Estimating water savings benefits of invasive plant removal using the OpenET remote sensing platform: a case study with *Arundo donax*

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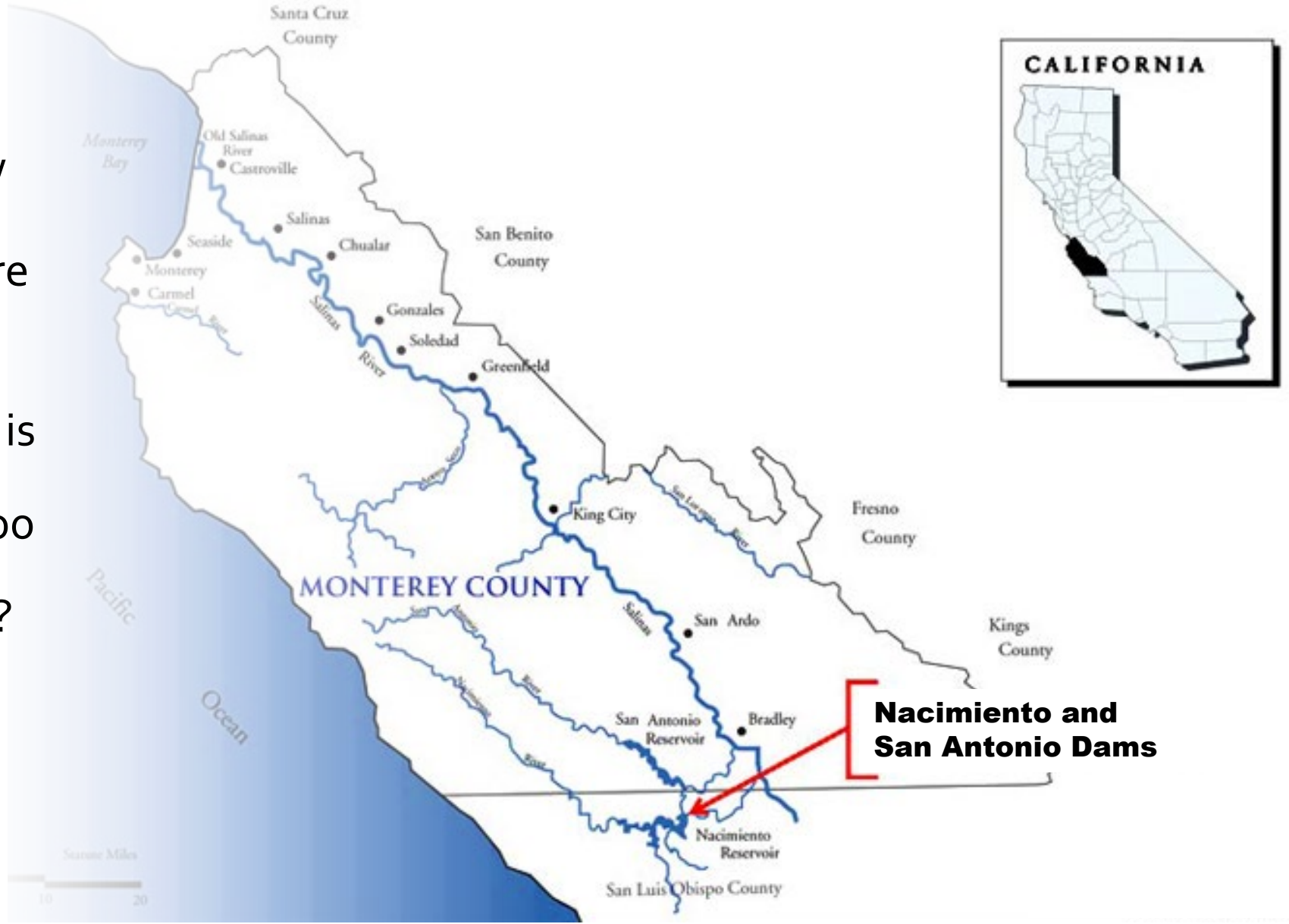
Background

- RCD of Monterey County has been controlling *Arundo donax* along Salinas River since 2014
- Program has multiple benefits:
  - Habitat enhancement
  - Restoration of natural fluvial processes
  - Flood risk reduction
  - Fire risk reduction
  - Water savings
    - Arundo has high consumptive water use

