Biological Monitoring Plan

Cotoni-Coast Dairies unit of the California Coastal National Monument
Updated December 2021

Presidential Proclamation 9563 added Cotoni-Coast Dairies to the California Coastal National Monument in 2017. The most frequently used term in the Cotoni-Coast Dairies (C-CD) section of the Presidential Proclamation is "diversity," used to highlight the importance of the native biological diversity of species utilizing these lands. The Proclamation discusses the diversity of habitat types, species listed under the Endangered Species Act, and some of the unlisted native species onsite. The BLM will work towards conserving, protecting and restoring all species noted in the Proclamation, as well as the diversity of native species not noted. For many of the common wildlife and plant species noted in the Proclamation, the BLM can meet this goal by managing their habitats effectively. For example, working towards protection and enhancement of riparian areas accounts for many of the common species noted in the Proclamation, such as red alder. Therefore, specific restoration goals or formal monitoring protocols for each species discussed in the Proclamation is not recommended or proposed.

The BLM released its Cotoni-Coast Dairies Proposed Resource Management Plan Amendment (RMPA) and Environmental Assessment in September 2020. The RMPA was developed to allow for public access and enjoyment of C-CD, while ensuring the conservation, protection and restoration A key component of the approach described above is effective monitoring. BLM will use a biological monitoring approach that is adaptive to incorporate changes in policy and updates in biological information over time, such as the listing or discovery of any species utilizing these Monument lands, and improved understanding of threats to species related to BLM's land management practices. See **Figures 1, 2 and 3** for monitoring locations at C-CD.

The monitoring approaches identified here provide a broad suite of monitoring tools. The BLM's ability to complete the full suite of monitoring components will be subject to the availability of funds and staff. The BLM envisions this monitoring plan as a living document that will evolve over time as monitoring capacity and needs change.

Document Outline:

I.	**Weather and Climate**
II.	**Water Quality**
III.	**Soil, Vegetation, and Rangelands**
IV.	**Wildlife**
V.	**Special Status Species**
VI.	**Recreation**
VII.	**Emerging Technologies**
VIII.	**Research and Education**
IX.	**References**

Biological Monitoring Plan Indicators, Methods, Timing, Frequency Summary Table:

Resources	Indicators	Methods	Timing	Frequency	Status
Weather and Climate	Air temperature, wind speed and direction, relative humidity, precipitation, and soil moisture. Quantitative.	Automated, instrumental – Remote Automated Weather Station (RAWS)	Constant, continuous	Hourly	Underway as of August 2021
Water Quantity – Springs	Flow rate. Quantitative.	Manual for springs.	Year-round	Monthly for springs for 1st two years, then quarterly.	Underway as of January 2020
Water Quantity - Streams	Flow rate. Quantitative.	Automated gauging station	Year-round	Continuous; hourly	Subject to availability of funding
Water Quantity - Ponds	Water depth. Quantitative.	Manual – Visual read. Staff gauges.	Year-round	Quarterly	Set to begin at key CRLF breeding ponds in January 2022
Water Quality - Streams	pH, Electrical Conductance (EC), Total Dissolved Solids (TDS), Oxidation reduction potential, temperature	Manual, instrumental	Year-round	Monthly	Set to begin (with emphasis on RMZ1) in January 2022
Water Quality – Streams and Ponds	Invertebrate diversity and abundance. Quantitative.	Manual – Collection and identification.	Summer/Fall	At least every 5 years, Annually	Subject to availability of funding

Soil Integrity	See **Vegetation**	See **Vegetation**	See **Vegetation**	See **Vegetation**	
Vegetation - Plant Species	Diversity. Quantitative.	Manual - Casual surveys. Crowdsourcing/ Citizen Science	Year-round	Incidental, all year	Pending public access (estimated Summer 2022)
Vegetation – All Types	Vegetation cover and structure. Weeds presence and abundance. Pathogen (SOD) presence and abundance. Evidence of soil erosion. Qualitative.	Manual – Photomonitoring. Landscape level photopoints. Digital camera, T-post marker.	Year-round	Quarterly	Partially underway for fire-impacted sites. Full roll out in January 2022
Vegetation (upland) – Grasslands, Rangelands	Cover and abundance, by species. Residual Dry Matter (RDM). Quantitative	Manual - Photo-based monitoring of randomized study plots (quadrat grid) with quantitative data extraction. Cover type (plant or bare soil) and abundance by species. RDM collected and weighed and subset of sites.	Spring/Summer	Annually	Set to begin (with emphasis on RMZ1) in January 2022
Wildlife – All Species	Diversity. Quantitative.	Manual - Casual surveys. Crowdsourcing/ Citizen Science	All year	Incidental, all year	Pending public access (estimated Summer 2022)
Wildlife – Non-Native Species	Presence/absence	Incidental observations	All year	Incidental, all year	Underway
Wildlife – Terrestrial Invertebrates	Diversity, distribution.	Manual - Collection and identification.	Spring/Summer	Two or more year cycle.	Subject to availability of funding

Wildlife - Monarchs	Population census. Quantitative.	Manual – Survey, Counts.	Winter (over-wintering)	Annually	Underway, led by partner organizations (Groundswell, Xerces)
Wildlife – Reptiles and Amphibians	Diversity, distribution, and abundance. Quantitative.	Manual - Drift fences and coverboards for counts.	All year	Incidental, all year	Subject to availability of funding
Wildlife - Birds	Diversity, distribution, and abundance. Quantitative.	Manual - Surveys. Visual, auditory. Counts.	-Breeding season (March-May), -Spring migration (Feb-April) -Fall migration (Sept. – Nov.)	Specific season surveys on three year cycle. Incidental, all year.	Subject to availability of funding
Wildlife - Mammals	Diversity, distribution, and abundance.	Camera trap array	Dry season	Continuous	Subject to availability of funding in partnership with San Vicente Redwoods
Wildlife - Badgers	Diversity, distribution, and abundance. Quantitative.	Scent detection dogs	Summer	Two or more year cycle. Determine best frequency to maximize detection	Subject to availability of funding
Wildlife – Puma	Distribution and abundance. Quantitative.	Manual - Identification. Visual documentation, trapping,	All year	Dependent on research needs.	Underway, led by partner organization (UCSC)

