February 2022 to principals of ACUF firms operating in the following states: Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, Maine. A clearly defined population of ACUF firms does not exist; thus, to reach as many firms as possible, the survey was formally disseminated through direct partnership with the New England Chapter of the International Society of Arboriculture (NEC ISA), who distributed the survey via their list-serve. The Massachusetts Arborist Association (MAA) and state agency urban forestry coordinators were also asked to help notify stakeholder groups about the survey through their respective state-wide networks. Follow-up emails were sent at one-week intervals and an email was sent on 15th March announcing that the survey deadline had been extended until 21st March, with a final email being sent the day before the formal close of the survey.

## Results and discussion

An initial question asked if the respondent was a business owner/representative of an ACUF firm that operated during 2021; 80% (168) of the respondents said “yes,” 19% (40) replied “no,” and two respondents did not answer the question. Those who replied “no” ended the survey. The NEC ISA reports 333 commercial members, and our initial response represents about 50% of those members. Respondents were then asked if at least 50% of their income was derived from ACUF-related activities. There were 119 responses to this question and about 97% (115) replied “yes.” There was significant attrition at this point with 49 respondents choosing not to answer this initial question about firm income. It was not possible to follow-up with non-respondents because cooperating associations and colleagues sent the survey link via email to their members and clients. The 115 respondents represent 35% of the NEC ISA commercial members.

Respondents were asked about the state that was the principal place of business for their firm (see Table 1 for a comparison of the distribution of firms across the six New England states). Those in the “other” category had principal places of business in states across the U.S.A.; there were international firms as well. While the distributions of respondents and NEC ISA members are not the same, we do find that the two distributions by state are similar for the survey respondents and the NEC ISA membership. The distribution for our sample shows that ACUF firms are more highly concentrated in the most populous states of Connecticut and Massachusetts, and follow-up discussions revealed that industry representatives agreed with these findings.

**Table 1.** In which state is your principal place of business?.

State	Survey respondents		NEC ISA members	
	Number of firms	Percent	Number of firms	Percent
Connecticut	17	14.8	56	16.8
Maine	10	8.7	18	5.4
Massachusetts	52	45.2	164	49.2
New Hampshire	8	7.0	42	12.6
Rhode Island	7	6.1	14	4.2
Vermont	8	7.0	23	6.9
Other (please specify):	13	11.3	16	4.8
	115	100.0	333	100.0

**Table 2.** Average percent of 2021 business gross income by state and principal place of business.

Principal place of business	Percent of income earned by state						
	CT	ME	MA	NH	RI	VT	Other
Connecticut	93.1	0.0	1.6	0.0	0.3	0.0	5.1
Maine	0.0	96.0	2.0	2.0	0.0	0.0	0.0
Massachusetts	0.6	0.4	95.2	2.3	1.1	0.3	0.2
New Hampshire	0.0	1.9	1.3	93.8	0.0	3.1	0.0
Rhode Island	0.1	0.0	12.0	0.0	87.9	0.0	0.0
Vermont	0.0	0.0	0.0	0.0	0.0	98.6	1.4
Other states:	12.1	0.3	1.6	0.2	0.2	0.2	85.4

Respondents were asked what percentage of their 2021 gross income was earned across the New England states. On average, the greatest percentage of income was earned in Massachusetts (44.4%) followed by Connecticut (15.4%), Maine (8.7%), New Hampshire (7.8%), Vermont (7.2%), and Rhode Island (5.9%). Respondents reported an average of 10.6% of their income was from other states (see Table 2 regarding averages for firms' percent of business gross income by state by their principal place of business). For example, firms with a principal place of business in Connecticut earned, on average, 93.1% of their business gross income in their home state and 5.1% of their income in "other" states. Rhode Island firms had the lowest average percent of income in the home state at 87.9% with 12% of their income in Massachusetts. The median percent of income earned in firms' principal place of business was 100% for all New England states except Rhode Island, where the median was 90%. Thus, a majority of firms earned all their gross income in their "home state."

