Roadmap for Restoration

STRATEGIC LAND RESTORATION IN THE SAN JOAQUIN VALLEY OF CALIFORNIA

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This Policy Brief summarizes the results of a study on the potential for strategic habitat restoration in the San Joaquin Valley of California as an important part of reducing overall water demand to achieve groundwater sustainability under the Sustainable Groundwater Management Act (SGMA). It also provides policy recommendations based on these results and the existing barriers and opportunities for land restoration. The study was conducted by The Nature Conservancy (TNC), the Natural Capital Project and Water in the West Programs at Stanford University to assess the opportunity for upland habitat restoration on agricultural lands that may come out of production due to water use constraints that will be imposed as part of SGMA. The views expressed in this summary are those of The Nature Conservancy.

INTRODUCTION

California has a once-in-a-lifetime opportunity to restore habitats for unique plants and animals, including the iconic San Joaquin Kit Fox — found nowhere else on Earth — in the San Joaquin Valley. Over the past century, dramatic transformation of this landscape has led to the loss of ~95 percent of the Valley's unique upland desert and dryland ecosystems. As a result, this landscape is home to one of the highest concentrations of threatened and endangered species in the continental United States. Now, due to the state mandate to achieve groundwater sustainability, groundwater pumping will be significantly reduced, pushing the Valley into another major transformation as local agencies chart a path to achieve sustainable groundwater management by 2042.

In addition to the complex system of aqueducts and canals that deliver surface water to the region, the water-stressed San Joaquin Valley has an estimated annual groundwater overdraft[1] of approximately 1.8 million acre-feet.[2] Over-pumping of groundwater to supplement surface water supplies causes drinking water wells to go dry, impairs water quality, dewaters rivers and wetlands, and causes land to collapse, damaging infrastructure such as canals and bridges. These negative impacts increased during the recent drought, spurring the passage of the Sustainable Groundwater Management Act (SGMA) in 2014.

To end overdraft, as SGMA requires, the Public Policy Institute of California (PPIC) estimates that at least 535,000 acres of irrigated agricultural land will need to be idled.[3] This includes lands that would be intermittently taken out of production, as well as lands that may be permanently retired.

The Roadmap for Restoration offers a path forward for stakeholders to consider how consolidating and restoring upland habitat on permanently idled lands could minimize the economic impact to local communities and maximize wildlife benefits from land use change. By collaboratively planning, incentivizing, and delivering restoration projects, we have an opportunity to bring back healthy populations of San Joaquin Kit Fox and other imperiled species, while easing the transition for landowners.

This study focuses on restoration of the San Joaquin Valley's arid grassland and shrubland habitats where over 35 wildlife and plant species are listed as threatened or endangered. **Our results suggest that restoring only 22 percent of the lands predicted to be permanently idled could meet many of the habitat needs of the plants and animals that once thrived in the San Joaquin Valley.**

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1 Overdraft is when groundwater use exceeds the amount of recharge into an aquifer, which leads to continued declines in groundwater level over time, making it more expensive to use and ultimately depleting the sources of groundwater all together.

2 Hanak et al. 2017.

3 Hanak et al. 2019.

METHODS

FIGURE 1: Focal species included in the study.

Tipton's Kangaroo Rat | Giant Kangaroo Rat | Blunt-Nosed Leopard Lizard | San Joaquin Woolly Thread | San Joaquin Kit Fox

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The *Roadmap for Restoration* presents a possible path toward the recovery of dozens of threatened and endangered species in the San Joaquin by focusing on meeting the habitat needs of four endangered animals and one endangered plant.

Meeting the habitat needs of these focal species requires identifying lands where restoration will be most effective. The study therefore focused on where restoration could occur given expected reductions in pumping and where those lands would be best-suited to meet ecological needs with minimal economic impact. To help make the case for restoration, the study also quantified two community and environmental benefits that might result from the restoration of idled lands: reduced nitrogen contamination in groundwater and improved sequestration of soil carbon.

How much and where is land likely to be idled?

Because restoring arid grassland and shrubland habitats will have the greatest benefit for imperiled species if done on permanently idled lands, the study sought to estimate how many acres might be permanently taken out of production and where these lands are likely to occur.

We applied the Statewide Agricultural Production model[4] (SWAP) to estimate the change in acreage of irrigated agriculture needed to meet groundwater sustainability targets within 10 regions of the San Joaquin Valley. The SWAP model simulates water supply availability and agricultural production based on economic conditions that govern how agricultural producers are likely to respond to SGMA. Using subbasin-specific estimates of projected groundwater use, which will be constrained to comply with SGMA, we derived the average annual acreage of cultivation predicted under future SGMA conditions, as well as acres likely to be temporarily or permanently taken out of production due to SGMA, for each of the ten regions across the Valley.

