Jack and Laura Dangermond Preserve Rangeland Management Plan

Preferred Citation: Butterfield, H.S., M. Katkowski, J. Cota, O. Sage, C. Sage, K. Easterday, D. Zeleke, L. Riege, S. Gennet, K. Lin, B. Leahy, M. Bell, and M. Reynolds. 2020. Jack and Laura Dangermond Preserve Rangeland Management Plan. 54 pages. The Nature Conservancy.

1. Introduction

1.1 Purpose of the Rangeland Management Plan

The Nature Conservancy's (hereafter, TNC) Rangeland Management Plan (hereafter, the Plan) is intended to guide grazing and fire management at the Jack and Laura Dangermond Preserve (hereafter, the Preserve) for the next 3-5 years. The Plan nests within the goals, objectives, and priority actions that were established for grazing and fire management in TNC's Jack and Laura Dangermond Integrated Resources Management Plan (hereafter, IRMP) (Butterfield et al. 2019).

1.2 Natural Resource Management Philosophy

1.2.1 Grazing and Conservation Management Goals and Objectives

For each resource type identified in the IRMP, we have developed an overall long-term goal and a set of long-term (> 5 years) objectives, near-term (1-5 years) objectives, and priority actions that we will use to meet this goal (Butterfield et al. 2019). Near-term rangeland management objectives in the IRMP are focused on supporting overall conservation goals and objectives of the IRMP, the California Coastal Commission (CCC) priority restoration projects (described in greater detail in the IRMP), reducing fine fuel loads and the overall fire threat (ignition and spread) to the Preserve and limiting potential cattle (and other management) impacts to natural resources. The IRMP also establishes a set of management methods and recommendations for each resource type and goal, which include using cattle grazing to 1) reduce fine fuels and the overall fire threats (ignition and spread) to the Preserve, 2) reduce non-native annual grass populations while increasing the native grass composition of the Preserve's grassland and oak woodland ecosystems, 3) reduce priority noxious weed species, and 4) provide the necessary disturbance needed for the establishment and maintenance of Gaviota tarplant (*Dreinandra increscens* ssp. *villosa*) in priority management units (Butterfield et al. 2019).

Research demonstrates that cattle grazing in California annual grasslands can be an effective and efficient tool for controlling invasive species, reducing the threat of fire ignition and spread, and can help support native plants (Hayes and Holl 2003) and songbirds (Gennet et al. 2017). The moderate level of grazing currently applied at the Preserve is in the recommended range for ecological and other management goals (Bartolome et al. 2002). Outcomes of grazing management are highly variable and responses can occur slowly relative to climate factors; land use history and soil conditions are also strong influences on grassland community composition and function. Grazing research or monitoring data applicable to site-level decisions that balance the wide range of ecological targets' needs at the Preserve is currently sparse. TNC has therefore developed a monitoring protocol (see Section 4.5.3) that will inform cattle grazing activities over the next 3-5 years.

1.2.2 Fire and Fine Fuels Management

TNC's current vision for using cattle grazing at the Preserve is to enhance resilience (e.g., maintain current cover and ecosystem processes) of the grassland, oak woodland, scrub, freshwater and riparian habitats to rapidly changing climate conditions, including extreme events, prolonged droughts, fire risk (e.g. Schoennagel et al. 2017), and other major unforeseen disturbances. TNC seeks to maintain or improve, where possible, overall stand condition, age structural diversity and recruitment of shrubs and trees, and native species diversity including new arrivals and novel assemblages resulting from changing climatic conditions. Throughout the planning process, TNC has engaged Orrin and Cindy Sage (Sage Associates) to develop approaches to grazing management (including using grazing to reduce fine fuels and the potential threat of fire ignition and spread) that can help support these goals and objectives. Max Moritz and Matthew Shapero from University of California Cooperative Extension (UCCE) are working with TNC to further investigate potential grazing and fire management prescriptions, including using 1) grazing to reduce potential fire ignition and spread and 2) prescribed burning – as a range management tool – to reduce invasive plant species and improve forage quantity and quality. This multi-year project, which will launch in April 2020, will produce fuel model and fire threat maps and management recommendations, including for prescribed burning, that TNC will incorporate into future iterations of this Plan and to its on-the-ground rangeland management efforts.

Currently, fine fuel management at the Preserve is carried out by cattle grazing. Grazing reduces the fine fuel load, potentially reducing the risk of fire ignition and spread. TNC is also reducing fire risk by maintaining roads, creating safe perimeters around structures, and coordinating these measures with neighbors and local agencies. Prescribed fire is a tool that can be used to reduce the threat of fire by reducing the Preserve's fine fuel load. Prescribed fire can also be used to reduce non-native plant species cover and promote native plant species (DiTomaso et al. 1999, Meyer and Schiffman 1999). Prescribed fire has been conducted on the Preserve in the past as a range improvement tool and to reduce the threat of fire ignition and spread. Due to broad concerns about destructive fire and poor air quality associated with fire, prescribed fires have not been conducted on the Preserve since the early 2000s. Ideally, the collaboration with UCCE will lead to long-term grazing and fire research that will continue to inform our adaptive approach to grassland and oak woodland management. The 2017 Thomas Fire is evidence enough that fire management needs are real and serious at the Preserve and across Santa Barbara County.

1.2.3 Adaptive Management and Precautionary Approach

Cattle grazing and fire management will be implemented within the same adaptive management framework (Holling 1978) that was established in the IRMP (Butterfield et al. 2019) and based upon monthly and annual monitoring efforts (see Section 4.5.3) and changing environmental conditions. We plan to formally review our management strategies annually in June as part of work plan and budget development, and will revise the Plan, when necessary, based on new information, including new management techniques, the ecology of the systems and species, and our own monitoring data.

For all management decisions, we will use a precautionary approach and take changes in human activities slowly and with stepwise increases while monitoring habitat impacts, responses by wildlife, and herd health (e.g. calving birth rate/death rate). Second, we will use a structured decision-making approach (Conroy and Peterson 2013) to clearly articulate the elements of decisions including problem statement, potential impacts, consistency with goals, site design, and an evaluation of risks and tradeoffs. We will approach rangeland management, including herd health and well-being at the Preserve with the short-term aim of "doing no harm" to secure our longer-term IRMP goals (Butterfield et al. 2019).

1.3 Rangeland Management Planning Assumptions

Cattle grazing is the major land management tool that TNC currently has at the Preserve to meet its goals and objectives (Butterfield et al. 2019). Therefore, this Plan will focus on the application of cattle grazing to meet a diversity of rangeland-based goals and objectives but will also include potential proposed mowing and prescribed fire applications as well as active restoration activities within the 3-5-year management planning window. This Plan will not focus on the economics of the cattle grazing operation and will assume that these considerations have been built into the proposed grazing rotation (based on Ranch Advisory Partners (2018) and advising from Sage Associates). TNC will monitor the economics of the cattle grazing operation and make adjustments to herd size and type of operation, as necessary to meet the goals and objectives in the IRMP.

This Plan assumes that staff capacity will stay relatively constant during this 3-5-year planning widow but acknowledges that additional stewardship management position(s) may be added as funding becomes available. This Plan assumes that major infrastructure projects (e.g., changing management unit structure – Fig. 1 – with fencing) will likely be limited to production well development (see Section 4.4.3.2) and assumes that these wells will eventually be permitted by Santa Barbara County and the CCC. This Plan also assumes that no major changes to the resource management philosophy (see Section 1.2) will occur during the 3-5-year planning window. The Preserve is currently managed as a cow-calf operation with yearlings/heifers. The Preserve has set stocking rates and is managed with two herds, one on the Cojo side of the Preserve and one on the Jalama side of the Preserve. For the 3-5-year planning window of this Plan, TNC assumes that these characteristics of the grazing operation will stay the same.

1.4 Jack and Laura Dangermond Preserve Rangeland Management Planning Team

- Scott Butterfield, Senior Scientist, TNC-CA (*Science Lead for Rangeland Management Team*)
- Moses Katkowski, Stewardship Manager, Jack and Laura Dangermond Preserve (*Programs Lead for Rangeland Management Team*)
- Justin Cota, Lead Cowboy, Jack and Laura Dangermond Preserve (*Stewardship Lead for Rangeland Management Team*)
- Dawit Zeleke, Associate Director, Conservation Farms & Ranches, TNC-CA
- Kelly Easterday, Lead Conservation Technology Manager, Jack and Laura Dangermond Preserve
- Laura Riege, Restoration Project Manager, Jack and Laura Dangermond Preserve
- Sasha Gennet, Director, North America Sustainable Grazing Lands, TNC
- Karin Lin, Preserve Programs Associate, Jack and Laura Dangermond Preserve
- Mark Reynolds, Lead Scientist, Jack and Laura Dangermond Preserve
- Bill Leahy, Deputy Director, Jack and Laura Dangermond Preserve
- Michael Bell, Director, Point Conception Institute
- Advisors: Orrin & Cindy Sage, Sage Associates
- Reviewers/collaborators: Matthew Shapero (UC Cooperative Extension), Max Moritz (UC Cooperative Extension), Zach Principe (TNC-CA), Michael White (independent consultant)

Figure 1. Jack and Laura Dangermond Preserve Management Unit Map

1.5 Goals, Objectives, and Priority Actions

Plan goals, objectives, and priority actions are consistent with the IRMP (Butterfield et al. 2019) but have been refined to include grazing rotation and other actions to implement in specific management units (Figure 1). The major goals of the Plan break down in to 5 categories (Table 1):

- CCC Priority Restoration Projects
- Fire Management
- Freshwater Management
- Noxious Weed Management
- Biodiversity Management

Where relevant for these goal categories, we have chosen to focus on management units that are most representative or most important for the goal category. We identified these management units in three ways: 1) Specific project location (e.g. CCC Priority Restoration Projects – Figure 2), 2) Expert review/Identification (e.g. Priority Management Units for grass-nesting birds), and 3) Spatial Analysis (e.g. Management Units for native perennial bunchgrasses – see Section 4.5.2). Table 1 provides more detail on goals, objectives and priority actions.

Figure 2. CCC Priority Restoration Projects

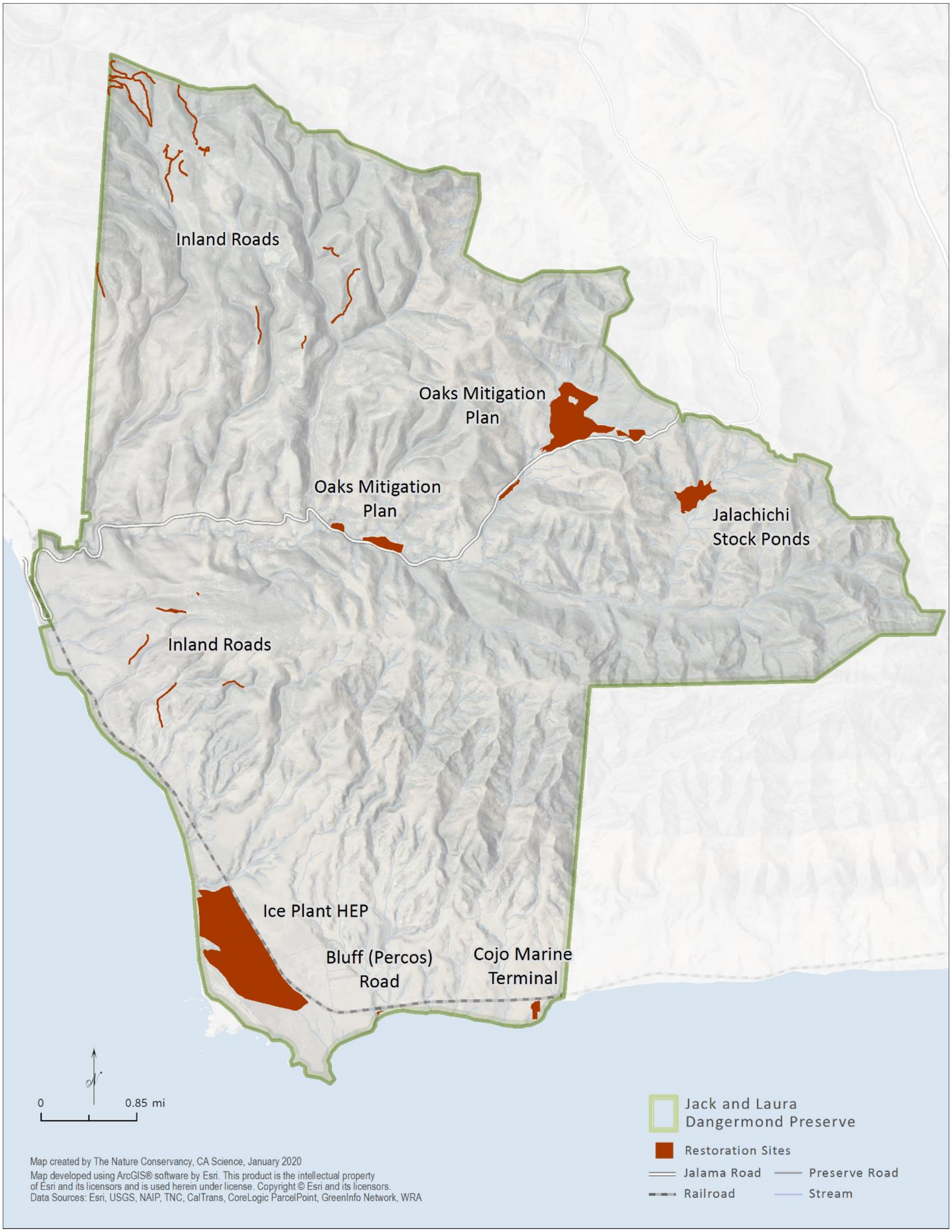


Table 1. Resource Categories, Goals, Objectives, and Priority Actions for the Jack and Laura Dangermond Preserve Rangeland Management Plan.			
Resource	**Goal**	**Objective(s)**	**Priority Action(s)**
CCC Priority Restoration Projects	Leverage CCC-mandated restoration projects to test methods for iceplant eradication and native plant restoration, including the expansion of Gaviota tarplant and coast live oak populations	Iceplant restoration project: - Use cattle grazing to support 300-acre iceplant eradication project (in the Cojo Bull MU), including potential management of veldt grass and other invasive grass and forb species - Use cattle grazing to encourage re-establishment and expansion of Gaviota tarplant within 300-acre iceplant eradication project Oak restoration project: - Use cattle grazing to support 200-acre oak restoration project (in the Water Canyon, Venadito, Black Brush, and Ramajal Field MUs, and potentially in the Jalama Bull, Little Cojo, and Green Tank MUs (i.e. the Army Camp study area)), including to prepare sites for oak planting and to reduce non-native annual grasses/noxious weeds once oak saplings have established Road restoration project: - Retire/restore ~6 miles of CCC-mandated road closures (in the Green Tank, Little Cojo, West and East Tinta, and Escondido MUs)	Iceplant restoration project: - Use early season (Oct-March) cattle (by the bulls) grazing to help create establishment sites and to support Gaviota tarplant expansion across iceplant restoration sites Oak restoration project: - Use cattle grazing, when possible, to prepare sites, by reducing cover and competing vegetation for oak plantings - Eliminate cattle usage for up to 3 years while irrigation lines are in place - After 3 years (and oak seedling growth to the sapling stage), use short-term (1-2 weeks) early season grazing (or mowing if oaks not to sapling stage) to reduce non-native annual grass cover to support oak sapling growth Road restoration project: - Fence CCC road restoration/retirement sites on the Cojo Ranch side (Green Tank and Little Cojo MUs), either with barbed or hot wire, to eliminate cattle usage and allow roads to be re-claimed - Move two troughs, “Green Tank/Little Cojo fenceline” and “Middle Arco” to reduce cattle impacts at CCC road restoration sites

