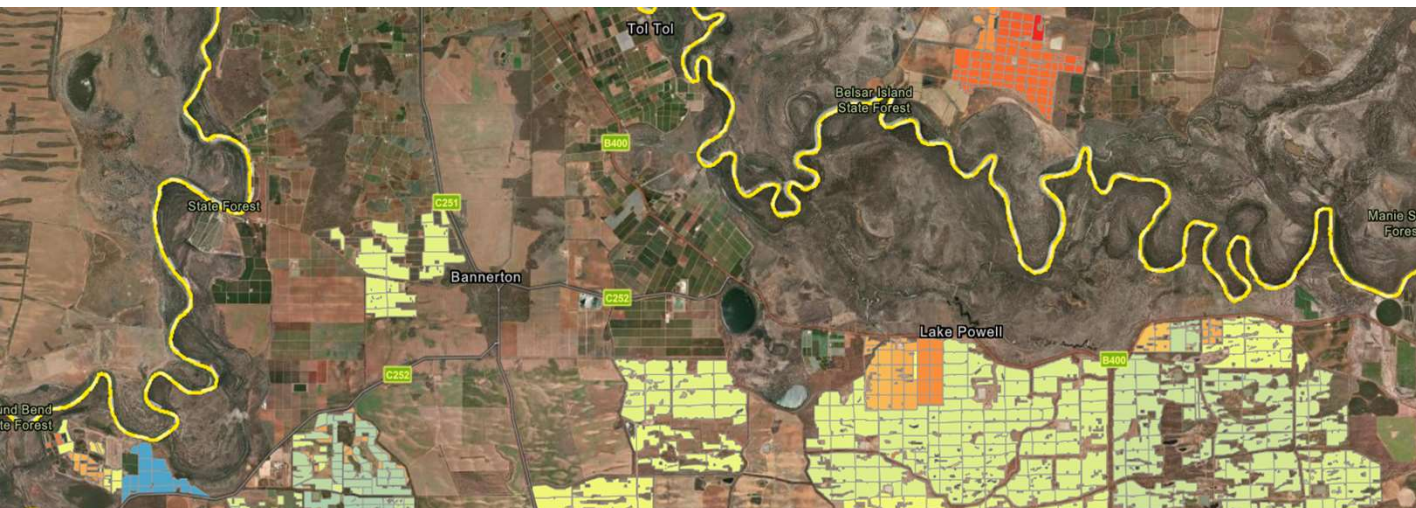


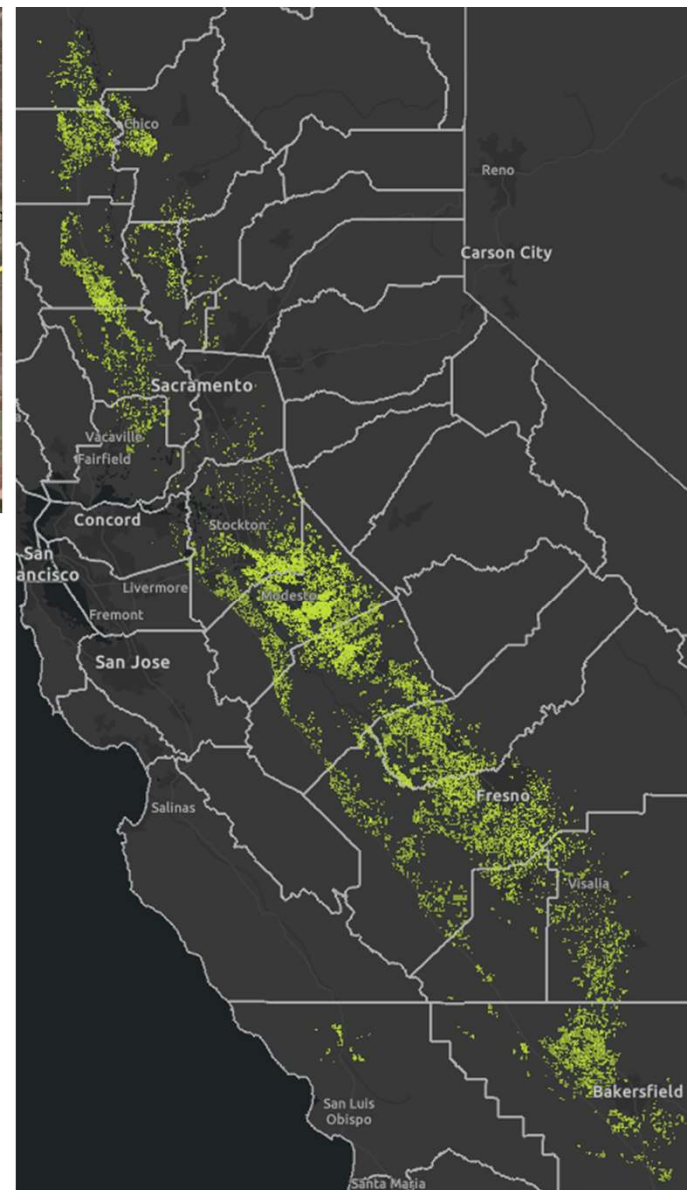


Mapping the Almond Industry: Results and Applications from California and Australia



**Australian Almond
Conference
October 15, 2026**

Joel Kimmelshue, PhD





**Mapping the
Almond Industry:
Results and
Applications from
California and
Australia**

PRESENTATION OUTLINE

- Land IQ introduction
- Research and development timeline
- US and global mapping efforts
- Historical and current mapping
- California almond mapping results
- Australian almond mapping results
- Applications



LAND IQ TECHNICAL DISCIPLINES

Land-Based Sciences: Land and Water Resources

- Agronomic assessments/soil science
- Water quality and supply evaluations
- Salinity and nutrient management
- Agricultural reuse
- Land stabilization
- Soil reclamation and irrigation/drainage

Spatial Sciences: Remote Sensing and GIS

- Crop identification and consumptive use estimation
- Large landscape evaluations
- Irrigation and drainage
- Production agriculture

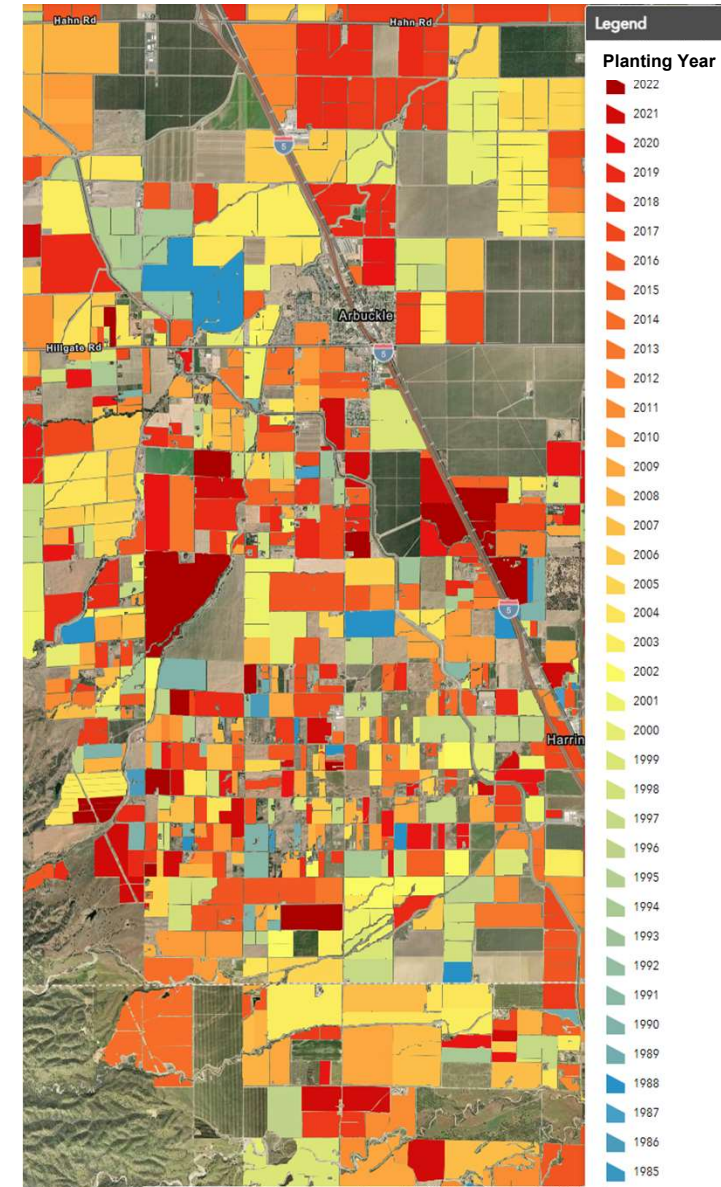
Development Sciences:

- Data management tools
- Multiple commodity groups, water/irrigation districts, regulatory and government agencies, etc.

ALMOND MAPPING TIMELINE

A decade of research, development & mapping

- Idea developed in 2010 and before
- Almond Board of California – Are USDA acreages too low?
- Initial Pilot Study - Madera County in 2011
- Secondary Pilot Study - Madera County in 2013
- Statewide tree crop mapping in 2014 including almonds, walnuts, pistachios, and prunes
- Additional attributes – permanent crop age, removals, abandoned, stressed, etc.
- Sustainable Groundwater Management Act: Requires statewide land use mapping for all crops for California
Department of Water Resources: 2014, 2016, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026 (in progress)



US AND GLOBAL MAPPING



California:

- California Department of Water Resources
- California Department of Fish and Wildlife
- Almond Board of California
- Walnut Board of California
- California Prune Board
- California Association of Winegrape Growers
- California Table Grape Commission
- Raisin Administrative Committee
- California Avocado Commission
- California Rice and Wild Rice Industries
- California Blueberry Commission
- California Fresh Fruit Association

Other Areas:

- Almond Board of Australia
- Pistachio Growers Association of Australia
- Arizona Department of Water Resources
- American Pecan Council
- American Pistachio Growers
- Pecans in Mexico
- Almonds in Arizona
- Pecans in Arizona
- Pistachios in Arizona

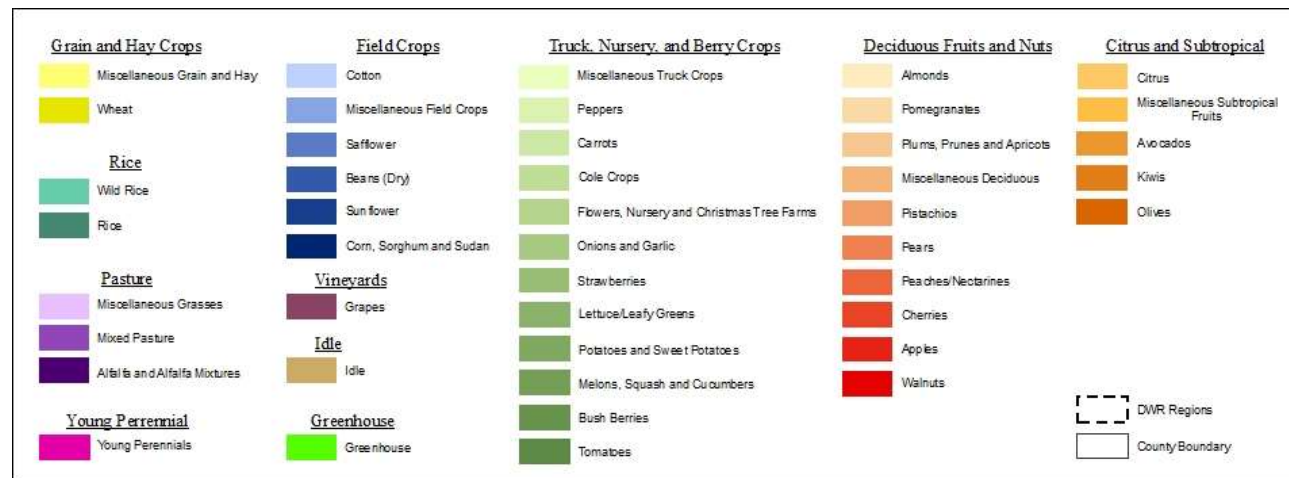
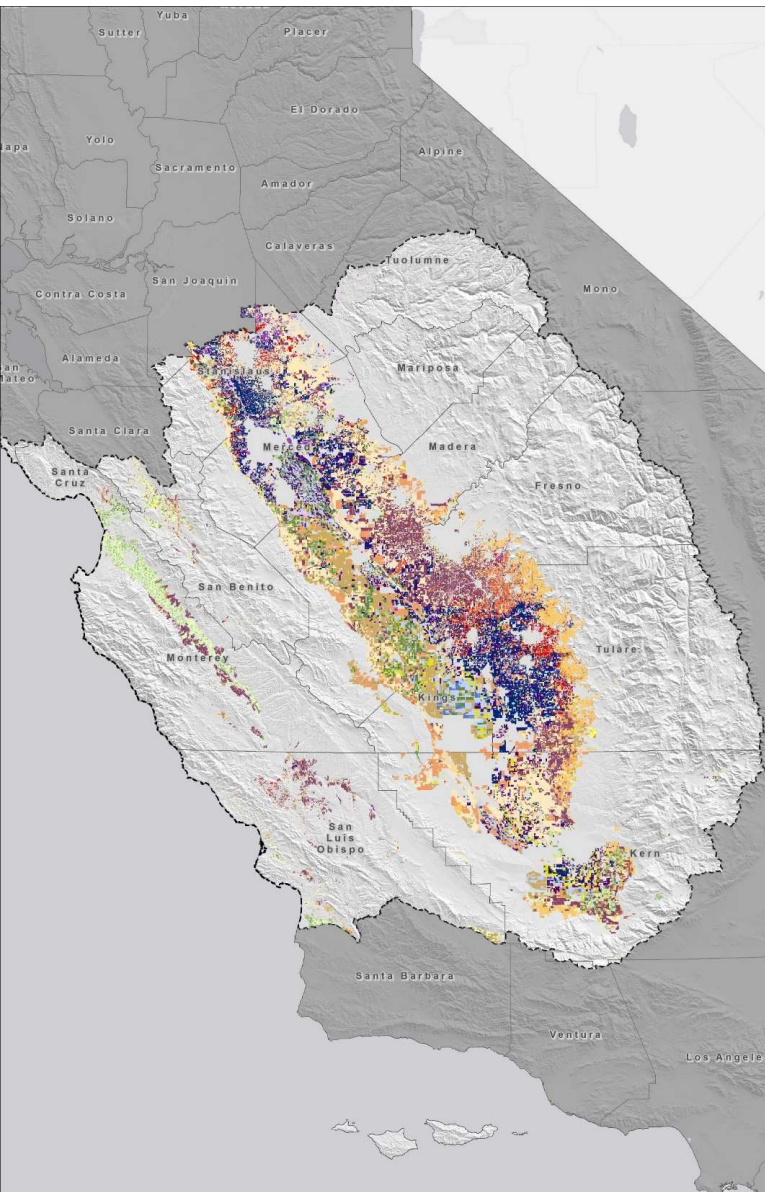