Respondents were asked about the gross income of their firm in 2021 (see Table 3). Income questions often cause concern among respondents, and we chose to use a categorical question to help alleviate concerns about providing exact income values. However, there was still attrition in our sample either due to hesitation or perhaps timing of the survey. It was possible that firms were not yet certain about their 2021 gross income in February/March 2022. The income distribution was fairly "top heavy" with about 48% of the firms reporting gross income of over \$500,000. There were also a relatively large number of very small firms (about 10%) earning <\$25,000. The median gross income category for this sample was \$400,000–\$499,999. The mean income category was \$300,000–\$399,999 showing the effect of the relatively large number of small firms.

The sources of firms' 2021 incomes and the activities that generated income for this sample are also shown in Table 3. The greatest percentage of ACUF firms' gross income for our sample came from *private individuals* (over 70%), dwarfing the gross income percentages from *commercial sources* (17.9%), *local governments* (5.3%), and *state governments* (1.8%). Perhaps surprisingly, the largest firms, those with gross incomes of \$500,000 and over, reported an even greater percentage of income from *private individuals* (74.2%). They reported slightly lower percentages of gross income from *commercial* and *local governments*, but a slightly higher percentage (2.3%) from *state governments*. These descriptive statistics provide a summary of the 2021 ACUF industry, but there are exceptions to the averages presented and the large standard deviations illustrate that there is great variation in the percentages reported by these firms. Firms with the greatest gross income (over \$10 million) did earn a greater percentage of their income (21%) from *commercial sources*, and there were firms that earned most of their gross income from specific commercial activities.

**Table 3.** Descriptive statistics for sample ACUF firms, 2021.

Variable	Number of firms	Mean	Std. Dev.	Median
<b>Business gross income</b> (categorical)	119	\$300,000-\$399,999	NA	\$400,000-\$499,999
<b>Business gross income by source</b> (% of gross income):				
Commercial (e.g. business campus/grounds)	120	17.9	23.7	10.0
Local government (e.g. town, municipal, county grounds parks)	120	5.3	9.9	0.0
State government (e.g. grounds, parks, roadways)	120	1.8	5.82	0.0
Private individuals	120	70.1	32.8	80.0
Other	120	4.9	18.0	0.0
<b>Income generating activities</b> (% of gross income):				
Tree pruning and removal	120	55.3	34.1	62.5
Tree fertilising, pesticide, health care applications	120	16.8	21.2	10.0
Tree planting	120	4.6	7.3	0.0
Consultations (tree risk assessment, tree appraisal, urban forest inventory)	120	8.8	21.7	0.0
Landscape services	120	7.4	19.5	0.0
Other arboriculture/commercial urban forestry	120	6.2	20.5	0.0
Non-arboriculture/commercial urban forestry	118	1.1	4.4	0.0
<b>Number of workers:</b>				
Full-time (30 h or more per week; 9 months or more during the year)	109	53.9	279.5	4.0
Part-time (less than 30 h per week and 9 months or more during the year)	108	2.6	17.3	0.0
Seasonal (any number of hours per week, but less than 9 months of the year)	108	4.5	23.6	0.0
<b>Total amount of business payroll</b> (categorical)	103	\$150,000-\$199,999	NA	\$150,000-\$199,999
<b>Total tax bill</b> (property, sales and use, excise and income)	101	\$30,000-\$39,999	NA	\$20,000-\$29,999

*Tree pruning and tree removal* was the most important activity for these ACUF firms representing 55.3% of their gross income on average. *Tree fertilizing and tree health care* was next averaging 16.8% of their gross income. Other activities represented less than 10% of gross income and *non-arboriculture/commercial urban forestry activities* averaged just 1.1% of gross income. Once again, the large standard deviations indicate a great amount of variation in percentages reported. For the largest firms, those with gross incomes of \$500,000 and over, the two top income activities were *tree pruning and tree removal* and *tree fertilizing and tree health*; percentages for the largest firms were greater at 61.9% and 19.7%, respectively. There were many firms across the size distribution that focused on single activities. The maximum reported percentages were 100% for all ACUF activities except *tree planting*.