Special Status Species – California Red Legged Frog	Population census, species distribution, habitat condition. Quantitative.	Manual – California Red legged frog monitoring protocol. Night driving surveys, stream surveys, pond surveys. Counts of breeding adults. Counts of tadpoles.	Winter, Spring. October-March following rain events ---------- During breeding season	Annually	Underway
Special Status Species – Steelhead trout and Coho salmon	Species distribution. Quantitative.	Manual – Steelhead trout and Coho salmon monitoring protocols.	Spring to Fall	Determined by organizations conducting specific surveys.	Underway, led by partner organizations (City of Santa Cruz, NOAA-NMFS)
Recreation - Parking	Parking availability	Incidental documentation of parking availability/issues at BLM parking lots	Year-round	Monthly monitoring, quarterly documentation	Pending public access (estimated Summer 2022)
Recreation – Trail Condition	Identification of trail maintenance issues and erosional features	Monthly trail monitoring	Year-round	Monthly monitoring, quarterly documentation	Pending public access (estimated Summer 2022)
Recreation – Social Trails	Identification of social/unauthorized trails	Monthly trail monitoring	Year-round	Monthly monitoring, quarterly documentation	Pending public access (estimated Summer 2022)
Recreation – Sensitive Habitats	Documentation of unauthorized entry into sensitive habitat areas in RMZ 2 and 4	Monitoring using trail cameras	Year-round	Monthly data collection, quarterly documentation	Pending public access (estimated Summer 2022)

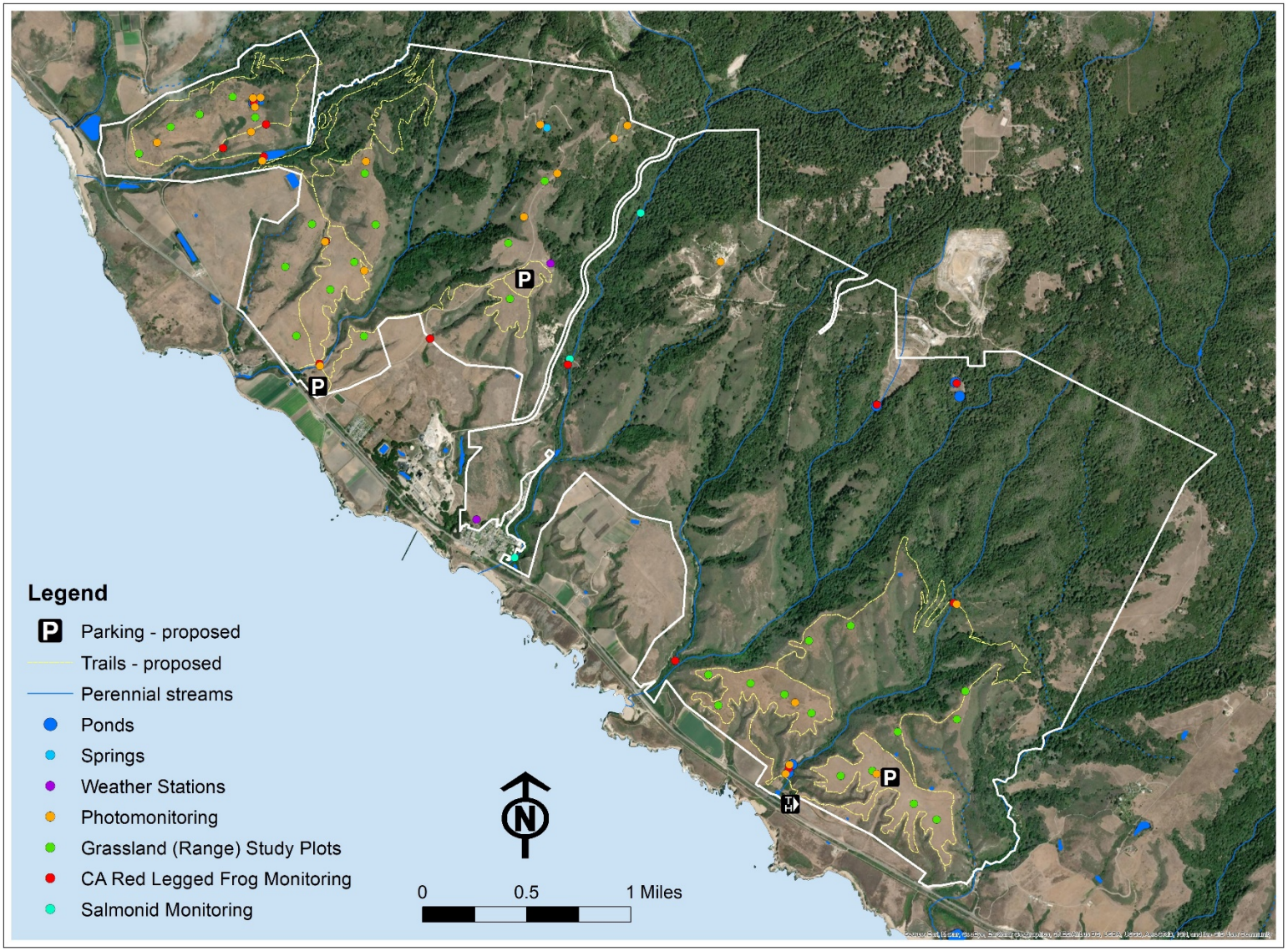

Figure 1. Monitoring overview of C-CD - Entire. Monitoring data collection locations.

