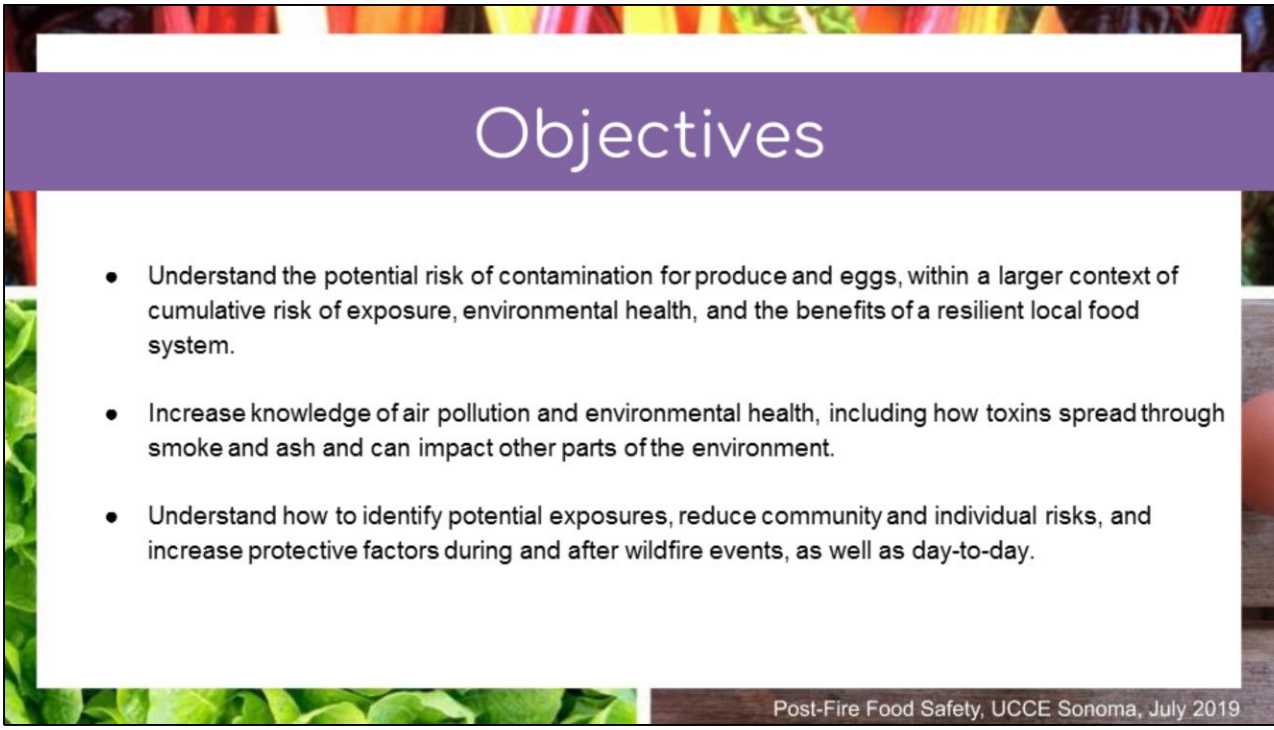
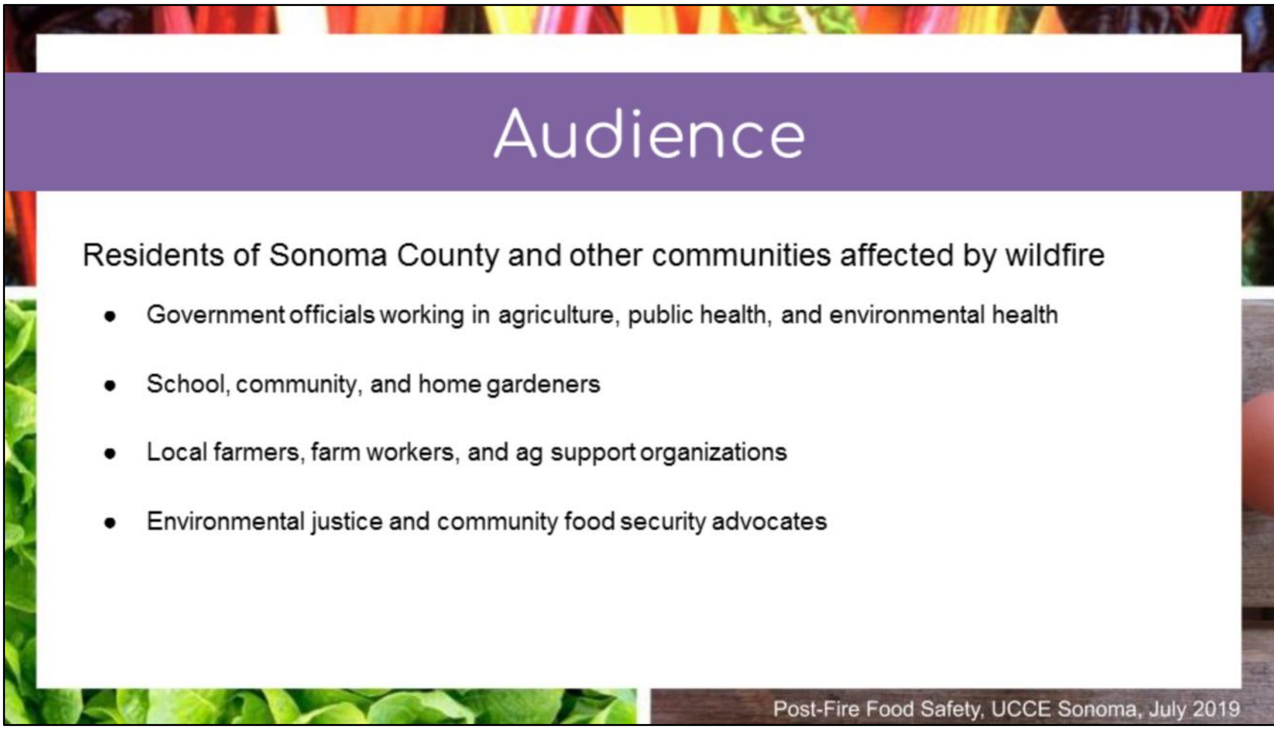
Welcome:

- Welcome to this presentation on Post-Fire Food Safety which provides an overview of how wildfire impacts the health and safety of locally-grown produce and backyard chicken eggs from home, school, and community gardens and local farms.
- This presentation draws on two University of California studies done after wildfires spread through Sonoma County and California in the fall of 2017.
- Together, the joint studies sought to find out if garden- and farm-grown produce and backyard chicken eggs exposed to ash was safe to eat, mobilized the community in the days and weeks after the fire to collect leafy greens from sites across the county and backyard chicken eggs from across the State for later analysis, formed a unique partnership between the University and community researchers, and ultimately led to a workshop series, a scientific report, and a toolkit for other communities affected by wildfire to assess the safety of their own unique context.



By the end of this webinar, we hope you will:

- Understand the potential risk of contamination for produce and eggs, within a larger context of cumulative risk of exposure, environmental health, and the benefits of a resilient local food system.
- Increase your knowledge of air pollution and environmental health, including how toxins spread through smoke and ash and how they can impact other parts of the environment.
- Understand how to identify potential exposures, reduce community and individual risks, and increase protective factors during and after wildfire events, as well as day-to-day.

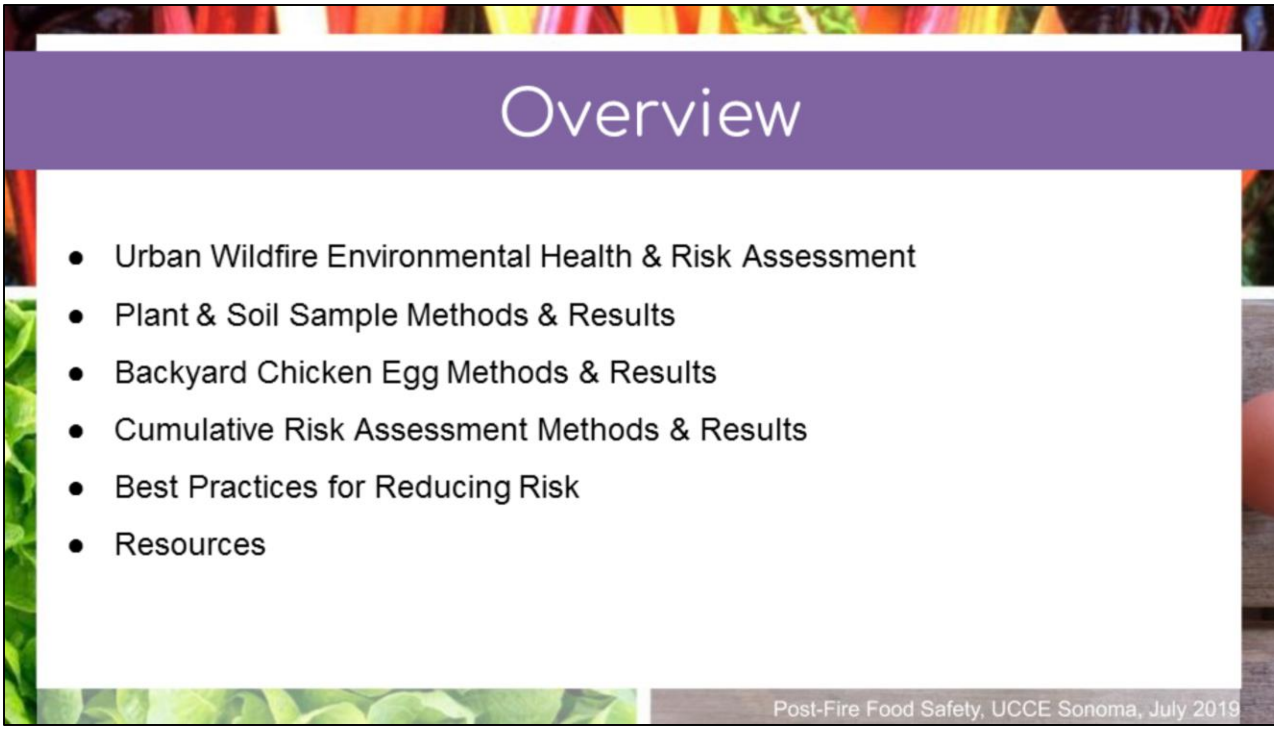


This webinar is intended for:

- Residents of Sonoma County, as well as residents of other communities affected by wildfire--particularly urban wildfires.
- Government officials working in agriculture, public health, & environmental health;
- School, community, and home gardeners;
- Local farmers, farm workers, and ag support organizations; and
- Environmental justice and community food security advocates.

Presenters today include: [INSERT YOUR OWN PRESENTER(S)]

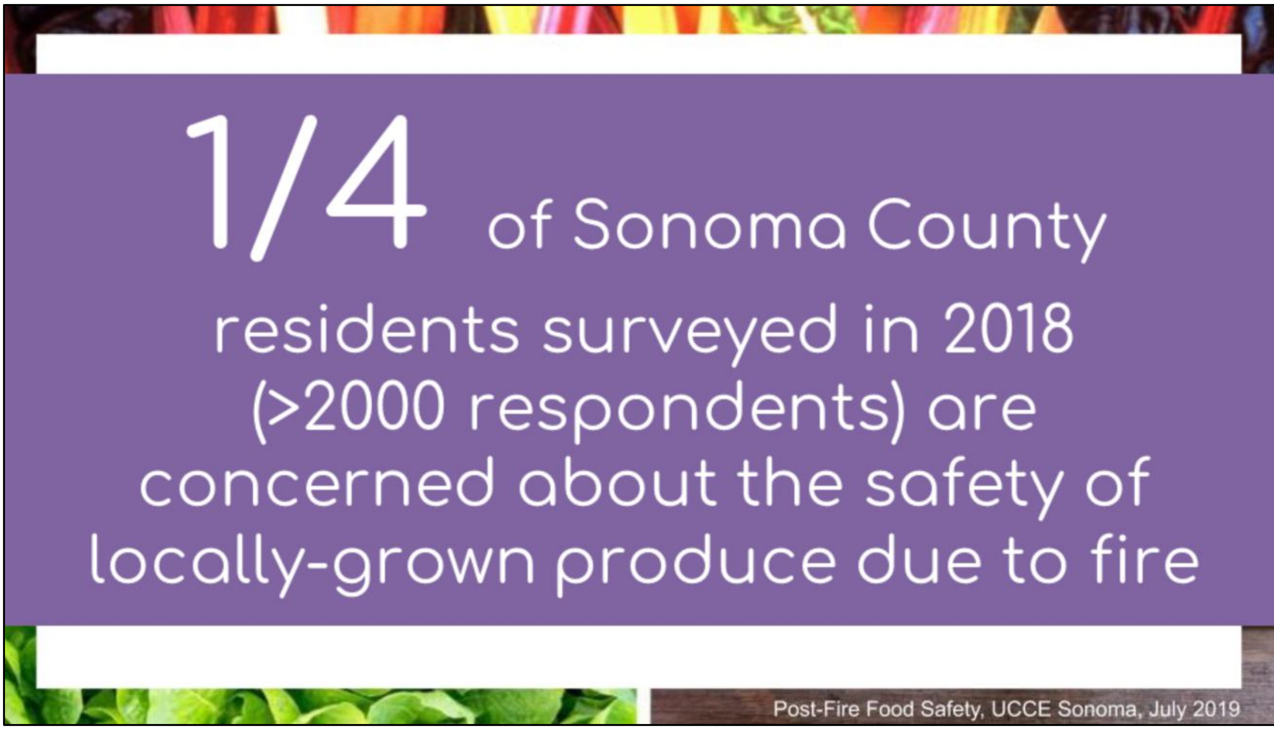
- **Julia Van Soelen Kim,** a UC Cooperative Extension Food Systems Advisor with a background in public health and community food security.
- **Vanessa Raditz,** Science Coordinator for the Post-Fire Produce Safety Study with a background in urban farming and Environmental Health.
- **Todd Kelman,** a veterinarian and UC Davis researcher with the Post-Fire Egg Safety Study.
- **Rob Bennaton**, a UC Cooperative Extension Bay Area Urban Agriculture Advisor with a background in urban soil quality.



Note that all sites in these studies are ***confidential.***

Clarify that the data presented today ***do not*** represent sites that were burned or directly adjacent to burned buildings.

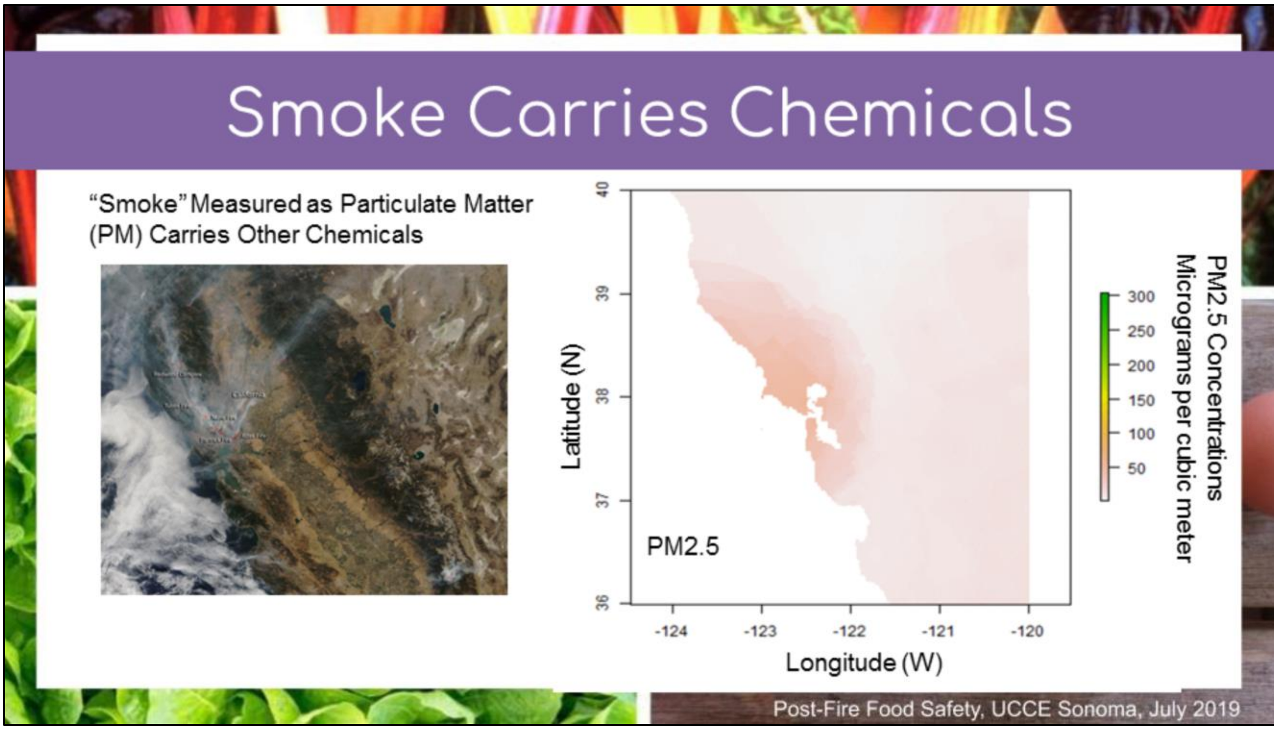

Urban Wildfire
Environmental Health
& Risk Assessment
Post-Fire Food Safety, UCCE Sonoma, July 2019



Impact on Local Farms and Gardens

Local farms and gardens played a significant role in food relief efforts immediately following the fires, contributing produce to shelters and kitchens. Many farmers, gardeners, and community members have been concerned about how the fire-related air pollution might impact locally-grown produce. Farmers have been unsure of the potential health impacts of the fire on themselves, their workers, and their consumers. School, community, and home gardeners have been concerned about the potential health impact on children and other vulnerable groups.

