



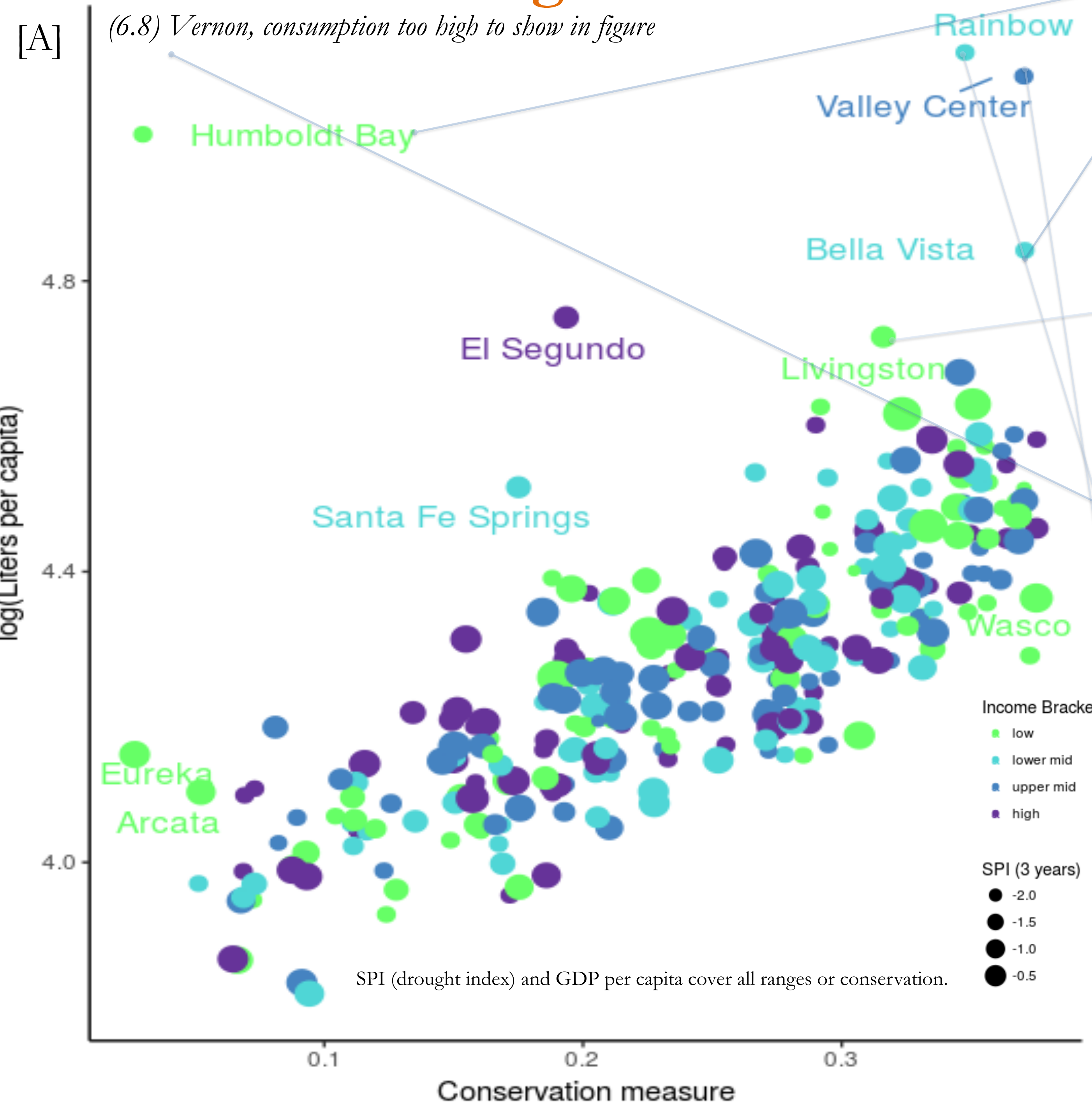
California Drought Water Conservation Necessitates an Equitable and Multidimensional Approach

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Background: Disparities in Water Rationing

Between June 1, 2015 and February 29, 2016 Governor Jerry Brown mandated a 25% reduction in collective urban water use across the state of California. Urban water suppliers were given conservation targets ranging from 8-36%, facing fines for non-compliance. Systems chose which measures they used to accomplish conservation. Conservation effectiveness and equity implications under the mandate remain unstudied despite their obvious importance to water security. [A] shows conservation across California towns as a function of total consumption per capita. Higher consumption required higher conservation, but the figure also suggests that local climate and economic factors were not accounted for when defining conservation objectives.



