OUTLOOK

There's a path forward in the San Joaquin Valley to benefit farmers, communities, and nature — but only if we plan . . . and plant

To help transition farmland to benefit local communities and reduce financial risk to farmers, we need an approach to restoration that is budget conscious and experimental.

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For most of its history, California treated groundwater and surface water as legally distinct. Unlike surface water diversions, groundwater pumping was largely unrestricted until 2014 when the state passed the Sustainable Groundwater Management Act (SGMA), which requires the parts of the state where groundwater is pumped more quickly than it is replenished to set limits on current and future groundwater pumping. In the San Joaquin Valley alone, pumping exceeded replenishment by 2 million acre-feet per year for the three decades prior to 2014. To meet the goals of SGMA in the San Joaquin Valley, it is estimated that more than 500,000 acres of irrigated agricultural land will need to be retired by 2040 (Hanak et al. 2023).

Repurposing land at this scale is a daunting challenge that requires strategic planning and tactical implementation. Without doing so, the negative aspects of abandoned or fallowed lands — such as worsening air quality, economic losses to farmers, and uninhabitable lands — are likely to be more severe, and we could miss this once-in-a-lifetime opportunity to restore wildlife habitat in the valley. The good news is that conservation organizations, water agencies, local communities, and others have been planning and preparing for this transition — and our early efforts to demonstrate how land can be repurposed strategically and at scale to support groundwater sustainability and the recovery of imperiled species are bearing fruit. Too



Seeded native forbs in bloom. For some sites, transitioning land to native or non-native annual grasses with microtopography could be an endpoint in itself — one that immediately reduces groundwater use and dust from fallowed fields — or it may be a stepping stone while waiting for additional dollars to introduce native plants or contemplate far more ambitious efforts like species translocations.

often the stories of early restoration efforts go untold. Our hope in sharing these early outcomes is to showcase the significant planning that has already taken place and the early results and conclusions from those efforts to inform the next wave of projects. From planning, to partnership, to planting, we are getting closer to a sustainable future for the San Joaquin Valley and hope for its flora and fauna.

A vision for habitat restoration

In 2017, The Nature Conservancy (TNC) and partners developed a vision for large-scale habitat restoration on retired agricultural lands that would directly support recovery criteria for more than 25 imperiled San Joaquin Valley species (Williams et al. 1998); we focused on areas most likely to be retired and with the highest potential to be restored to habitat (Butterfield et al. 2017; Kelsey et al. 2018). In 2020, TNC worked with partners to refine these areas and to identify consolidated areas across the landscape where species recovery goals could be met in the most efficient way possible (Bryant et al. 2020). These areas were characterized by high potential habitat value and predicted likelihood to be retired due to limited water supply and relatively low agricultural value.

Our goal at Capinero Creek is to determine how we can generate the greatest habitat benefits for our imperiled species of interest at the lowest cost possible, and to take these lessons and apply them at future land rehabilitation sites.

Bryant et al. (2020) used agricultural-economic, land use change, and climate-based habitat suitability modeling together with systematic conservation planning to predict these areas and quantify co-benefits that could be delivered by repurposing these consolidated areas to habitat, like reduced nitrogen loading, increased carbon sequestration, and reduced groundwater pumping. The study also showed that species recovery and SGMA implementation goals could potentially be met on 50,000 to 90,000 acres of strategically retired farmlands. This research set the stage for TNC to gather more than 30 partners to write *Rewilding Agricultural Landscapes: A Case Study in Rebalancing the Needs of People and Nature*, a book that captures our shared vision for achieving the goals of SGMA and San Joaquin Valley habitat restoration at scale (Butterfield et al. 2021).