Fire Management	Adaptively manage rangeland ecosystems to be resilient (maintain cover and ecosystem processes) to fire and climate change and to support high levels of native plant and animal diversity, ecosystem function, and habitat structure	- Use cattle grazing, and mowing, where applicable and possible (especially along roads), to reduce fine fuel loads and decrease fire ignition and spread threat	- Maintain an average of 800 lbs/acre of Residual Dry Matter (RDM) within each management unit, with no areas with less than 500 lbs/acre and no areas with more than 3,000 lbs/acre - Regularly mow roads and fire breaks to facilitate travel (and potential access for fire fighters) across the Preserve and to reduce the threat of fire spread from off-site ignition locations. - Establish fire learning project with UCCE scientists with the goal to develop fire threat and fuel load maps and management recommendations about ways to reduce fuels and the threat of fire ignition and spread
Freshwater Management	Adaptively manage freshwater ecosystems to preserve biodiversity, ecosystem function, and processes	- Maintain or restore 10+ miles of healthy and diverse instream and riparian habitats in Jalama Creek and Canada del Cojo Creek - Maintain or restore healthy and diverse instream and riparian habitats in Espada Creek, Gasper Creek, Escondido Creek, and Cojo Creek - Restore natural freshwater ecosystem processes by excluding livestock access, adapting, and minimizing human infrastructure and, where needed, restoring natural habitat and species - Manage human and livestock access and prevent trampling, illegal take of freshwater resources, and human disturbance of wildlife	- Fence selected portions of Jalama Creek and provide off-site water and limited/restricted access to cattle to facilitate continued cattle grazing in the Jalama Bull, Jalama Mare, and No. 10 MUs while removing negative impacts (including erosion, incision, loss of riparian cover, decreased water quality) - Limit cattle access to Espada, Gaspar, and Escondido Creeks in the summer dry months (June-Sept/Oct), both through production well and off-site water development and grazing rotations

Noxious Weed Management	Adaptively manage rangeland ecosystems to be resilient (maintain cover and ecosystem processes) to fire and climate change and to support high levels of native plant and animal diversity, ecosystem function, and habitat structure	- Reduce the cover of invasive noxious weed species, including large stands of iceplant and fennel - Manage the cattle grazing operation to maintain high levels of native plant and animal diversity - Eliminate invasive noxious weed species in areas where direct competition could lead to loss of special-status species	- Use early season (Oct-May) cattle grazing (in combination with other mechanical and chemical methods – treated under separate cover in the Invasive Plant Species Action Plan) to graze priority noxious weed (and other non-native annual grass) species before they set seed - To complement grazing efforts, mow fennel populations early- to mid-summer before flowering and seed set

Biodiversity Management	Adaptively manage rangeland ecosystems to be resilient (maintain cover and ecosystem processes) to fire and climate change and to support high levels of native plant and animal diversity, ecosystem function, and habitat structure	- Increase the current acreage of native perennial bunchgrass populations through compatible management and restoration - Create a mosaic of grassland structure, which includes both open, short-grass conditions and dense, tall-grass conditions to support native plant and animal diversity, including priority grass-nesting bird species - Increase the absolute cover and species richness of native grassland herbs by reducing the cover of herbaceous exotic plants - Manage the cattle grazing operation to maintain high levels of native plant and animal diversity - Increase the current acreage of coast live oak woodlands through compatible management and restoration - Ensure grazing is compatible with recovery of Gaviota tarplant and evaluate whether we can expand populations using seasonal grazing - Maintain healthy freshwater habitat in seasonal wetlands	- Overall, use cattle grazing to maintain an average of 800 lbs/acre of RDM within each management unit, with no areas with less than 500 lbs/acre and no areas with more than 3,000 lbs/acre - For the Jalachichi MU, which has the largest percentage of native perennial bunchgrasses, use grazing outside of the rapid growth and seeding stages (e.g. Aug.-Feb.) to support healthy perennial bunchgrass populations - For the Cojo Mare, Hollister Flat, and Steve's Flat MUs, which have the largest percentages of grass-nesting birds, avoid grazing during the nesting season (March-June) and but also use grazing to maintain both preferred open, short-grass and dense, tall-grass conditions - For the Little Cojo MU, which has the highest percentage of Gaviota tarplant across the Preserve, avoid late-season grazing (July-Oct) during flowering and seed set, but also use early season grazing to help provide preferred ground disturbance/growing conditions - Preserve-wide, use/identify best management practices, including moderate intensity year-round grazing, to support healthy seasonal wetlands - In years of, and within those MUs with, exceptional rainfall/wildflower expression, use best management practices, including limiting cattle grazing during seed set/flowering to increase the number of native seeds that return to the seedbank.

2.0 Existing Natural Resources Conditions Summary

Detailed resource condition assessments can be found in the IRMP (Butterfield et al. 2019). Sage Associates conducted a rapid condition assessment in September 2019 during the development of the Plan. Orrin and Cindy Sage have both done extensive work at the Preserve over the past 30 years – their insight in to changes they have seen during that time period are a valuable part of TNC's rangeland management planning efforts.

Sage Associates identified that coastal scrub on the coastal terraces (Little Cojo, Green Tank, Cojo Cow MUs; Figure 1) increased approximately 30 to 45 percent, a trend identified in Anderson et al. (2019) – which focused on comparisons from 1938 to 1978 and 1978 to 2012 – using historical aerial imagery and field plots. Interestingly, Anderson et al. (2019) found that grassland to shrubland transitions occurred more often from 1978 to 2012 than they did from 1938 to 1978 – shrubland to grassland transitions became less common after 1978. Sage Associates concluded that future management of the grassland/coastal sage scrub interface – through cattle grazing, mowing, and prescribed burning – will be necessary if grassland ecosystems, including those dominated by perennial grasses, are to be preserved and potentially expanded at the Preserve (Table 1). To achieve this goal Sage Associates recommended that TNC consider establishing a mowing program, focused on the flat tops of the coastal terraces (Little Cojo, Green Tank, Cojo Cow, Hollister Flat, Steve's Flat and Cojo MUs; Figure 1) where a grassland understory exists, and a mosaic grassland/coastal sage scrub habitat may be maintained.

Sage Associates estimated that chaparral and coastal sage scrub cover has increased about 70 percent in the Tinta Basin on the Jalama side of the Preserve (the West and East Tinta MUs; Figure 1) over the past 30 years – this estimate is larger than what was identified in Anderson et al. (2019) but supports the finding that grassland acreage has decreased and coastal sage scrub acreage has increased. Prescribed burning was used in the Tinta Basin during the Bixby Ranch era in cooperation with the Santa Barbara County Rangeland Improvement Association to maintain and expand grazeable acreage.

Sage Associates found that purple needlegrass cover has increased in abundance on the east edges of the coastal terraces and in the Jalachichi and Black Brush MUs (Figure 1) – this may be linked to greater survivorship over annual grasses during the most recent drought conditions along with beneficial cattle grazing and the removal of cattle during periods of rapid growth and seed development for perennial bunchgrasses, such as purple needlegrass.

While the Preserve has had large changes in the cover of coastal sage scrub and grasslands over the past 30+ years, oak woodland cover has not significantly changed – this qualitative observation by Sage Associates was not supported by the Anderson et al. (2019) analyses, which showed that oak woodland area has increased (although less so than the transitions from grassland to coastal scrub). Field surveys indicate that the density of trees within the oak woodlands have decreased, and there are fewer small trees today than there were in the 1930s (Anderson et al. 2019). Anderson et al. (2019) hypothesized that these changes could have been caused by a combination of summer cattle grazing, drought, deer browsing, pig consumption of acorns and rooting, and rodent/ground squirrel consumption of acorns. Together, the qualitative observations by Sage Associates and the quantitative analyses of Anderson et al. (2019) suggest an aging oak population with low overall recruitment. Identifying the drivers of this low overall recruitment are a major goal for TNC and are a focus of the oaks CCC restoration projects (Table 1).

Sage Associates' preliminary assessment in 2019 found that the riparian areas along Jalama Creek have improved – greater riparian vegetative cover, greater water clarity – over the past 30+ years with more seasonal use (and overall less access to the creek and riparian vegetation) by cattle. TNC plans to continue grazing practices in the future to support riparian habitat and instream habitat structure, water quality and quantity. Future proposed actions could include fencing selected portions of Jalama Creek to further reduce cattle access to the creek and riparian vegetation and also additions to upland water supply through strategic placement of water troughs to reduce cattle water needs in the creek – in addition to creek and riparian resources, these actions would be undertaken to support steelhead and California red-legged frog recovery (Table 1; Figures 3 and 4).

Figure 3. Freshwater Resources at the Jack and Laura Dangermond Preserve.

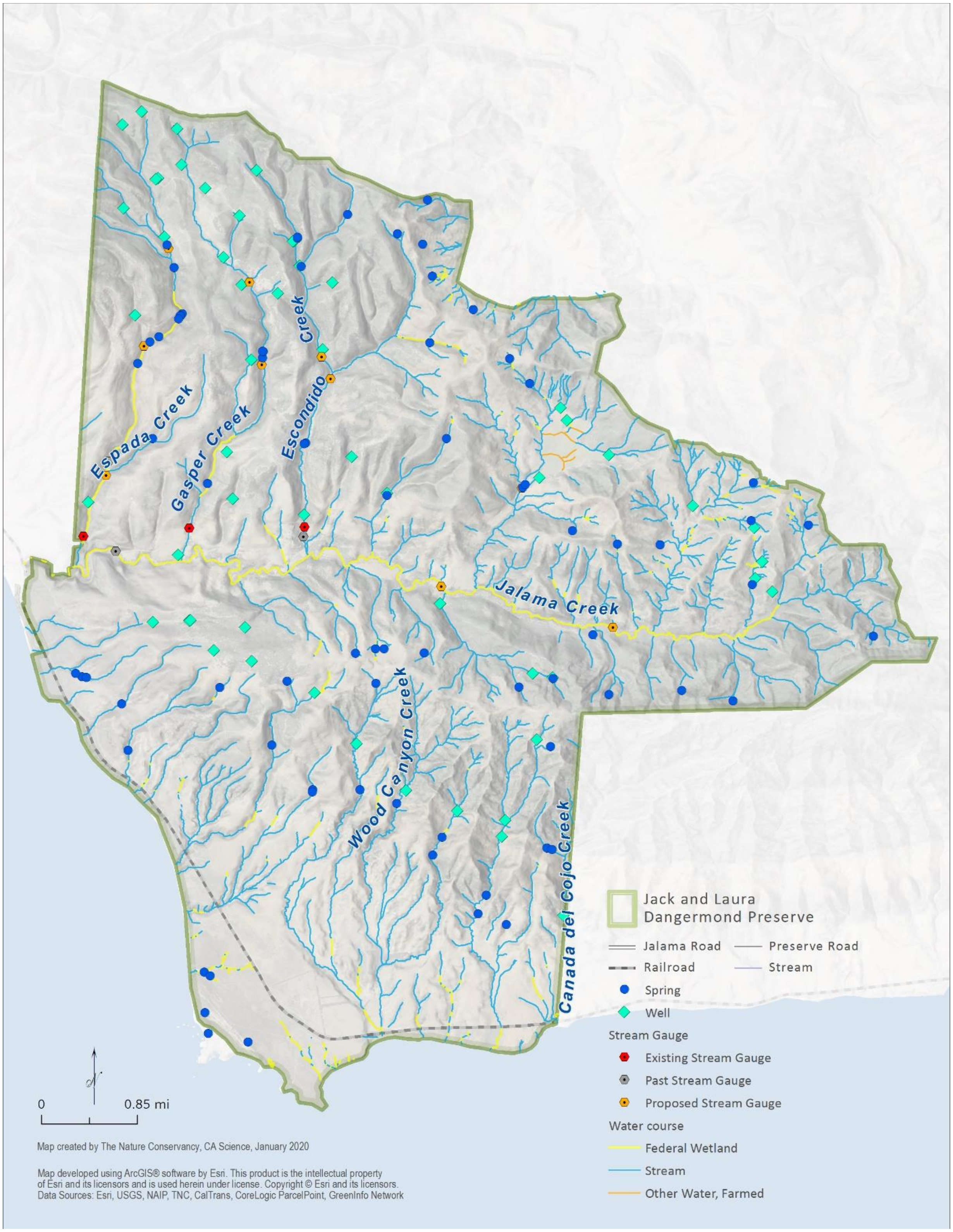


Figure 4. Priority Steelhead, California Red-Legged Frog, and Tidewater Goby Recovery Locations.