Humboldt Bay historical industrial water surplus.

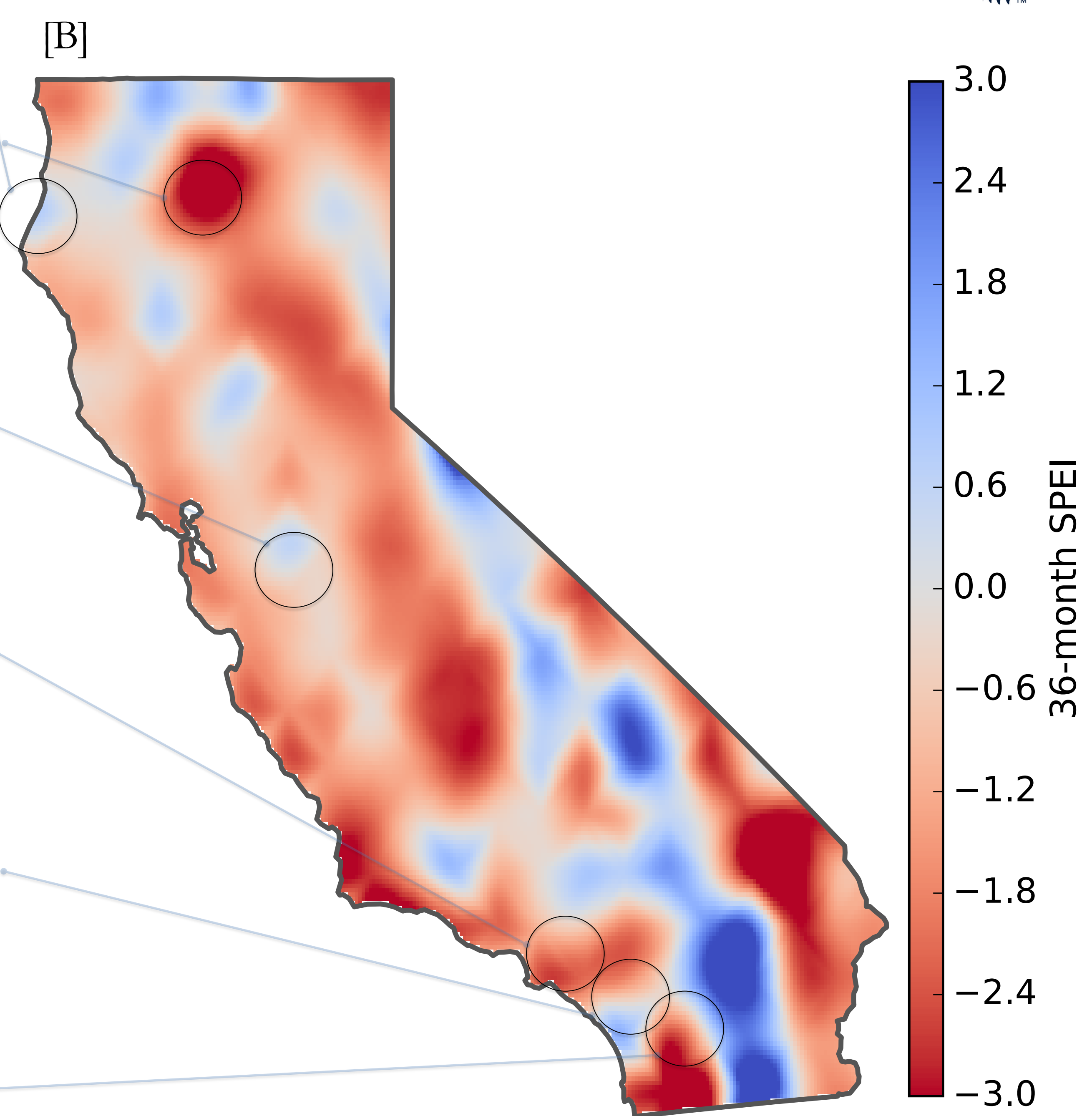
Bella Vista has a contract with the BR for ~25,000 acre-feet/year, but received far less in 2015 due to the drought. It buys additional water from neighboring districts with senior water rights and increased groundwater pumping.

