



Mapping Cannabis Farms

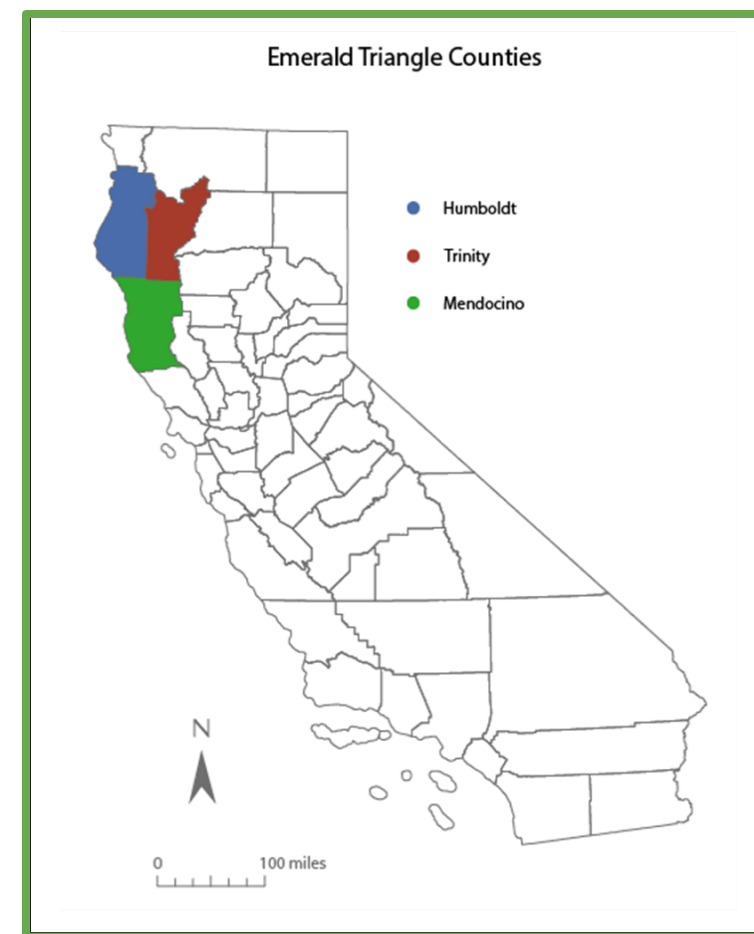
Marijuana and California's Emerald Triangle

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Introduction

The objective of this research project is to survey and map marijuana farms (*Cannabis sativa* or *C. indica*). Ultimately this will allow us to understand the environmental impacts of marijuana cultivation, a quasi-legal agricultural activity that has boomed in recent years. The work involves **digitizing indoor and outdoor cultivation sites using satellite imagery** from 2008-2014 available in Google Earth.



(Fig. 1 Map of the Emerald Triangle¹)

The main region of focus is a portion of **northern California** known as the “**Emerald Triangle**,” comprised of Humboldt, Mendocino, and Trinity Counties (Fig. 1). We focus on this region because it is estimated that **70—80% of cannabis** consumed in the United States originates from the Emerald Triangle (Corva, 2014). However, it has also been difficult to quantify production given the secretive nature of cannabis cultivation.

