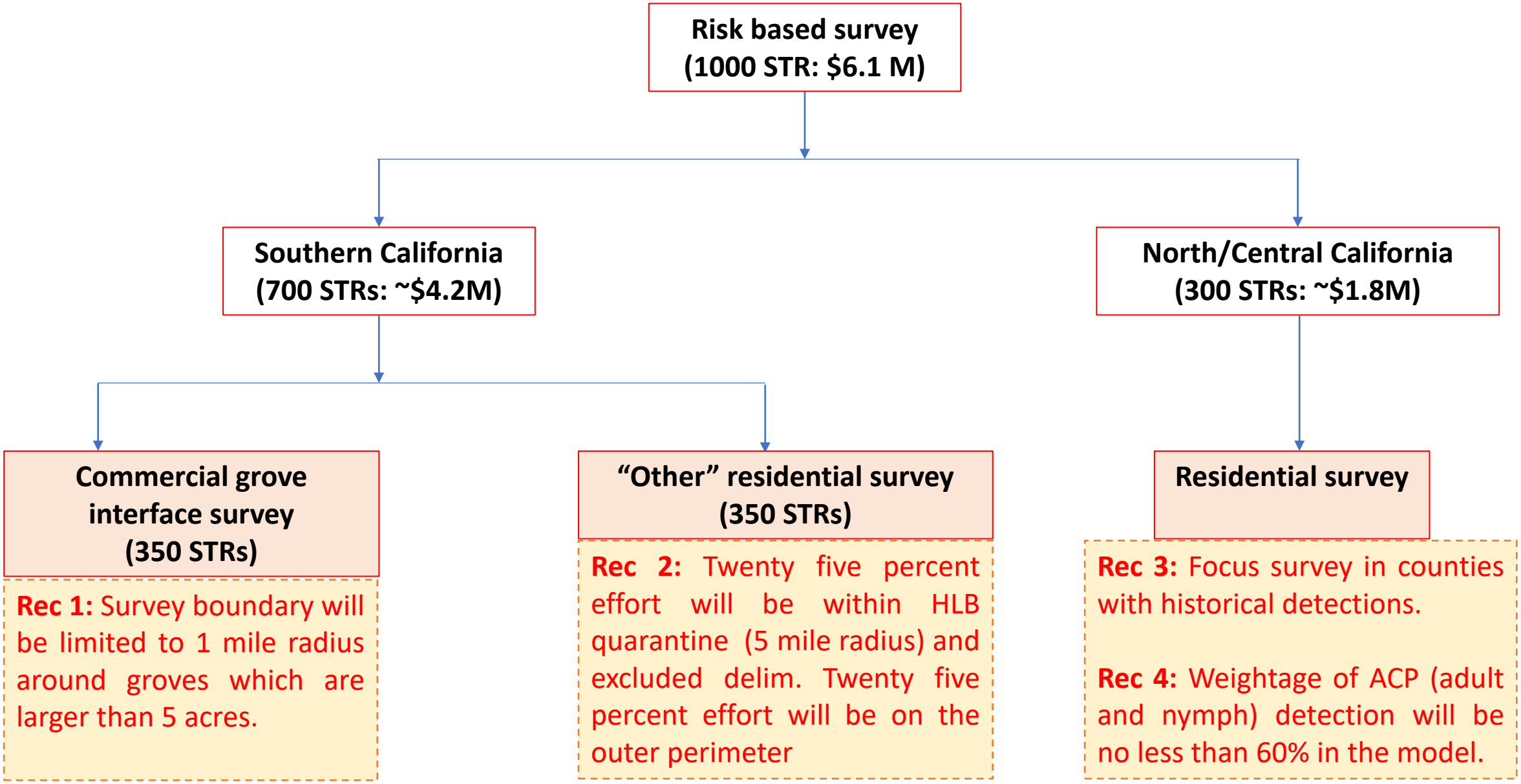
Risk based survey

08/29/2023

Current proposed program



Number and percentage of STRs in each county that fall within each distance to Commercial Citrus locations (considering all citrus acreage size)

County	<=250m	<=500m	<=750m	<=1000m	<=1250m	<=1500m	Total STR in County
San Bernardino	22 (1.77%)	**42 (3.38%)**	**64 (5.14%)**	91 (7.32%)	115 (9.24%)	138 (11.09%)	1,244 (100%)
Riverside	45 (3.58%)	**74 (5.89%)**	**111 (8.84%)**	151 (12.02%)	192 (15.29%)	246 (19.59%)	1,256 (100%)
San Diego	66 (5.48%)	**143 (11.88%)**	**203 (16.86%)**	253 (21.01%)	298 (24.75%)	331 (27.49%)	1,204 (100%)
Ventura	54 (13.47%)	**94 (23.44%)**	**129 (32.17%)**	149 (37.16%)	174 (43.39%)	199 (49.63%)	401 (100%)
Santa Barbara	11 (4.93%)	**23 (10.31%)**	**30 (13.45%)**	47 (21.08%)	60 (26.91%)	70 (31.39%)	223 (100%)
Los Angeles*	0 (0%)	**0 (0%)**	**0 (0%)**	0 (0%)	0 (0%)	0 (0%)	1,760 (100%)
Orange	1 (0.16%)	**2 (0.33%)**	**11 (1.81%)**	26 (4.28%)	37 (6.09%)	46 (7.57%)	608 (100%)
Imperial	2 (1.41%)	**2 (1.41%)**	**4 (2.82%)**	4 (2.82%)	4 (2.82%)	4 (2.82%)	142 (100%)
Total	201	**380**	**552**	721	880	1,034	6,838

*No Commercial Citrus within the county

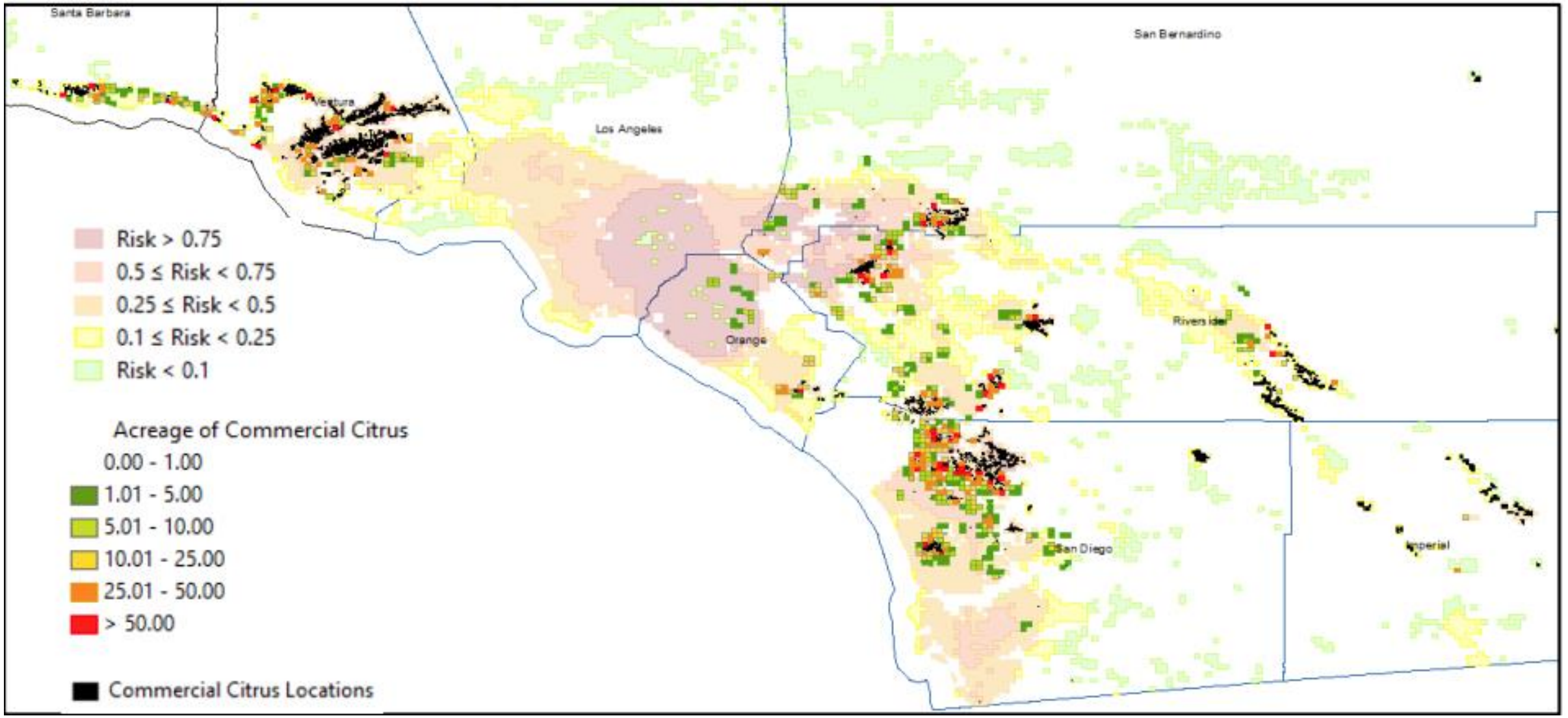
STRs with Commercial Citrus buffer within ~1 mile

CDFA survey capacity: ~**9,000** properties or ~**350** grids a year (assuming 50 / 50 split)

Number of STRs containing each range of total commercial citrus acreage that fall within each distance

		Distance to Commercial Citrus					
		<=250m	<=500m	<=750m	<=1000m	<=1250m	<=1500m
Total Commercial Citrus Acreages	All Sizes	201	380	552	721	880	935
	> 1 Acres	165	314	457	593	734	760
	> 5 Acres	102	217	326	451	560	565
	> 10 Acres	66	166	263	371	476	461
	> 25 Acres	21	95	177	241	331	326
	> 50 Acres	3	47	108	159	224	198

STRs with Commercial Citrus buffer within ~1 mile



ACP Detections Along Citrus Highways

7/17/14 - 7/17/2023

Effective 4/1/2017, all citrus fruit must be safeguarded while in transit by either covering the load with a tarp, an insect proof barrier, or transporting the fruit in an enclosed container. Prior to 2017, citrus fruit could be moved without safeguarding the load in transit.