To predict where those irrigated agricultural lands are most likely to be idled within each of the regions, we assumed that lands with lower agricultural capacity, reduced soil quality, less access to surface water, or higher groundwater extraction rates and dependence on groundwater are the most likely to be permanently idled to achieve sustainable groundwater management.[5]

4 Howitt et al. 2012.

5 Using these four separate potential drivers we developed five separate spatial scenarios for land idling based on different combinations of underlying suitability drivers; one scenario with each equally influential in identifying lands for idling and the other four scenarios with each individual driver strongly weighted (75%) to be the primary driver.

Which lands are ecologically desirable for restoration?

To identify the best places to restore habitat from an ecological perspective, the study focused on the habitat needs of five species that represent the needs of the broader ecological community. Using open-source spatial conservation planning software[6], we optimized the selection of lands for restoration to achieve the habitat goal of 25,000 acres of new, high quality habitat per species, while minimizing adverse economic impact on the agricultural economy.[7] Because larger areas and connected habitat better support species, lands for restoration were also selected based on their proximity to existing natural and protected lands or to each other.

What community and environmental benefits could come with restoration?

In addition to providing an alternate land use, restoration can bring additional societal benefits. The study examined two: reduced nitrogen application that could ultimately improve water quality in the Valley and reduced greenhouse gas emissions. In addition to these benefits, others will be created through SGMA-driven idling by reducing groundwater overdraft, like improving stores of underground water, which can help farms and communities be more resilient during drought, and, where lands are restored, the opportunity for public access and recreation in natural areas.

Nitrogen is commonly applied in agricultural production, but when applied in excess, it can lead to water quality degradation. The study predicted changes in excess nitrogen applied using a database of crop-specific nitrogen use efficiencies for the state of California. Avoided nitrogen application estimates were created by propagating per-area estimates from the California Nitrogen Assessment through to region-specific crop mixes.[8]

To assess greenhouse gas (GHG) impacts, the study used the Land Use and Carbon Scenario Simulator (LUCAS) to identify net ecosystem carbon balance (NECB)[9] and COMET-Farm[10] to assess nitrous oxide impacts. The LUCAS model has been used extensively to track carbon balances in California under varying land use scenarios. Net change in NECB and changes in soil carbon storage were tracked over time until 2100 assuming a steady rate of idling and restoration of lands (along with other predicted shifts in agricultural land use) between 2020 and 2040.

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6 Systematic conservation planning software to optimize the selection of lands for restoration (Hanson et al. 2019).

7 Lands were selected as optimal for idling and restoration based on minimizing agricultural revenue loss across the region while "restoring" at least 25,000 acres of high-quality habitat for each of the five species. Areas of high-quality habitat were those identified as in the top 10% of potential suitability based on state-of-the-art habitat suitability models. Stewart et al. 2019. Lands for restoration were also selected in order to enhance connectivity to existing natural and protected areas and increase overall patch size of areas identified for restoration.

8 California Nitrogen Assessment.

9 Sleeter et al 2019.

10 COMET-Farm.

KEY RESULTS

The Window of Opportunity for Species Recovery
Roadmap to Restoration

FIGURE 2: This study finds that as little as 47,000 acres — which represents less than one percent of future cultivated land in the San Joaquin Valley and only 22% of the area predicted to be permanently retired due to SMGA — would be sufficient to meet most of the habitat recovery goals of the five target species and the natural communities they represent.

1. **Consolidating restoration will create significantly better outcomes for nature than a fragmented pattern of land idling across the Valley.** Habitat supports more species better when it is consolidated in larger areas and is connected to other areas of habitat. This study reveals that strategically identifying lands for restoration could contribute substantially to meeting habitat recovery needs for the five focal species on as little as 47,000 acres, while minimizing negative economic impacts. Focused action on habitat restoration could lead to the down-listing or de-listing of threatened and endangered species, creating greater flexibility for a variety of land uses in the region. Three geographic "Habitat Hubs" emerged as priorities for strategic restoration:
   - **Southwestern Tulare:** The study identified approximately 7,000 acres that are both likely to be idled and also excellent for habitat restoration. Restoring habitat in this area would build on existing protected lands, like Pixley National Wildlife Refuge and Tule Elk State Natural Reserve.
   - **Kern:** The study revealed significant opportunities for restoration around existing habitat areas including Kern National Wildlife Refuge, Semitropic Ecological Reserve, and the Kern Water Bank. The study also identified opportunities to create new habitat areas to complement natural lands along portions of the historic Buena Vista lakebed and the Lost Hills. If implemented in these areas, new habitat in Kern County would significantly increase habitat connectivity across the southern San Joaquin and to the north in Pleasant Valley.
   - **Pleasant Valley:** The northern part of this valley has significant potential for creating high quality habitat in new protected areas that would increase connectivity between existing natural lands to the north and south. While the study predicted relatively little permanent idling in this region, significant acreage is expected to be idled annually to help achieve sustainable water management goals.