Respondents were asked about the number of workers (full-time, part-time, and seasonal) they employed during 2021. Full-time workers were defined as those working 30 h or more per week for at least 9 months during the year. Part-time workers were defined as those employees working less than 30 h per week and fewer than 9 months during the past year. The final category, seasonal workers, may have worked any number of hours, but fewer than 9 months during the past year. Respondents were also reminded to include themselves in their count of workers. The average number of full-time workers was 53.9 in 2021. The large standard deviation indicates a great amount of dispersion in numbers of full-time workers for firms. Average numbers of part-time and seasonal workers were 2.6 and 4.5, respectively.

Again, the large standard deviations show a great amount of dispersion also indicated by the median numbers of workers in all three categories. The median number of full-time workers was just four, and the medians for both part-time and seasonal workers were zero. The differences between means and medians show the impacts of large firms on the average number of workers. The medians show that 50% of the ACUF firms hired four or fewer full-time workers and no part-time and seasonal workers. Still, the firms in this sample hired a total of 5,874 full-time workers, 286 part-time workers, and 491 seasonal workers.

The average and median payroll category for the 103 firms reporting was \$150,000–\$199,999 in 2021; over 50% of firms had total payrolls less than \$200,000. Over 18% of the firms paid less than \$25,000 in total payroll and just over 28% paid less than \$50,000 in total payroll. Fewer than 20% of the firms had total payroll amounts over \$500,000 and only about 9% had payrolls that exceeded \$1 million. Total tax bills for these firms were \$30,000–\$39,999, on average. Half of the firms had tax bills that were \$20,000–\$29,999, or lower.

## ACUF changes during COVID-19

### *Gross income changes during COVID-19*

Respondents were asked to indicate how their business' gross income and payroll changed from 2019 to 2020, and from 2020 to 2021. The U.S.A. was affected by the COVID-19 pandemic beginning in March 2020, so these changes represent impacts of COVID-19 on the ACUF industry. Additional inquiries about how COVID-19 affected these firms were also made and are discussed.

There were 114 respondents to initial questions about business gross income changes. One hundred of those firms were in business during all 3 years, 2019, 2020, and 2021. One firm was in business during 2019 but did not operate in 2020. Seven firms were in business in 2020 and 2021, and six firms did not operate in either 2019 or 2020. Thus, numbers of respondents will differ in the tables below, and survey fatigue likely resulted in a few additional firms leaving the survey.

The distributions of firms reporting gross income changes for 2019–2020 and 2020–2021 are shown in [Table 4](#). Of the firms reporting they operated in 2019 and 2020, 57.6% saw an increase in gross business income and 31.3% reported gross income stayed about the same. Only 11.1% reported a decrease in business gross income. Business gross income looked better in 2021 with 70.5% of the firms reporting increases and only 4.8% reporting decreases. Nearly a quarter of the firms in 2021 had business gross income that remained the same compared to 2020.

[Table 5](#) shows the distributions of business gross income changes for firms reporting 2019–2020 increases and decreases. The modal increase for 2019–2020 was 10–14%, over 41% of the firms reported an increase from 2019 to 2020 of that magnitude. Most of the respondents reporting gross income increases (44 of 56) saw their gross income increase by 10% or more and nearly 18% saw increases of 25% or more. Using category mid-points, the average increase for these 56 firms was 14.9% from 2019 to 2020. The modal decrease was also 10–14% (three of the 11 firms) and eight of the eleven firms had decreases of 10% or more. The estimated average decrease using mid-points for the percent decrease categories is 15.3%. A weighted average increase for 2019 to 2020

**Table 4.** Business gross income changes for firms, 2019–2020, and 2020–2021.

Business' gross income	2019–2020		2020–2021	
	Number of firms	Percent	Number of firms	Percent
Increased	57	57.6	74	70.5
Stayed about the same	31	31.3	26	24.8
Decreased	11	11.1	5	4.8
	99		105	