3.0 Santa Barbara County Agricultural Land Use History

The history of cattle ranching in Santa Barbara County dates to the arrival of the Spanish along with the development of the California missions from about 1770 into the early 1800's. During the Spanish and Mexican era of the early 1800's, land grants were established in the Santa Ynez and Lompoc Valleys, and on the Santa Barbara coastal plain. The primary agricultural land use was cattle grazing and tallow and hides were a significant source of revenue. In the valleys north of Santa Barbara, the larger land grants included Rancho San Julian, Rancho Santa Rita, Rancho Lompoc, Rancho Los Alamos, Rancho La Laguna, Rancho San Carlos Jonata, Rancho Corral de Quati, Rancho Las Cruces, Rancho de Canada Los Penos, Los Prietos y Najalayegua, Rancho Sisquoc and Rancho Tequepis. On the South Coast, land grants ran from Rincon Point at the Ventura County line to Point Conception. Rancho Punta de la Conception (29,992 acres) was established in 1837, which included Rancho El Cojo (8,580 acres). A portion of the Jalama Ranch (15,813 acres) was part of the San Julian land grant (48,221 acres) until 1914. Fred H. Bixby acquired Rancho El Cojo in 1913 and Jalama Ranch in 1939. The Preserve today is a portion of those two original land grants.

Santa Barbara County (especially west County where the Preserve is located) had four significant events in the modern era that shaped agricultural productivity: 1) California Land Conservation Act of 1965; 2) Santa Barbara County Santa Ynez Valley Agricultural Rezone of 1975; 3) Santa Barbara County Lompoc Area Agricultural Rezone of 1978; and 4) inception of land conservation easements focused on the preservation of rangeland and open space.

The California Land Conservation Act (Williamson Act) of 1965 was adopted by Santa Barbara County in 1967 and allows for rangeland property to be taxed for its grazing value, rather that its potential development value. Landowners enter into a 10-year contract with the County that preserves agricultural land including rangeland from urban development. The contract renews each year so there is always a 10-year contract in effect. The agricultural preserve map for western Santa Barbara County shows that a vast majority of the rangeland west of U.S. Highway 101 and on both sides of State Highway 1 and along the Gaviota Coast to be in agricultural preserves. Despite the tax incentives, however, Santa Barbara County accounted for the largest decrease in Williamson Act enrollment in California between 2012 and 2013, where landowners did not renew on 8,194 acres.

The Santa Barbara County Santa Ynez Valley Agricultural Rezone of 1975 represented a milestone in efforts to slow the conversion of agricultural and open space lands to suburban and urban development. First envisioned by the Santa Ynez Valley General Plan Advisory Committee in the early 1970's, the rezone proposed to downzone lands within the 479,000-acre project area to 100-AG (100-acre minimum parcel size) from existing 40-AG (40-acre minimum parcel size) zoning, and to 40-AG from existing 5, 10 and 20-AG zoning. The land use policies driving this effort were intended to protect agricultural lands from conversion to other development, to retain and promote both prime and non-prime agricultural land uses, protect the scenic character of the Valley, and concentrate urban/residential development in well-defined urban envelopes surrounded by agriculture.

Santa Barbara County's decision to adopt the Santa Ynez Agricultural Rezoning project resulted in retention of large enough parcels just long enough to prevent rapid urbanization. The switch to higher cash crops in turn increased land values and gave landowners an alternative to selling to speculators and developers. It also bought time for the wine grape industry to develop and mature. Prior to about 1968, wine grapes were not a recognized or proven crop in the Santa Ynez Valley. In fact, there was only one producing vineyard in the Los Alamos area. Much of the Valley's land is not prime, but Class II or IV, sloping and with low productivity soils. But since wine grapes favor these conditions, it made the region a prime prospect for future wine grapes. Today, the Santa Ynez Valley is a prime wine grape-growing region and an economic engine for the County.

In 1978, the Lompoc Valley Agricultural Rezone project quickly followed the successful passage of the Santa Ynez Valley Agricultural Rezoning. Over 150,000 acres of land in the Lompoc Valley was included in the project. About 38,000 acres of land was downzoned to 100-AG (100-acre parcel minimum) adding to another 110,000 acres already in 100-AG. The soils and climate conditions of the Lompoc Valley are also highly favorable to wine grapes, and the region has seen vast expanses converted to wine grape production. The Preserve was included in the 1978 Lompoc Valley Agricultural Rezone project as a portion of Area 4 of the Environmental Impact Report (Sage and Sage 1978).

Conservation easements began in earnest in the early 1990's for preserving rangeland resources as working landscapes in California. In vicinity of the Preserve, there are conservation easements on Las Cruces Ranch, Arroyo Hondo, and Baron Ranch (Figure 5).

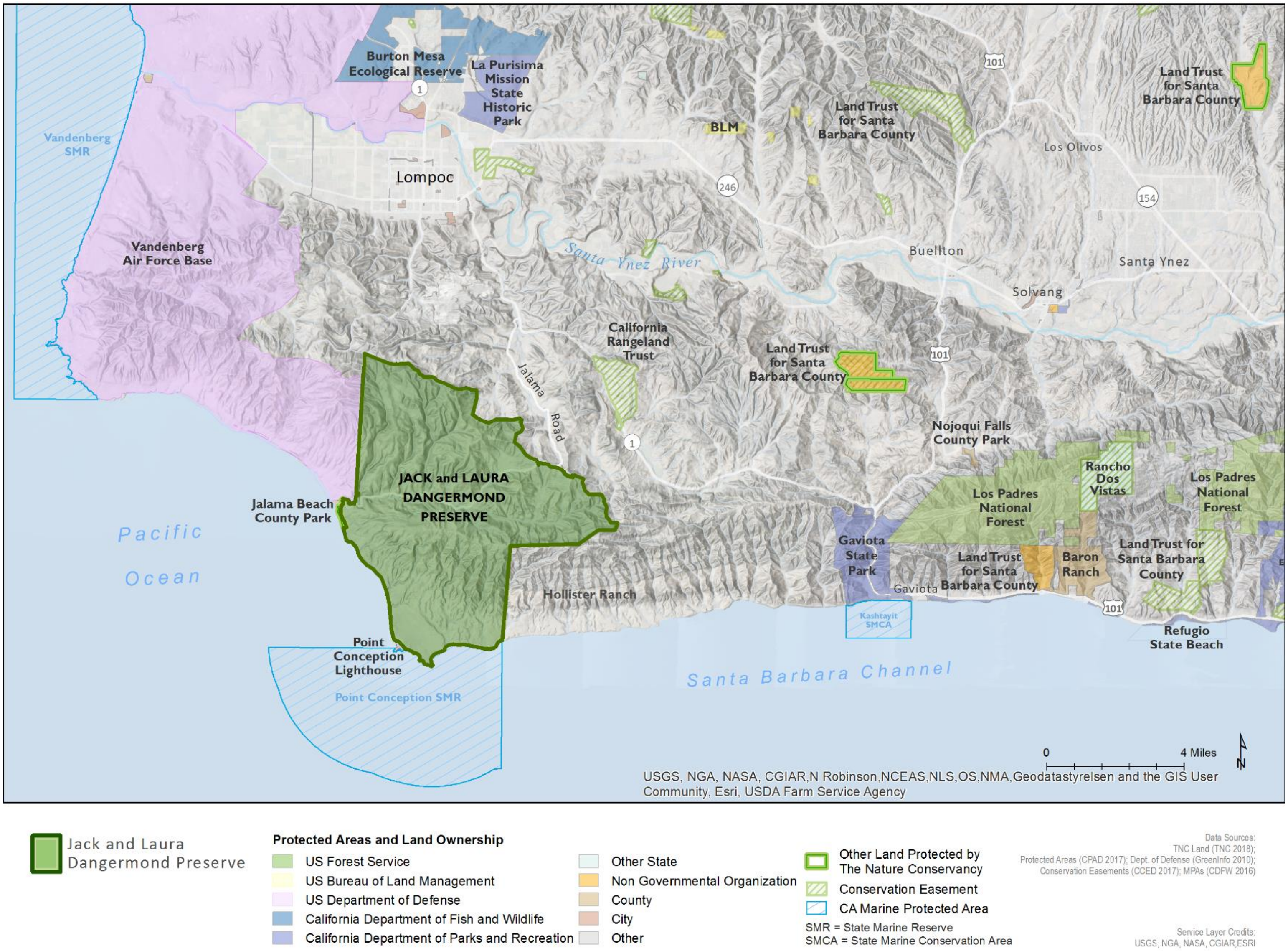
Santa Barbara County remains a significant agricultural resource producer, including for cattle and rangeland, as summarized in the 2018 Santa Barbara County Agricultural Production Report (Santa Barbara County 2018; Table 2). The number of head of cattle over time has varied due to climatic/drought conditions, and acres of rangeland has declined due wine grape plantings.

Table 2. Recent Cattle Grazing History in Santa Barbara County.

Year	**Head of Cattle**	**Acres of Rangeland**
2018	44,805	573,918
2010	37,022	584,125
2000	50,700	589,640
1990	85,881	774,349
1980	54,808	780,000
1970	101,000	575,000
1960	104,399	500,000

Large grazing operations adjacent to the Preserve include the 14,000-acre Hollister Ranch to the east and the 98,000-acre Vandenberg Air Force Base to the north (over 23,000 acres are utilized for grazing) (Figure 5), and the 12,000-acre San Julian Ranch to the northeast.

Figure 5. Preserve Location and Regional Context Including Proximity to Protected Areas.



4.0 Rangelands Operations and Management

4.1 Historic Ranch Operations

In 1913, Fred H. Bixby stocked the Cojo Ranch with 565 cattle, 143 horses, 9 bulls, and 2 stallions (PHR Associates 1990). Using financial records, journals, and interviews with ranchers, PHR Associates identified four distinct periods of agricultural operations within this time frame: 1) 1913-1941, 2) 1942-1952, 3) 1953-1972, and 4) 1973-1989.

1) 1913 to 1941: During this time, dairy cows and chickens were also raised on the property to feed the employees. In 1923, the Bixby family acquired 30-40 goats, which were not pastured. A 1925 survey listed 627 acres devoted to barley, 242 acres to bean, and 25 acres to a walnut orchard.
2) 1942 to 1952: The second ranching era on the property began after the purchase of the Jalama Ranch, which facilitated an increase in livestock numbers. Together, Cojo Ranch and Jalama Ranch had 1,630 cattle in 1943 and 1,296 cattle in 1947. Cojo Ranch was used primarily for crops, while Jalama Ranch supported the livestock operation. The greatest change in crop production from the first period was the addition of red mustard, which was very profitable.
3) 1953 to 1972: Bixby's death marked the beginning of the third ranching period on the property. Cattle numbers were kept around 1,200 on Jalama Ranch and 800 on Cojo Ranch, although this was reduced to 600 during a drought in the 1960s. Less land was used for barley, and there was an attempt to grow alfalfa. This required the construction of dams and wells, but the alfalfa crop proved unsuccessful.
4) 1973 to 1989: In the 1970s, barley production stopped, and the walnut orchard was removed. By the mid-1980s, crop farming had ceased on Cojo Ranch and the fields reverted to pasture and were used as holding areas.

Historically, the carrying capacity for Cojo and Jalama Ranches combined was approximately 1,680 animal units per year during average rainfall years (Sage Associates 1999). During the late 1980's drought conditions the herd was reduced to about 900 cows, 300 heifers and 75 bulls or about 1,235 animal units. Approximately 350 tons of hay were fed to 300 first-calf heifers and 75 bulls from about August to January. Cattle were also shipped to irrigated summer pasture-land in Oregon.