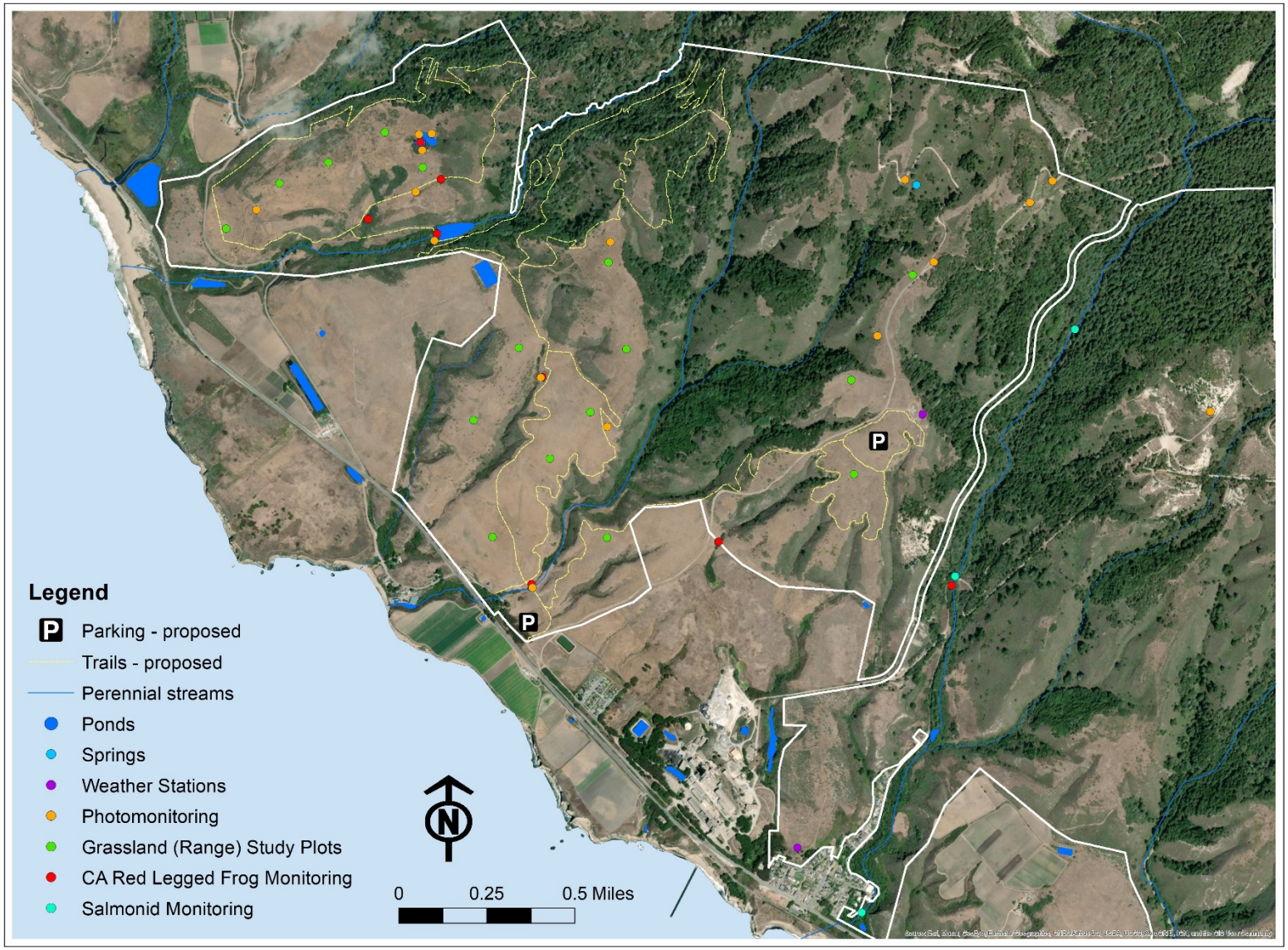

Figure 2. Monitoring overview of C-CD – North (RMZ 1 & 2). **M**onitoring data collection locations.

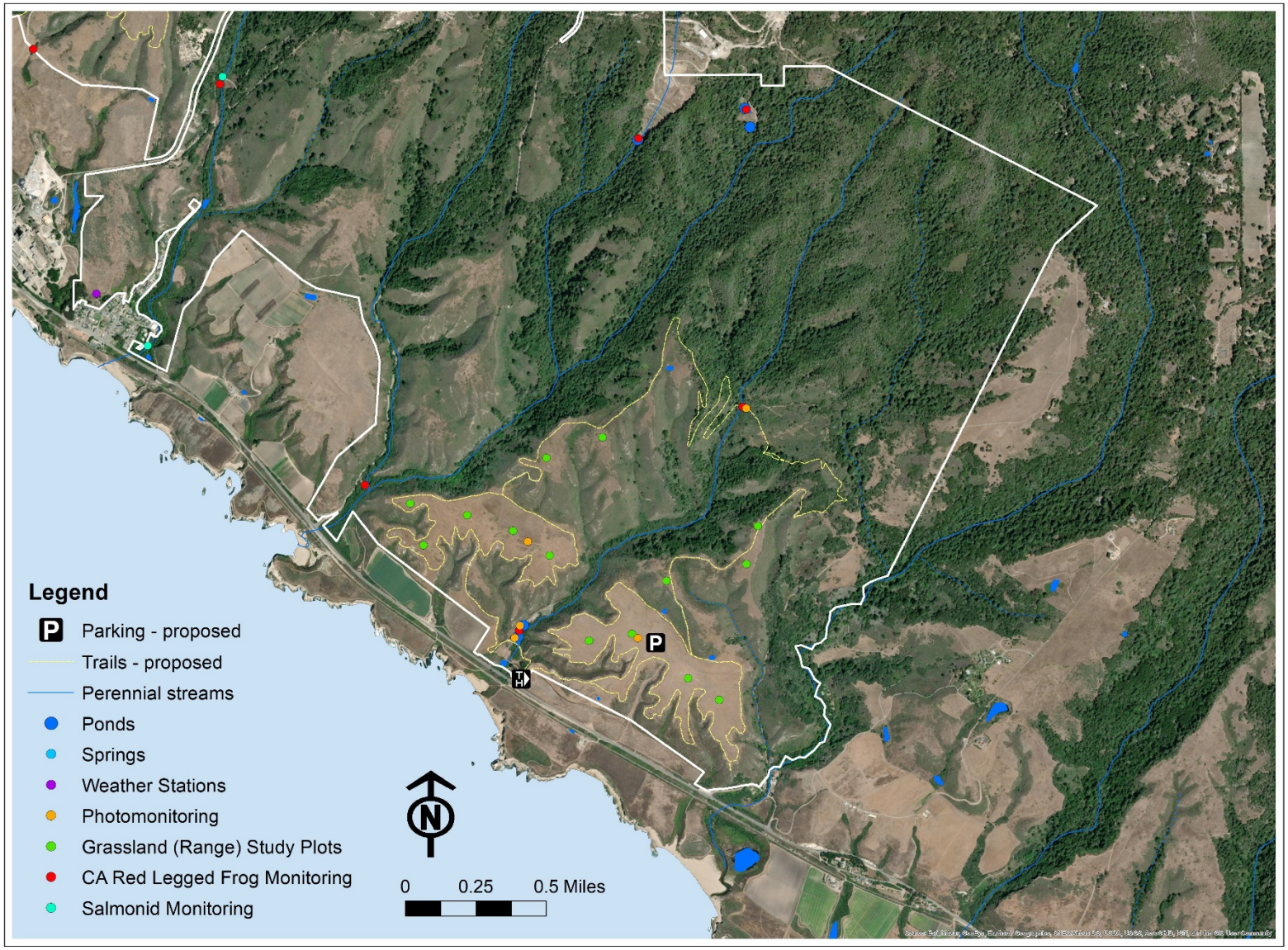

Figure 3. Monitoring overview of C-CD – South (RMZ 3 & 4). Monitoring data collection locations.