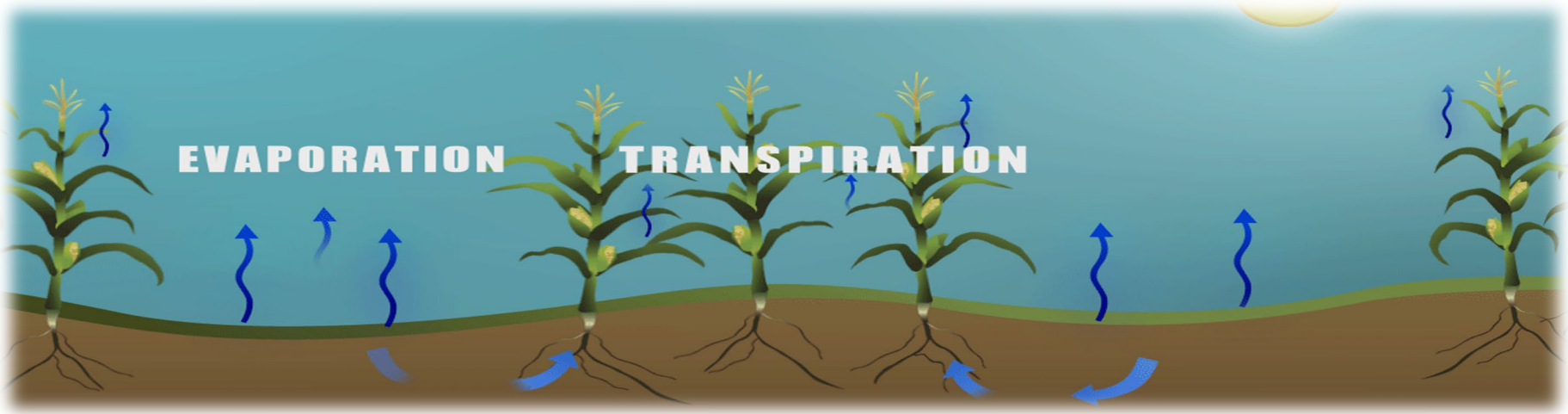
Background

- RCDMC received Wildlife Conservation Board Stream Flow Enhancement grant – needed to show streamflow benefit
  - Removing arundo = more water for surface flows and groundwater
- Problem: Salinas River flow is regulated by dams + humongous watershed (4600 sq mi) – how to measure increased water availability?
- Solution: Quantify arundo water use per acre and multiply by acres treated



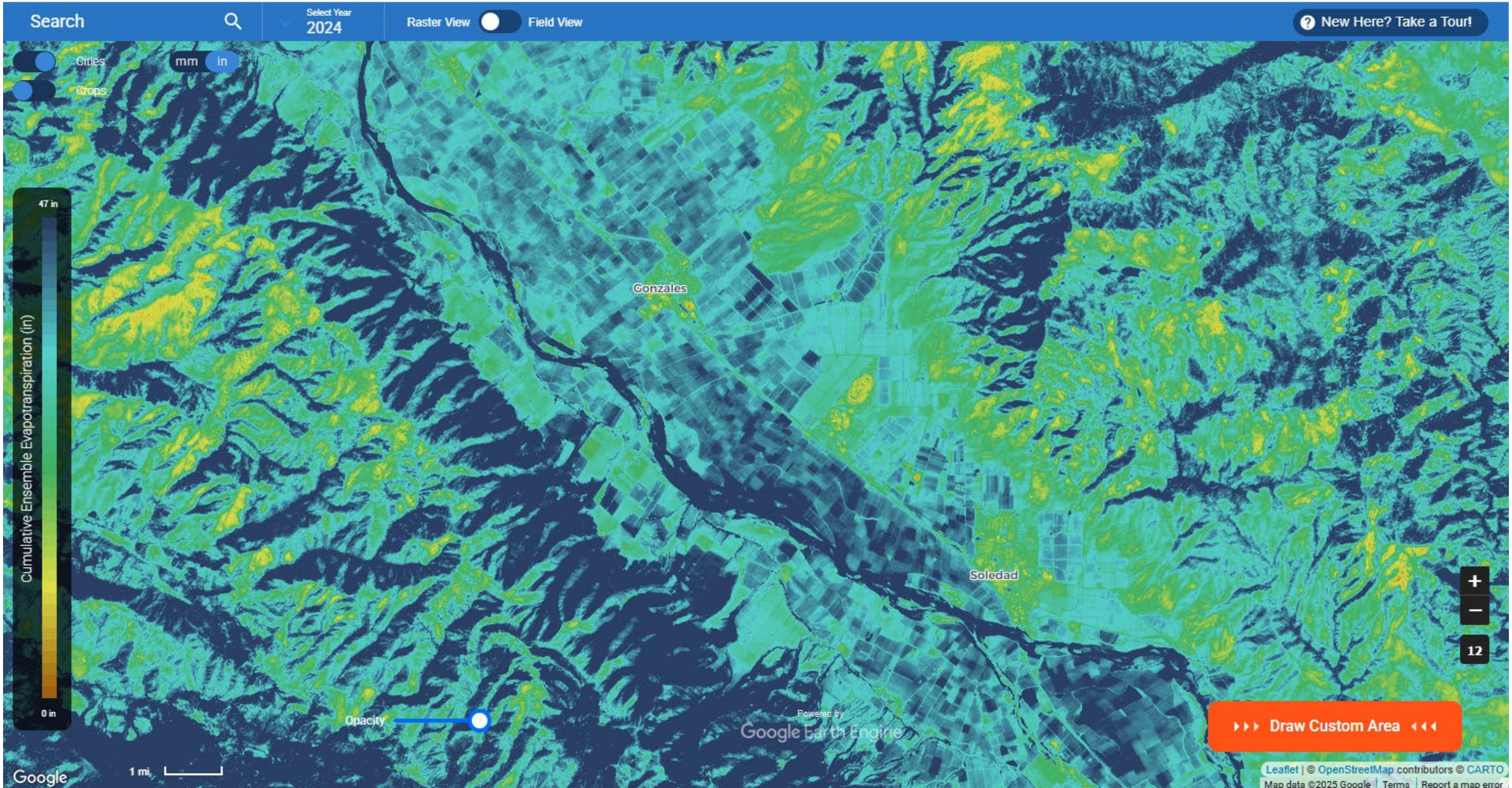
Background

- Problem: Measuring water use accurately is difficult!
  - Varies with time, season, weather, soil water availability
  - Arundo water use estimates vary greatly depending on methodology and location
    - 1-48 acre-feet/acre/year (2019 lit review by TNC)
  - Wanted "Salinas River Arundo" values for this study, and to support Groundwater Sustainability Plans
- Solution: Use OpenET to measure actual evapotranspiration (ET) of Salinas River arundo