GROUND TRUTHING: CALIBRATION & VALIDATION

- Defensible
- Independent validation
- Calibration to actual conditions
- Understanding specific field conditions and management
- Allows for crop-specific modeling
- Performed on approximately 15% of total fields for crop mapping
- About 35,000 km of ground truthing each year in California
- 70,000-80,000 data points collected each year.
- A “ground up” approach

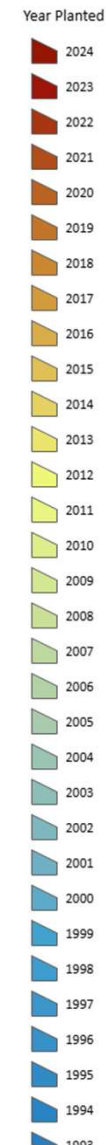


EXAMPLE REGION: SAN JOAQUIN AND SALINAS VALLEYS



• Major crops and land uses include:

- Wine grapes, Almonds, Pistachios, Broccoli, Lettuce, Strawberries, Table grapes, Raisins, Cucurbits, Citrus, Walnuts, Corn, Sorghum, Cotton, Alfalfa, Tomatoes, Wheat, Fallow
- Total Irrigated & Idle Land = 4,829,004 acres (1,954,000 hectares)

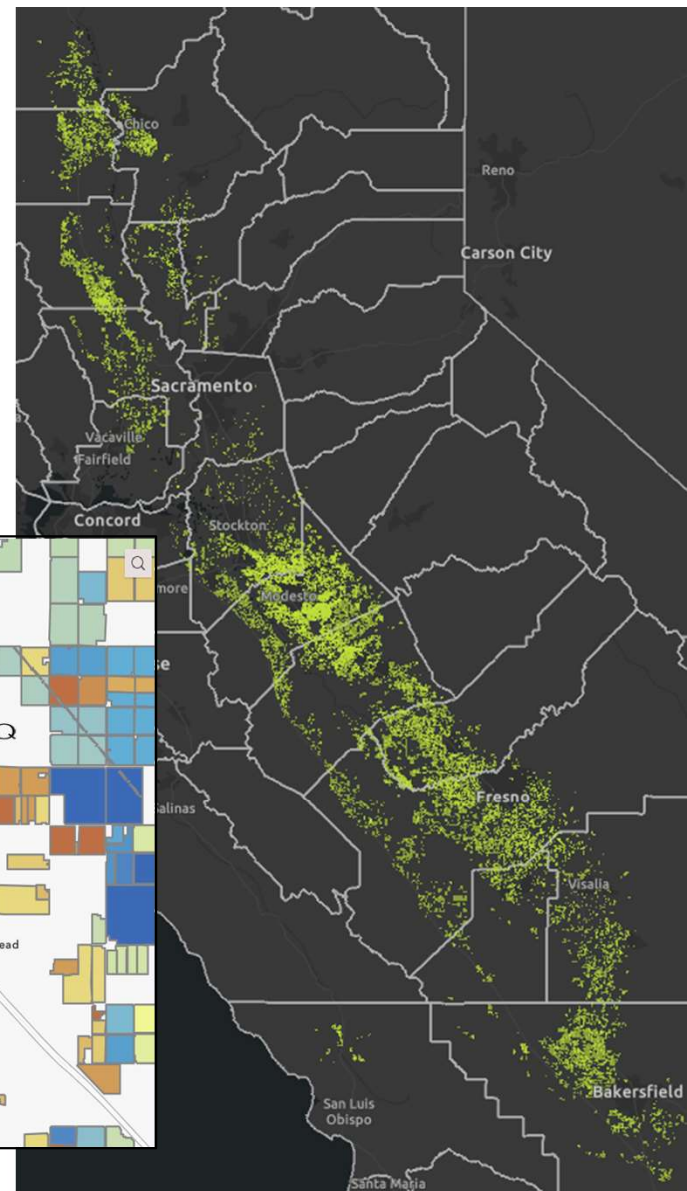


ALMOND MAPPING IN CALIFORNIA: THREE FUNDAMENTAL QUESTIONS TO BUILD ON:

Acreage – How many actual producing acres are there?

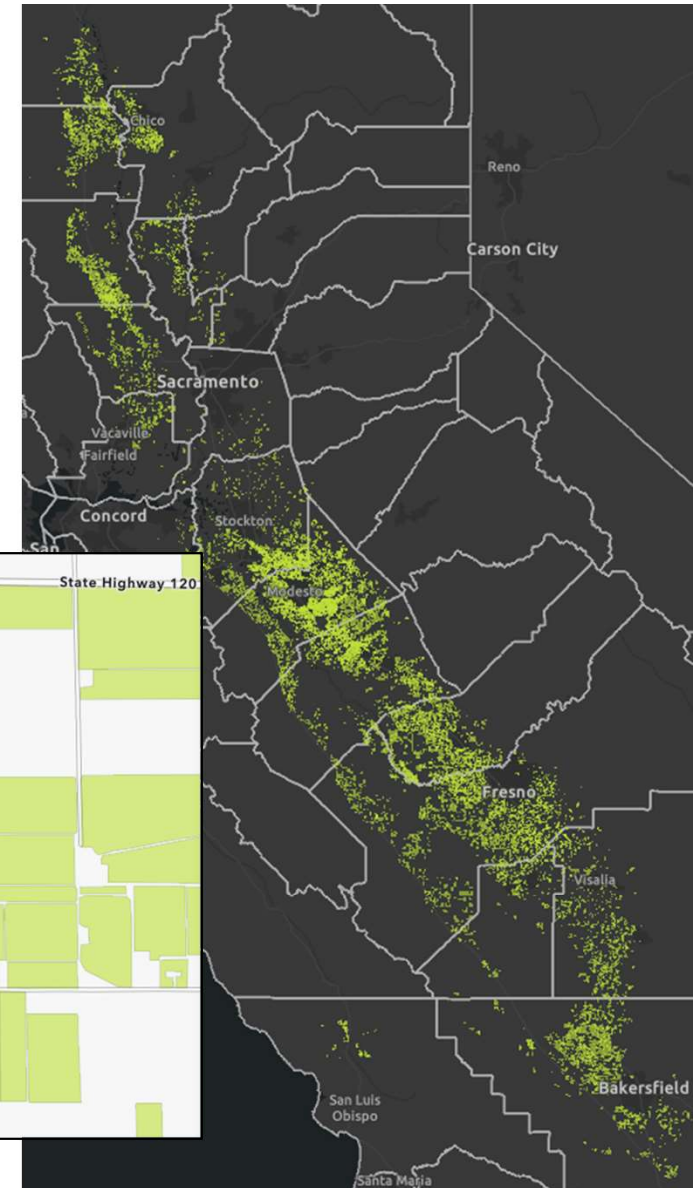
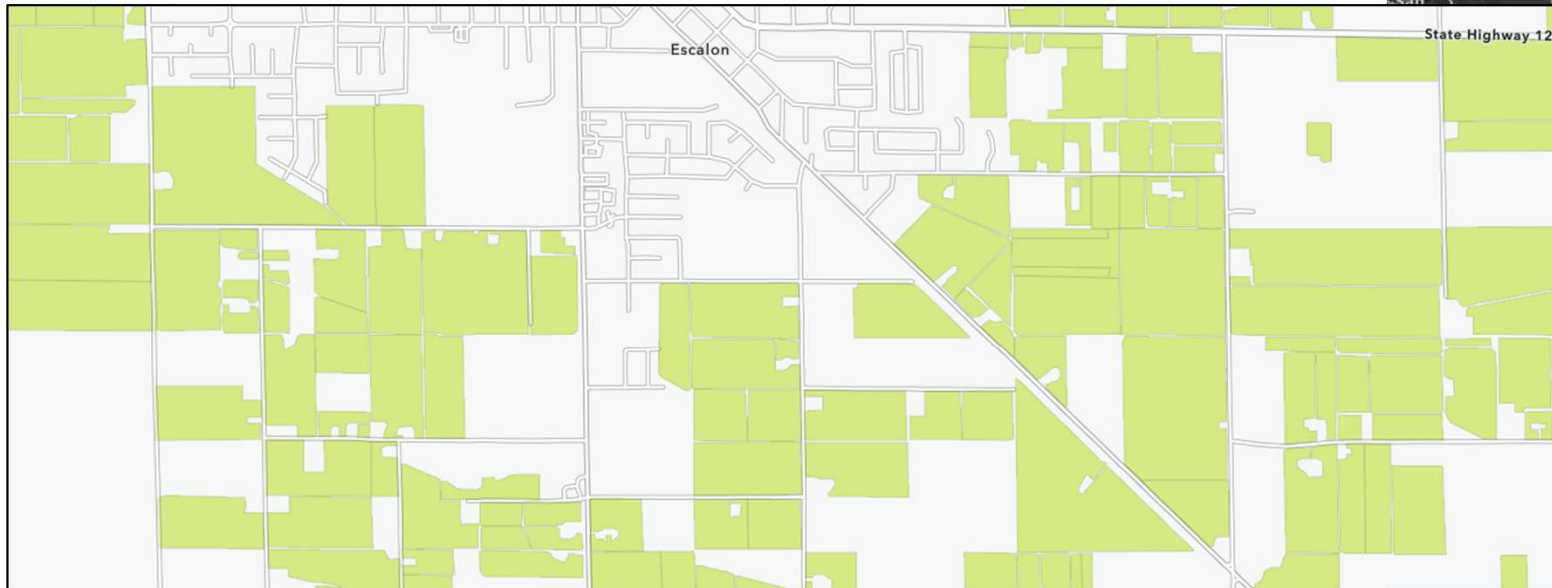
Location – Where are these actual production acres?

Age – How old is every orchard?