The tables below show the number of Pest Damage Records (PDR) with a confirmed Asian citrus psyllid (ACP) detection prior to and after the safeguarding requirement became effective. A single PDR may have multiple ACP detections. Detections in southern California were not considered as the area is generally infested with ACP

Highway 99		
	2014 - 2017	2018 - 2023
1 Mile Buffer	210	33
2 Mile Buffer	315	43

Highway 58		
	2014 - 2017	2018 - 2023
1 Mile Buffer	64	13
2 Mile Buffer	164	17

Highway 190		
	2014 - 2017	2018 - 2023
1 Mile Buffer	21	4
2 Mile Buffer	24	5

Highway 198		
	2014 - 2017	2018 - 2023
1 Mile Buffer	17	13
2 Mile Buffer	43	21

ACP Detections Within 2 Miles Along CA Highways 99, 58, 190, and 198

Bulk Citrus Fruit Moved Between Zones
January 1, 2022 - December 31, 2022

Origin County		Spray and Harvest Bins Moved To				Field Cleaned Bins Moved To				Grate Cleaned Bins Moved To				Wet Washed Bins Moved To				QC 1543	Total
		Zone 2	Zone 4	Zone 5	Zone 6	Zone 2	Zone 4	Zone 5	Zone 6	Zone 2	Zone 4	Zone 5	Zone 6	Zone 2	Zone 4	Zone 5	Zone 6	Zone 6	
Zone 2	Fresno	-	5,088			-				-				-					5,088
	Kern	-	26,186		3,000	-	490	100		-			34,950	-			100		64,826
	Kings	-				-				-				-					0
	Tulare	-	69,307	0	0	-	11,942		20	-				-			48		81,317
	Zone 2 Totals	**0**	**100,581**	**0**	**3,000**	**0**	**12,432**	**100**	**20**	**0**	**0**	**0**	**34,950**	**0**	**0**	**0**	**148**	**0**	**151,231**
Zone 3	Monterey	19,999	2,400			48				2,000	46,501								70,948
	San Luis Obispo	30,749	6,643			21,843	94		96				1,008	53			96		60,582
	Zone 3 Totals	**50,748**	**9,043**	**0**	**0**	**21,891**	**94**	**0**	**96**	**2,000**	**46,501**	**0**	**1,008**	**53**	**0**	**0**	**96**	**0**	**131,530**
Zone 4	Santa Barbara	4,018	-	3,744	4,512	8,795	-		92		-	192	113		-		24		21,490
	Ventura	148,872	-		8,512	14,969	-	384	7,913		-	240	9,606	334,321	-	0	8,482		533,299
	Zone 4 Totals	**152,890**	**0**	**3,744**	**13,024**	**23,764**	**0**	**384**	**8,005**	**0**	**0**	**432**	**9,719**	**334,321**	**0**	**0**	**8,506**	**0**	**554,789**
Zone 5	Imperial	608	23,276	-			312	48				-				-		96	24,340
	Riverside	38,333	61,961	-	960		96	-			2,220	-		117,601	546	-		624	222,341
	San Bernardino	443	14,658	-				-				-		1,704		-			16,805
	San Diego	2,376	4,548	-		708	48	-				-		7,629		-		148	15,457
	Zone 5 Totals	**41,760**	**104,443**	**0**	**960**	**708**	**456**	**48**	**0**	**0**	**2,220**	**0**	**0**	**126,934**	**546**	**0**	**0**	**868**	**278,943**
Zone 6	Orange	6,406	9,091	96															15,593
	Riverside	4,091	48		6,384	216			24			96	1,496	3,840	2,402		72		18,669
	San Bernardino				1,488								192						1,680
	San Diego																		0
	Zone 6 Totals	**10,497**	**9,139**	**96**	**7,872**	**216**	**0**	**0**	**24**	**0**	**0**	**96**	**1,688**	**3,840**	**2,402**	**0**	**72**	**0**	**35,942**
	Grand Totals	**255,895**	**223,206**	**3,840**	**24,856**	**46,579**	**12,982**	**532**	**8,145**	**2,000**	**48,721**	**528**	**47,365**	**465,148**	**2,948**	**0**	**8,822**	**868**	**1,152,435**
		Spray and Harvest		**507,797**	**44.06%**	**Field Cleaned**		**68,238**	**5.92%**	**Grate Cleaned**		**98,614**	**8.56%**	**Wet Washed:**		**476,918**	**41.38%**	**0.08%**	

ACP Insect-Resistant Structure
Breach Risk Model Guide
(DRAFT)

This risk model is to be used as a guide for evaluating the risk level of a breach of an insect-resistant structure. Qualifying factors listed below will be considered when determining the level of risk and appropriate regulatory path forward following a breach but are not comprehensive. The Risk Assessment Team will consider all available information before recommending action and any breach may warrant recommendations not listed in this guide.

A breach is defined as any hole or opening in an insect-resistant structure larger than approximately 0.3 square millimeters (0.5mm x 0.6mm) in size, large enough for an Asian citrus psyllid (ACP) to enter.

Risk Level	Qualifying Factors	Possible Result(s)*
Low	Small sized breach	Hold for 1 or 2 inspection cycles
	No ACP detections within 5 miles of the nursery within the prior 3 months	
	Breach was repaired or an effective safeguard was put in place within an hour	
Moderate	Moderate sized hole or breach of structure	Hold for 2 inspection cycles Scion trees on hold and tested for viruses and viroids after at least 5 months
	Multiple ACP have been detected within 5 miles of the nursery within the prior 3 months	
	Nursery is located within the ACP generally infested area	
	Breach was reparied within 1 day	
	Mother/increase trees are housed within the breached structure	
Severe	Large breach, entire wall(s) removed, or roof was removed	Hold until plants are sampled and tested All plants considered outdoor nursery stock Structure is de-certified (1)
	Nursery is located within the ACP generally infested area	
	Nursery is located within a huanglongbing (HLB) quarantine or within 5 miles of a Clas+ ACP detection	
	Breach was not repaired within 1 day	
	Mother/increase trees are housed within the breached structure	
	Intentional breach of structure without prior approval by the Risk Assessment Team	

*Any hold issued applies to shipments of plants from a certified insect-resistant structure. Plants may be moved or shipped as outdoor nursery stock while the hold is in effect. Inspections or sampling and testing following a breach must be complete with negative results before a structure can be recertified.

(1) Structure must be empty of all plant material for at least 1 ACP lifecycle to start the re-certification process

California Citrus Risk Assessment Team

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EcoData

CPDPC Science Subcommittee 15min talk: Data science results for HLB management

August 29, 2023

Rob Clark

Caveats before I begin

1. We're <5 months in and bringing a new, outside perspective
2. HLB monitoring & management is complex and its hard to simplify results (interpret carefully!)
3. Management recommendations are still tentative at this early stage