OpenET

- Open source platform developed to "provide easily accessible satellite-based estimates of evapotranspiration (ET) for improved water management across the western United States"
- Combines data to model ET at 30m x 30m resolution
  - Remotely-sensed thermal and optical data from Landsat program collected every 8 days
  - Daily reference ET measured at Spatial CIMIS weather stations
  - Other weather variables
- Output – estimated actual ET for any 0.22 acre pixel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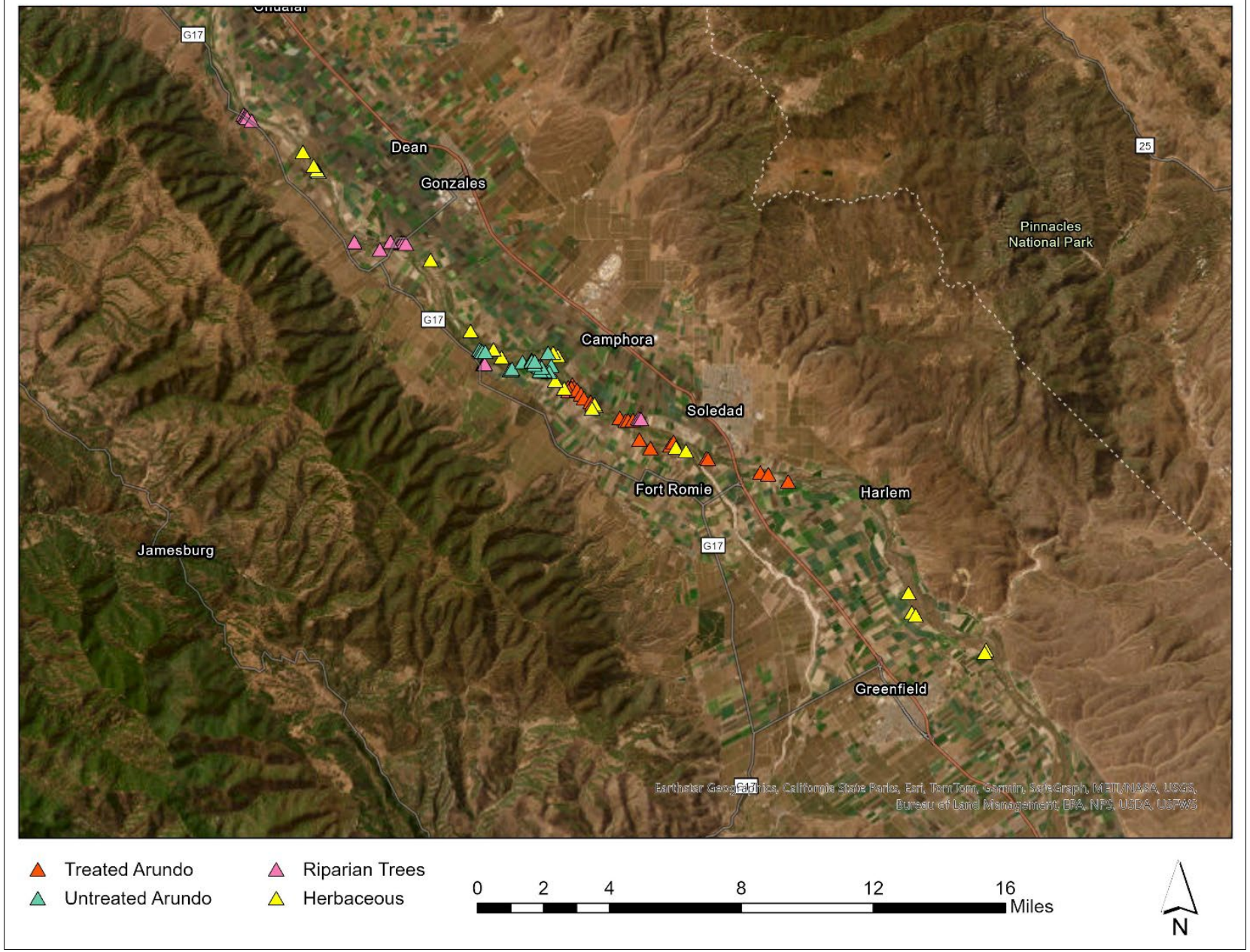
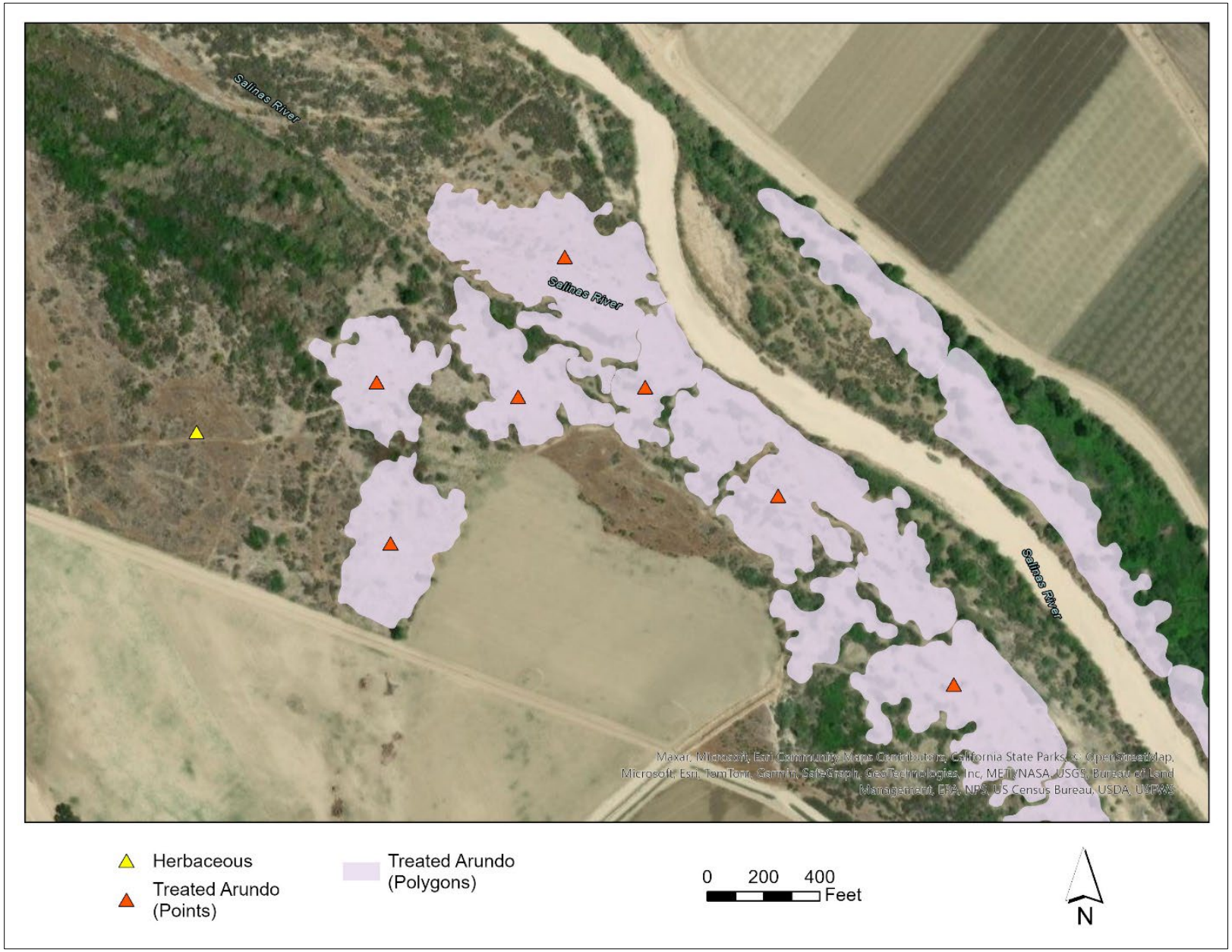