Methods

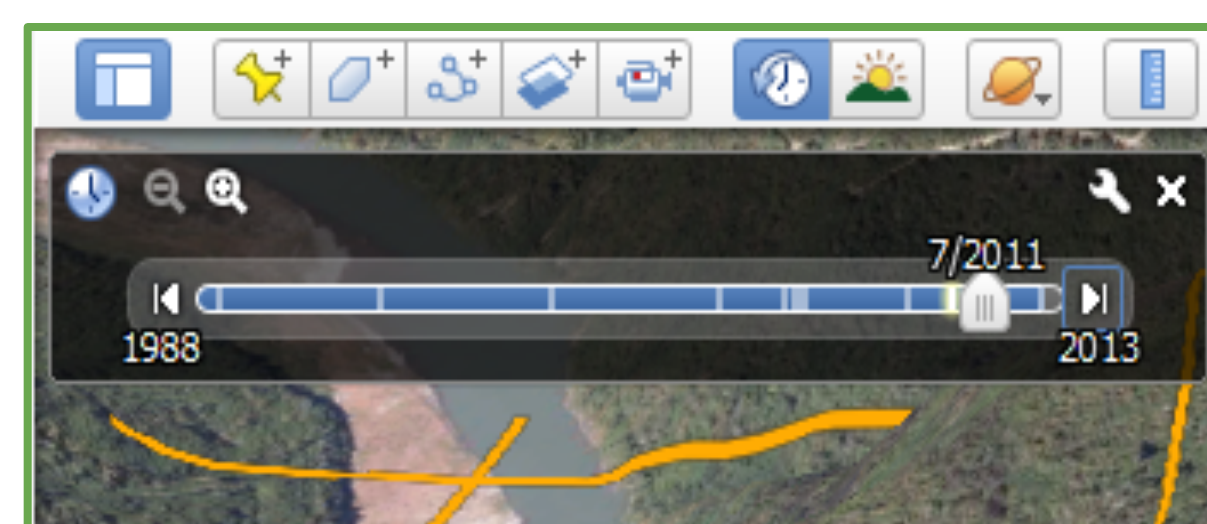
Satellite imagery provided by Google Earth is used to map both types of cannabis grows: **indoor greenhouses and outdoor gardens**. Our team uses 2012 imagery as the baseline. We use **summer imagery** because cannabis is actively growing and more visible July through September.

1. Select watershed as a unit of analysis
2. Systematically grid each watershed
3. Search through the grid squares
4. Identify indoor and outdoor grows (Fig. 6)
5. Digitize the area of the grow (Fig. 2)
6. Count the number of plants for each outdoor grow, or note the presence of a greenhouses for each indoor grow.

TIP: The time slider feature (Fig. 3) is then used to toggle back and forth to compare imagery from 2005 - 2014 in an effort to record how long the site, or structure, has been present.



(Fig. 2 Example of a digitized outdoor grow)



(Fig. 3 Google Earth time slider)

How to Identify a Grow



(Fig. 4 Example of a typical indoor and outdoor cannabis grow)



(Fig. 5 Unmarked cannabis cultivation area)