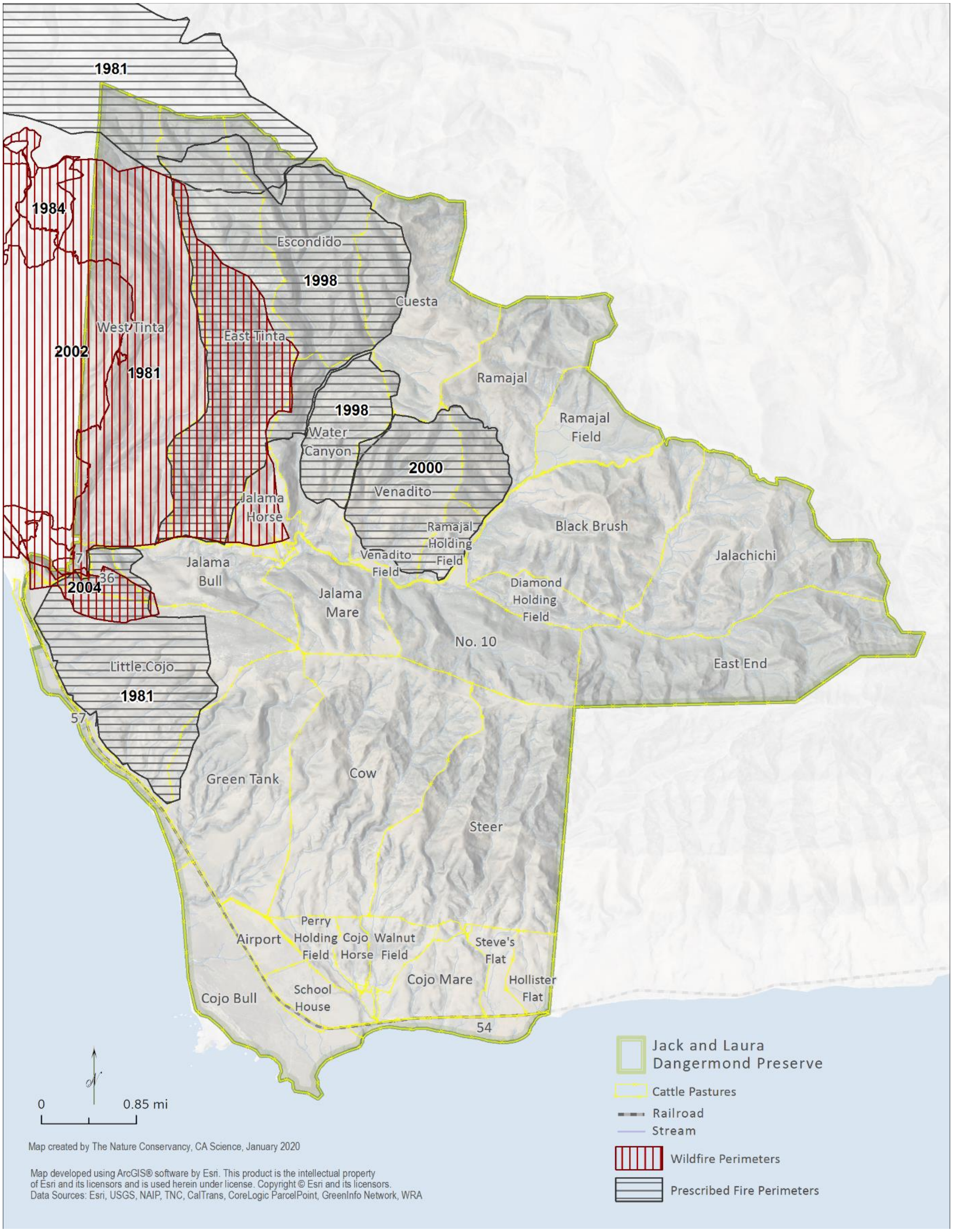
4.2 Historic Fire Management Practices

TNC partnered with a group from the Bren School at the University of California Santa Barbara in 2019 to among other things evaluate vegetation changes across the Preserve over the past 80+ years and to re-construct the history of fire and prescribed burning (Anderson et al. 2019). The Bren group found that fire regimes in the region of the Preserve have been anthropogenically influenced for centuries, primarily by the Chumash people. The Chumash intentionally set fires to improve cherry and elderberry harvests (Hardwick 2015), and records show several prescribed burns on the property from 1981 to 2000 (Figure 6). In addition to prescribed burns, Anderson et al. (2019) identified three recorded wildfires at the Preserve from 1981 to 2004 (Figure 6). Wildfire suppression was likely practiced during the Bixby years in order to protect crops and livestock, while prescribed burns were likely used as a tool to clear shrublands and increase grasslands. In 1945, the California State Legislature authorized range improvement activities through the California Division of Forestry, which included permits to burn in order to improve rangelands. This led to the founding of the Santa Barbara County Range Improvement

Association (RIA) in 1955, whose goal was to use controlled burning to reduce the threat of wildfire while also limiting brush growth.

TNC is currently collaborating with Shane Dewees (UC Santa Barbara), Matthew Shapero (UC Cooperative Extension), and Max Moritz (UC Cooperative Extension) to further extend the work of Anderson et al. (2019), with specific objectives to develop the following products for the Preserve: 1) updated fire history map, 2) updated grazing history map, 3) updated historical vegetation change map, 4) current fuel model, and 5) recommendations for management to reduce fire ignition and spread threats (including a possible prescribed fire plan for the Preserve).

Figure 6. Fire History at the Jack and Laura Dangermond Preserve.



4.3 TNC Dangermond Preserve Ranch Operations: December 2017-January 2020

Crops are no longer grown on the Preserve and oak woodland restoration is occurring on 150 acres of the cropland areas including in the Ramajal Field, Black Brush, Water Canyon and Venadito MUs (Figures 1 and 2). The cattle grazing operation has been reduced from historic levels (Sage Associates 1999, Ranch Advisory Partners 2018), however, a cow/calf operation has been maintained by TNC since the Preserve's creation (Table 3).

Table 3. Dangermond Preserve operations by month December 2017-January 2020.

Month	Activity
January	Breeding
February	Breeding, Branding
March	Branding, Spring forage growth
April	Spring forage growth
May	Spring forage growth slows
June	Weaning
July	Pregnancy checks, Calve marketing
August	On-going routine herd checking and maintenance
September	Possible supplemental protein
October	Calving, Possible supplemental protein
November	Calving, Possible supplemental protein
December	Calving, Possible supplemental protein

TNC worked with Ranch Advisory Partners (2018) from December 2017 to January 2020 to develop a grazing program. This program had a stocking rate of 500 mother cows (average weight 1,000 pounds), 23 bulls (average weight 1,800 pounds), 175 replacement heifers (average weight 750 pounds), 80 steers (average weight 700 pounds), 50 steers (average weight 600 pounds), and three horses; this stocking rate equated to approximately 760 animal units per year. In an average forage production year, the Preserve carrying capacity was calculated by Ranch Advisory Partners (2018) to be approximately 1,017 animal units per year, therefore the stocking rate from December 2017 to January 2020 was considered to be "moderate". During this period, pregnancy rates on the mother cows were about 95 percent and 85 percent for first-calve heifers. Death loss was about three percent.

4.4 TNC Dangermond Preserve Planned Ranch Operations: January 2020-June 2021

TNC collaborated Sage Associates in 2020 to evaluate the grazing program at the Preserve and to determine grazing practices that could be implemented to meet the goals and objectives of the IRMP (Table 1). Sage Associates has a long history at the property, having developed additional assessments and management plans over the past 30 years for previous owners (Sage Associates 1990, Sage Associates 1999). TNC wanted to maintain a cow/calf operation, keep two herds, one on the Cojo and one on Jalama side of the property, and to develop and implement planned rotations to meet the goals and objectives of the Plan (Table 1). The planned rotation, its justification, and planned monitoring and adaptive management procedures are detailed in Section 4.5.2 below.

Sage Associates emphasized that cattle rotation through management units is an important management tool that can benefit native perennial bunchgrass-dominated grasslands, oak woodlands, and riparian corridors. However, the cattle rotation schedule must factor in when cattle can be moved due to herd constraints such as breeding, calving, young calves, first-calve heifers, weaning, branding, and pregnancy checking (e.g. see Table 3). Holding fields (e.g. Diamond Holding Field – Figure 1) are in critical use for branding, weaning, pregnancy checking, shipping, and cattle movement, but have little use other times of the year. Planned rotation can be difficult with a cow/calf operation since calves and pregnant cows may be difficult to move on a larger scale when cows are "mothering up" calves. This may be especially problematic at the Preserve, which has steep canyons and thick scrublands. Mother cows will typically stash their calves, which may not be found when planned rotations are to occur. Any planned rotation must build in flexibility. TNC is working closely with ranch stewardship staff that have operated cattle on this property for more than 30 years. In addition to steers as an alternative to cow/calf herds on Cojo and Jalama, two additional solutions that may be evaluated in the future include: 1) using smaller sub herds; and 2) opening gates between management units and allowing the herds to drift into the next management units in line for rotation. Placing hay in the new management units may also encourage drifting.

As part of developing the grazing rotation for January 2020-June 2021, TNC and Sage Associates evaluated the soil conditions, rangeland dry matter productivity, target residual dry matter conditions, available forage, and carrying capacity for the Preserve. Herd health and well-being are also important factors for the grazing program at the Preserve. The specific parts of that process and the resulting planned grazing rotation are outlined below. To maintain herd health and well-being TNC has maintained the practices that were established when TNC took ownership of the property, including not mixing the Cojo and Jalama cattle herds and not bringing other cattle on to the property (and mixing with the Cojo and Jalama cattle herds) to maintain herd genetics, giving cattle annual vaccinations, wormer, and fly treatments, and providing the herd a copper supplement to deal with its deficiency the Preserve's soils. Antibiotics are not usually given to the cattle herd at the Preserve because there has not been a need since the herd genetics have been maintained over time. If antibiotics are given, those cattle are marked and kept separate from the rest of the herd.

4.4.1 Soil and Rangeland Agricultural Characteristics

The USDA Soil Survey of Santa Barbara County, California South Coastal Part (USDA 1981) and Soil Survey of Northern Santa Barbara Area, California (USDA 1972) describe over 70 soil map units within the Preserve (see Butterfield et al. 2019 for general characteristics for each soil series). The Soil Associations found on the Preserve are subdivided into Soil Series (soil types) by the USDA Natural Resources Conservation Service (NRCS). There are 50 Soil Series found within the Preserve; the Soil Series have been grouped together into nine Range Sites that are comprised of various Soil Series that have similar textures and produce similar quantities of dry matter forage (Table 4; Figure 7).

Fig. 7. Soil Series Range Sites Map.

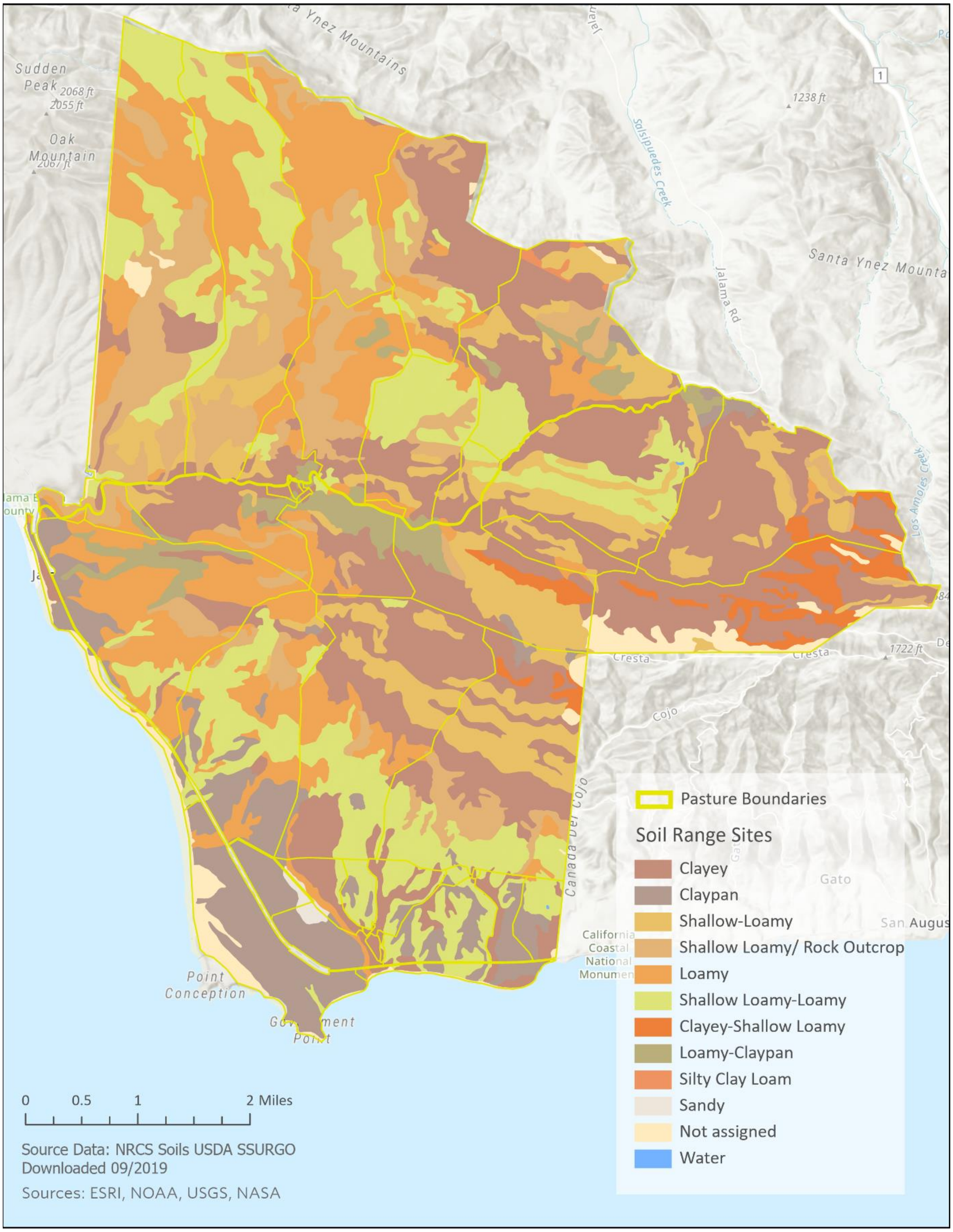


Table 4. Range Sites and Soil Series Designations at the Jack and Laura Dangermond Preserve.

Range Site	**Soil Series**
Clayey	Agueda Argixerolls Botella Camarillo Diablo Linne Los Osos Nacimiento Zaca
Clayey-Shallow Loamy	Los Osos LhG
Claypan	Concepcion Milpitas
Loamy	Ballard Crow Hill Gaviota GcC Santa Lucia
Loamy-Claypan	San Andreas
Shallow Loamy	Capitan CcF Gaviota GaE Gaviota GaG Gaviota GME Gaviota GMG
Silty Clay Loam	Shedd SrE Shedd, SrF
Shallow Loamy-Loamy	Lopez
Shallow Loamy/Rock Outcrop	Capitan CdG Gaviota GbG Lopez LdG
Sandy	Baywood
Not assigned	Beaches Dune land Escarpments Gullied land Maymen Pits/Dumps Rock Outcrops

The best areas of available forage-producing soils are located on the gentler slopes, terraces, swales, and ridgelines of the Preserve (Sage Associates 1999). Topography and slopes vary across the Range Sites. As slopes increase, canopy cover of brushy plants may increase along with erosion hazard and surface runoff, which can limit cattle accessibility and use. Shallow soils will have less forage production, will support shrub and brush growth, and often contain rock outcrops.

4.4.2 Preserve Carrying Capacity and Distribution

The Preserve cattle grazing carrying capacities are approximated for each MU in Table 5. Based on the average year forage production estimates, the TNC Residual Dry Matter (RDM) targets – which are defined based on Bartolome et al. (2002), and the pasture acreages, the Preserve average year carrying capacity was calculated by Sage Associates to be ~967 animal units (Table 5). The Ramajal Field has 116 acres in restoration oak plantings that will not be grazed for three years, which would then add about 11 animal units per year at that time, for an overall Preserve total of about 978 animal units per year. An animal unit equates to a 1,000-pound cow with unweaned calf, or two 500-pound weaned steers or replacement heifers. Larger bulls are approximately 1.25 animal units per bull. Animal unit month (AUMs) is calculated by multiplying animal units per year (AU/YR) by 12 months. Carrying capacity varies significantly from year to year depending on rainfall amounts, rainfall monthly distribution, and temperatures. Sage Associates estimates that in favorable forage production years, carrying capacity may increase by 50 percent or more, and in unfavorable forage production years may decrease by 50 percent or more.