I. Weather and Climate

Indicators Monitored: Weather

Methods: Remote Automatic Weather Station (RAWS). Air temperature, wind speed and direction, relative humidity, precipitation, and soil moisture at three depths (2, 4, and 8 inches). Automatic data collection. A RAWS station will be installed and maintained at C-CD, according to RAWS program specifications. Data will be available to BLM and all public via the RAWS website. https://raws.dri.edu/. All resulting data can be utilized by BLM and all interested researchers during onsite resource management, which should be informative for fire, wildlife, botanical, and recreational resources.

Timing: Installation of the RAWS at C-CD is anticipated in Fall 2021. The RAWS will remain in place for at least a few decades, collecting data. All year. Continuous, automatic.

Equipment and Personnel: One RAWS will be installed at C-CD in Fall 2021. In addition to the C-CD RAWS, there is an existing rain gauge at Davenport (DAP) and measures precipitation (only).

II. Water

Indicators Monitored: Water Quantity - Spring flow

Methods: Flow rate. Manual data collection. Molino, Agua Puerca, Lower Warrenella, Upper Warrenella

Timing: Monthly for first two years, quarterly thereafter.

Equipment and personnel: Funnels (flow capture), volumetric measuring, stopwatch. Capture water flow (volume) per unit time = flow rate.

Indicators Monitored: Water Quantity - Stream flow

Methods: Flow rate. Automated data collection for potential inclusion in the USGS streamflow water monitoring network (https://waterdata.usgs.gov/nwis). San Vicente Creek

Timing: All year. Continuous, automatic.

Equipment and personnel: Stream gauge. Proposed, San Vicente Creek.

Indicators Monitored: Water Quantity - Ponds

Methods: Depth. Staff gauge reading (visual, manual). Molino Pond, Yellow Bank Ponds, Bonny Doon Quarry ponds (tailings ponds)

Timing: Monthly or incidental

Equipment and personnel: Staff gauges.

Indicators Monitored: Water Quality - Streams

Methods: Water quality handheld tester. Manual data collection. Stream crossings (roads and trails) at each of six perennial creeks at C-CD – Molino, Agua Puerca, San Vicente, Liddell, Yellowbank, Laguna. Data collected for pH, electrical conductance (EC), total dissolved solids (TDS), oxidation reduction potential, temperature

Timing: Monthly with focus on areas of recreation development

Equipment and personnel: water quality tester. 1-2 days per time

Indicators monitored: Water Quality – Streams and Ponds

Methods: Collect aquatic invertebrates from streamcourses onsite. Manual data collection. Utilize storage methods customary for preserving such collections. Collect location information (GPS coordinates). Ship collections to aquatic entomology experts.

Timing: Need to collaborate with aquatic entomologists to determine study design and timing for maximizing utility of information.

Equipment and Personnel: * Conduct if all steps in this program are feasible. 1-2 biologists, nets and other required collection and storage materials, shipping costs.

Funding for contract required for external partners to review and document inventory of invertebrate species collected, summarize resulting data, and provide counsel regarding significance of species found to onsite resource management.

III. Soil, Vegetation, and Rangelands

Indicators Monitored: Soil Integrity

Methods: Landscape-level photomonitoring, qualitative assessment (Hall 2001; Pellant et al. 2005). Photo-based monitoring of randomized grassland study plots (quadrat grid) with quantitative data extraction using point intercept method (Pellant et al. 2005). Manual data collection. The landscape photomonitoring will include a total of 21 points used to visually assess (qualitative) soil integrity and identify any erosion – rills, gullies. Cover data collection from quadrat photos (30 study plots) will provide a quantitive measure of the % bare soil.

Timing: Annual

Equipment and personnel: Landscape-level Photomonitoring and Photo-based monitoring of randomized study plots (quadrat grid) with quantitative data extraction.

Indicators Monitored: Plant Species Diversity

Methods: BLM casual surveys with data uploaded to Calflora. Crowdsourcing and Citizen Science with observations uploaded to iNaturalist. Manual data collection.

Timing: Incidental, but mostly Spring and Summer.

Equipment and personnel: BLM – GPS. Public – Smartphone.

Indicators Monitored: Vegetation Cover and Structure –All Vegetation Types

Methods: Landscape-level photomonitoring, qualitative assessment (Hall 2001; Pellant et al. 2005). Manual data collection. Changes in vegetative cover and structure. Presence and relative abundance of weeds. See **Figure 4**, as an example. A total of 8 landscape photomonitoring points were established in Winter 2021, following the CZU August Lightning Fire, in order to monitor burned vegetation recovery. An additional 13 landscape photomonitoring points are proposed to be established to monitor features and landscapes including – springs, ponds, trail creek crossings, weeds, and abandoned quarry revegetation. BLM may consider establishing casual photomonitoring points along trails for the Public to participate in Citizen Science – using http://monitorchange.org/.

Timing: Quarterly for first two years (2022, 2023). Annually thereafter, in Spring.

Equipment and personnel: T-posts, digital camera. BLM - One to two days per quarter for first two years. BLM - One to two days per year, thereafter. For Public photomonitoring points along trails – Angled steel bracket for smartphone alignment, mounting surface (post, etc.). Public uses their own smartphone to capture a photo and upload to the website. These photos can be used by BLM and additionally it shows the Public how photomonitoring is used to monitor landscape change.