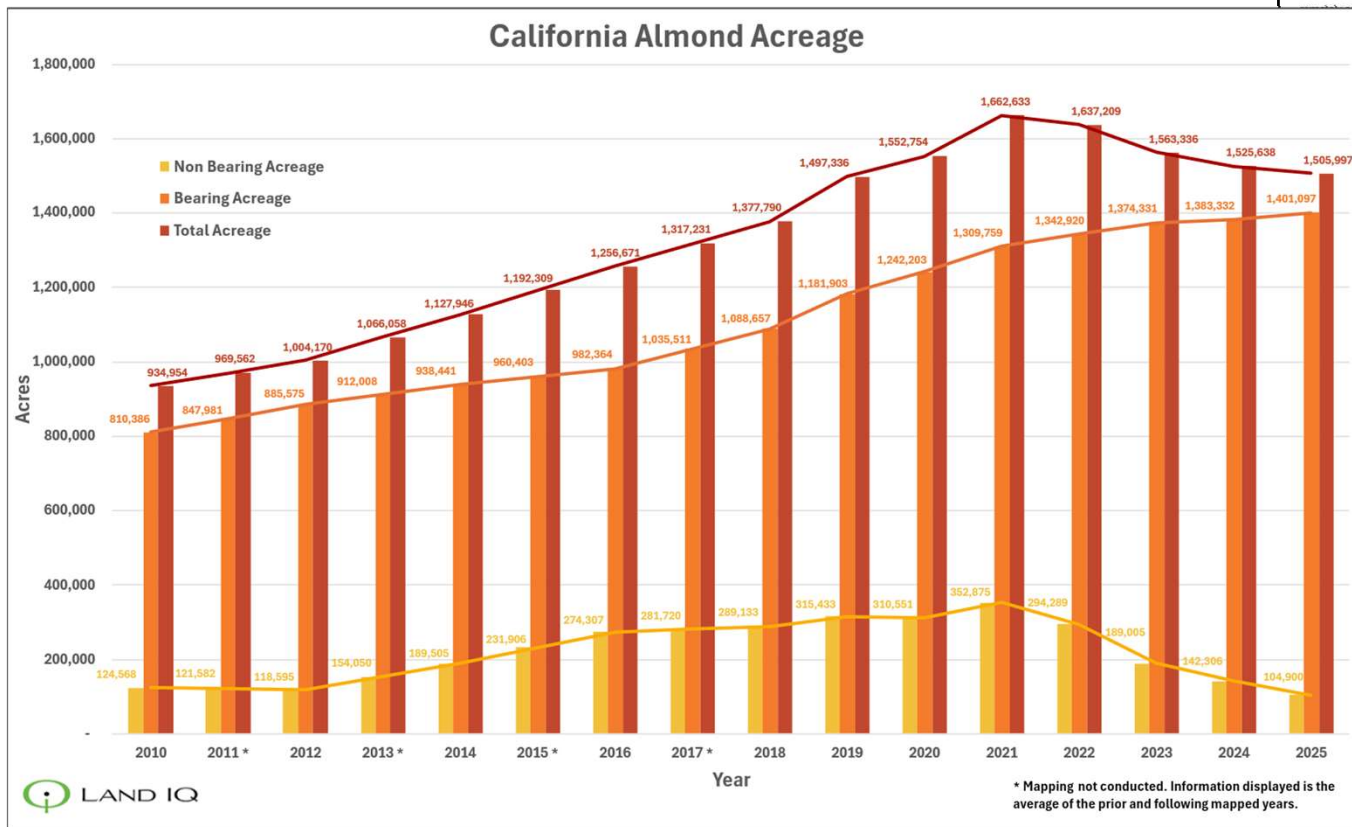
Acreage – How many actual acres are there?

- Fundamentals:
 - Accurate field boundaries
 - Comprehensive ground truthing of all crops
 - Utilizing multiple lines of non-spatial evidence (e.g. crop reports, pesticide use reports, past mapping, etc.)
 - Implementing advanced remote sensing by spatial scientists
 - Manual checking by skilled agronomists and land scientists



Acreage – How many actual producing acres are there?

- History and Approach – Standing footprint only. Grower driven.
- Advancements to now a Producing footprint:
 - Bearing versus non-bearing, Removed orchards, Abandoned orchards, Stressed orchards



2025 STANDING ACREAGE - FINAL ESTIMATE

In cooperation with the Almond Board of California

Released: November 19, 2025

RESULTS

Each year Land IQ produces an in-year, statewide almond acreage estimate. This estimate is the result of extensive ground truthing and advanced remote sensing analytics, allowing Land IQ to differentiate almond orchards from other tree and annual crops.

The result is a highly accurate mapping of almonds that are a minimum of three years old. Almond orchards that are less than 3 years old cannot be consistently differentiated from other similarly aged tree crops using the methods. The ground truthing data, proportionality of tree tree crops, and other lines of evidence are used to estimate acreage for orchards that are one and two years old. Remotely sensed and numerical estimates are combined for the acreage estimate. The 2025 estimate is 98.8%.

The 2025 acreage estimate is:

Non-bearing acres

are those orchards planted in 2023, 2024, and 2025)

Bearing acres

are those orchards planted in 2022 and earlier)

Total acres

are total standing acres during the growing season of 2025)

Partially abandoned acres

are orchards experiencing high levels of stress but are included in the bearing and total acres above)

Change in the number of bearing acres between the initial and final estimates. This is the result of additional acreage (planted in 2021 or earlier) and the difference between the initial and final analyses. Additionally, the acreage was less than originally estimated. These two factors account for most of the difference in final bearing acreage from the initial estimate.

Each year, Land IQ not only maps all almond orchards within the state but also applies a separate algorithm to quantify the age of each orchard. The accuracy of this estimate is greater than any other. Based on that analysis, Land IQ determined that: 1) of California's almond orchards were 1-3 years old, 2) it were between 4 and 10 years old, 3) it were between 11 and 20 years old, 4) it were between 21 and 25 years old, and 5) it were over 25 years old.



APPROACH

Land IQ draws upon multiple lines of evidence including agronomic and remote sensing knowledge, unique field boundaries, robust on-the-ground verification, customized image analysis, artificial intelligence and machine learning algorithms to classify almond orchards.

For each mapped year, the following steps are taken as the basis for determination of bearing acreage and the numerical estimate of non-bearing acreage.

Imagery Acquisition

Evaluate and acquire imagery from various sources based upon cost and spectral, spatial, and temporal resolution suitability. New imagery sources allow for annual mapping of almonds.

Field Boundary Delineation

Utilize imagery and other resources to delineate individual fields defined as a homogenous crop. These boundaries are not legal boundaries of the property and do not include roads, homes or farmsteads. Irrigated field boundary positional accuracies are +/- 6 feet at a 95% confidence interval.

Ground Truthing

Identify and geo-reference crops through thousands of miles of actual verified orchards from Tehama to Kern County. These data provide necessary training data for algorithms as well as validation data for the classification.

Remote Sensing Analysis

Utilize custom image analysis, artificial intelligence, and machine learning algorithms to determine crop type. This allows for the differentiation of almond orchards from other tree and annual crops. Accuracy assessments are performed using statistical probability and validated against ground truth information.

Change Analysis and Update

Determine which orchards have been removed or added using a change analysis as part of the overall remote sensing efforts.

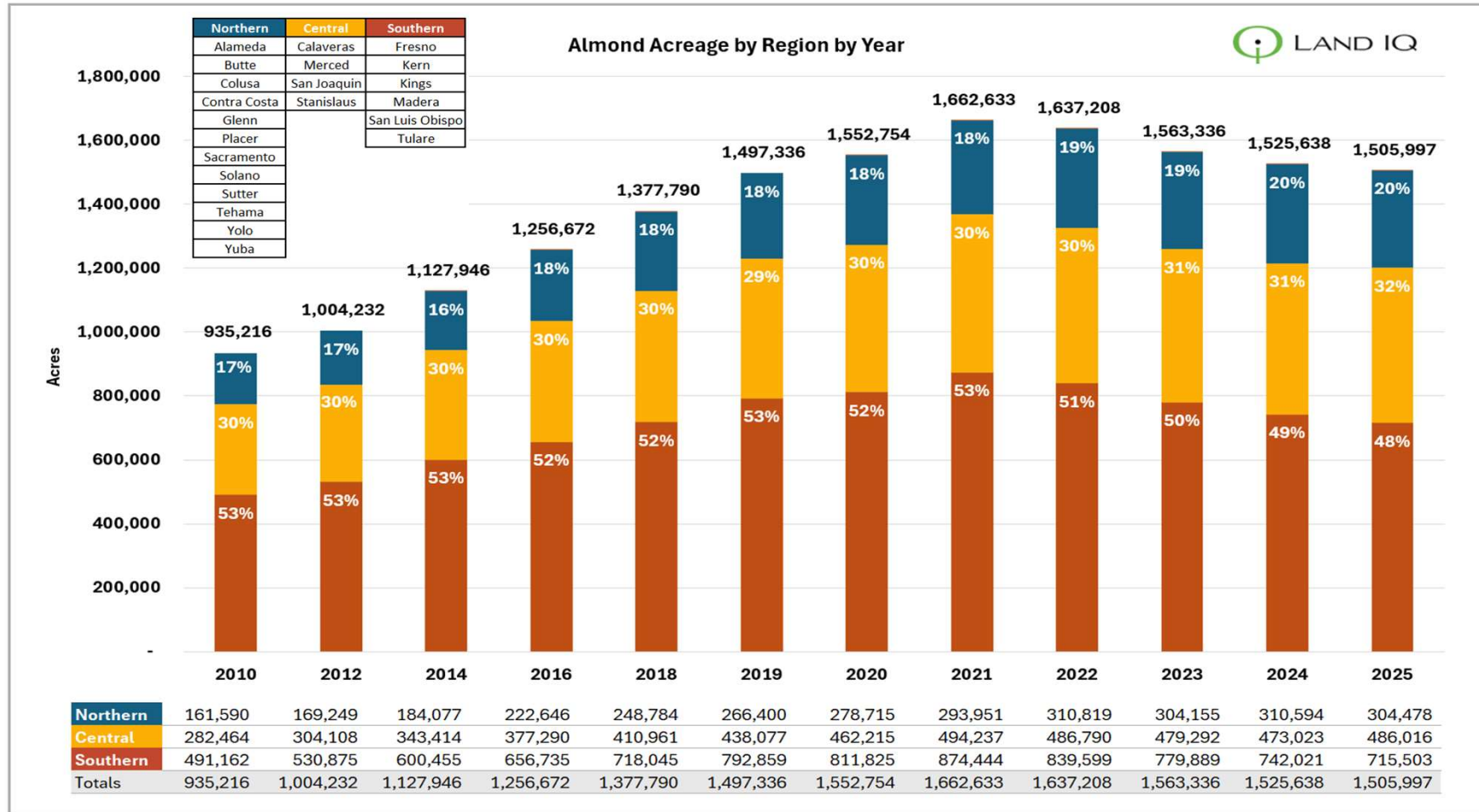
Non-Bearing Estimate

During the second mapping event, an estimate of non-bearing acreage is conducted, taking into account the data collected with ground truthing in the summer months.

