BEYOND THE NUMBERS

BLS

August 2014 | Vol. 3 / No. 17

WORKPLACE INJURIES

Fatal injuries and nonfatal occupational injuries and illnesses involving insects, arachnids, and mites

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Although not often associated with injuries and deaths at the workplace, insects, arachnids, and mites were involved in 83 fatal occupational injuries from 2003 to 2010.[1] The majority of these workplace deaths were due to bee stings. Annual nonfatal work-related injury and illness case counts involving insects, arachnids, and mites that led to days away from work ranged from 4,930 to 6,870 between 2008 and 2010. Most of these nonfatal cases were due to stings or bites, some venomous and some nonvenomous.

This issue of Beyond the Numbers article examines fatal and nonfatal workplace injuries and illnesses related to insects, arachnids, and mites using data from two Bureau of Labor Statistics (BLS) sources: the Census of Fatal Occupational Injuries (CFOI)[2] and the Survey of Occupational Injuries and Illnesses (SOII).[3] CFOI data used here are from 2003 to 2010 and aggregated to support extended analysis. SOII data are from 2008 to 2010. BLS began publishing national SOII estimates for state and local government in 2008, so that period was chosen to keep the coverage of CFOI and SOII data in this study as comparable as possible.[4] For this article, the term "insects" refers to the entire category, for short.

Workplace hazards

The two leading federal agencies dedicated to ensuring the safety and health of employees in the workplace have each recognized insects as a workplace hazard. The National Institute for Occupational Safety and Health (NIOSH), which is part of the Centers for Disease Control and Prevention, notes that "Thousands of people are stung by insects each year, and as many as 90–100 people in the United States die as a result of allergic reactions."[5] NIOSH devotes a section of their website to workplace safety measures related to insects. The Occupational Safety and Health Administration (OSHA) has issued several fact sheets that are designed to help workers identify and protect themselves from different types of insects. Noteworthy among these are the brown recluse spider, fire ants, and the black widow spider.[6]

Characteristics of fatal occupational injuries

Over the 8-year period from 2003 to 2010, an average of 10 fatal occupational injuries per year involving insects were recorded. The high was in 2005 (15), and the series low was in 2003 (6). (See table 1.)

Table 1. Fatal occupational injuries involving insects by year, 2003–2010

Year	Fatal injuries
2003	6
2004	10
2005	15
2006	10
2007	11
2008	10
2009	9
2010	12

NOTE: Data for all years are revised and final. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries

Bees were the most common insect involved, with 52 fatal occupational injuries. Eleven workers were killed in wasp-related incidents including three incidents involving yellow jackets. In addition, seven fatal occupational injuries over that period were from spiders and four were from ants.

Insect-related deaths were most commonly associated with three types of jobs: farming, construction, and landscaping. A total of 20 farmers and farm workers were killed during the 8-year period. Construction occupations (19), landscaping workers (17), and farmers and farm workers accounted for two thirds of the deaths. (See table 2.)

Table 2. Fatal occupational injuries involving insects by selected characteristics, 2003–2010

Characteristics	Fatal injuries
Total	83
Type of insect	
Bee	52
Wasp	11
Yellow Jacket	3
Spider	7
Ant	4
Other or unknown insect	9
Employee Status	
Wage and salary[(1)]	62
Self-employed[(2)]	21
Gender	
Male	82
Age	
20 to 24	5
25 to 34	12
35 to 44	19
45 to 54	23
55 to 64	12
65 and older	9
Race or ethnic origin[(3)]	
White, non-Hispanic	55
Black or African American, non-Hispanic	11
Hispanic or Latino	16
Event[(4)]	
Injections, stings, venomous bites	70
Nonhighway falls from vehicle	5
Other transportation incidents	3
Occupation[(5)]	
Farming occupations[(6)]	20
Farmworkers and laborers, crop, nursery, and greenhouse	8
Farmers and ranchers	6
Farmworkers, farm, and ranch animals	4

See footnotes at end of table.