Major analyses

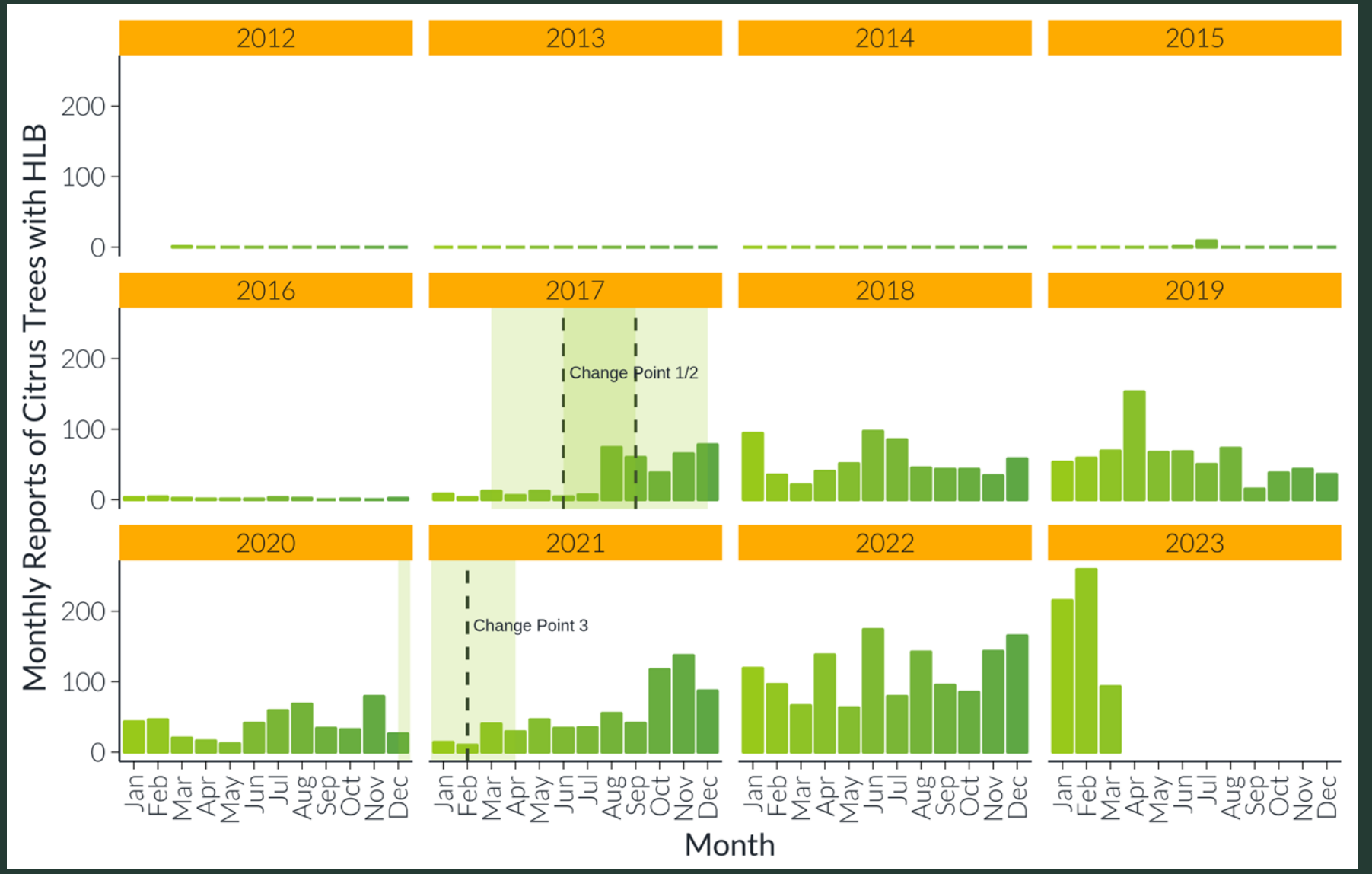
1. Historical analysis of HLB surveys
2. First analysis on effectiveness of tree removal
3. Protype machine-learning models for HLB surveys
4. Ongoing: Historical analysis of quarantines

Major analyses

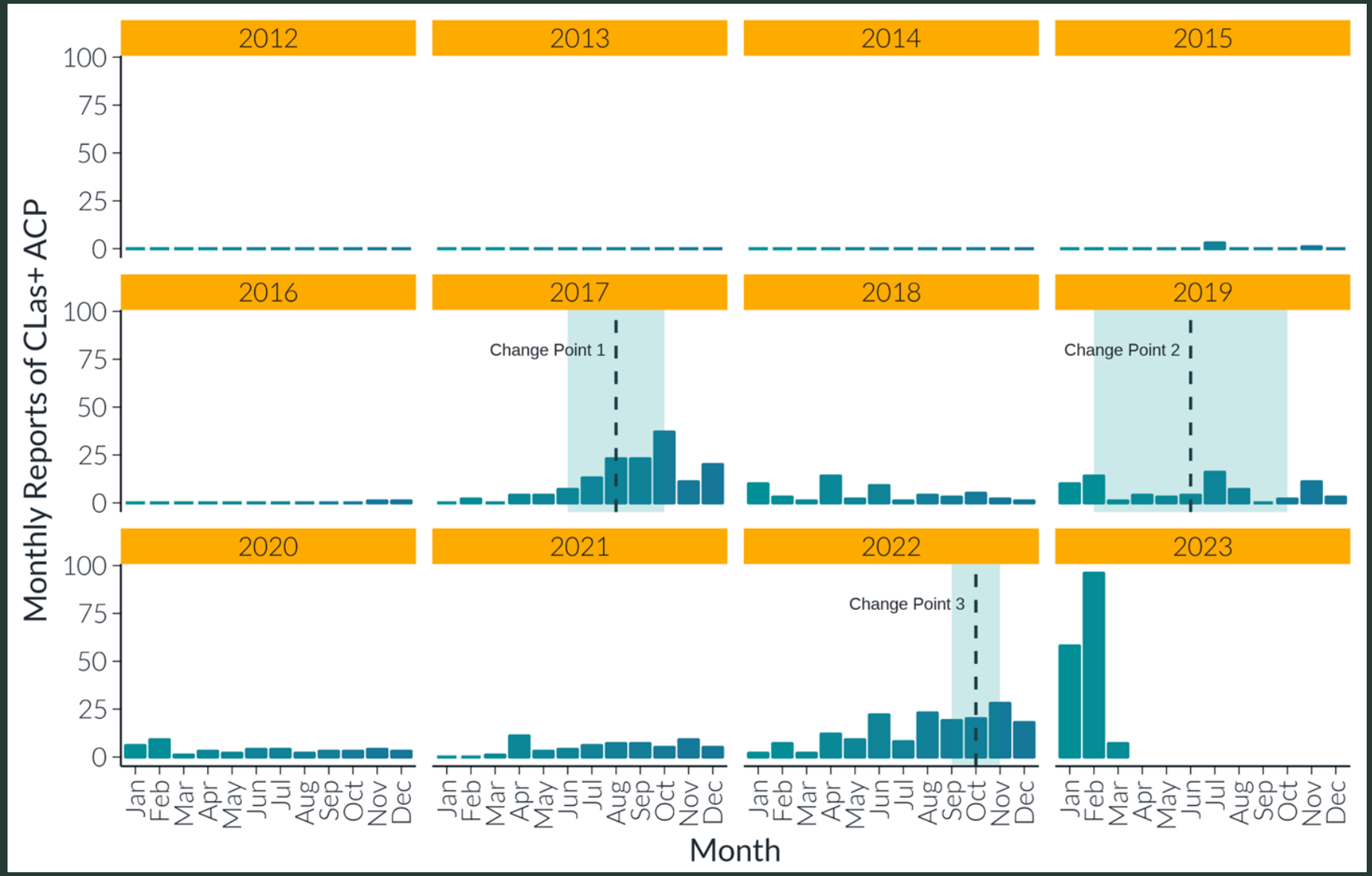
Historical analysis of HLB surveys

I completed a time series analysis to reveal when trend changes were statistically significant

Citrus trees with HLB started to increase in 2017 and then accelerated in 2021. New data from April to July suggest this trend is continuing.



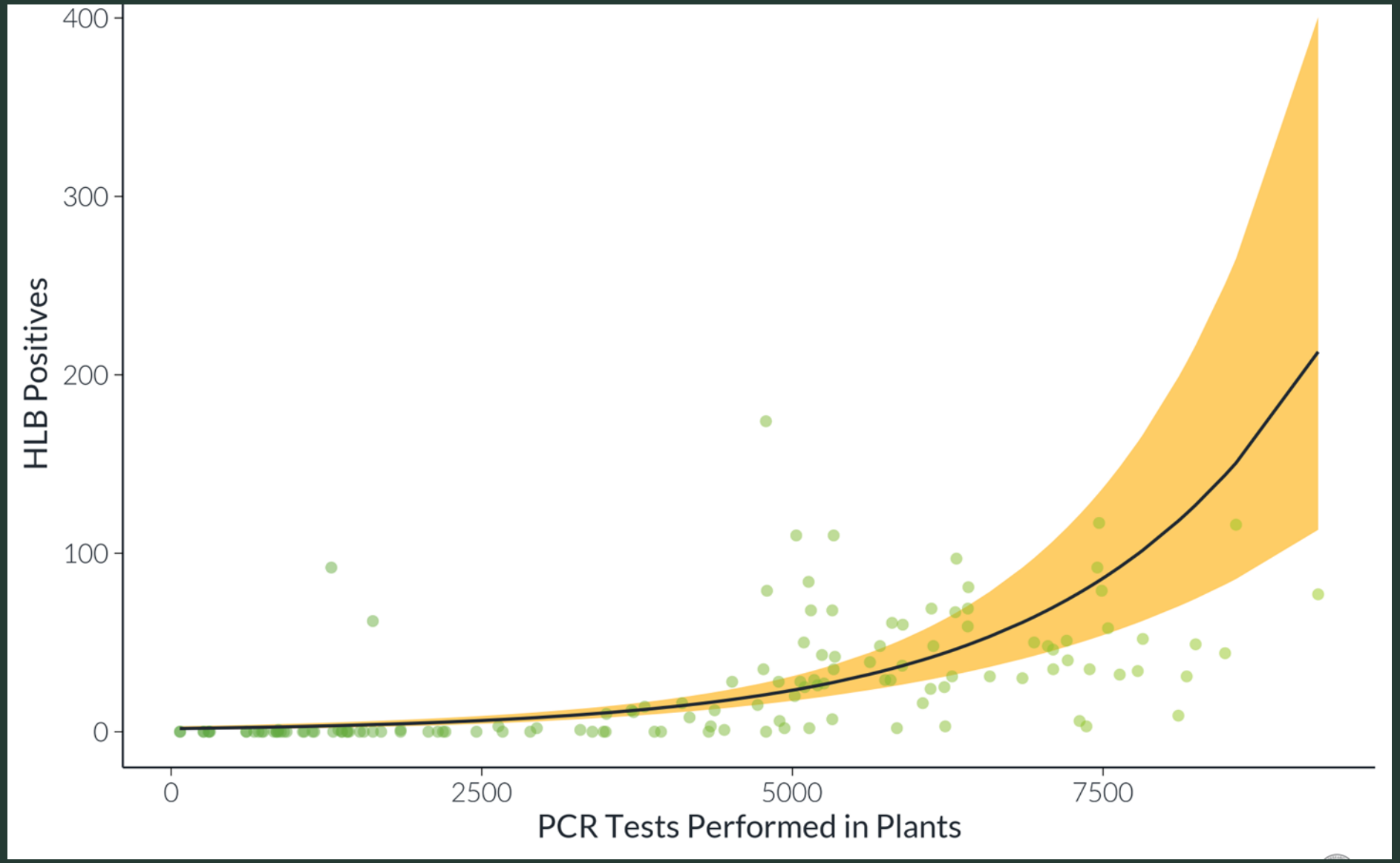
ACP with CLas increased in 2019, with a plateau between 2019 and 2022. A recent spike in CLas+ ACP started in Oct. 2022.