**Table 5.** Firms with business gross income increases and decreases from 2019 to 2020.

Gross income change	Increased		Decreased	
	Number of firms	Percent	Number of firms	Percent
Less than 5%	4	7.1	1	9.1
5 to 9%	8	14.3	2	18.2
10 to 14%	23	41.1	3	27.3
15 to 19%	5	8.9	1	9.1
20 to 24%	6	10.7	2	18.2
25% or more	10	17.9	2	18.2
	56	100.0	11	100.0

was estimated using the firms' numbers, percentage increase or decrease mid-points, and assuming zero change for those reporting "about the same." The weighted average for the 98 firms responding was 6.7%, a healthy increase considering the difficulties that arose in 2020.

Table 6 shows survey respondents reported gross business income percent changes for 2020 to 2021. The modal increase was again 10–14% with 21 of the 73 respondents reporting business gross income increases in this range. The modal decrease was lower at 5–9%. Using mid-points, the average increase would be 15.1% for the 73 respondents reporting increases; the average decrease was 10.2% for the five firms reporting decreased gross income in 2021 compared to 2020. A weighted average change in gross income from 2020 to 2021 was calculated using mid-points as described above. For the 105 firms that responded to this survey, business gross income increased by 10.1% in 2021 compared to 2020. Again, a healthy increase in difficult times and likely reflects the economy's recovery as the pandemic effects declined.

Table 7 shows the joint distribution for business income changes over the 3 years. Firms in this table reported being in business all 3 years and responded to the survey questions on increases and decreases in gross income (99 firms). Business gross income increased for 51 firms (51.5%) in both 2020 and 2021 compared to the previous year.

**Table 6.** Firms with business gross income increases and decreases from 2020 to 2021.

Gross income change	Increased		Decreased	
	Number of firms	Percent	Number of firms	Percent
Less than 5%	5	6.8	1	20.0
5 to 9%	14	19.2	3	60.0
10 to 14%	21	28.8	0	0.0
15 to 19%	11	15.1	0	0.0
20 to 24%	10	13.7	0	0.0
25% or more	12	16.4	1	20.0
	73	100.0	5	100.0



**Table 7.** Joint distribution of business gross income changes, 2019–2020, and 2020–2021.

Change 2019–2020	Change 2020–2021			Row totals
	Increased	Stayed about the same	Decreased	
Increased	51	5	1	57
Stayed about the same	14	17	0	31
Decreased	6	3	2	11
Column totals	71	25	3	99

Only two of the firms responding to this survey had decreases in business gross income for both 2020 and 2021. Fifty-six of the firms with increased gross income in 2020 (98%) saw either an increase in 2021 or remained essentially unchanged. Of the firms that had gross income in 2020 about the same as 2019, forty-five percent (14 of the 31 firms) saw an increase in their 2021 gross income; the remaining 55% remained essentially unchanged. Of the eleven firms that saw their gross income decline in 2020 compared to 2019, six had an increase in 2021 and three had their gross income stay the same. In terms of business gross income, the ACUF firms responding to this survey generally did well during a tumultuous period for the U.S.A. and regional economies.

### *Labour and payroll changes during COVID-19*

Changes in business gross income are only part of the story for these ACUF firms. Survey respondents were also asked how their labour and payroll changed from 2019 to 2020, and from 2020 to 2021. Total employment numbers are shown in [Table 8](#). Mean and median numbers of full-time, part-time, and seasonal workers are reported in [Table 3](#) for 2021 and are compared to means and medians for 2019 and 2020 in [Table 9](#).

Total employment in 2021 was over 6,600 full-time, part-time and seasonal workers. Total full-time, part-time, and seasonal employment numbers for the firms in our sample are shown in [Table 8](#). We see steady increases over the past 3 years in all three categories of employment consistent with the increase in the number of firms in our sample operating in the ACUF industry. The total number of full-time employees for firms in our sample increased by 4.5% from 2019 to 2020 and then by 7.7% from 2020 to 2021. This includes the entry of firms in 2021 – six firms indicated they did not operate in 2019 or 2020, and one firm operated in 2019, but not 2020. Part-time employment by these firms increased by 12.3% from 2019 to 2020 and by 7.9% from 2020 to 2021. Seasonal employment had the greatest gains increasing by 18.8% in 2020 and then by 43.6% in 2021.