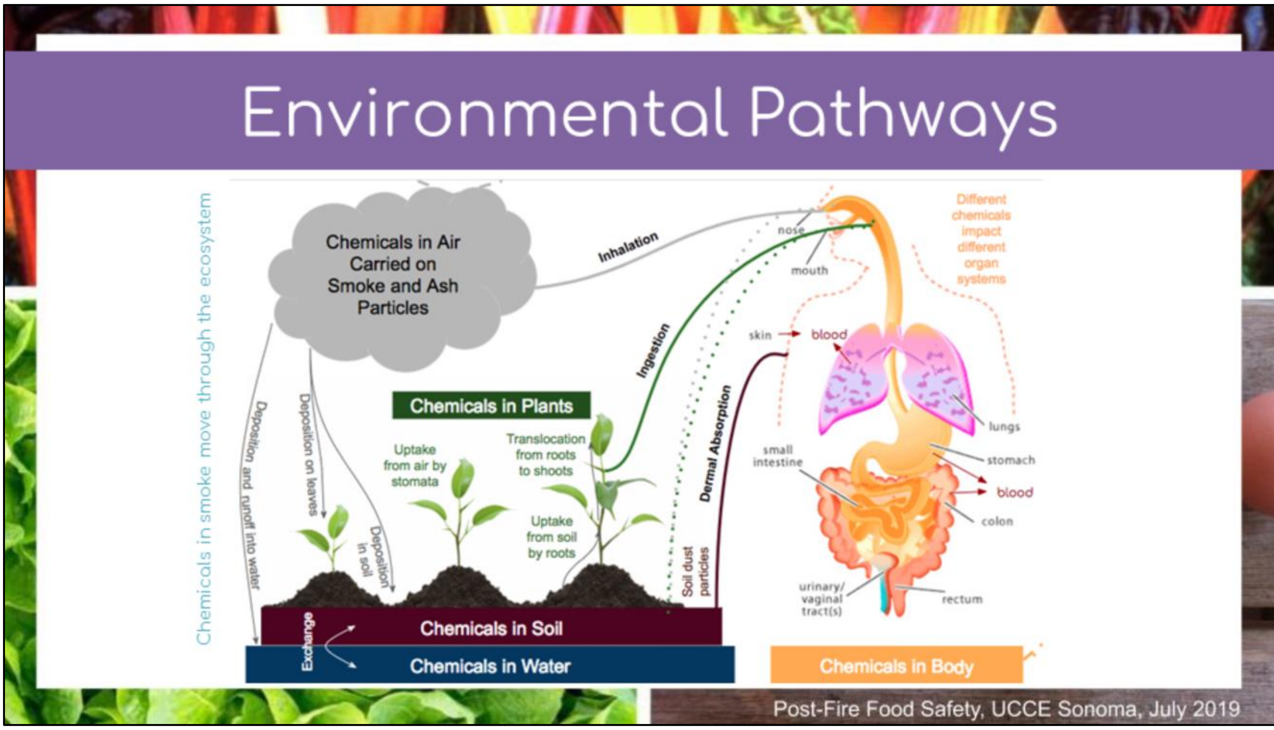
Preliminary results from UC Davis' 2018 survey of Sonoma County residents shows that a quarter of respondents (>2000) reported concerns about the safety of locally-grown produce.8



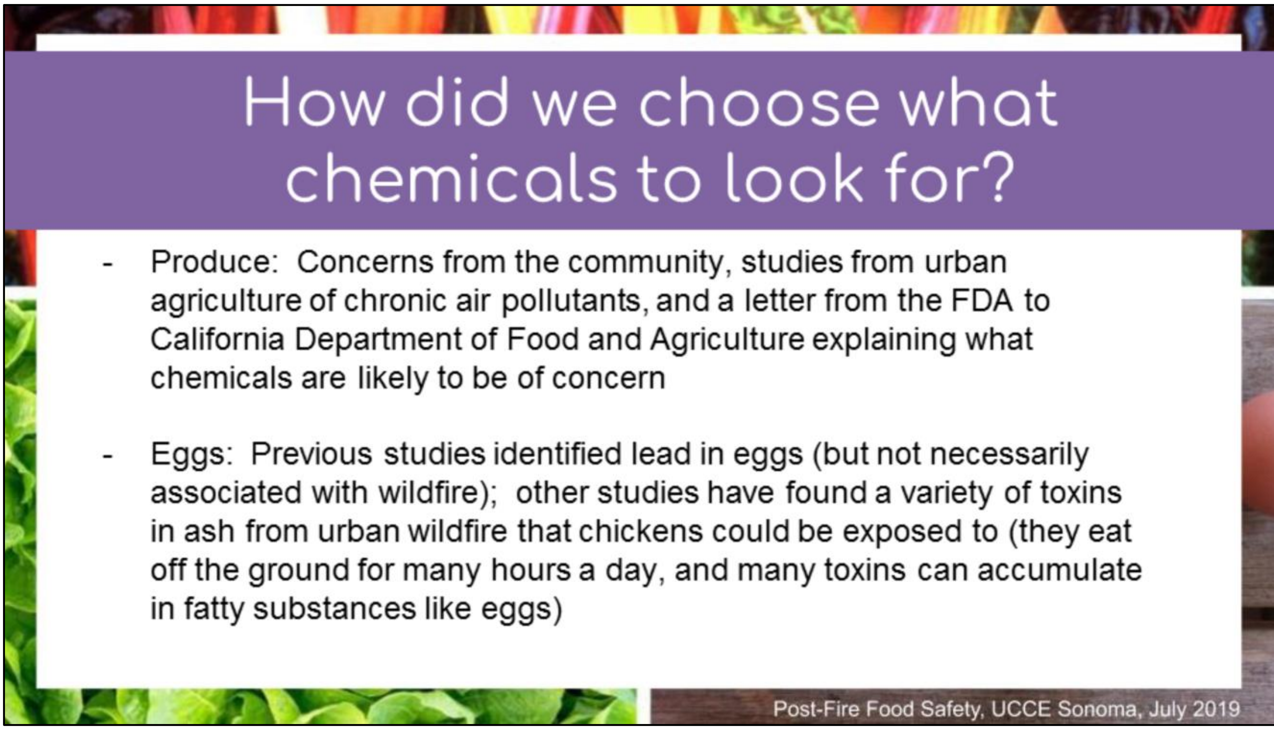
- Smoke from a wildfire is different from an urban burn/ structure
- Each wildfire event is unique
- Exposure to a particular chemical will depend on your proximity to the burning structures and types of structures

Wildfire smoke dramatically increases air pollution levels, with immediate health impacts from acute exposures. A 2015 literature review of over twenty years of wildfire health research indicates that particulate matter levels may increase by up to ten times higher during wildfires, and acute exposure to wildfire smoke is associated with respiratory disease, cardiovascular disease, and mortality.

In the case of an urban wildfire, there is the potential for this smoke to carry toxic chemicals in the products and building materials of the built environments that burned, which has been a major theme of concern among Sonoma County residents

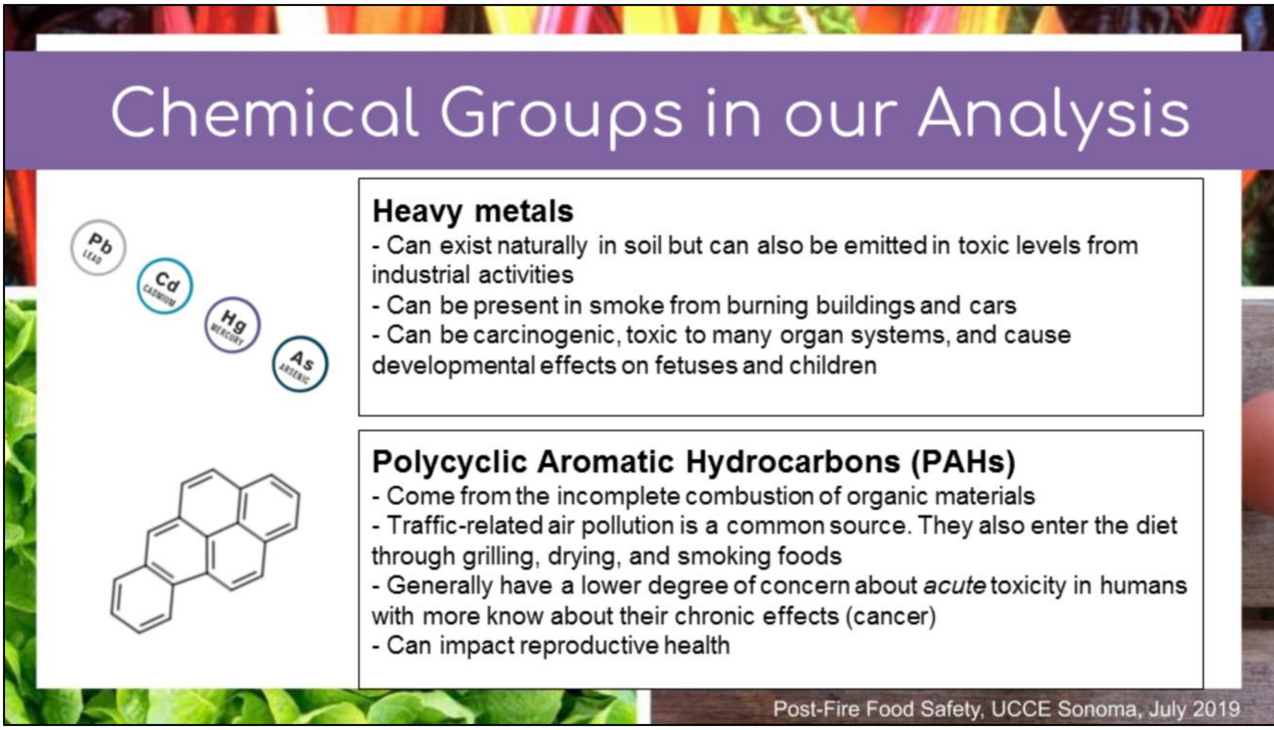


Chemicals from urban wildfire smoke can enter the body through inhalation, ingestion, and absorption through skin. Once in the blood, they can move to other organs. There are already chemicals in all air, soil, water, plants, and bodies present from before the wildfire. At an point along this pathway, chemicals in the environment and body can interact with each other or break down into new chemicals, called “metabolites”.



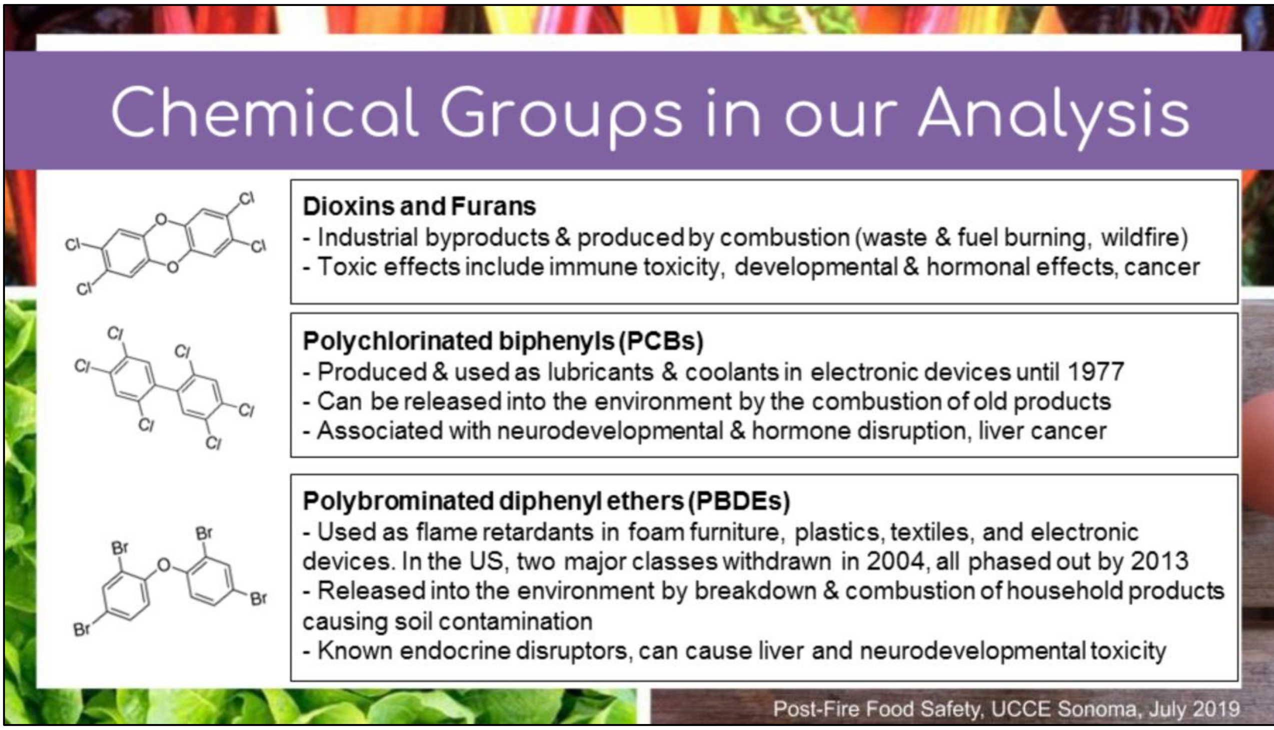
There are many different chemicals that could be released from a wildfire or urban burn that are worthy of analysis. Fires can cause some chemicals to vaporize, turning into gas, while other chemicals attach themselves to particulates, which are the non-combusted solids suspended in smoke. Additionally, the combustion process can transform existing chemicals into new chemicals. Some chemicals have highly toxic effects to humans quickly, while others may not show health effects for years. Some build up in your body, or build up through the ecosystem over time.

Altogether, this makes it really hard to decide what to test for. You can narrow the scope of possible chemicals to test for by conducting a site history, identifying your lab and its capacity, and determining your budget.

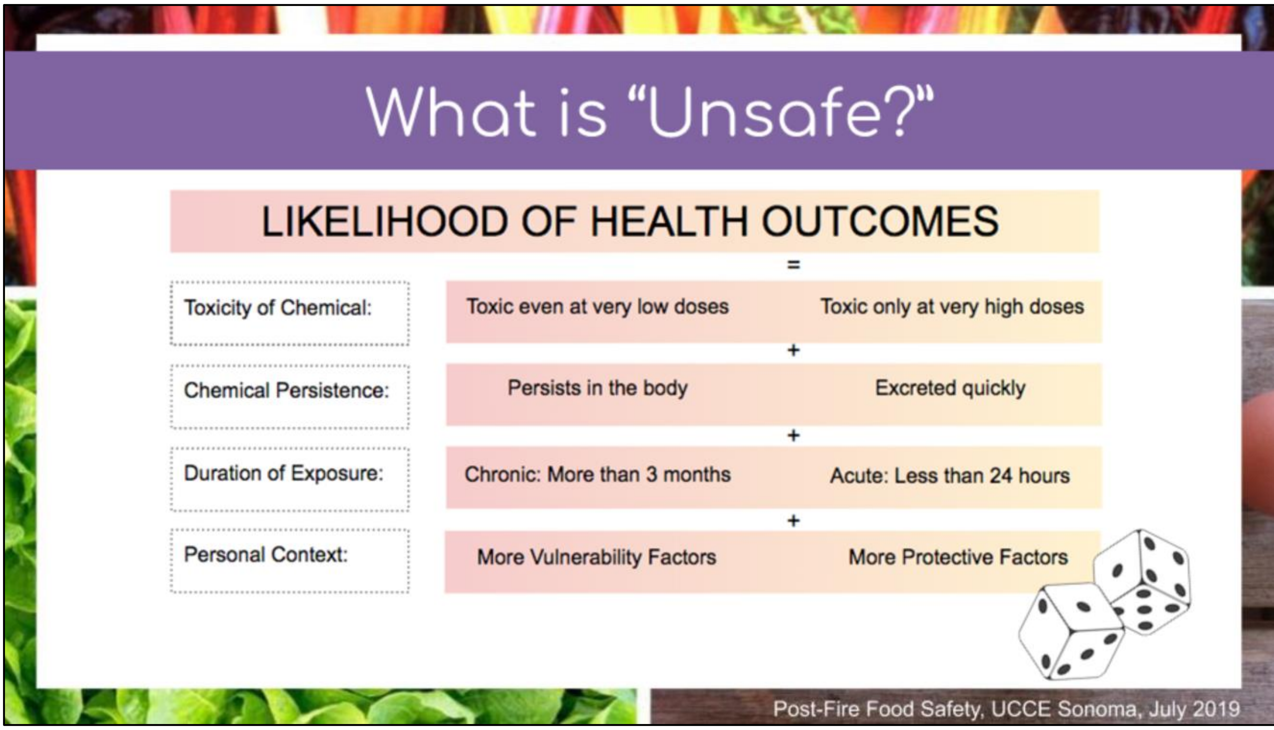


Further notes for Lead regulations in the United States:

1. plumbing:
   a. 1986: "lead free" from household pipes and fixtures in 1986 (but could contain up to 8%); noted that service lines (from water main to househound) can still contain lead
2. paint:
   a. 1978: Consumer Safety Product Commission limits lead in paint for household and on items to 600ppm (parts per million)
   b. 2009: limited to 90ppm
3. gasoline:
   a. 1973: phase down
   b. 1988: virtual elimination
4. food cans:
   a. 1995: ban on lead solder
5. water:
   a. 1974: safe drinking water act
   b. 1988: lead contamination control act (drinking fountains)
   c. 1991: lead and copper rule (drinking water)
   d. current EPA limit for public water supply: 15ug/L
   e. current FDA limit for bottle water: 5ug/L



These chemicals are all “persistent pollutants”. They bioaccumulate (build up over time) in fat in the body of living organisms, and they biomagnify up the food chain.

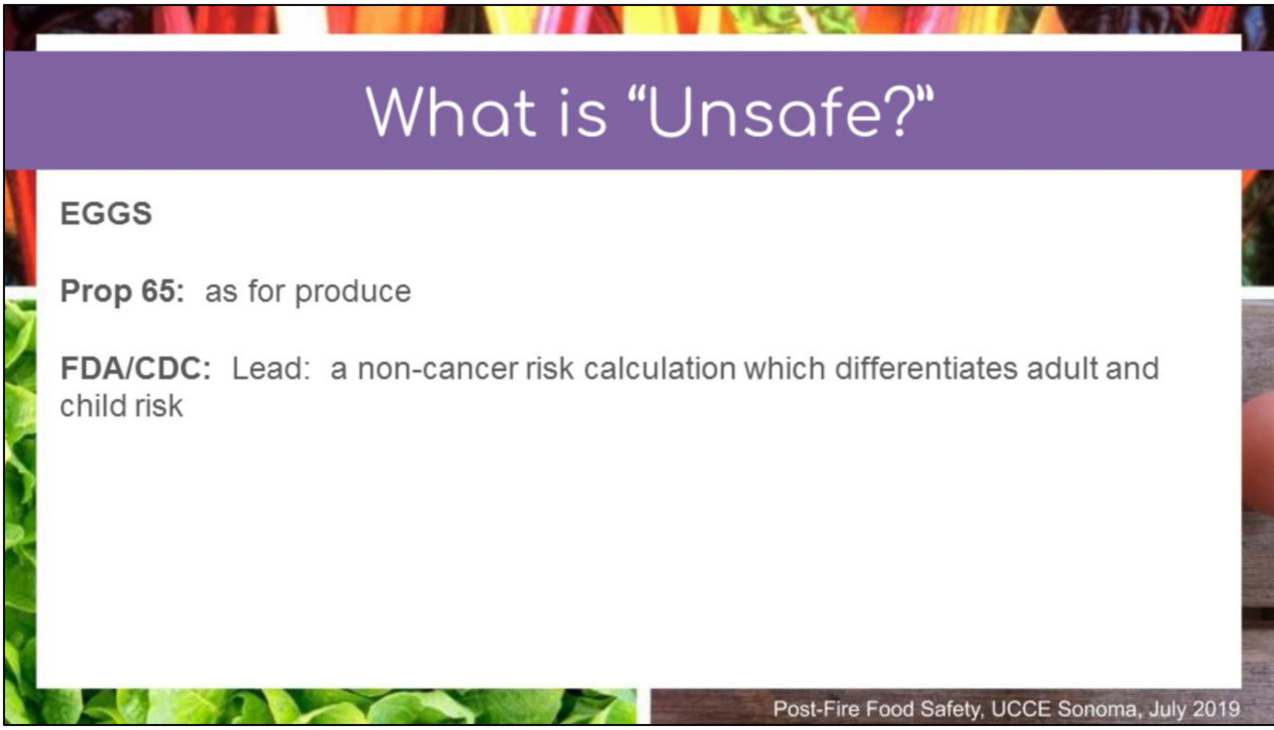


Personal context: more vulnerability factors include potentially diet-related illnesses like diabetes; those facing economic & social hardship (i.e. those that are chronically food insecure) have greater incidence of these types of diseases. Also can include the differences in vulnerability of a neonate vs. a child vs. an adult

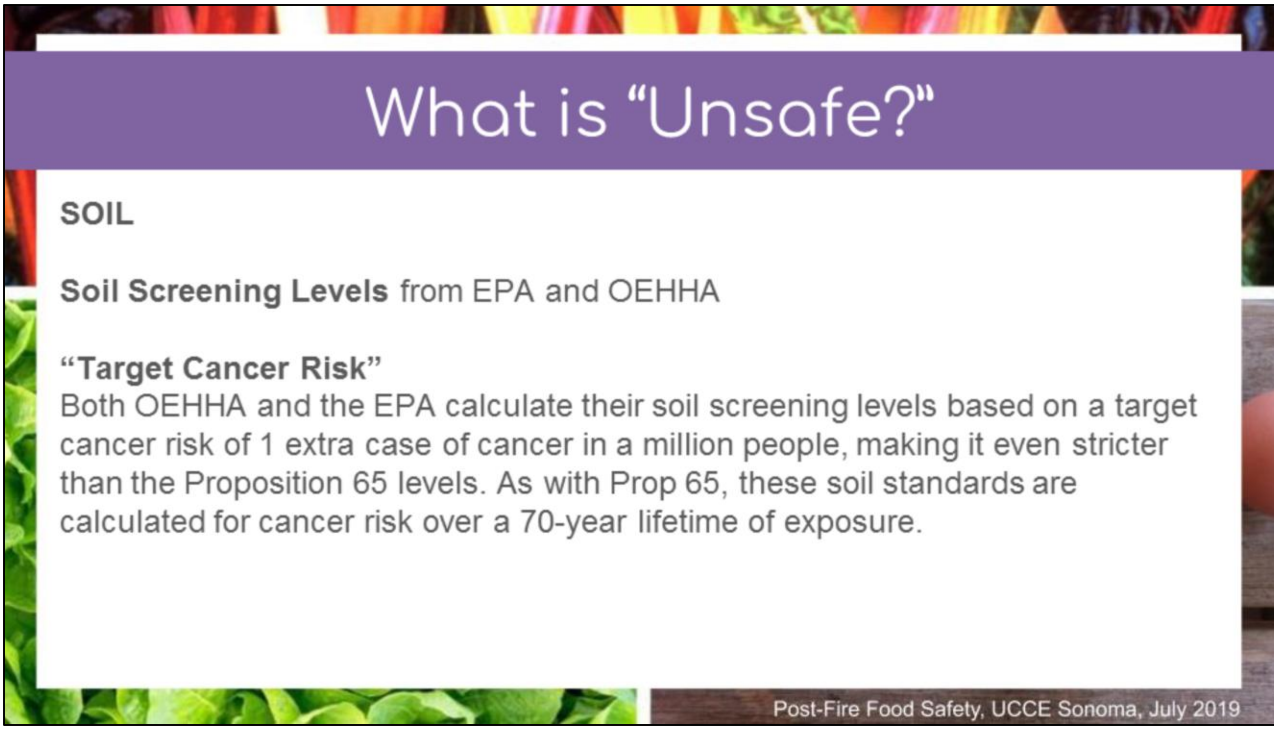
In order to determine whether levels of contaminants on produce were "safe", we compared our laboratory results to the "No Significant Risk Level" (NSRL) established by California's Office of Environmental Health Hazard Assessments (OEHHA) under Proposition 65.[i]

Proposition 65 is officially known as the "Safe Drinking Water and Toxic Enforcement Act of 1986". It was enacted as a ballot initiative to protect drinking water and to inform consumers about exposures to chemicals in consumer products shown to cause cancer, reproductive harm, and neurological impacts in products for sale in California. Under the law, businesses selling products containing these chemicals at levels that pose significant risk must inform customers with a Proposition 65 warning on the package.