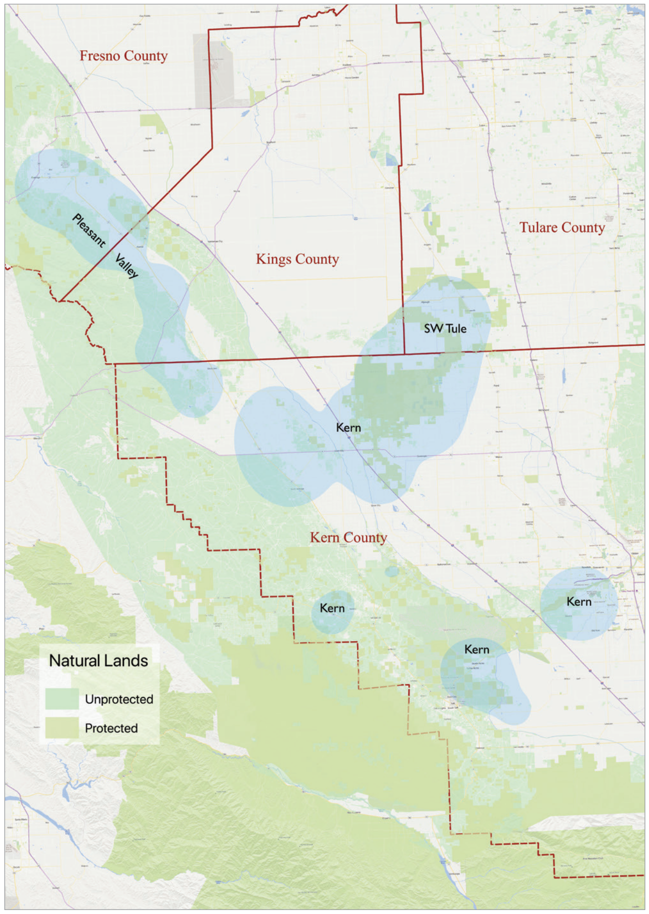

FIGURE 3: Areas where the pressure to idle land permanently overlaps with optimal areas for upland and dryland habitats for five focal species. Together these represent "Habitat Hubs" where strategically restoring idled lands would have the greatest benefit to nature and people.

2. **Habitat Restoration on permanently idled lands can create human health benefits and reduce emissions.** Ceasing agricultural production will eliminate fertilizer applications and therefore will reduce future nitrogen runoff, helping to reduce groundwater contamination. The temporary and permanent idling predicted in this analysis will reduce overall excess nitrogen applications by 19,000 tons annually. Restoration also improves sequestration of soil carbon through reduced tilling of soil and the increased carbon storage that will occur in soils and natural vegetation. Thus, restoring 47,000 acres or more of idled farmland to grassland and shrubland has the potential to enhance soil carbon by 1.59M tCO_2e and 1.78M tCO_2e, respectively, over the next 80 years. On a per hectare basis, restored grasslands and shrublands would contribute an average of 27-133 tCO_2e per hectare and, therefore, would contribute significantly to California's goal to become carbon neutral by 2045.[11]

3. **Strong overlap, but not entirely.** The study shows that much of the habitat needs of upland species can be met on lands likely to be idled due to groundwater pumping limitations, poor soils, and other market conditions. In some areas, such as Pleasant Valley and western Kern, the study indicates that restoration would create high value habitat, but idling may be less likely. In these cases, proactive planning that integrates land use will be important given that strategically restoring habitat in places like Pleasant Valley and western Kern could be achieved as compensation for not retiring other areas in the region.

4. **Important opportunities for new habitat areas may exist.** In addition to the Habitat Hubs identified above, strategic restoration has the potential to establish new protected areas, such as in the Westlands subbasin. This area may require idling of up to 48,000 acres of agricultural land to meet groundwater sustainability goals. Habitat could potentially be restored along the western margins of the sub-basin, creating an important wildlife area and corridor, offering an alternative land use in an area where idling of land is likely.

11 Getting to Neutral: Options for Negative Carbon Emissions in California.

RECOMMENDATIONS

The study provides a path for contributing to groundwater sustainability by restoring habitats for some of California's rarest species while minimizing loss to local and regional economies. To realize this vision, agencies, policy makers, water managers, academics and NGOs will need to come together to incentivize and implement a *Roadmap to Restoration*.