2020 L Street, Ste 210
Sacramento, CA 95811
www.LandIQ.com - (916) 265-6330

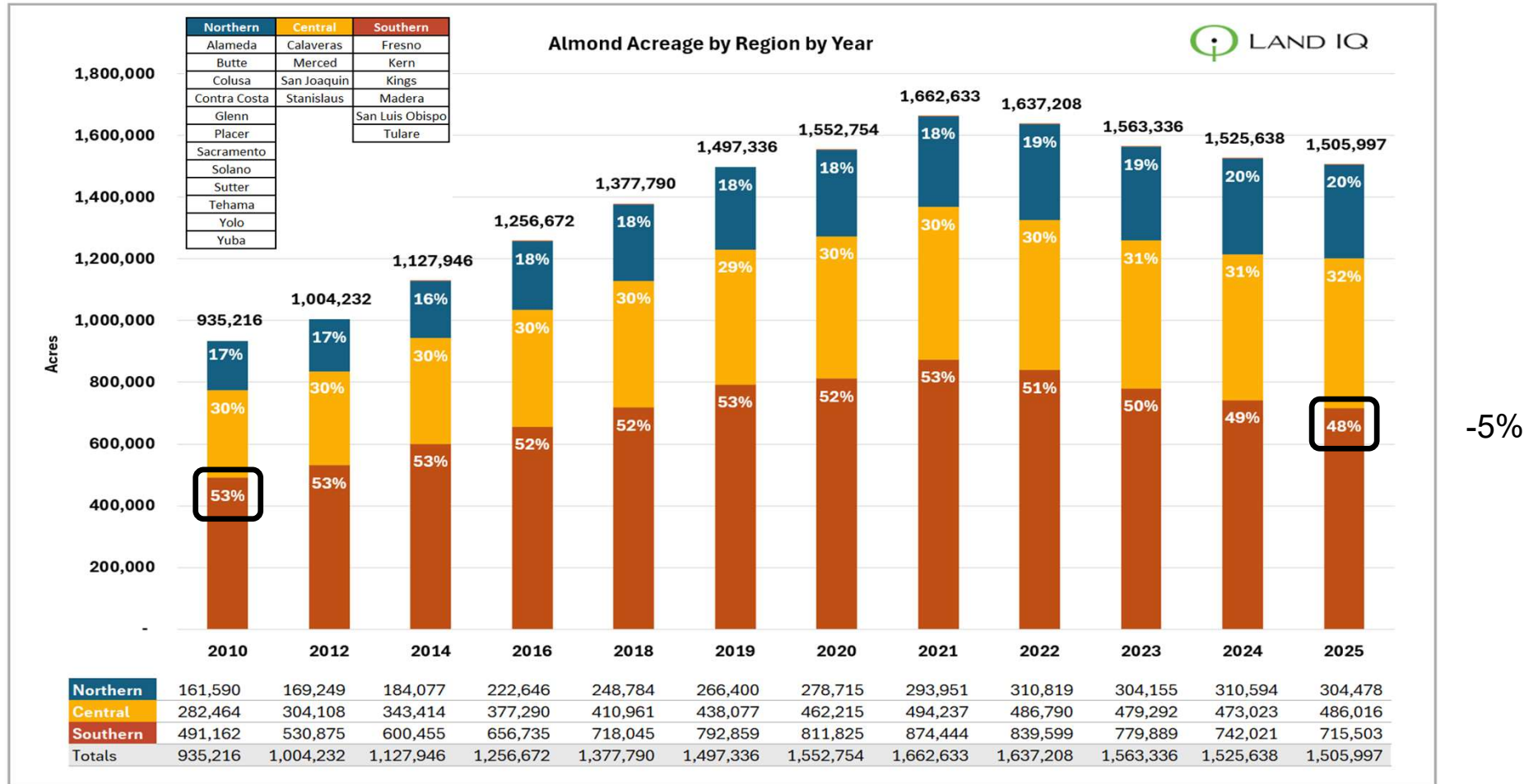
Location – Where are these actual production acres?

- Known relationship between yield and location – yields generally increase from north to south



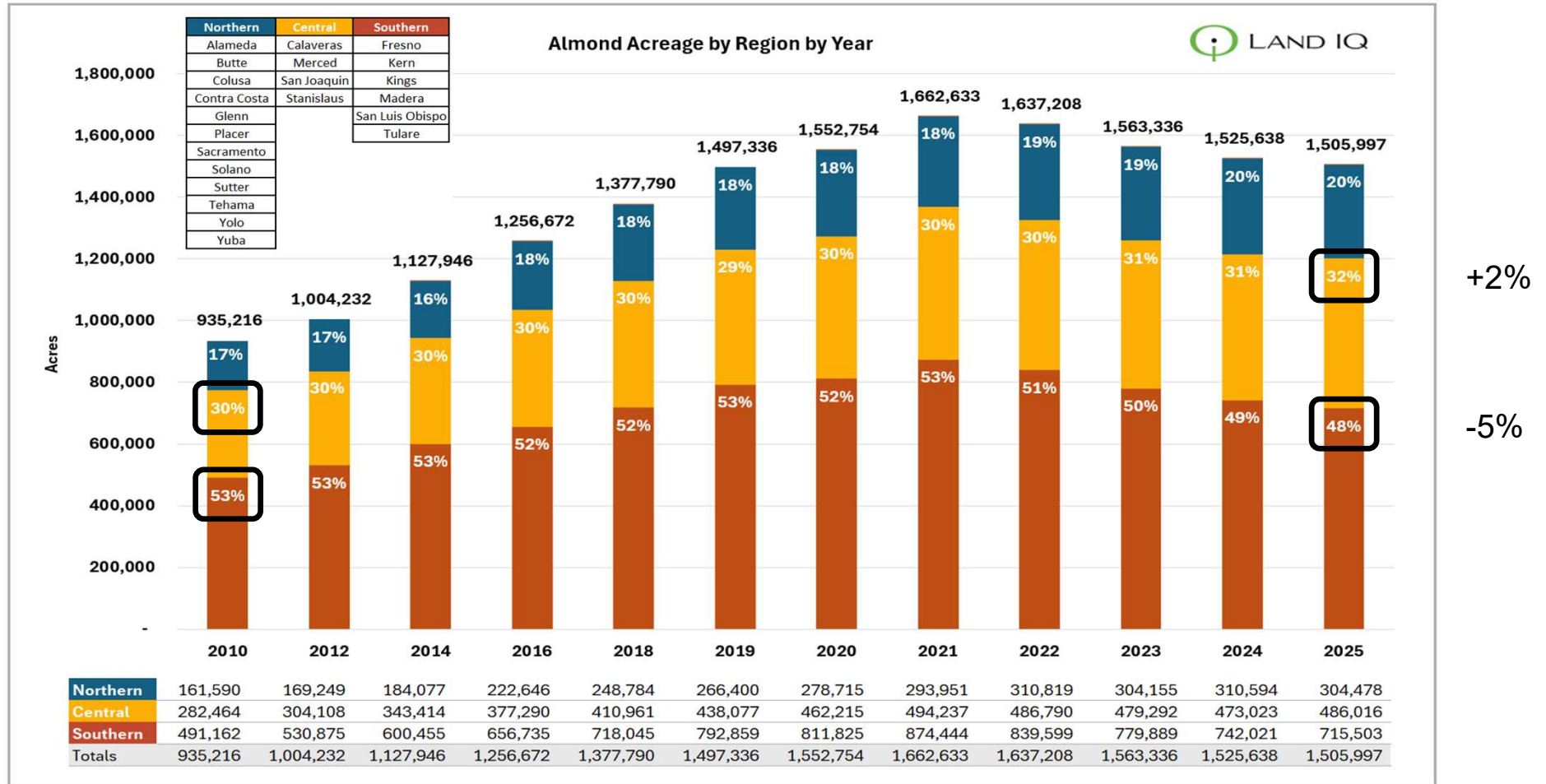
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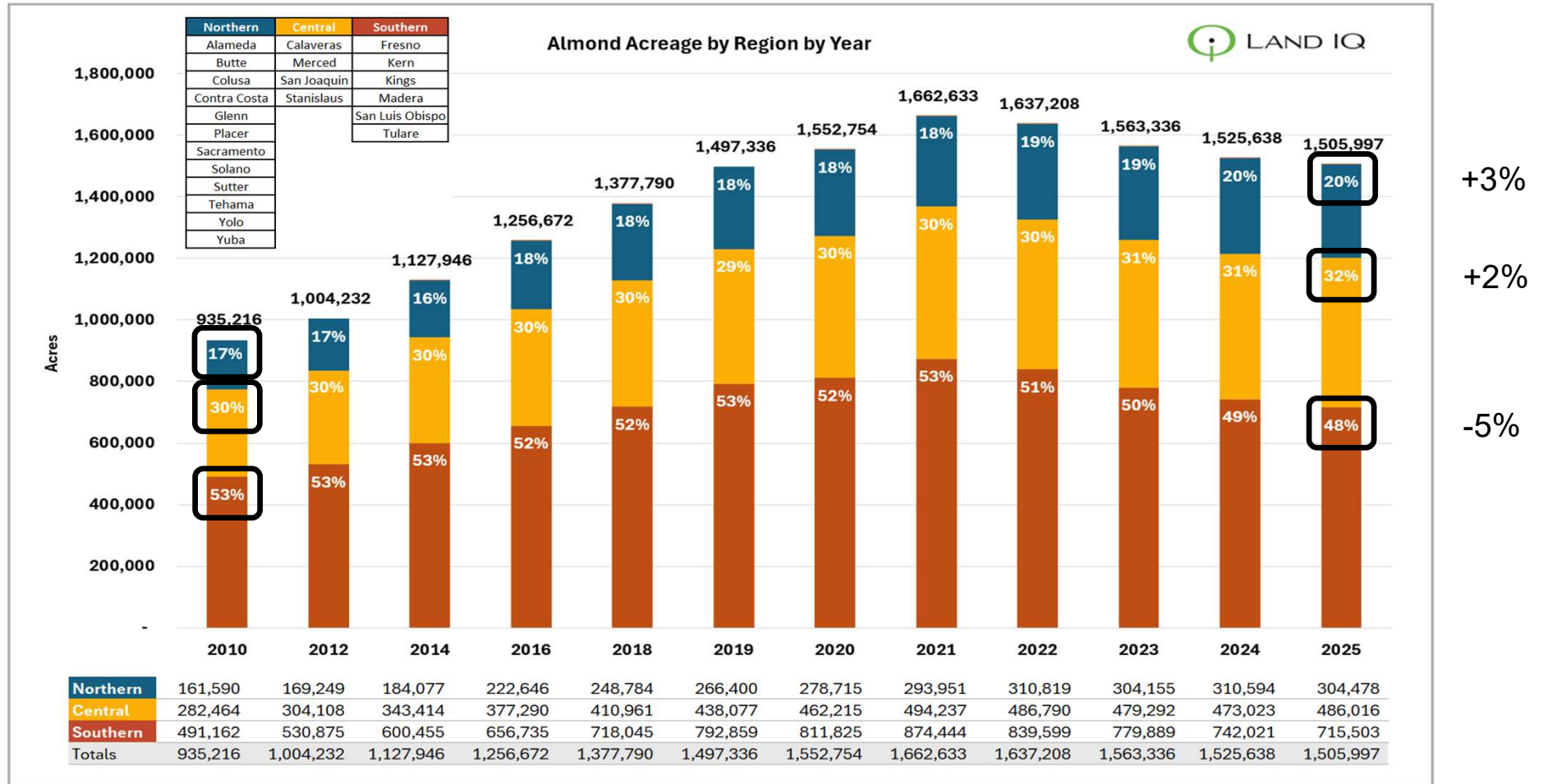
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Age – How old is every orchard?

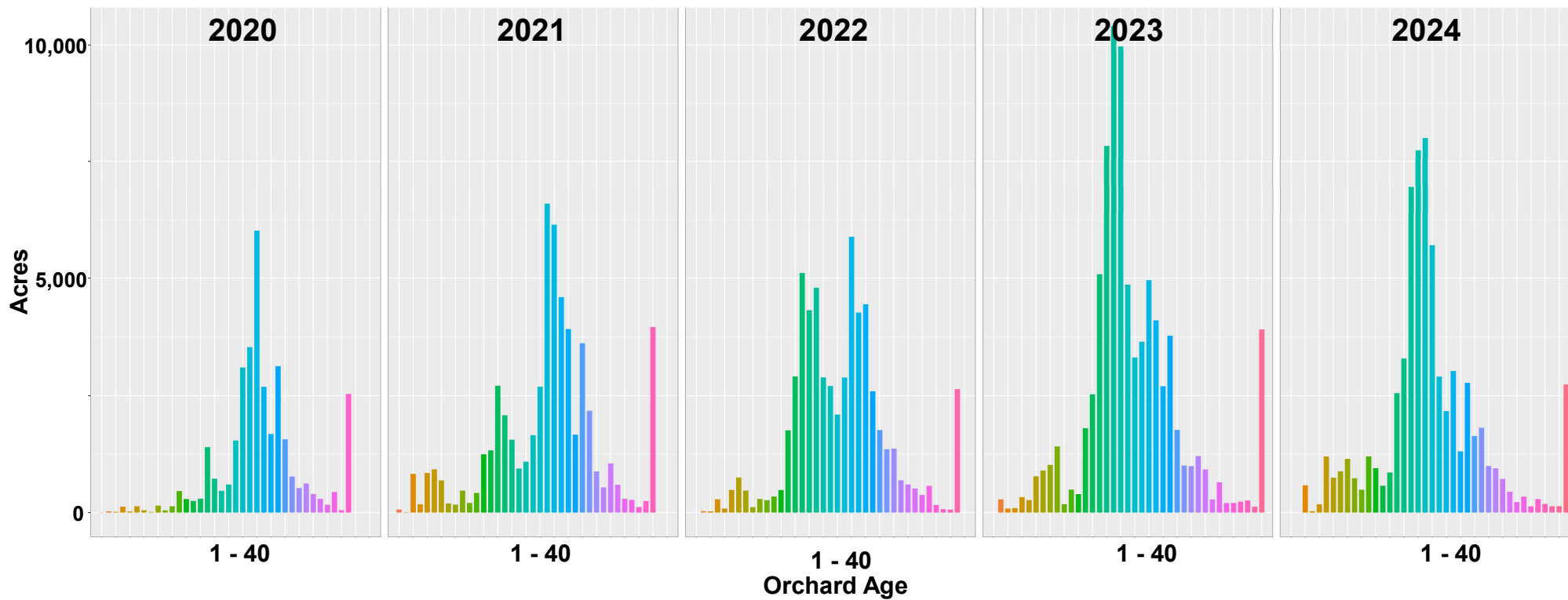
- Known relationship between yield and age – yields increase with age, to a point.
- Southern SJV (#/ac): Year 3: 600, Year 4: 1200, Year 5: 2400, Year 6+: 2800



