

MATH MODELING CAN

MAKE YOU FILTHY RICH


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Why do we
have word
problems?

MILNE'S
INDUCTIVE ALGEBRA

Milne's Inductive Algebra © 1881

183. DIRECTIONS FOR SOLVING.—*Represent one of the unknown quantities by x , and from the conditions of the problem find an expression for each of the other quantities given.*

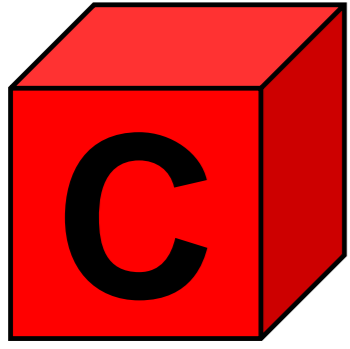
Find from the problem two expressions that are equal, and express them as an equation.

Solve the equation.

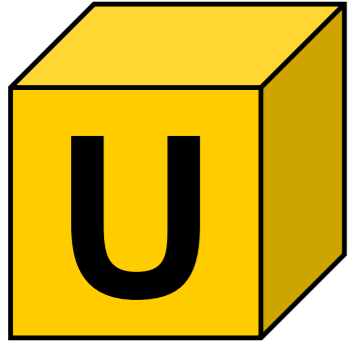
51. When the half of a certain number is added to the number, the sum is as much more than 60 as the number is less than 65. What is the number? *50 ans*

52. The difference between two numbers is 8, and the quotient arising from dividing the greater by the less is 3. What are the numbers?

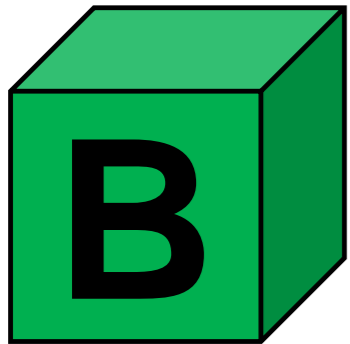
53. A man left one-half of his property to his wife, one-sixth to his children, a twelfth to his brother, and the rest, which was \$600, to charitable purposes. How much property had he?



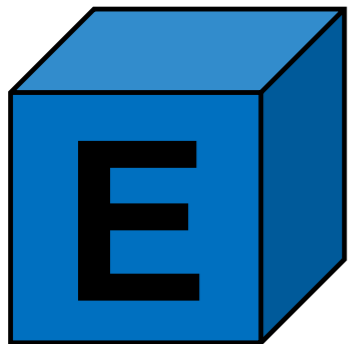
CIRCLE the numbers



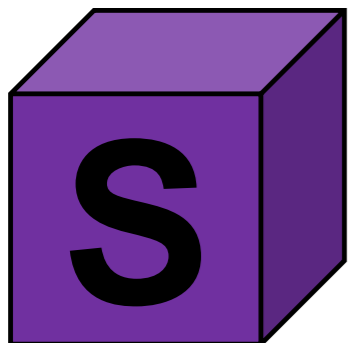
UNDERLINE the question



BOX the key words



~~ELIMINATE~~ info not needed



SOLVE and check ✓

In a class of 30 children, there are 3 girls for every 2 boys. How many girls are there altogether?

Source: Marilyn Burns

There are 125
sheep and 5 dogs
in a flock. How old
is the shepherd?

Making sense: 8

Not making sense: 24

$$\begin{array}{r} 5 \sqrt{125} \\ \underline{10} \\ 25 \\ \underline{25} \\ 0 \end{array}$$



Real-World Link



Common Core
State Standards

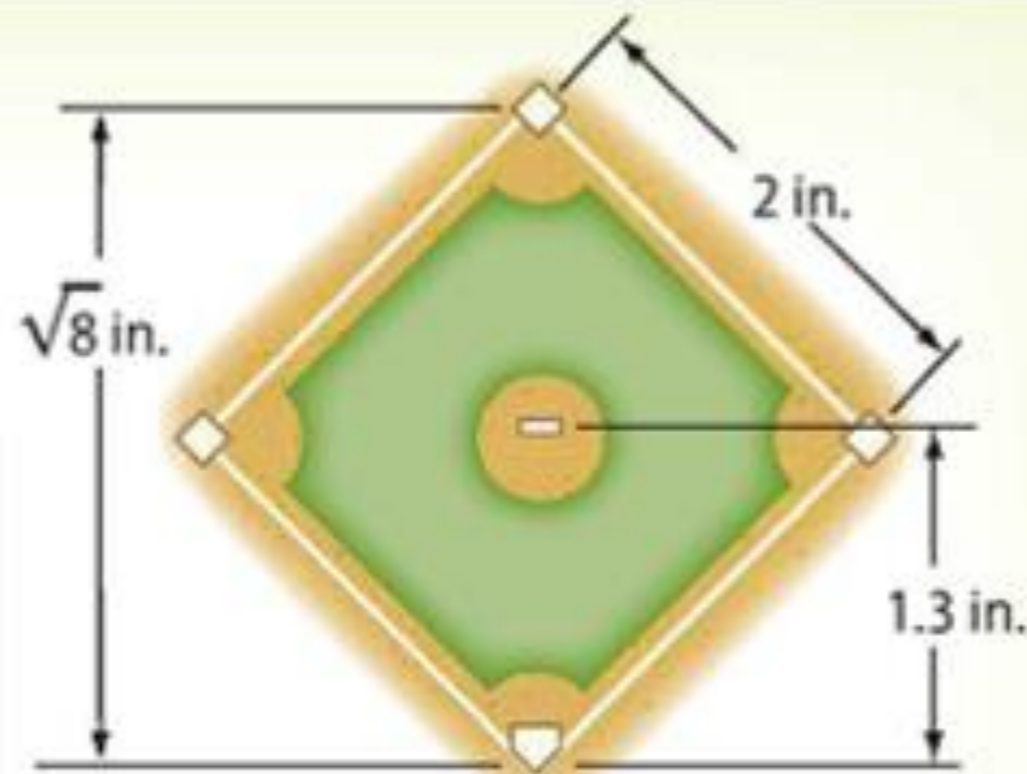
Content Standards

8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices

1, 3, 4, 6

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?





Real-World Link



Common Core State Standards

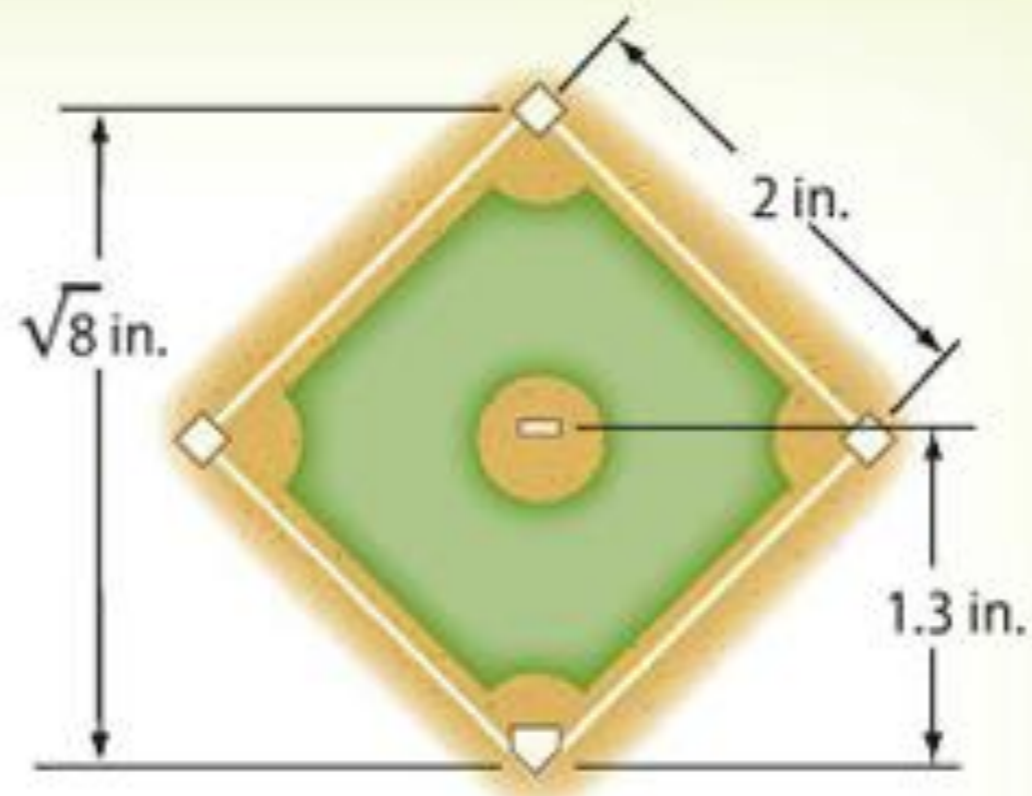
Content Standards

8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices

1, 3, 4, 6

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3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?





Doritos® & Cheetos® Mix **20** Singles

DORITOS® Nacho Cheese Flavored Tortilla Chips 1 OZ. EA. DORITOS® COOL RANCH® Flavored Tortilla Chips 1 OZ. EA. CHEETOS® Puffs Cheese Flavored Snacks 7/8 OZ. EA. CHEETOS® Crunchy Cheese Flavored Snacks 1 OZ. EA.

20 INDIVIDUAL BAGS: 7/8 OZ. EACH, 1 OZ. EACH, TOTAL NET WT. 19 5/8 OZ. (1 LB. 3 5/8 OZ.) 556.3 g ⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

THINKING TIME

- Why did many of you expect there to be five of each?
- Why was it not five of each?
- How might they decide on this combination?



Classic Mix

20
Singles

LAY'S® Classic Potato Chips. DORITOS® Nacho Cheese Flavored Tortilla Chips. DORITOS® COOL RANCH® Flavored Tortilla Chips. CHEETOS® Crunchy Cheese Flavored Snacks. SUNCHIPS® Original Multigrain Snacks. FRITOS® Original Corn Chips (All 1 OZ. Each)

20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g

⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

GOALS

HOW DO WE MAKE SENSE OF MATH MODELING?

IS IT JUST ANSWERING QUESTIONS?

HOW DO YOU PROFIT FROM MATH MODELING?

HOW DO WE HELP OUR STUDENTS IMPROVE?

WHERE CAN WE FIND MORE RESOURCES?