Livingston in a month where California residents exceeded the expectations of a state-mandated target and reduced water use by 27 percent, the state ordered the town to reduce its water use by 32%, only reduced by 3%.

Vernon with 49,111 GPD, the city is characterized by a small population, with lots of industry (e.g., meatpacking).

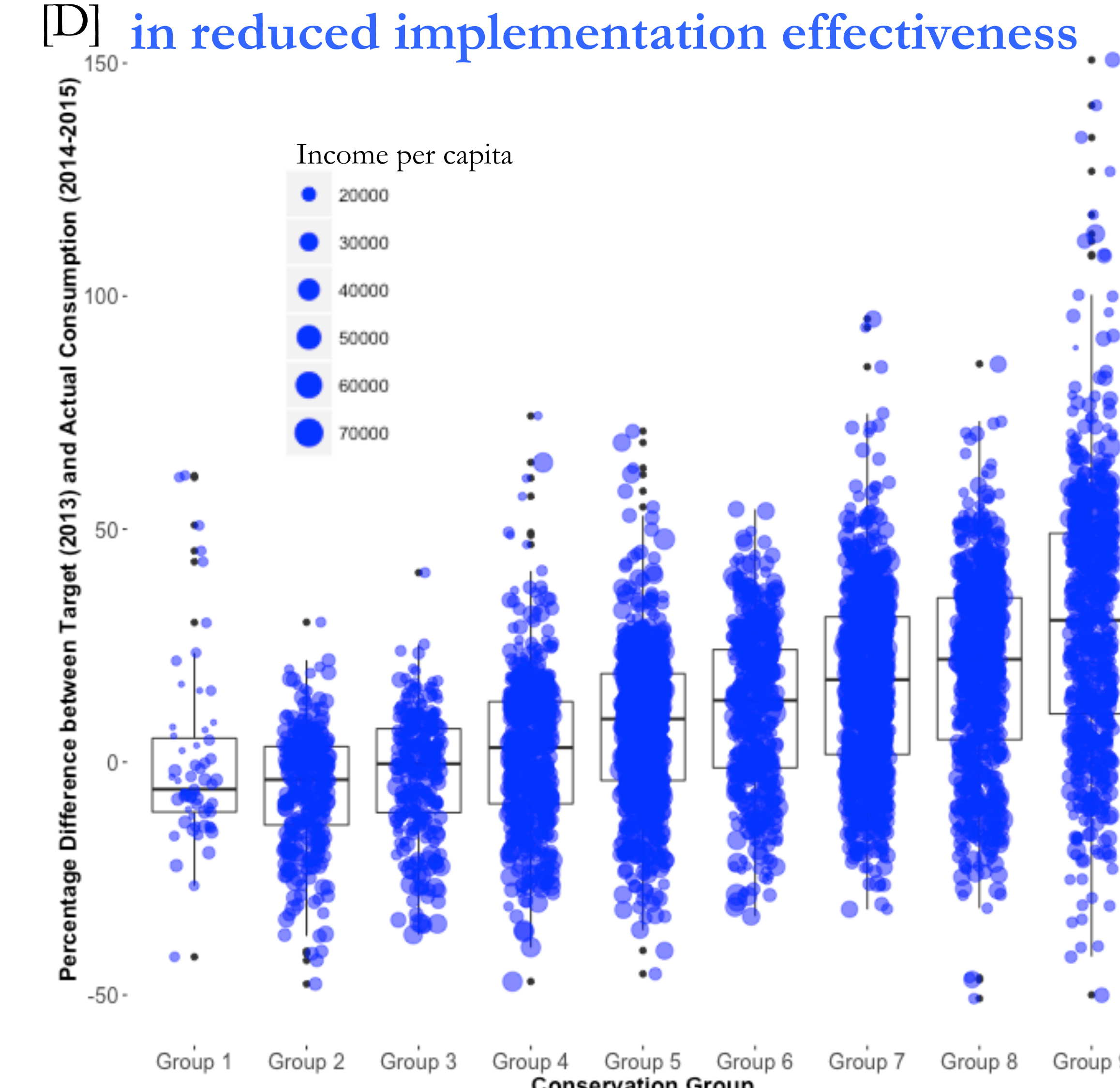
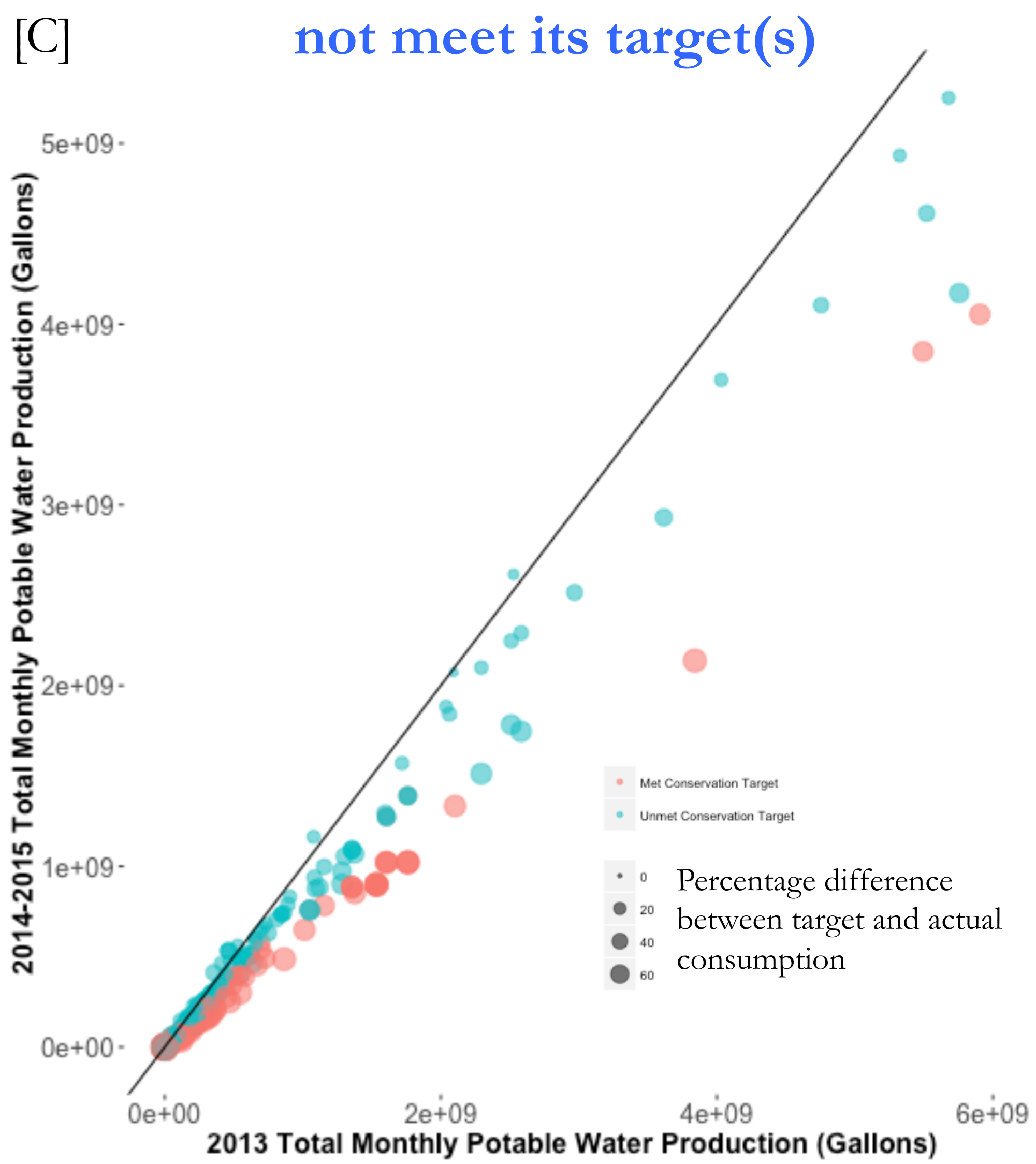
Rainbow Municipal Water, in 2015, the largely agricultural district rejected a proposal to merge with the nearby residential district, negatively affecting a financially and environmentally beneficent outcome.