Table 5. Dangermond Preserve Management Unit Carrying Capacity.

Management Unit (acres; ac)	Range Site (acres; ac)	Rangeland Dry Matter Productivity Average Years Pounds/Acre	Target Residual Dry Matter Pounds/Acre	Available Forage Pounds/Acre	Carrying Capacity Animals Units/Year
7 (65 ac)	Clayey (8 ac)	1,850	800	1,050	<1
	Loamy (9 ac)	1,550	800	750	<1
	Claypan (3 ac)	675	500	175	<1
	Shallow Loamy-Loamy (9 ac)	850	500	350	<1
	Shallow Loamy-Rock Outcrop (30 ac)	275	500	0	0
	Not assigned (9 ac)	0	0	0	0
					Total = 1
36 (94 ac)	Clayey (3 ac)	1,850	800	1,050	<1
	Loamy (28 ac)	1,550	800	750	2
	Loamy-Claypan (14 ac)	1,175	800	375	<1
	Shallow Loamy-Rock Outcrop (49 ac)	850	500	350	1
	Shallow Loamy (<1 ac)	550	500	50	<1
					Total = 3
54 (142 ac)	Clayey (36 ac)	1,850	800	1,050	3
	Claypan (59 ac)	675	500	175	1
	Shallow Loamy-Loamy (29 ac)	850	500	350	1
	Not assigned (14 ac)	0	0	0	0
					Total = 5
57 (156 ac)	Clayey (20 ac)	1,850	800	1,050	2
	Loamy (4 ac)	1,550	800	750	<1
	Claypan (47 ac)	675	500	175	1

	Shallow Loamy (13 ac) Not assigned (72 ac)	550 0	500 0	50 0	<1 0 **Total = 3**
Airport (137 ac)	Clayey (14 ac) Claypan (123 ac)	1,850 675	800 500	1,050 175 (2 ice plant)	1 1 **Total = 2**
Black Brush (1,275 ac)	Clayey (564 ac) Claypan (26 ac) Shallow Loamy (302 ac) Shallow Loamy-Loamy (314 ac) Loamy-Claypan (33 ac) Shallow Loamy-Rock Outcrop (10 ac)	1,850 675 550 850 1,175 275	800 500 500 500 800 500	1,050 175 50 350 375 0	54 <1 1 10 1 <1 **Total = 66**
Cojo Bull (712 ac)	Claypan (523 ac) Loamy (22 ac) Shallow Loamy-Loamy (7 ac) Not assigned (143 ac)	675 1,550 850 0	500 800 500 0	175 (2 ice plant) 750 350 0	4 2 <1 0 **Total = 6**
Cojo Horse (99 ac)	Clayey (3 ac) Claypan (23 ac) Shallow Loamy-Loamy (74 ac)	1,850 675 850	800 500 500	1,050 175 350	<1 <1 3 **Total = 4**
Cojo Mare (345 ac)	Clayey (41 ac) Claypan (119 ac) Shallow Loamy-Loamy (185 ac)	1,850 675 850	800 500 500	1,050 175 350	4 2 6 **Total = 12**

Cow (1,740 ac)	Clayey (800 ac) Loamy (262 ac) Shallow Loamy (285 ac) Shallow Loamy-Loamy (328 ac) Shallow Loamy-Rock Outcrop (28 ac) Claypan (35 ac)	1,850 1,550 550 850 275 675	800 800 500 500 500 500	1,050 750 50 350 0 175	76 18 1 10 0 <1 **Total = 106**
Cuesta (1,083 ac)	Clayey (542 ac) Loamy (198 ac) Shallow Loamy (57 ac) Shallow Loamy-Loamy (101 ac) Shallow Loamy-Rock Outcrop (173 ac)	1,850 1,550 550 850 275	800 800 500 500 500	1,050 750 50 350 0	52 14 <1 3 0 **Total = 69**
Diamond Holding Field (229 ac)	Clayey (154 ac) Loamy (15 ac) Shallow Loamy (60 ac)	1,850 1,550 550	800 800 500	1,050 750 50	15 1 <1 **Total = 16**
East End (1,308 ac)	Clayey (689 ac) Shallow Loamy-Loamy (330 ac) Shallow Loamy (39 ac) Shallow Loamy-Rock Outcrop (20 ac) Not assigned (237 ac)	1,850 850 550 275 0	800 500 500 500 0	1,050 (2 brush) 350 (2 brush) 50 0 0	33 6 <1 0 0 **Total = 40**
East Tinta (1,727 ac)	Clayey (23 ac)	1,850	800	1,050	2

	Loamy (464 ac) Shallow Loamy (186 ac) Shallow Loamy-Loamy (582 ac) Shallow Loamy-Rock Outcrop (486 ac)	1,550 550 850 275	800 500 500 500	750/2 brush 50/2 brush 350/2 brush 0	16 <1 10 <u>0</u> **Total = 29**
West Tinta (2,229 ac)	Clayey (164 ac) Loamy (586 ac) Shallow Loamy (112 ac) Shallow Loamy-Loamy (564 ac) Shallow Loamy-Rock Outcrop (708 ac) Not assigned (44 ac)	1,850 1,550 550 850 275 0	800 800 500 500 500 0	1,050 750/2 brush 50/2 brush 350/2 brush 0 0	16 20 <1 10 0 <u>0</u> **Total = 46**
Escondido (1,046 ac)	Clayey (4 ac) Loamy (587 ac) Shallow Loamy-Loamy (141 ac) Shallow Loamy-Rock Outcrop (283 ac)	1,850 1,550 850 275	800 800 500 500	1,050 750/2 brush 350/2 brush 0	<1 20 3 <u>0</u> **Total = 23**
Green Tank (1,283 ac)	Clayey (38 ac) Loamy (393 ac) Shallow Loamy-Loamy (436 ac) Shallow Loamy (22 ac) Shallow Loamy-Rock Outcrop (77 ac) Claypan (305 ac)	1,850 1,550 850 550 275 675	800 800 500 500 500 500	1,050 750 350 50 0 175	4 27 14 <1 0 <u>5</u>

					Total = 50
Hollister Flat (163 ac)	Clayey (38 ac) Loamy (2 ac) Shallow Loamy-Loamy (63 ac) Claypan (57 ac) Not assigned (2 ac)	1,850 1,550 850 675 0	800 800 500 500 0	1,050 750 350 175 0	4 <1 2 1 0 **Total = 8**
Jalachichi (1,337 ac)	Clayey (957 ac) Clayey-Shallow Loamy (69 ac) Loamy (14 ac) Shallow Loamy (246 ac) Shallow Loamy-Rock Outcrop (41 ac) Claypan (24 ac)	1,850 1,200 1,550 550 275 675	800 800 800 500 500 500	1,050 400 750 50 0 175	91 3 1 1 0 <1 **Total = 96**
Jalama Bull (541 ac)	Clayey (259 ac) Loamy (150 ac) Shallow Loamy (36 ac) Shallow Loamy-Rock Outcrop (44 ac) Loamy-Claypan (12 ac)	1,850 1,550 550 275 1,175	800 800 500 500 800	1,050 750 50 0 375	25 10 <1 0 <1 **Total = 36**
Jalama Horse (210 ac)	Clayey (73 ac) Loamy (52 ac) Loamy-Claypan (16 ac) Shallow Loamy (22 ac)	1,850 1,550 1,175 550 850	800 800 800 500 500	1,050 750 375 50 350	7 4 <1 <1 <1

	Shallow Loamy- Loamy (22 ac) Shallow Loamy-Rock Outcrop (25 ac)	 275	 500	 0	 0 **Total = 13**
Jalama Mare (484 ac)	Clayey (203 ac) Loamy (87 ac) Loamy-Claypan (142 ac) Shallow Loamy (13 ac) Shallow Loamy- Loamy (7 ac) Shallow Loamy-Rock Outcrop (44 ac)	1,850 1,550 1,175 550 850 275	800 800 800 500 500 500	1,050 750 375 50 350 0	19 6 5 <1 <1 0 **Total = 31**
Little Cojo (1,448 ac)	Clayey (105 ac) Loamy (776 ac) Loamy-Claypan (185 ac) Claypan (178 ac) Shallow Loamy- Loamy (91 ac) Shallow Loamy-Rock Outcrop (93 ac)	1,850 1,550 1,175 675 850 275	800 800 800 500 500 500	1,050 750 375 175 300 0	10 53 6 3 3 0 **Total = 75**
#10 (848 ac)	Clayey (277 ac) Clayey-Shallow Loamy (98 ac) Shallow Loamy (286 ac) Loamy-Claypan (85 ac) Shallow Loamy-Rock Outcrop (22 ac)	1,850 1,200 1,550 550 1,175 275	800 800 800 500 800 500	1,050 400 750 50 375 0	26 4 7 1 3 0

	Claypan (16 ac) Not assigned (6 ac)	675 0	500 0	175 0	3 0 **Total = 41**
Perry Holding (145 ac)	Clayey (99 ac) Loamy (32 ac) Shallow Loamy-Loamy (18 ac) Claypan (12 ac) Sandy (9 ac)	1,850 1,550 850 675 1,050	800 800 500 500 800	1,050 750 350 175 250	10 2 <1 <1 <1 **Total = 14**
Ramajal Holding Field (156 ac)	Clayey (59 ac) Loamy (2 ac) Shallow Loamy (51 ac) Shallow Loamy-Loamy (41 ac)	1,850 1,550 550 850	800 800 500 500	1,050 750 50 350	6 <1 <1 1 **Total = 8**
Ramajal (1,420 ac)	Clayey (548 ac) Loamy (126 ac) Loamy-Claypan (106 ac) Shallow Loamy-Loamy (165 ac) Shallow Loamy (146 ac) Shallow Loamy-Rock Outcrop (100 ac) Claypan (22 ac) Not assigned (32 ac)	1,850 1,550 1,175 850 550 275 675 0	800 800 800 500 500 500 500 0	1,050 750 375 350 50 0 175 0	40 (-116 acres for CCC Restoration) 9 4 5 <1 0 <1 0 **Total = 59**
School House (202 ac)	Clayey (12 ac) Loamy (10 ac)	1,850 1,550	800 800	1,050 750	1 1

	Claypan (178 ac)	675	500	175/2 ice plant	1
	Sandy (22 ac)	1,050	800	250	<1
					Total = 3
Steer (1,742 ac)	Clayey (37 ac)	1,850	800	1,050	4
	Loamy (32 ac)	1,550	800	750	2
	Clayey-Shallow Loamy (45 ac)	1,200	800	400	1
	Shallow Loamy (394 ac)	550	500	50	2
	Shallow Loamy-Loamy (367 ac)	850	500	350	12
	Shallow Loamy-Rock Outcrop (226 ac)	275	500	0	0
	Claypan (10 ac)	675	500	175	<1
	Not assigned (32 ac)	0	0	0	0
					Total = 22
Steve's Flat (147 ac)	Clayey (43 ac)	1,850	800	1,050	4
	Claypan (73 ac)	675	500	175	1
	Shallow Loamy-Loamy (30 ac)	850	500	350	<1
					Total = 5
Venadito Field (16 ac)	Loamy (16 ac)	1,550	800	750	Restoration; <1
					Total = 0
Venadito (721 ac)	Clayey (191 ac)	1,850	800	1,050	18
	Loamy (45 ac)	1,550	800	750	3
	Loamy-Claypan (11 ac)	1,175	800	375	<1
	Shallow Loamy (57 ac)	550	500	50	<1
	Shallow Loamy-Loamy (323 ac)	850	500	350	10
	Shallow Loamy-Rock Outcrop (92 ac)	275	500	0	0
					Total = 32

Walnut Field (177 ac)	Clayey (76 ac) Claypan (14 ac) Shallow Loamy-Loamy (85 ac)	1,850 675 850	800 500 500	1,050 175 350	7 <1 3 **Total = 10**
Water Canyon (795 ac)	Clayey (68 ac) Loamy (341 ac) Loamy-Claypan (47 ac) Shallow Loamy (12 ac) Shallow Loamy-Loamy (46 ac) Shallow Loamy-Rock Outcrop (281 ac)	1,850 1,550 1,175 550 850 275	800 800 800 500 500 500	1,050 750 325 50 350 0	7 23 1 <1 2 0 **Total = 33**
					Total = 967