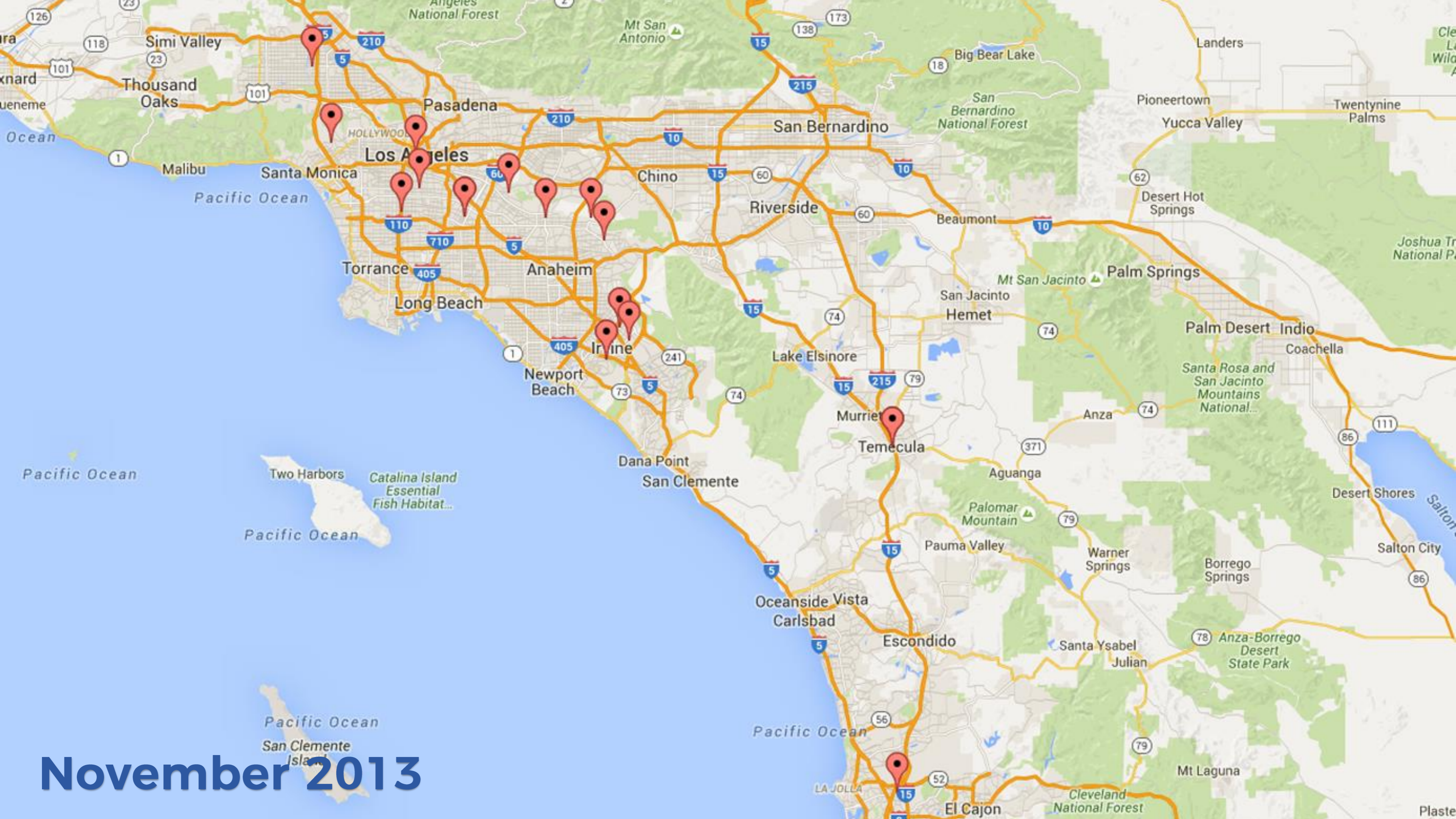




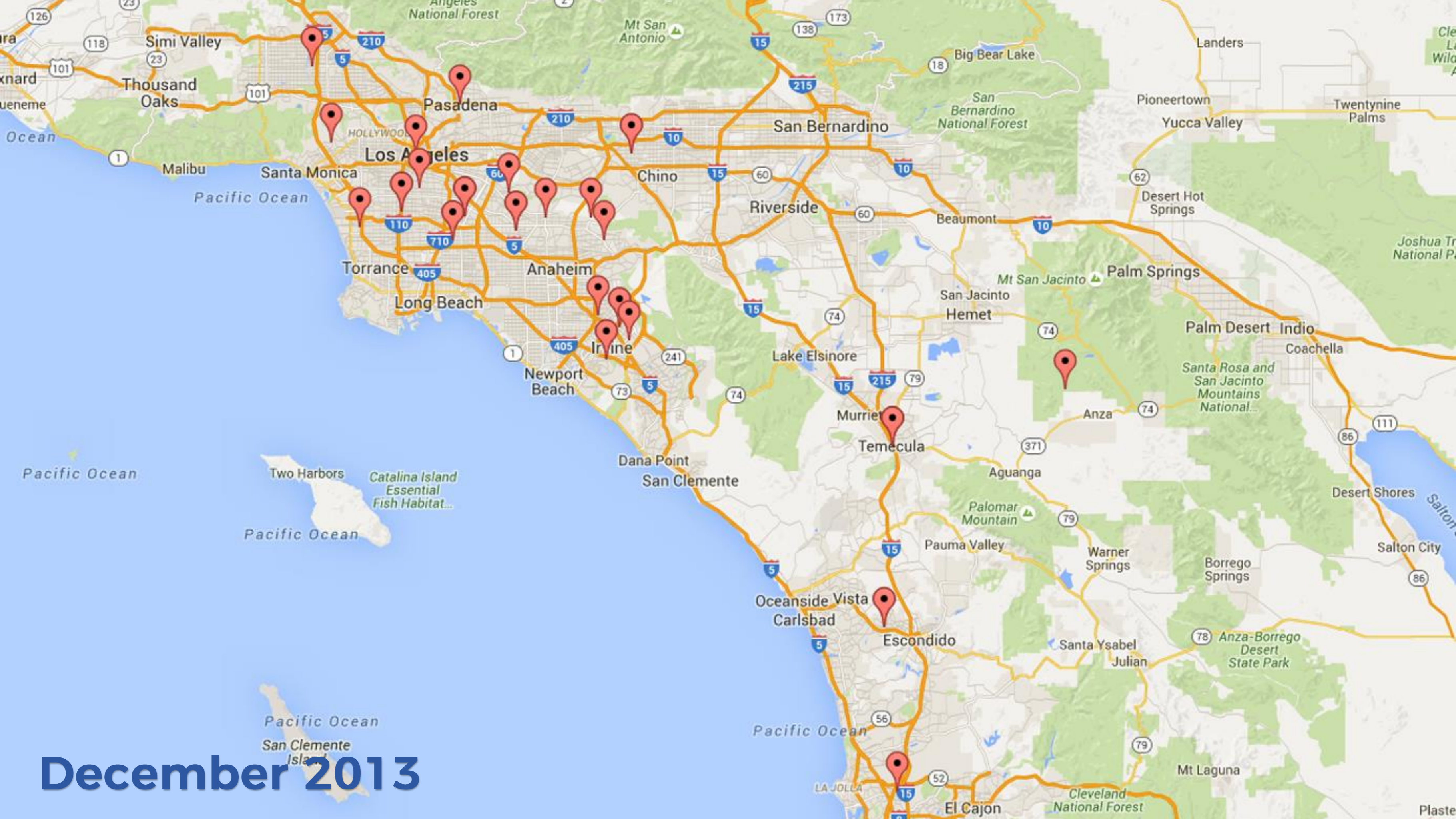
Spies

Analysts

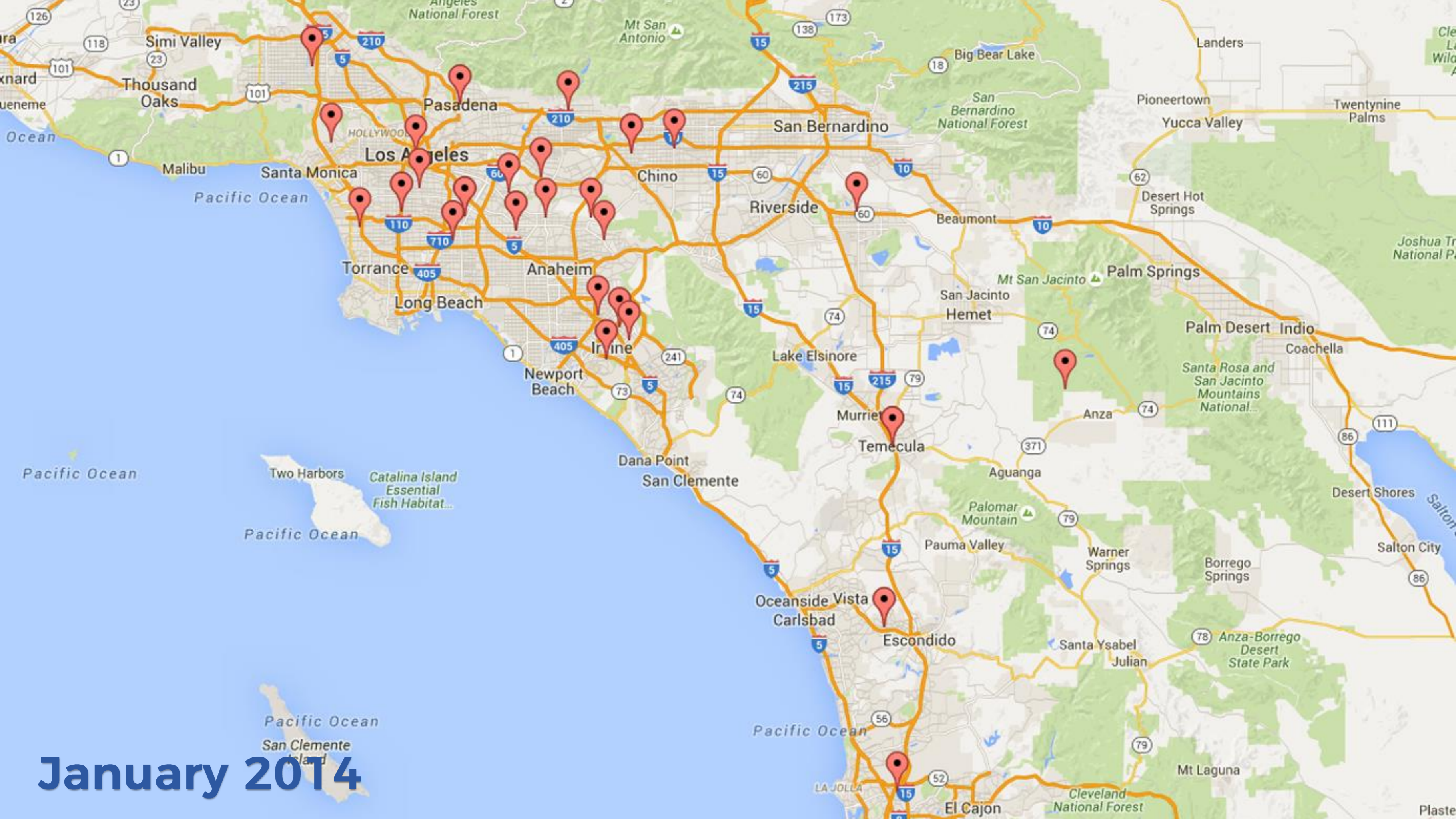
Model



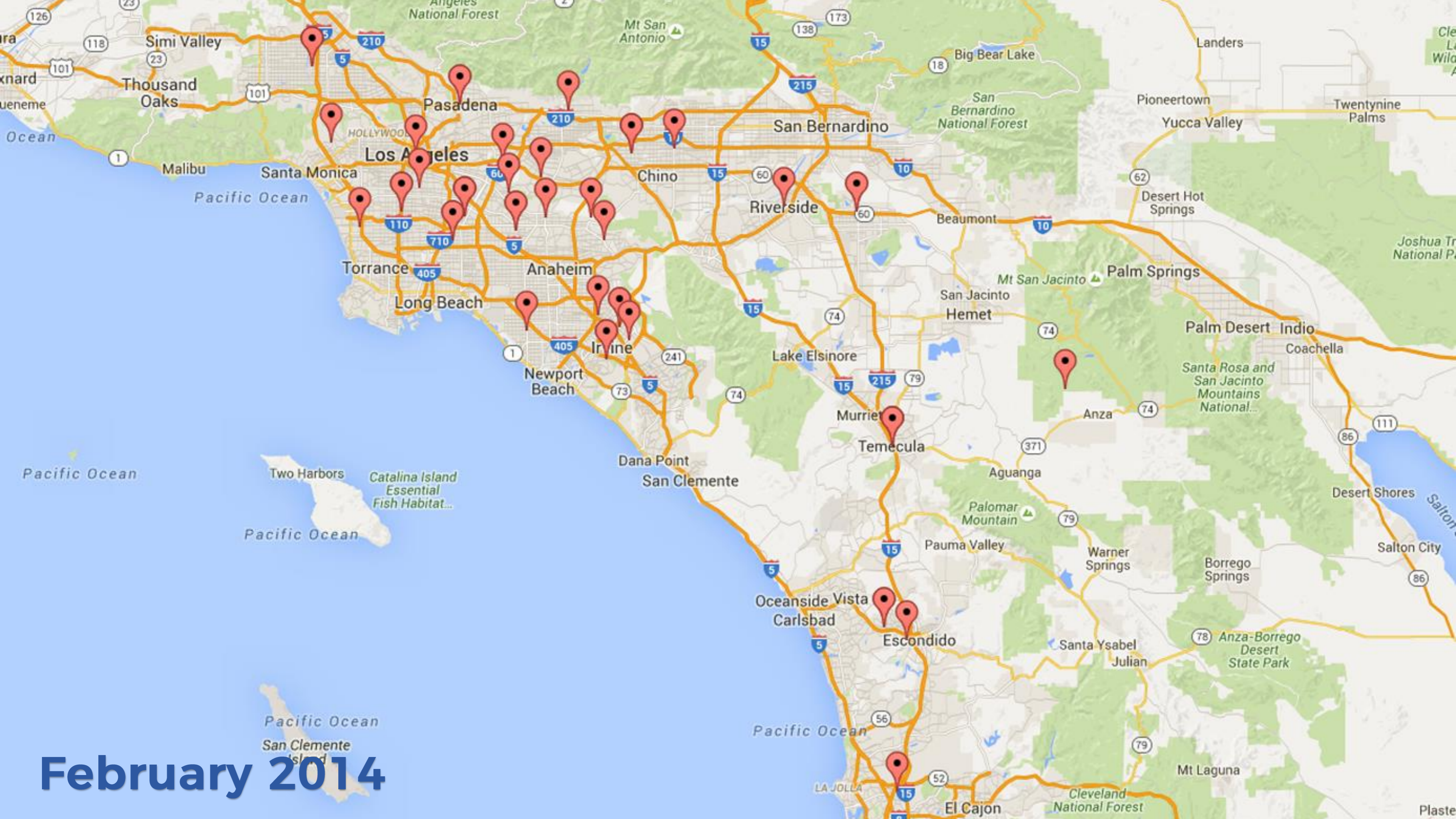
November 2013



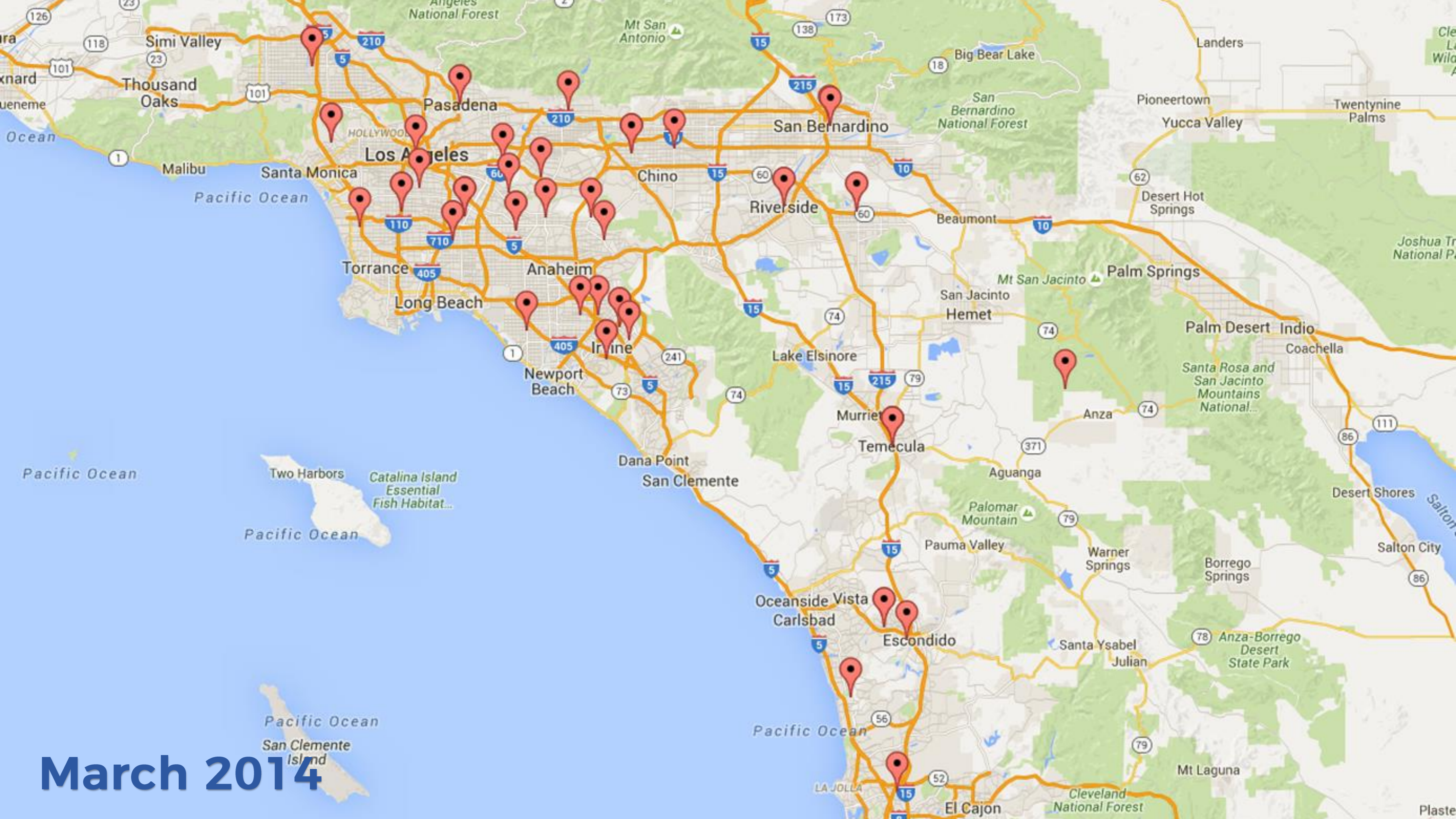
December 2013



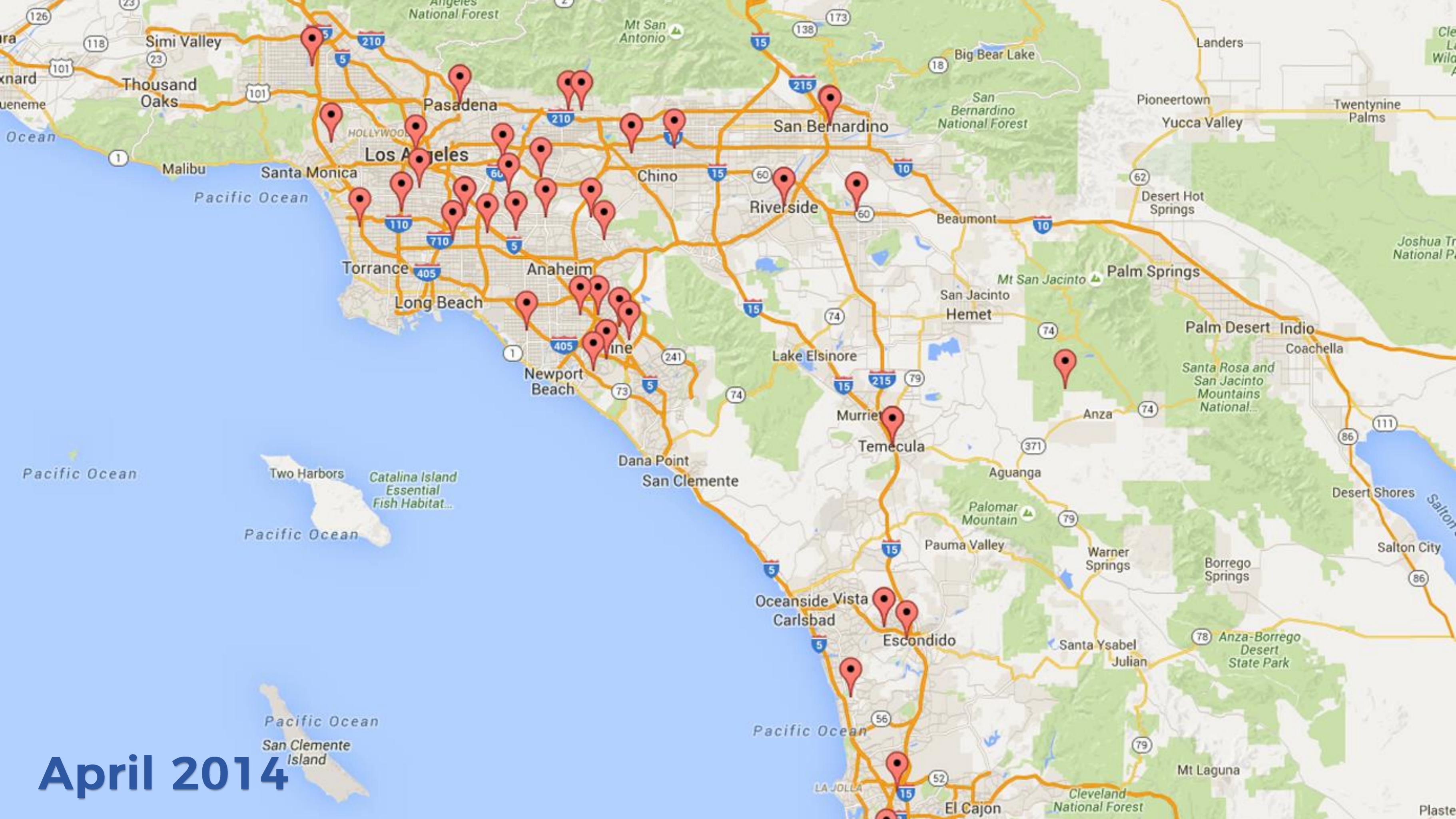