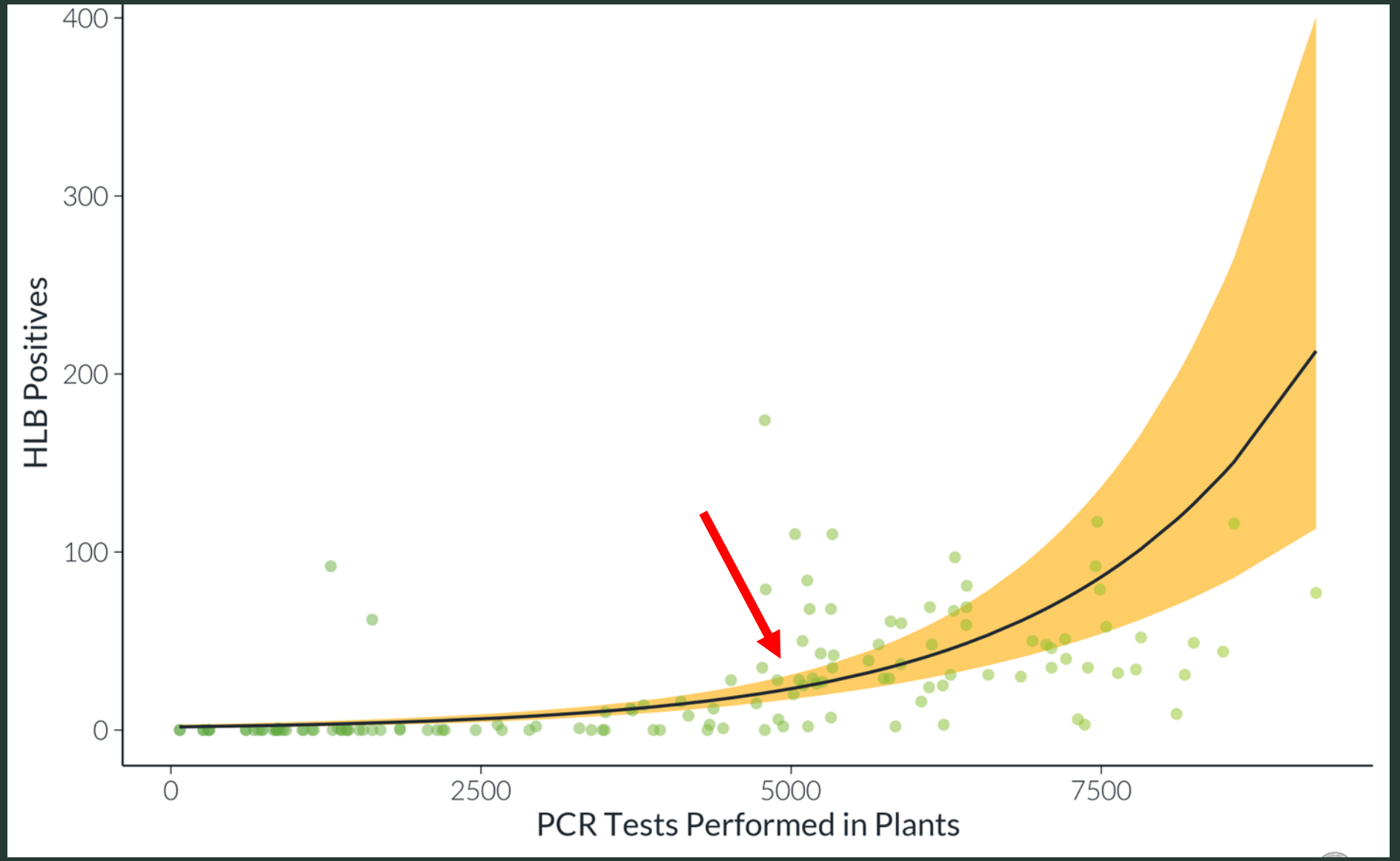
Implications of trends

A. The plateau period is partially due to decreased sampling during the covid19 pandemic
B. The increase in CLas+ trees since 2021 is steady
C. Early 2023 had the highest rate of CLas+ Asian citrus psyllid – the correlation with more CLas+ trees suggests very recent growth in CLas+ reservoir

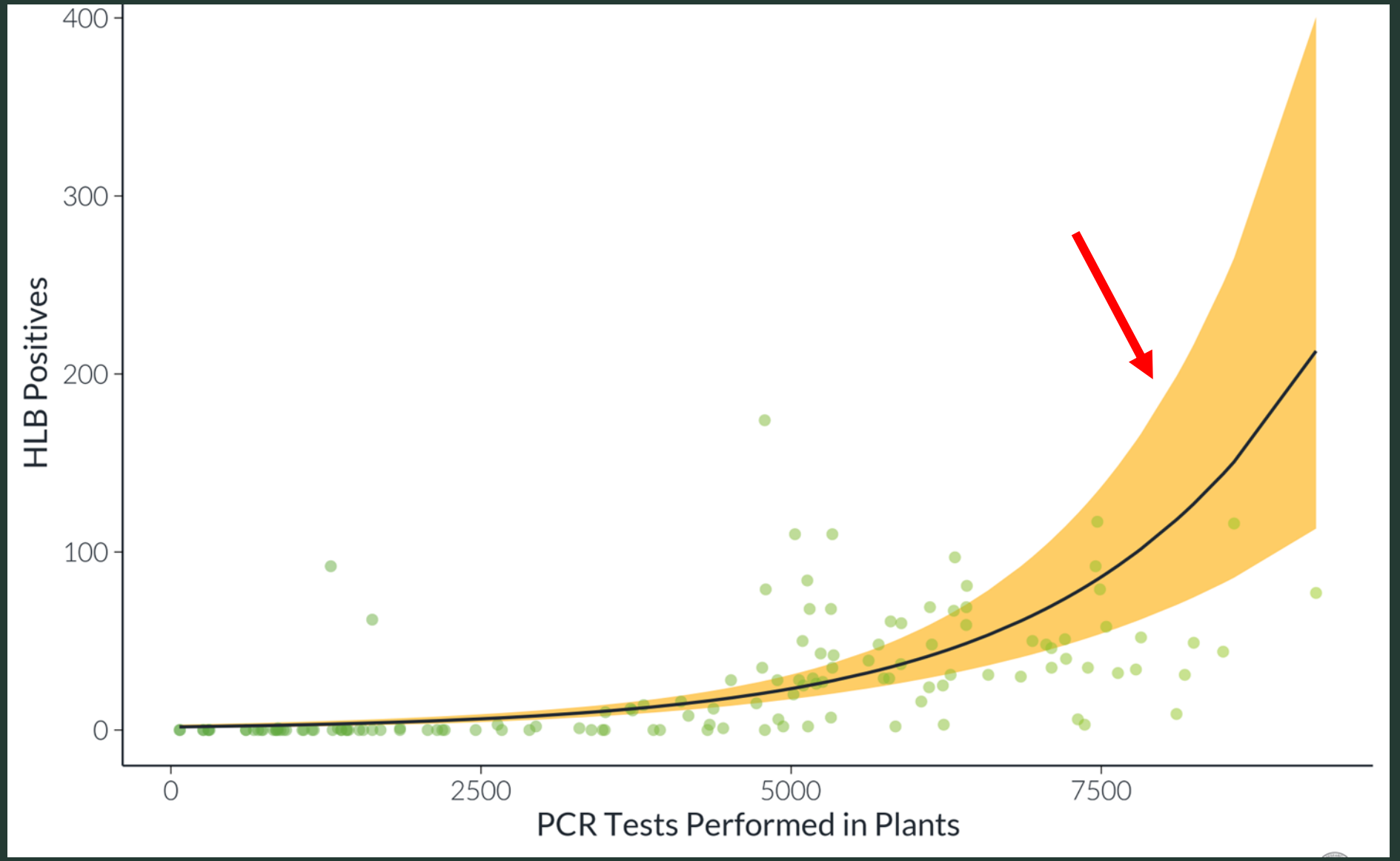
I confirmed that increasing sampling effort (# of PCR tests) does indeed correlate with more detections of HLB in trees