Methods

Selected 23 data points each for four vegetation types:

- Treated Arundo (mowed in 2020)
- Untreated Arundo
- Riparian Trees (dense cottonwood/willow)
- Herbaceous (grasses, forbs)

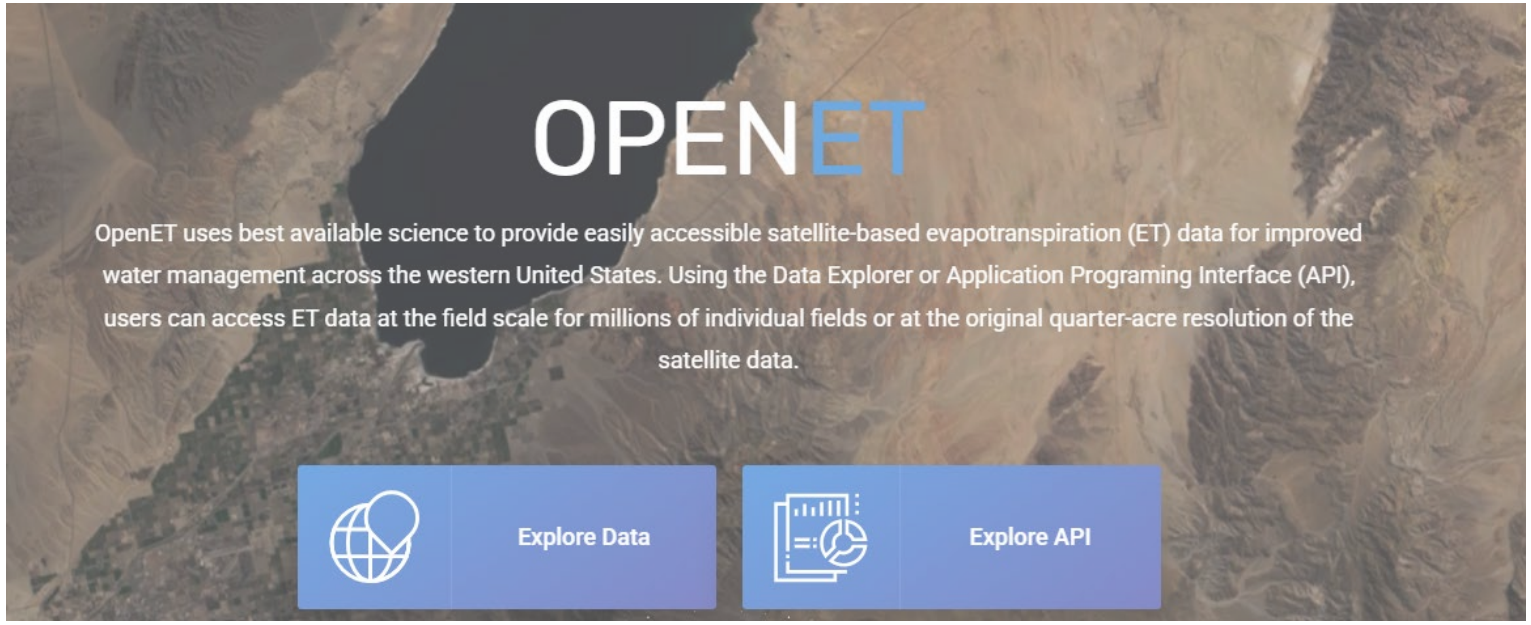


Methods

- Each data point selected to have same vegetation type for at least 30m in all directions.