January 2014



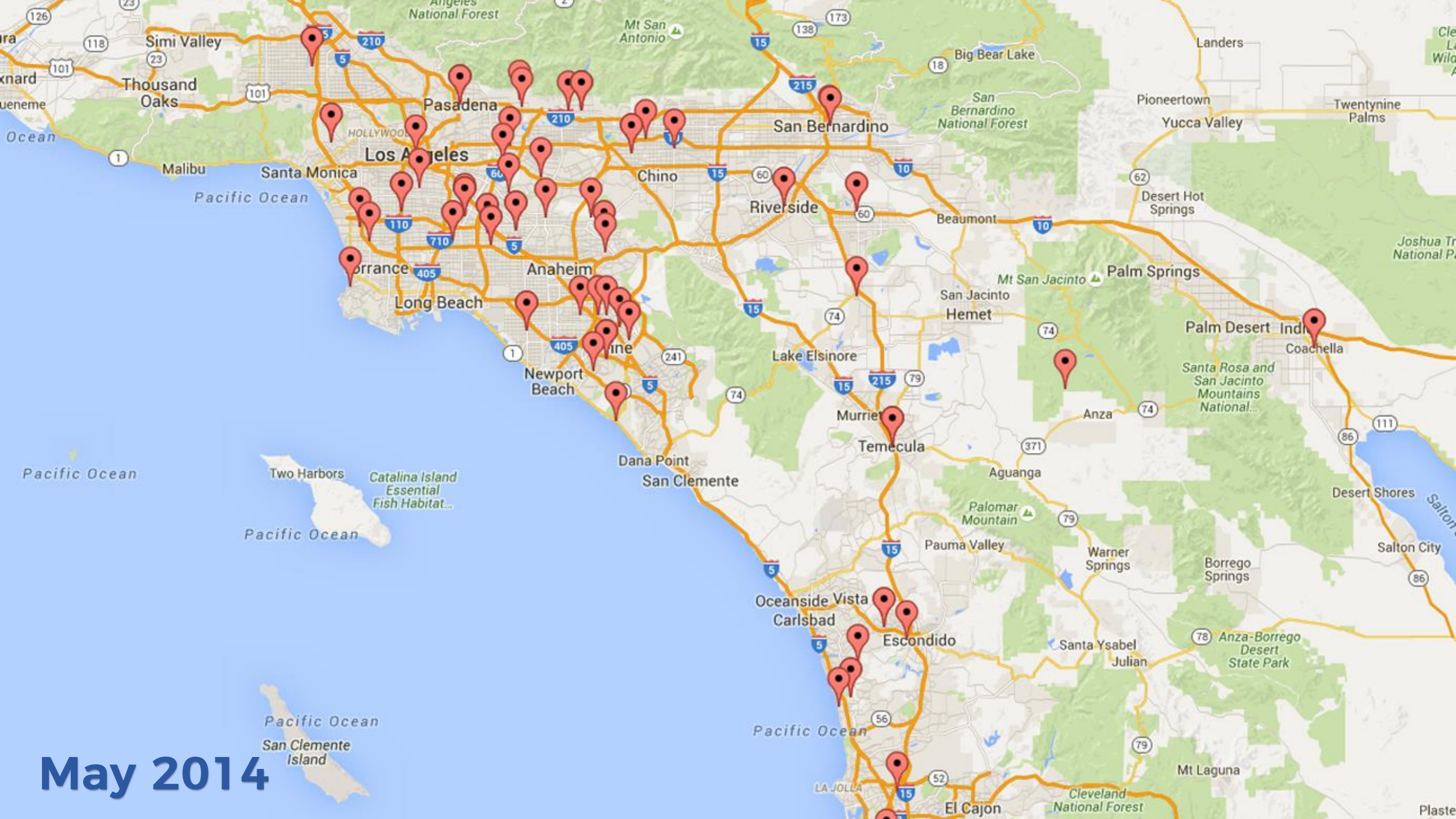
February 2014



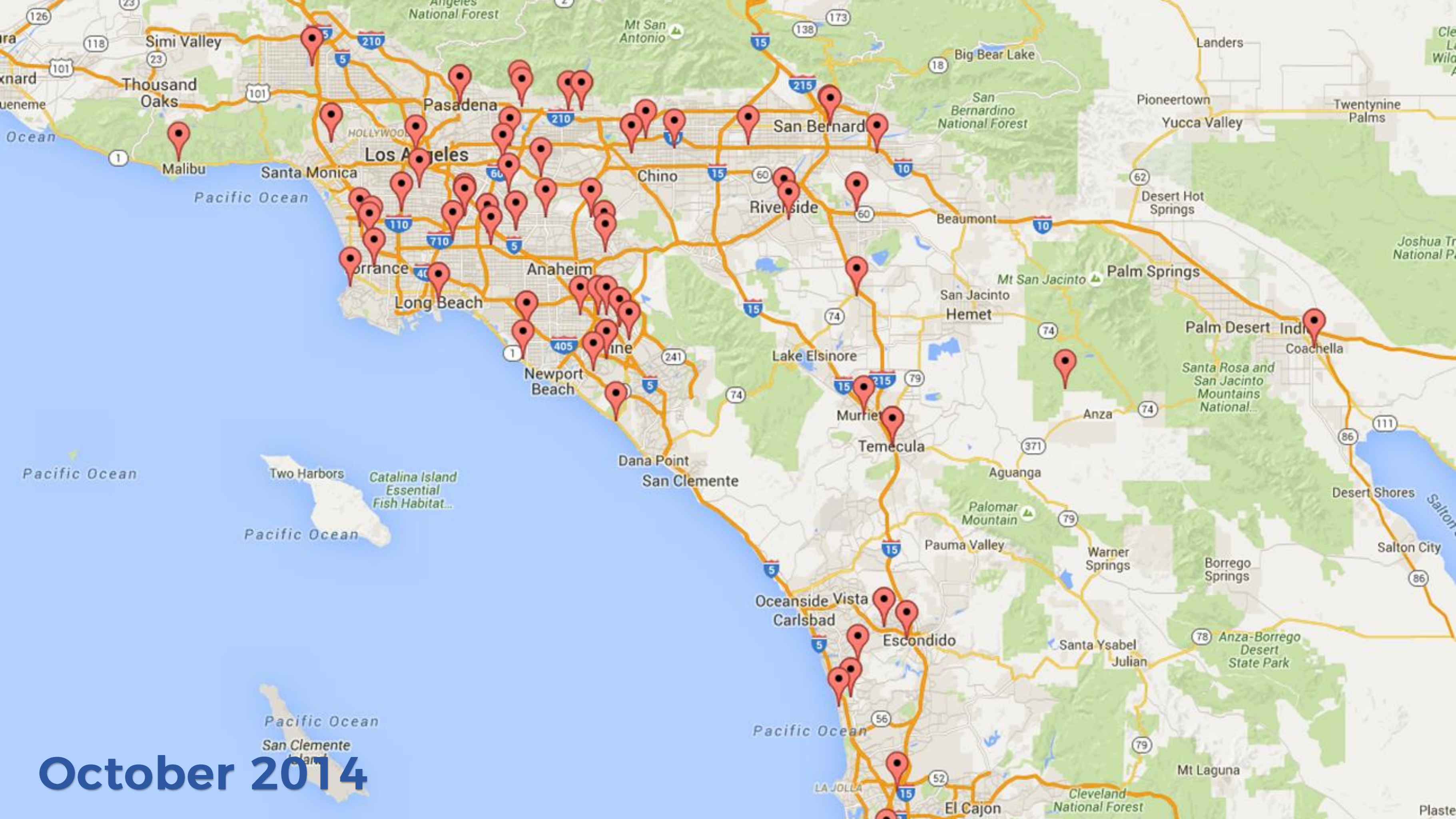
March 2014



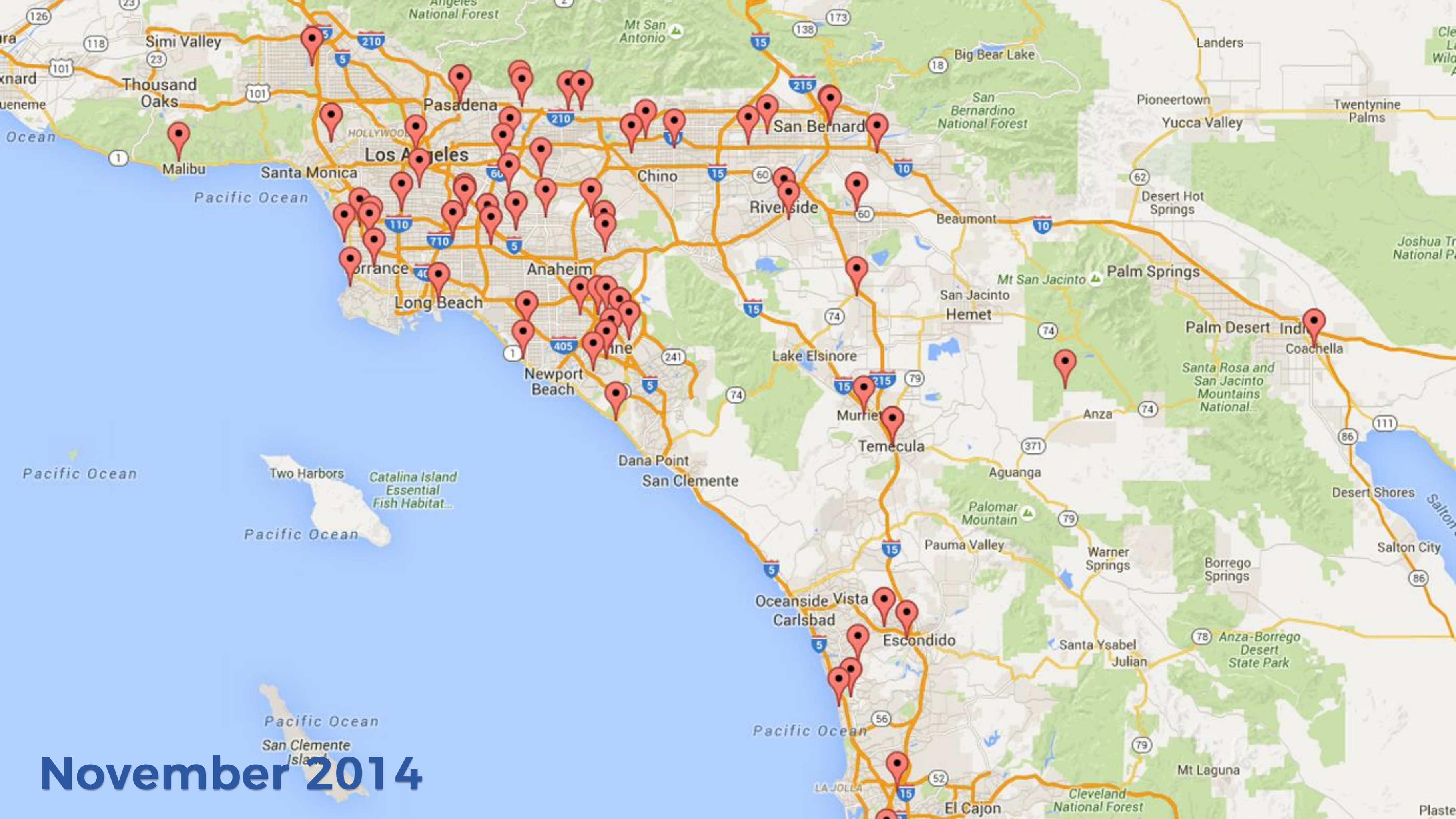
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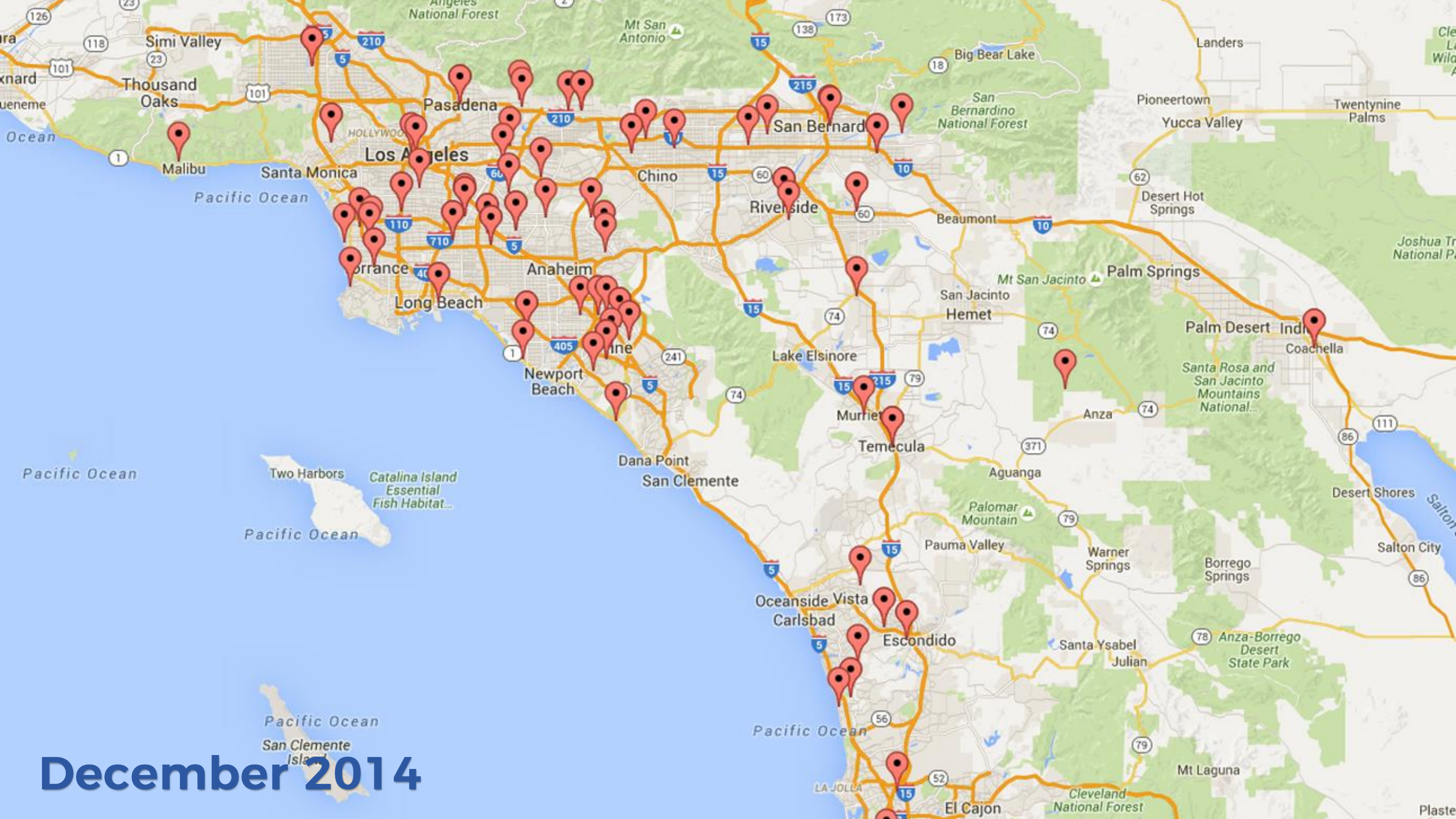
May 2014