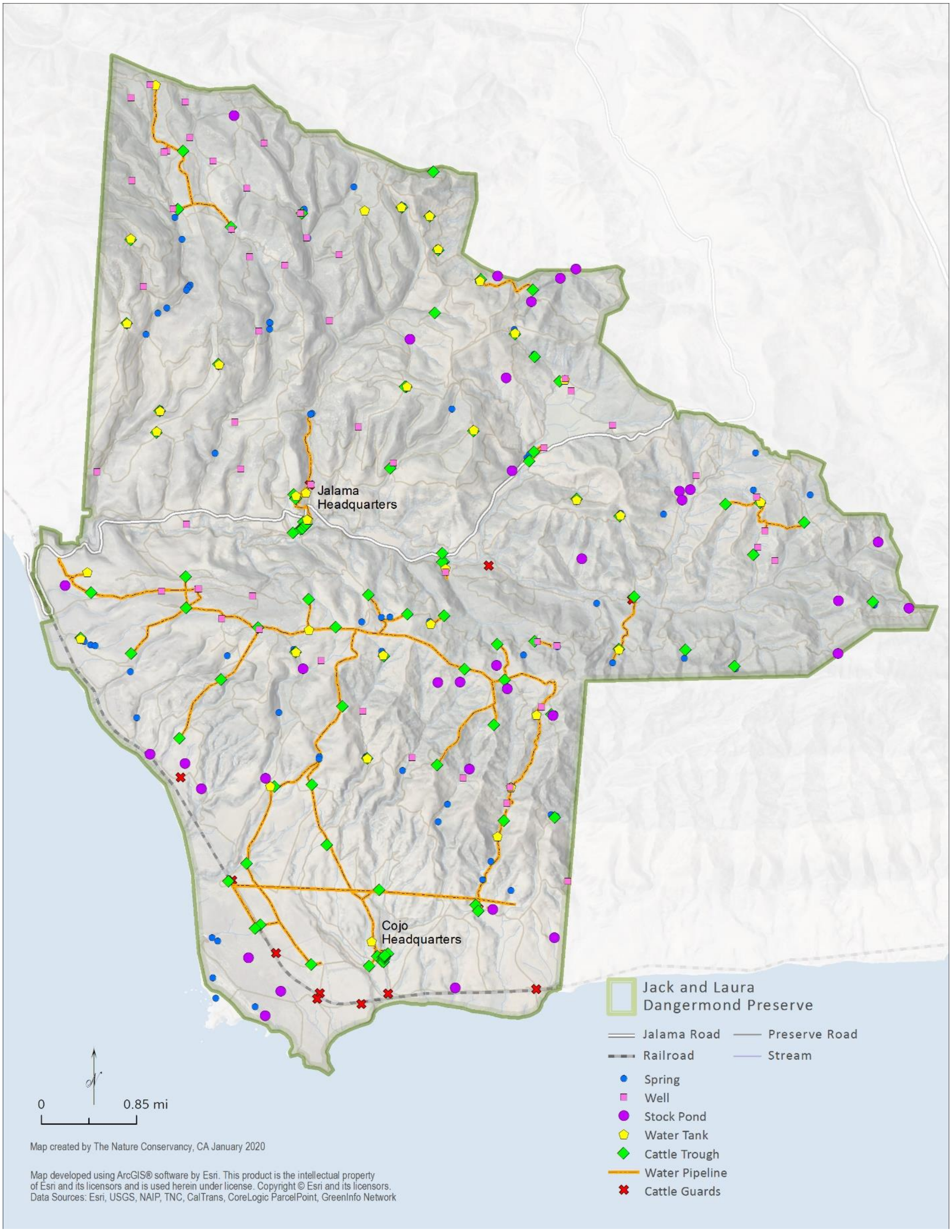
Note: Range Site/Acres are based on USDA Natural Resources Conservation Service Soil Surveys data. Acre calculations were developed using the Preserve's geodatabase. Range Sites contain Soil Series that have similar textures and forage production. Rangeland Dry Matter Productivity Average Year Pounds/Acre was developed for each Range Site based on NRCS guidelines. TNC set RDM targets of 800 lbs/acre with a low minimum of 500 lbs/acre for each Management Unit. The low minimum is utilized for Range Sites/Management Units with low forage production that will still be grazed. Available Forage Pounds/Acre was calculated by subtracting target RDM from the dry matter productivity. Carrying Capacity Animal Units/Year provides an estimated carrying capacity for each Management Unit. A 1,000-pound cow (animal unit) will consume about 11,000 pounds of dry matter forage per year. For example, if the available dry matter forage for a Range Site Management Unit area is 22,000 pounds, then the carrying capacity would be 2 animal units per year.

Stocking rates can be described as a particular "level" or intensity of cattle grazing (UCCE 1982, 1984, 1985, 1990). A moderate level of grazing is recommended by UCCE, and by NRCS through their prescribed grazing practices (UADS-NRCS 1996, 1997), so that all forage types are more evenly utilized, reseeding of annual and perennial grasses is encouraged, and erosion is controlled. Heavy grazing does not leave adequate unused plant material for reseeding and erosion control. Light grazing, without planned MU rotation, often allows animals to pick and choose the more palatable plants while leaving less desirable plants to more readily reproduce. Existing cattle stocking practices at the Preserve would be classified as in the moderate grazing category. Supplemental feeding of hay, or liquid/solid protein supplements may be necessary during unfavorable rainfall years and/or to ensure adequate/optimal nutrition in certain seasons or life stages, or to compensate for site-specific micro or macro nutrient deficiencies. Mother cows, replacement heifers, and bulls may require short-term feeding in order to maintain their health and condition. Any feeding should be at least a ¼ mile from livestock water in order to encourage cattle distribution across the rangeland.

4.4.3 Preserve Operations Infrastructure

The Preserve operations infrastructure includes corrals, fencing and livestock/wildlife water (Figure 8).

Figure 8. Operations Infrastructure at the Jack and Laura Dangermond Preserve.



4.4.3.1 Preserve Operations Fencing

Preserve perimeter and interior fencing, which separates the various management units, holding fields, and corral traps are all well-maintained and repaired as necessary. Access to many of the fencelines are difficult or impossible during the rainy season, so any damaged fences from storm events may not be immediately accessible for repair. No new fencelines are specifically proposed in this Plan but may be considered in future iterations of the Preserve's rangeland management planning processes. The use of electric fencing may be necessary around future restoration areas (e.g. during iceplant removal or restoration of the Jalachichi Ponds). It is recommended that trial areas of electric fencing be established for yearling bulls and replacement heifers, so that as they enter the herd they will be sensitized to electric fencing.

4.4.3.2 Preserve Operations Water Sources

Preserve operations water sources consist of seasonal creeks, springs, wells, and ponds (Figure 8). The springs and wells flow into water tanks and troughs.

The water system on the Cojo side of the Preserve currently supplies 20 drinking troughs, plus another 5 troughs on Jalama side of the Preserve (Figure 8). The Cojo water system allows cattle to drink at higher elevations as well as away from natural water sources, which supports Preserve goals and objectives (Table 1). The Palo Alto Pump Station is located in the Steer MU and contains a well, pump, four 10,000-gallon storage tanks, and diverters to various drinking points. A booster pump station exists higher on the ridge in the Steer MU and sends water north toward Jalama and west toward further Cojo MUs. Many of the main water distribution lines are a large diameter 2" line or greater, meaning substantial water may be stored in the line itself. These larger lines often neck down into smaller diameter pipelines as they "T" off to individual drinking troughs, a benefit which allows for designing more flexible livestock operations. The drinking troughs themselves are well distributed across the Cojo side of the Preserve, with most, but not all, lying on higher elevation ridges and flat areas. The location of troughs is important, for it can draw cattle to higher elevations and away from natural water sources, including riparian areas.

Additional troughs will be added in the Jalama Bull, Jalama Mare, East Tinta, West Tinta, and Little Cojo MUs when the Jalama Creek steelhead recovery fencing project begins. Sage Associates have recommended that water troughs in the Airport Field and the Schoolhouse Field MUs (Figures 1 and 8) may be removed that are adjacent to the Cojo access road because the MUs will not be used for grazing. Proposed water trough locations (Table 6) are dispersed along terraces, ridgelines and swales that will aid in the distribution of cattle and will complement the Preserve's existing water supply. Additional troughs will be located away from existing natural water sources to benefit wildlife, reduce siltation, and improve water quality and the potential for riparian habitat management. TNC will install wildlife-friendly water troughs with wooden or mesh escape ramps.

Table 6. Proposed New Troughs.

Trough Location (#of troughs)	Conservation Justification
Jalama Bull Pasture (2)	Jalama Creek fencing project to support steelhead recovery and riparian vegetation

Jalama Mare (1)	Jalama Creek fencing project to support steelhead recovery and riparian vegetation
West Tinta (4)	Supports steelhead recovery and riparian vegetation
East Tinta (5)	Supports steelhead recovery and riparian vegetation

On the Jalama side of the Preserve, no central stock water system exists, and stock water is supplied by individual wells, storage tanks, distribution pipelines, and troughs. The Jalama side of the Preserve also relies more on springs and streams, which run well in good moisture years, but tend to go dry in poor years. Water on this steeper portion of the Preserve is also hauled, which is less appealing and more expensive. Many of the troughs are spring fed (Figures 1 and 8) with low summer flow that are unable to keep pace with cattle water demands.

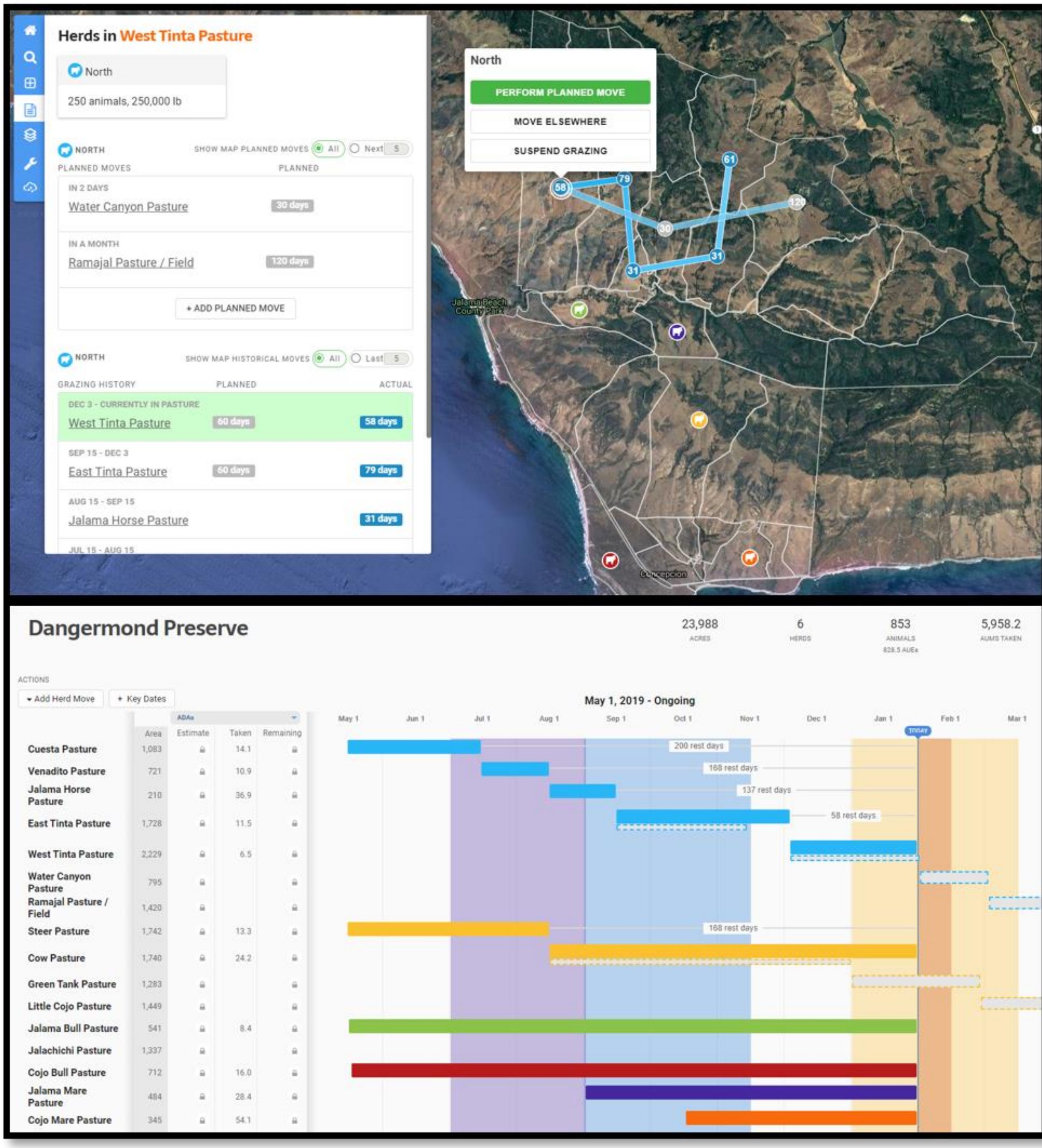
4.5 Rangeland Management Plan Implementation

4.5.1 Rangeland Management and Conservation Technology

TNC will use the PastureMap software application to manage the Preserve's grazing rotations and to communicate the specifics of our grazing management to TNC staff outside of the Rangeland Management Team (Figure 9). PastureMap was determined to be the most efficient and cost-effective tool for planning and communication in the Preserve's adaptive management and structured decision-making framework. In addition, PastureMap connects with the Preserve's larger vision of using technology to improve the collection and dissemination of data for efficient and timely decision making and data sharing (Butterfield et al. 2019).

The Rangeland Management Team will primarily use PastureMap to document the grazing plan and record accurate dates, and cattle numbers and weights as the cattle are being rotated between pastures (Figure 9). PastureMap also allows the Rangeland Management Team to record the operational aspects of the Plan including branding, breeding, calving, and weaning. As TNC manages cattle grazing over the next 3-5 years for conservation outcomes, the record keeping that PastureMap provides will provide TNC and potential external researchers the ability to test and measure the impacts of grazing on our conservation goals.

Figure 9. PastureMap shows where each herd is currently grazing, where they have grazed and where they will graze next and allows TNC to produce a grazing rotation.



4.5.2 Planned Rotation January 2020-June 2021

TNC's planned rotation can be found in Table 7. The planned rotation takes in to consideration the IRMP goals and objectives for the Preserve and for the rangeland management program (Table 1), but also constrains itself based on infrastructure, staffing capacity, funding, and operational (e.g. using a cow-calf herd, using two larger herds) assumptions and limitations (see Section 1.3).