FOUR VARIABLES NEEDED TO ESTIMATE TOTAL ALMOND YIELD

3. Age – How old is every orchard?

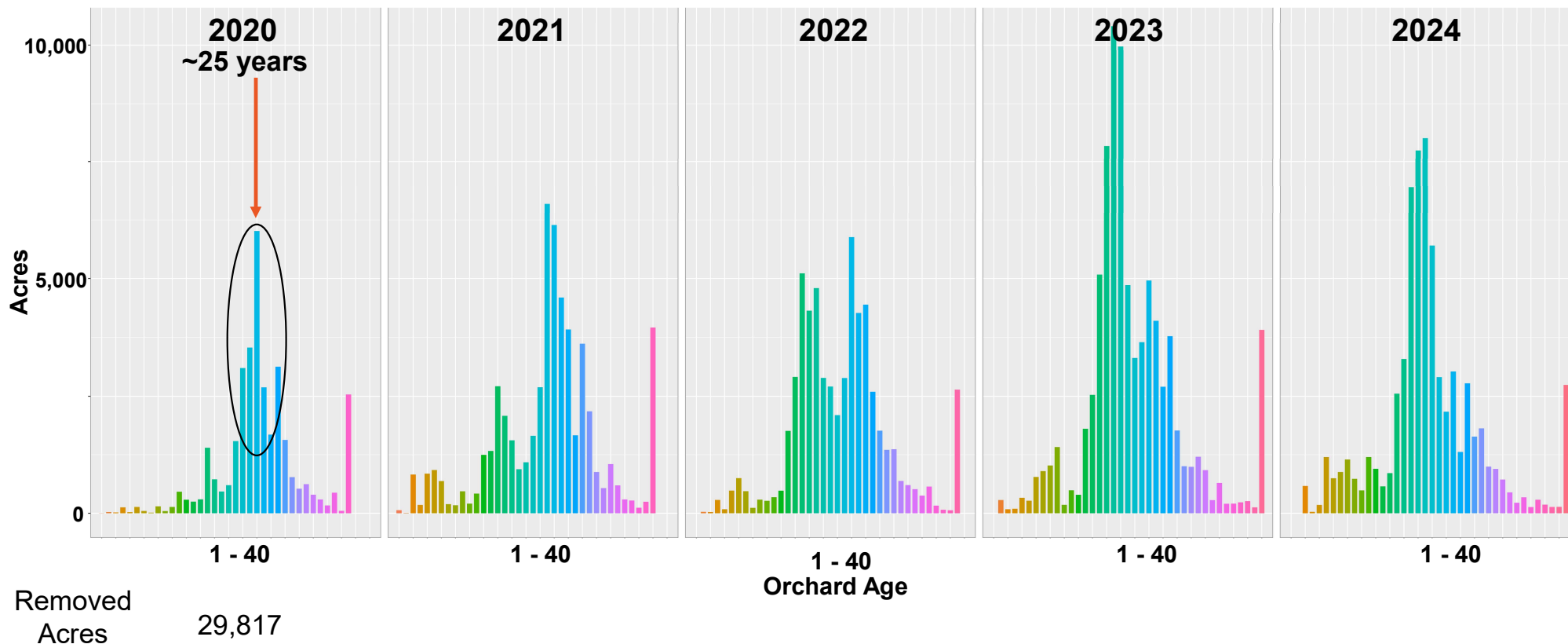
- Application - Removed orchards by age: Is there a trend in removals associated with age?



FOUR VARIABLES NEEDED TO ESTIMATE TOTAL ALMOND YIELD

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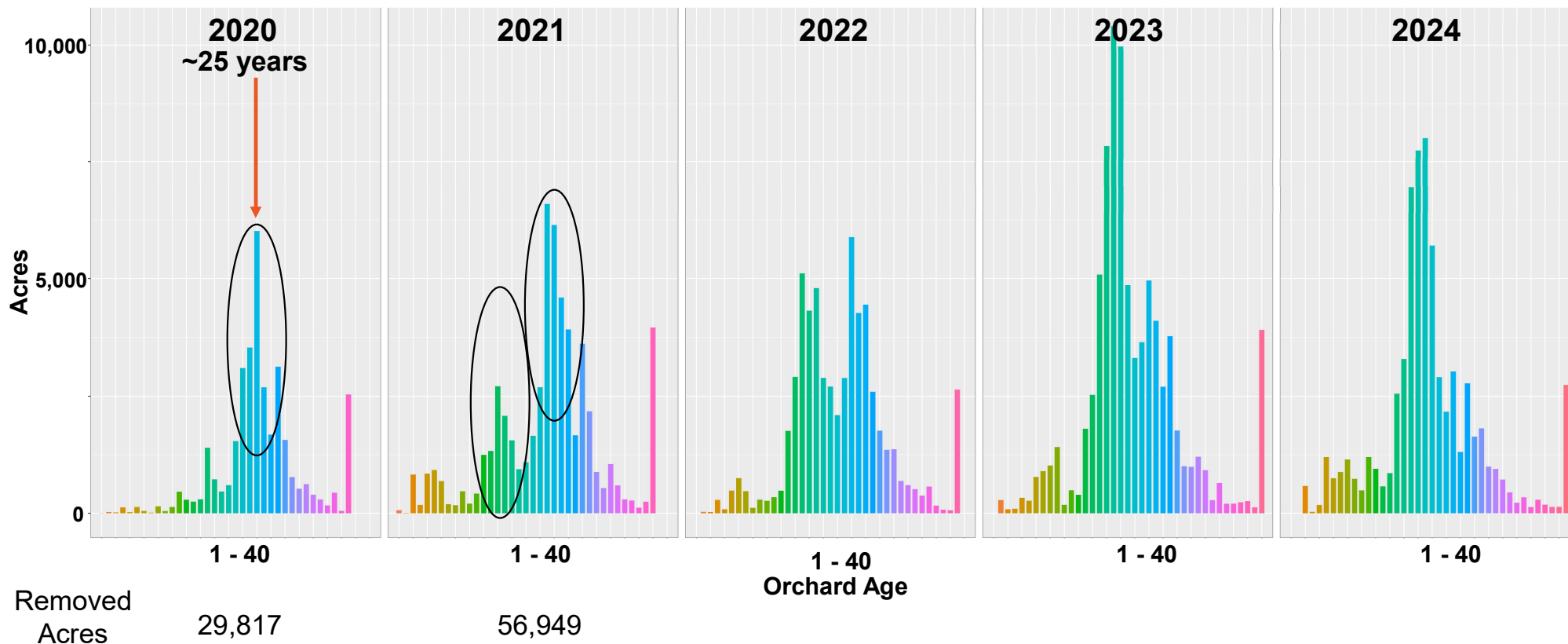
- Removed orchards by age: Is there a trend in removals associated with age?
- Was this driven by price? Regardless, it's a quantifiable trend