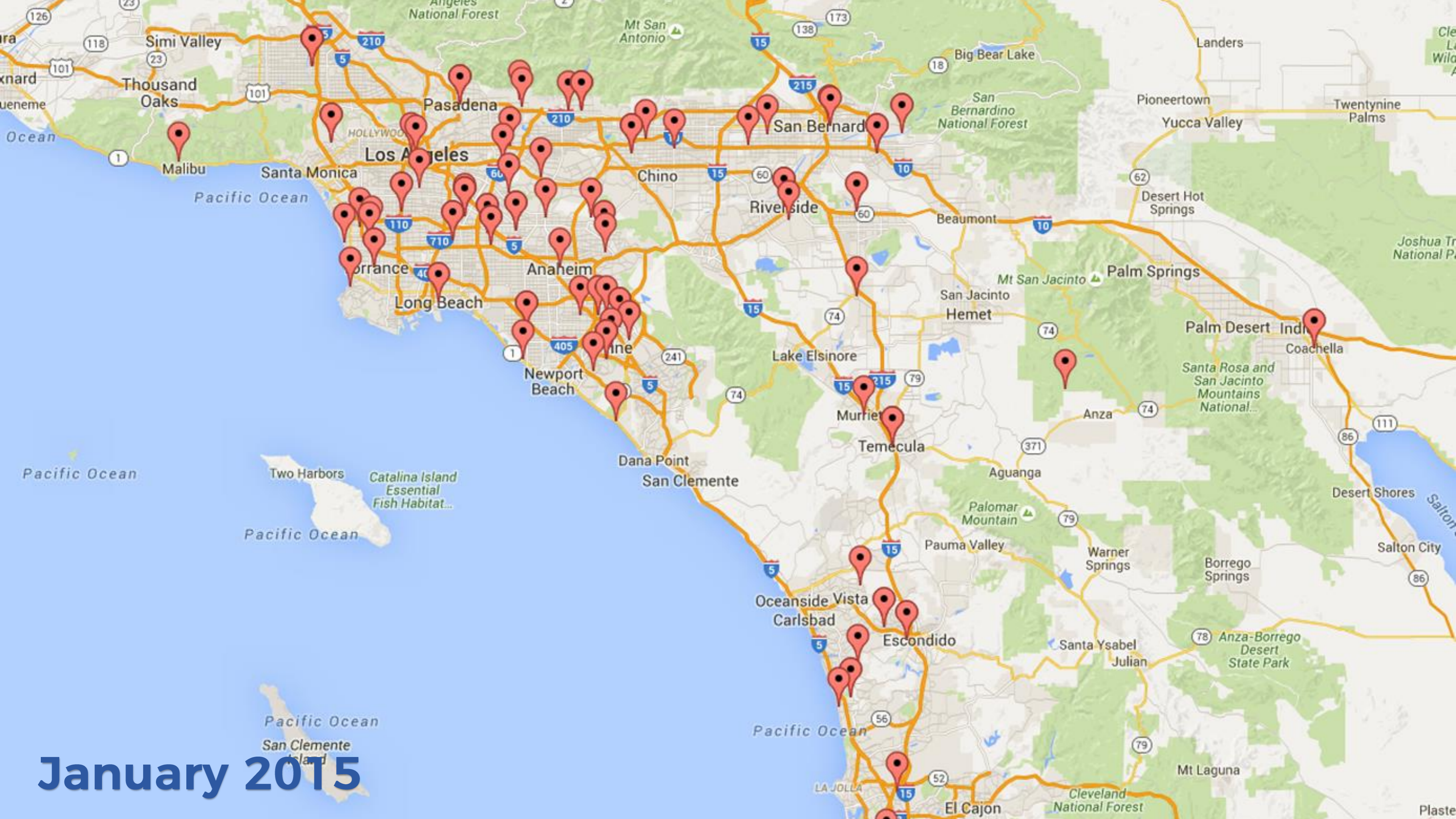
October 2014



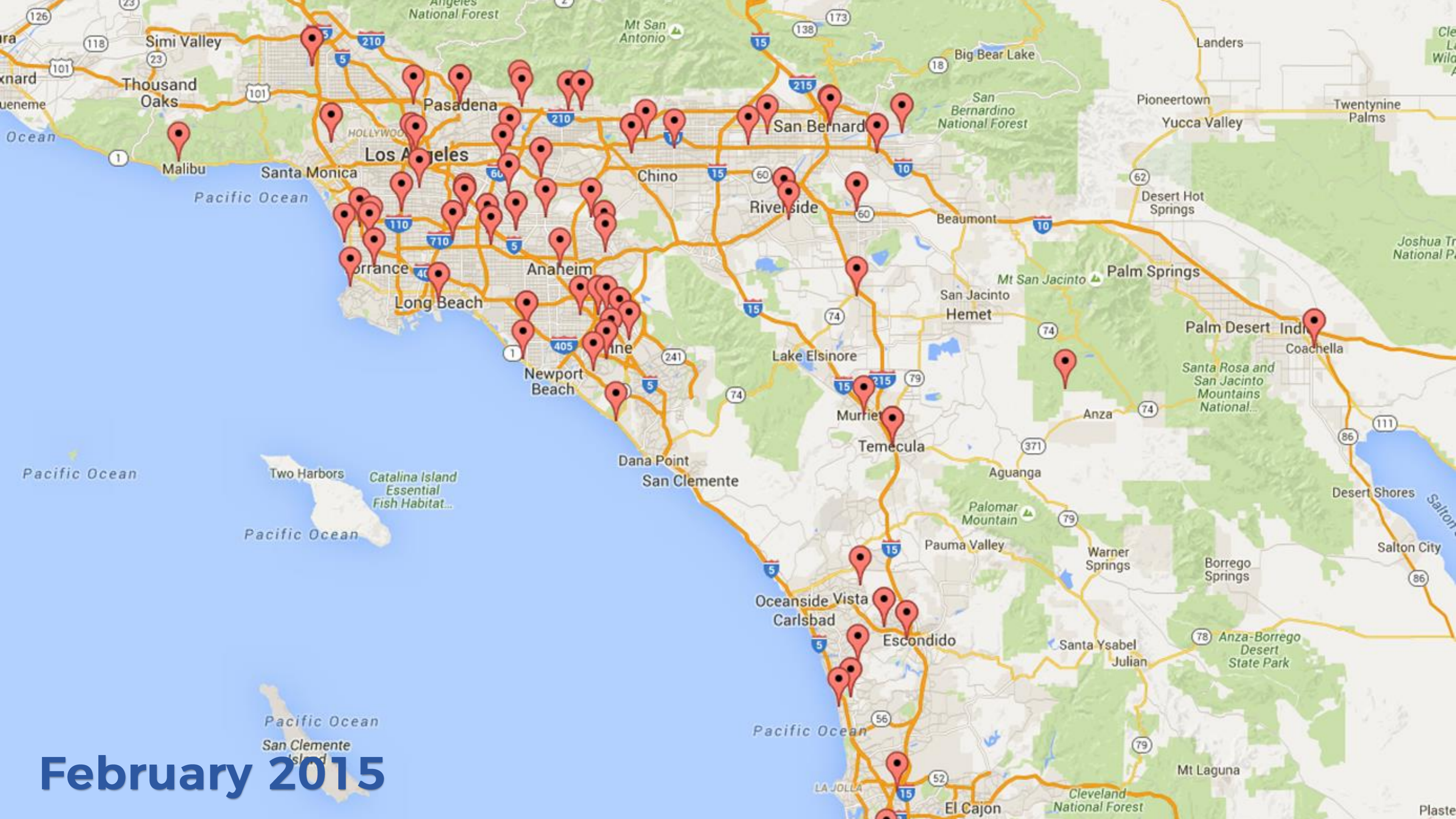
November 2014



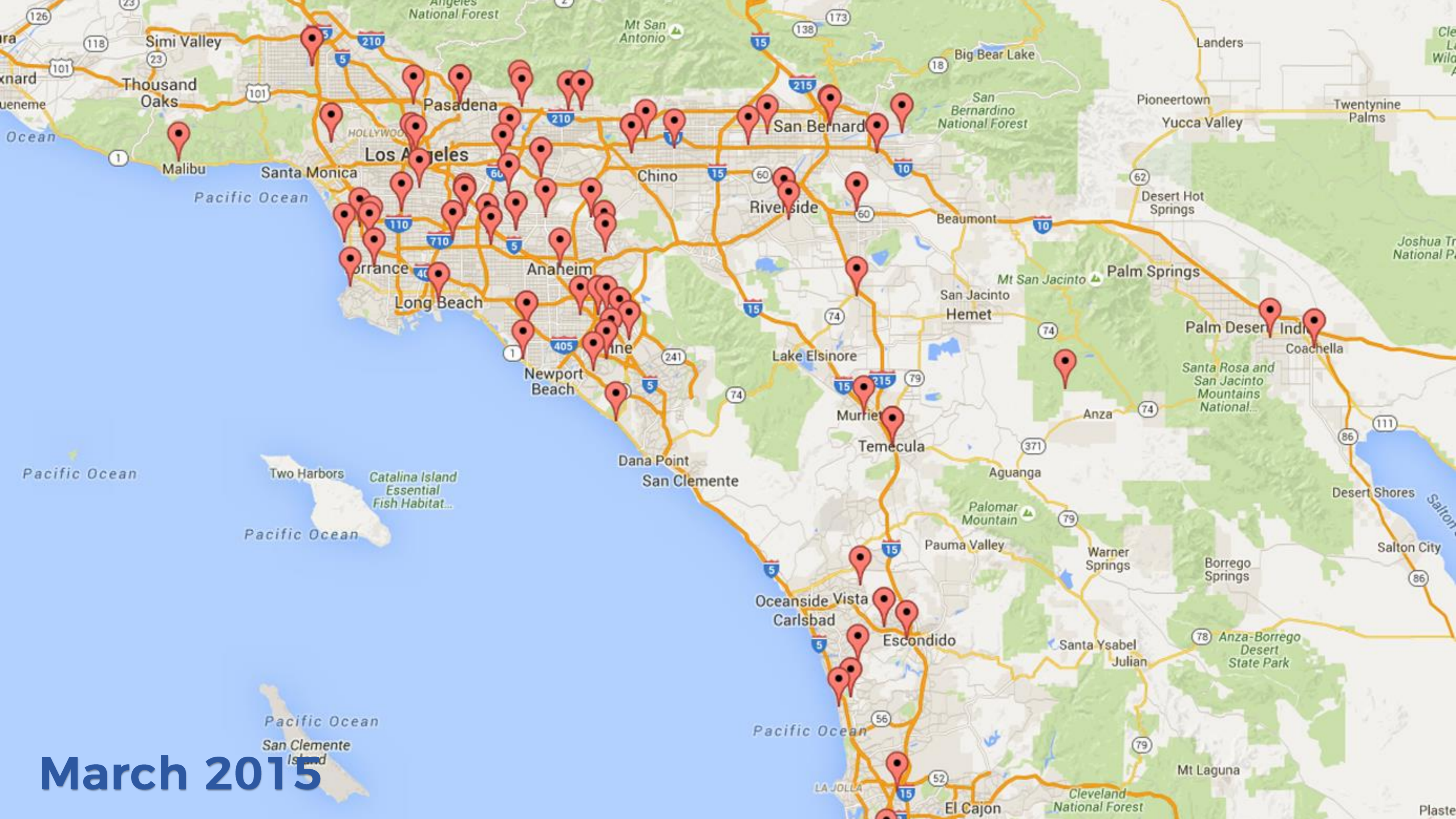
December 2014



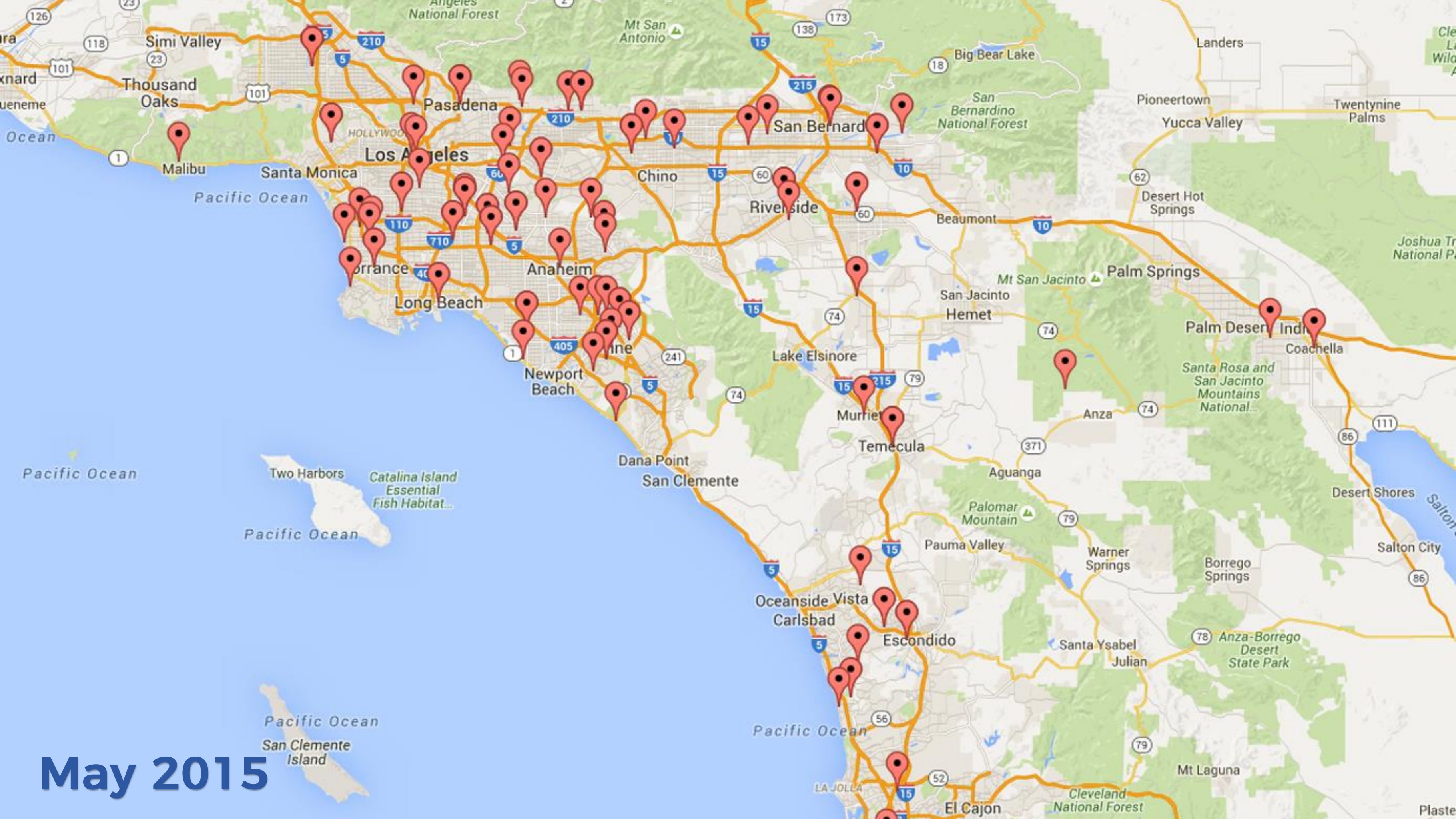
January 2015



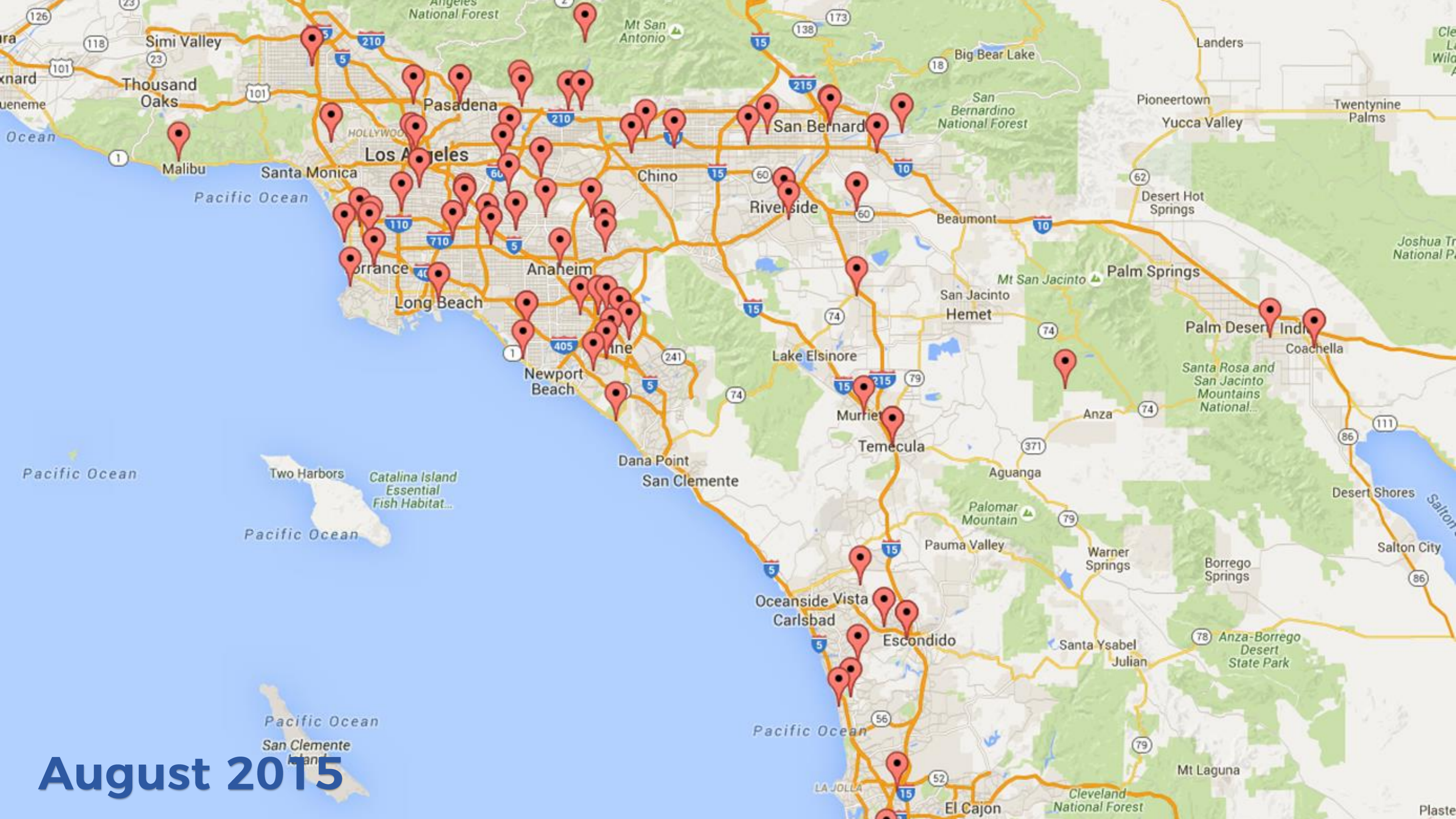
February 2015



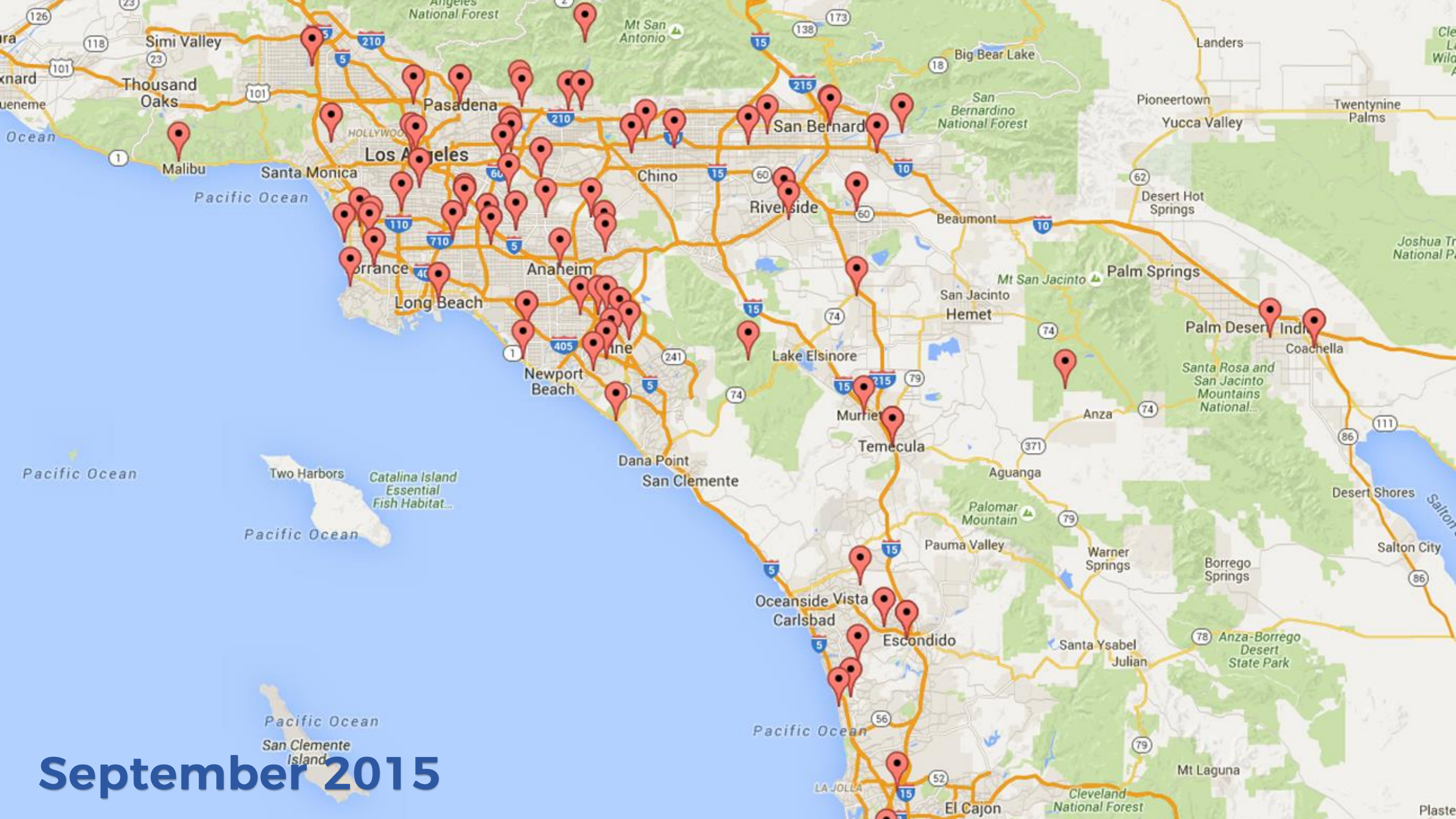
March 2015



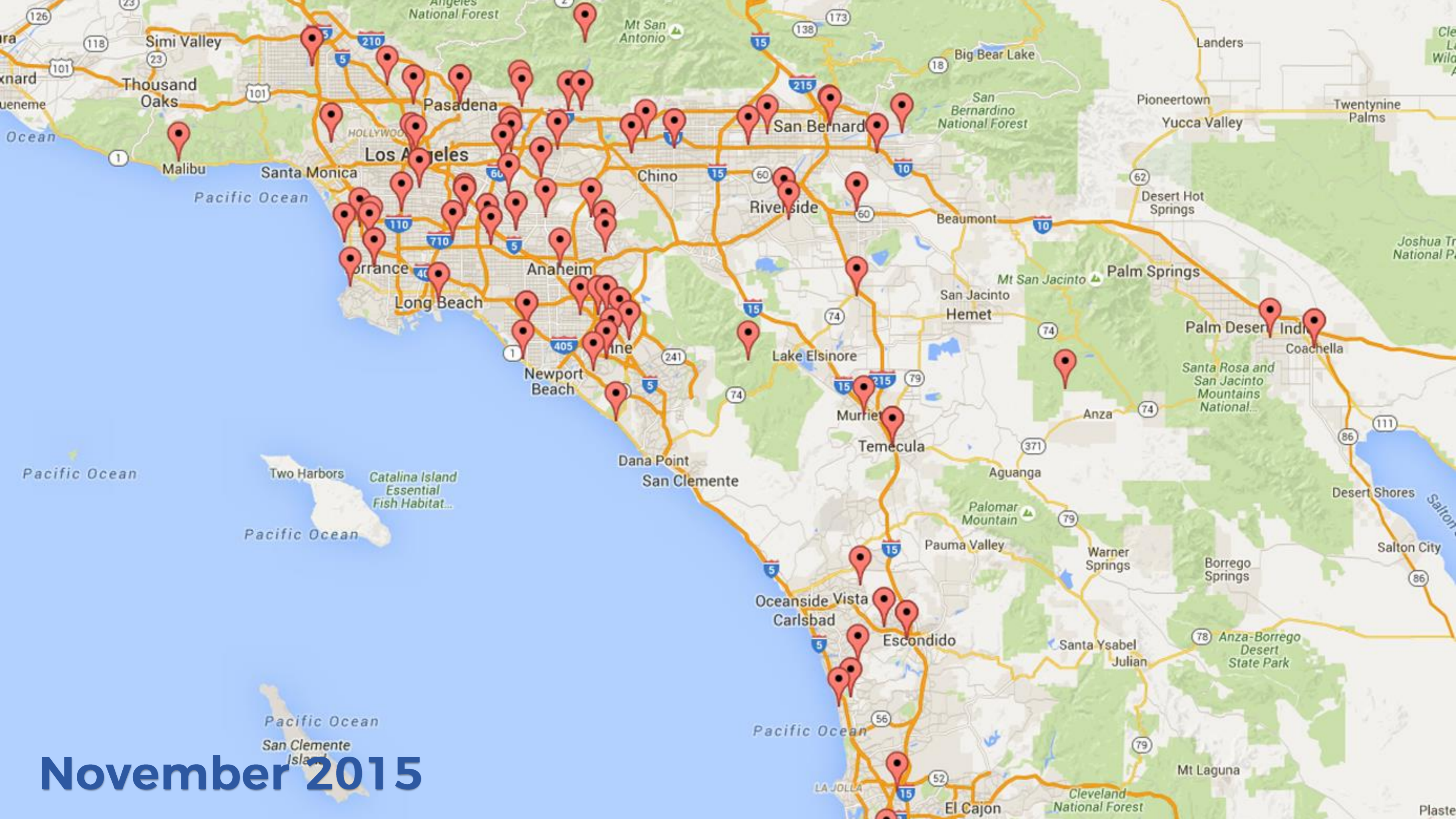
May 2015



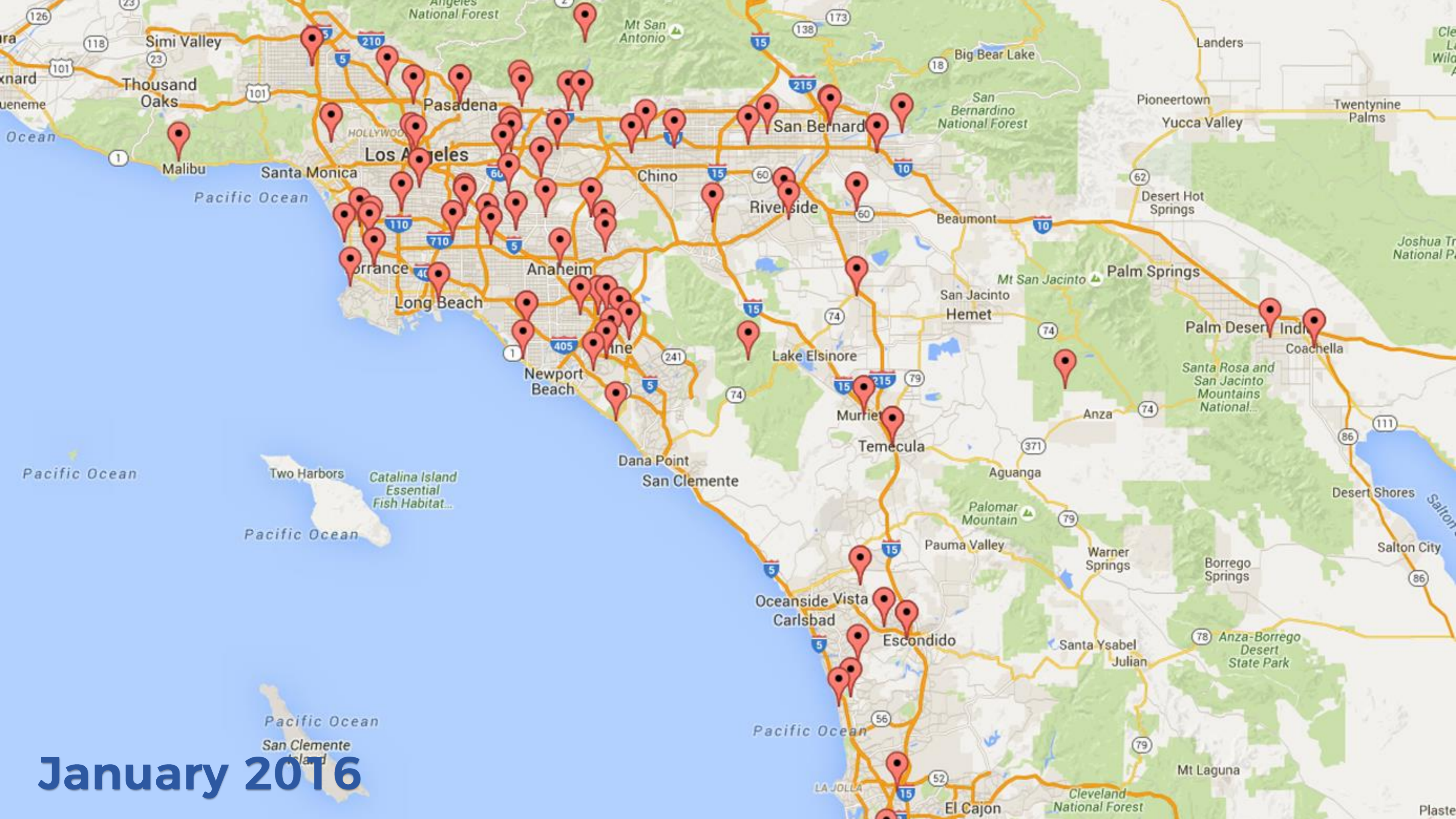
August 2015



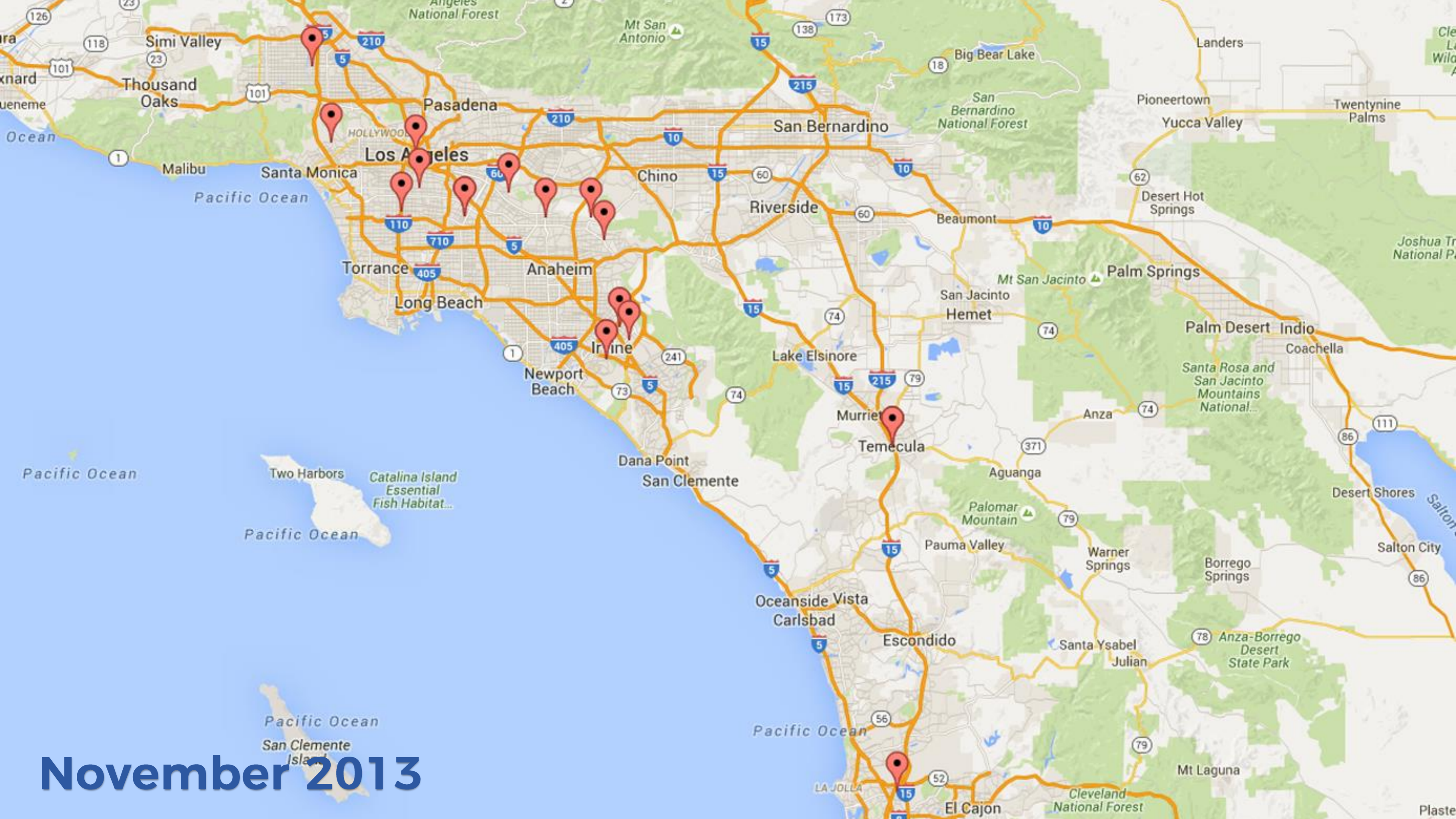
September 2015



November 2015



January 2016



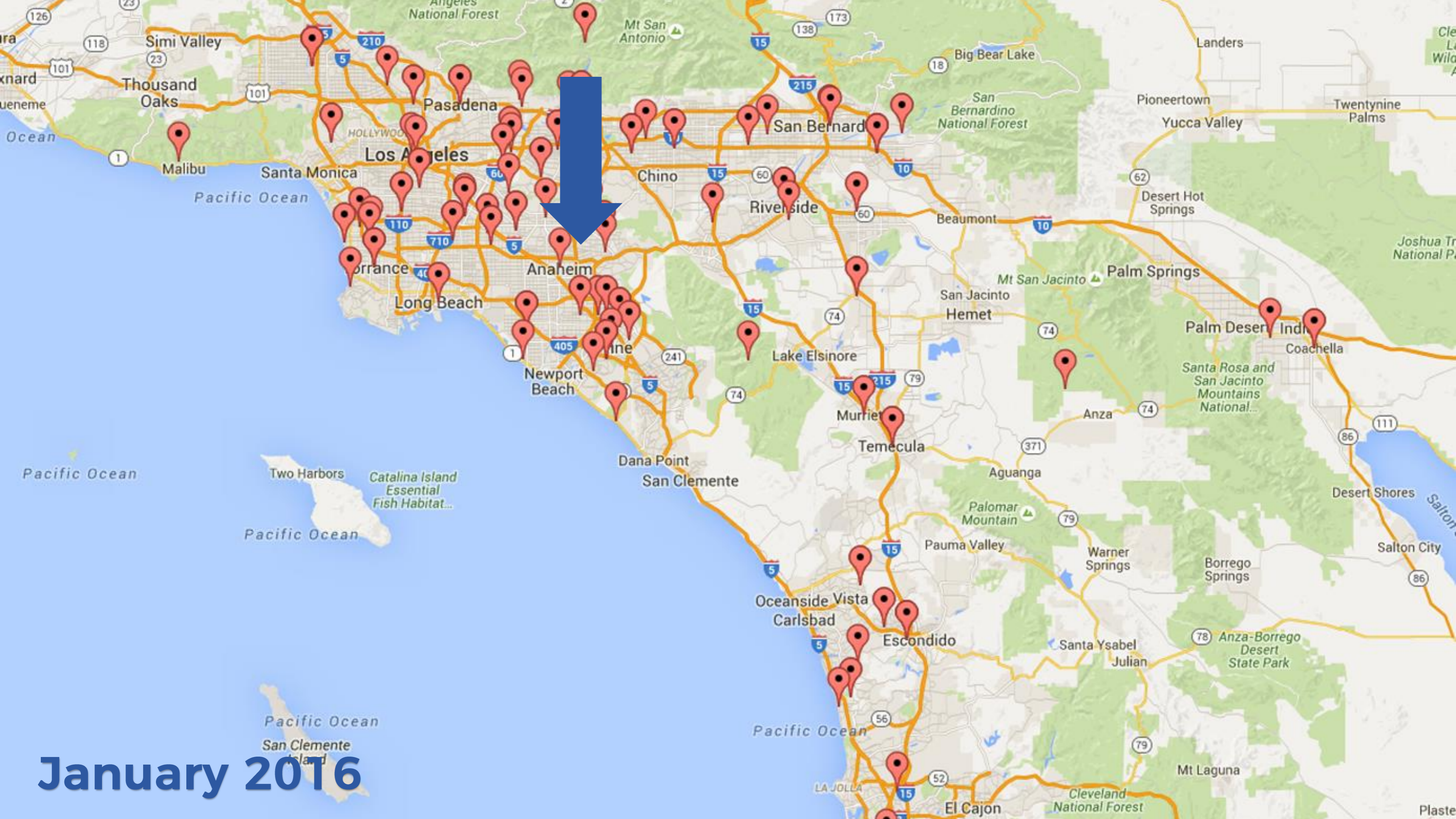
November 2013



Spies

Analysts

Model

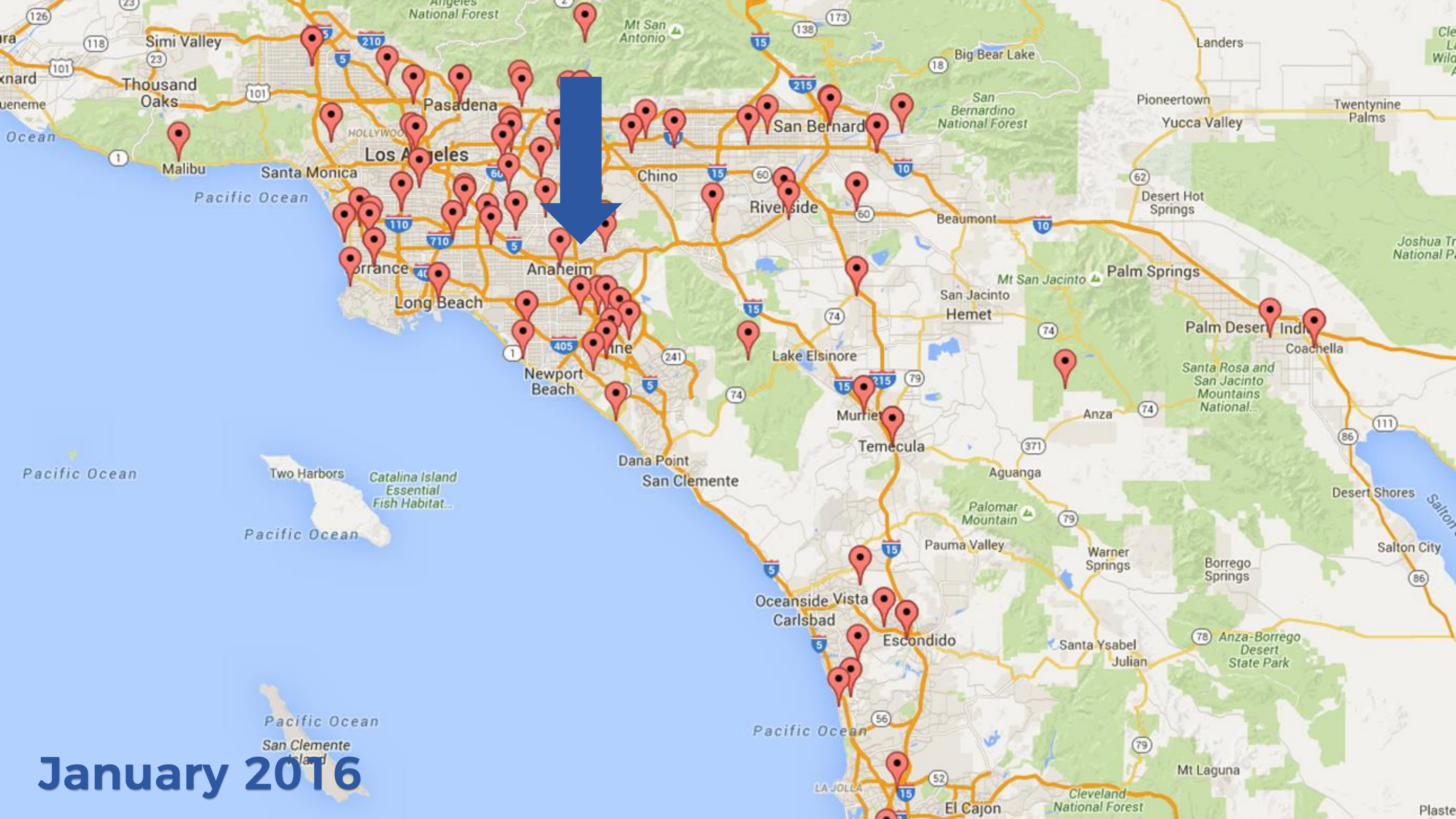


January 2016


Spies

Analysts

Model



January 2016



All models are
wrong, but some
are useful.

GEORGE E. P. BOX



Classic Mix

20
Singles

LAY'S® Classic Potato Chips, DORITOS® Nacho Cheese Flavored Tortilla Chips, DORITOS® COOL RANCH® Flavored Tortilla Chips, CHEETOS® Crunchy Cheese Flavored Snacks, SUNCHIPS® Original Multigrain Snacks, FRITOS® Original Corn Chips (All 1 OZ. Each)

20 INDIVIDUAL BAGS: 1 OZ. EACH, TOTAL NET WT. 20 OZ. (1 LB. 4 OZ.) 567 g

⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.



Spies

Analysts

Model

THINKING TIME

EASY TO STORE.



Classic Mix **20**
Singles

4 LAY'S® Classic Potato Chips, 4 DORITOS® Nacho Cheese Flavored Tortilla Chips, 2 DORITOS® COOL RANCH® Flavored Tortilla Chips, 4 CHEETOS® Crunchy Cheese Flavored Snacks, 2 SUNCHIPS® Original Multigrain Snacks, 4 FRITOS® Original Corn Chips (All 1 OZ. Each)
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Robert Kaplinsky

@robertkaplinsky



Hey #MTBoS, can you do me a favor and complete this 3 question anonymous survey about your favorite chips? I need data for a presentation. Please RT.

goo.gl/forms/etPtujll... #iteachmath



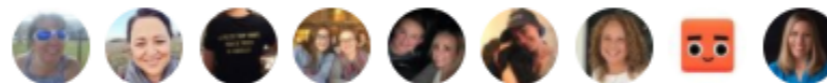
Favorite Chips

Please complete this anonymous survey. I'll be using this data in a presentation.

docs.google.com