[i] "Current Proposition 65 No Significant Risk Levels (NSRLs) Maximum Allowable Dose Levels (MADLs)." Office of Environmental Health and Hazard Assessment. Accessed May 2018. <https://oehha.ca.gov/proposition-65/general-info/current-proposition-65-no-significant-risk-levels-nsrls-maximum >



FDA/CDC lead: based on how much an adult or child would have to ingest daily to reach a blood lead level (BLL) at which monitoring is recommended (highest 2.5% in the US)



We used soil screening levels from the Environmental Protection Agency (EPA) and OEHHA.

We used the EPA’s Regional Soil Screening tables, and selected the Resident Soil level with a target hazard quotient of 1.[i] We used OEHHA’s California Human Health Screening Levels (CHHSLs) table and selected the Residential Scenario values.[ii]

For heavy metals, we also compared our laboratory results to the Sonoma County Complex Fire Cleanup Goals set by the Sonoma County Department of Health Services Public Health Division.[iii]

[i] “Regional Screening Levels (RSLs) – Generic Tables; Updated November 2018.” Environmetnal Protection Agency. Accessed December 2018. <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>

[ii] “California Human Health Screening Levels (CHHSLs).” Office of Environmental Health and Hazard Assessment. Accessed December 2019. <https://oehha.ca.gov/risk-assessment/california-human-health-screening-levels-chhsls>

[iii] Robinson, Barbie, and Ellen Bauer. “Sonoma County Complex Fires Health Screening Level Guidance, Cleanup Goals and Background Data Sets.” Sonoma County Department of Health Services, Public Health Division. February 28, 2018.

What is "Unsafe?"

Proposition 65 and Soil Screening Levels:

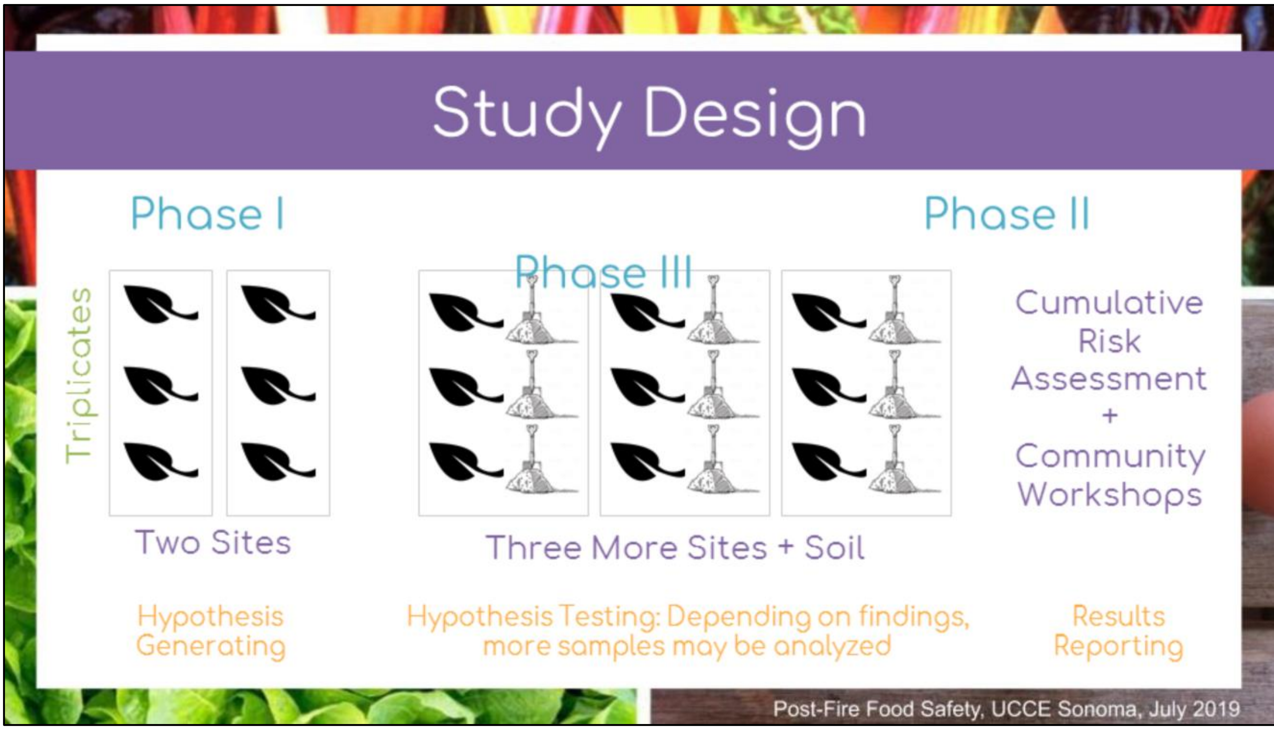
Both of these methods provide an overestimate of risk


Produce
& Soil

Citizen Science Initiative

In the weeks following the Sonoma County fires, concerned community members came together to launch the Produce Safety after Urban Wildfire Citizen Science Initiative. Sonoma County residents and members of the UC Master Gardener Program of Sonoma County collaborated to take samples from over 25 sites across the region using a sampling protocol created under advisement by University of California specialists in Environmental Health and Food Safety. Samples included washed and unwashed produce, each in triplicate, to determine if contaminants are present and whether contaminants can be easily washed off produce. Volunteers focused on leafy greens with large surface area directly exposed to air pollution: kale, collards, chard, and lettuce. In total, over 200 samples were taken and frozen for subsequent laboratory analysis.

In the months following the fire, soil contamination became a greater concern for the community. Community-led soil sampling was initiated in June 2018 using a protocol developed in collaboration with UC Berkeley graduate students. Three sites at various distances from the urban wildfire perimeter were analyzed to test for persistent chemicals in the soil.



PHASE 1

- Our preliminary analysis tested samples from two high-priority sites that were most likely to have received deposits of toxic chemical from combustion of residential and urban structures.
- We provided two varieties of leafy greens (kale, lettuce) from the two sites to TestAmerica in Sacramento for analysis for PAHs, CAM17 metals, and dioxins and furans. We then sent another set of samples from the same two high priority sites to Enthalpy Analytics in Berkeley to help validate our first results. With this second lab, we tested for PAHs in chard samples from both sites, and we tested for dioxins using collards from one site
- ***Based on these preliminary findings, we hypothesized that produce safety was not significantly affected by the fires and that heavy metal deposits may be mitigated by washing produce.***

PHASE 2

- We selected three sites for additional testing based on three variables: distance from urban burn area, ranking on meteorological deposition model used in preliminary analysis, and ranking on particulate matter levels during fire.
- For these three sites, we sent washed and unwashed kale samples to Enthalpy

Analytical to be tested for Polychlorinated Biphenyls, Dioxins and Furans, and Heavy Metals.

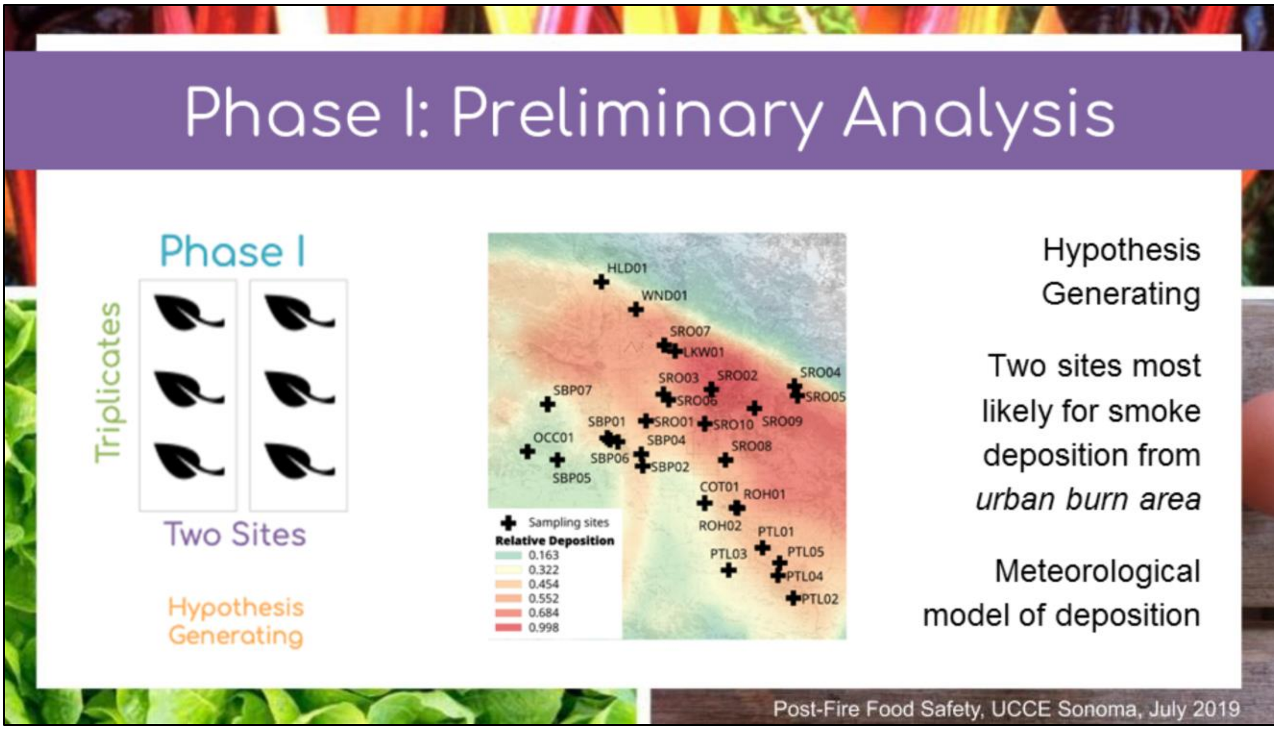
- We selected an additional, fourth, site to send in washed and unwashed kale samples to test for Polycyclic Aromatic Hydrocarbons.

PHASE 3

- In addition to examining each chemical in each route of exposure, our study uses a cumulative approach to examine the total set of exposures that could impact health, including an assessment of chemical mixtures, a risk-benefit analysis of ingesting smoke-exposed produce (as commonly recommended in the EU, including by European Food Safety Authority[i] and the European Commision-funded Benefit Risk Assessment for Food study[ii]), and a literature review of social determinants of health considerations in wildfire health impacts. Our mixed-methods analysis evaluates health hazards and protective factors. Our conclusions draw from the synthesis of these traditional risk assessment and holistic methods.
- Workshops and curriculum-building

[i] EFSA Scientific Committee. "Guidance on human health risk-benefit assessment of foods." *EFSA Journal* 8.7 (2010): 1673. Accessed 4/25/2019. https://www.efsa.europa.eu/en/efsajournal/pub/1673

[ii] Hoekstra, Jeljer, et al. "BRAFO tiered approach for benefit–risk assessment of foods." *Food and Chemical Toxicology* 50 (2012): S684-S698.



- We created a meteorological model of particulate matter deposition from the urban burn area in Santa Rosa using NOAA meteorological data - wind, weather, topography to model where smoke may have moved. Using this model, we constructed a polygon to determine where fire map intersects with urban map and simulated deposition of particulates emanating from this area.

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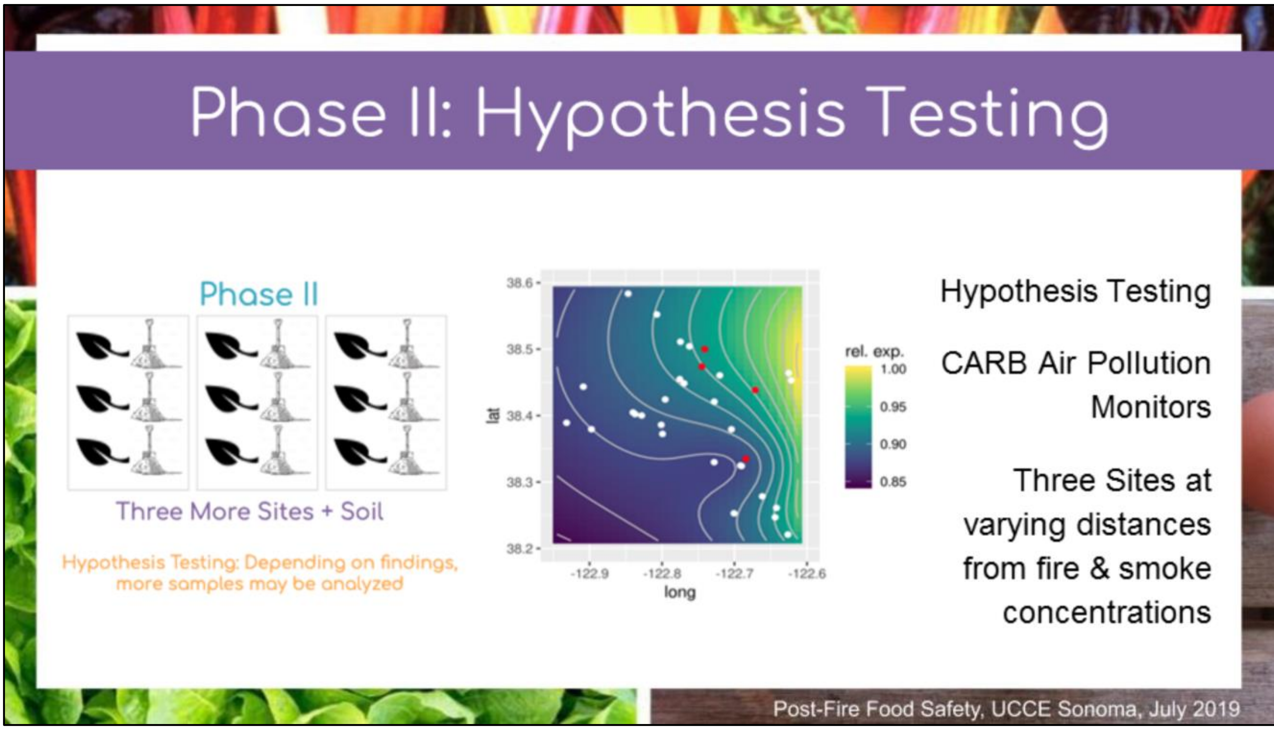
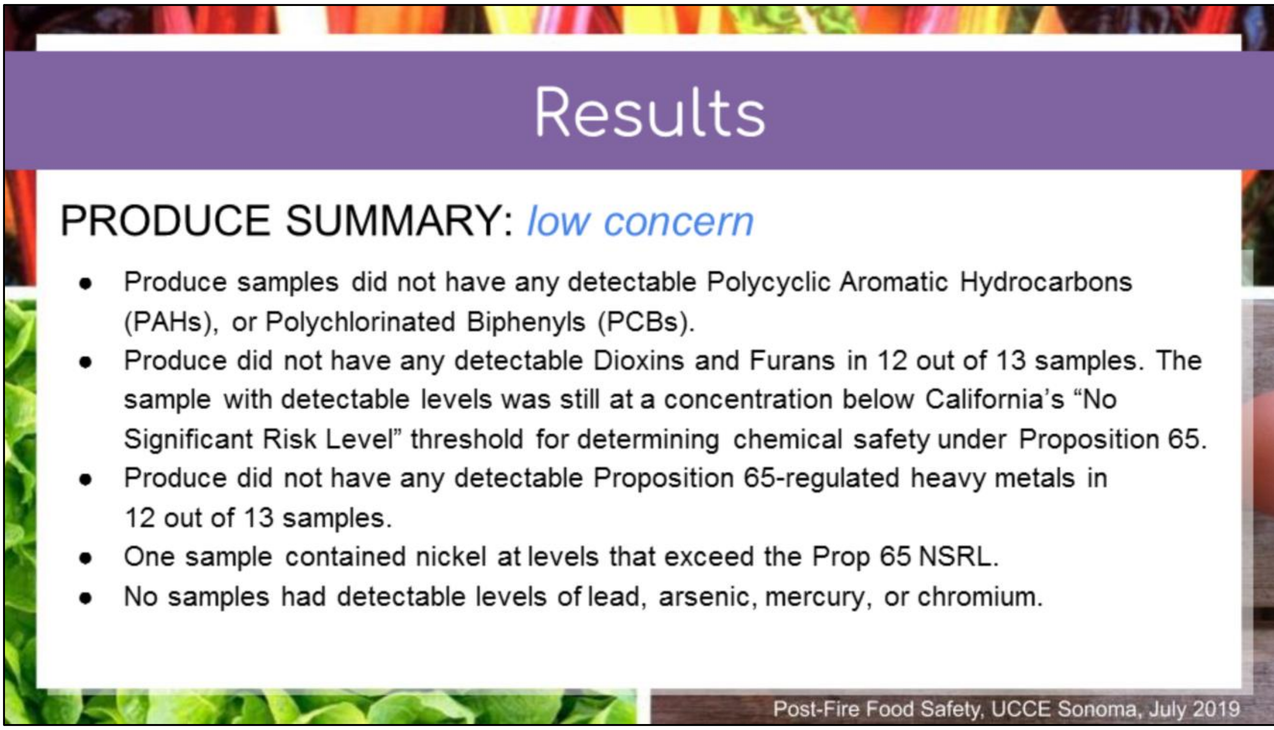


- To determine th sites to test, we analyzed Sonoma County air quality sensor data collected during October 2017, provided by California Air Resource Board (CARB). Averages were calculated between Oct 8 and Oct 20 (capturing most peaks on sensor measurements with relatively uniform sensor coverage) from four air pollution monitors in Sonoma County. Two monitors in Sonoma County were removed from analysis due to anomalous low levels indicating possible calibration issues. Initially, the air quality data and deposition models were inversely proportional. Removing the anomalous monitors improved correlation of the two data sets.

PHASE 2

- We selected three sites for additional testing based on three variables: distance from urban burn area, ranking on meteorological deposition model used in preliminary analysis, and ranking on particulate matter levels during fire.
- For these three sites, we sent washed and unwashed kale samples to Enthalpy Analytical to be tested for Polychlorinated Biphenyls, Dioxins and Furans, and Heavy Metals.
- We selected an additional, fourth, site to send in washed and unwashed kale samples to test for Polycyclic Aromatic Hydrocarbons.