Indicators Monitored: Vegetation Cover, Plant Species Diversity and Abundance, and RDM in Grasslands, Rangelands

Methods: Photo-based monitoring of randomized grassland study plots (quadrat grid) with quantitative data extraction using point intercept method (Pellant et al. 2005). Manual data collection. See **Figure 5**, as an example. Residual Dry Matter (RDM) collection and

quantification by weight (mass; Pellant et al. 2005). A total of 30 permanent study plots will be established - distributed throughout the grasslands of C-CD. These 3 ft (1 m) square study plots will be delineated by steel stakes imbedded in the soil that serve as anchor points (alignment) for the 3 ft (1 m) square quadrat grid. The steel stakes anchor the diagonal corners of the quadrat. For data sampling (Spring), the portable quadrat grid is aligned on the steel stakes. A high resolution overhead photo is collected for each study plot. The photo should be taken as close to perpendicular to the soil surface as possible. This photo will contain geotags that identify the location. Later, the photo is then visually examined later on a computer screen and the points visible on the quadrat grid are used to collect cover data (point intercept method).
At the end of Summer, Residual Dry Matter (RDM) will be collected from within a 1 ft (30 cm) square subarea of the 3 ft (1 m) square study plots. The RDM will be collected into paper bags, dried, and then weighed.

Timing: Annual

Equipment and personnel: GPS, digital camera, steel stakes, 3 ft (1 m) square quadrats, 1 ft (30 cm) RDM squares, paper bags. BLM – One to two weeks per year.

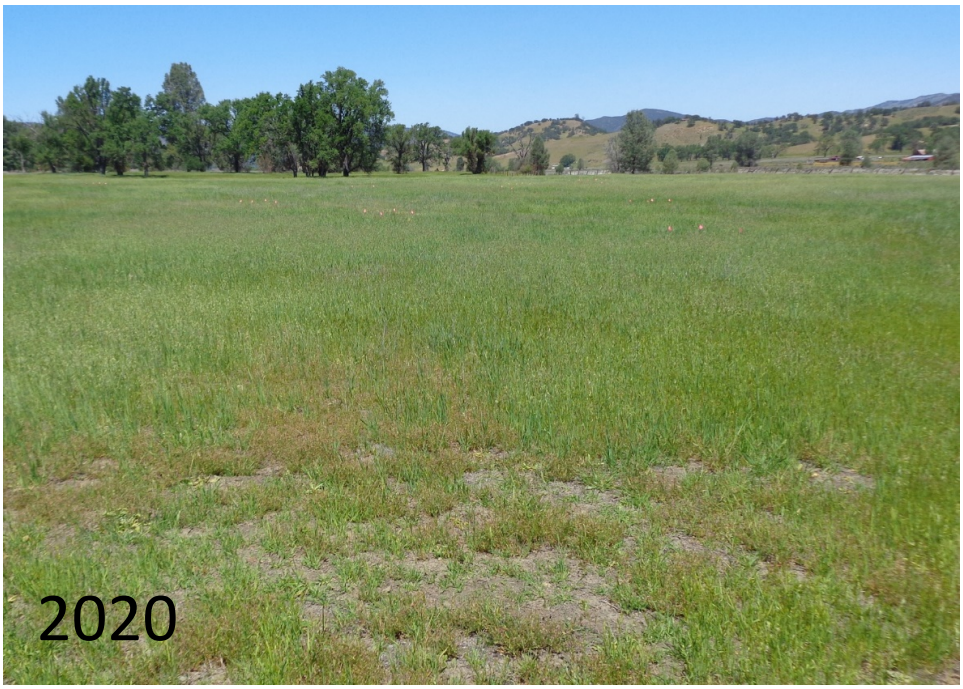

Figure 4. Example of landscape-level photomonitoring. A grassland in 2008 before control of yellow starthistle was initiated (top). The area had >80% cover of yellow starthistle (gray). The same grassland in 2020 after 12 years of control of yellow starthistle with a combination of prescribed fire in Summer and herbicide application the following Spring (bottom). Yellow starthistle has been virtually eradicated (<1% cover). The grassland is now dominated by annual grass species.

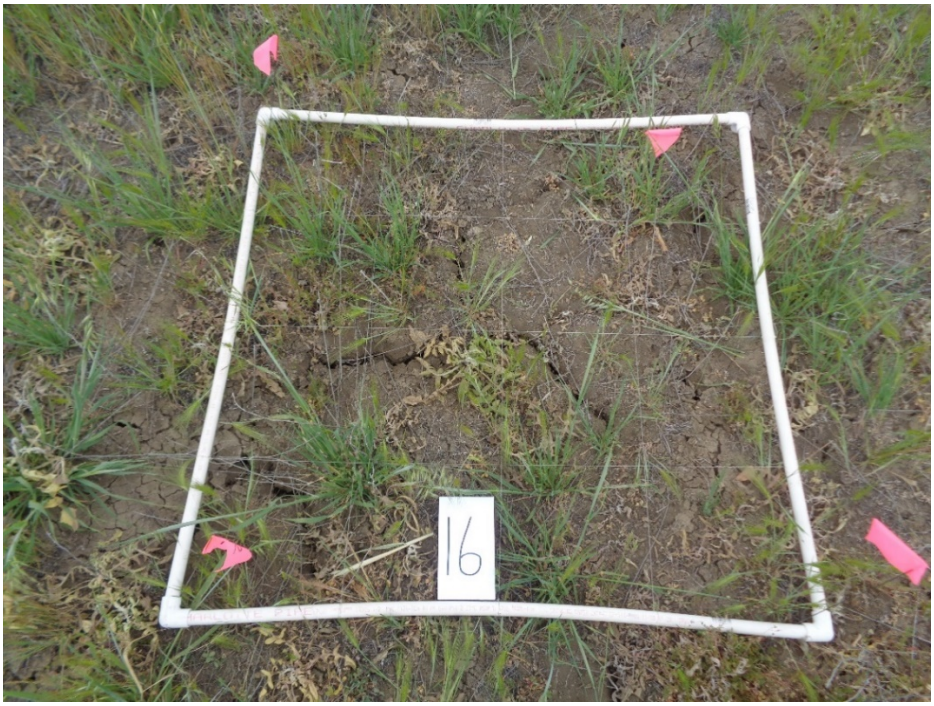

Figure 5. Examples of study plots - quadrat grid overhead photos. Monitoring quadrat in April before herbicide treatment (top) of yellow starthistle and four weeks after herbicide treatment in May (bottom). High resolution photos of quadrat grids on study plots are used to collect quantitative cover data by point intercept method. The photos also serve as a permanent record of the visual appearance of the study plot.