8:05 PM - 4 Feb 2018

63 Retweets **45** Likes



18

63

45



Favorite Chips (Responses)

File Edit View Insert Format Data Tools Form Add-ons Help

Comments

Share

100%
 \$ % .0 .00 123
Arial
10
B *I* ~~U~~ A

...

fx Timestamp

	A	B	C	D	E	F	G	H
1	Timestamp	Lays (Classic)	Doritos (Nacho Cheese)	Doritos (Cool Ranch)	Cheetos (Crunchy)	Sun Chips (Original)	Fritos (Original)	Time Zone
2	2/4/2018 20:06:53	6	5	4	2	3	1	Central Time Zone
3	2/4/2018 20:06:55	1	5	6	3	2	4	Eastern Time Zone
4	2/4/2018 20:06:56	5	2	1	3	6	4	Central Time Zone
5	2/4/2018 20:06:57	2	1	6	3	5	4	Pacific Time Zone
6	2/4/2018 20:07:36	4	1	2	3	5	6	Pacific Time Zone
7	2/4/2018 20:08:02	5	1	6	4	2	3	Pacific Time Zone
8	2/4/2018 20:08:05	6	2	4	3	5	1	Pacific Time Zone
9	2/4/2018 20:08:07	4	2	1	5	3	6	Pacific Time Zone
10	2/4/2018 20:08:29	5	3	4	1	6	2	Central Time Zone
11	2/4/2018 20:08:56	4	5	6	1	2	3	Central Time Zone
12	2/4/2018 20:09:54	5	6	5	6	5	4	Pacific Time Zone
13	2/4/2018 20:10:01	4	2	3	1	5	6	Pacific Time Zone
14	2/4/2018 20:10:04	6	2	3	1	5	4	Central Time Zone
15	2/4/2018 20:10:04	3	5	6	1	4	2	Central Time Zone
16	2/4/2018 20:10:05	4	2	6	1	3	5	Eastern Time Zone
17	2/4/2018 20:10:06	3	2	6	5	1	2	Pacific Time Zone
18	2/4/2018 20:10:10	4	2	6	3	5	1	Mountain Time Zone
19	2/4/2018 20:10:12	3	1	5	6	2	4	Eastern Time Zone
20	2/4/2018 20:10:26	5	3	6	2	4	1	Pacific Time Zone

+ Sheet3

Explore

THINKING TIME

- The available data includes:
 - Lays, Nacho Cheese Doritos, Cool Ranch Doritos, Cheetos, Sun Chips, and Fritos ranked from 1 to 6
 - Geographic region: West, Central, or Eastern

ANALYSTS' JOB FOR THE TOP 1

1. **Count** all the first place votes for each chip type.
2. **Divide** the total first place votes for each chip type by the total number of votes.
3. **Multiply that fraction** by 20 to find how many bags there would be in a twenty pack, **rounding** as necessary.

ANALYSTS' EXAMPLE

CHIP BAG RESULTS

GOALS

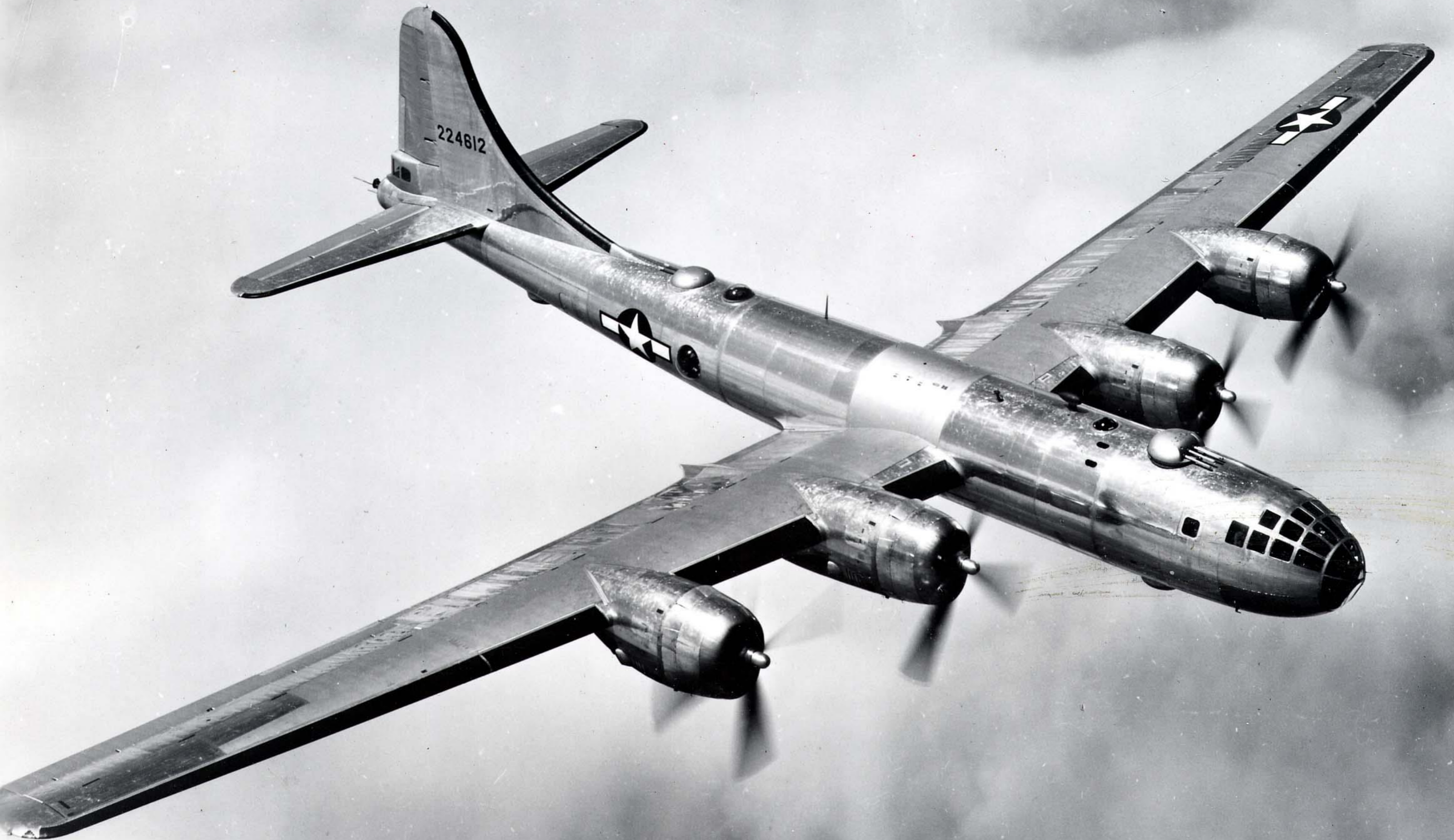
HOW DO WE MAKE SENSE OF MATH MODELING?