Table 2. Fatal occupational injuries involving insects by selected characteristics, 2003–2010

Characteristics	Fatal injuries
Construction occupations[7]	19
First-line supervisors of construction trades and extraction workers	3
Carpenter	3
Construction laborers	3
Operating engineers and other construction equipment operators	3
Landscaping occupations[8]	17
Landscaping and groundskeeping workers	13
Tree trimmer	3
Driver/sales workers and truck drivers	6
Pest control workers	3
Industry[9]	
Private	78
Agriculture, forestry, fishing, and hunting	22
Crop production	10
Animal production	11
Cattle ranching and farming	6
Construction	21
Residential building construction	4
Administrative and support and waste management and remediation services	16
Services to buildings and dwellings	15
Landscaping services	12
Exterminating and pest control services	3
Retail trade	3
Transportation and warehousing	3
Government[10]	5
State government	3

Footnotes:
(1) May include volunteers and workers receiving other types of compensation.
(2) Includes self-employed workers, owners of unincorporated businesses and farms, paid and unpaid family workers, businesses or members of partnerships and may include some owners of incorporated businesses or members of partnerships.
(3) Persons identified as Hispanic or Latino may be of any race. The racial categories shown exclude data for Hispanics and Latinos.
(4) Based on the original BLS Occupational Injury and Illness Classification System (OIICS).
(5) Occupation data are based on the 2000 Standard Occupational Classification (SOC) system.
(6) Farming occupations include SOC 11-9012, SOC 45-1*, and SOC 45-2*.
(7) Construction occupations include SOC 11-9021, SOC 47-1*, SOC 47-2*, SOC 47-3*, and SOC 47-4*.
(8) Landscaping occupations include SOC 37-1012 and SOC 37-3*.
(9) Industry data from 2003 to 2008 are based on the 2002 North American Industry Classification System. Industry data from 2009 to the present are based on the 2007 North American Industry Classification System.
(10) Includes fatal injuries to workers employed by governmental organizations regardless of industry.
NOTE: Data for all years are revised and final. Totals for major categories may include subcategories not shown separately. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries

Fatal occupational injuries involving insects are often associated with anaphylactic shock. In total, 39 of the case narratives noted the decedent suffered anaphylactic shock.

While 9 percent of all fatal workplace injuries from 2003 to 2010 occurred in Texas, 25 percent (21) of insect-related fatal workplace injuries occurred in this state. Florida had the next highest percentage with 10 percent (8) (See table 3.)

Table 3. Fatal occupational injuries involving insects by State of Incident, 2003–2010

State	Fatal injuries
Total	83
Texas	21
Florida	8
California	6
Ohio	6
Pennsylvania	5
New York	4
North Carolina	4
Arizona	3
Colorado	3
South Carolina	3

NOTE: Data for all years are revised and final. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries

Not surprisingly, these incidents tended to occur in the warmer months.[7] Almost 94 percent of the cases occurred between April 1 and October 31. The largest number of deaths (17) occurred in September. (See table 4.)

Table 4. Fatal occupational injuries involving insects by month of injury, 2003–2010

Month	Fatal injuries
Total	83
April	4
May	10
June	13
July	14
August	14
September	17
October	6

NOTE: Data for all years are revised and final. CFOI fatality counts exclude illness-related deaths unless precipitated by an injury event.
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, in cooperation with State, New York City, District of Columbia, and Federal agencies, Census of Fatal Occupational Injuries

Of the total 83 deaths, 72 were directly caused by an insect. These include cases in which the worker was bitten or stung. Another 11 deaths were indirectly caused by insects. These include cases where an insect distracted the worker while driving or caused the worker to fall from a height.

In the 72 direct cases, there were 33 instances in which the worker was attacked by multiple insects. In 27 of these instances, bees attacked the worker. There were also 12 cases in which the decedent was attacked by insects (10 of which involved bees) after disturbing a nest or other home of the insects. In all of these cases, multiple insects attacked the worker.

Five of the direct cases involved a worker who used or tried to use an epinephrine autoinjector or other antivenom and still died from the insect bite.

For indirect incidents, five deaths resulted from the decedent falling from a tractor while trying to evade insects.

Characteristics of nonfatal occupational injuries and illnesses

Every year from 2008 to 2010, the estimated number of nonfatal cases with days away from work involving insects, including bees, wasps, and spiders, exceeded 4,600.[8] (See table 5.) Due to limitations in the data, estimates identifying how often particular types of insects were involved in days-away-from-work cases are not publishable.