To help address the use of cattle grazing to meet our goals and objectives (Table 1), TNC completed a spatial analysis (and developed a spatial planning tool – see Table 9) to identify the MUs that contained the highest percentage of specific resources, including CCC-related projects (Figure 2), freshwater targets, including Jalama Creek and other potential steelhead-bearing streams (Figures 3 and 4), native perennial bunchgrasses (Figure 10), Gaviota tarplant (Figure 11), coast live oak woodlands, and grass-nesting birds (Table 8). The tool has been designed to help to inform our grazing planning and decision-making. The tool is intended to help us understand the relative importance of each management unit for each conservation/resource target. Examples include:

- The Cojo Bull MU (Figure 1) contains 94% of all mapped marshes and sedges on the Preserve. To protect the marshes and sedges in this management unit, we have proposed to only graze the bull herd (Table 8).
- The Jalachichi MU (Figure 1) contains 31.4% of the native bunchgrasses mapped on the Preserve. For the January 2020 to June 2021 grazing period we propose to graze outside of the period when native perennial bunchgrasses are rapidly growing, flowering and setting seed – typically March through July at the Preserve (Tables 7 and 8) – to test the hypothesis that this type of season grazing can reduce the cover of competing non-native annual grasses while increasing the cover of native perennial bunchgrasses.
- The Jalama Bull MU (Figure 1) accounts for 25% of the length of Jalama Creek (Figures 3 and 4) and thus has been targeted as a key location to add riparian exclusion fencing (as part of the Jalama Creek steelhead and California red-legged frog recovery project).
- Gaviota tarplant is an important conservation target at the Preserve. Grazing outside of the periods of flowering and seed set has been hypothesized to be compatible with protection and expansion of Gaviota tarplant populations on the Preserve – Gaviota tarplant typically flowers and sets seed July through October at the Preserve. Grazing has also been hypothesized to be positive for Gaviota tarplant establishment – grazing disturbs the soil and removes thatch that allows short-statured Gaviota tarplant seedlings to establish and grow. For the January 2020 to June 2021 grazing period, we have proposed to test these hypotheses in the Little Cojo MU (Tables 8 and 9), which has 32.6% of the total mapped Gaviota tarplant on the Preserve.
- Grass nesting birds are also a priority for our management efforts at the Preserve. The highest densities of grass nesting birds occur across the coastal management units of the Preserve, including the Cojo Mare, Steve's Flat, and Hollister Flat MUs (Figure 1). We have proposed to graze outside of the breeding and nesting season for grass nesting birds (June-August) in these management units (Table 7).

Even though cattle grazing is our main management tool at the Preserve, it cannot support all the rangeland resources/conservation targets we have prioritized (e.g. coast live oak woodlands). However, we can manage the seasonal timing of our grazing efforts, where and when possible, to complement other management efforts. For example, it has been hypothesized that oak seedlings and saplings may be negatively impacted by summer cattle grazing (e.g. Swiecki et al. 1997, McCreary and George 2005). To test this and similar hypotheses, we need to understand the impacts of other factors that contribute to seedling and sapling mortality, including deer browsing, consumption of acorns by feral pigs and rodents, rooting by feral pigs and ground squirrels, and other climatological (e.g. drought) and biophysical (e.g. limitations of oak seedling establishment – see Davis et al. 2016) factors. Seedling caging may be more effective at preventing browse damage (McCreary and George 2005). We plan to test these hypotheses as part of a CCC restoration project (Table 1).

Table 7. Planned Grazing Rotation January 2020-June 2021.

	2020												2021					
Jalama Ranch	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
Cuesta										North Herd	North Herd	North Herd						
Venadito							North Herd	North Herd	North Herd									
West Tinta	North Herd	North Herd															North Herd	North Herd
East Tinta															North Herd	North Herd		
Water Canyon			North Herd	North Herd	North Herd													
Ramajal Pasture													North Herd	North Herd				
Escondido				North Herd	North Herd	North Herd												
Jalama Mare	Yearlings 1	Yearlings 1																
Ramajal Holding																		
Diamond Holding																		
Cojo Ranch																		
Steer																		
Cow	South Herd	South Herd																
Green Tank			South Herd	South Herd													South Herd	South Herd
Little Cojo					South Herd	South Herd											South Herd	South Herd
Jalama Bull	Yearlings 2	Yearlings 2	Yearlings 2	Yearlings 2	Yearlings 2	Yearlings 2	South Herd								South Herd	South Herd		
Jalachichi								South Herd	South Herd	South Herd	South Herd	South Herd	South Herd	South Herd				
Black Brush								South Herd	South Herd	South Herd	South Herd	South Herd	South Herd	South Herd				
Cojo Mare	Yearlings 3	Yearlings 3	Yearlings 3	Yearlings 3	Yearlings 3													
Steve's Flat	Yearlings 3	Yearlings 3	Yearlings 3	Yearlings 3	Yearlings 3													
Hollister Flat	Yearlings 3	Yearlings 3	Yearlings 3	Yearlings 3	Yearlings 3													
Cojo Bull	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd	Bull Herd
Walnut Field	Walnut Field is not part of the grazing rotations; however, cattle may be moved through these small pastures for short periods of time.																	
Perry's Field	Perry's Field is not part of the grazing rotations; however, cattle may be moved through these small pastures for short periods of time.																	
Cojo Horse	The Cojo Horse pasture is grazed by the ranch's working and personal horses year-round. It is not part of the preserve's cattle grazing rotation.																	
Airport	The Airport pasture is not planned to be grazed in 2020-2021.																	
North Herd		North Herd is the main cow herd that grazes on the Jalama Ranch side of the preserve. The herd averages between 200-300 head.																
South Herd		South Herd is the main cow herd that grazes on the Cojo Ranch side of the preserve. The herd averages between 200-300 head.																
Yearlings 1		Yearlings 1 herd is grazing in the Jalama Mare pasture and will be sold in 2020.																
Yearlings 2		Yearlings 2 herd is grazing in the Jalama Bull pasture and will be sold in 2020.																
Yearlings 3		Yearlings 3 herd is grazing in the SE coastal Cojo pastures between Steve's Flat, Hollister Flat and Cojo Mare. They will be sold in 2020.																
Bull Herd		The bull herd is kept in the Cojo Bull pasture, at Point Conception, year-round except for the breeding period of January through March																

Table 8. Resource Target Prioritization Table. Green shading indicates a hypothesized positive benefit associated with cattle grazing. Red shading indicates a hypothesized negative impact associated with cattle grazing. No shading indicates either a lack of specific knowledge about the impact of cattle grazing or no effect associated with cattle grazing.

	Calendar											
Conservation Target	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Goal 1: CCC Restoration												
Gaviota Tar Plant Expansion in Iceplant												
Prepare Oak Plantings												
Planted Oaks First 3 Years												
Planted Oaks After 3 years												
Goal 2: Fire Management												
Reduce Fuel Loads												
Goal 3: Freshwater Management												
Jalama Creek												
Marsh / Seep / Sedge												
Goal 4: Noxious Weed Management												
Noxious Weeds												
Goal 5: Biodiversity Management												
Native Bunchgrasses												
Coast Live Oak Woodland												
Gaviota Tarplant												
Grass Nesting Birds												

Figure 10. Percent of Total Preserve Native Bunchgrass Cover by Management Unit.

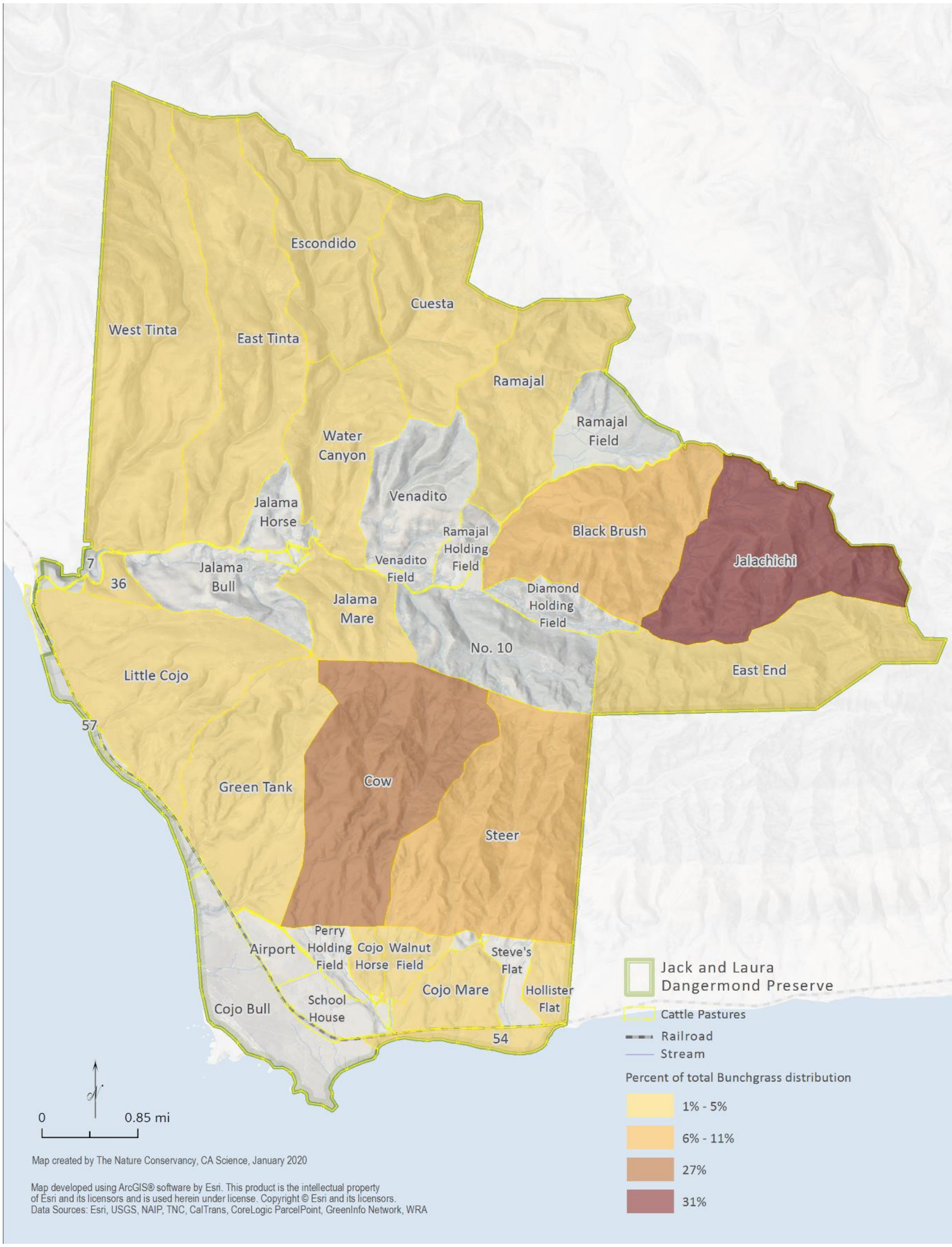
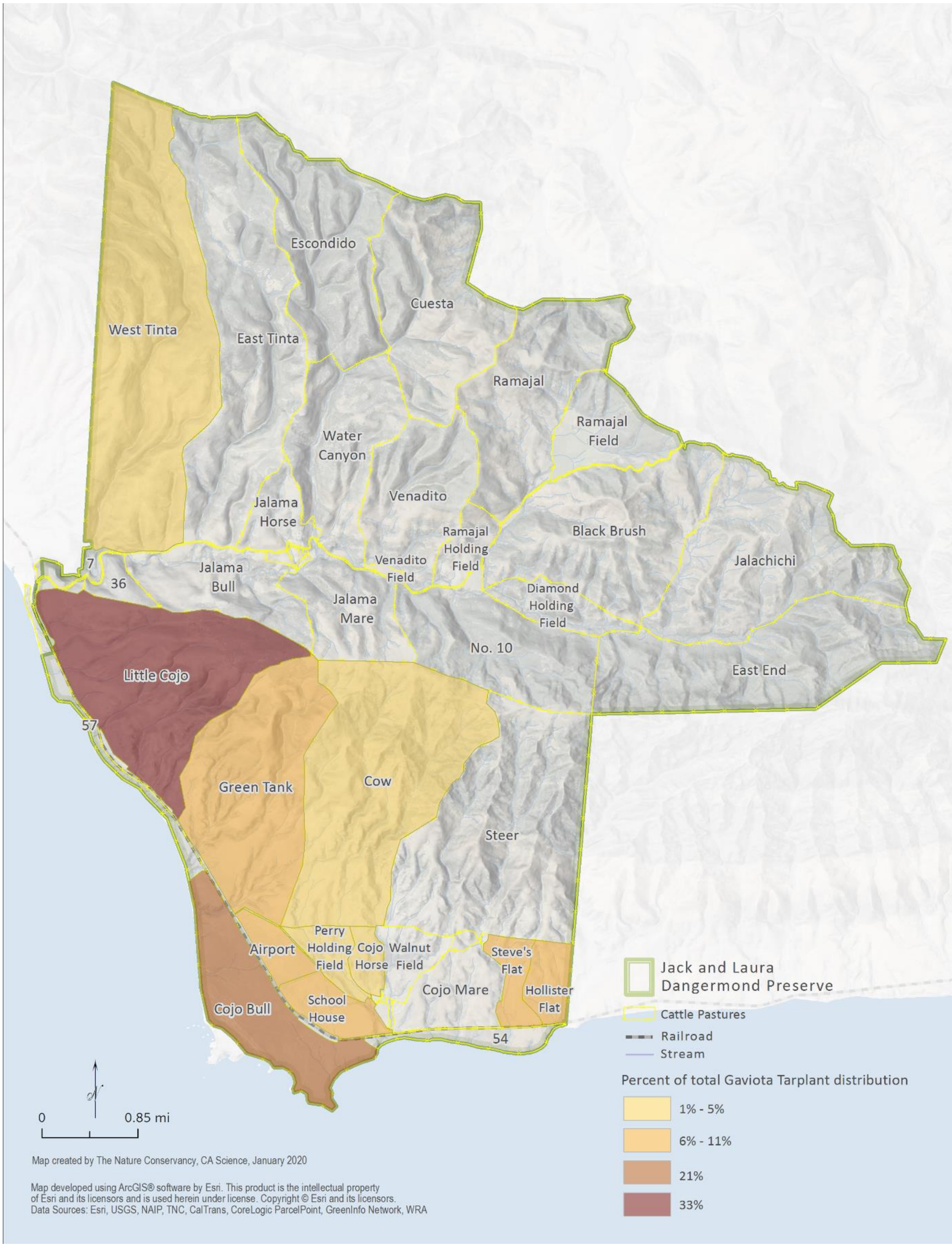


Figure 11. Percent of Total Preserve Gaviota Tarplant Cover by Management Unit.



4.5.3 Monitoring Program

4.5.3.1 Integrated Monitoring

TNC is in the process of developing an integrated monitoring plan for the Preserve. In that plan, TNC recommends three types of monitoring:

- Implementation monitoring to evaluate whether the management techniques are being implemented as prescribed in the plan
- Biological effectiveness monitoring to evaluate progress toward the biological goals and objectives for the conservation targets
- Individual project monitoring to evaluate the effectiveness of specific management projects

Monitoring protocols to evaluate the effects of specific management projects will be developed on a project-by-project basis using an adaptive management approach.