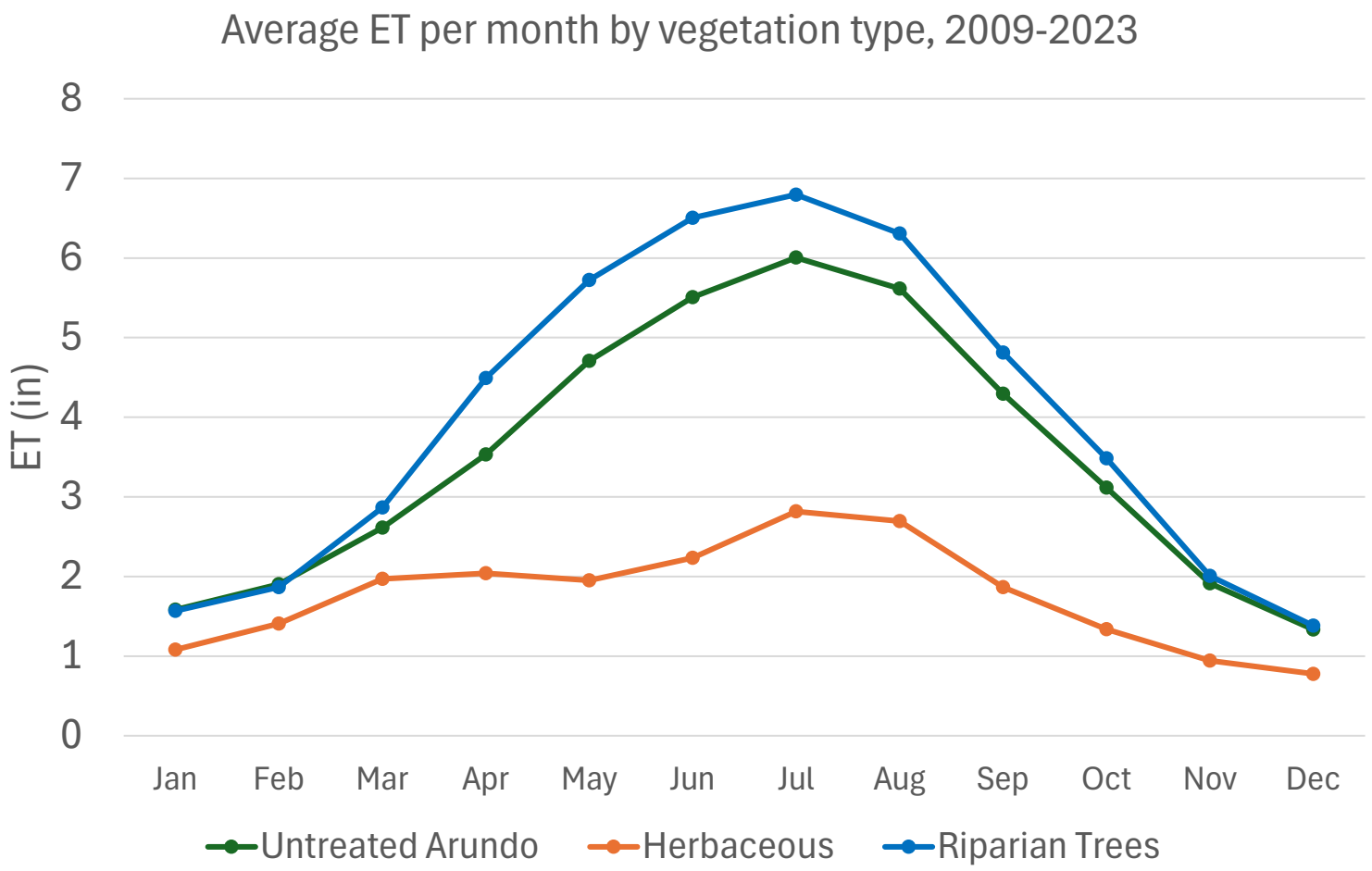
Methods

- Retrieved total monthly ET from OpenET application programming interface (API) for each point from 2009 - 2023
- Calculated average monthly and yearly ET for each vegetation type
- Plotted data to answer questions about effects of arundo removal on water use