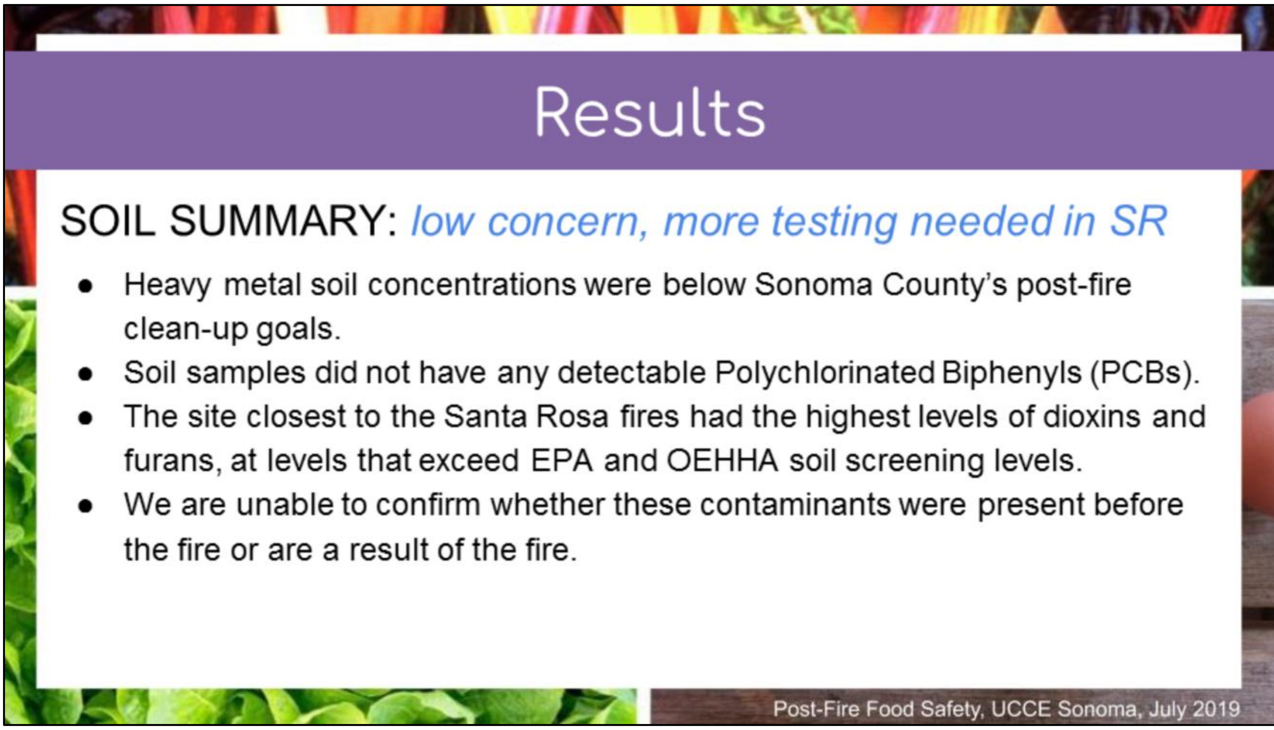


NOTE:

- PAHs & PCBs: There were no PAHs or PCBs detected in the plant samples from any site. However, due to the high reporting limit from standard laboratory methods, we are not able to confirm whether or not sites had PCBs at levels below our reporting limit that still exceed the Proposition 65 NSRL.
- NICKEL: Nickel was detected on one sample out of nineteen samples tested, and only on an unwashed sample. Consuming this concentration of Nickel daily would lead to consumption rates above Proposition 65's "No Significant Risk Level". However, this NSRL was established based on the toxicity of nickel refinery dust from the pyrometallurgical process, which may not accurately represent the toxicity of the nickel found in our samples. Levels found in this analysis may reflect nutritionally-beneficial nickel levels within the range of typical consumption. Recommendations: Wash produce in running water.

"Reporting Limit"

A method reporting limit (MRL) is the lowest concentration of a chemical that a lab *test would be able to detect in a sample. This is also sometimes refered to as the Detection Limit (DL), Limit of Detection (LOD), or Estimated Detection Limit (EDL) depending on the test.*



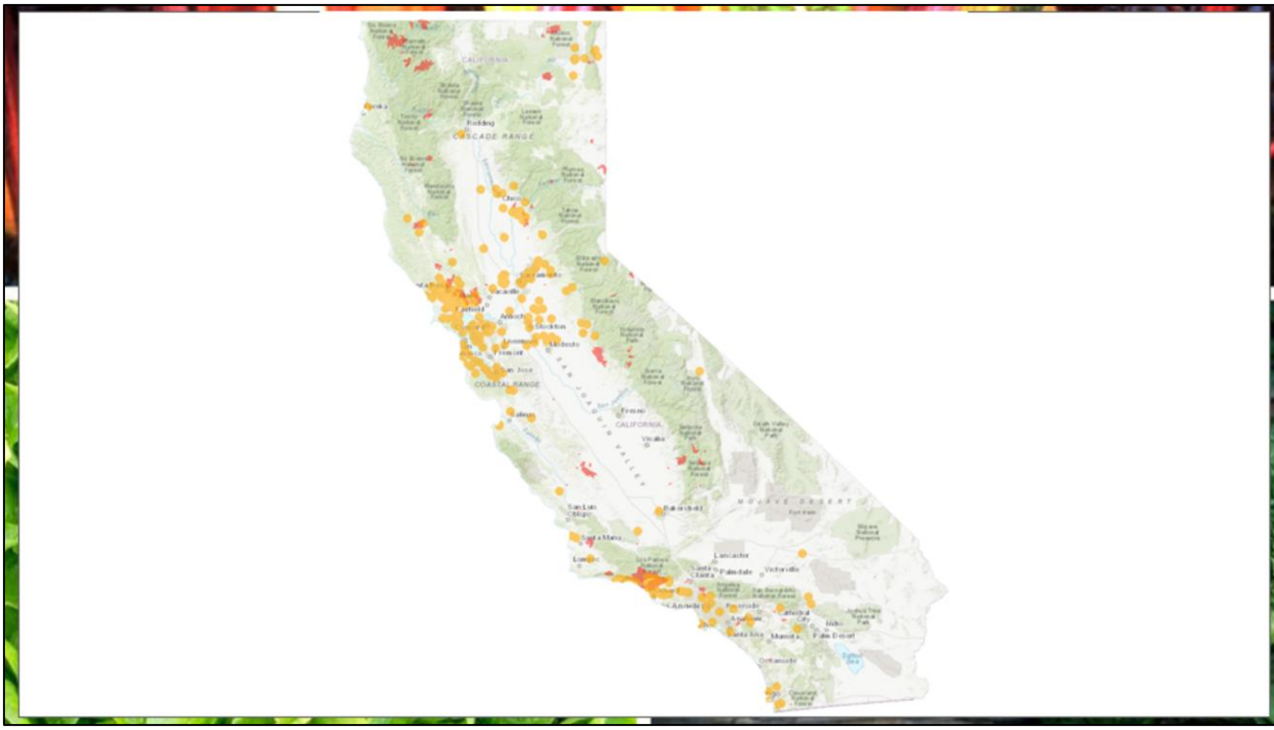
NOTES

- DIOXIN: At the Santa Rosa site closest to the urban burn perimeter, dioxins and furans were detected in soil at cumulative concentrations that exceed the EPA and OEHHA's Screening Levels. The Rohnert Park and Petaluma sites had detectable levels of some dioxins, but cumulative concentrations were below screening levels.
- Recommendations: The main concern with soil dioxin contamination is from direct inhalation and ingestion of soil. Children are more likely to ingest soil. *Short-term*: Reduce direct contact with soil. Wash hands after working with soil. Wash produce thoroughly, and peel root vegetables. *Long-term*: Heavily amend soil with compost and mulch to dilute dioxins and build up. Use drip irrigation to reduce the up-splash of soil and dust. Re-test soil.


Backyard
Chicken Eggs

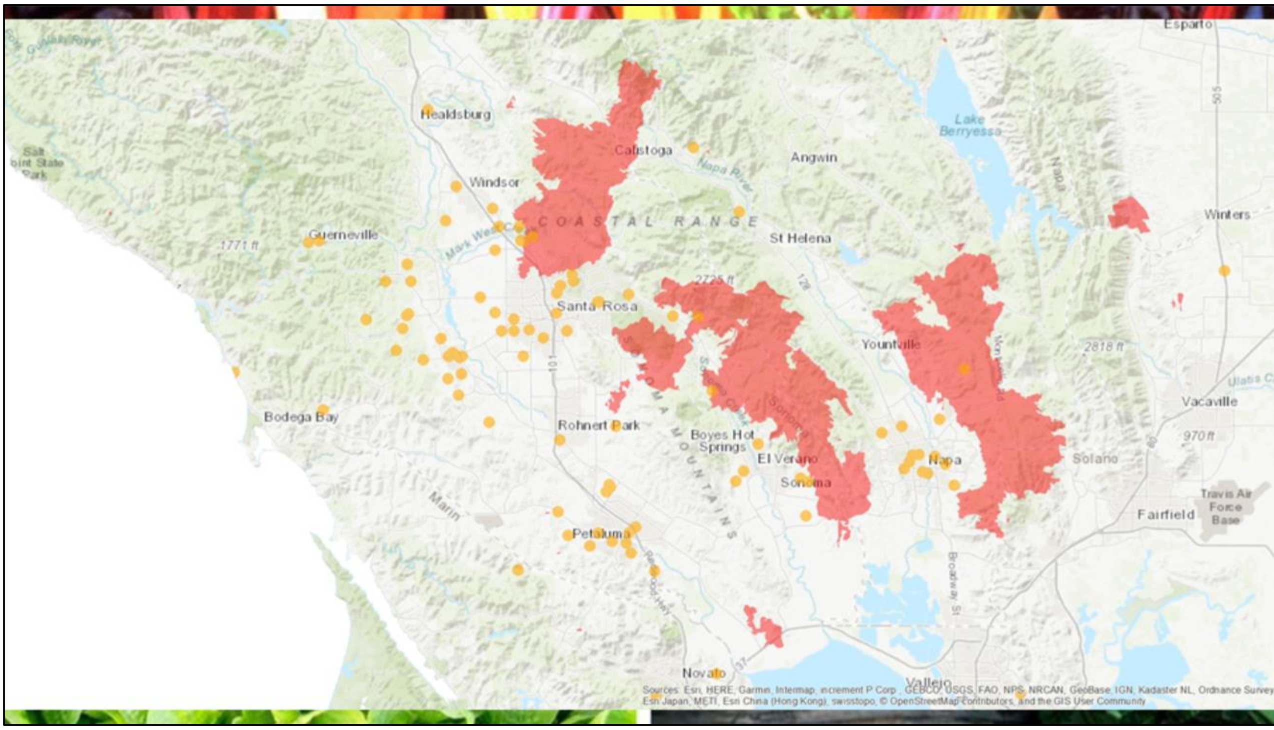
Completely voluntary: a call went out over various social media outlets, cooperative extension offices, through the UC Davis website

...and we had a lot of people respond! 344 premises total (75 in Sonoma, 16 Napa)
Also had samples from two conventional (indoor) facilities for comparison

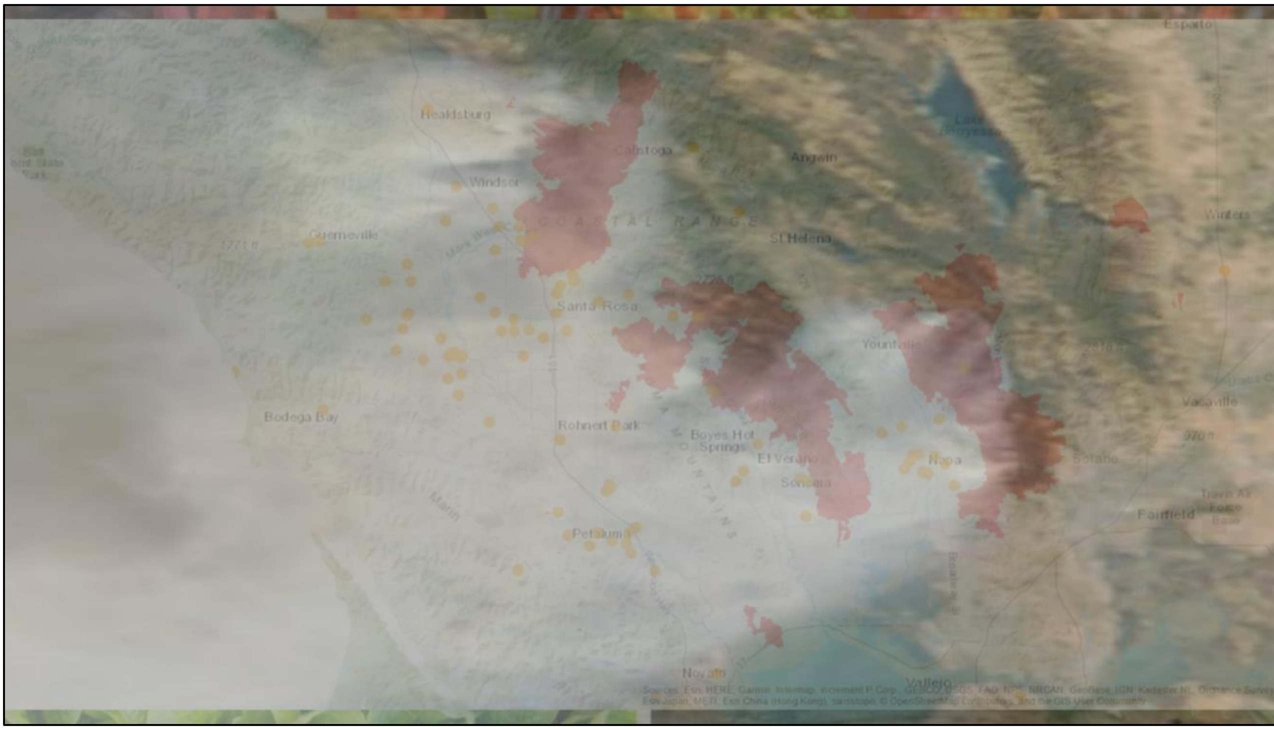


Overview of premises from within the state (orange dots): 344 premises with an average submission of 5 eggs per premise, collection during the first 6 months of 2018

Red outline is 2017 wildfires

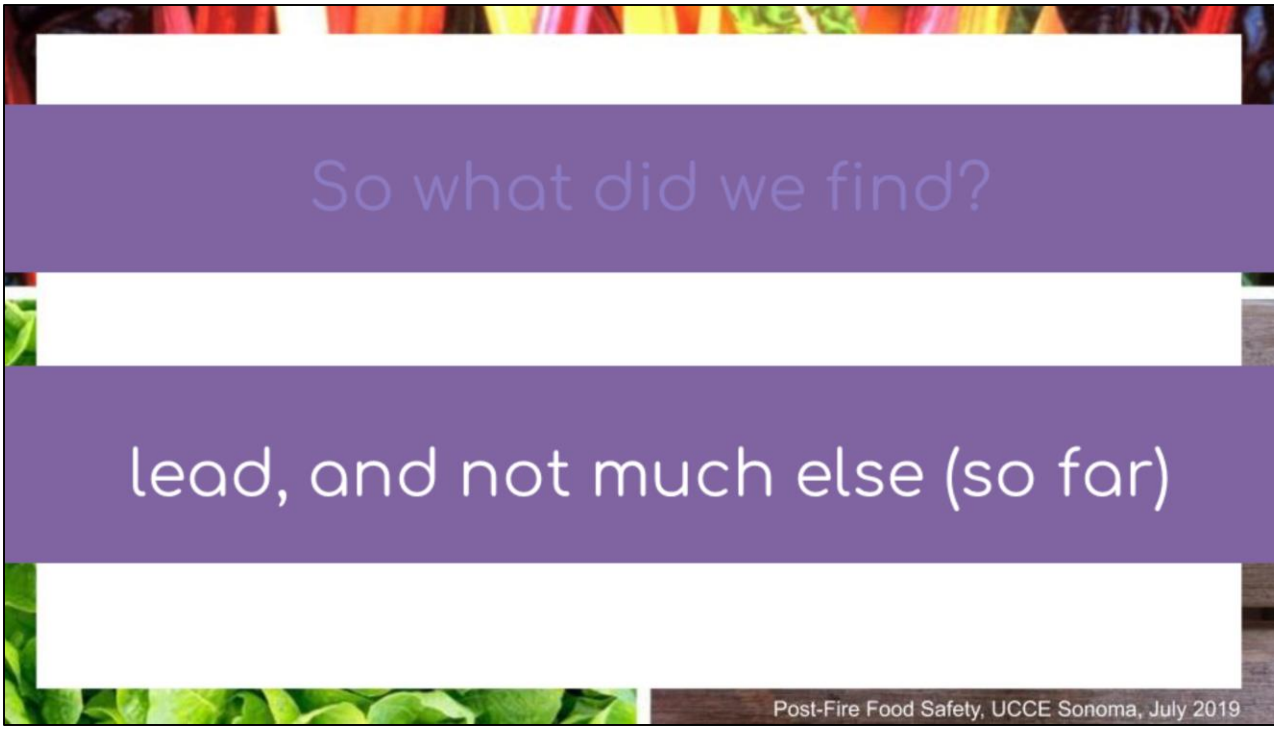


Zoom in to Sonoma/Napa area in Northern California:
Napa premises: 16
Sonoma premises: 75
Wildfires from top left to right (Tubbs, Nuns, Atlas)



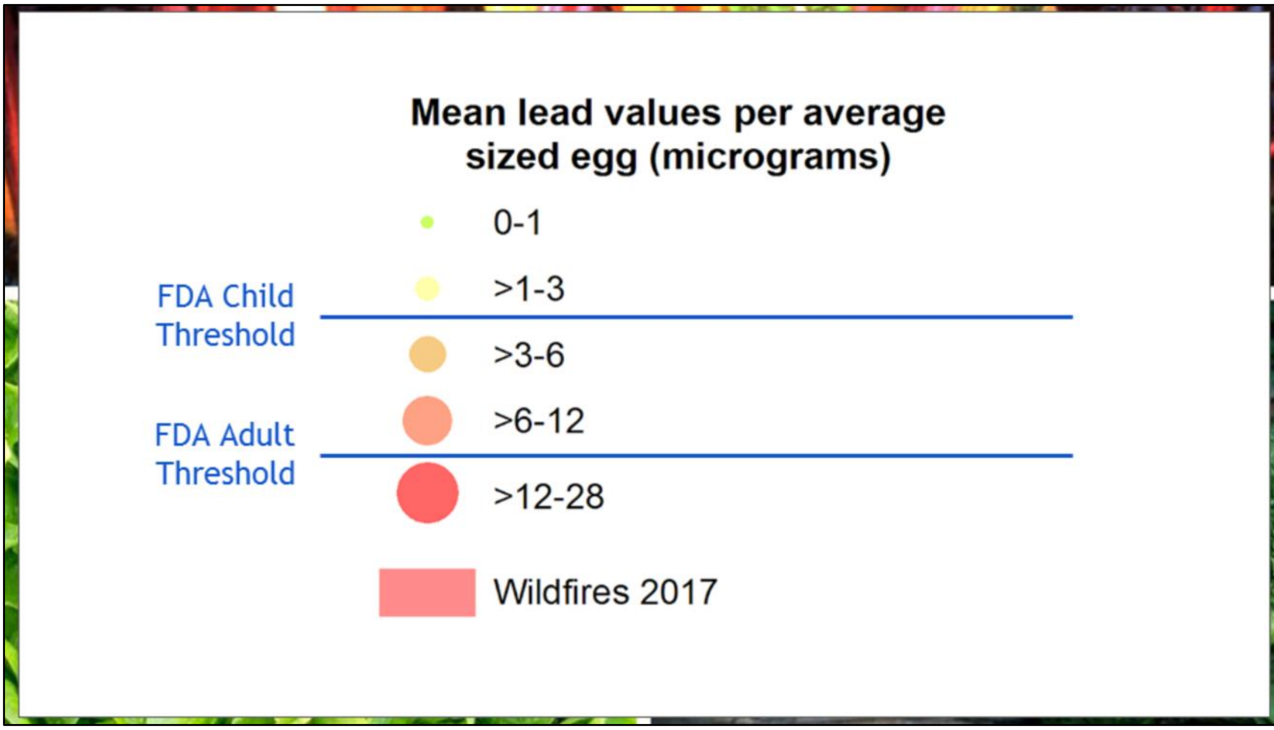
Overlay of satellite smoke map from day two of the fires - all premises blanketed with smoke and ash

So what did we find?