Don’t reduce testing capacity below 5000 tests per month



There is not convincing evidence to go a lot higher above 7,500



Sampling effort analysis

A. As it stands, it looks as if more PCR tests yields more positive detections
B. Tentatively, this result means more extensive testing may yield more detections
C. While statistically significant, this trend is not a perfect fit to the data

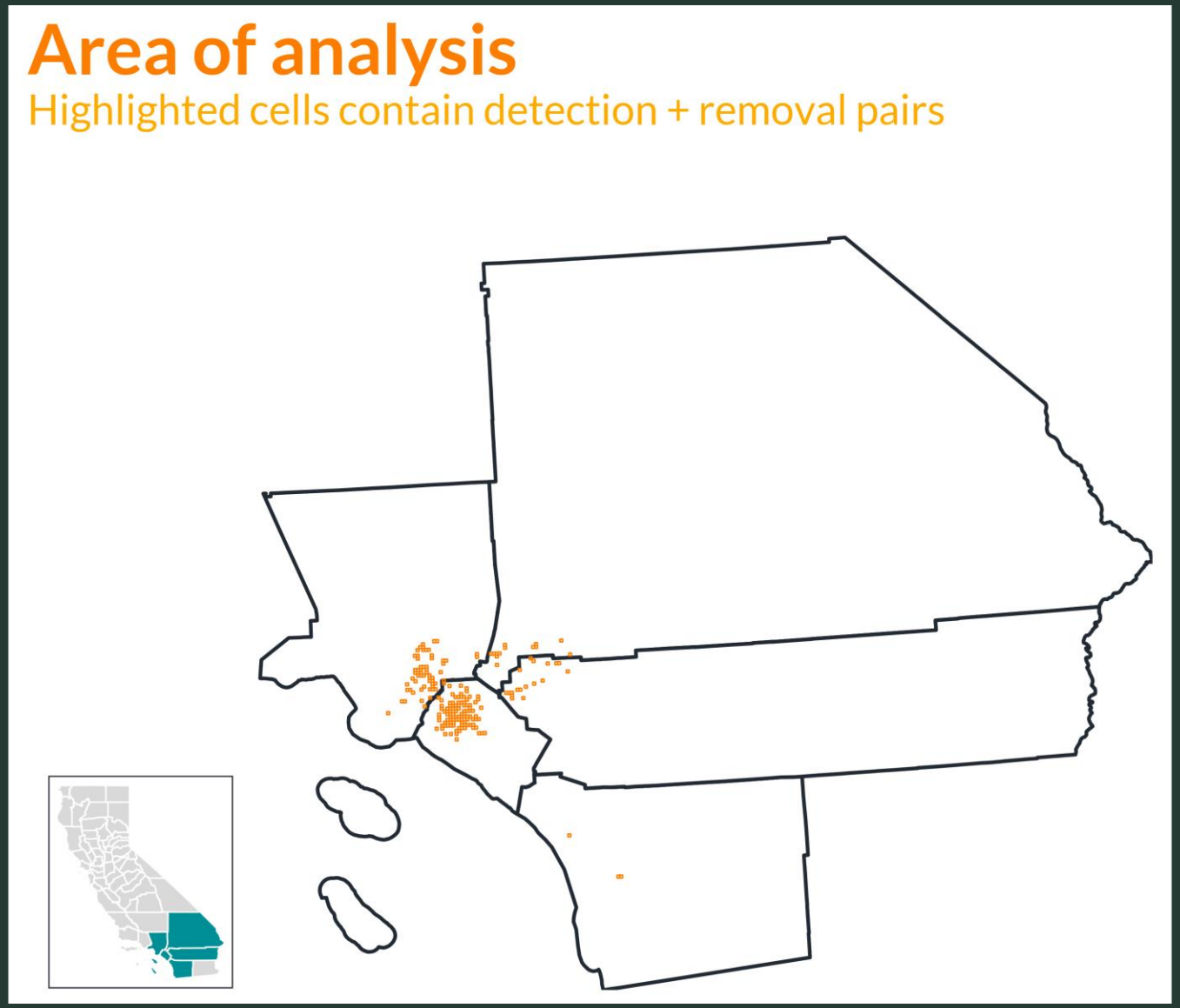
Major analyses

First analysis on effectiveness of tree removal

I focused on the 'reservoir hypothesis' where tree removals keep the regional, overall amount of CLas inoculum low

Classic epidemiology: Managing reservoir size decreases the chance of pathogens moving outside quarantine areas

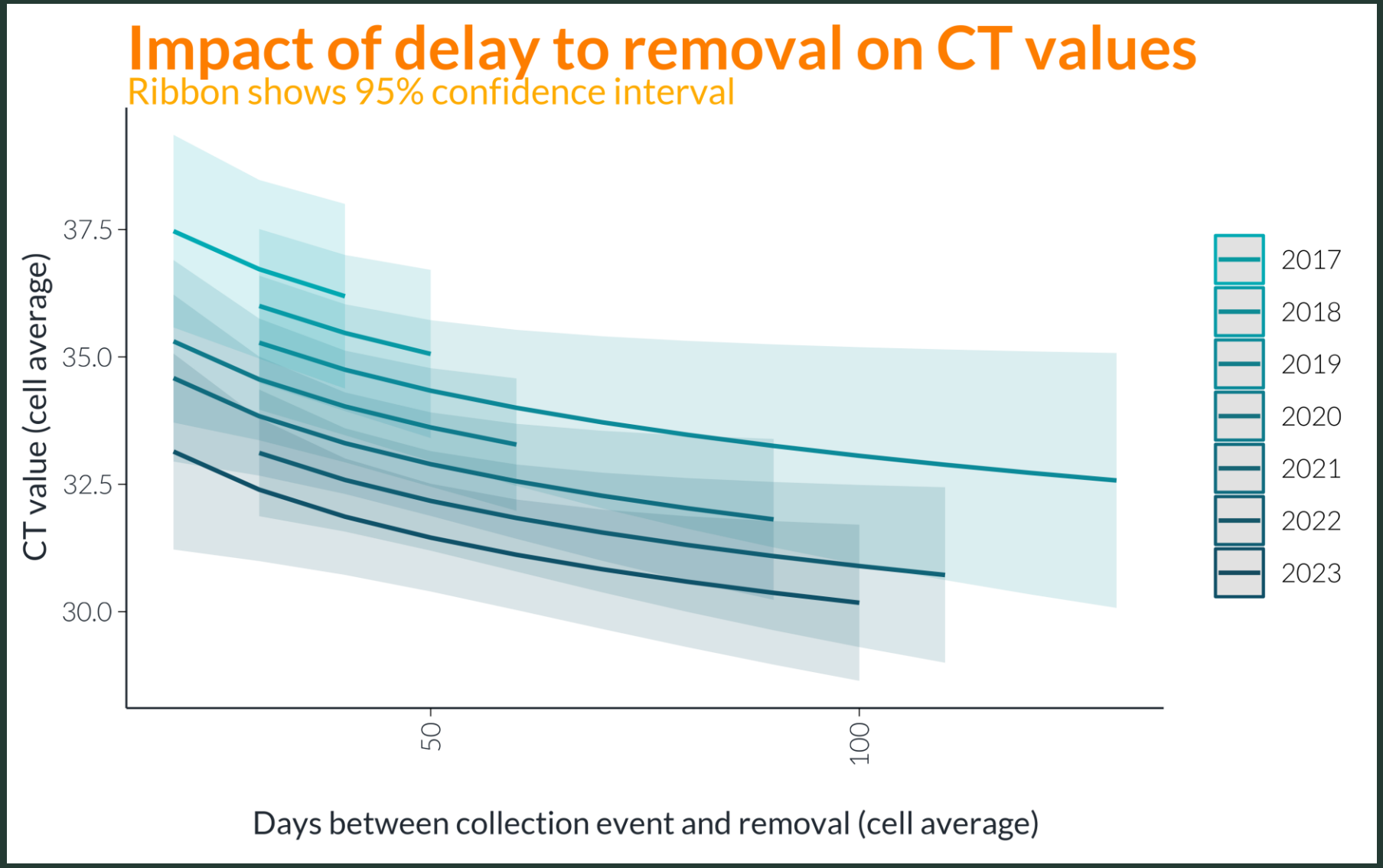
I compared ct values in locations where tree removals happened quickly versus locations where tree removals were delayed