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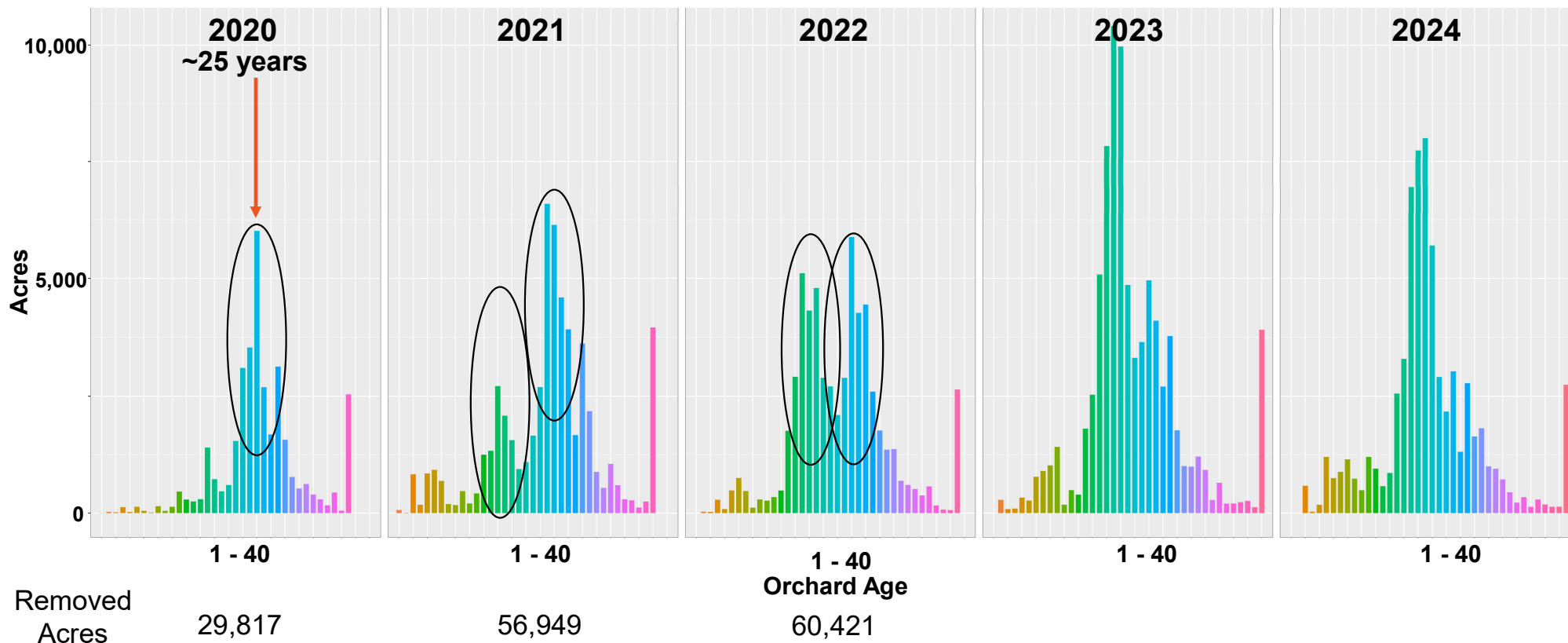
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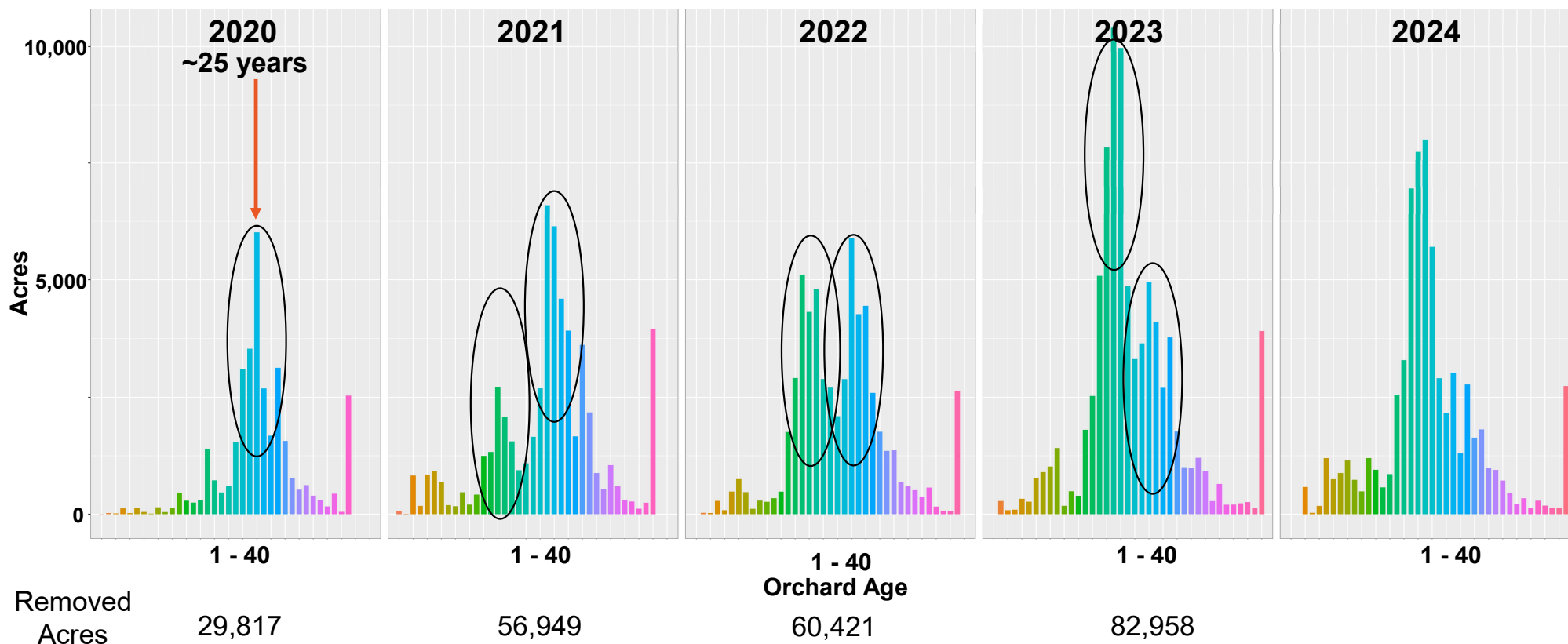
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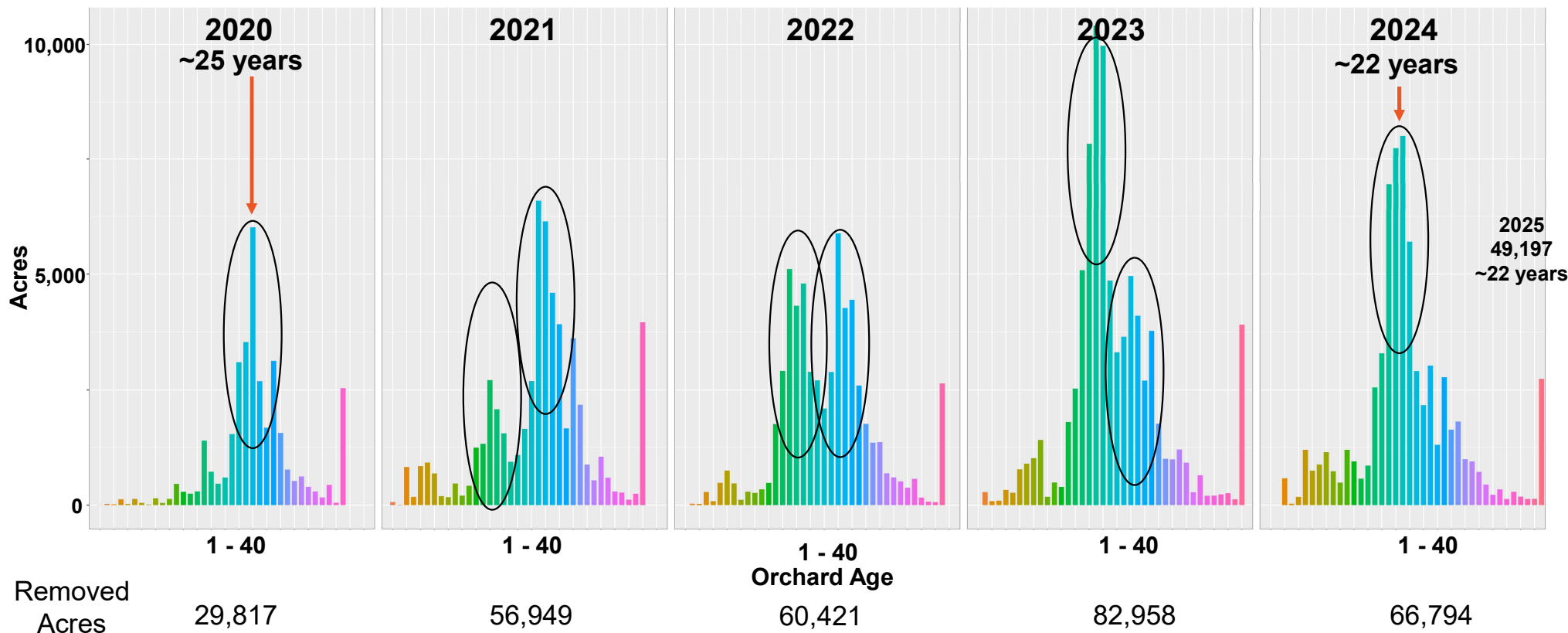
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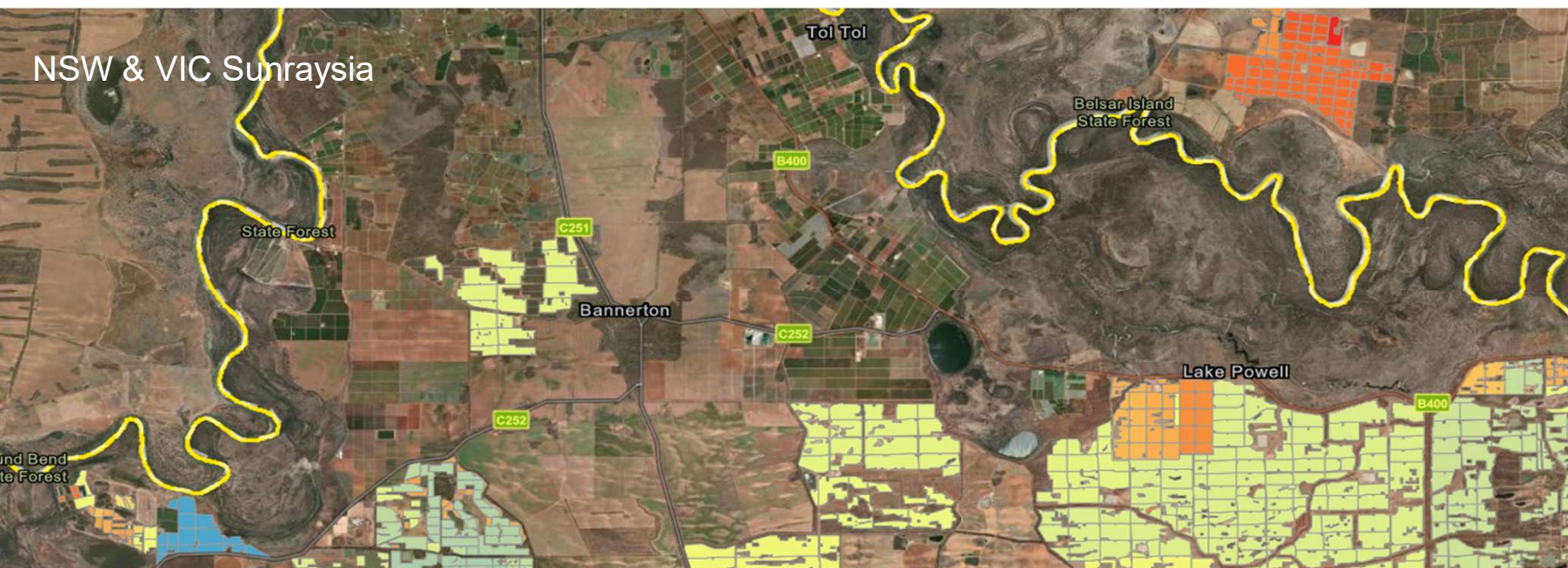
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ALMOND MAPPING IN AUSTRALIA: SAME APPROACH - FAMILIAR RESULTS

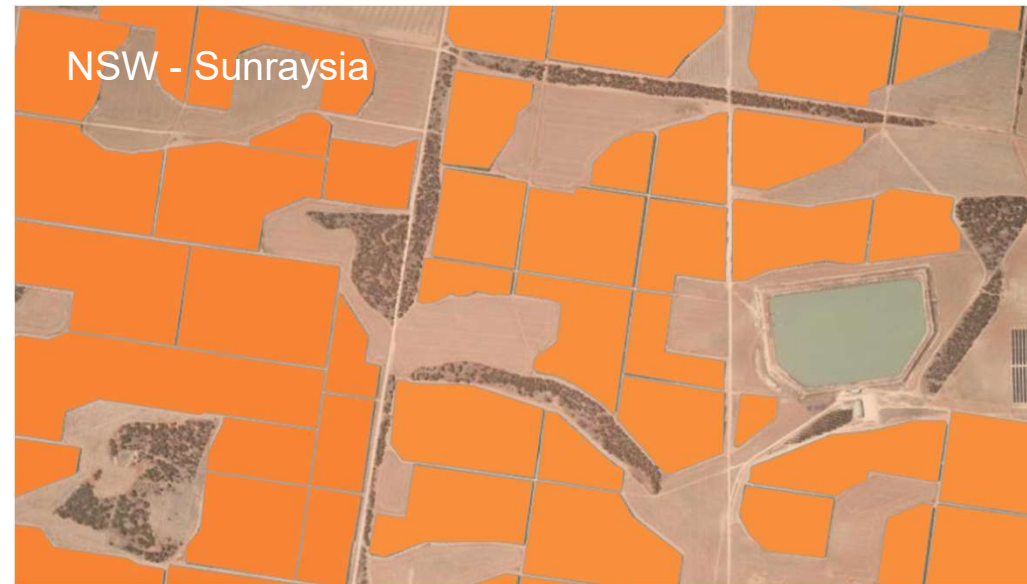
- Mapped for 2023 and 2026
- Rigorous ground truthing each year
- Age classification each year
- Accuracies are 98% or greater – but never perfect



ALMOND MAPPING IN AUSTRALIA:

SAME APPROACH – DETAILED FIELD BOUNDARIES

- All field boundaries are hand digitized
- Updated between 2023 and 2026 mapping
- Horizontal field edges are +/- 2 meters at 95% confidence interval
- Represent the true cropped and managed footprint of each block

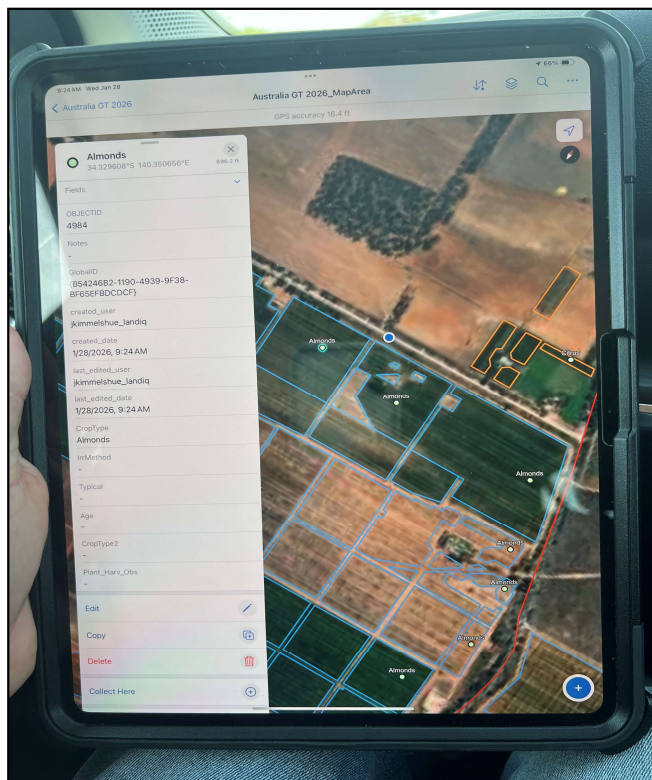


ALMOND MAPPING IN AUSTRALIA:

SAME APPROACH – RIGOROUS GROUND TRUTHING

January 2026

- 8 days
- Over 3,900 km



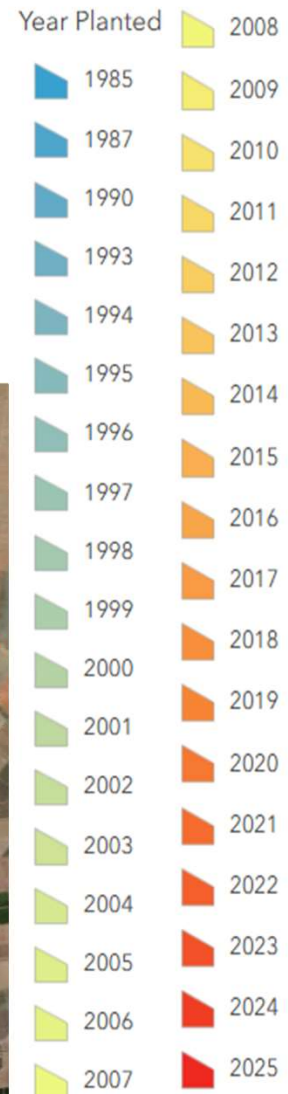
ALMOND MAPPING IN AUSTRALIA: RESULTS

2023

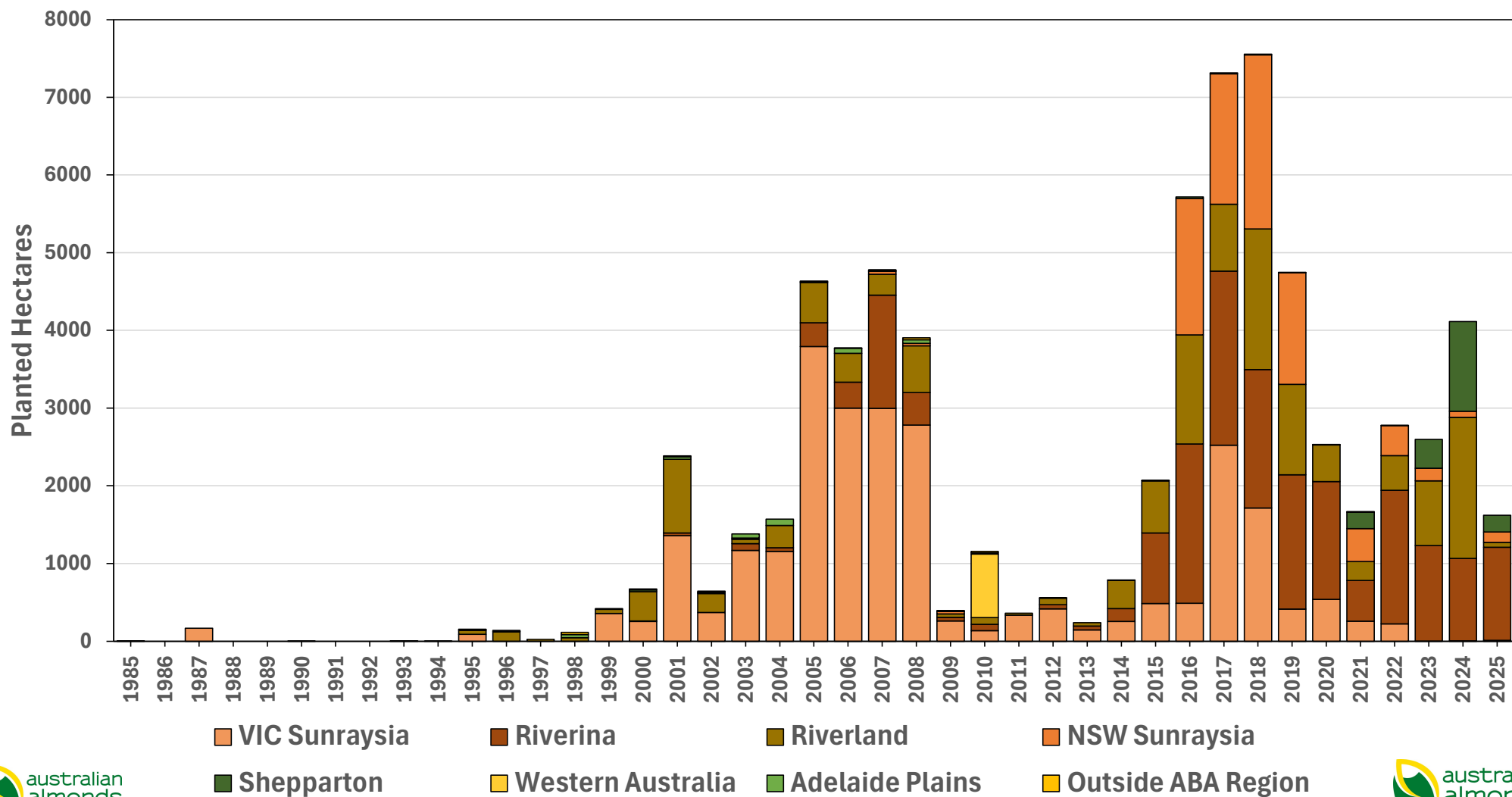
- 62,428 standing hectares

2026

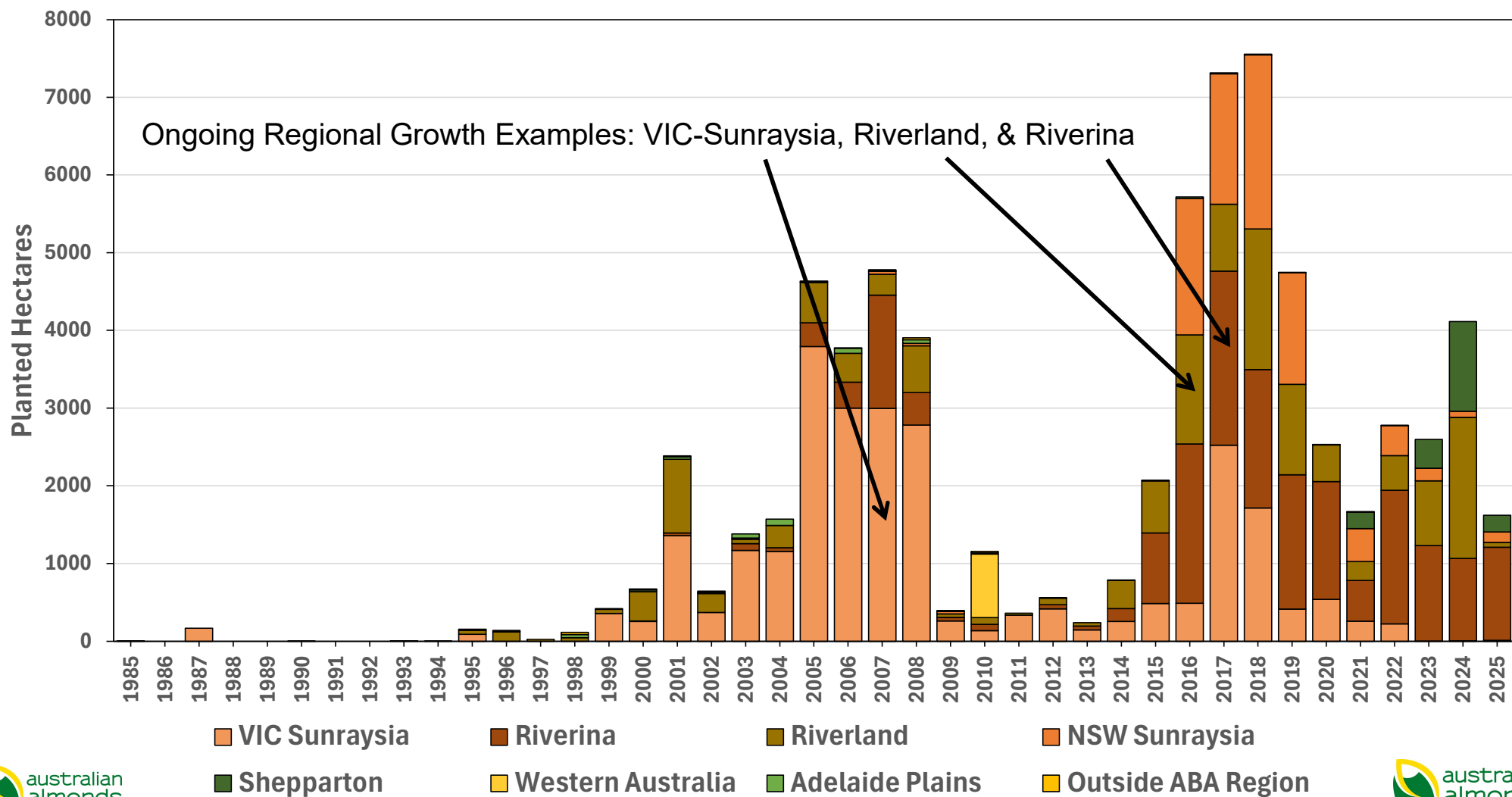
- 70,967 standing hectares
- 767 hectares removed (1.1%) since 2023



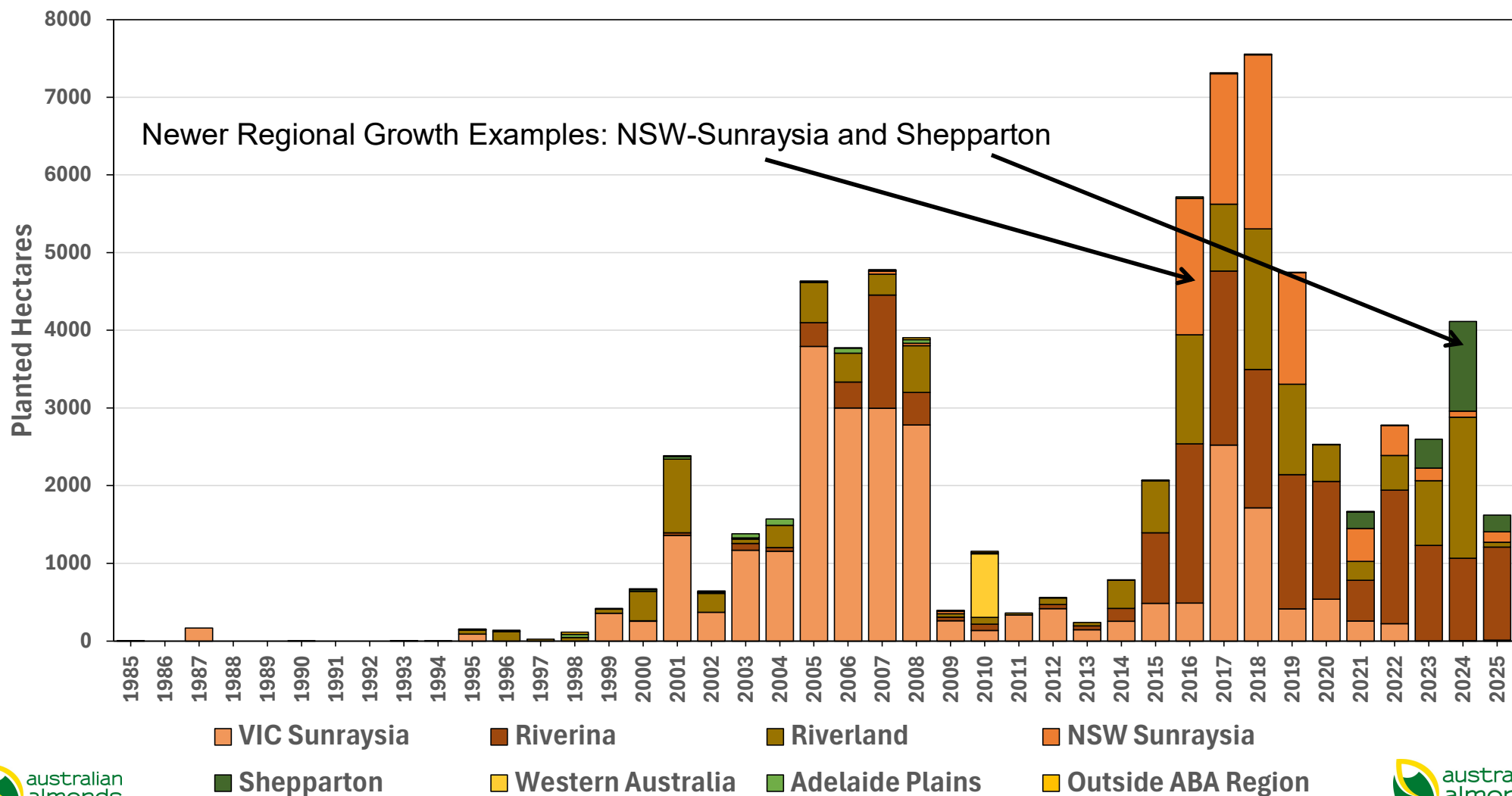
Australian Almonds by Planting Year by Growing Region