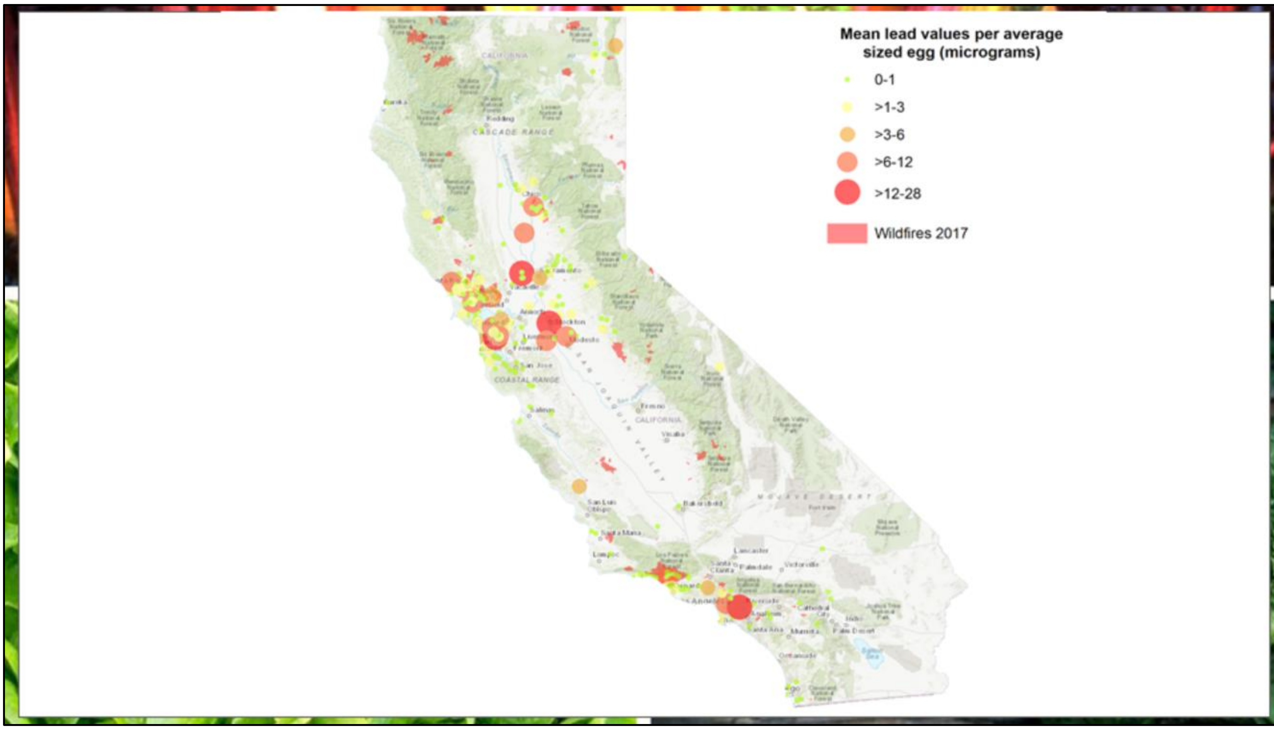


We found Pb. Rest of the heavy metals were of extremely low concern. Thus results will focus on lead.

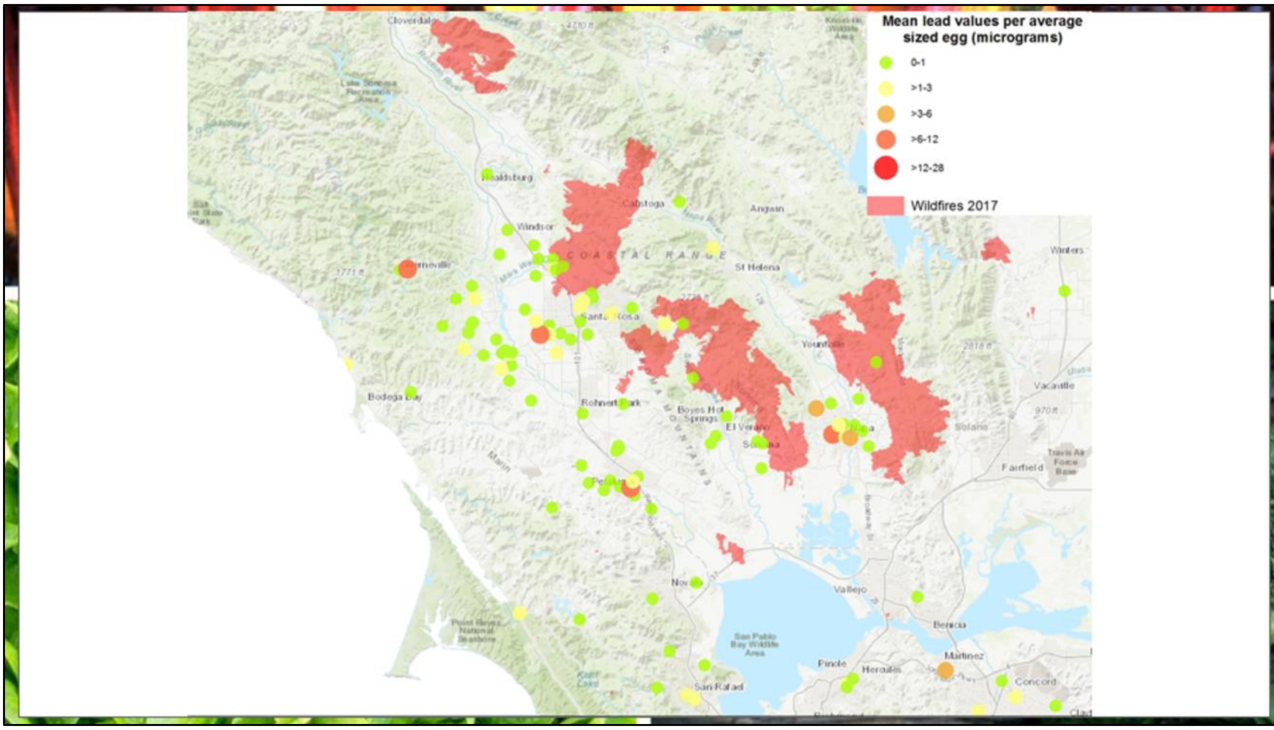
A quick guide to interpreting lead results



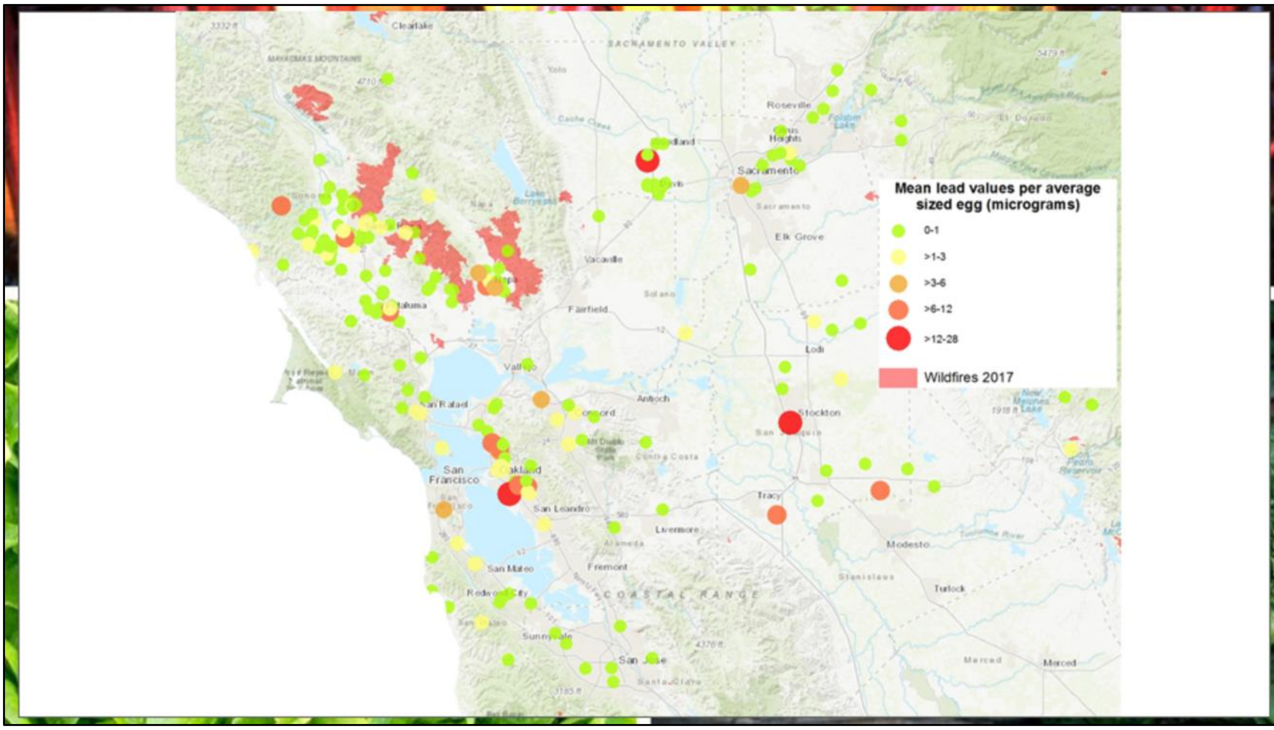
The FDA recommendation for daily intake of lead for a child is 3ug/day. For an adult, it is 12.5ug/day (rounded to 12ug/day for display purposes)



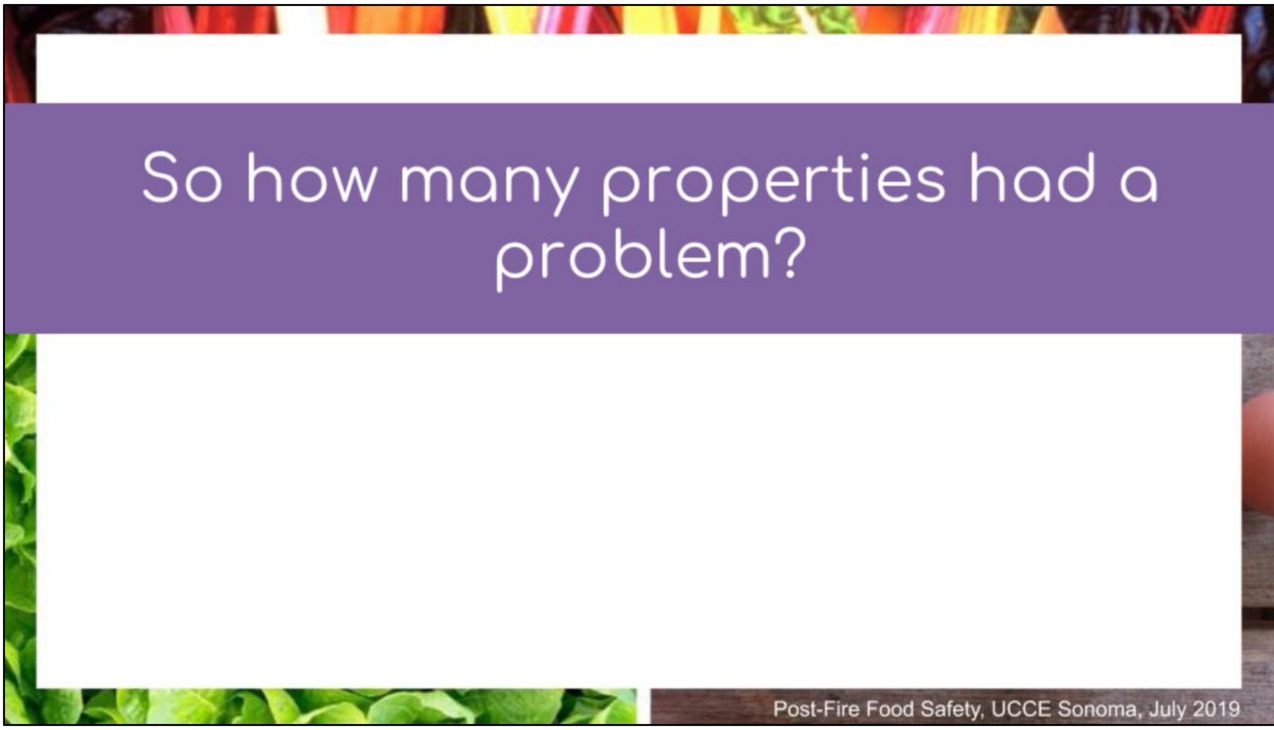
This is a high level overview of lead concentrations in the entire state. It's very difficult to get an appreciation of the distribution at this scale, but what does appear to be clear is that the highest concentrations do *not* appear to be localized to fire affected areas.



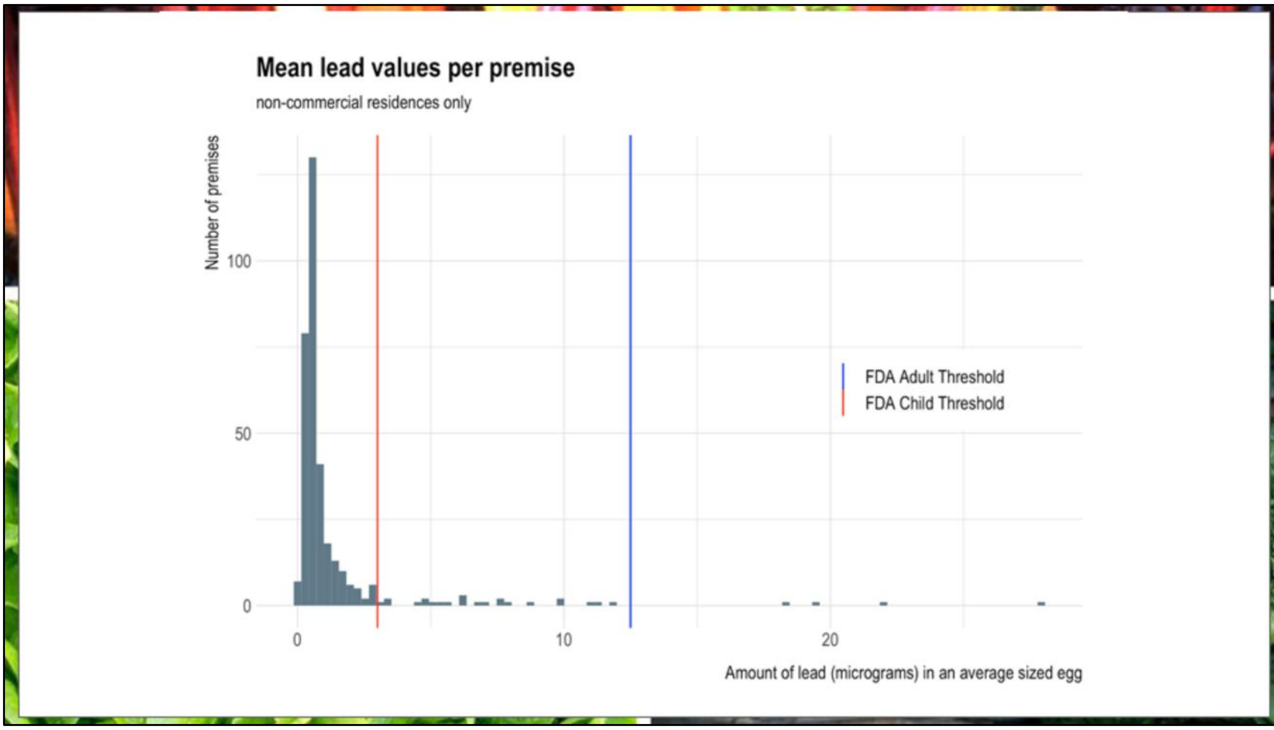
Zooming into the Sonoma/Napa region, the most striking takeaway is the number of low (green/yellow dots) lead concentration sites in proximity to wildfire. This does not lend evidence to the hypothesis that proximity to wildfire is a risk factor for lead in eggs of backyard poultry.



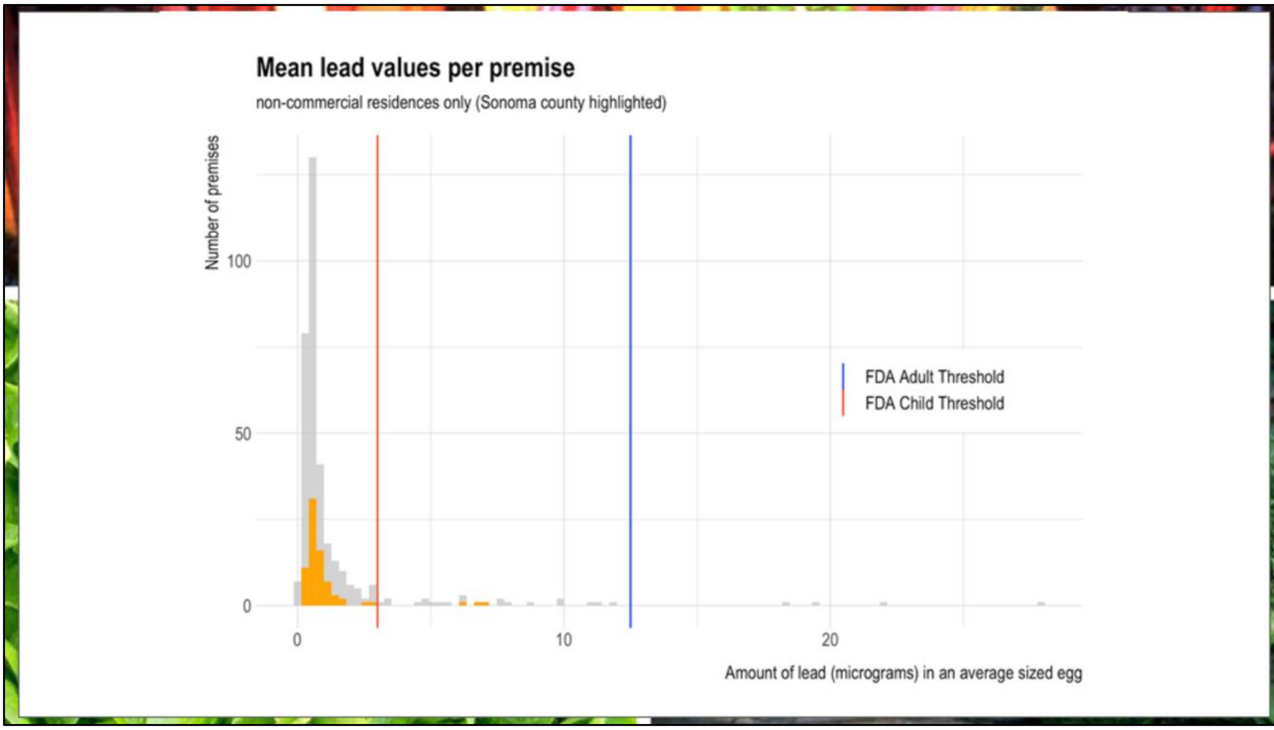
Zooling out slightly, we now find three of the highest four lead concentrations in our study - in Oakland, Stockton, and in between Davis/Woodland. Again, not in direct proximity to wildfire.