Table 5. Non-fatal occupational days away from work [(1)] cases involving insects by year and ownership, 2008–2010

Year	Private Industry	Local Government	State Government	Total All Ownerships
2008	4650	1460	430	6540
2009	4820	1660	390	6870
2010	3650	980	300	4930

Footnotes:

[(1)] Days-away-from-work cases include those that resulted in days away from work, some of which also included job transfer or restriction
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Survey of Occupational Injuries and Illnesses in cooperation with participating State agencies.

Most insect-related nonfatal cases involved stings or bites of some kind. More than 65 percent of all insect-related cases were due to injections, stings, or venomous bites for each year in the reference period. At least 20 percent of the remaining cases involving insects in each of those years were from nonvenomous bites. (See table 6.)

Table 6. Non-fatal occupational days away from work [(1)] cases involving insects by selected characteristics, 2008–2010

Characteristic	2008	2009	2010
Total	6540	6870	4930
Gender			
Male	4710	4970	3380
Female	1790	1880	1540
Gender Not Reported	30	20	20
Age			
16 to 19	110	490	110
20 to 24	580	850	480
25 to 34	1580	1230	1110
35 to 44	1630	1600	1200
45 to 54	1580	1970	1450
55 to 64	790	570	420

See footnotes at end of table.

Table 6. Non-fatal occupational days away from work [1] cases involving insects by selected characteristics, 2008–2010

Characteristic	2008	2009	2010
65 and older	170	70	80
Other or Not Reported	110	90	70
Event[2]			
Injections, stings, venomous bites	4750	4680	3450
Nonvenomous bites	1690	1910	1370
Contact with skin or other exposed tissue	-	50	20
Occupation[3]			
Management	80	90	90
Education, training, and library	40	180	90
Healthcare practitioner and technical	130	140	150
Registered nurses	20	40	80
Healthcare support	230	230	250
Home health aides	50	50	80
Nursing aides, orderlies, and attendants	160	160	110
Protective service	360	750	510
First-line supervisors/managers, fire fighting and prevention workers	-	20	50
Fire fighters	50	50	80
Correctional officers and jailers	20	90	70
Police and sheriff's patrol officers	60	120	140
Security guards	100	60	140
Food preparation and serving related	50	70	70
Building and grounds cleaning and maintenance	1530	1400	790
First-line supervisors/managers of housekeeping and janitorial workers	40	-	70
Janitors and cleaners, except maids and housekeeping cleaners	660	310	340
Landscaping and groundskeeping workers	530	790	260
Personal care and service	130	90	130
Amusement and recreation attendants	30	-	40
Sales and related	170	210	220
Cashiers	40	50	90
Retail salespersons	70	100	60
Office and administrative support	450	390	570
Customer service representatives	120	120	110
Stock clerks and order fillers	60	50	50
Farming, fishing, and forestry	170	110	210
Farmworkers and laborers, crop, nursery, and greenhouse	140	90	150
Farmworkers, farm and ranch animals	-	-	50
Construction and extraction	650	1100	200
Construction laborers	240	160	50
Installation, maintenance, and repair	620	600	700
Telecommunications equipment installers and repairers, except line installers	40	70	70
Automotive service technicians and mechanics	50	170	60
Maintenance and repair workers, general	170	120	180

See footnotes at end of table.

Table 6. Non-fatal occupational days away from work [1] cases involving insects by selected characteristics, 2008–2010

Characteristic	2008	2009	2010
Telecommunications line installers and repairers	80	70	60
Installation, maintenance, and repair workers, all other	40	-	80
Production	300	320	270
Transportation and material moving	1170	860	570
Truck drivers, heavy and tractor-trailer	310	170	110
Truck drivers, light or delivery services	40	90	100
Laborers and freight, stock, and material movers, hand	320	330	200
Industry[4]			
Private	4650	4820	3650
Agriculture, forestry, fishing, and hunting	180	150	190
Mining	30	-	20
Utilities	90	50	20
Construction	580	730	230
Manufacturing	300	260	290
Wholesale trade	240	240	460
Retail trade	350	860	380
Transportation and warehousing	440	320	190
Information	190	170	190
Finance and insurance	20	20	30
Real estate and rental and leasing	420	190	240
Professional, scientific, and technical services	150	80	50
Management of companies and enterprises	30	20	30
Administrative and support and waste management and remediation services	470	510	420
Health care and social assistance	690	670	580
Educational services	20	40	20
Arts, entertainment, and recreation	200	110	150
Accommodation and food services	120	60	90
Other services	130	330	80
State government	430	390	300
Educational services	110	100	40
Health care and social assistance	50	90	30
Public administration	210	160	210
Local government	1460	1660	980
Construction	-	150	-
Educational services	130	340	280
Health care and social assistance	60	20	30
Public administration	1110	1020	490
Transportation and warehousing	30	-	40
Utilities	60	50	-