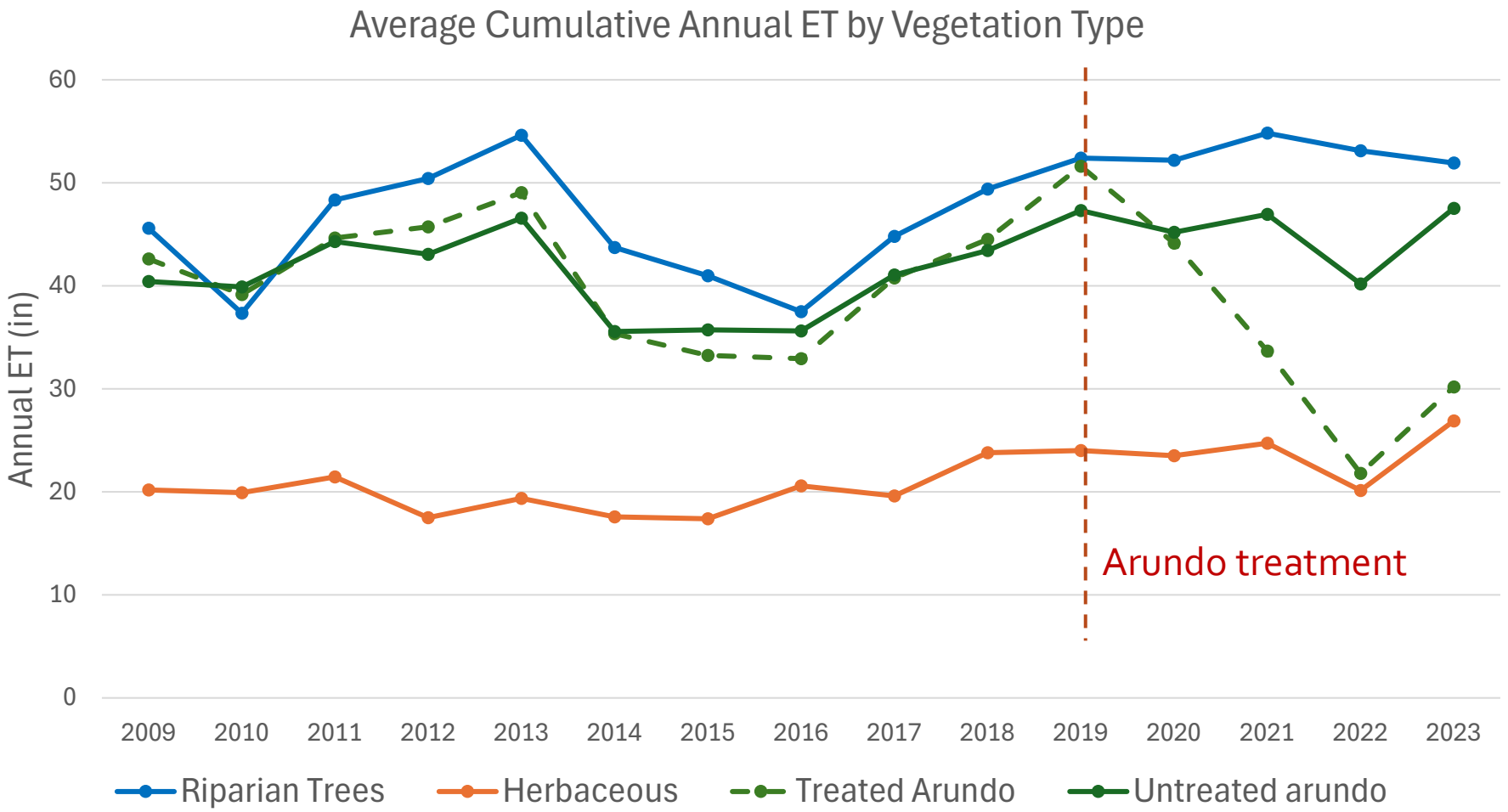
Results

Question: How does ET of Arundo compare to ET of different vegetation types?



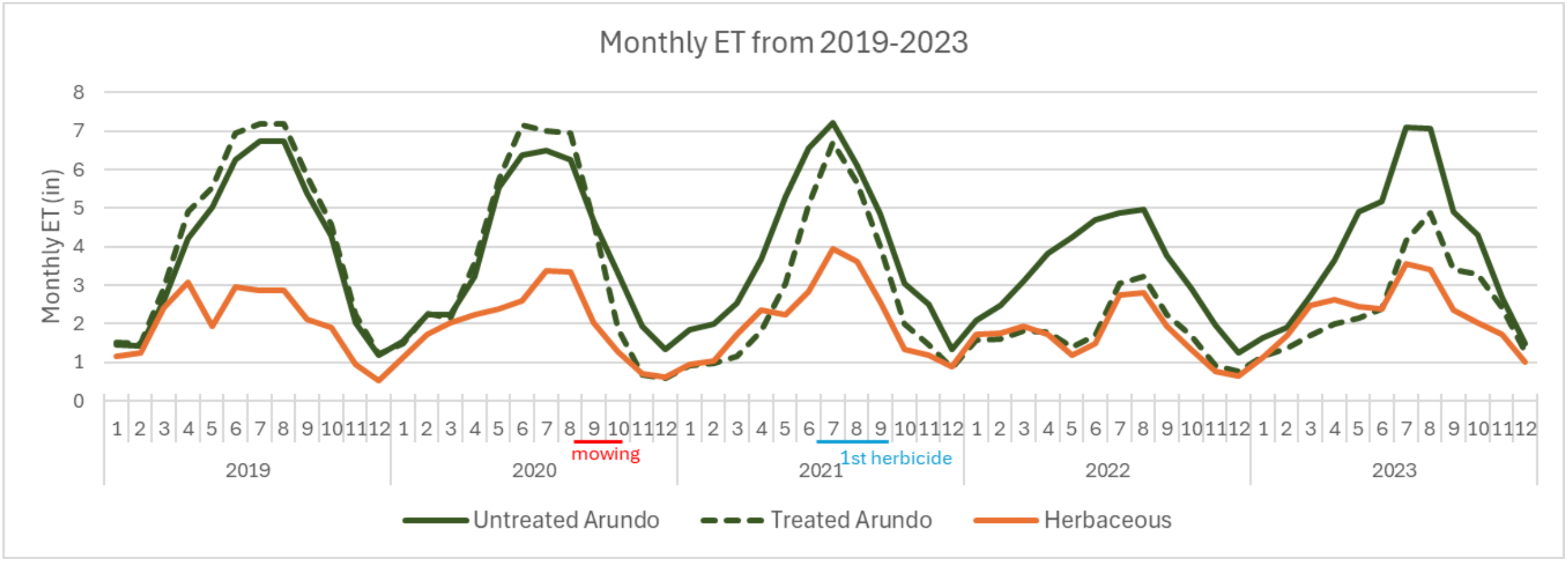
Results

Question: How does ET of vegetation types change annually?