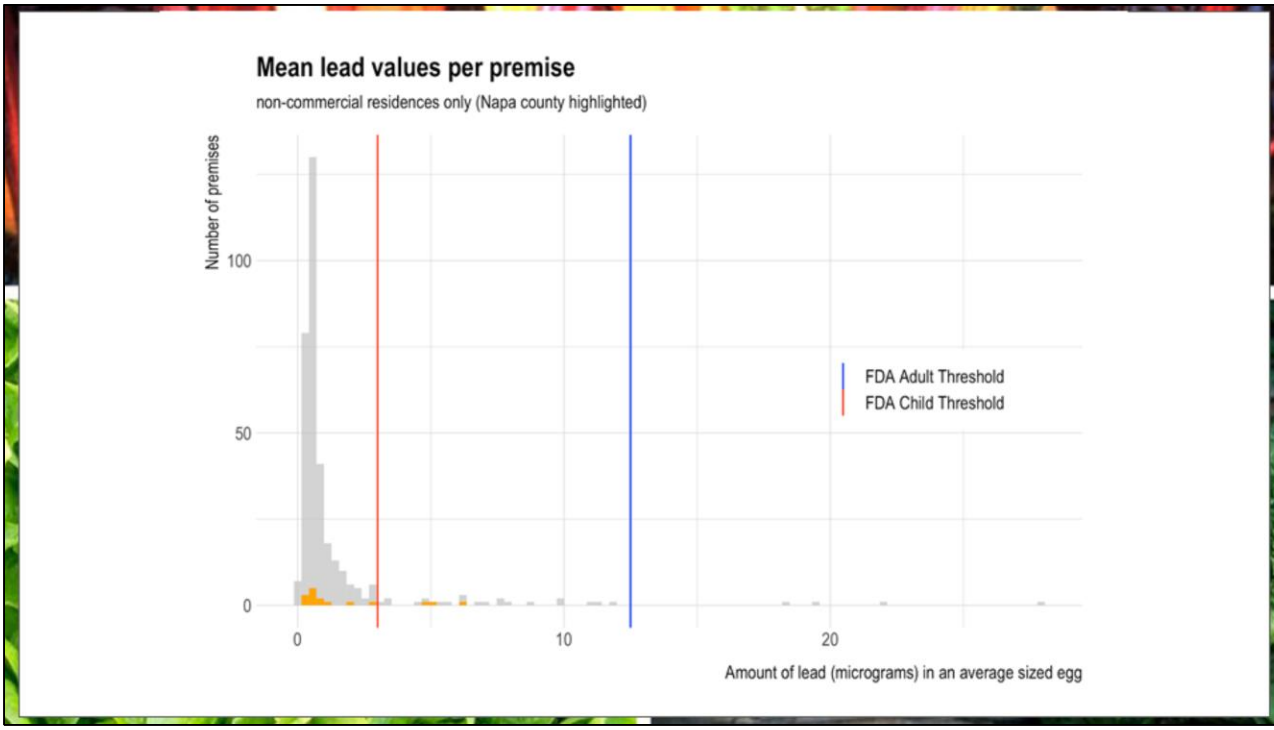
Quantitatively, 27 of 344 (8%) had average lead value that exceeded FDA daily intake recommendations for a chile



This is a histogram of the number of properties (on the y-axis) whose eggs had a given average lead value (on the x-axis). The FDA daily recommended intake thresholds for children (3ug in red) and adults (12.5ug in blue). Only four properties had eggs that on average exceeded the adult threshold (none of which were directly adjacent to fire affected areas). Twenty-seven properties (approx 8%) exceeded the child threshold.

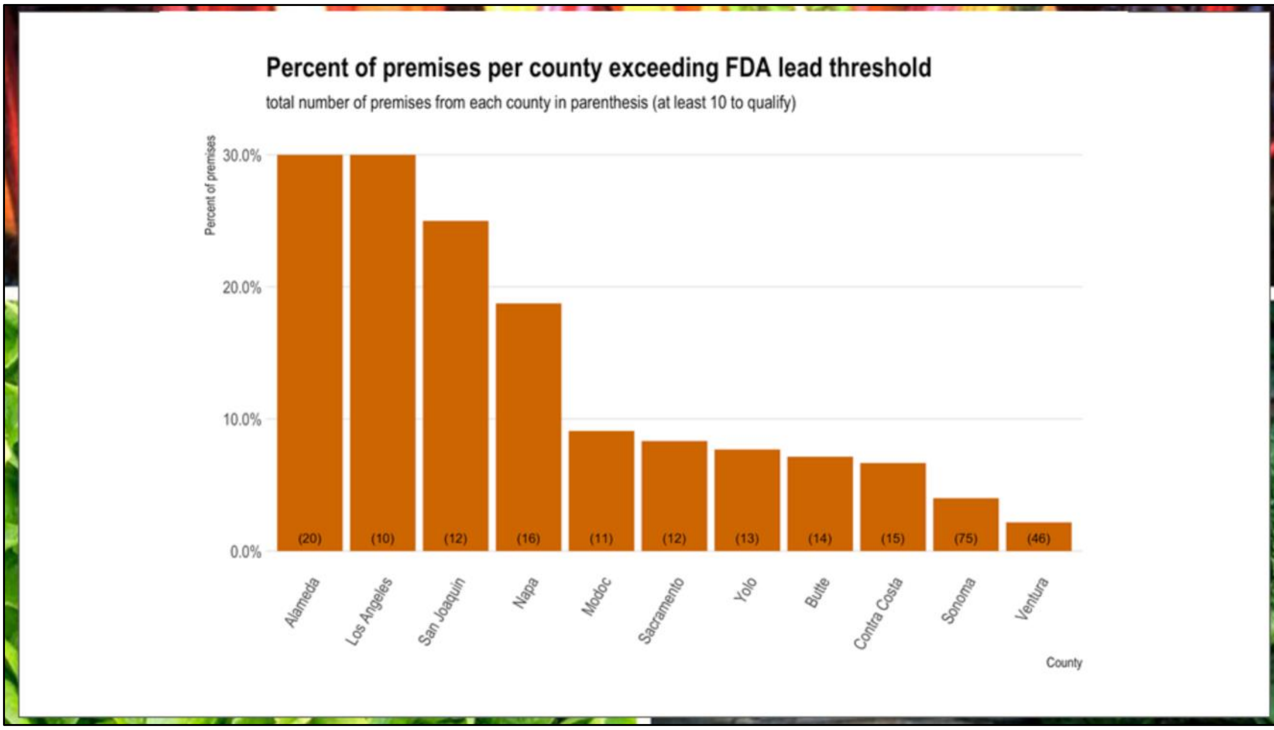


This slide highlights the Sonoma properties - only three of the 75 exceeded child threshold, much lower than the state average from our sample.



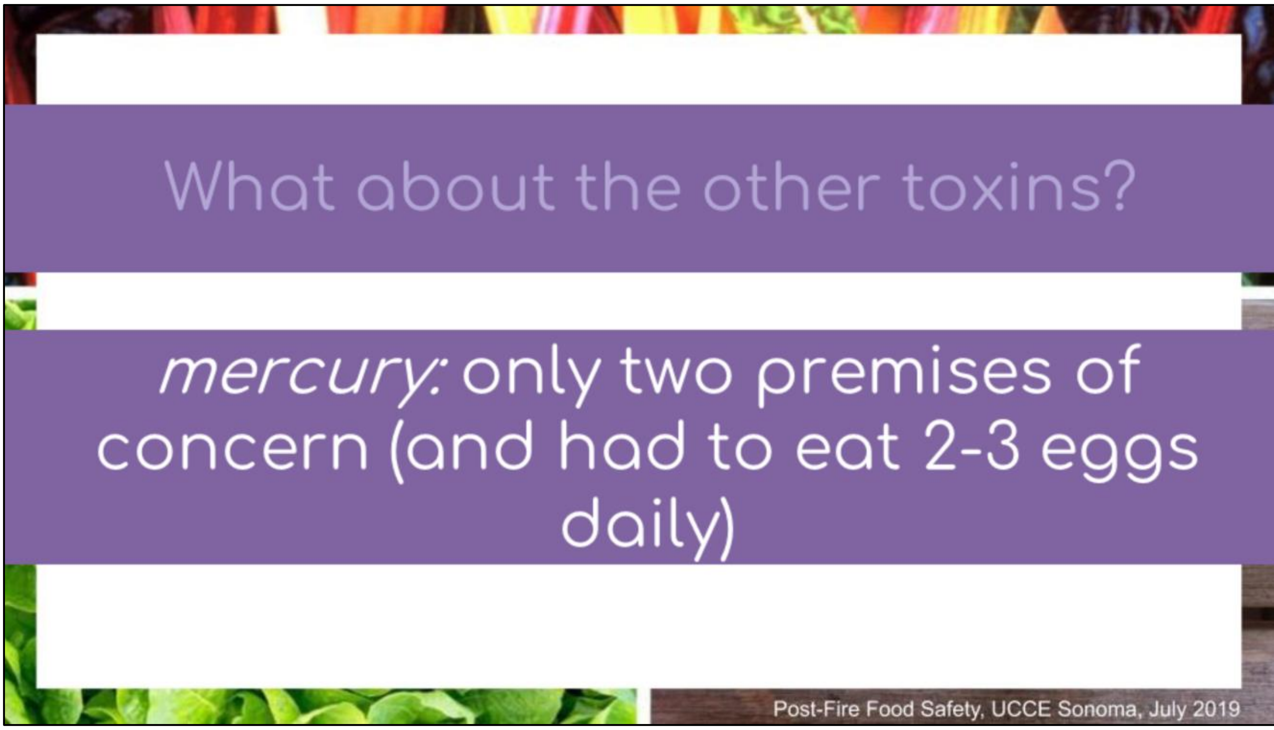
This slide highlights premises located in Napa county. There were also three premises that exceeded child threshold, but of only 16 total premises

So how do Sonoma and Napa compare to other counties?

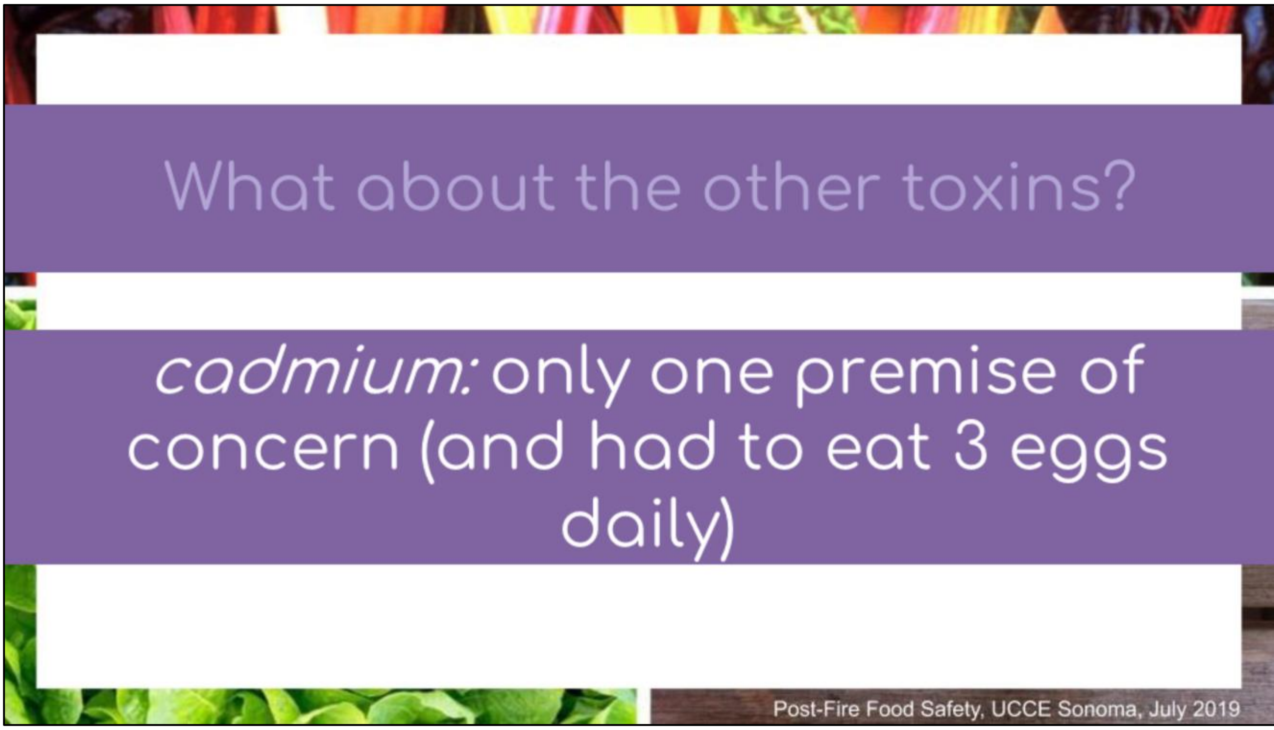


The takeaway from this slide is that the two counties most affected by 2017 wildfire (Sonoma and Ventura) have relatively lower percentages of premises whose eggs on average exceeded FDA daily child threshold for lead (3ug). Again, this does not lend evidence that proximity to wildfire is a risk factor for lead in eggs of backyard poultry.

What about the other toxins?



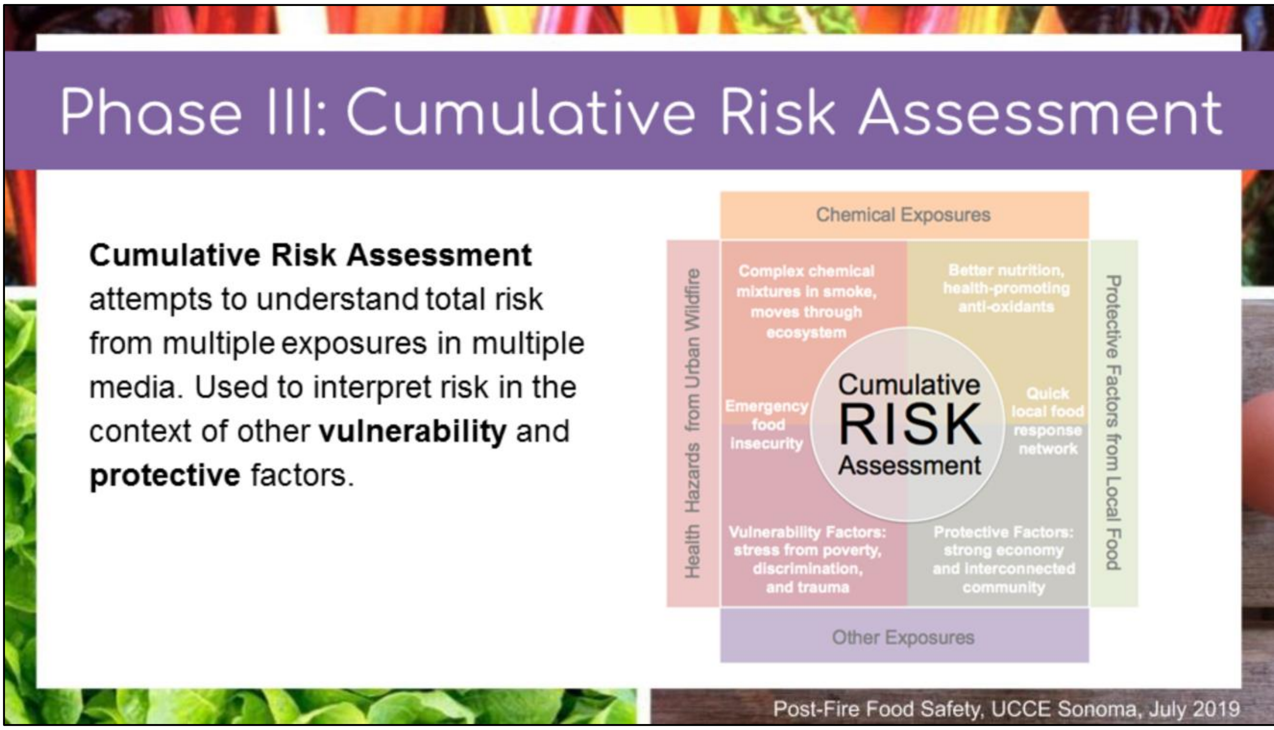
One premise out of 344 with mercury levels such that if two eggs were eaten every day, it may pose a reproductive hazard. One premise had a similar concern if three eggs were eaten daily.



Regarding cadmium, there were two premises out of 344 such that if three eggs were eaten daily, it may pose a reproductive hazard.

These results are not yet available for the egg toxin study.


Cumulative
Risk Assessment



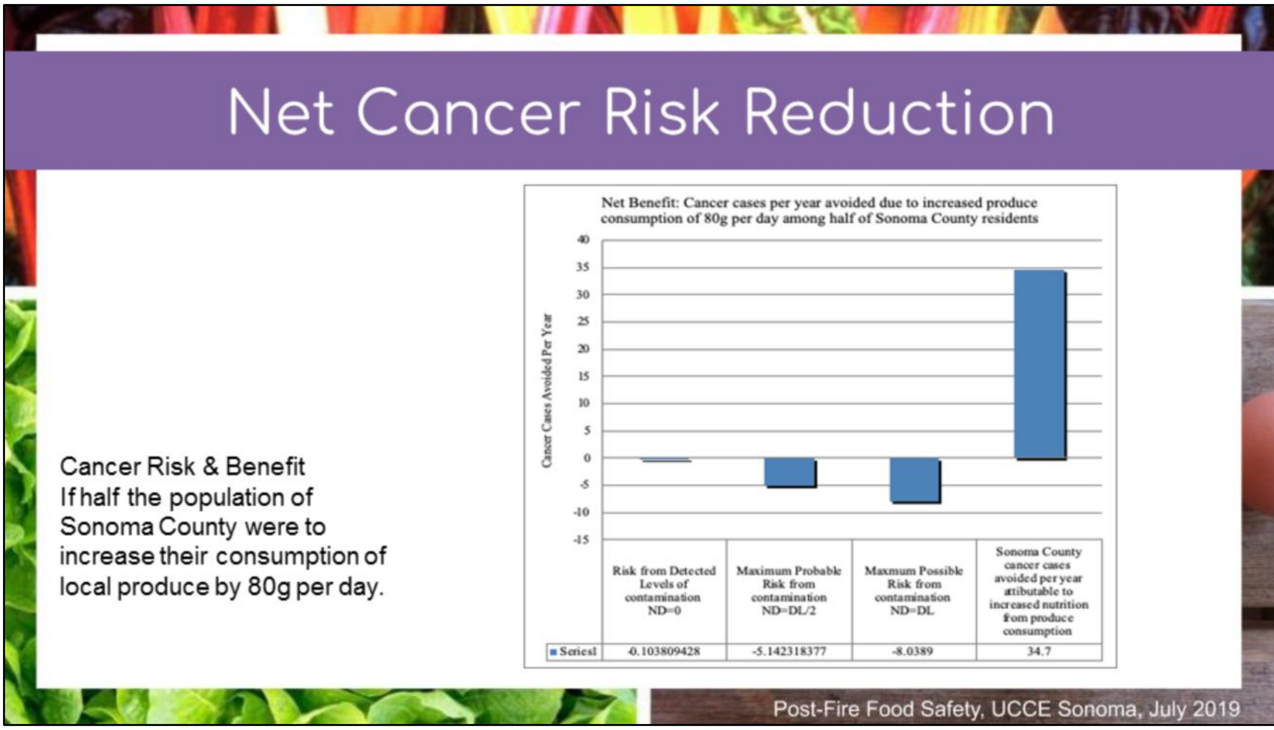
Our cumulative assessment examines the total set of exposures that could impact health, including an assessment of chemical mixtures, a risk-benefit analysis of ingesting produce, and a literature review of social determinants of health considerations in wildfire health impacts.

We used this model to guide our literature review. Wildfires hitting an urban area create innumerable ***health hazards*** for communities and the smoke from the fire can impact an even larger geographic area. We holistically evaluate the larger context of these health impacts, as well as the larger context of ***protective factors*** from local food, such as the health benefits of open green spaces and nutritious produce, and the socio-economic impacts of a strong local economy and interconnected community.

THIS METHOD LOOKS FOR A HIGH OVERESTIMATE OF RISK

- This study examined multiple chemical groups that were likely to be present in smoke, and so an evaluation of the risk from mixtures is warranted. In 1996, the Safe Drinking Water Act required the EPA to create methods for the evaluation of mixtures of chemicals that are likely to co-occur in specific media, and since then multiple frameworks have been tested.
- To establish cumulative risk values, we used OEHHA's Air Toxics Hotspots Exposure Assessment guidance documents.[i]
- Lifetime Cancer Risk can be converted to an estimate of "Cancer cases per year" by multiplying by Sonoma County's population, divided by 70 to convert lifetime risk into an annual figure.[ii] However, this should be considered a crude "upper bound" estimate. Due to the low confidence in such an estimate, the "Cancer Cases per Year" in the interpretation should be used with caution.
- This analysis shows that the health risks from smoke contamination are not negligible. Contamination from urban wildfire smoke warrants further study to determine how closely real risks approximate these estimated maximum risk values.