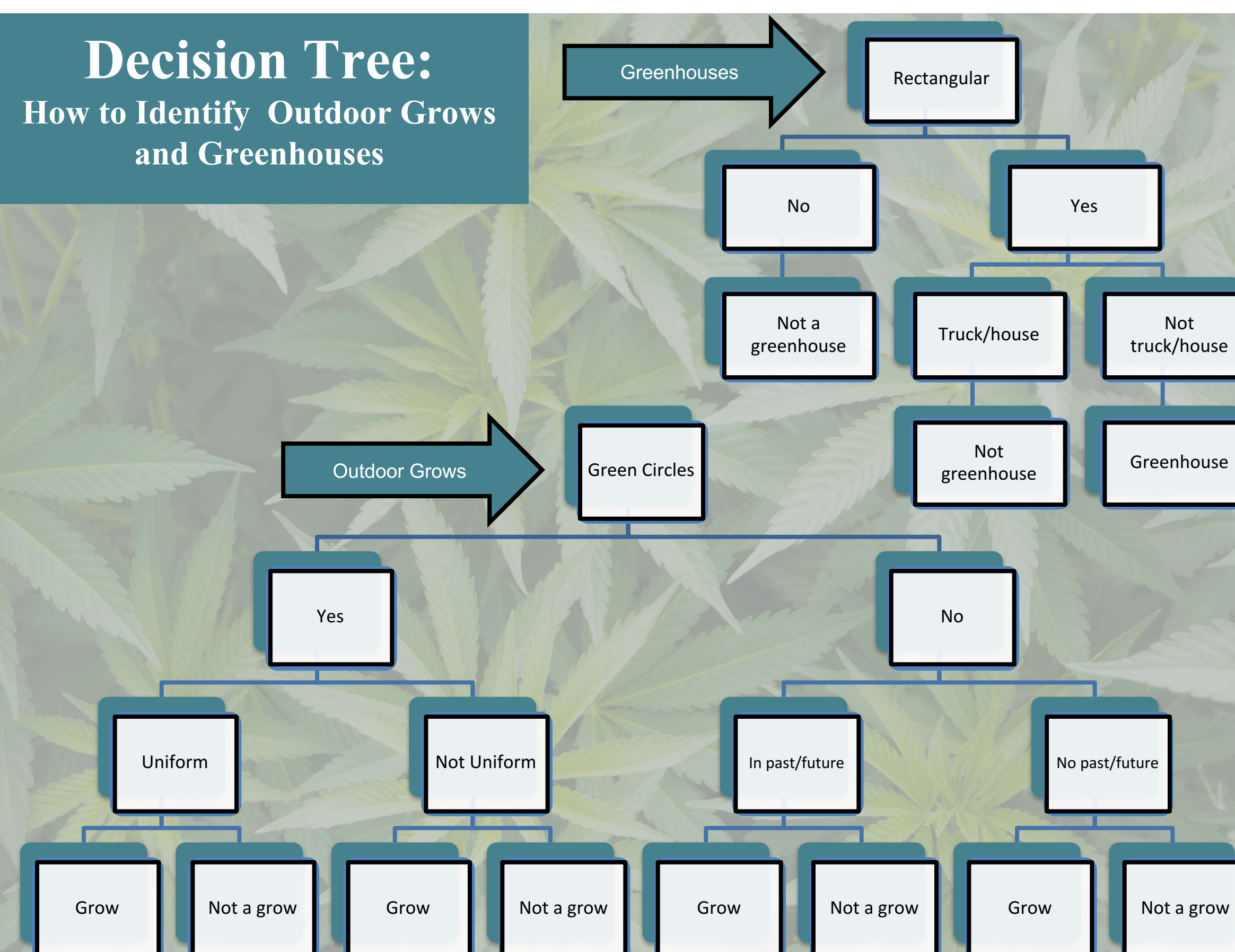
Identifying Features

- Plants are aligned in rows or a gridded pattern
- Plants are consistent in shape, size, and color
- Images were taken during the cannabis growing season (July - September)
- Water source is present
- Greenhouses located near the outdoor grow
- Land has been cleared

Fig. 4 shows a **greenhouse** (1) identified by its size, elongated shape, color, and proximity to the **outdoor grow** (3). To the left of the cultivation site there are **water tanks** (2).

What can you find in Fig. 5?

Decision Tree: How to Identify Outdoor Grows and Greenhouses



(Fig. 6 Flowcharts to help identify indoor and outdoor grows)

Environmental Impacts

- Growing cannabis demands a large water supply, especially in dry areas such as Humboldt County. As a result, water withdrawals are high.
- Most grows are clustered in headwaters of tributary streams, where water is limited for threatened and endangered fish.
- Due to the quasi-legality status of cannabis, growers avoiding capture plant on steep slopes.



(Fig. 7 Example of how one cannabis cultivation site changed from 2009 to 2014)

What Comes Next?

This data will be part of the first-ever direct measurement of cannabis cultivation in this region, and the first-ever estimate of the production volume. With spatially-explicit data on cannabis production, local environmental impacts can then be modeled.

Next Steps

- Finish mapping the Emerald Triangle
- Try this in any other places where cannabis is grown
- Analyze and measure the social impact of growing cannabis on economies, job growth, communities (change in land structures), urbanization
- Evaluate how the legality of cannabis affects the environment and local communities, and what would happen if it were to become completely legal to grow

Acknowledgements

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 3. Corva, D. (2014). Requiem for a CAMP: The life and death of a domestic U.S. drug war institution. *International Journal of Drug Policy*, (25), 71-80. Retrieved April 11, 2017.