4.5.3.2. Implementation Monitoring

Implementation monitoring is recommended to evaluate whether the plan components are being implemented as prescribed and identify deviations from the plan strategies. This monitoring component is essential to the success of biological effectiveness monitoring, which relates changes or differences in the observed communities to the management strategies that are implemented. If the strategies are not implemented as described, then such deviations need to be considered when evaluating the effectiveness of management at attaining the biological goals and objectives.

4.5.3.2.1 RDM and Forage Monitoring

Grassland ecosystems can degrade when subjected to inappropriate grazing —becoming more dry, devoid of vegetation, and susceptible to erosion and invasive noxious weeds. Well-managed cattle grazing, on the other hand, can have a positive effect on grasslands by controlling non-native species, allowing native plants to flourish, and maintaining habitat conditions preferred by many species of wildlife. In fact, a certain amount of disturbance from grazing is often essential for healthy grassland ecosystems and can even benefit the establishment and growth of certain endangered native annual forb species like Gaviota tarplant. Cattle grazing also can reduce the threat of fire ignition and spread by reducing fine fuel loads in grassland ecosystems (Russell and McBride 2003).

To ensure that cattle grazing continues to be compatible with Preserve grassland and oak woodland communities as well as special status animal species goals and objectives, annually, in the Fall (Sept-Oct), we will monitor residual dry matter (RDM) in each MU. RDM goals for each MU have been established based on Bartolome et al. (2002) recommendations, and in consultation with Sage Associates. Photopoints within each management unit will be used to visually document RDM conditions. At the Preserve, TNC will monitor RDM using ground-based methods (Guenther and Hayes 2008) to establish RDM and grazing baselines. TNC plans to assess RDM terms/goals each year after annual end-of-the-season monitoring (and as part of annual work plan and budgeting development in June), to make sure that Preserve-wide goals and objectives are being met. TNC plans to use RDMapper, TNC's web-based grassland monitoring tool (Tsalyuk et al. 2015, Ford et al. 2017), to complement on-the-ground monitoring.

RDM is a measurement of the aboveground plant material left standing or on the ground just prior to the first autumn rains and start of a new growing season (Bentley and Talbot 1951). RDM has been shown to be a good predictor of rangeland productivity and overall rangeland condition (Bartolome et al. 2007). Quantitative evidence, qualitative observations made over time, and inference from other ecological systems suggests that keeping sufficient RDM levels benefits rangeland conservation values, helping slow or stop invasion of noxious and other introduced flora, conserving existing native species richness and cover, encouraging the maintenance of preferred wildlife habitat conditions, and protecting watersheds and streams from excessive soil erosion (Bartolome et al. 2002). Each year after annual RDM monitoring, we will adjust grazing timing and intensity, as necessary, to meet RDM goals within each MU.

In addition to annual RDM monitoring, TNC will conduct monthly monitoring for forage conditions across MUs where the cattle are currently grazing and where they are planned to move in the grazing rotation to ensure that RDM goals are met in the Fall Preserve-wide. Monthly monitoring will include photopoint monitoring and visual forage assessment – TNC may use more quantitative approaches to forage assessment, including height and on-the-ground green biomass when needed to specifically evaluate the necessity to move cattle. Monthly monitoring will involve members of the rangeland management team, including the leads for science, programs, stewardship, and rangeland finances. This will allow the rangeland management team to make important decisions including on cattle grazing movements, cattle sales (during key points in the season), and rangeland infrastructure improvements. Monthly monitoring will also evaluate roads and fire breaks as well as fence and livestock water conditions, assessing whether additional management is required. Monthly forage conditions monitoring reports will be developed by TNC programs staff and stored on the Preserve's Box storage system. Monthly and annual RDM and forage monitoring data will be stored digitally on both RDMapper and PastureMap.

4.5.3.3 Biological Effectiveness Monitoring

The biological effectiveness monitoring that we are recommending as part of the Preserve's Rangeland Management Plan includes (*note: more detailed monitoring protocols are in development as part of the Jack and Laura Dangermond Preserve Integrated Monitoring Plan*):

- Oak woodland seedling/sapling survival and recruitment monitoring in the Water Canyon, Venadito, Black Brush, Ramajal Field, Jalama Bull, Little Cojo, and Green Tank MUs to evaluate effectiveness of our CCC-mandated oak restoration efforts designed to promote the expansion of coast live oak populations.
- Iceplant, veldt grass and Gaviota tarplant percent cover monitoring within the Cojo Bull MU to evaluate the effectiveness of our CCC-mandated iceplant eradication project.
- Areal extent monitoring of: 1) purple needlegrass cover in the Jalachichi MU to assess the effectiveness of seasonal grazing at supporting the expansion of purple needlegrass populations; 2) seasonal wetland cover across the Preserve to monitor cattle grazing and climate change impacts on wetland extent and the timing of wet up and dry down; 3) riparian vegetation cover along Jalama Creek, Canada del Cojo Creek, Espada Creek, Gaspar Creek, Escondido Creek, and Cojo Creek to evaluate how seasonal cattle grazing or grazing exclusion impacts riparian vegetation cover.

- Gaviota tarplant percent cover monitoring within the Little Cojo MU to evaluate the impact of seasonal grazing on Gaviota tarplant establishment and persistence.
- Presence/absence monitoring of grass-nesting bird populations (along with RDM and forage conditions monitoring – see compliance monitoring section) – as part of annual breeding bird surveys at the Preserve – within Cojo Mare, Hollister Flat, and Steve's Flat MUs to evaluate the effectiveness of seasonal grazing at maintaining current levels of grass-nesting birds.
- Stream monitoring, including establishing steam gauges, within Jalama Creek, Espada Creek, Gaspar Creek, Escondido Creek, and Cojo Creek to establish quantitative and repeatable measurements of the stream's physical/habitat conditions and benthic macroinvertebrates, and to better determine the environmental extremes and seasonality of flow. Stream monitoring will also allow us to determine how seasonal cattle grazing or grazing exclusion impact these stream-related variables and to adjust our grazing-related activities, as necessary (especially in those places that are not fenced).
- Ground water monitoring of a subset of the wells at the Preserve. This will include level loggers to document water levels and allow for monitoring extraction rates and sustainable pumping conditions.

Every 5 years we will use a combination of aerial, drone imagery and field assessment to assess the areal extent of: 1) purple needlegrass populations in the Jalachichi MU; 2) coast live oak seedlings/saplings in the 200-acre oak restoration project in the Water Canyon, Venadito, Black Brush, and Ramajal Field MUs and the Army Camp oak restoration sites in the Jalama Bull, Little Cojo, and Green Tank MUs; and 3) seasonal wetlands across the Preserve. Monitoring will be based on a combination of existing vegetation maps developed by WRA (2017) (and referenced in Butterfield et al. 2019) and field surveys conducted by TNC as part of the CCC-mandated restoration projects. We will calculate the change in areal extent of the current and future plant community coverages . For field assessments of purple needlegrass in the Jalachichi MU, we will use step point methods to estimate basal cover within each stand, and a detailed sampling regime based on pilot/sequential sampling that uses multiple transects per stand to ensure adequate statistical power (Coulloudon et al. 1999). Each sampling event will be completed at approximately the same time of year as previous events. If areal extent declines for purple needlegrass in the Jalachihi MU (25% reduction over 10-year period), we will consider more focused management actions, including 1) adjustments to the timing and intensity of cattle grazing, 2) experimenting with prescribed burning, and 3) seeding/re-seeding, with the goal to support population expansion. If areal extent of coast live oak seedlings and saplings (within the CCC-mandated oak restoration projects) declines significantly (15% reduction over 10-year period), we will consider more focused management actions, including additional planting or re-planting across the CCC restoration sites, to encourage population expansion. If seasonal wetlands are seen to be declining significantly over time (15% reduction over 10-year period), we will consider planting additional native wetland vegetation in suitable areas around these water bodies.

Annually, we will conduct presence/absence surveys during flowering periods for Gaviota tarplant in the Little Cojo and Cojo Bull MUs (in response to the CCC-mandated iceplant restoration project). Every 5 years or in years of significant rainfall/native wildlfower expression, we will conduct a full botanical inventory to document rare/sensitive native grass and forb occurrences, including extent and density of Gaviota tarplant. If the extent or density of Gaviota tarplant declines within Little Cojo MU, we will evaluate the impacts of our cattle grazing management efforts and make adjustments to ensure Gaviota tarplant can persist and expand across the Preserve. If Gaviota tarplant does not establish in the Cojo Bull MU restoration sites, our restoration team will evaluate whether additional actions may be required, including further treatment (e.g. herbicides, mechanical removal, grazing) for the eradication of iceplant and veldt grass, and additional seeding of Gaviota tarplant.

Every 5 years in late March through early April, we will monitor Jalama Creek, Canada del Cojo Creek, Espada Creek, Gaspar Creek, Escondido Creek, and Cojo Creek to: 1) evaluate the effectiveness of management of the stream ecosystems (including fencing and/or seasonal cattle grazing restrictions), and 2) determine whether there is a need for remedial action, such as additional fencing of grazing animals outside of the riparian community, or further restricting the time period when they can be present within the riparian. Stream monitoring is designed to establish quantitative and repeatable measurements of the stream's physical/habitat conditions and benthic macroinvertebrates. The field work will follow the Surface Water Ambient Monitoring Program Procedures (Ode et. al. 2016). The macroinvertebrates will mostly be identified to the genus level. Seven different metrics will be calculated from the macroinvertebrate results, and this information will be compared to the South Coast Index of Biotic Integrity to determine the degree of water quality and the impairment of the streams. Analysis of physical/habitat conditions data, combined with the study of the benthic macroinvertebrate communities, will allow us to determine an overall measure of the health of the sampled streams. Stream gauges and HOBO temperature data loggers will be established throughout the creeks to better determine the environmental extremes and seasonality of flow. The temperature gauges will record the stream temperature every thirty minutes. The stream flow gauge will record stream flow constantly throughout the year. The temperature gauges will allow us to determine if the temperature becomes too warm for cold water species such as steelhead and some sensitive macroinvertebrates. If this occurs, we may need to further restrict cattle from the riparian areas or reduce the withdrawal of water from the creeks.

Annually, from mid-March through June, we will do a presence/absence surveys of grasshopper sparrows, which are good indicators of maintaining habitat quality for grass-nesting birds overall. Grasshopper sparrows will be identified by sight and sound. Presence or absence will be recorded monthly from mid-March through June. Once we establish a baseline for grasshopper sparrows within the MUs of interest, we will use annually monitoring to establish whether our grazing and grass-nesting bird goals are compatible. We will adjust grazing timing and intensity, as necessary, to meet our grass-nesting bird goals and objectives.

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6. Appendices

6.1 Operations Projects at the Jack and Laura Dangermond Preserve

6.1.1 Preserve Operations Fencing Projects

Fencing projects will be determined based on available funding. In general, TNC plans to fix 1-2 miles of fencing per year. Replacement costs for Preserve fences are estimated at ~$60,000/mile.

6.1.2 Preserve Operations Water Projects

TNC hopes to use as many as 19 of the wells (for water production) that were installed by the previous landowner without a permit; TNC is seeking to get some of these wells permitted for production – to support conservation management goals and objectives – and others for monitoring – to support watershed-scale science and research), which will allow water to be more sustainably used across the Preserve. Well development will not only help support conservation grazing practices but will provide water sources (e.g. troughs) for wildlife, including deer, bobcats, birds, mountain lions, California red-legged frog, frogs, and other species.

Table S1. Proposed Production Wells.

Well Name	Well Location	Conservation Justification
Oaks Well Cluster (#1-5)	Little Cojo, Cojo Ranch	Get cattle away from Jalama Creek in the Jalama Bull pasture. Provide more reliable water for the western portion of the Cojo Ranch
Alegria	Steer, Cojo Ranch	Improve forage utilization and conservation target protection across Cojo Ranch
Buckhorn 1	Jalachichi, Jalama Ranch	Provide additional water to keep cattle away from the Jalama Creek headwaters
Buckhorn 2	Jalachichi, Jalama Ranch	Provide additional water to keep cattle away from the Jalama Creek headwaters
Diamond Corral (aka Sierra)	No. 10, Jalama Ranch	Water need for Diamond Corrals
Gaucho 2	No. 10, Jalama Ranch	Improve forage utilization and conservation target protection for the East End and No. 10
Ramajal East	Ramajal, Jalama Ranch	Water for CCC oak restoration project
Ramajal South	Ramajal, Jalama Ranch	Water for CCC oak restoration project
Vaqueros	Steer, Cojo Ranch	Improve forage utilization and conservation target protection across Cojo Ranch

Gaspar 1	East Tinta, Jalama Ranch	Reduce spring usage; provide more secure water source for Jalama HQ and for fire fighting
Escondido 4	Escondido, Jalama Ranch	Get cattle away from Escondido Creek for steelhead and riparian vegetation
Quarry 1	West Tinta, Jalama Ranch	Get cattle away from Espada Creek for steelhead and riparian vegetation; establish water to VAFB fenceline to allow for more even grazing and fine fuel management along Preserve boundary
Tinta 1	East Tinta, Jalama Ranch	Get cattle away from Gaspar Creek for steelhead and riparian vegetation
Tinta 2	East Tinta, Jalama Ranch	Get cattle away from Gaspar Creek for steelhead and riparian vegetation
Venadito 1	Venadito, Jalama Ranch	Get cattle away from Escondido and Venadito Creeks for steelhead and riparian vegetation

Water is essential for all Preserve activities, including the cattle grazing operation. Therefore, TNC will maintain water lines and fix water line issues as they arise.

6.1.3 Preserve Operations Road Projects

Roads are essential for Preserve activities, including research, environmental education/outreach/visition, fire management, as well as for the cattle grazing operation. Road projects, including general maintenance and major road repair, will be determined based on available funding. In general, TNC plans to conduct 1 major road repair each year. Major road repairs are estimated to be $200,000-250,000. In general, TNC also plans to conduct annual road maintenance, which is estimated to be $100,000-200,000.