Based on the study, we offer the following recommendations:

1. **Collaborate.** Partnerships are needed to shape land use change in the San Joaquin Valley in a way that increases the long-term viability of agriculture, while improving social and environmental outcomes. To ensure that all voices are represented, it is important to include many stakeholders from the beginning, especially those voices representing local governments, disadvantaged communities, farmers, and the environment.

2. **Plan consolidated restoration.** If we can strategically restore lands around Habitat Hubs, we have the opportunity to recover imperiled species such as the San Joaquin Kit Fox. Centralizing habitat enables restored lands to provide the most ecological benefit on the smallest footprint — estimated in this study to be as little as 47,000 acres. Planning can also take advantage of existing public and private investments in habitat areas, as well as ensure connectivity between restored lands. Local and regional planning can build on this study to optimize land uses around local values and needs. Once completed, strategic restoration plans should be integrated into groundwater sustainability plans, general plans and other plans related to land use and water resources.

   While this study focuses on upland habitat restoration, there are other future land use types that should be incorporated into local planning, including creation of other habitat types (e.g., floodplains and wetlands) and development of renewable energy where they conflict least with protecting agricultural and ecosystem goals on other idled lands across the region.[12]

3. **Incentivize strategic restoration.** Financial incentives delivered through grant programs and market mechanisms can help mitigate the costs of agricultural idling in areas most desirable for restoration.

   Strategically targeted funding mechanisms are needed to protect land, undertake restoration and manage restored habitat over time. Public and private funding can incentivize landowners to choose restoration as a future land use in areas with strong restoration potential. Existing federal, state and local funding can be pooled from coordinated water management and habitat conservation sources. New public funding sources, such as

12 Bourque et al. 2019; Kelsey et al. 2018; Heard et al. 2019.

bonds and tax credits should be designed to incentivize strategic restoration planning and implementation, as well as the partnerships necessary for success. Senate Bill 45, a climate resilience bond, includes $200 million for the Wildlife Conservation Board to implement groundwater sustainability projects that provide wildlife habitat and support implementation of SGMA. Private funding sources are also critical to enable experimentation and address public funding gaps. Consolidated restoration can be facilitated by well-designed groundwater markets. Groundwater markets, such as the one being launched by Fox Canyon Groundwater Management Agency, will likely be necessary to provide the flexibility needed by farmers to trade pumping allocations between lands.[13] Through markets, farmers opting to idle land can be compensated for reduced pumping, while benefiting neighboring farms that need additional allocations to stay in production. As a result, when markets are designed to implement groundwater sustainability plans and adequately address the needs of all users they can be an effective mechanism to incentivize consolidation of idled lands.

4. **Protect, restore and steward.** Restored lands can only provide habitat, human health, and groundwater sustainability benefits if they are protected from future conversion to other land uses. This requires that qualified entities, such as public agencies or NGOs, have sufficient capacity and capital to acquire fee title or easement interests in idled lands.

   Once protected, lands designated for habitat restoration must be restored and managed for habitat values over the long term. Restoration should be based on site-specific restoration plans that identify target species, suitable habitat and desired ecosystem functions. To efficiently restore habitat on tens of thousands of acres, experimentation and monitoring is critical for early projects to create cost-effective methods of restoration.

   Restored lands require long-term stewardship to maintain habitat, encourage use by target species, monitor impact and manage issues, such as invasive species and public access. Entities owning these lands will need funding sources to cover ongoing operating costs.

Collaborative Multi-benefit Effort in the Lower Deer Creek Watershed

The Lower Deer Creek Watershed is located in Tulare County, at the southern end of the San Joaquin Valley. It is a sub-watershed of the Tulare Lake Basin and part of the Tule groundwater sub-basin and has experienced critical groundwater overdraft, flooding, degradation of groundwater quality, and loss of historic wetland and upland habitat. The Pixley Irrigation District GSA and the Lower Tule River Irrigation District GSA received a grant from NRCS to develop a watershed plan for the Lower Deer Creek Watershed. An interdisciplinary watershed management team of Pixley ID staff, technical specialists, stakeholders, and consultants is working collaboratively to develop and implement the watershed plan.

The overall objective for the watershed plan is to develop multi-benefit projects that bring the Tule groundwater sub-basin into balance over the next two decades by 1) improving groundwater quality and quantity, 2) providing wetland and upland habitat, and 3) supporting the ongoing viability of agriculture within the Lower Deer Creek Watershed.

13 Heard et al. 2019.

ENDNOTES

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