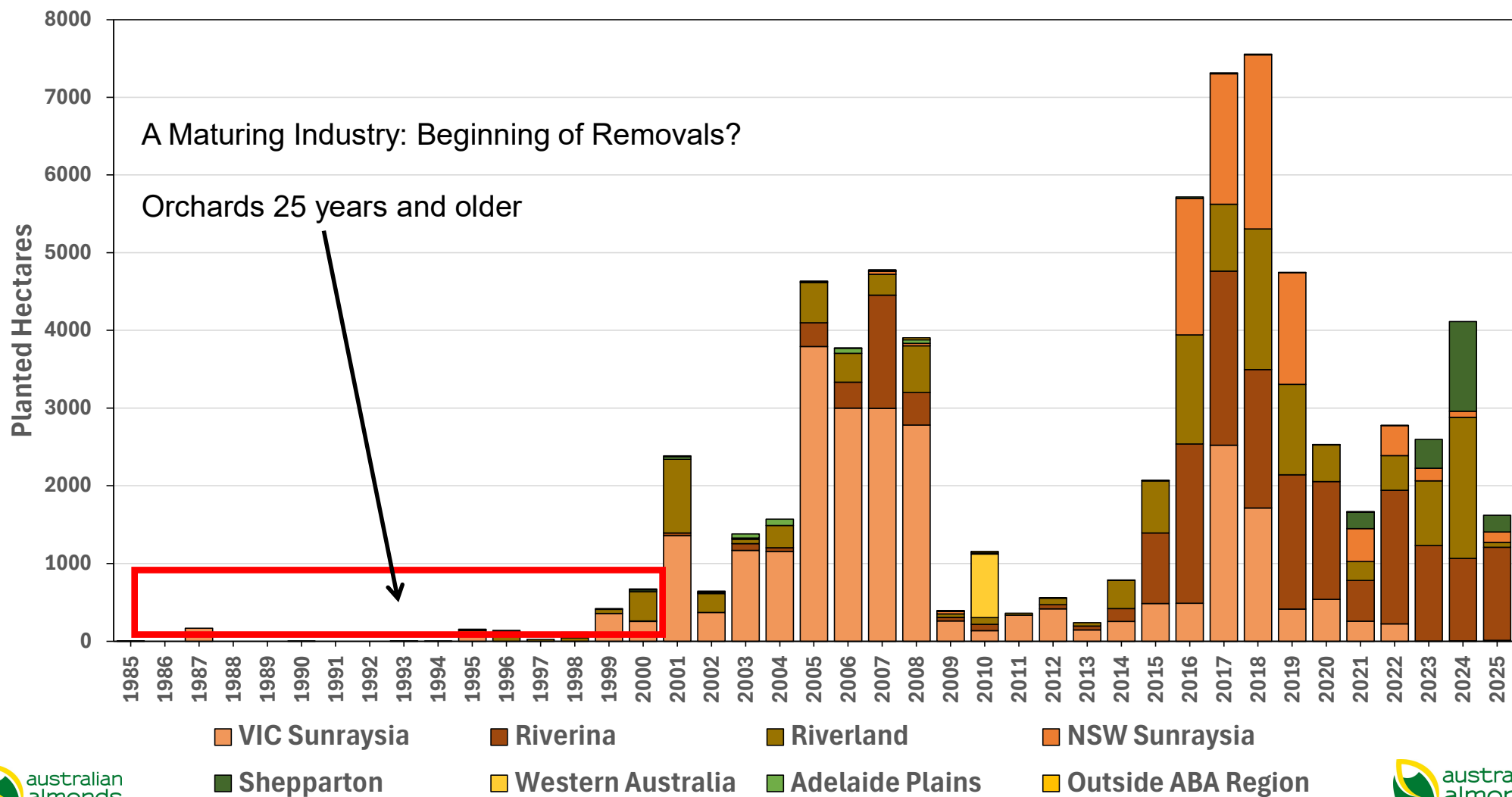
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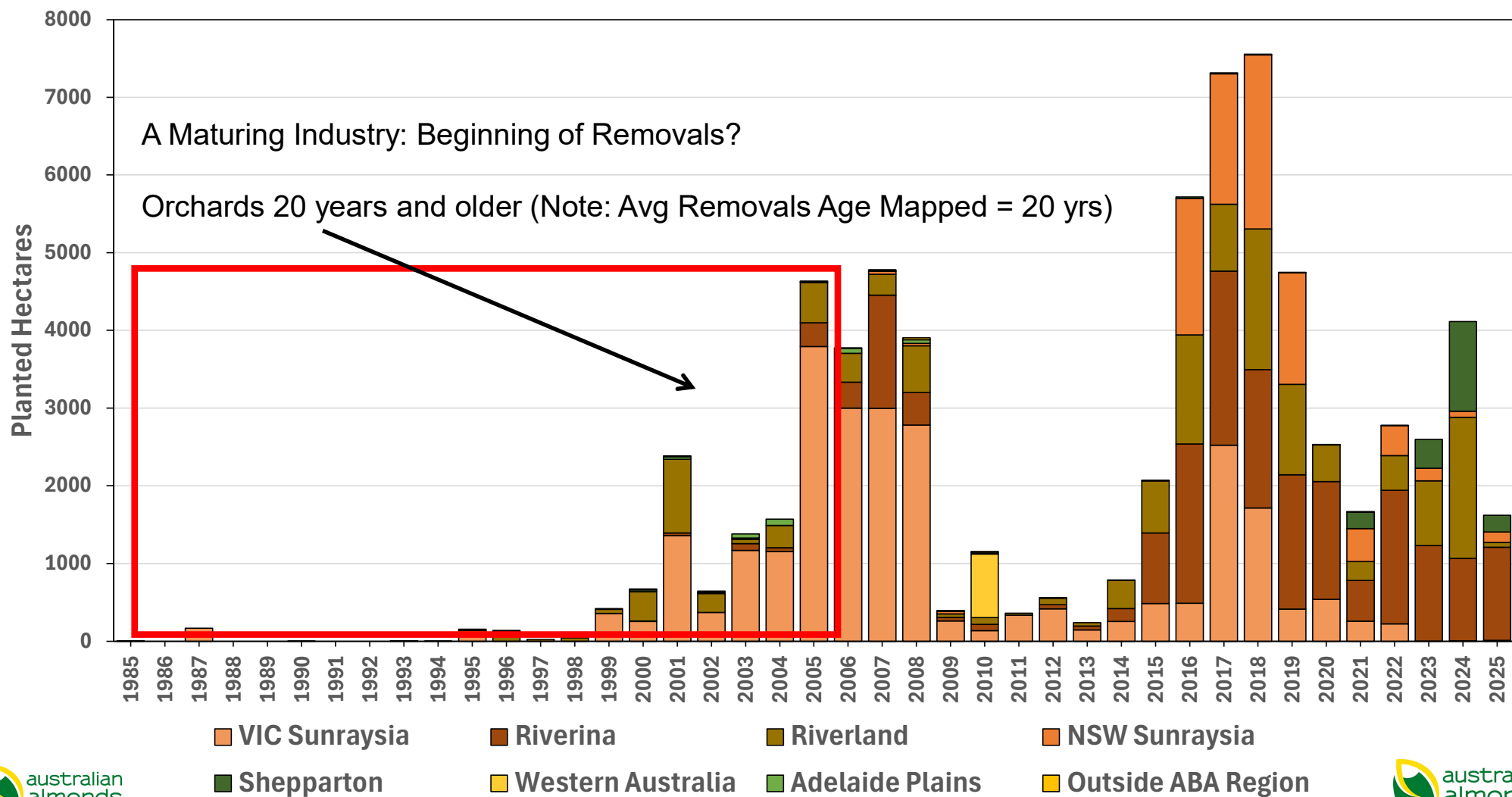
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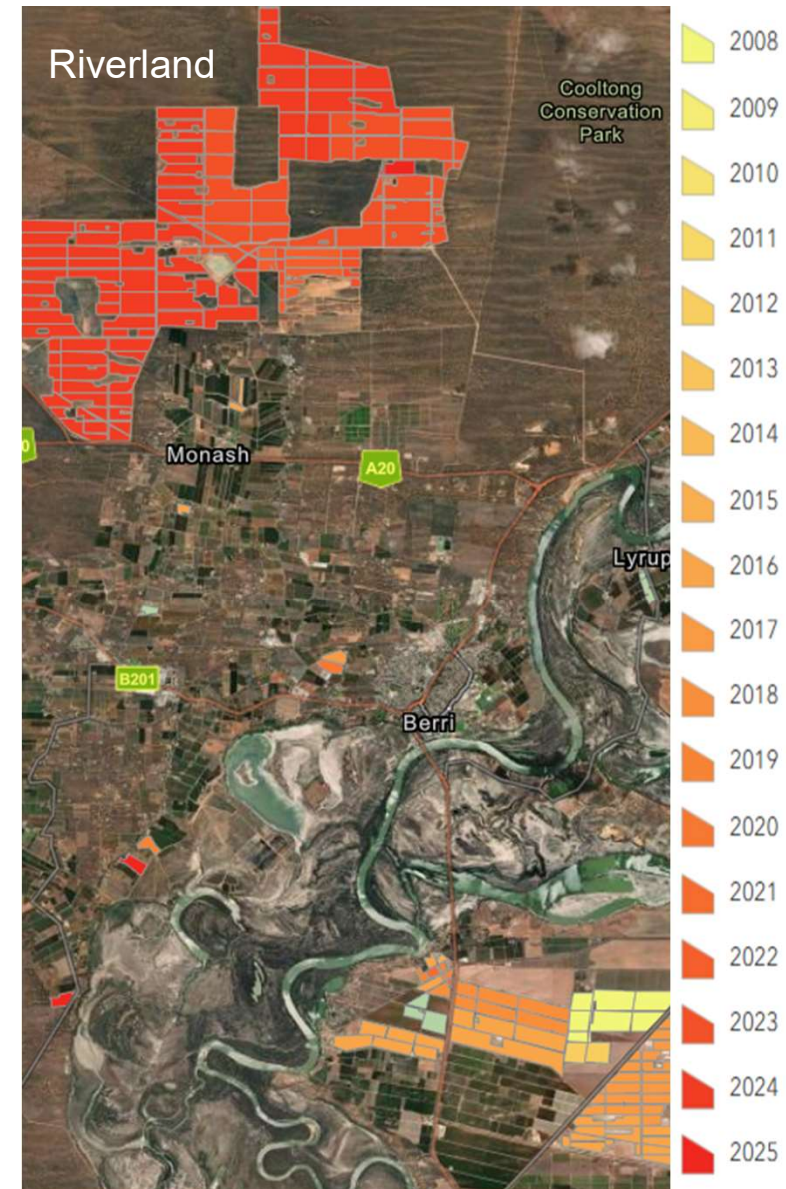
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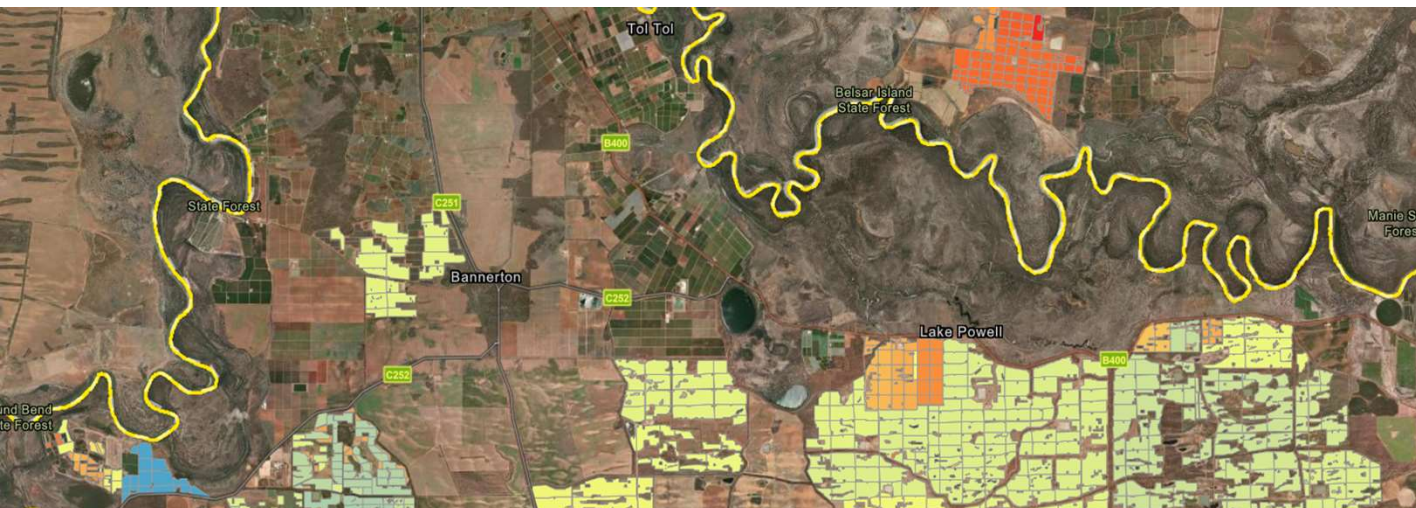


APPLICATIONS

Multiple Uses

- Area cropped
- Total, bearing and non-bearing footprints
- Removal and planting trends
- Biosecurity
- Varietal tracking
- Yield forecasting
- Grower and industry management
- Marketing intelligence
- Water use
- Regulatory compliance
- Various proximity analyses





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