In 2022, the Tule Basin Land & Water Conservation Trust (TBLWCT), with support from TNC, began to make the vision a reality by purchasing a portion of a former dairy in southwestern Tulare County, Capinero Creek. The 500-acre Capinero Creek project was selected in part because it was adjacent to Pixley National Wildlife Refuge, a possible template for the habitat that we hoped to recreate from this former dairy, and a natural connection for target species, such as the endangered San Joaquin kit fox and blunt-nosed leopard lizard. We launched Capinero Creek to experimentally explore in a systematic way how large-scale land rehabilitation can be sustainable, funded, scalable and beneficial to local communities. Previous efforts like this in the San Joaquin Valley have been limited and none have been experimentally designed to explicitly consider the costs of restoration, with the goal of ultimately identifying ways to rehabilitate 50,000 to 90,000 acres of retired farmland over the next 10 to 20 years. To do that, lessons learned from projects like Capinero Creek will need to be shared broadly with the conservation, restoration, agricultural and local San Joaquin Valley communities while they are occurring, before all the data is collected and conclusions are formed. This communication is intended to inspire those also thinking about land rehabilitation and SGMA implementation in the San Joaquin Valley, and to share some of the initial good news around the first couple phases of our work at Capinero Creek.

An experimental and budget conscious approach

At Capinero Creek, we used lessons learned from previous San Joaquin Valley restoration efforts, such as the Bureau of Land Management's Atwell Island Project in Tulare County, and started this project by introducing topographic complexity to the fallowed fields. This action transitioned fields that had been laser-leveled for farming efficiency into fields with topographic variation and features like hummocks (rounded knolls), where a variety of plants and animals could establish and flourish (fig. 1A). This action immediately led to occupation of the site by ground squirrels and kangaroo rats, keystone species that jump started land rehabilitation efforts by burrowing, turning up the hardened agricultural soils, and grazing down the agricultural weed species present.

The next lesson we applied was to start our land management and seeding efforts immediately after fallowing, to prevent agricultural weeds from taking hold above ground or in the seed bank. We did this in two ways: (1) in 2022, we planted a cover crop of clovers, ryegrass and barley, which effectively reduced weed levels while producing a crop that TBLWCT was able to harvest and sell to earn money that supported management efforts; and (2) in 2023, we planted non-native grasses, similar to those present and dominant at the adjacent Pixely National Wildlife Refuge, to function as a permanent cover crop, a decision necessitated by both the lack of availability of native grass seed for the approximately 500-acre site and the prohibitive cost of native grass seed.

It could be argued that non-native grass should not be a component of land rehabilitation. We did not make this decision lightly. Our goal is to demonstrate how retired farmland can be transitioned into habitat for imperiled species, not just at the scale of 500 acres

but 50,000 to 90,000 or more acres. Non-native grass seeds are much less expensive, more readily available at large scales, and can quickly provide habitat and food sources for the native plants and animals we are targeting. We established the non-native grasses, a mix of annual brome, barley and rye, across 500 acres for $169 per acre and did so without additional irrigation. Native grass seeds are expensive, and at the time of project launch were not available at even the scale of 500 acres. We hope that with more projects like this, more native grass seed will be available, and its price will decline. Until then, we argue that the natural lands where our target species exist, including the neighboring Pixley National Wildlife Refuge, are dominated by the same non-native grasses we have used, and for more than 100 years have provided habitat and food sources for these species. It is possible, even likely, that those seeds would migrate from Pixley to Capinero Creek and come to dominate the site, as they have done all over California over the past more than 150 years. Importantly, we needed the non-native grasses to establish quickly with no irrigation to reduce the establishment of agricultural weeds on the site. Our non-native grasses did successfully establish (fig. 1B) with low weed levels (fig. 1C) and have been maintained with grazing and cover crop harvesting (fig. 1D) since 2023.