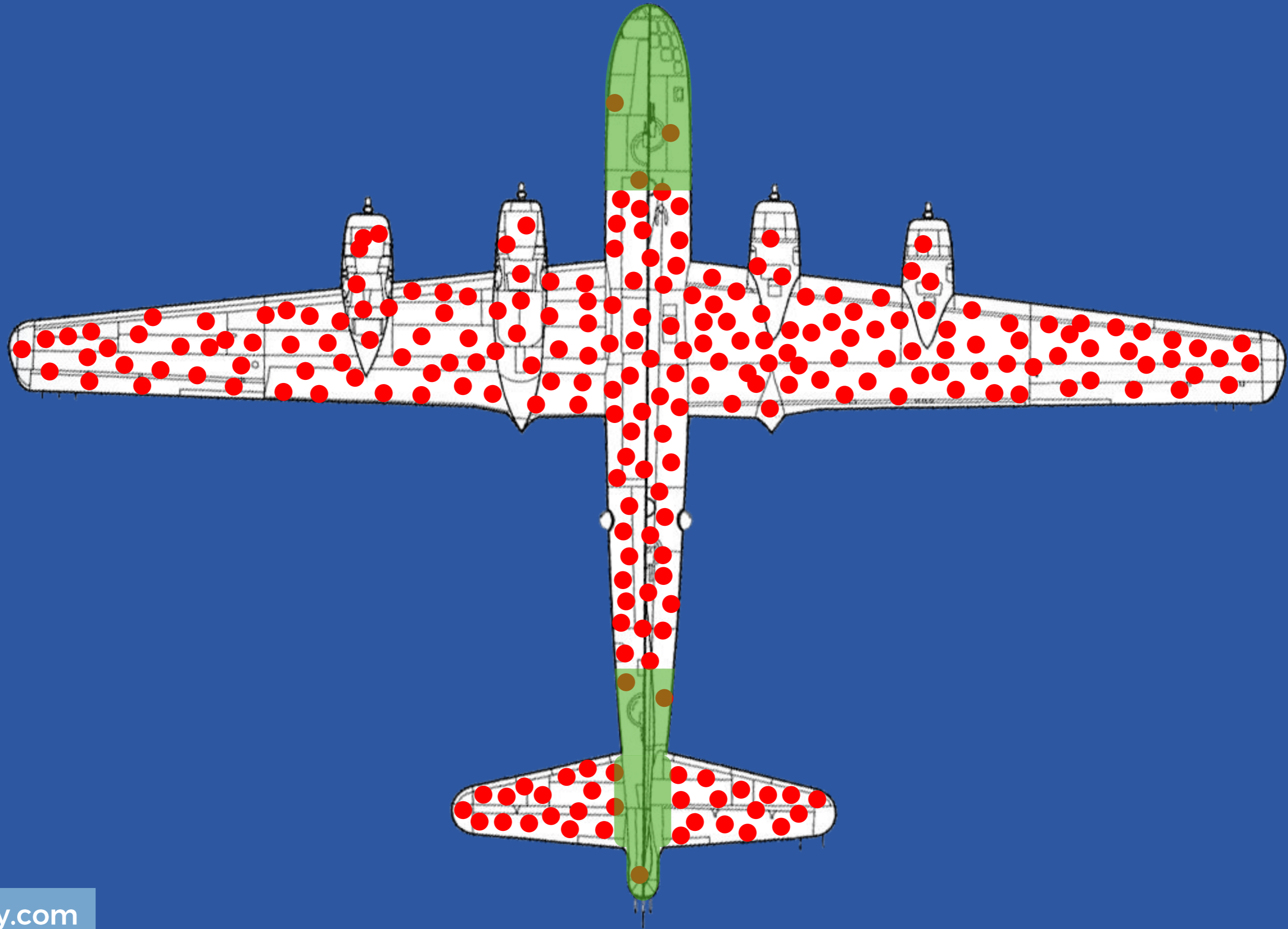
IS IT JUST ANSWERING QUESTIONS?

HOW DO YOU PROFIT FROM MATH MODELING?

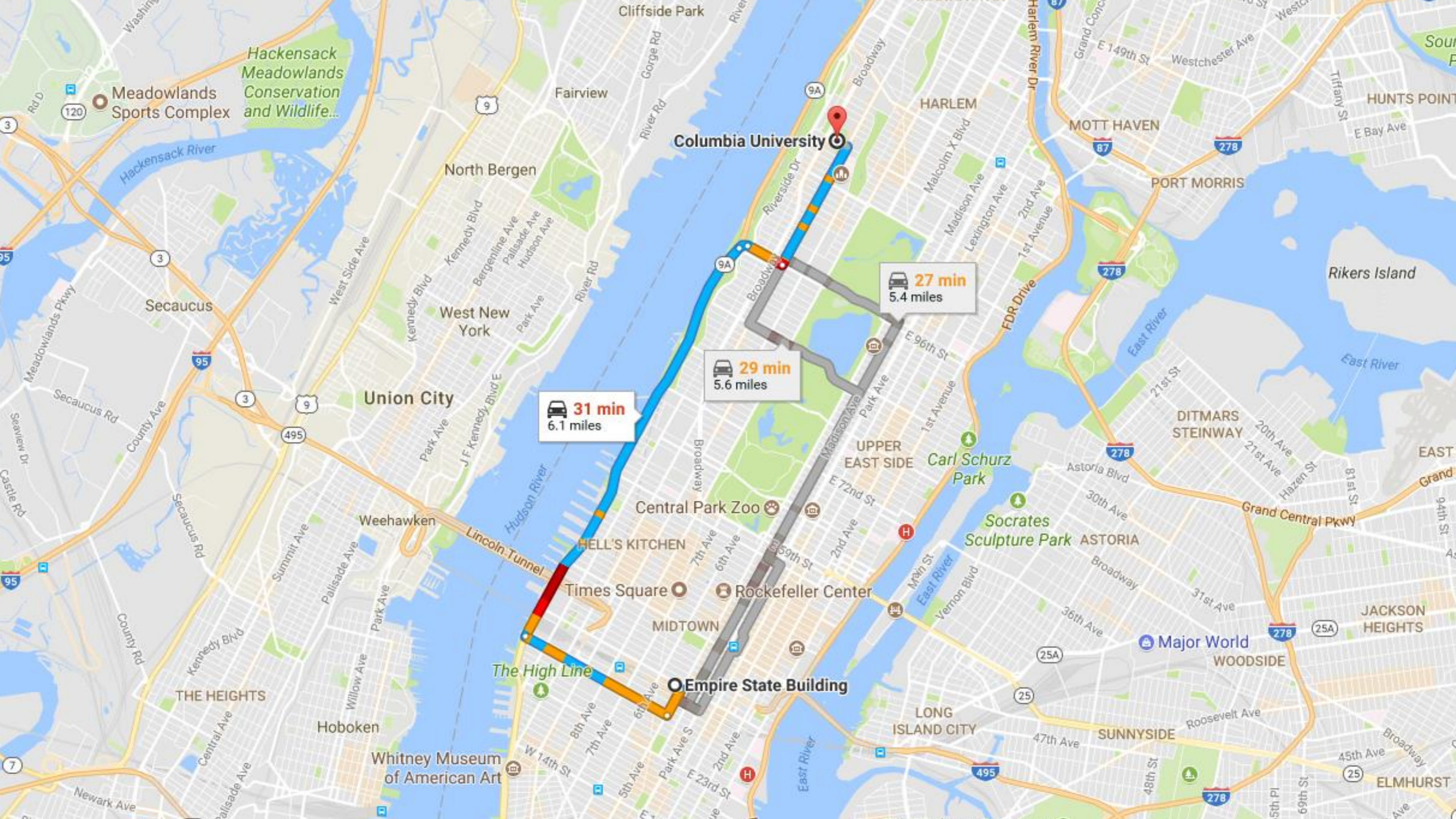
HOW DO WE HELP OUR STUDENTS IMPROVE?

WHERE CAN WE FIND MORE RESOURCES?





- ~~How do we protect our planes?~~
- ~~Which parts of the plane are being hit by the most bullets?~~
- Which parts of the plane are the most critical to protect?



Columbia University

Empire State Building

31 min
6.1 miles

29 min
5.6 miles

27 min
5.4 miles

- ~~How do we find the fastest route for each customer?~~
- How do we find the fastest route for each customer without impacting our other customers?



Classic Mix

20
Singles

4 LAY'S® Classic Potato Chips, 4 DORITOS® Nacho Cheese Flavored Tortilla Chips, 2 DORITOS® COOL RANCH® Flavored Tortilla Chips, 4 CHEETOS® Crunchy Cheese Flavored Snacks, 2 SUNCHIPS® Original Multigrain Snacks, 4 FRITOS® Original Corn Chips (All 1 OZ. Each)

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⚠ WARNING: PREVENT ENTANGLEMENT AND STRANGULATION. KEEP THIS BAG AWAY FROM YOUNG CHILDREN. IT IS NOT A TOY.

- ~~How many of each flavor should we put in a package?~~
- ~~How many of each flavor should we put in a package for each region?~~
- How can we determine if the extra cost of creating different packages will make us more money?

Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later.

CCSS MATH PRACTICE 4

They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

CCSS MATH PRACTICE 4

GOALS

HOW DO WE MAKE SENSE OF MATH MODELING?

IS IT JUST ANSWERING QUESTIONS?

HOW DO YOU PROFIT FROM MATH MODELING?

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WHERE CAN WE FIND MORE RESOURCES?




TARGET PARKING



Spies

Analysts

Model



They used 25 products for a pregnancy prediction' score including:

- **unscented lotion**
- **mineral supplements**
- **cotton balls**

Source: New York Times



UNITED



4047

B G →

A319
4047

B →

← G A

Spies

Analysts

Model

Priority is determined by:

- passenger's fare class
- itinerary
- frequent flyer program membership
- check-in time

Source: United Airlines



Search



Robert

Home



Robert Kaplinsky

News Feed

Messenger

Watch

Marketplace

Explore

Pages

Events

Groups

Friend Lists

On This Day 3

Insights

Games 7

Fundraisers

Live Video

Pokes

See More...

Create

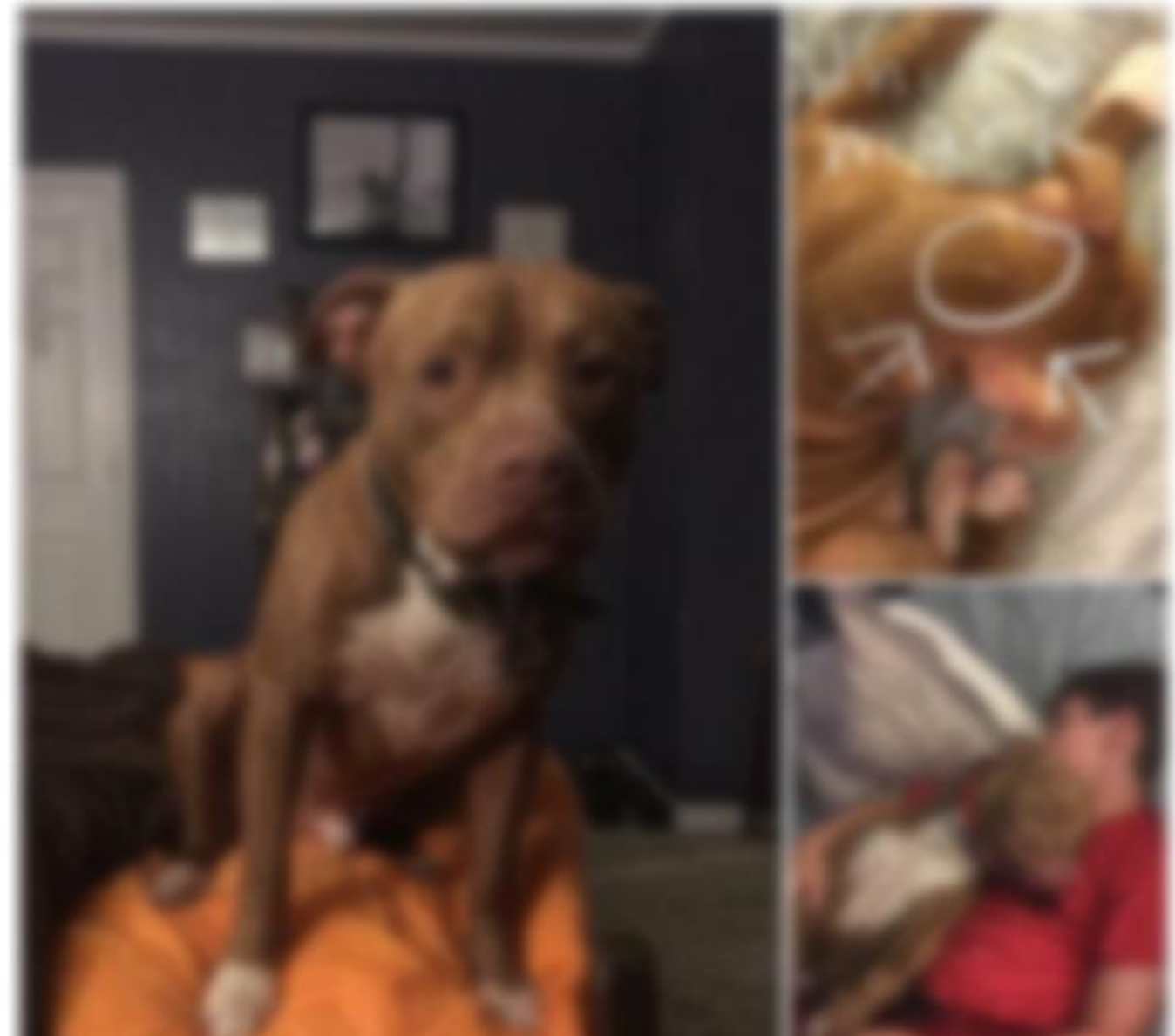
Ad · Page · Group · Event · Fundraiser

Make Post | Photo/Video Album | Live Video

What's on your mind, Robert?

Photo/Video | Feeling/Activity | ...

Ad Schedule...
Missing this dog gets back to his family



News Center

Trending

- James Madison: The Disappearance of James and Isabella's Personal Email Server
- Fredericksburg, Virginia: Mother recovering from copperhead snake bite at Virginia Wildlife
- Anthony Weiner: Anthony Weiner Sentenced to 21 Months in Prison

Watchlist: Latest Episodes

- Episode 1: The Making of a Legend
- Episode 2: The Making of a Legend
- Episode 3: The Making of a Legend

See All

Sponsored Create Ad



Spies

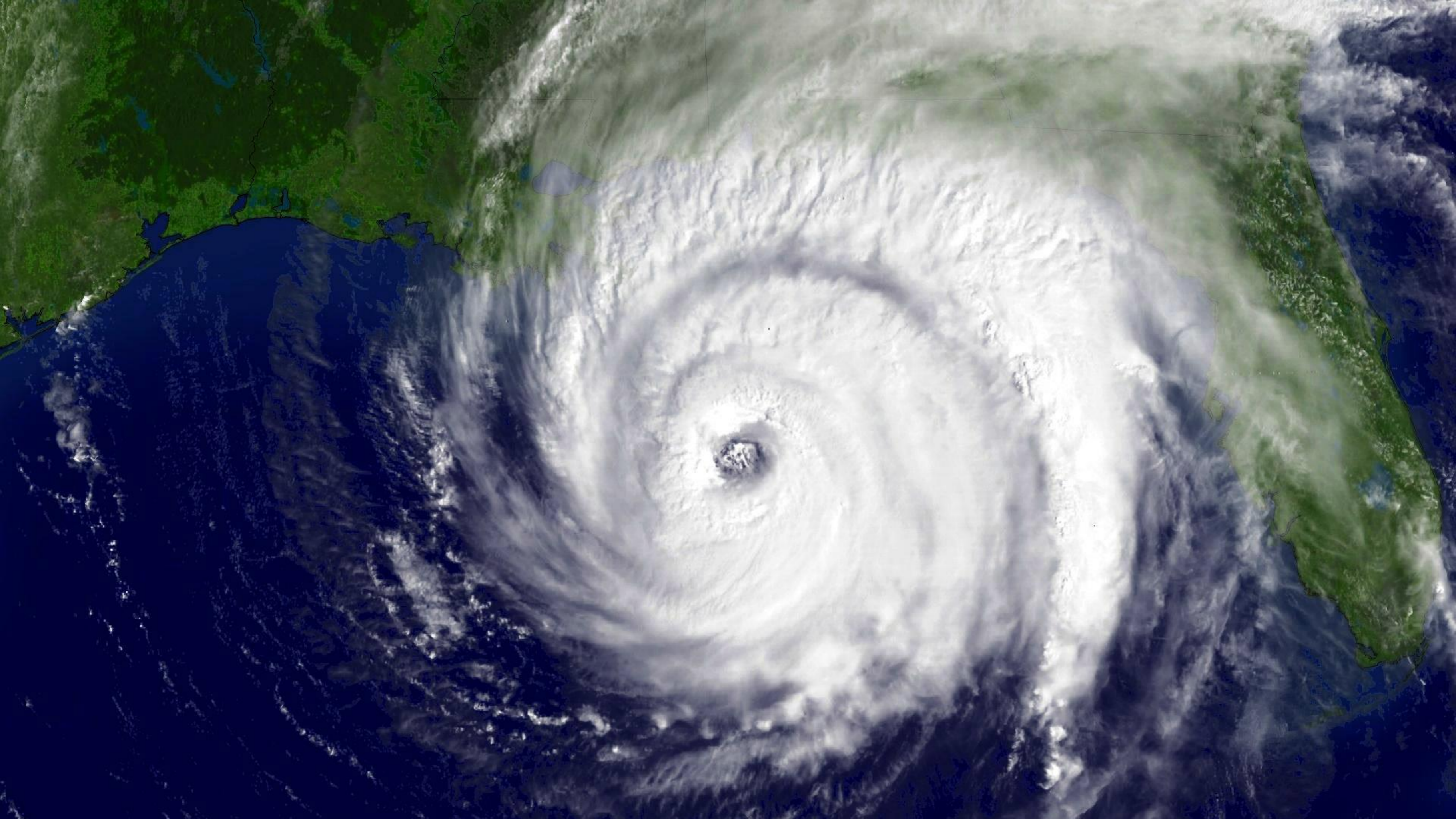
Analysts

Model

The stories that show in your News Feed are influenced by:

- friends you interact with the most
- the number of comments and likes a post receives
- what kind of story it is (ex: photo, video, status update)

Source: Facebook



Spies

Analysts

Model



WAFFLE HOUSE

WAFFLE HOUSE

The index has three levels:

- **Green:** full menu - restaurant has power and damage is limited.
- **Yellow:** limited menu - no power or only power from a generator, or food supplies may be low.
- **Red:** the restaurant is closed - indicating severe damage.

Source: Wikipedia

MORE EXAMPLES

- How does US News and World Reports rank colleges?
- How does Google know which results to show?
- How do sports teams know who to draft?
- How does Amazon know what products to recommend?
- How does Zillow estimate home prices?
- How does Pandora know what music to play?
- How does eHarmony know which people to show you?
- How do they figure out who should speak at a conference?

GOALS

HOW DO WE MAKE SENSE OF MATH MODELING?

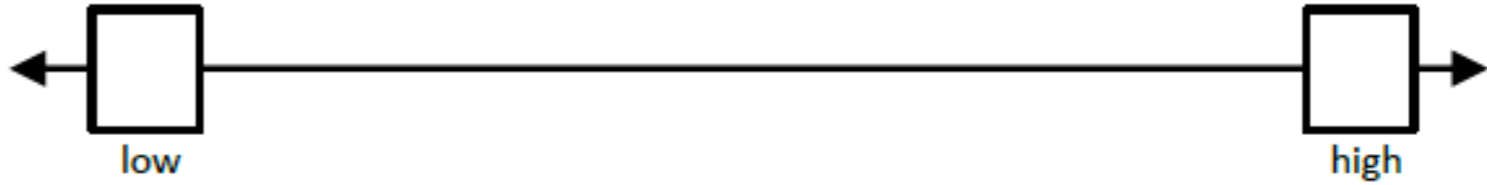
IS IT JUST ANSWERING QUESTIONS?

HOW DO YOU PROFIT FROM MATH MODELING?

HOW DO WE HELP OUR STUDENTS IMPROVE?

WHERE CAN WE FIND MORE RESOURCES?

Name: _____ Period: _____ Date: _____

What problem are you trying to figure out?	What estimates do you have?
	 <p>Place your estimate on the number line.</p>
What info do you already know about the problem?	What info do you need about the problem?
<p>TOP SECRET!</p>	<p>SPIES ONLY</p>
What is your conclusion? How did you reach that conclusion?	

Your work

DANGER

**ANALYSTS
AT WORK**

MODELING EXAMPLES

□ ELEMENTARY SCHOOL

□ MIDDLE SCHOOL

□ HIGH SCHOOL

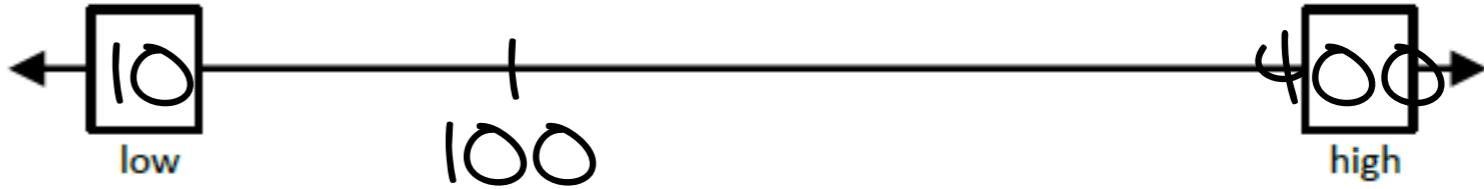


Spies

Analysts

Model

THINKING TIME

What problem are you trying to figure out?	What estimates do you have?
<p>How many beverage choices are there?</p>	 <p style="text-align: center;">Place your estimate on the number line.</p>
What info do you already know about the problem?	What info do you need about the problem?
<ul style="list-style-type: none"> • There are main flavors and added flavors. • Lemonade is yummy. 	<ul style="list-style-type: none"> • How many main flavors are there? • How many added flavors are there? • Can we mix them all together?
What is your conclusion? How did you reach that conclusion?	