Footnotes:

[1] Days-away-from-work cases include those that resulted in days away from work, some of which also included job transfer or restriction
[2] These codes are based on the original Occupational Injury and Illness Classification System developed by the Bureau of Labor Statistics.
[3] Standard Occupational Classification Manual, 2000, Office of Management and Budget

See footnotes at end of table.

(4) Industry data for 2008 are based on the North American Industry Classification System - United States, 2002. Industry data from 2009 to the present are based on the North American Industry Classification System - United States, 2007.
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Survey of Occupational Injuries and Illnesses in cooperation with participating State agencies.

Building and grounds cleaning and maintenance, transportation and material moving, and construction and extraction occupations had consistently high counts of nonfatal insect-related cases. (See table 6.) Employees in these fields are likely to deal with the natural habitat of insects or arachnids such as the brown recluse spider, which can be found "any place which had remained undisturbed for lengthy periods of time, such as behind pictures, beneath or behind furniture, in boxes of toys, in clothing, among stored papers, in the corrugations of cardboard boxes, and in discarded articles, such as tires, inner tubes, and assorted other junk."[9]

Four states[10] had case counts higher than 250 in all 3 years of the reference period: California, Florida, New York, and Texas. (See table 7.) As a percentage of all days-away-from-work cases in those large population states, though, insect-related cases were less than 1 percent of the total cases in any year. Seven other states had case counts that exceeded 1 percent of all nonfatal days-away-from-work cases for the state in at least 1 year: Georgia, Kansas, Louisiana, New Mexico, South Carolina, Tennessee, and West Virginia.[11]

Table 7. Non-fatal occupational days away from work (1) cases involving insects by State of Incident, 2008–2010

State	2008	2009	2010
National Total	6540	6870	4930
Alaska	-	-	-
Alabama	140	140	130
Arkansas	90	110	70
Arizona	130	160	60
California	840	680	750
Colorado	NP	NP	NP
Connecticut	180	210	50
District Of Columbia	20	-	-
Delaware	-	20	20
Florida	630	420	390
Georgia	170	150	610
Hawaii	70	70	30
Iowa	80	-	30
Idaho	NP	NP	NP
Illinois	110	260	80
Indiana	100	90	60
Kansas	50	140	20
Kentucky	110	110	90
Louisiana	210	210	100
Massachusetts	80	NP	60
Maryland	170	120	180
Maine	-	-	-
Michigan	100	50	50
Minnesota	20	70	70
Missouri	70	50	80

See footnotes at end of table.

Table 7. Non-fatal occupational days away from work [1] cases involving insects by State of Incident, 2008–2010

State	2008	2009	2010
Mississippi	NP	NP	NP
Montana	-	-	-
North Carolina	210	140	140
North Dakota	NP	NP	NP
Nebraska	20	-	-
New Hampshire	NP	NP	NP
New Jersey	200	160	120
New Mexico	40	150	170
Nevada	20	-	20
New York	360	340	320
Ohio	NP	NP	NP
Oklahoma	70	70	100
Oregon	20	140	60
Pennsylvania	NP	NP	NP
Rhode Island	NP	NP	NP
South Carolina	80	270	80
South Dakota	NP	NP	NP
Tennessee	410	220	110
Texas	570	330	620
Utah	10	40	30
Virginia	110	90	140
Vermont	-	-	-
Washington	120	130	140
Wisconsin	70	40	60
West Virginia	50	130	30
Wyoming	-	-	-

Footnotes:

[1] Days-away-from-work cases include those that resulted in days away from work, some of which also included job transfer or restriction
NOTE: State participation in the survey may vary by year. NP denotes a non-participating state for which no estimates are available. Dash indicates data do not meet publication guidelines.
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Survey of Occupational Injuries and Illnesses in cooperation with participating State agencies.