We used these non-native grasses to support the next phase of experimental land rehabilitation treatments — planting native seeds and seedlings, which began in 2024. In fall 2024, together with River Partners and TBLWCT, we seeded native forbs and shrubs into 80 of the 500 total acres of non-native grass habitat at Capinero Creek. We seeded high, medium and low budget native forb seed mixes (all three with and without native shrub potted stock) and then planted just the potted stock, and tested the effects of two levels of irrigation, high and annual average. Per acre seeding costs ranged from $4,396 per acre (native shrub potted stock only) to $10,804 per acre (high budget native forb and shrub mix with native shrub potted stock). This approach will allow us to begin to quantify the habitat benefits gained and sustained through time for different experimental treatments that in some cases have dramatically different overall costs. Our goal at Capinero Creek is to determine how we can generate the greatest habitat benefits for our imperiled species of interest at the lowest cost possible, and to take these lessons and apply them at future land rehabilitation sites.

Data collection and analysis on plant survival, establishment and growth from the 80-acre native restoration treatment, air quality on and off the restoration site, and blunt-nosed leopard lizard presence are underway. So far, our work at Capinero Creek has demonstrated that reshaping topography, seeding non-native grasses and managing weeds through grazing and harvesting creates a landscape that can be quickly inhabited by foundational keystone species like ground squirrels and kangaroo rats, which in turn will speed