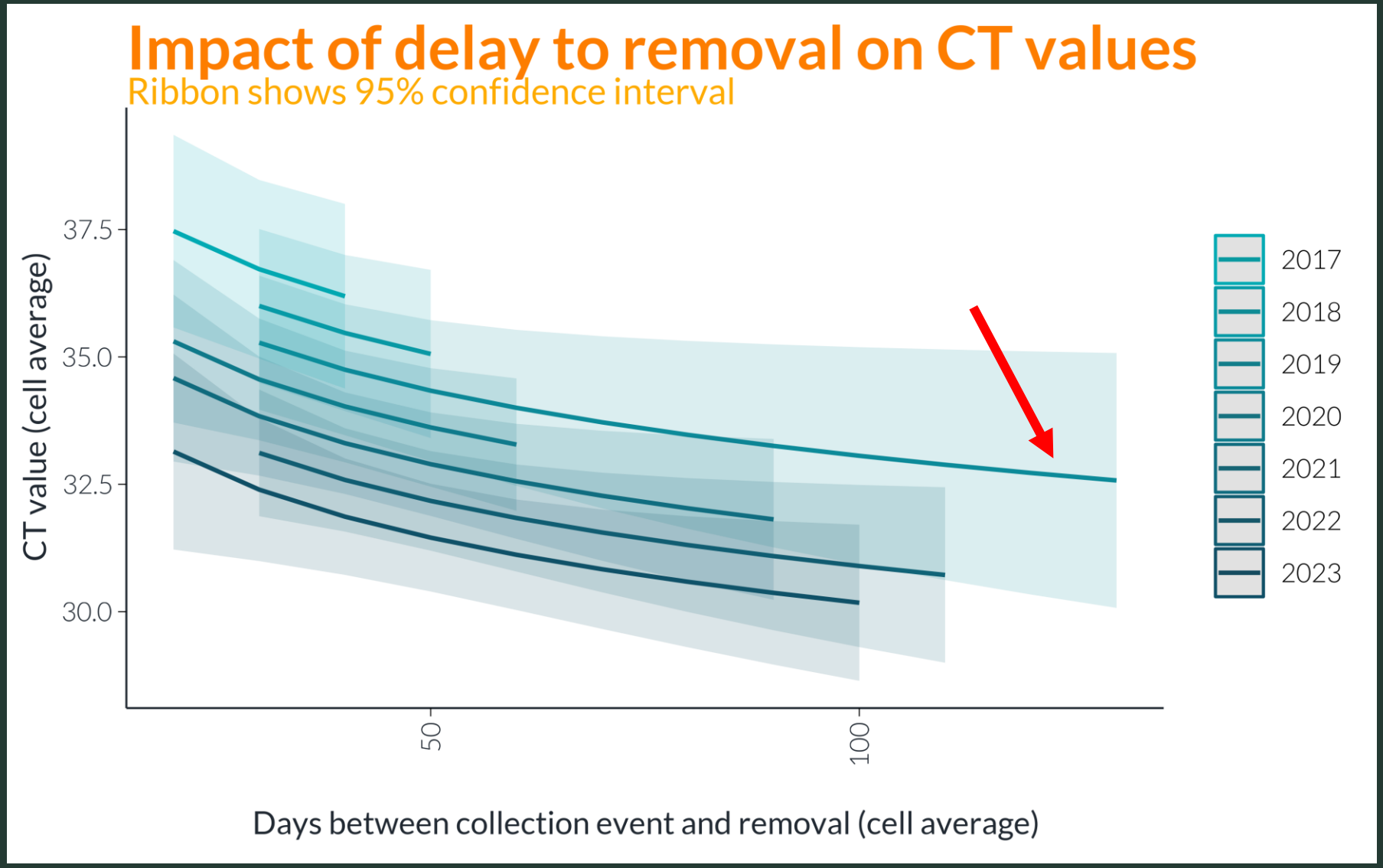
Analysis on tree removal delay

A. I tabulated the time difference between sampling events and physical removal of trees (“delay”)
B. The analysis examined 1.4x1.4km cells as the unitof replication
C. If the reservoir hypothesis is true, increased delays should lead to decreased ct values (more inoculum) each cell

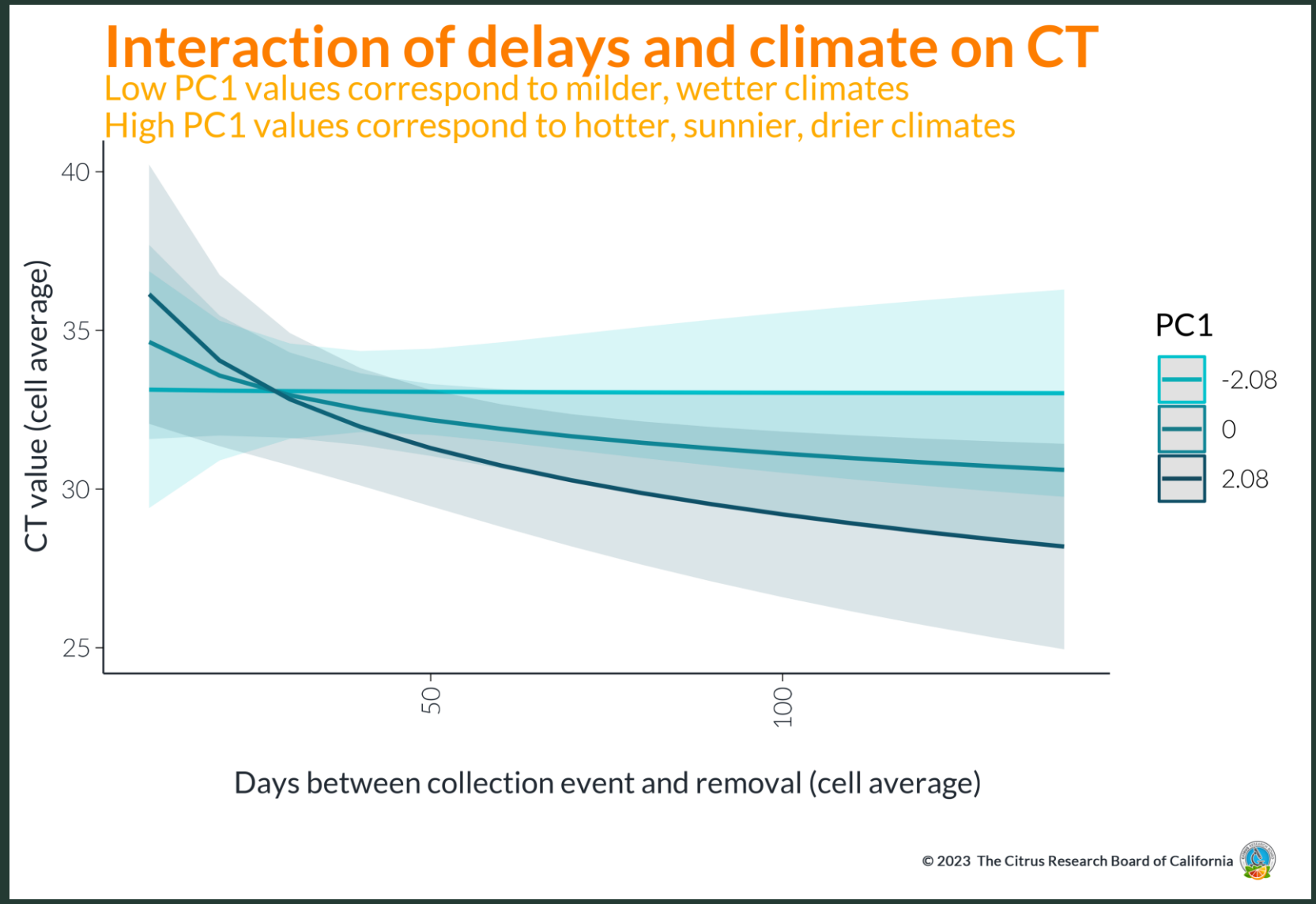
In locations with delayed tree removal, ct values were lower (more inoculum), meaning tree removals probably impact local ct values



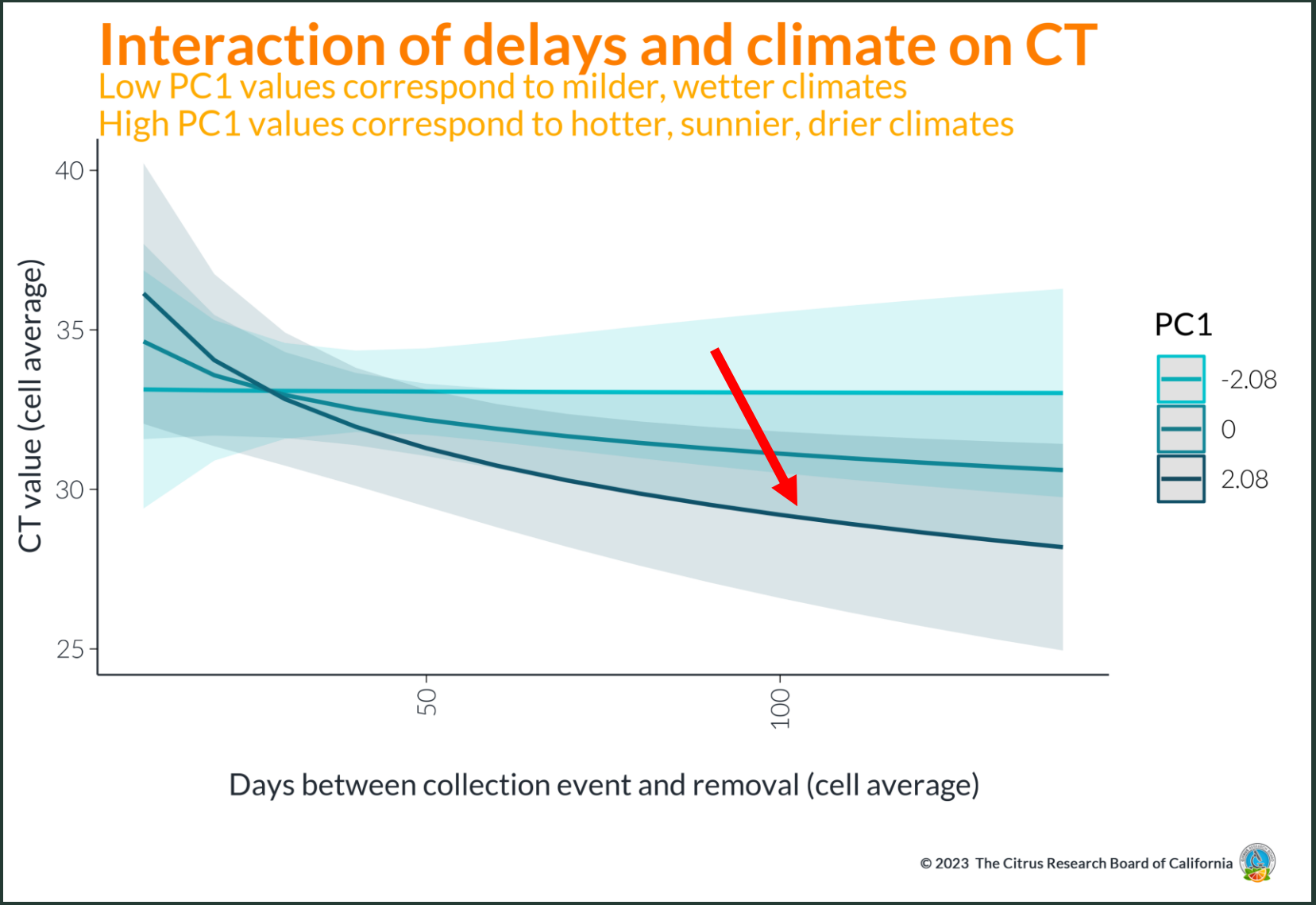
In cells where tree removals took >100 days, future tree detections had more CLas