As with the fatalities data, more nonfatal days-away-from-work cases involving insects occur during summer and fall.[12] (See table 8.) Note that decreased hours of sunlight and temperature associated with seasonal change from fall to winter may not necessarily reduce the insect population.[13]

Table 8. Non-fatal occupational days away from work [1] cases involving insects by month, 2008–2010

Month	2008	2009	2010
Total	6540	6870	4930
January	220	200	110
February	170	260	80
March	280	220	110

See footnotes at end of table.

Table 8. Non-fatal occupational days away from work [1] cases involving insects by month, 2008–2010

Month	2008	2009	2010
April	350	260	250
May	410	540	360
June	690	720	470
July	1280	1600	830
August	990	1100	910
September	960	820	910
October	670	620	530
November	250	300	260
December	270	120	100

Footnotes:

[1] Days-away-from-work cases include those that resulted in days away from work, some of which also included job transfer or restriction
SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Survey of Occupational Injuries and Illnesses in cooperation with participating State agencies.

Generating these estimates for months using the Survey of Occupational Injuries and Illnesses (SOII) microdata is straightforward (see table 8), but obtaining standard errors for those estimates are not. Due to the fact that the SOII sampling methodology does not include month as a defining characteristic but month of occurrence affects the likelihood of a case being submitted for the survey, standard errors using the regular SOII ratio method computation of standard errors are likely to be biased. More detailed information on methods used in this paper is available from the authors upon request.[14]

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NOTES

[1] For fatal occupational injuries, insect-related cases were found by searching for cases where the source and/or secondary source of the injury was coded 514x insects, arachnids (spiders, ticks, scorpions, etc.) per Occupational Injury and Illness Classification System (OIICS) (see note 4 for more on OIICS). All other case narratives were searched using the following keywords: insect, bug, bee, hornet, wasp, scorpion, yellow jacket, spider, and ant. Due to the subjectivity of classifying cases as insect-related, this analysis may not match results published in other Census of Fatal Occupational Injuries (CFOI) publications.

There are a few limitations of the fatal data that bear mentioning. BLS does not rely on narrative searches in its official data so users are cautioned about comparing data in this analysis to published CFOI figures. To be included in this dataset via a case narrative search, the case narrative must have been sufficiently detailed to return a match. It is possible that some cases were not included because the narrative did not have enough detail to meet the search criteria. In addition, determining inclusion based on case narrative searches is inherently subjective. Even using the same criteria, different cases will be included in the dataset based on the interpretations of different data users.

For nonfatal occupational injuries and illnesses, insect-related cases were identified as cases where the source and/or secondary source on the detailed case report was coded 514x insects, arachnids (spiders, ticks, scorpions, etc.) per OIICS. Microdata case narratives were inspected by the authors but not used in classifying cases. The set of cases used in this analysis matches those used in official Survey of Occupational Injuries and Illnesses (SOII) estimates, but may differ in totals due to rounding.

[2] CFOI has published data on all fatal occupational injuries in the United States since 1992. Multiple source documents, including death certificates, workers' compensation reports, media accounts, police reports, and reports from the Occupational Safety and Health Administration (OSHA), are used to identify and fully detail each fatal occupational injury. More information on CFOI can be found here: https://www.bls.gov/iif/oshcfoi1.htm.

[3] SOII publishes data on nonfatal occupational injuries and illnesses. In addition to total case counts and incidence rates by industry and case types, the data include additional detail about the case circumstances and worker characteristics for cases that required at least one day away from work to recuperate. More information on SOII can be found here: https://www.bls.gov/iif/oshcdnew.htm.

[4] Both CFOI and SOII employ similar coding structures: OIICS for case circumstances, the Standard Occupational Classification (SOC) system for occupation, and the North American Industry Classification System (NAICS) for industry. OIICS includes coding structures for the nature of the injury, the part of body injured, the source of the injury, the secondary source of the injury (if any), and the event that precipitated the incident. More information on OIICS can be found here: https://www.bls.gov/iif/oshoiics.htm. The full manual is available here: https://www.bls.gov/iif/oiics_manual_2007.pdf. For more information on SOC, please see https://www.bls.gov/soc/. From 2003 to 2008, CFOI and SOII used the 2002 NAICS. For 2009 and 2010, CFOI and SOII used the 2007 NAICS. More information on NAICS can be found here: https://www.bls.gov/bls/naics.htm.