- [i] “Notice of adoption of technical support document for exposure assessment and stochastic analysis Aug 2012.” Office of Environmental Health and Hazard Assessment. Accessed December 2018. <https://oehha.ca.gov/air/crnr/notice-adoption-technical-support-document-exposure-assessment-and-stochastic-analysis-aug>
- [ii] Reiss et al

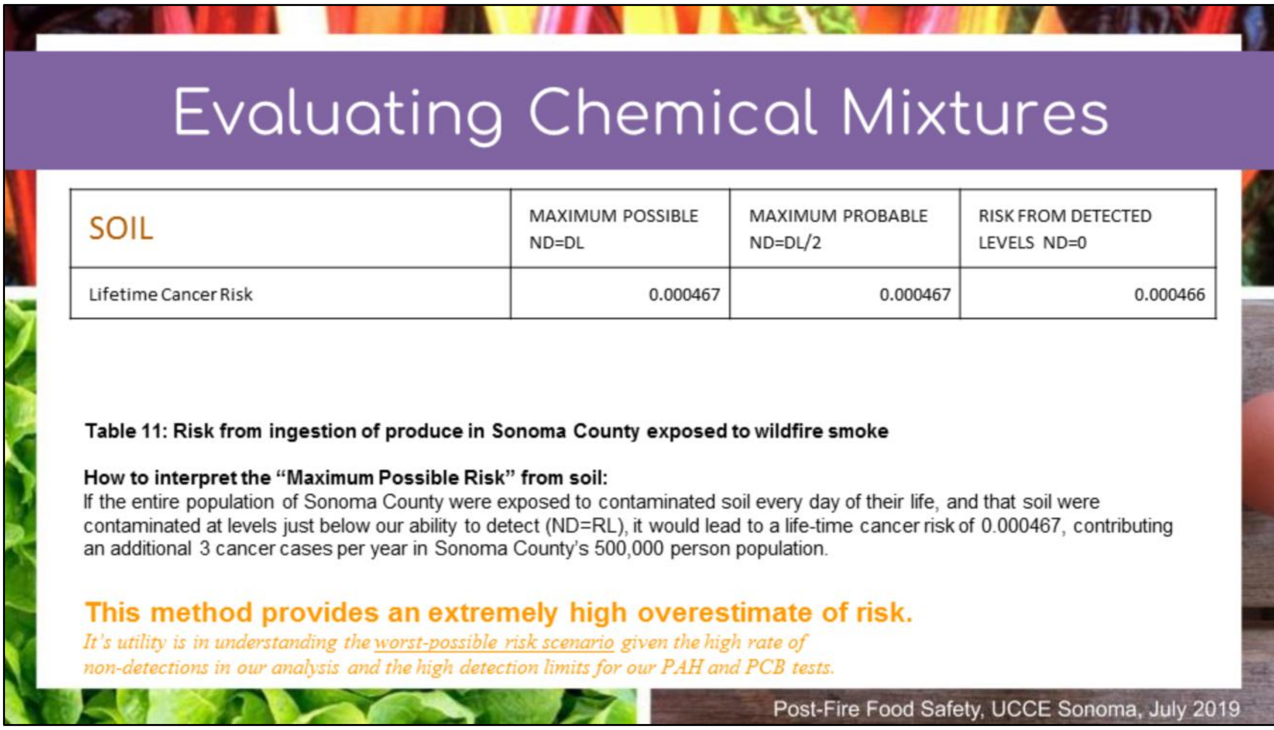


- When considering the potential for contamination in local produce, some consumers may reduce their overall produce consumption. This is particularly true of communities receiving food from local food security projects. Knowing that green leafy vegetables are also some of the most nutritiously dense foods, we conducted a risk-benefit analysis for lifetime cancer risk, using the methods outlined in Reiss et al. (2012) “Estimation of cancer risks and benefits associated with a potential increased consumption of fruits and vegetables.”

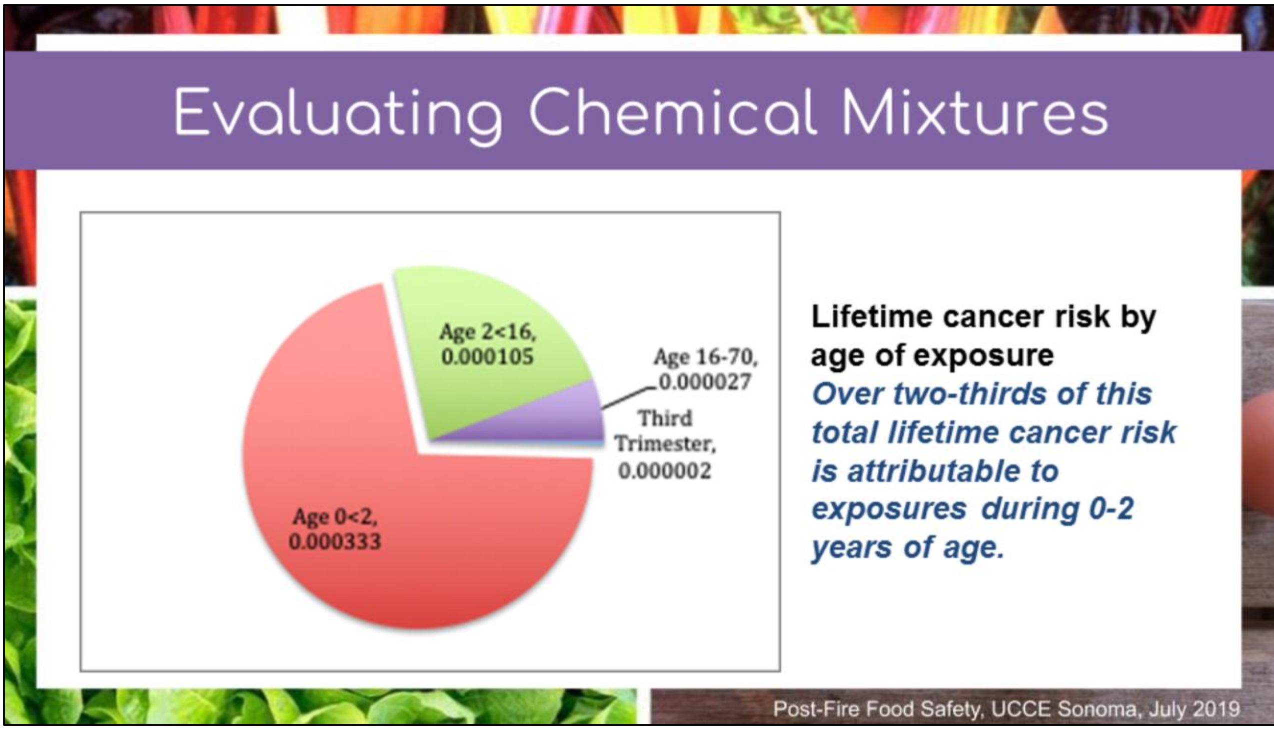
- Reiss et al used results from the 2007 meta-analysis by the World Cancer Research Fund and American Institute of Cancer evaluating the available epidemiologic evidence for the relationship between various foods and cancer rates. These relative risk results compare the cancer incidence for populations with higher consumption versus lower consumption of fruits and vegetables. Using these relative risks, Reiss et al calculated the cancer risk reduction likely in the scenario that the half of the US population (155 million) with the lowest produce intake increased their daily consumption by one serving (80g) of produce per day.

- We scaled the results of Reiss et al’s analysis to Sonoma County’s population of 500,000.

- To calculate the health risks from eating contamination on produce, we calculated a “cancer cases per year” value using the “Maximum Probable” risk calculated using contamination levels at half the detection limit (ND=DL/2)), and assuming daily ingestion rate of 80g of produce per day among half of Sonoma County’s population.



- Soil ingestion is the most common pathway of exposure to chemicals in soil. Skin absorption and inhalation of dust are secondary pathways that were not considered in this analysis. To create a risk of exposure through this media, we used the calculations described in the Air Toxics Hotspots Exposure Assessment Chapter 4: "Soil Ingestion".



- ***The OEHHA Toxic Air Hot Spots method predicts that over two-thirds of this total lifetime cancer risk is attributable to exposures during 0-2 years of age.***
- ***This implies that risk reduction strategies focused on eliminating exposures for this age group would have maximum impacts on lifetime cancer risk.***

Of the chemicals that we evaluated in this study, produce is not typically the primary route of exposure within the food system. Therefore, consumers reducing their consumption of local produce and increasing their consumption of eggs, dairy, meat, processed foods, or canned produce may increase their overall chemical exposure from food.

- Dioxins and other fat-soluble chemicals are more likely to accumulate in meat and dairy products. The FDA dioxin monitoring project showed that, compared to fruits and vegetables, dairy products likely contribute three times more dioxins to the American diet, and meats contribute nine times more.[i]
- Polycyclic Aromatic Hydrocarbons are most commonly found in food that has been processed (especially smoking or drying) and foods that are cooked at high temperatures. PAH levels in smoked meat and fish can be as high as 200 ug/kg.[ii]
- Polychlorinated Biphenyl's enter the diet primarily through fish, especially sportfish caught in contaminated lakes and rivers, which can contain PCB contamination at the order of magnitude around 1mg/kg.[iii]
- Heavy Metals in the food system are tracked by FDA's Total Diet Study. Meat and processed foods are typically the highest contributors to heavy metal exposure:

○ The highest dietary sources of arsenic are in fish and seafood (.99mg/kg in canned tuna, 0.5 mg/kg in frozen fish sticks, 0.424 mg/g fish sandwich, .315 mg/kg in shrimp, and .293 in salmon steaks);

○ The highest dietary sources of lead are in processed deserts (0.01mg/kg in canned fruit cocktail, 0.011mg/kg in milk chocolate candy bar, 0.016 mg/g in chocolate syrup, 0.01 mg/kg in brownies, 0.012mg/kg in canned sweet potatoes.

○ The highest dietary sources of nickel are in processed foods (2.1mg/kg in “Oat Ring Cereal”, 0.947 in milk chocolate candy bar, 0.927 in chocolate syrup, 0.6mg/kg in chocolate chip cookies). Higher levels of nickel are also found in sunflower seeds (3.2mg/kg) and legumes (0.6mg/kg dried pinto beans, 0.577 in frozen lima beans, .489mg/kg in dry roasted peanuts)

Consumers switching from local produce to other produce sources may shift exposures:

· Canned produce frequently contains Bisphenol A, a chemical used in plastics that can leach into produce from can linings. BPA from canned vegetables makes up around a third to a fifth of adult BPA intake.[iv]

· Close to 50% of conventional produce contain pesticide residues[v] and diet is the leading source of pesticide exposure for the general population.[vi] The research on the cancer risk from pesticide residues is divided, with some risk assessments showing low risk from pesticide residues.[vii] Other studies indicate negative cognitive,[viii] behavioral,[ix] and reproductive health impacts.[x] A recent longitudinal study of 70,000 adults shows organic food consumption is protective against several kinds of cancer.[xi]

[i] “ 2001-2004 PCDD/PCDF Exposure Estimates; Based on PCDD/PCDF Concentrations assuming ND=0”. Food and Drug Administration. Accessed January 2019 < https://wayback.archive-it.org/7993/20170406021806/https://www.fda.gov/Food/FoodborneIllnessContaminants/ChemicalContaminants/ucm077498.htm>

[ii] Larsen, J. C., et al. "Polycyclic Aromatic Hydrocarbons–Occurrence in foods, dietary exposure and health effects." *Brussels Belgium* (2002).

[iii] Agency for Toxic Substances and Disease Registry (ATSDR), “Health Statement for PCBs”. Accessed January 2019 < https://www.atsdr.cdc.gov/phs/phs.asp?id=139&tid=26>

[iv] Lorber, Matthew, et al. "Exposure assessment of adult intake of bisphenol A (BPA) with emphasis on canned food dietary exposures." *Environment international* 77 (2015): 55-62.

[v] US Food and Drug Administration. "Pesticide residue monitoring program fiscal year 2015 pesticide report." (2017).

[vi] Riederer, Anne M., et al. "Diet and nondiet predictors of urinary 3-phenoxybenzoic acid in NHANES 1999–2002." *Environmental health perspectives* 116.8 (2008): 1015-1022.

[vii] Reiss et al

[viii] Engel, Stephanie M., et al. "Prenatal exposure to organophosphates, paraoxonase 1, and cognitive development in childhood." *Environmental health perspectives*119.8 (2011): 1182-1188.

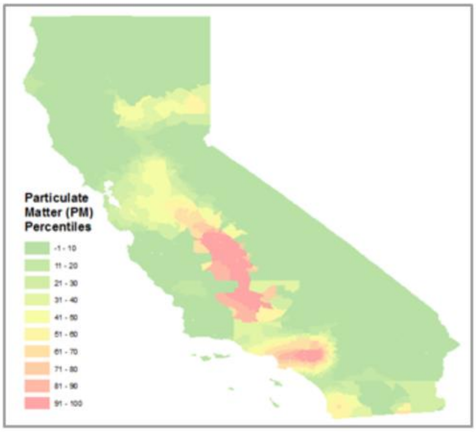
[ix] Quirós-Alcalá, Lesliam, Suril Mehta, and Brenda Eskenazi. "Pyrethroid pesticide exposure and parental report of learning disability and attention deficit/hyperactivity disorder in US children: NHANES 1999–2002." *Environmental health perspectives* 122.12

(2014): 1336-1342

[x] Bretveld, Reini W., et al. "Pesticide exposure: the hormonal function of the female reproductive system disrupted?." *Reproductive Biology and Endocrinology* 4.1 (2006): 30.

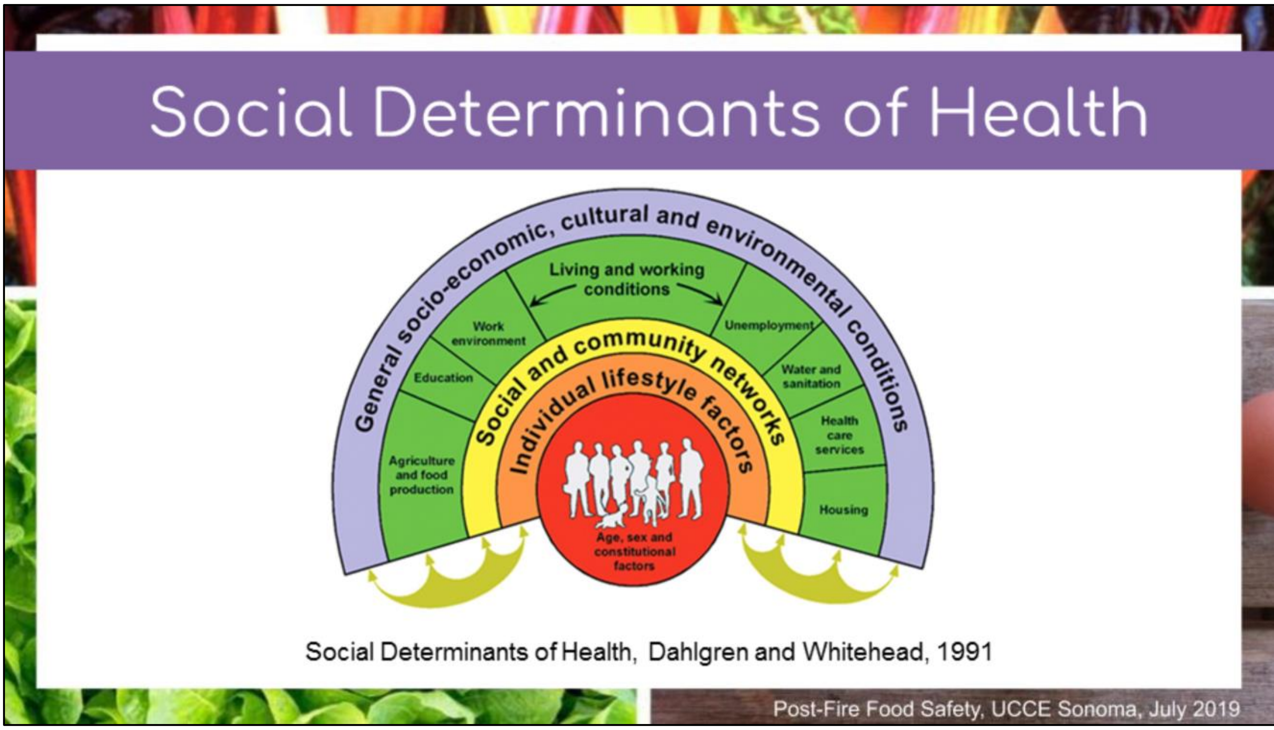
[xi] Baudry, Julia, et al. "Association of frequency of organic food consumption with cancer risk: findings from the NutriNet-Santé prospective cohort study." *JAMA internal medicine* 178.12 (2018): 1597-1606.

Other Chemical Exposures in Food System

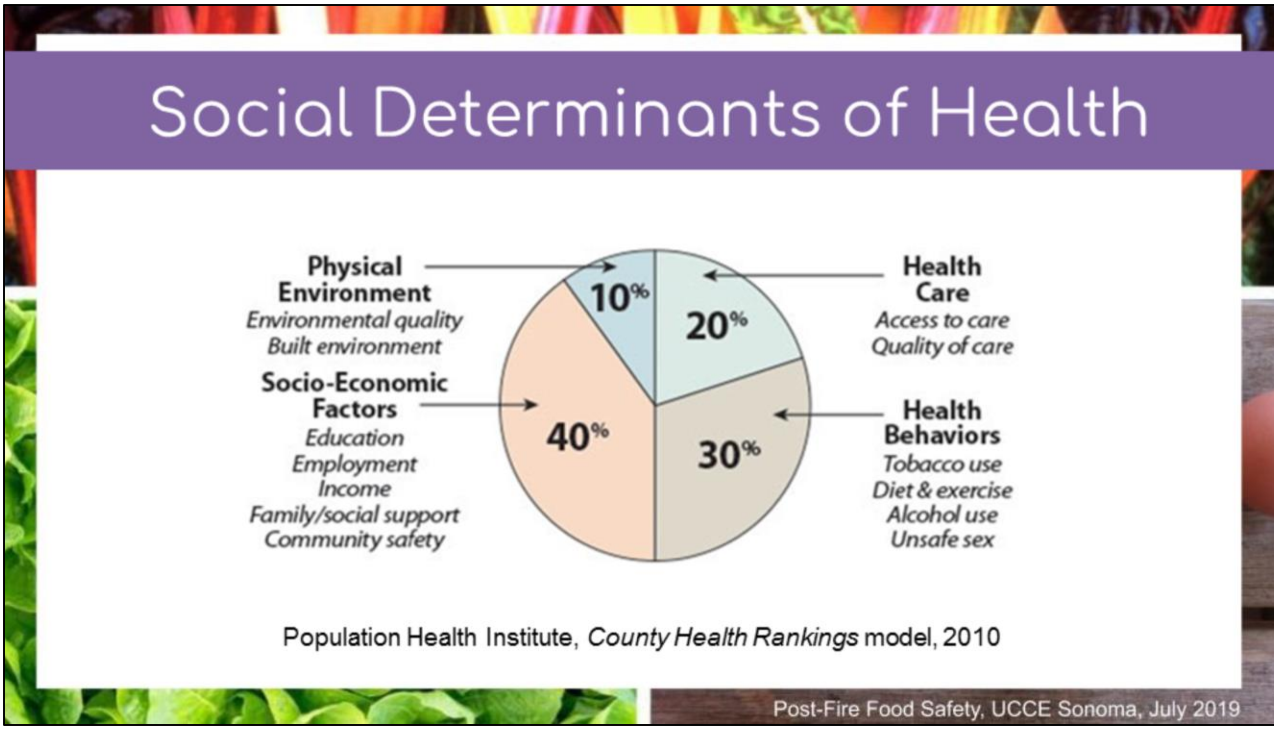


The valleys, where the majority of CA's food is grown, are much more impacted by particulate matter. High PAH levels and other contaminants are likely.