Results

Question: How does arundo treatment affect ET?



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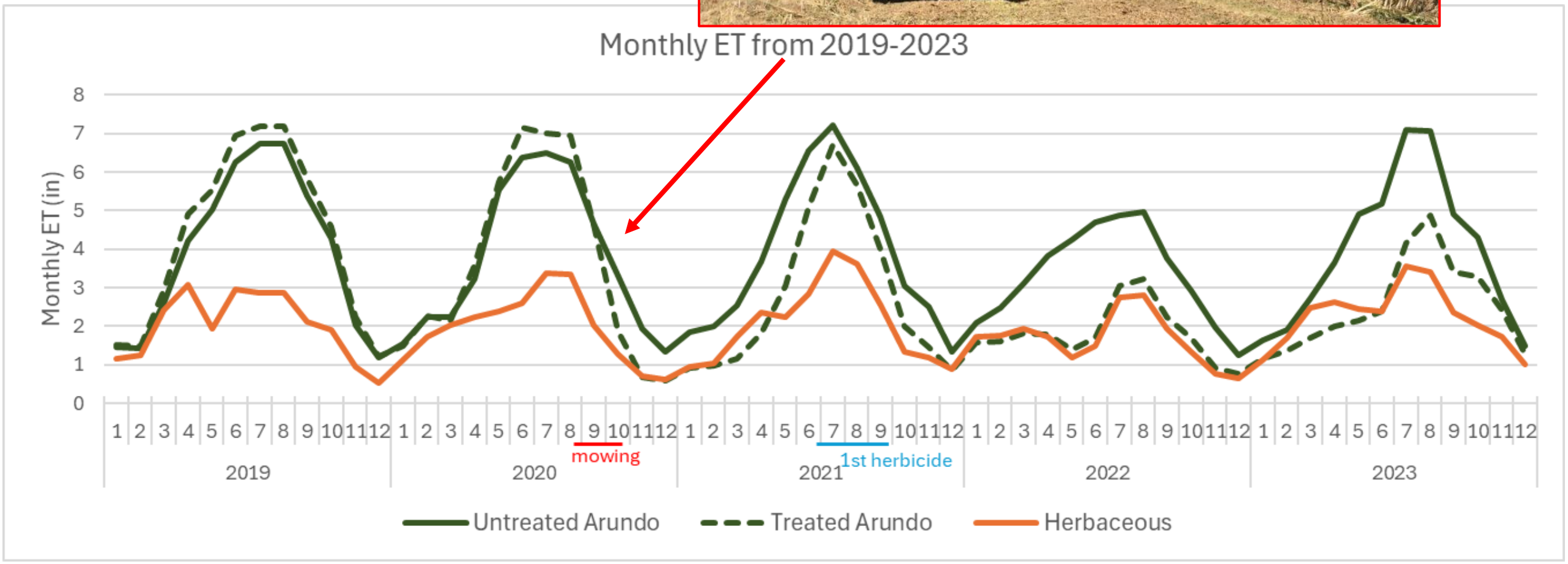