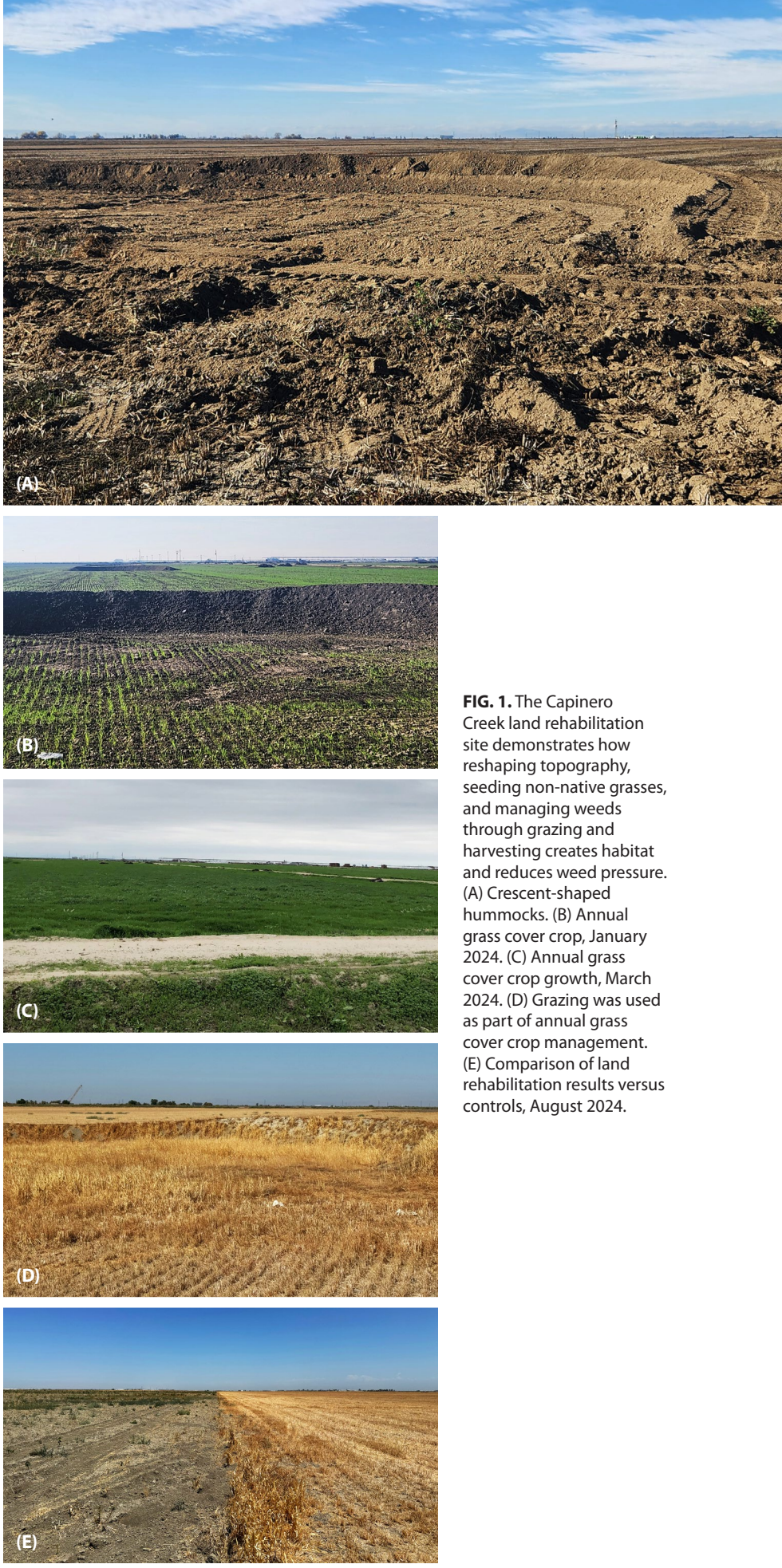


FIG. 1. The Capinero Creek land rehabilitation site demonstrates how reshaping topography, seeding non-native grasses, and managing weeds through grazing and harvesting creates habitat and reduces weed pressure. (A) Crescent-shaped hummocks. (B) Annual grass cover crop, January 2024. (C) Annual grass cover crop growth, March 2024. (D) Grazing was used as part of annual grass cover crop management. (E) Comparison of land rehabilitation results versus controls, August 2024.

up and improve opportunities for future native restoration while mitigating potential air quality concerns from fallowed lands (fig. 1E). By spring 2024, following the planting of native forb and shrub seeds and native shrub potted stock, pollinators — such as honeybees, native solitary bees and butterflies, and hoverflies (fig. 2) — were already active, supporting ecological functions by pollinating native plants and preying on crop-damaging pests like aphids. Notably, by spring 2025, this emerging habitat has led to site use and occupation by the blunt-nosed leopard lizard and the Crotch's bumble bee — both are endangered or at-risk species that restoration of this kind is meant to support.

Funding and collaboration for scaling

Parallel to these efforts on the ground, TNC, the TBLWCT and others are advocating for large, continuous funding programs that can help support land repurposing efforts, such as those at Capinero Creek, at scale. TNC and the TBLWCT were among the first round of grantees and local partners to implement the state of California Department of Conservation's Multibenefit Land Repurposing Program (MLRP), a new program launched in 2022. Multibenefit land repurposing is the act of transitioning irrigated agricultural land to other uses that consume less water and provide additional benefits to ecosystems and surrounding communities, including the installation of groundwater recharge basins, restoration of lands to habitat for native plants and animals, transition to dryland farming or non-irrigated rangeland, renewable energy projects, reestablishment of tribal land uses, and the creation of non-irrigated parks. To date, MLRP has awarded $75 million in block grants to eight regions and has connected more than 100 partner organizations. While the MLRP provides critical funding to support land use transition, far more funding over many more years is needed to help achieve groundwater sustainability goals across the San Joaquin Valley. This is especially true for efforts like habitat restoration that can take many years to implement, require broad partnership, and need sufficient funding to support both acquisition or easements and ongoing stewardship of restored areas.

Habitat restoration and rehabilitation is often a slow process and documenting benefits to ecosystem services, such as air and water quality and habitat values, can take years. Rehabilitating tens of thousands of acres will not work with a one-size-fits-all approach. To help transition farmland to benefit local communities and reduce financial risk to farmers, we need a budget conscious and experimental approach, which we are attempting to develop and communicate about at Capinero Creek. For some sites, transitioning land to native or non-native annual grasses with microtopography could be an endpoint in itself — one that immediately reduces groundwater use and dust from fallowed fields — or it may be a stepping stone while waiting for additional dollars to introduce native plants or contemplate far more ambitious efforts like species translocations. Three years at Capinero Creek have shown promise for achieving what is urgently needed across the San Joaquin Valley to meet the goals of SGMA — ensuring groundwater sustainability and access to clean air and water, and open space. CA



FIG. 2. A western honeybee collects pollen from native forbs.

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