Accounting for climate, county, and year effects, there is a pattern where tree removal is important for managing inoculum in a confined area



Faster removal times are more important in hotter, drier areas just within the area of historical removals



Tree removal analysis

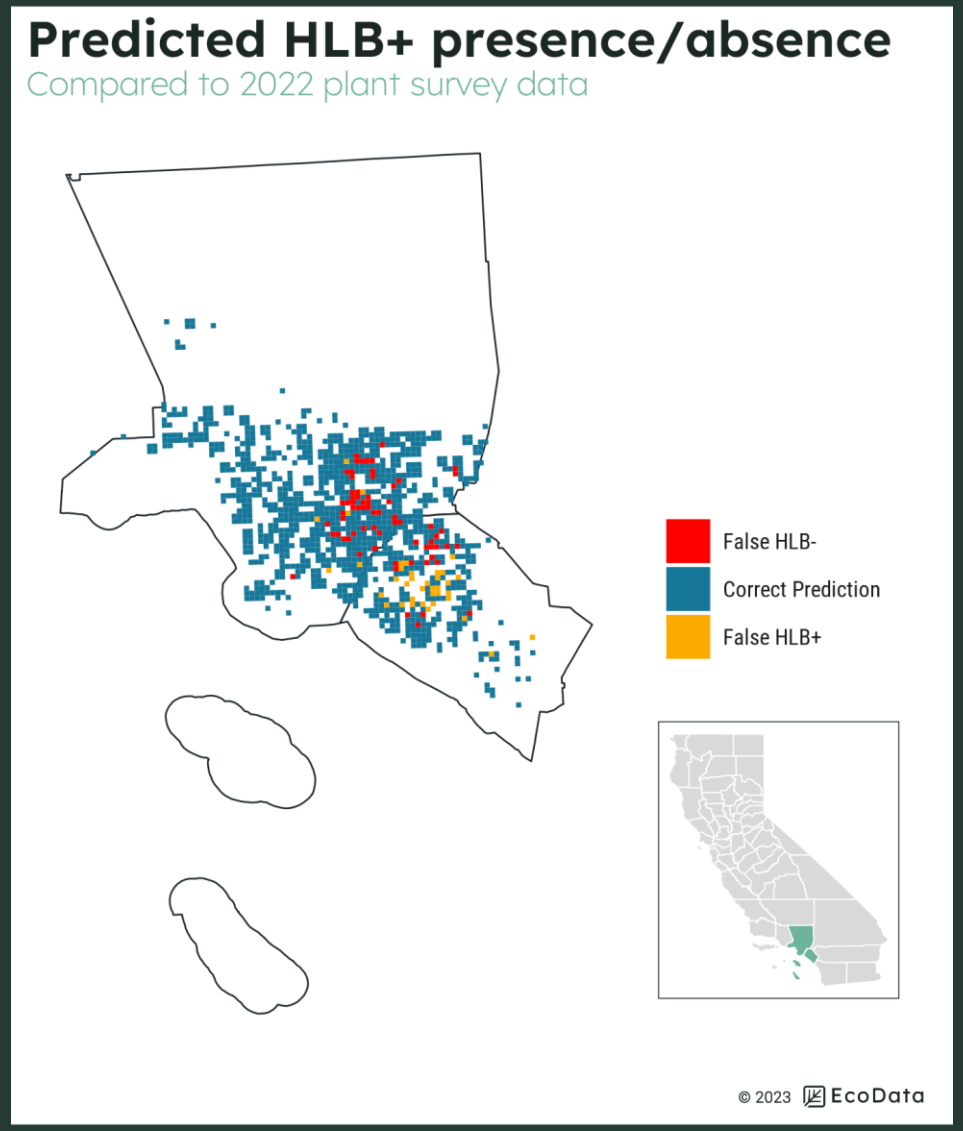
A. In terms of *just* the Clas+ reservoir, tree removals do appear to affect surrounding ct values
B. This evidence is a correlation only, without a different sampling design we can't pin down cause-effect
C. To my knowledge, this is the only evidence showing tree removals affecting CLas+ reservoir in nearby trees, but ct values are still decreasing year to year

Major analyses

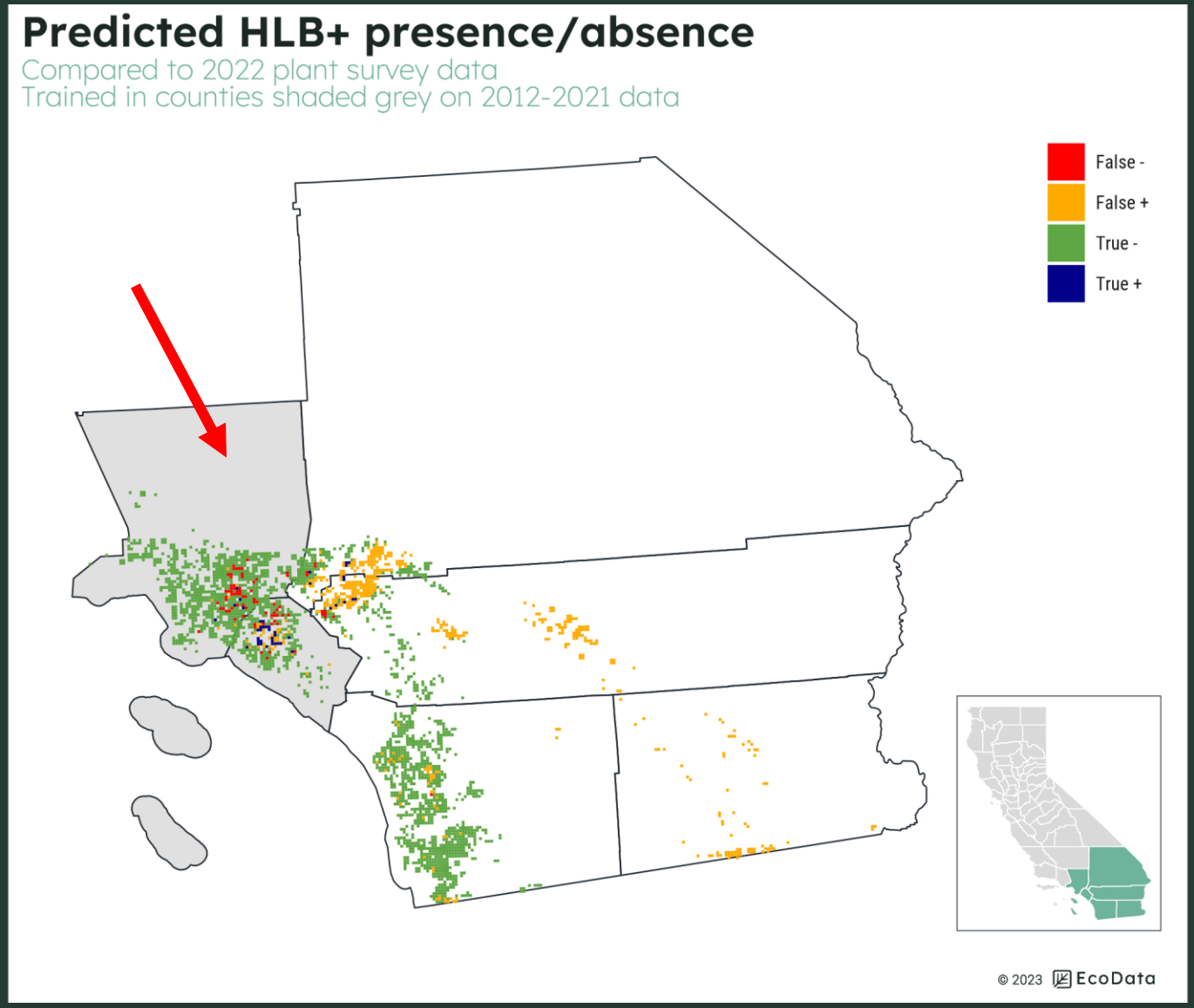
Protype machine-learning models for HLB surveying