**Table 8.** Total employment for firms in this sample, 2019, 2020, and 2021.

Type of labour	2019		2020		2021	
	Number of firms	Total	Number of firms	Total	Number of firms	Total
Full-time (worked 30 h or more per week, and 9 months or more during the year)	94	5219	99	5454	109	5874
Part-time (worked less than 30 h per week and 9 months or more during the year)	93	236	98	265	108	286
Seasonal (worked any number of hours per week, but less than 9 months of the year)	93	288	98	342	108	491

**Table 9.** Mean and median numbers of workers for firms in this sample, 2019, 2020, and 2021.

Type of labour	2019			2020			2021		
	No. of firms	Mean	Median	No. of firms	Mean	Median	No. of firms	Mean	Median
Full-time	94	55.5	4.0	99	55.1	4.0	109	53.9	4.0
Part-time	93	2.5	0.0	98	2.7	0.0	108	2.6	0.0
Seasonal	93	3.1	0.0	98	3.5	0.0	108	4.5	0.0

The mean numbers of full-time workers varied only slightly during these 3 years, from a high of 55.5 in 2019 to 53.9 workers in 2021. The number of firms operating increased in 2020 (from 94 to 99) and again in 2021 (from 99 to 109). The small decrease in the mean number of full-time workers likely reflects the entrance of relatively small firms. The median number of full-time workers remained constant at four workers throughout these 3 years. Median numbers of part-time and seasonal workers were zero indicating most firms (at least 50%) do not hire part-time or seasonal workers. The large differences between the medians and means indicate the distribution for number of full-time workers is skewed to the right. Most firms are small, but the great number of employees (a maximum in the thousands) of the largest firms has a large effect on the mean number of full-time workers.

The 2021 median total payroll category was \$150,000–\$199,999 for the firms in this sample (Table 3). However, over 20% of the firms in this sample had total payrolls of more than \$500,000 in 2021. Table 10 shows the distribution of firms' payroll change responses; 57.1% and 63.9% had increases in payroll for 2019–2020 and 2020–2021, respectively. Comparing 2020 to 2019, 14.3% of the respondents had payrolls that "stayed about the same." In 2021, 11.3% of the respondents had payrolls that "stayed about the same" as their 2020 payroll. Notable is the percent of firms that had decreases in their payroll during these two periods: 28.6% for 2019 to 2020 and 24.7% for 2020 to 2021. As would be expected, the percentage of firms with both increases in gross income and payroll are relatively consistent. The percentages of firms with payrolls that "stayed about the same" are quite different from the percentages with gross incomes that "stayed about the same." The same is true for payrolls and gross incomes that decreased. We do not have data on the number of hours worked (e.g. over-time for full-time workers, more hours for part-time), wage changes, other costs, and physical measures of firm output so it is difficult to discern why there are these differences.

Table 11 shows the distributions of firms for different categories of payroll increases and decreases. For firms with payrolls that increased in 2020 compared to 2019, the modal response was "5 to 9%" (19 firms). The modal response for firms with payrolls that decreased during the same period was "20 to 24%" (four firms). Most of the firms with

**Table 10.** Payroll changes for firms, 2019–2020 and 2020–2021.

Payroll	2019–2020		2020–2021	
	Number of firms	Percent	Number of firms	Percent
Increased	52	57.1	62	63.9
Stayed about the same	13	14.3	11	11.3
Decreased	26	28.6	24	24.7
	91	100.0	97	100.0

**Table 11.** Distribution of firm payroll increases and decreases for 2019–2020.

Payroll changed by	Increased		Decreased	
	Number of firms	Percent	Number of firms	Percent
Less than 5%	6	11.8%	1	7.7%
5 to 9%	19	37.3%	1	7.7%
10 to 14%	13	25.5%	1	7.7%
15 to 19%	6	11.8%	3	23.1%
20 to 24%	4	7.8%	4	30.8%
25% or more	3	5.9%	3	23.1%
	51	100.0%	13	100.0%

payroll increases (38 of 51 or 74.5%) had increases of less than 15% between 2019 and 2020. Of the 13 firms with payroll decreases, most (10 of the 13) had decreases of 15% or greater.