IV. Wildlife

Indicators Monitored: Native Wildlife Species Diversity and Abundance

Methods: Crowdsourcing and Citizen Science. Manual data collection. As public access increases to portions of project site, interpretive, outreach and educational materials including BLM websites brochures should encourage all members of the public to utilize the crowdsourcing and citizen science websites deemed informative by BLM Biologist, including eBird.org and iNaturalist.org. Additional crowdsourcing projects will develop over time which could also be informative for fields in addition to wildlife. Include interpretive information at trailheads with points of interest along trails for inclusion of such crowdsourcing information, such as specific sites which would be suitable for birdwatching and for whale watching lookouts. Develop additional crowdsourcing options with partners that will inform BLM.

Timing: Incidental, all year.

Equipment and personnel: Agency support to include relevant information into our interpretive materials and websites. Devices BLM employees should have while conducting onsite work: (camera, cell phone, and/or tablet).
Estimated Biologist time: 150 hours for checking for sightings of species of concern and interest noted on and adjacent to project site, review of eBird.org and iNaturalist.org websites, which would increase as additionally informative websites are utilized.

Funding for partner organizations to compile information needed if a report is desired, and this funding level would depend on the level of detail of the report.

Indicator Monitored: Non-Native Wildlife Species Distribution and Abundance

Background: The non-native aquatic predators present in Santa Cruz County are American bullfrog (*Lithobates catesbeianus*), Western mosquitofish (*Gambusia affinis*), white crappie (*Pomoxis annularis*), Red Swamp crayfish (*Procambarus clarkii*) and signal crayfish (*Pacifastacus leniusculus*) (USGS, 2019). None of these species except for *P. leniusculus* have been recorded within Cotoni-Coast Dairies, but the American bullfrog has been recorded at Rios Pond on Trust for Public Lands property immediately adjacent to C-CD. The next closest documented population of bullfrogs is at Antonelli Pond in Santa Cruz, approximately ten miles East of Cotoni-Coast Dairies. Guideline 4 for the development of watershed management plans in the Recovery Plan for the California Red-legged Frog states that lands will be managed to control or eliminate non-native predators of CRLF (pg. 65).

An invasive mollusk, the New Zealand mudsnail (*Potamopyrgus antipodarum*), was recorded in Liddell Creek in August 2018 (USGS). The New Zealand mudsnail is a species that can rapidly colonize an area, reaching very high densities (Alonso & Castro-Diaz, 2012). The effects of this species are variable depending on the other co-occurring species (Bennett, Dudley, Cooper, & Sweet, 2015). USGS states that there are no current realized impacts of the New Zealand mudsnail on CRLF, but it has the potential to negatively impact native invertebrate populations, reducing biodiversity and altering the C and N cycle of the invaded water body, which in turn could have indirect effects on CRLF (Kerans, Dybdahl, Gangloff, & Jannot, 2005; Alonso & Castro-Diaz, 2012). One key message to emphasize: no methods are known to be effective in removing the New Zealand mudsnail from an aquatic system once it has been introduced.

Methods: Seek to use a combination of onsite documentation and evaluation during other wildlife work, discussion with surrounding land managers, and encouragement of crowdsourcing documentation within the Santa Cruz County region. BLM biologists will stay apprised of closest known proximities of these aquatic invasive species, look for signs of aquatic invasives during all aquatic surveys, and discuss sightings with other relevant organizations, including United States Fish and Wildlife Service, and the National Marine Fisheries Service, and with surrounding land managers, and residents.

Incorporate educational information regarding known and potential aquatic non-native species into interpretive materials at trailheads, in brochures, BLM websites to include relevant links for all partners working onsite, and the public. Include information regarding why the public should never release pets such as red-eared slider turtles into the wild. Encourage partner and public to alert BLM immediately to all non-native wildlife noted onsite, including bullfrogs and pigs though contact information in interpretive materials, and encourage documentation in the region of such species in iNaturalist.org and other crowdsourcing websites.

Timing: Ongoing. Performed while conducting other onsite efforts, including development of recreational resources.

Equipment and personnel: BLM time while conducting other onsite efforts and coordination with surrounding land managers. Development of interpretive and online materials.

Indictors monitored: Terrestrial Invertebrate Diversity & Abundance.

Methods: Collect invertebrates onsite using malaise and/or pitfall traps. Manual data collection. Utilize storage methods customary for preserving such collections. Collect location information (GPS coordinates). Ship collections to entomology experts.

Timing: Spring likely. Need to collaborate with entomologists to determine study design and optimal timing.

Equipment and Personnel: * Conduct if all steps in this program are feasible. 1-2 biologists to set up and utilize malaise traps and other required collection and storage materials, shipping costs, and funding for external partners to review and document inventory of invertebrate species collected, summarize resulting data, and provide counsel regarding the significance of the species found onsite for resource management.

Indicators monitored: Monarch Butterfly Distribution and Abundance

Methods: Evaluating distribution of monarch populations utilizing BLM lands could be undertaken through discussion with partnering organizations conducting surveys. Manual data collection. BLM could utilize iNaturalist.org and possibly additional croudsourcing websites for employee and public notation of monarchs onsite, which would require educational efforts. Consider restoration actions such as reduction of invasive plants in specific areas that may benefit this species.

Timing: Primarily during monarch overwintering and migratory seasons. BLM employees could note casual onsite observations year-round.

Equipment and personnel: 1 Biologist, 80 hours onsite annually estimated, plus all BLM employee time required to collaborate with Groundswell, Xerces Society, and other partners that will be involved in working onsite towards conservation of this species.

Indicators Monitored: Reptile and Amphibian Diversity & Abundance

Methods: Drift fences. Manual data collection. Drift fences can be used to assess diversity and abundance in snake communities. For these lands, it might be useful to utilize these for reptiles in riparian areas in each of the major watersheds, near the active ponds, and at terrestrial sites in coastal scrub and the redwood-Douglas fir stands. Arrays of up to three fences in series can be longitudinally located along the major creeks at the riparian / grassland ecotone, as depicted in **Figure 3**.
Drift fences can be made from 4 ft wide strips of light plywood (1.4") in lengths of 8 ft. Fences are buried 2-4 inches in the soil and at either end a surface funnel trap can be located on each side of the fence. Funnel traps are kept closed until open sampling periods. Therefore, drift fences can be installed and utilized for several years.

Timing:
For reptiles: May through August
For terrestrial salamanders: December through March
Permanent annual activity

Equipment and personnel:
Plywood sheets, constructed traps, digging and construction tools
1-3 people, 500 hours / year. Set up fences in beginning of season, remove at end, check daily.