COUNT ALL



1		8		16		24		27		32		40		46															
			no caffeine		no caffeine						no caffeine		no caffeine																
2		5		9		13		17		21		28		30		37		44		47		51							
3		6		10		14		18		22		25		29		31		33		38		42		45		48		52	
4		7		11		15		19		23			no caffeine			34		39		43		49		53					
				12				20		26		35		36						50									

low/no calories

54		62		69		76		84		92		95		103		111		117		125																	
					no caffeine		no caffeine		no caffeine		no caffeine		no caffeine		no caffeine		no caffeine																				
55		59		63		66		70		73		77		81		85		89		93		96		100		104		108		112		115		118		122	
56		60		64		67		71		74		78		82		86		90		94		97		101		105		109		113		116		119		123	
57		61		65		68		72		75		79		83		87		91		98		102		106		110		114		120		124					
58						80		88		94		99		107								121															

COUNT GROUPS



7

Coca-Cola

Cherry Raspberry

Orange Vanilla

NEW Lime Cherry Vanilla

8

Sprite

no caffeine

Strawberry Cherry

Grape Peach

Raspberry Orange

NEW Vanilla

8

Fanta

Orange

no caffeine

Fruit Punch Strawberry

Raspberry Cherry

NEW Lime Grape

Peach

1

Pibb

2

Bany's

no caffeine

NEW

5

Vault

Red Berry Grape

Orange Peach

8

Hi-C

Orange

no caffeine

Fruit Punch Strawberry

Raspberry Cherry

Grape Raspberry Lime

NEW Orange Vanilla

6

Minute Maid

LEMONADE

no caffeine

Strawberry Cherry

Orange Raspberry

NEW Fruit Punch

8

Powerade

Orange

no caffeine

Fruit Punch Strawberry

Raspberry Cherry

NEW Lime Grape

Lemon

low/no calories

Coca-Cola zero

Cherry Raspberry

NEW Orange Vanilla

NEW Lime Cherry Vanilla

NEW Lemon

8

Diet Coke

Cherry Raspberry

Orange Vanilla

NEW Lime Cherry Vanilla

7

Diet Coke

no caffeine

Cherry Raspberry

Orange Vanilla

NEW Lime Cherry Vanilla

7

Sprite zero

no caffeine

Strawberry Cherry

Grape Peach

Raspberry Orange

NEW Vanilla

8

Fanta zero

Orange

no caffeine

Fruit Punch Strawberry

Raspberry Cherry

NEW Lime Grape

Peach

8

Pibb zero

1

Diet Bany's

no caffeine

NEW

2

DA SANI

Lemon

no caffeine

Orange Strawberry

Raspberry Cherry

NEW Lime Grape

Peach

8

o DASANI sensations

Lemon

no caffeine

Orange Strawberry

Raspberry Cherry

NEW Lime Grape

Peach

8

Minute Maid

Light

LEMONADE

no caffeine

Strawberry Cherry

Orange Raspberry

NEW Fruit Punch

6

POWERADE ZERO

Orange

no caffeine

Fruit Punch Strawberry

Raspberry Cherry

NEW Lime Grape

Lemon

8

Seagram's

LEMON LIME

Seltzer

no caffeine

1

INVENTED STRATEGY



8

8

no caffeine

8

no caffeine

7

7

no caffeine

7

no caffeine

8

no caffeine

low/no calories

8

8

no caffeine

8

no caffeine

8

no caffeine

8

8

no caffeine

8

no caffeine

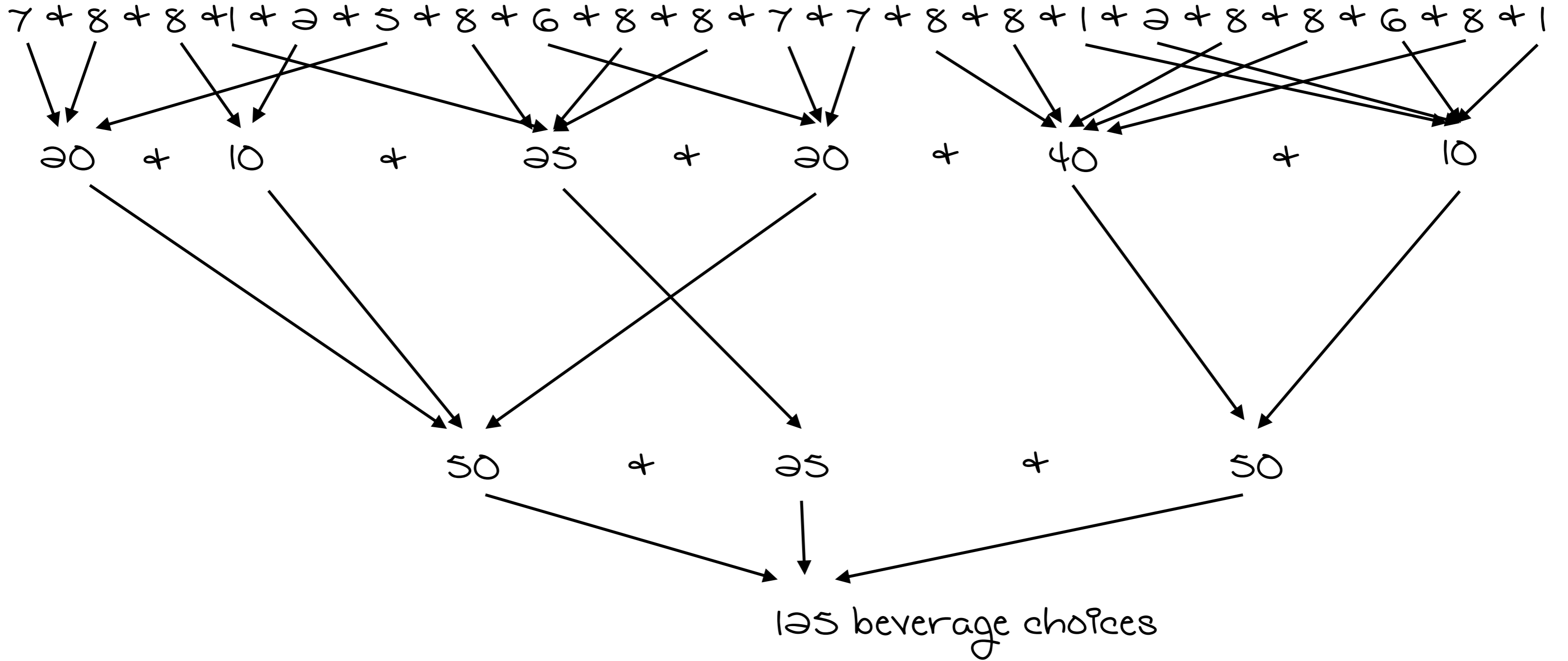
8

no caffeine

8

no caffeine

8



The main attraction for a busload of Dover fifth-graders was supposed to be the Museum of Fine Arts, but that all changed when they stopped by Kelly's Roast Beef and got a glimpse of their soda-drinking future.

At the entrance of Kelly's sat a sleek **Coca-Cola** Freestyle fountain crafted to resemble an old-fashioned vending machine, but with a twist: a touchscreen computer embedded in the machine gives customers **the option of 125 flavors**. You can quench your thirst with a Coke or a Sprite, or try something more exotic — Sprite with Grape or a Hi-C Orange Vanilla.

MODELING EXAMPLES

ELEMENTARY SCHOOL

MIDDLE SCHOOL

HIGH SCHOOL



IVE

FOX
NEWS

Junction

Spies

Analysts

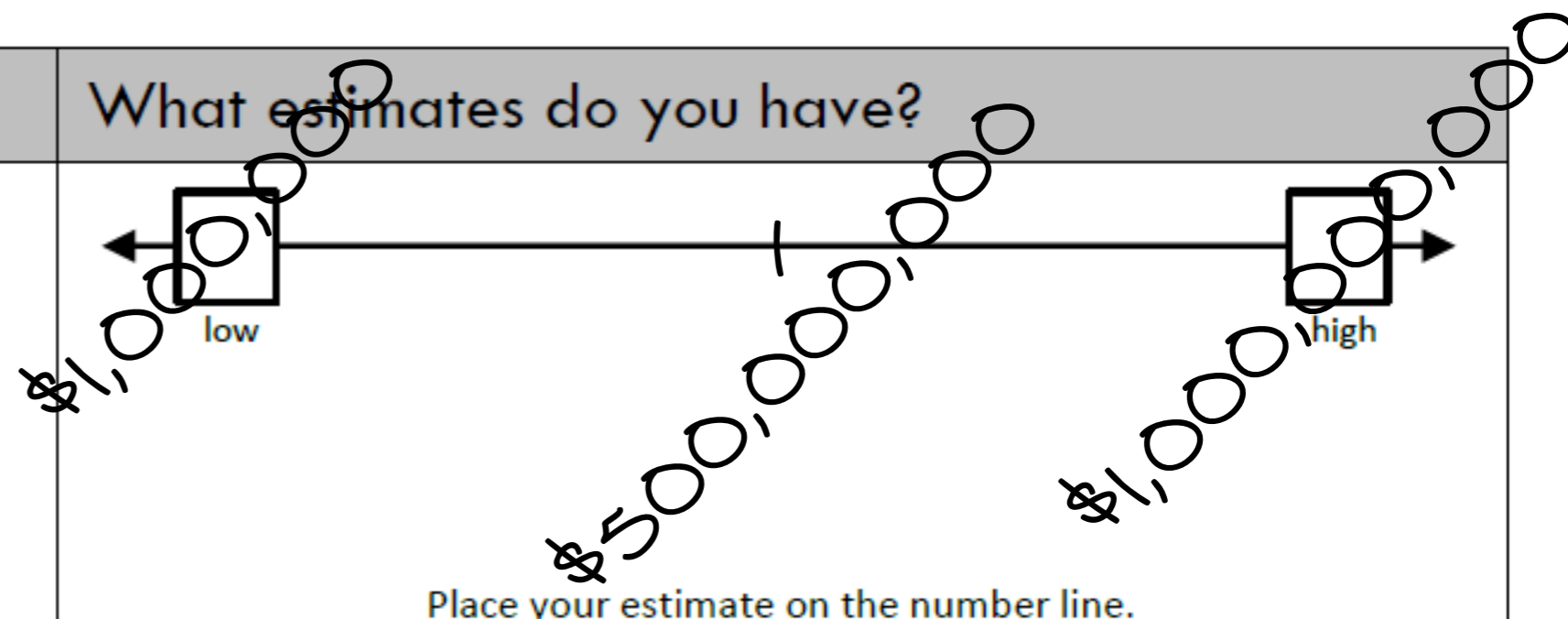
Model

THINKING TIME

What problem are you trying to figure out?

How much money was that?

What estimates do you have?



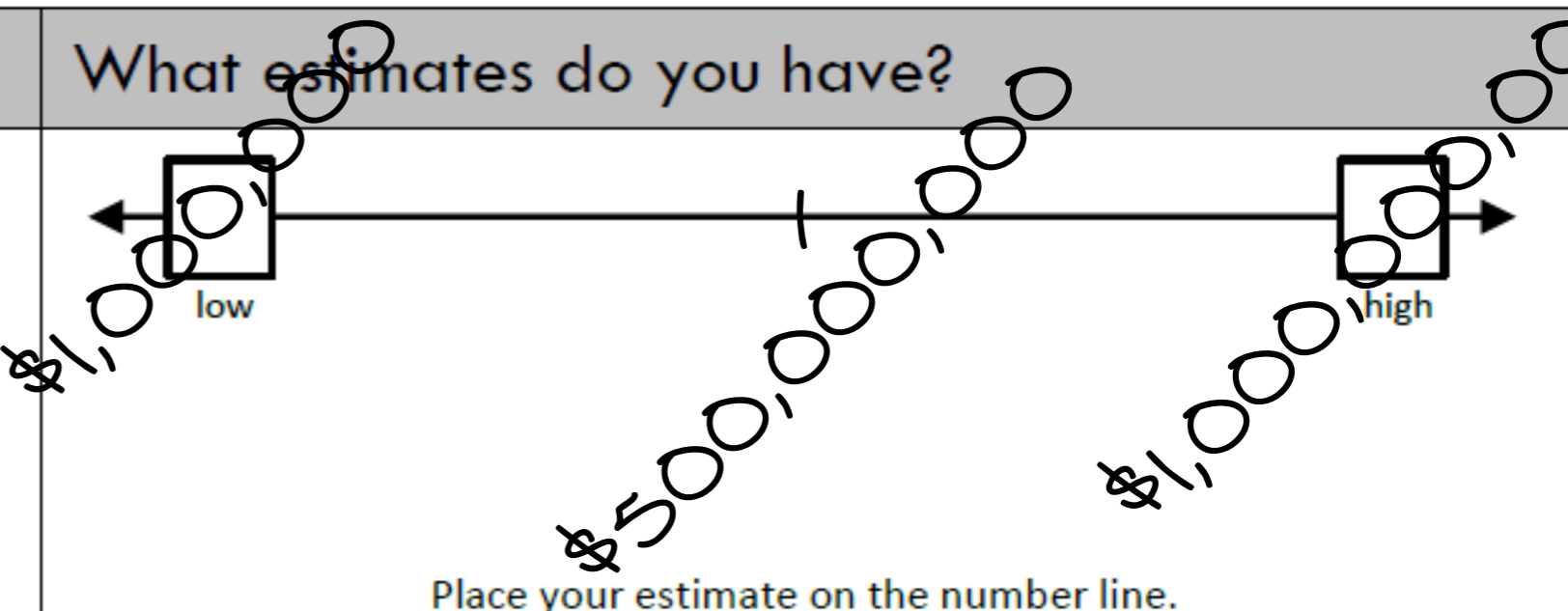
What info do you already know about the problem?

- There is a lot of money.
- It is in a pile.
- It is in bundles.

What info do you need about the problem?

- Is it all the same denomination?
- ~~How much does one bill weigh?~~
- ~~How much does all the money weigh?~~

What is your conclusion? How did you reach that conclusion?

What problem are you trying to figure out?	What estimates do you have?
<p>How much money was that?</p>	 <p>Place your estimate on the number line.</p>
What info do you already know about the problem?	What info do you need about the problem?
<ul style="list-style-type: none"> • There is a lot of money. • It is in a pile. • It is in bundles. 	<ul style="list-style-type: none"> • Is it all the same denomination? • How many rows and columns are there? • How many bills are in one stack?
What is your conclusion? How did you reach that conclusion?	



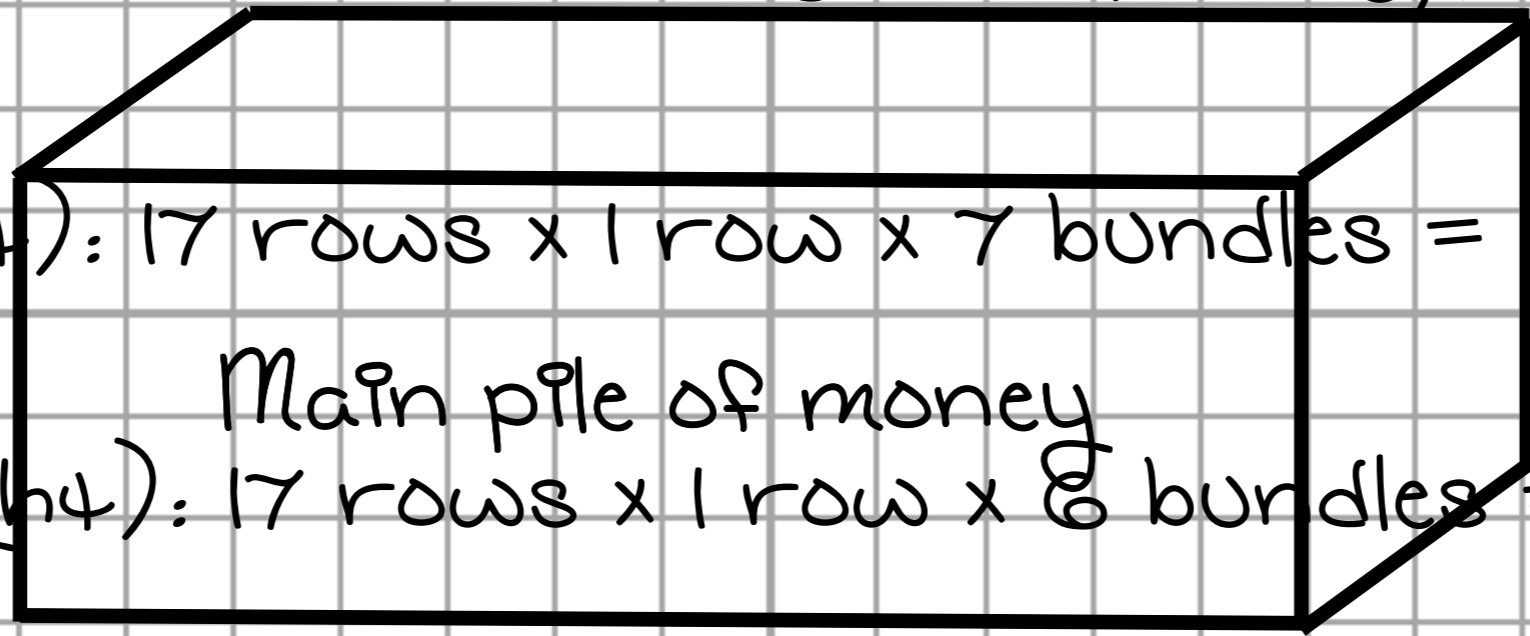


Your work

Main pile: 34 rows x 11 ~~rows~~ ~~bundles~~ = 3,740 bundles

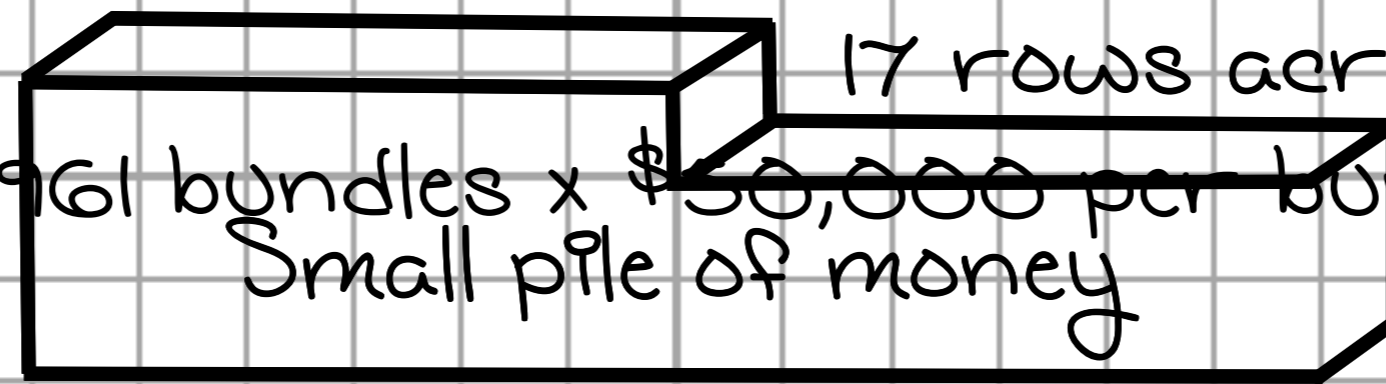
Small pile (left): 17 rows x 1 row x 7 bundles = 19 bundles
10 bundles

Small ^{high} pile (right): 17 rows x 1 row x 8 bundles = 102 bundles
11 rows deep