A weighted average increase (based on category mid-points) for the 51 respondents whose payrolls increased between 2019 and 2020 was 11.3%. The estimated average decrease (13 respondents) was 18.7%. Combining the 26 firms with payrolls that “stayed about the same” (26 respondents with assumed zero change), the overall weighted average increase in payroll was 3.7% for 2019 to 2020. Recall that total full-time, part-time, and seasonal labour all increased between 2019 and 2020 by 4.5, 12.3 and 18.8%, respectively. Simply adding workers (full-time, part-time, and seasonal) results in an increase of 5.5% between 2019 and 2020. With differences in the number of firms, the weighted average growth in payroll (3.7%) and the growth in total labour (5.5%) for our sample are not substantially different.

The results are similar for payroll increases from 2020 to 2021 (Table 12). A weighted average increase was estimated to be 12.5% for the 61 firms that had increases in their payrolls. The weighted average for firms with decreased payrolls (11 respondents) was much lower at 9.8%. Again, combining these averages with the 24 firms with payrolls that “stayed about the same” and weighting by the number of firms gave an average payroll increase of 7.9% for 2020 to 2021. Full-time workers, part-time, and seasonal employment increased by 7.7, 7.9, and 43.6%, respectively. These increases were due to an addition of 10 firms in 2021 and firms hiring more workers. Weighting the employment numbers by the number of workers in each category gave an average 2020–2021 growth in total labour of 9.7% for the respondents to this survey. For 2020 to 2021, the average increase in payroll (7.9%) and total labour (9.7%) were again not substantially different. One might expect equal gains in labour and payroll, but the greatest labour gain was in seasonal workers during this period.

**Table 12.** Distribution of firm payroll increases and decreases for 2020–2021.

Payroll changed by	Increased		Decreased	
	Number of firms	Percent	Number of firms	Percent
Less than 5%	7	11.5	2	18.2
5 to 9%	17	27.9	5	45.5
10 to 14%	19	31.1	2	18.2
15 to 19%	6	9.8	0	0.0
20 to 24%	6	9.8	2	18.2
25% or more	6	9.8	0	0.0
	61	100.0	11	100.0

### COVID-19 impacts on ACUF firms

Respondents were asked how their business was affected by the spread of COVID-19. For this survey, we defined four periods, shown in Tables 13–15, to capture COVID-19 effects during two different seasons of each year. March through to October is expected to be the busiest season and we wanted to control for possible seasonal effects while estimating the effects of COVID-19.

Table 13 reports how respondents felt their business (private contracts, state and local contracts, etc.) was affected during each of the four periods. Consistent with the increases in gross business income that we reported, the greatest percentage of respondents reported that they were either “slightly busier” or “much busier” in each of the four periods compared to a typical season before 1st March 2020. For the first period, March 2020 to October 2020, 46.8% of the respondents (44 of 94 firms) reported they were either “slightly busier” or “much busier.” That percentage grew to 52.1% for the November 2020 to February 2021 period and again to 66% for March 2021 to October 2021. For the final period, November 2021 to February 2022, 47.9% of the firms reported they were either “slightly busier” or “much busier.” The results show most firms in our sample found business were “about the same” or busier. Nearly three-quarters of the firms (73.4%) indicated business was “about the same” or busier during the period March–October 2020. That strong majority increased to 80.9% for the second period (November 2020–February 2021) and to 88.3% during the third period (March–October 2021). Over 85% of the firms indicated business was “about the same” or busier for the final period (November 2021–February 2022). Modest positive correlations with gross income indicate larger firms found business busier during the four periods following the start of COVID-19.