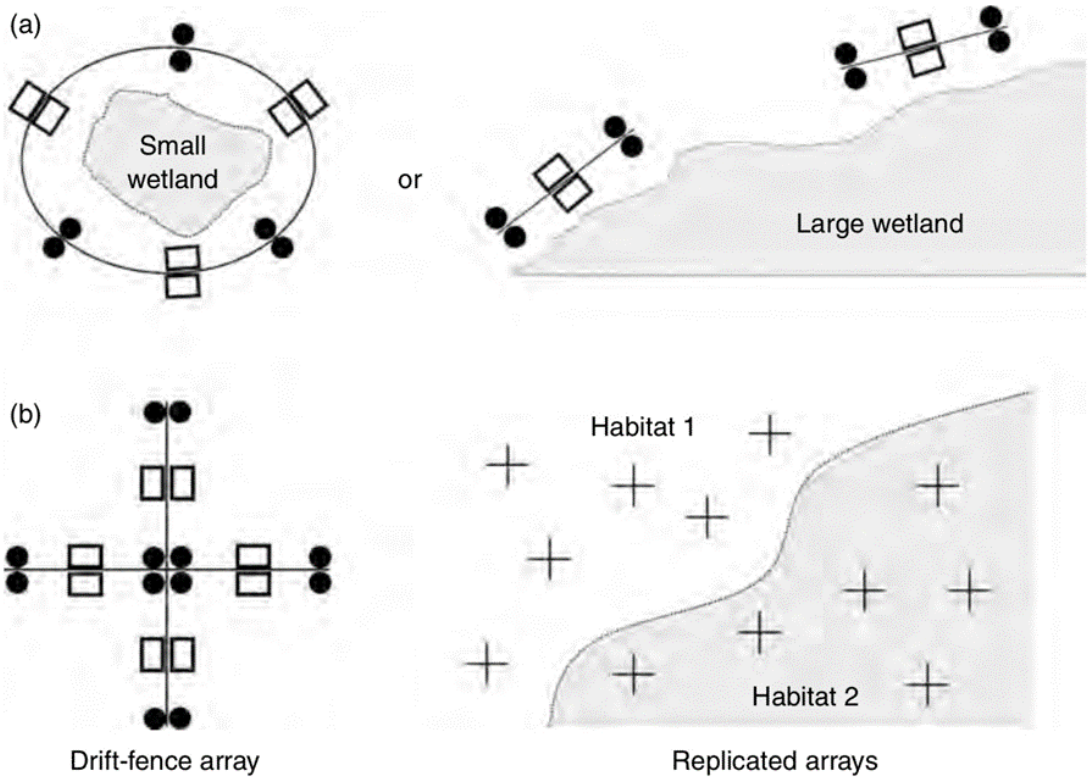

Figure 6. Drift Fence array would follow this conceptual model. Appropriate locations within 200 meters of riparian zones will be determined in the field.

Indicators monitored: Reptile and Amphibian Diversity and Abundance

Methods: Coverboards. Manual data collection. Coverboards can be used to assess abundance and diversity in herpetological communities. Arrays can vary in number and layout, but a minimum of 10 coverboards per array / site is recommended. Coverboards can be set out in tandem with drift fences. A linear series of 10 coverboards (4' x 2' 3/4" plywood) should be set out at the ecotone between riparian and grassland habitat along each of the 6 major streams and in a ring around the functioning ponds (including Liddell Creek mitigation ponds and Upper Molino Pond). Coverboards can remain on the land indefinitely without requiring action since they are passive traps that allow free movement of animals.

Timing: Coverboards will be left onsite all year round.

Equipment and personnel: Personnel needed to complete the task: 1-3 people, 200 hours / year. Supplemental funding for equipment likely not significant, as plywood sheets and other equipment costs would be minimal. Specific locations will be determined in the field.

Indicators monitored: Bird Diversity and Abundance

Methods: Bird mist netting/ bird banding. Manual data collection. For evaluating riparian bird diversity across the 6 major riparian corridors, each corridor could be established as mist netting and banding stations. A minimum of three 30' mist nets would be erected perpendicular to the corridor within 100m of each other. Nets can remain on the land in "closed" setting indefinitely, and opened prior to dawn on survey days. Mist netting requires at least one USFWS-permitted personnel. Banding is recommended as it allows for mark-recapture estimation of bird abundance.

Timing: (e.g. frequency, time of year, duration)

Breeding season (March-May)

Spring migration (Feb-April)

Fall migration (September - November)

Equipment and Personnel: * Conduct if feasible. Contract with external partner. Estimate: $50,000/year.

Indicators monitored: Bird Diversity and Abundance

Methods: Bird point surveys: Three point surveys could be established along each of the six major riparian corridors. Manual data collection. Points would be geolocated and standardized across survey days. Surveyors must be qualified to conduct surveys. For example, surveyors must be able to recognize all calls from a list of 'Expected" birds and must have uncompromised hearing. Point surveys would occur at least monthly and weekly during the 10 weeks of peak breeding season. Surveys would follow a standardized protocol establishing set distances (such as 100m) for detections. Visual surveys could be augmented by recordings of calls.

Timing:
Breeding season (March-May)
Spring migration (Feb-April)
Fall migration (September – November)

Equipment and Personnel:
* Conduct if feasible. Contract with external partner. Estimate: $20,000/year

Indicators monitored: Mammal Distribution and Abundance

Methods: Camera trap array. Manual data collection. An array of sufficient size and duration would be needed in order to be used for trend analysis. Stations developed would need to be very stable in many locations given the cattle onsite in grazing areas, which will rub against installations, and can knock over unstable stations such as T- posts, and trample trail cameras. Installing sturdy steel pipes into ground with holes for cameras would enable each station to remain stable even if cattle rub against these. Installing stable stations at standardized height also

increases the opportunity of later incorporating upcoming artificial intelligence (A.I.) species-recognition software into the analyses of hundreds of thousands of photos resulting from a camera trap array. Given all considerations discussed in this section, specific locations would be determined in the field based on a grid array design and adjusted as needed during program.

Timing: Camera stations could be established during non-rainy season and stations would remain onsite for duration of project (up to multiple years, with changes in equipment needed). Camera maintenance and replacement of cameras, batteries, and memory cards would be needed throughout the year.

Equipment and Personnel:
* Conduct project if all steps in this program are feasible.
It would be critical to secure funding for all the needed steps in the overall process for such a program to be worthwhile to initiate. These steps include: project design, installation, data collection, maintenance, data review and management, statistical analyses, review and evaluation by BLM and external biologists, and time to develop information to inform land management. If funding is only available for the initial purchase of cameras and onsite equipment, the program will not be able to progress to the next stages, given the costs of analyzing and interpreting the data.