One notable difference between CFOI and SOII is that they differ in the scope of workers they cover. CFOI includes all workers in the United States including the self-employed, federal workers, resident military, and volunteers. SOII does not include the self-employed, federal workers, and resident military. SOII also excludes workers on farms with fewer than 11 employees and most volunteers.

[5] See the NIOSH Workplace Safety & Health Topic page for Insects and Scorpions: http://www.cdc.gov/niosh/topics/insects/.

[6] See https://www.osha.gov/OshDoc/data_Hurricane_Facts/brown_recluse_spider.pdf, https://www.osha.gov/OshDoc/data_Hurricane_Facts/fire_ants.pdf, and https://www.osha.gov/OshDoc/data_Hurricane_Facts/black_widow_spider.pdf.

[7] Photoperiod diapauses cycles, whether reproductive or strictly developmental, can depend on temperature, light, or other ecological factors tied to seasonality. Regardless of which specific factors are involved, we are interested in the common seasonal timing of changes in environmental conditions. See, for example, Saunders, et al., Insect Clocks 3rd Ed. Amsterdam: Elsevier Science, 2002.

[8] The first year of the Survey of Occupational Injuries and Illnesses (SOII) with comprehensive coverage of state and local government entities nationwide was 2008. Limiting the reference period to the 3-year window of 2008–2010 maintains consistency in coverage and sampling for the SOII data used. Comparison to the fixed value 4,600 is statistically significant in all 3 years at the 95-percent confidence level.

[9] Edwards, G.B., "The Present Status and a Review of the Brown Recluse and Related Spiders, Loxosceles spp. (Areneae: Sicariidae), in Florida", Florida Department of Agriculture and Consumer Services Division of Plant Industry, Entomology Circular No. 406, May/June 2001, p. 3, available online at: http://www.freshfromflorida.com/content/download/9810/135128/ent406.pdf.

[10] State level estimates are not available for all state entities and territories covered by the SOII. “State participation in the survey may vary year by year.” See Selby, Burdette, and Huband, “Overview of the Survey of Occupational Injuries and Illnesses Sample Design and Estimation Methodology,” October 2008, available online at: https://www.bls.gov/osmr/research-papers/2008/pdf/st080120.pdf Non-participating states for which estimates are not available are denoted in table 7.

[11] These years were as follows: GA 2010, KS 2008, LA 2008–2009, NM 2009–2010, SC 2009, TN 2008, WV 2009. The indicated state–year combinations had days away from work cases in which insects were either the source or secondary source of nonfatal injuries. These case were significantly higher than a value equal to 1 percent share of that state’s overall total days away from work cases estimate at the 95-percent confidence level in those years.

[12] For a broader view on temporal variation in SOII data, see Pierce, Brooks, "The Seasonal Timing of Work-Related Injuries," available online at: https://www.bls.gov/osmr/research-papers/2013/st130230.htm

[13] Insect-related incidence rates may be linked to other life cycle effects such as maturation speeds and endocrinal changes. Varley, Gradwell, and Hassell, Insect Population Ecology: An Analytical Approach, University of California Press, 1974, Chapter 5: 75-93. In particular, p.81-83 and figure 5.3.

[14] Month of occurrence cannot be treated the same way as other variables because it is incorporated into subsampling processes used during SOII data collection. The statistical basis for computational methods used in this paper are from Efron and Tibshirani, “Bootstrap Methods for Standard Errors, Confidence Intervals, and Other Measures of Statistical Accuracy, Statistical Science, Vol.1, No.1, 54-77, available online at: http://projecteuclid.org/download/pdf_1/euclid.ss/1177013815.

SUGGESTED CITATION

Steve Pegula and Andrew Kato, “Fatal injuries and nonfatal occupational injuries and illnesses involving insects, arachnids, and mites,” *Beyond the Numbers: Workplace Injuries*, vol. 3, no. 17 (U.S. Bureau of Labor Statistics, August 2014), https://www.bls.gov/opub/btn/volume-3/fatal-injuries-and-nonfatal-occupational-injuries-and-illnesses-involving-insects-arachnids-and-mites.htm