A majority of firms indicated that business from private homeowners increased in the periods following 1st March 2020 (Table 14). Over 51% (48 of 94 firms) indicated homeowner business increased (combined “slight increase” and “increase”) during March 2020 to October 2020. Homeowner business increases were indicated by 60.6% of the firms for November 2020 to February 2021; 64.9% of the respondents saw homeowner business increases for March 2021 to October 2021. Fifty percent of respondents reported increased homeowner business for the final period November 2021–February 2022. Very few reported that homeowner business decreased during these four periods. Only 19.1% reported seeing a “decrease” or “slight decrease” in homeowner business for March 2020 to October 2020. That percentage declined over the other three periods with a low of just 8.5% for March 2021 to October 2021. There were statistically important associations between firm size and homeowner business increases, but while statistically important, the simple correlations indicated modest positive associations between business gross income and increased homeowner business during the first three periods. There was no important

**Table 13.** Number of firms indicating arboriculture business was slower, about the same or busier than a typical season before 1st March 2020.

	Much slower	Slightly slower	About the same	Slightly busier	Much busier	n
March 2020–October 2020	13	12	25	18	26	94
November 2020–February 2021	8	10	27	18	31	94
March 2021–October 2021	2	9	21	19	43	94
November 2021–February 2022	3	11	35	19	26	94

**Table 14.** Number of firms indicating how business from private homeowners changed after 1st March 2020, during COVID-19.

	Decrease	Slight decrease	About the same	Slight increase	Increase	n
March 2020–October 2020	12	6	28	15	33	94
November 2020–February 2021	5	7	25	17	40	94
March 2021–October 2021	2	6	25	15	46	94
November 2021–February 2022	6	8	33	20	27	94

association between business gross income and homeowner business increases for the final period, November 2021 to February 2022.

While business was good for most firms from March 2020, that does not mean ACUF firms were free of COVID-19 problems. Table 15 shows how respondents felt their ability to secure the necessary labour to conduct business was affected during the same four periods. For the first three periods, most respondents reported it was “more difficult” or “slightly more difficult” to secure the workforce they needed. For the first two periods, 53.2% found it “more difficult” or “slightly more difficult” to find the labour they needed. The percentages dropped to 50 and 47.9% in the final two periods as COVID-19 waned. The number of respondents who reported finding labour to be “about the same” remained steady around 45% throughout the four periods. Very few found it less difficult. Simple correlations indicate that there were modest associations between firm size and difficulty finding the necessary labour. Larger firms found it more difficult to find the necessary labour during the four periods following the start of COVID-19.

COVID-19 also affected business costs as shown in Table 16. A majority of respondents indicated that they saw either an “increase” or “slight increase” in costs for “employee wages and salaries” (60.2%), “health insurance” (57.6%), “personal protection equipment” (67%), and “costs due to employee absence” (51.1%) following 1st March 2020. In addition, 49.5% saw “office expenses” rise. Nineteen “other costs” were listed by respondents, including fuel (9 responses), materials and supplies (3 responses), and equipment-related expenses (3 responses). Simple correlations indicated that cost increases related to labour (wages and salaries, health insurance, employee absence) were positively related to firm size, with larger firms more likely to indicate increases in these costs following 1st March 2020. Thus, despite generally strong demand for ACUF services, the firms in this study reported a number of challenges associated with the COVID-19 pandemic.

## Summary and conclusions

The survey asked about changes over the years 2019 to 2021. Comparing income of 2020 to 2019 most firms in this sample, about 89%, had increased income or income had

**Table 15.** Number of firms indicating securing necessary labour was more difficult, about the same, or less difficult than a typical season before 1st March 2020.