Valley Center a 2016 proposal by the Metropolitan Water District of Southern California included a fixed-charge proposal based on treated water sales from a decade ago.



Drought intensity (Aug. 2013 - Aug. 2016): The Standardized Precipitation Evapotranspiration Index (SPEI) is a metric for drought intensity which quantifies the water deficit based on both rainfall decrease and temperature increase. The drought unequally affects California, and higher impacts can be felt in the Central Valley and along the coast.

Conservation was largely effective, but did not meet its target(s) Greater conservation responsibility resulted in reduced implementation effectiveness



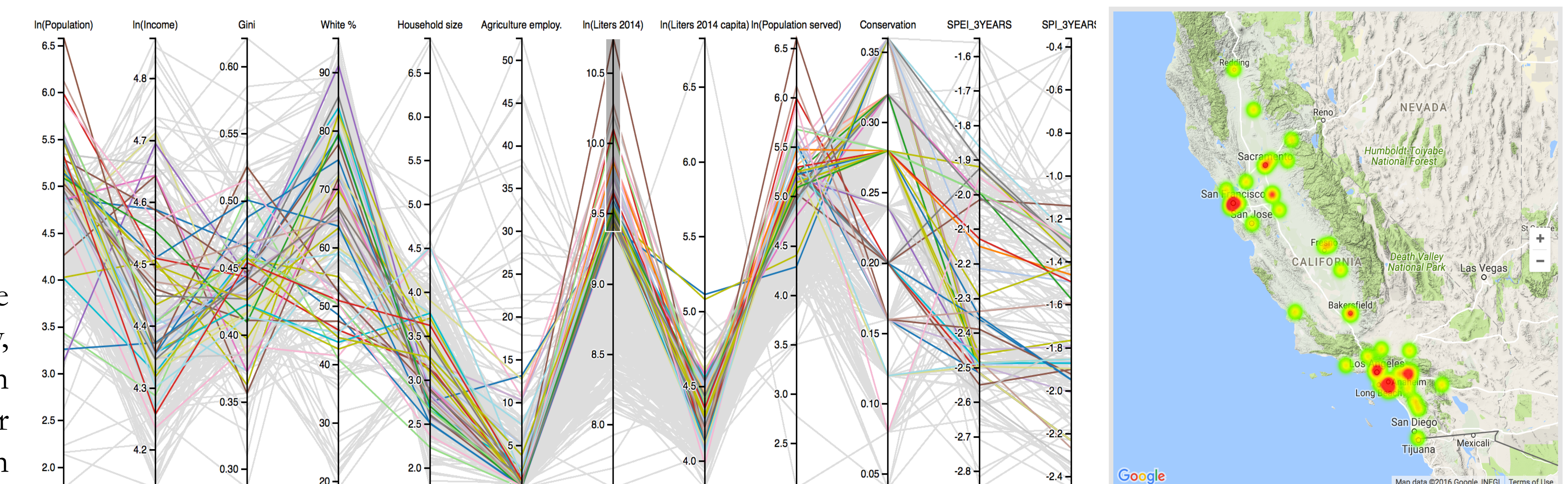
We use the percentage difference between target (2013) and actual consumption (2014-2015) as a measure of conservation effectiveness. While almost all towns across the state successfully reduced their month-by-month consumption, conservation limits (2013) were surpassed 30% of the time by approximately 10%.

The data suggests that the conservation groups with the greatest responsibility experienced greater variability, and reduced conservation effectiveness. Conservation targets based only on water consumption volumes per capita miss important leverage points for conservation that reflect system heterogeneity. Accounting for inter-system heterogeneities are considered explicitly in conservation targets and implementation.

How could we better ration?

This initial exploration into public, state-level data in California reflects that water systems with high conservation targets struggled to achieve ends meet, despite overall high levels of conservation. Monthly seasonal variability affected how well the towns conserved, suggesting that seasonal components need to be integrated into a more dynamic rationing framework. Critically, Small Water Systems and private wells remain absent from this data and yet reflect systems that are likely more vulnerable: 2,228 of the 2,411 dry wells are concentrated in the inland regions within the Central Valley, where known social disparities around water access and quality persist. Future research could expand the question of conservation to the broader drought response and actively include small water systems, a longer time series to explore legacy conservation actions into the drought period, water system financial capacity, and water cost data.

waterequity.us is a web portal that uses parallel coordinates for the visualization of multiple factors related to water and society in California. **Access it to explore the data!**



Sources: U.S Census, California State Water Resources Board, Mercury News, Lost Coast Outpost, San Diego Reader, San Diego Union Tribune, KPCC, Sacramento Bee, Record Searchlight, SPEI Global Drought Monitor tool: <http://sac.csic.es/spei>, H. Cooley, K. Donnelly, S. Soqo, C. Bailey, "Drought and Equity in the San Francisco Bay Area" Pacific Institute & Environmental Justice Coalition for Water (2016)