Data from CalEnviroScreen

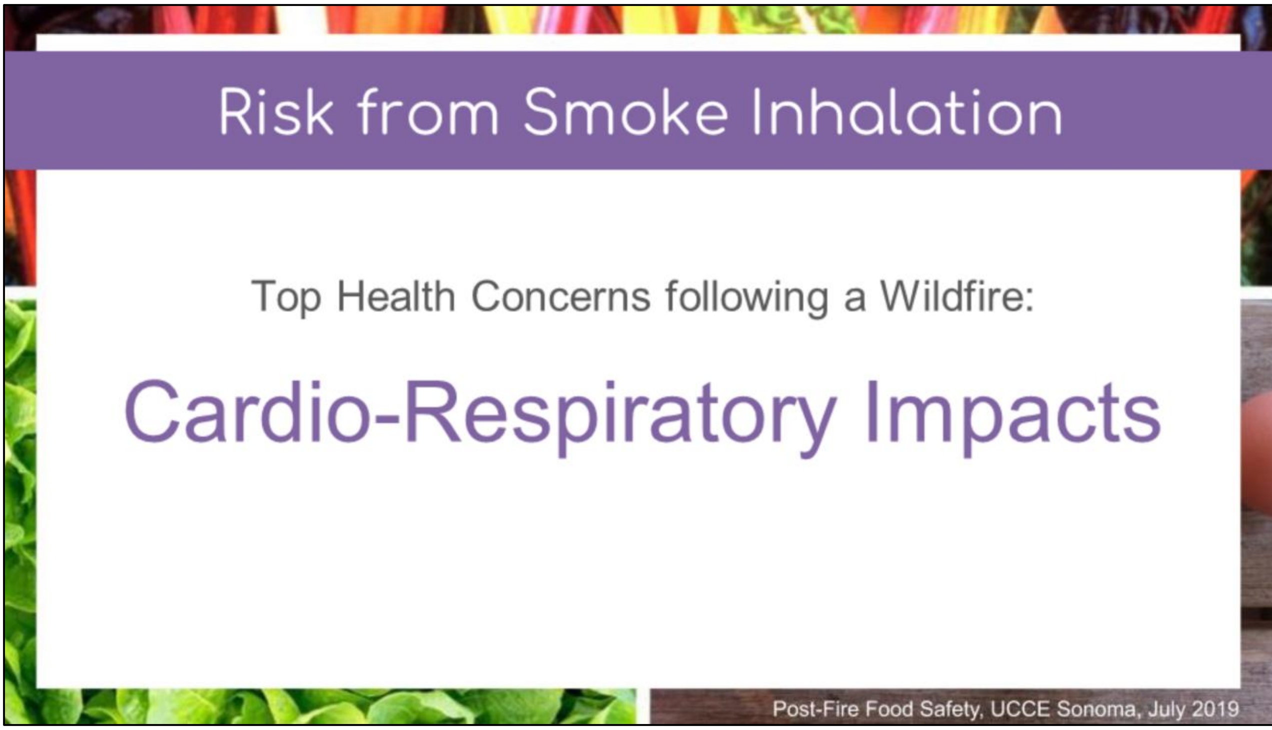


- Over the past several decades, public health research has increasingly expanded its focus from individual constitutional factors and lifestyle behaviors towards the larger social and economic contexts that structure disparities in health. This greater picture of the wholistic set of factors that impact the distribution of health and illness across a population gives ***perspective on the small amount of potential risk that we have shown from eating local produce exposed to wildfire smoke***



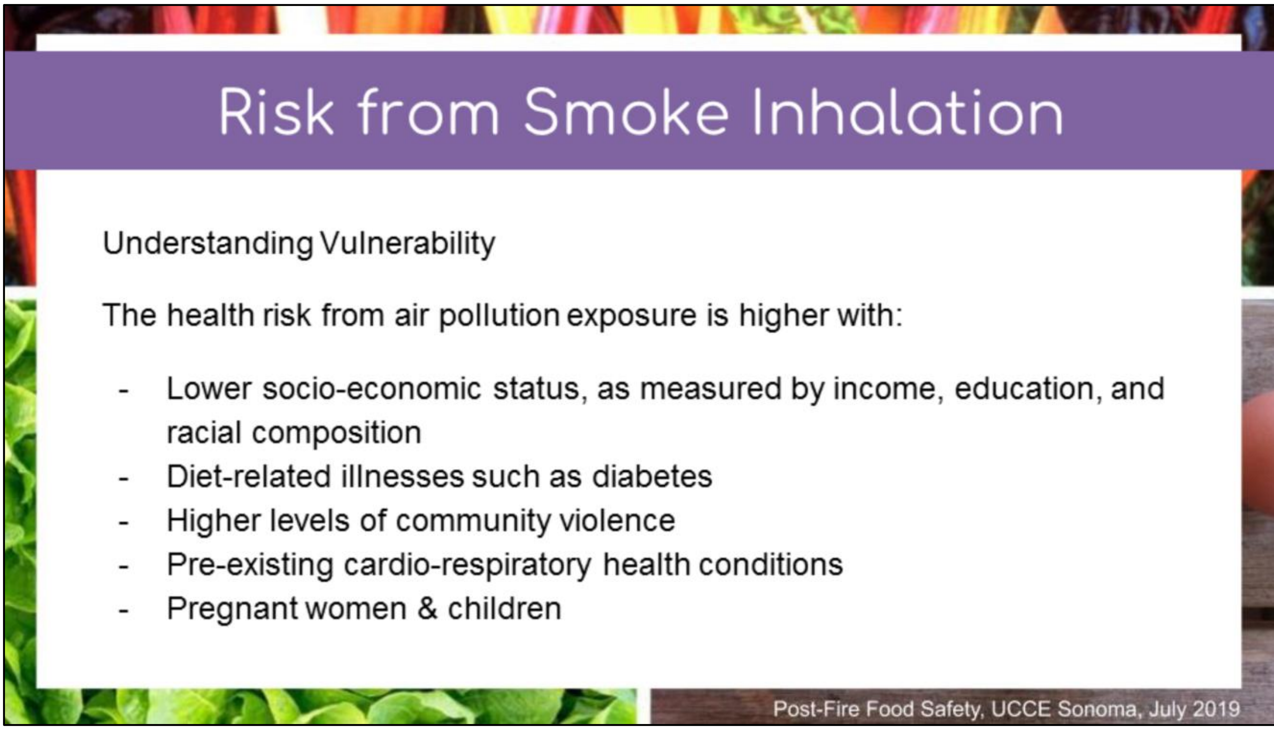
- Based on our results, we have found a low concern of health risks from the ingestion of produce and soil exposed to smoke in the 2017 urban wildfires. Furthermore, this risk represents a miniscule slice of the environmental quality and built environment conditions that also impact health. In turn, these environmental conditions are approximately only 10% of the totality of factors that shape population health, with the other major drivers of population health being access to health care (20%), health behaviors (30%), and socio-economic factors (40%).[i][i] Population Health Institute, *County Health Rankings* model, 2010
- Socio-economic factors contribute to health disparities through simultaneous and overlapping pathways. Communities marginalized by poverty, racism, and other intersectional oppressions are more likely to experience psychological stressors of marginalization[i], [ii],[iii] and stigmatized and blighted neighborhoods,[iv], [v] physical stressors including demanding physical labor, sleep deprivation and malnutrition, and chemical stressors from hazardous exposures that are more likely to be situated in low-income communities.[vi], [vii] It can be difficult to separate the impacts of environmental, social, and economic stressors, as communities are simultaneous exposed to multiple stressors.

- [i] Krieger, N., Rowley, D. L., Herman, A. A., & Avery, B. (1993). Racism, sexism, and social class: implications for studies of health, disease, and well-being. *American Journal of Preventive Medicine*.
- [ii] Krieger, N., Smith, K., Naishadham, D., Hartman, C., & Barbeau, E. M. (2005). Experiences of discrimination: validity and reliability of a self-report measure for population health research on racism and health. *Social science & medicine, 61*(7), 1576-1596.
- [iii] Meyer, I. H. (2003). Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. *Psychological Bulletin, 129*(5), 674.
- [iv] Atari, D. O., Luginaah, I., & Baxter, J. (2011). “This is the mess that we are living in”: residents everyday life experiences of living in a stigmatized community. *GeoJournal, 76*(5), 483-500.
- [v] Sandel, M., & Wright, R. (2006). When home is where the stress is: expanding the dimensions of housing that influence asthma morbidity. *Archives of disease in childhood, 91*(11), 942-948.
- [vi] Morello-Frosch, R., Zuk, M., Jerrett, M., Shamasunder, B., & Kyle, A. D. (2011). Understanding the cumulative impacts of inequalities in environmental health: implications for policy. *Health Aff (Millwood), 30*(5), 879-887. doi: 10.1377/hlthaff.2011.0153
- [vii] O'Neill, M. S., Jerrett, M., Kawachi, I., Levy, J. I., Cohen, A. J., Gouveia, N., . . . Schwartz, J. (2003). Health, wealth, and air pollution: advancing theory and methods. *Environmental health perspectives, 111*(16), 1861.



- The unknown potential health risk from the ingestion of smoke in local produce pales in comparison to the well-established health risks from inhalation of the wildfire smoke itself.
- In a study of the immediate health impacts of the wildfires in Alameda County in 1991, researchers conducted a retrospective review of the health records and coroner records, finding that over half of all emergency room visits in the aftermath of the fire were due to respiratory-related conditions, and that 61% were bronchospasms- irritation of the lungs due to particulates.[i] A study of the 2003 wildfires in Southern California found that exposure to wildfire smoke increases hospital admissions for cardiovascular disease.[ii] Another study of the same fires found that exposure to smoke led to reduced birth weight among children born to mothers exposed to smoke, which has implications for infant development and lifelong health.[iii]
- These cardio-respiratory impacts of acute smoke are well reported in several studies of the public health impacts of wildfire smoke and generally undisputed.[iv] Other studies also point to the long-term impacts of smoke exposure among firefighters.[v], [vi]

- [i] Shusterman, Dennis, Jerold Z. Kaplan, and Carla Canabarro. "Immediate health effects of an urban wildfire." *Western journal of medicine* 158.2 (1993): 133.
- [ii] Delfino, R.J.; Brummel, S.; Wu, J.; Stern, H.; Ostro, B.; Lipsett, M.; Winer, A.; Street, D.H.; Zhang, L.; Tjoa, T.; *et al*. The relationship of respiratory and cardiovascular hospital admissions to the Southern California wildfires of 2003. *Occup. Environ. Med.* **2009**, *66*, 189–197.
- [iii] Holstius, David M., et al. "Birth weight following pregnancy during the 2003 Southern California wildfires." Environmental health perspectives 120.9 (2012): 1340-1345.
- [iv] Youssouf, Hassani, et al. "Non-accidental health impacts of wildfire smoke." *International journal of environmental research and public health* 11.11 (2014): 11772-11804.
- [v] LeMasters, Grace K., et al. "Cancer risk among firefighters: a review and meta-analysis of 32 studies." *Journal of occupational and environmental medicine* 48.11 (2006): 1189-1202.
- [vi] Navarro, Kathleen M., et al. "Wildland firefighter smoke exposure and risk of lung cancer and cardiovascular disease mortality." *Environmental Research* (2019).



- While the smoke from the wildfires impacts everyone in the region, socio-economic factors can modify the health impact of the smoke. A public health study of the cardiovascular and respiratory health impacts of wildfire smoke provides a thorough review of this issue:
- “communities with lower socio-economic status (SES) typically measured by income, education, and racial composition, have consistently been shown to be at increased risk from air pollutants but other health factors associated with low SES such as limited access to clinical care or an unhealthy diet may also play an important role in determining a community’s health outcome to poor air quality… Socio-Economic Factors should be considered as modifying risk factors in air pollution studies and be evaluated in the assessment of air pollution impacts.”[i]
- [i] Rappold, Ana G., et al. "Cardio-respiratory outcomes associated with exposure to wildfire smoke are modified by measures of community health." *Environmental Health* 11.1 (2012): 71.

- Diet-related illnesses such as diabetes have been found to increase vulnerability to chemical exposures in air pollution.[i], [ii] Chronically food insecure communities are more likely to be diagnosed with diet-related illnesses,[iii] and many rely on local food security programs for free and reduced-cost produce. ***Promoting nutrition from local produce and supporting local food systems (particularly programs that serve low-income***

and food insecure communities) can improve community health and resilience to the cardio-respiratory impacts of a fire event.

- [i] Schneider, Alexandra, et al. "Association of cardiac and vascular changes with ambient PM 2.5 in diabetic individuals." *Particle and fibre toxicology* 7.1 (2010): 14.
- [ii] O'neill, Marie S., et al. "Diabetes enhances vulnerability to particulate air pollution–associated impairment in vascular reactivity and endothelial function." *Circulation* 111.22 (2005): 2913-2920.
- [iii] Seligman, Hilary K., et al. "Food insecurity is associated with diabetes mellitus: results from the National Health Examination and Nutrition Examination Survey (NHANES) 1999–2002." *Journal of general internal medicine* 22.7 (2007): 1018-1023.

- Produce sample results support the hypothesis that there is a low concern for health impacts from eating local produce exposed to the urban wildfire smoke in Sonoma County in the fall of 2017. Our cumulative analysis further suggests that eating trace contaminants on produce does not provide a significant chemical exposure during an urban wildfire event, and the potential cancer risk may be outweighed by the cancer risk reduction from the nutritional value of eating produce.

- **Protect Your Lungs**
- During a wildfire, the number one thing you can do to protect your health is to avoid inhaling the smoke. Protect your lungs by staying indoors whenever possible and wearing a respirator mask when outdoors. An N95 respirator is the minimum protection recommended, while a P100 will provide additional protection from petroleum-based chemicals and smaller particles.

- **Wash Your Produce**
- Thoroughly wash produce under running water before storing, cooking and eating. Remove older, outer leaves of lettuce or leafy greens before eating. Peel root vegetables before eating.

- **Eat Fresh Produce**
- Increasing produce consumption, particularly green leafy vegetables, promotes healthy nutrition and resilience to chemical exposures.

- **Take Extra Precautions**
- When considering the impact on vulnerable communities, it is important to consider both the additional health risk from exposure to chemicals in the environment including produce, as well as the protective factors that the nutrition of local produce and a strong local food system can provide, particularly for communities for which local food assistance programs are one of their primary sources of produce.

A strong and connected local food system and flourishing agricultural sector help a community respond to its residents' needs for healthy food during a disaster, recover more quickly after a disaster, and provides social and economic benefits that act as protective factors for vulnerable communities. Ultimately, a robust local food system is an indicator of a resilient community.

University of California Agriculture and Natural Resources Division report on the Benefits of Urban Agriculture:

Social impacts include the creation of safe places, community development, the building of social capital, and cross-generational and cultural integration.

Health impacts include enhanced food access and food security, increased fruit and vegetable consumption, and general well-being through improved mental health and physical activity.

Economic impacts of urban agriculture include job creation, training and business incubation, market expansion for farmers, economic savings on food for low-income consumers, savings for municipal agencies, and increased home values.

Urban agriculture is the growing of food beyond that which is strictly for home consumption or educational purposes--which includes the production, distribution and marketing of food and other products within the cores of metropolitan areas and at their edges.[66]

Our local food system was an instrumental part of the emergency response during the fires, though its impact was often invisible. Following the 2017 fires, the Sonoma County Food System Alliance convened a gathering of people and organizations that were critical to the emergency food response, in order "to analyze how the emergency food response evolved during the disaster in an effort to improve the model for future disasters, to minimize the number of community members who transition from short-term emergency food assistance to long term chronic food insecurity, and to strengthen the region's food system."

The Food System Alliance released a report following the gathering, describing how farmers, distributors, chefs, and emergency food providers leveraged existing and new community-based connections to provide a quick local response in order to feed thousands of evacuees and first responders. The "spontaneous outpouring" of food from local farmers who provided a "surge of local produce," and local chefs who "stepped up" to capitalize on their pre-existing food business relationships and use excess food to "get meals out" to the community were highlights of what functioned well during the disaster. The report concludes with suggestions for learning from the emergency food system that emerged during the fire in order to strengthening the local food system to better prepare for future disasters, and to ensure ongoing food security for the region.[i]

[i] Borgeson, Phina et al.. “Sonoma County Emergency Food Response Gathering – Summary of Findings and Recommendations, August 2018.” Sonoma County Food System Alliance. Accessed 3/20/2019. <https://sonomacofsa.files.wordpress.com/2018/11/efr-report-final-2018-8-14.pdf>

Beyond providing meals, the local food response gave people a sense of community connectedness and support, which is critical for modulating the toxic impacts of stressful circumstances.[i],[ii] Gardens hosted spaces for community members to come together, share resources, access donations, provide emotional support, offer legal consultations, clinical health and wellness support, and more.

Using the social determinants of health approach, it is clear that supporting strong local food system is critical for community health and resilience.

[i] Franke, Hillary. "Toxic stress: effects, prevention and treatment." *Children* 1.3 (2014): 390-402.

[ii] Weissbecker, Inka, et al. "Psychological and physiological correlates of stress in children exposed to disaster: Current research and recommendations for intervention." *Children Youth and Environments* 18.1 (2008): 30-70.

Lead pipes banned in 1986, but they remain throughout much of the country's drinking water infrastructure, which largely pre-dates the ban. Until 2014, pipes & fittings with as much as 8% lead-by-weight could be legally labelled "lead free".
https://fas.org/sgp/crs/misc/RL31243.pdf

So, is it safe to eat the eggs?!

1. A low percentage of eggs from backyard poultry could contribute to a level of exposure requiring monitoring of blood lead levels, especially of children.

2. As of today, that concern is not wildfire related - it's a *general* concern

The CAHFS lab is the "California Animal Health and Food Safety" lab - there are four locations around the state. If you are not in the US but outside of California, all states have state veterinary diagnostic laboratories (google <name of your state> veterinary diagnostic lab)

How to reduce your risk?

1. Doing the Basics
2. Know When Wildfire is Nearby
3. If You Grow Crops / Have Backyard Chickens

How to reduce risk - the basics

- Wash your hands before eating & handling food.
- Wash your produce before eating, storing & cooking.

  Post Harvest: Soak Produce in 10% Vinegar Solution
  & Peel Root Crops

- Keep the outdoors… outdoors!: **Use a Boot-Brush!**
- Know what you're being exposed to (in water, soil, paint)!
  Get Your Soils Tested, and Keep a Map of Your Sample Spots to Correlate with Your Test Results Once Received!

How to reduce risk during wildfire

- ***Protect your lungs!***
- Do everything on the previous slide - *twice!*
- Contain your soil - use raised beds with landscape fabric
- Add compost/clean soil -->Dilute Low Level Contaminants
- Know what you're being exposed to (repeating a theme)

How to reduce risk during wildfire

Minimize Soil Dust and Soil Up-Splash/Particle-Spreading

- Mulch, Mulch, Mulch*!: Cover Soils - Minimize Airborne Dust*
- Sub-Surface Irrigate: Use Drip Irrigation-Reduce Up-Splash
- Promote Good Drainage, Especially @ Bottoms of Slopes and Allow Good H20 Infiltration

How to reduce risk - backyard eggs

- Know Your Site's Land Use History
- Use feeders for all types of feed, including scraps!
- Limit contact of hens with high risk areas of yard!
- Consider supplementing with calcium - but not too much!
- Know what you're being exposed to (so repetitive!)

Thank you Rob, to close out today's webinar, I want to reiterate that:

- This is a timely and an emerging area of research given the increasing frequency and severity of wildfires.
- Each wildfire event is unique. Our studies looked at wildfires that were urban in nature. More traditional wildfires carry little risk of contamination to produce and eggs. However, more urban wildfires may carry more risk--depending on the unique makeup of built environments structures and industries that burned.
- We also want to acknowledge that we as researchers choose to look for may evolve with new research and a deepening understanding of what contaminants to test for, where, when, & why
- For this reason, we encourage other communities to do further research into their own local context

- Please know that UCCE is a resource for University-Community Partnership, and can help connect impacted communities with University of CA resources.

Here are resources where you can get information on soil testing and stay-up-to-date on these two studies' ongoing findings.

I want to thank each of our presenters today-- Vanessa Raditz, Todd Kelman, and Rob Bennaton.

Together, we want to thank all those who participated in our studies by sending in their chicken eggs, opening their farms and gardens for produce samples, volunteering their time to collect soil samples, or donating to this project.

Thank you, also, to the Bay Area Air Quality Management District, UC ANR, USDA/NIFA, and Sonoma County residents for funding this project.

END 12:38