	More difficult	Slightly more difficult	About the same	Slightly less difficult	Less difficult	Number of firms
March 2020–October 2020	39	11	42	1	1	94
November 2020–February 2021	38	12	42	1	1	94
March 2021–October 2021	35	12	43	3	1	94
November 2021–February 2022	28	17	43	3	3	94

**Table 16.** Number of firms indicating how business costs changed following 1st March 2020, during COVID-19.

	Decrease	Slight decrease	About the same	Slight increase	Increase	Number of firms
Employee wages and salaries	4	2	31	17	39	93
Health insurance	3	1	35	24	29	92
Personal protection equipment	2	0	29	35	28	94
Office expenses (computing, additional software, etc.)	3	3	40	24	21	91
Costs due to employee absence	3	1	42	16	32	94

stayed about the same. Income increases for firms were substantial, on average about 15%. Several firms had income about the same and a few had decreased income. An estimated average income increase for all firms was 6.7%. For this sample of ACUF firms, 2020 was a relatively good year in terms of business income, despite the troubles caused by the pandemic. Comparing incomes for 2021 to 2020, these firms again saw mostly positive changes in business activity with an estimated average income increase of more than 10%. There were also additional firms that did not report being in business in 2019 or 2020. The ACUF firms in this sample had another strong year in 2021 despite the problems faced across the U.S.A. and regional economies.

Increased business income for the firms in this sample logically lead to increased employment and/or increased hours worked. Our survey did not ask about hours worked, but firms did report increased employment on average. Firms in this sample increased employment in 2020 compared to 2019, and again in 2021 compared to 2020. There was also the increased number of firms in 2021 that provided a boost to total employment. The weighted average increases in employment of 5.5% (2019–2020) and 9.7% (2020–2021) resulted in similar percentage changes in payroll of 3.7% (2019–2020) and 7.9% (2020–2021). The greatest percentage increases in employment were in part-time and seasonal employment, labour categories for which wages and benefits are typically lower. These changes in the distribution of labour across full-time, part-time and seasonal workers provide one explanation for the differences between percentage increases in labour and payroll.

The survey asked about business activity for the sample firms during four periods associated with the COVID-19 pandemic compared to before the pandemic. Most firms reported they were either “slightly busier” or “much busier” in the latter three periods. Combining the category “about the same” resulted in strong majorities of 73% and greater. In general, the ACUF firms in this sample did see increased business during the COVID-19 pandemic, and firms generally reported that homeowner business increased during the pandemic with a majority reporting a “slight increase” or “increase.” Many homeowners found themselves at home more during the pandemic and may have focused additional expenditures on tree care. As stated previously, private individuals represented the greatest percentage of firms’ business income (over 70%) and that tree care activities (pruning and removal, fertilising and health care) represented over 70% of income generating activities.

The responses by this sample of ACUF firms indicates that the COVID-19 pandemic period was one of strong income and employment growth for the industry fuelled in part by increased demand by private homeowners. The COVID-19 pandemic periods saw growth for the ACUF industry, but the firms in this sample also

faced many of the same difficulties that other industries faced. Firms reported problems securing the labour they needed and reported cost increases. A majority of firms reported increased costs associated with wages, salaries and health insurance. Whether these increases are short-term phenomena or longer-term shifts for the ACUF industry remains as a future research question. This survey and the results obtained provide statistics to make general statements about the ACUF firms in this sample.

Analysis of this segment of the broader “green industry” enables stakeholders and interested parties to educate legislators, regulatory decision-makers, and others about the importance of the COVID-19 pandemic in relation to the ACUF sector. Additionally, organisations that include land-grant universities and professional associations may use findings from this research to validate and inform training and research opportunities. Important research questions about the health of the industry and structural changes to the industry following the COVID-19 pandemic remain and merit further examination.

## Acknowledgments

We would like to thank the following individuals and organizations: Heather Leff (New England Chapter of the International Society of Arboriculture); Virginia Wood, Carrie Martin (Massachusetts Arborists Association); the New England State Urban & Community Forestry coordinators & staff; the arborists & commercial urban foresters who took the time to participate in this survey; University of Massachusetts (UMass) Department of Environmental Conservation; Centre for Agriculture Food & the Environment @ UMass.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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