I wanted to demonstrate that a model training and model validation approach would be compatible with HLB detection data in California

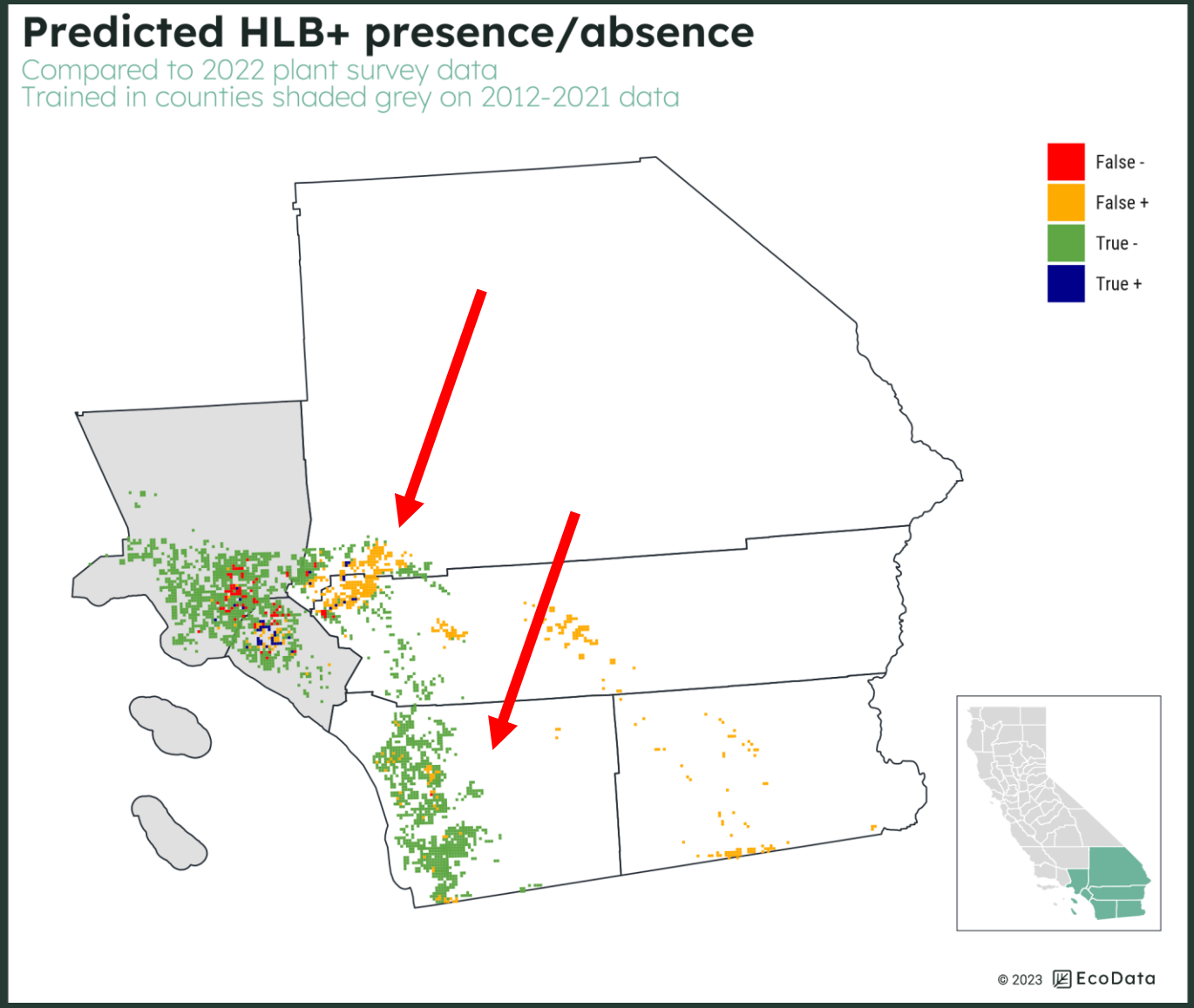
Working with my team at EcoData, we performed the first prototype analysis on HLB+ trees with machine-learning and climate data



A core question: can we make predictions outside areas where a machine-learning model is trained?



Yes: we were able to make equally accurate predictions outside the area used to train the model



Machine learning conclusions

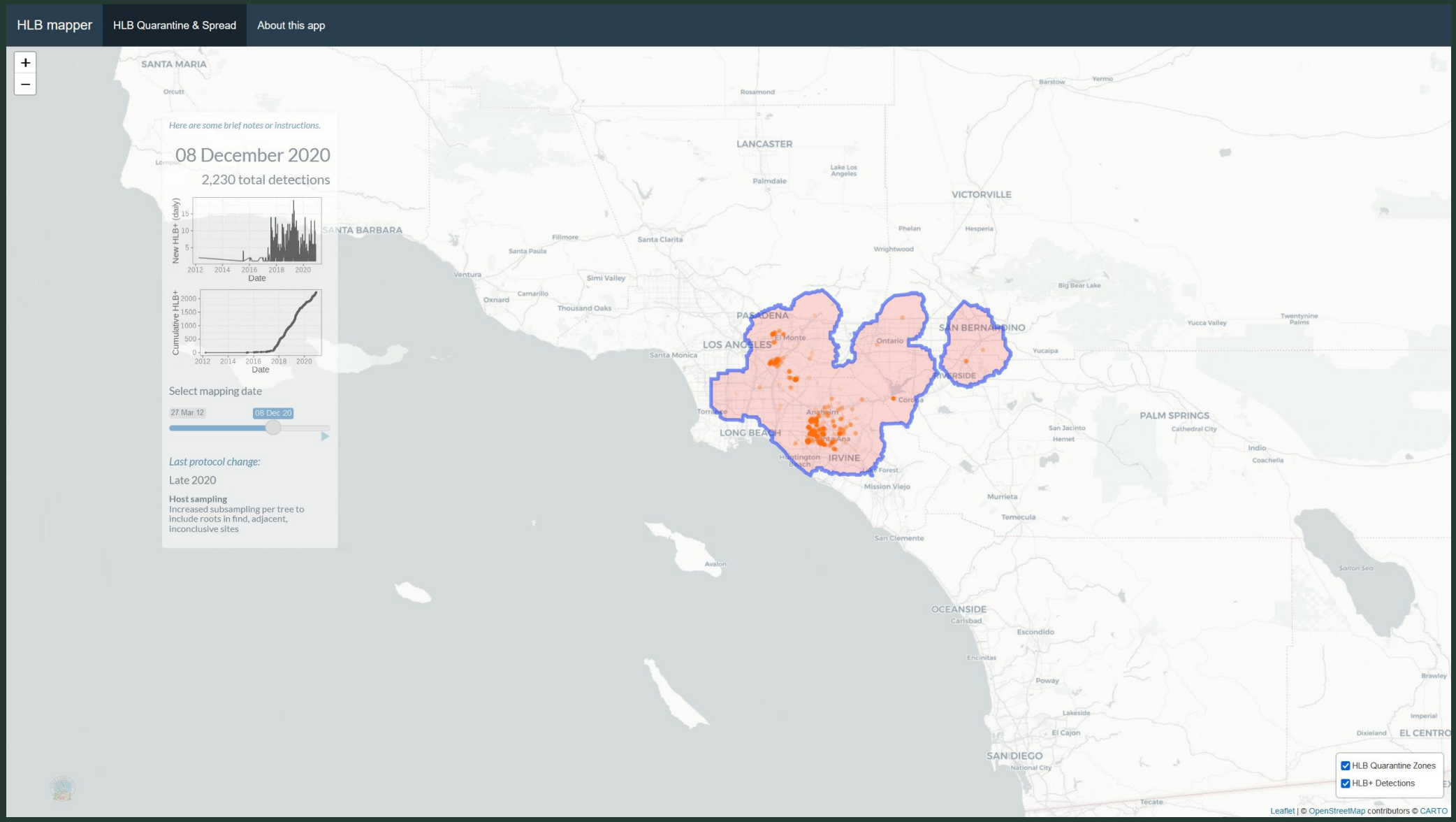
A. The survey efforts have generated enough data to meet the assumptions of machine-learning techniques
B. As simple prototype is already promising as a predictive tool. It can make reasonably accurate predictions outside areas the model was trained on.
C. Dramatically more data needs to be fed into this model before it is completed, and it is still not yet optimized

Major analyses

Ongoing: Historical analysis of quarantines

I am currently reconstructing the history and intent of quarantines to hone the best analytical approach

I am currently developing maps and models to examine historical trends in quarantines. These analyses should be complete by late September or early October.



Quick summary

A. There is a recent uptick in CLas+ Asian citrus psyllid and host trees starting since early 2023
B. One of the core arguments for doing tree removal (managing CLas+ reservoir) has limited statistical support
C. Survey efforts have collected enough data to support more sophisticated predictive models