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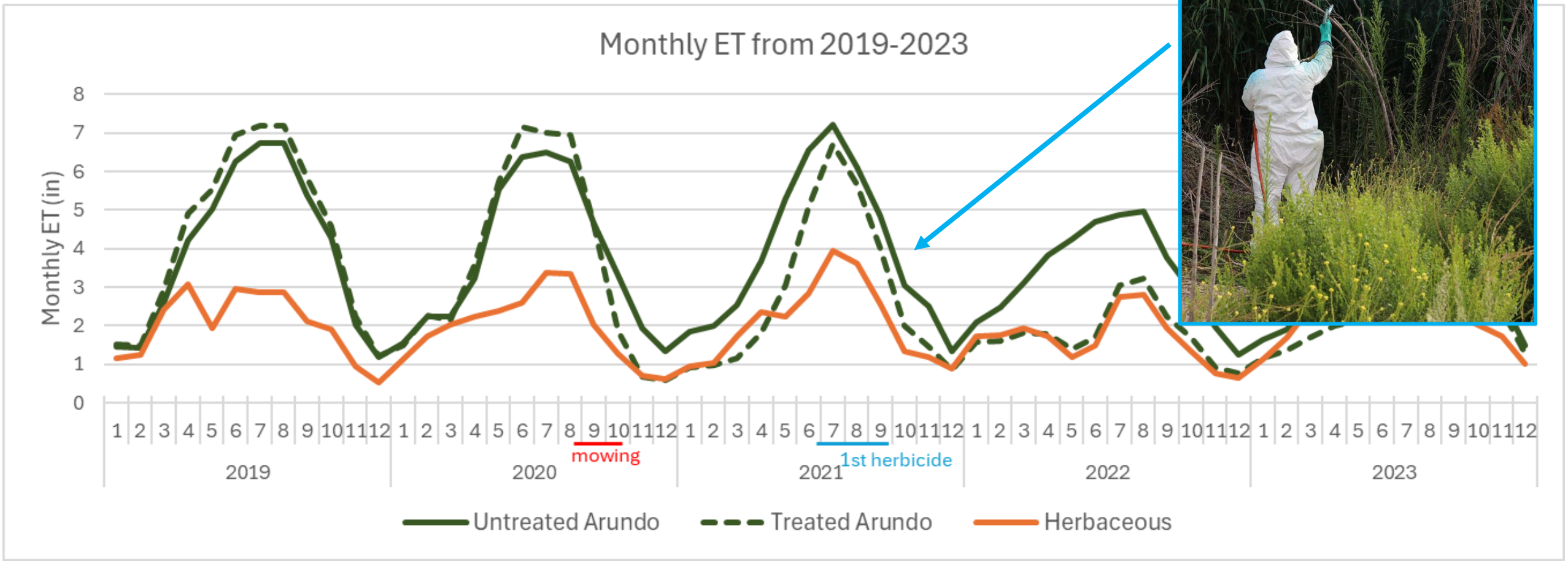
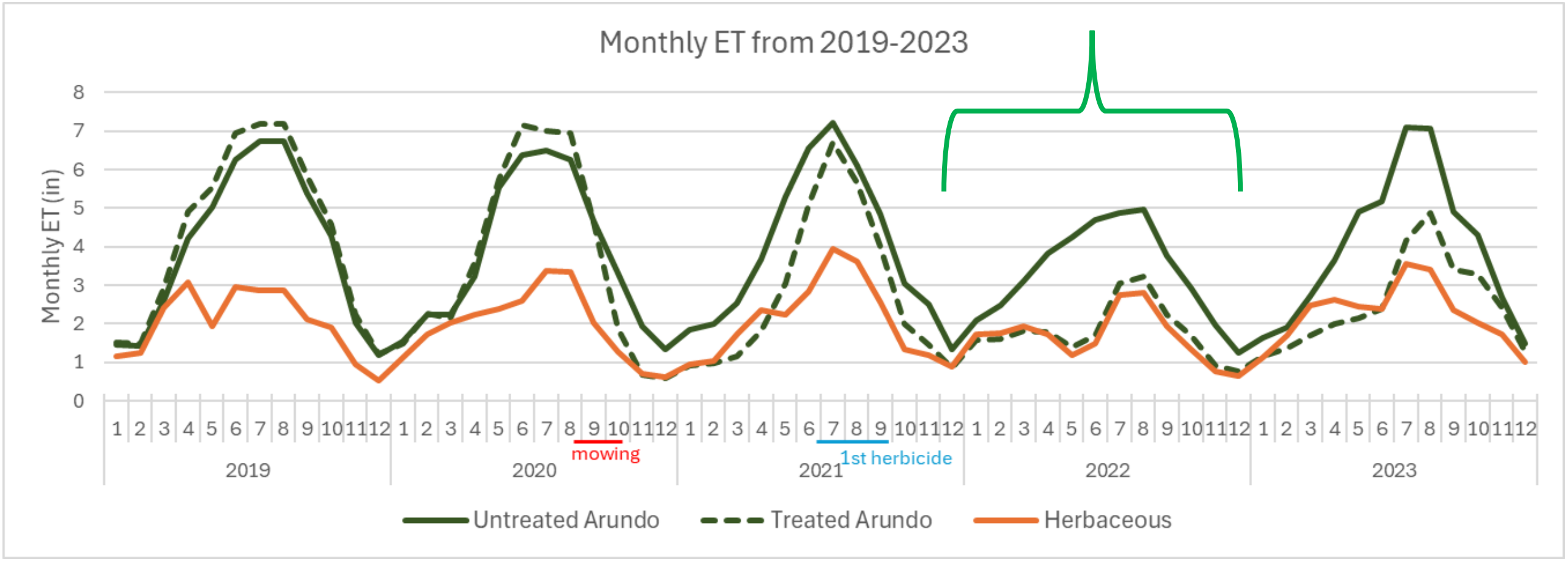


Results

Question: How does arundo treatment affect ET?

Treated Arundo = Herbaceous!



Results

- Graphs demonstrate data seem reliable – follow logical patterns
- Calculated average values for each vegetation type from 15-year dataset

Annual ET values, 2009-2023

	Arundo donax	Riparian Trees	Herbaceous
Minimum	35.6 in	37.3 in	17.4 in
Maximum	47.5 in	54.8 in	26.9 in
Average	**42.2 in**	**47.8 in**	**21.1 in**

Arundo transpires 3.52 ft per year

Water Savings Estimates

Results

- If arundo is replaced by herbaceous vegetation, average annual water savings of **21.1 inches** (+/- 3.0 inches) or 1.76 ft (+/-0.25 ft) per area treated
- Salinas River Arundo Eradication Program had treated 1054.4 acres of arundo as of 2024 Work Season
- Total estimated annual water savings of **1856** (+/- 264) **acre-feet/year**.

Take-Home Messages

- Arundo removal can result in **significant water savings** in river system (though maybe less than previously thought)
- OpenET is a useful (free!) tool that can be used to estimate invasive plant water use and evaluate water savings benefits of invasive plant removal

Acknowledgements

- Funding came from California Wildlife Conservation Board Prop 1 Stream Flow Enhancement Program
- Forrest Melton and AJ Purdy at the Water Agriculture Technology Remote Sensing (WATRS) lab at the California State University Monterey Bay and NASA Ames Research Center helped us acquire and interpret the data used in this study

Questions?

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RESOURCE CONSERVATION DISTRICT OF MONTEREY COUNTY