Total bundles: 3,740 + 19 + 102 = 3,961 bundles
17 rows across

Total money: 3,961 bundles x \$50,000 per bundle = \$198,050,000



8 bundles
high

7 bundles
high

FOX



50%

MODELING EXAMPLES

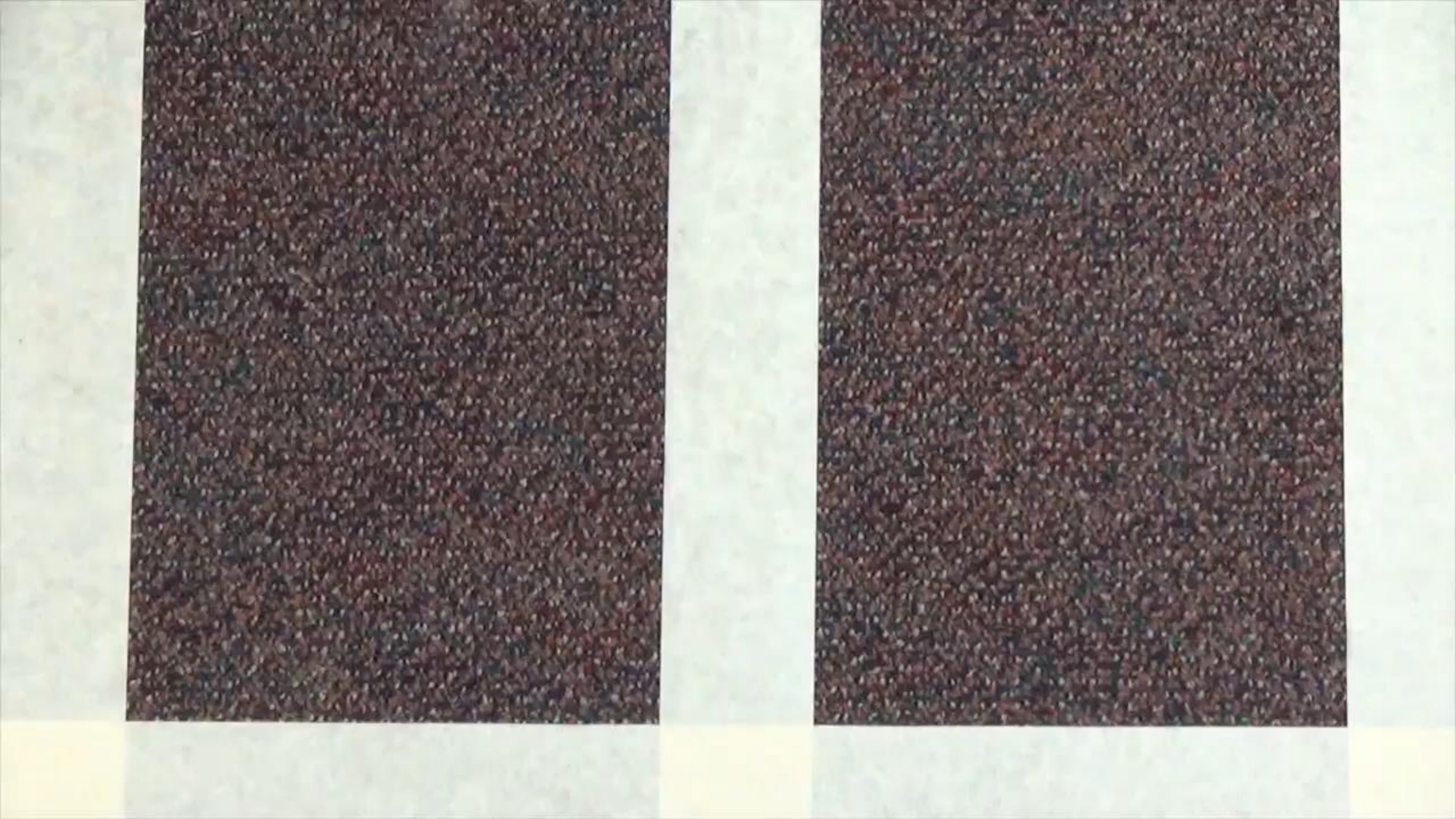
ELEMENTARY SCHOOL

MIDDLE SCHOOL

HIGH SCHOOL

NON-STAGGERED

STAGGERED

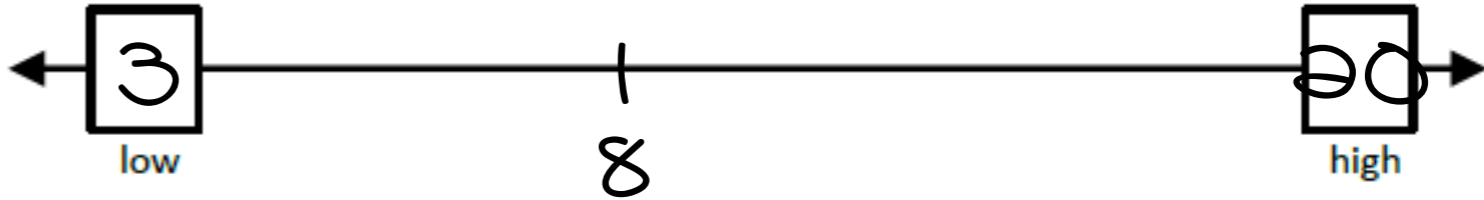


Spies

Analysts

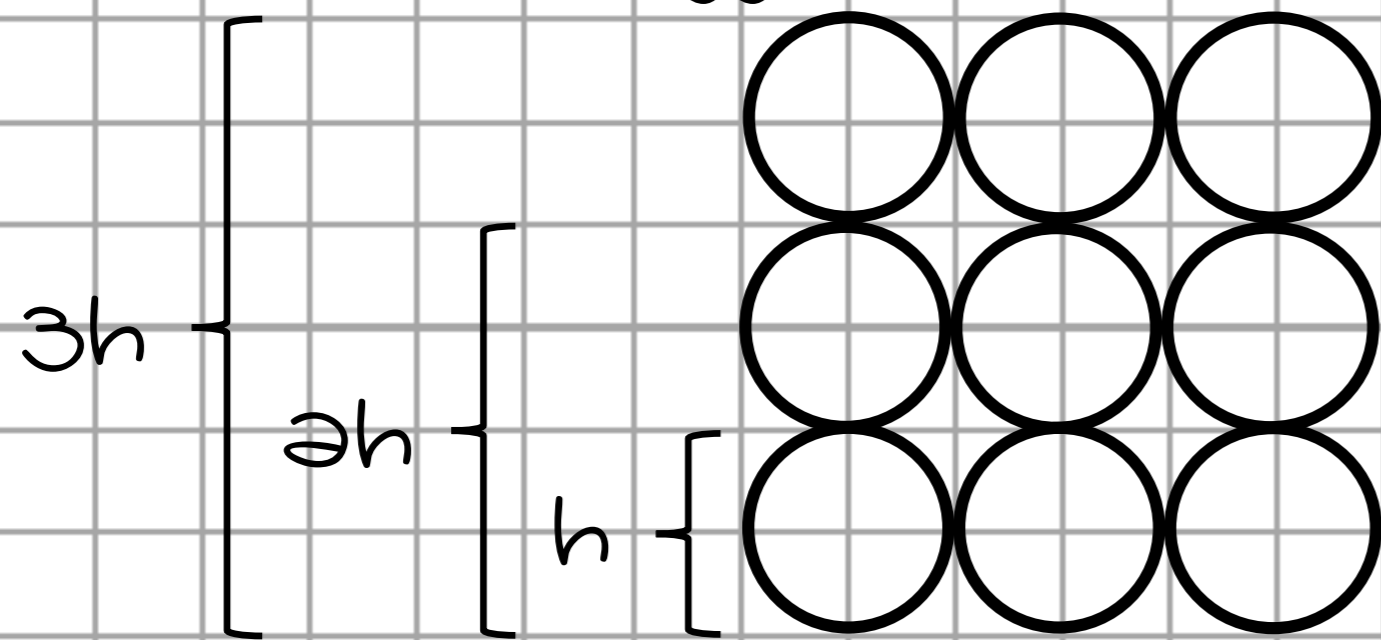
Model

THINKING TIME

What problem are you trying to figure out?	What estimates do you have?
<p>How much shorter are 20 layers of non-staggered pipes?</p>	 <p>(in inches)</p> <p>Place your estimate on the number line.</p>
What info do you already know about the problem?	What info do you need about the problem?
<ul style="list-style-type: none"> • One pile of pipes is staggered. • One pile of pipes is not staggered. • We have to compare 20 layers of each. 	<ul style="list-style-type: none"> • What are the dimensions of a pipe? • What units are we using to measure?
What is your conclusion? How did you reach that conclusion?	



Non-staggered pipes



1 pipe = h cm

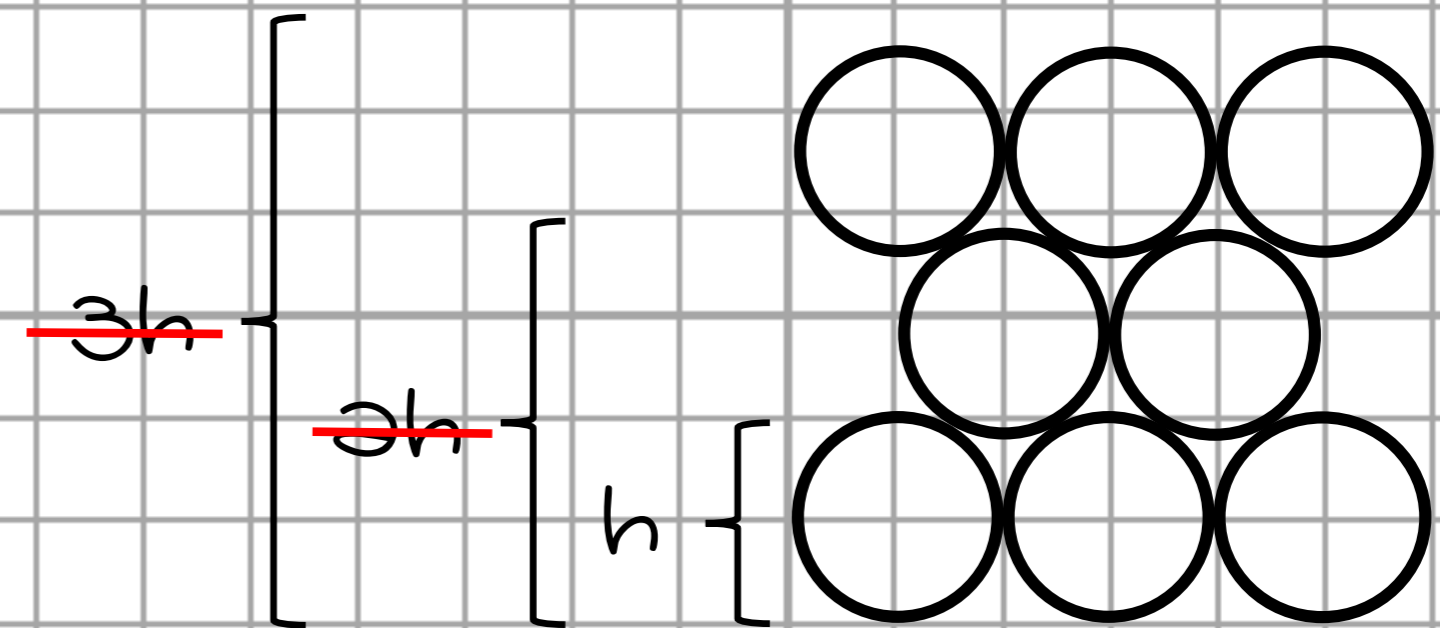
2 pipes = $2h$ cm

3 pipes = $3h$ cm

⋮

n pipes = nh cm

Staggered pipes



1 pipe = h cm

2 pipes = $2h$ cm

3 pipes = $2h$ cm

⋮

n pipes = $2h$ cm

MODELING EXAMPLES

ELEMENTARY SCHOOL

MIDDLE SCHOOL

HIGH SCHOOL

GOALS

HOW DO WE MAKE SENSE OF MATH MODELING?

IS IT JUST ANSWERING QUESTIONS?

HOW DO YOU PROFIT FROM MATH MODELING?

HOW DO WE HELP OUR STUDENTS IMPROVE?

WHERE CAN WE FIND MORE RESOURCES?

PBL RESOURCES

- Problem-based lesson search engine:
robertkaplinsky.com/prbl-search-engine
- My lessons (Elementary, Middle, and High School)
robertkaplinsky.com/lessons
- Dan Meyer (Middle and High School)
threeacts.mrmeyer.com
- Andrew Stadel (Elementary and Middle School)
www.estimated180.com/lessons.html
- Graham Fletcher (Elementary and Middle School)
gfletchy.com/3-act-lessons

Home

Math resources that create problem solvers, not robots.

Download my favorite lessons for elementary, middle, and high school.

[GET FREE LESSONS](#)[TAKE MY WORKSHOP](#)

What happens next?



Keep coming back for more free lessons and resources.



Learn implementation tips from my blog and weekly emails.



Take my online workshop for more implementation support.

Lessons

- [View all](#)
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- [3rd](#)
- [4th](#)
- [5th](#)
- [6th](#)
- [7th](#)
- [8th](#)
- [Alg.1](#)
- [Geo](#)
- [Alg.2](#)



How Much Money Were Those Pennies?



How Can We #SaveNelly?



How Many Chip Bags Will There Be?



How Can We Make Stronger Passwords?



Search

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First Name

Last Name

Email address

Zip Code (optional)

Job Role(s)

- Elementary School
- Middle School
- High School
- Higher Education

Resources

Depth of Knowledge

- ▶ [Open Middle](#)
- ▶ [Open Middle Worksheet - English \(student version\)](#)
- ▶ [Open Middle Worksheet - English \(document camera version\)](#)
- ▶ [Open Middle Worksheet - Spanish \(student version\)](#)
- ▶ [Open Middle Worksheet - Spanish \(document camera version\)](#)
- ▶ [Robert's blog posts on Depth of Knowledge](#)
- ▶ [Tool to Distinguish Between Depth of Knowledge Levels](#)

Problem-Based Lesson Tools

- ▶ [Problem-Based Lesson Search Engine](#)
- ▶ [Problem Solving Framework v8.1](#)
- ▶ [Robert's blog posts on Problem-Based Learning](#)

Problem-Based Lesson Sources

- ▶ [101 Questions](#)
- ▶ [Andrew Gael](#)
- ▶ [Andrew Stadel](#)
- ▶ [Catherine Castillo](#)
- ▶ [Christina Tondevold](#)
- ▶ [Dan Meyer](#)
- ▶ [Dane Ehlert](#)
- ▶ [Emergent Math's Problem Based Curriculum Maps](#)

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Job Role(s)

- Elementary School
- Middle School
- High School
- Higher Education

GOALS

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WHERE CAN WE FIND MORE RESOURCES?



Real-World Link



Common Core
State Standards

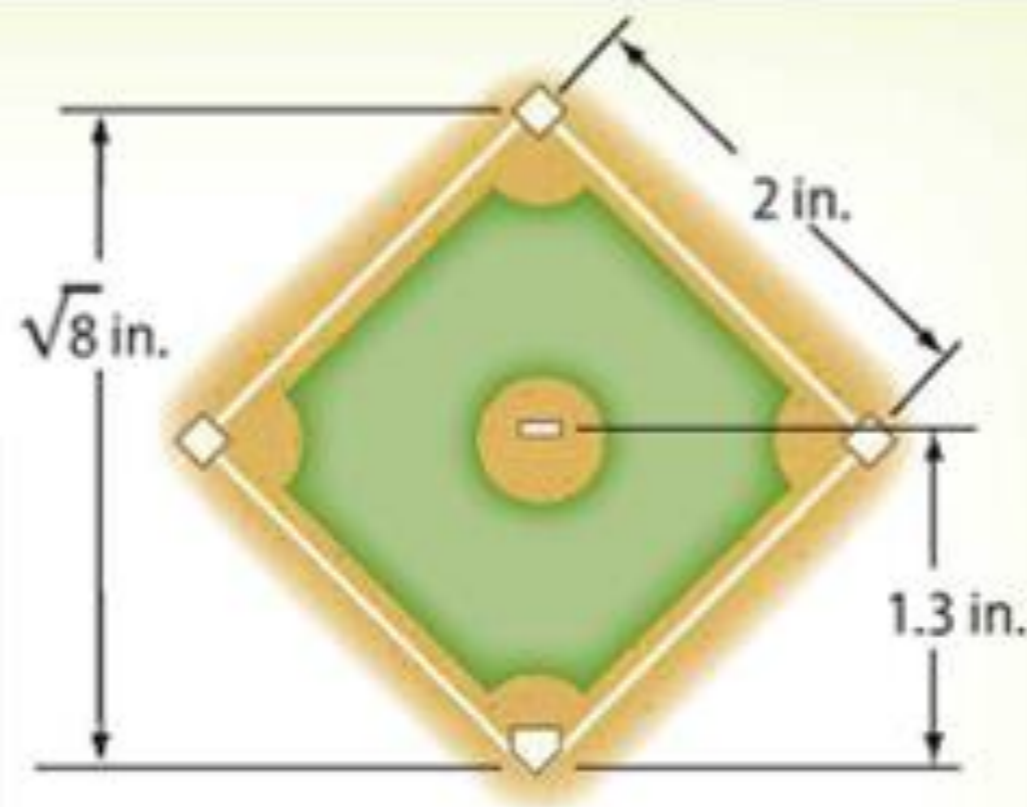
Content Standards

8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices

1, 3, 4, 6

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.



1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?





Real-World Link



Common Core State Standards

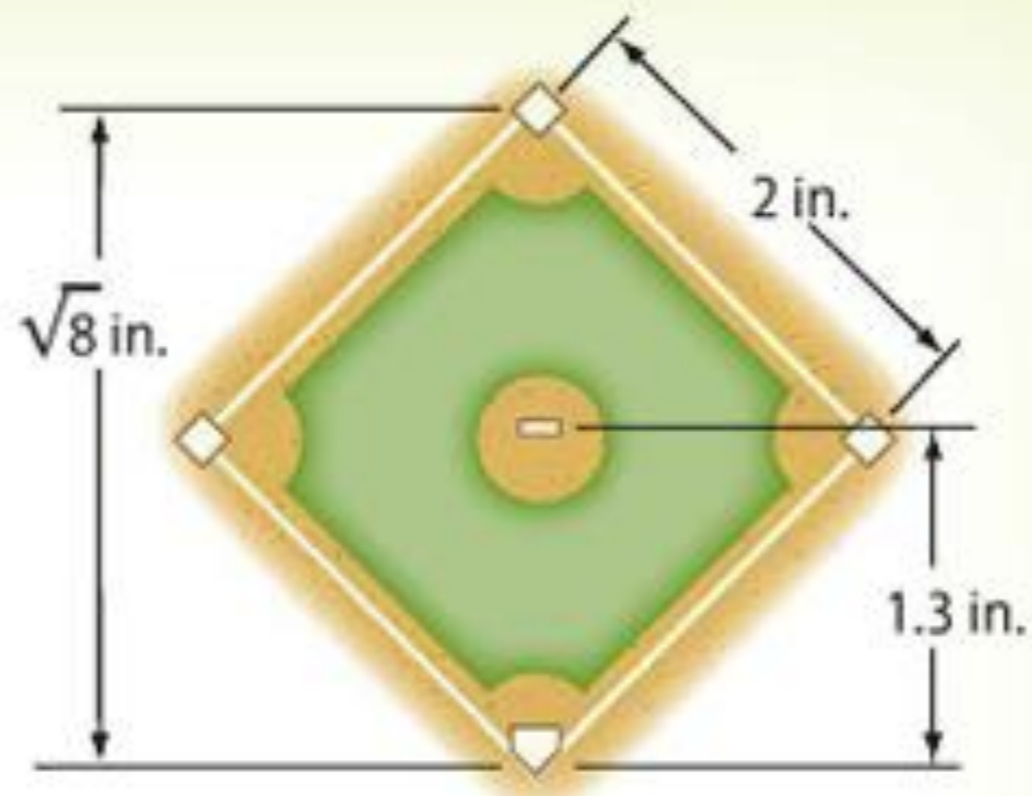
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Scary & Dangerous







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2009

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AMOUNT: ONE MILLION

00/100

FOR: The Netflix Prize

Reed Hastings

MATH MODELING CAN

MAKE YOU FILTHY RICH

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