Estimated minimum cost for a multi-year camera trap array program to be worthwhile based on estimates from camera trap arrays in San Vicente Redwoods and other areas: $40,000 per year minimum for external partnering organization(s) for 3 or more years. One estimate from SVR was approximately $30,000 per year for development of their implementation of a camera trap array onsite, but this did not include data processing, analyses, and evaluation costs.

Unless funding for development, management, and analyses for a camera trap array with a sufficient number of stations (likely at least 20) and duration is available, using a camera trap approach will likely not be worthwhile to further inform resource and land management regarding distribution and abundance of large to medium sized wildlife, or detect changes.

Costs includes program development, field work (installation and maintenance) in collaboration with BLM, development/utilization of a software platform for data storage and analyses, review of photos (up to hundreds of thousands), associated data entry, statistical analyses by specialists, and evaluation by wildlife ecologists in interpreting results of analyses to inform land and resource management.
BLM labor would need to cover all coordination with partners during the process - estimated to be 500 hours annually.

Indicators monitored: Badger Distribution and Abundance

Methods: Given this is a mesocarnivore that is rarely observed during visual surveys, and very rarely documented using trail cameras, develop a trial project using scent dogs to survey for

badger presence and/or scat. Manual data collection. Any badger scats encountered could be collected for genetic analyses, with the goal of working towards evaluating population size and structure, and potential hazards to this species in this area (such as toxicology, influence of human presence on distribution).

Equipment and Personnel: * Conduct if all steps in this program are feasible. Contract needed for scent dog external partner such as Working Dogs for Conservation, $30,000. Costs for genetic analyses to external organization TBD. 1-2 biologists' time onsite during scent dog field work.

Indicators monitored: Puma Distribution and Abundance

Methods: UCSC puma team utilizes established methods while performing multiple studies onsite (involving puma radio-collars, trapping), studies involving deer, in conformance with other agency regulations. Manual data collection.

Timing: Throughout the year.

Requirements: BLM continues ongoing coordination with puma team regarding onsite research under the BLM/UC MOU. If a site-specific research report on pumas is required of BLM, additional funding for a contract for data analyses and evaluation may be needed. In general, for any wildlife ecology research requested of this lab in addition to their preparation of their publications listed on the "UCSC puma lab" website, additional funding would likely be needed.

V. Special Status Species

Federally Listed Species:
California Red-legged frog (*Rana draytonii*). Threatened.
Steelhead trout (*Oncorhynchus mykiss*); South - Central Coast DPS. Threatened.
Coho salmon (*Oncorhynchus kisutch*); Central Coast DPS. Endangered.

California Red-legged Frog Monitoring Protocol

Due to the importance of Cotoni-Coast Dairies for the recovery of the California Red-legged Frog, the BLM has developed a monitoring protocol tailored to this species.

The management and monitoring of Red-legged Frog habitats will be in alignment with the "Maximizing Compatibility" guidelines laid out by Partners in Amphibian and Reptile Conservation in "Habitat Management Guidelines for Amphibians and Reptiles of the Northwestern United States and Western Canada".

Red-legged Frog surveys can include any or all of the following methodologies:
Night driving surveys
Stream surveys = mapping out microhabitat (i.e. plunge pools) and counting frogs encountered
Pond surveys during breeding season = dipping for tadpoles/adults and night surveys for adults

Night driving surveys

Methods: Survey. Manual data collection. Highway One borders the west side of C-CD and provides a convenient transect for recording the presence of CRLF as they move around on the landscape on rainy nights. Surveys will be conducted on rainy nights by one to 3 people along a prescribed route starting at Swift Street at the north end of Mission Street in Santa Cruz, to the intersection of Hwy One and Hwy 92 in the town of Half Moon Bay. The route includes lands beyond C-CD's boundaries to provide a necessary comparison of observed patterns and abundances at C-CD vs the coastal habitat overall. Roadkilled CRLF will be collected and transferred to USGS. All frogs will be geolocated and an annual map of the pattern of CRLF presence will be created. Unusual changes in distribution will be noted.

Timing: Rainy season (October-March)

Equipment and personnel: Vehicle, 1-2 people, 10 nights at 10 hrs / night

Stream Surveys

Methods: Survey. Manual data collection. Habitat monitoring of the six main creeks on Cotoni-Coast Dairies. STIC meters will be installed to monitor water flow, temperature, and detect contaminants. Secchi disks will be used to assess water turbidity. Each creek will also be surveyed for pools. Creek pools are a microhabitat of known ecological significance to CRLF (Fellers & Kleeman, 2007) and an effort will be made to record the locations of pools vis GPS along each creek and the size (surface area and depth) of each pool. This data will then be input into ArcGIS to create a detailed and up-to-date map of each creek. Creeks in close proximity to recreation areas will be monitored more frequently to document and assess any adverse impacts and determine if more extensive buffer zones are necessary to mitigate those impacts in compliance with Guideline 7 of the Recovery Plan (USFWS, 2002).

To determine CRLF presence or absence in creeks, walking surveys will be performed during the timeframe discussed below alongside each creek and the number and location of any observed adult frogs will be recorded. During the active breeding season, November to March, surveys will include a count and location of any egg masses encountered. More extensive model-based occupancy surveys will be conducted by two observers alongside each creek on a basis

determined by preliminary surveys. This data will be used to gauge the annual relative abundance of CRLF in all of the creeks within Cotoni-Coast Dairies.

Timing:
Annually if possible; At least every five years.
Breeding season (March-May)
Summer CRLF stream occupancy (August)

Equipment and personnel:
1-2 people, 3 surveys x 8 creeks

Pond surveys

A staff gauge will be installed in each pond evaluated so that water level can be measured at least once in spring and once in late summer/early fall and quarterly if possible. Photomonitoring will also be used to track water level, vegetation, and any disturbance (i.e. trampling). Photomonitoring is further discussed in Landscape-level Photomonitoring Section.

Methods: A staff gauge will be installed in each pond evaluated so that water level can be measured quarterly. Manual data collection. Photomonitoring will also be used to track water level, vegetation, and any disturbance (i.e. trampling). Photomonitoring is further discussed in Landscape-level Photomonitoring, below.

To determine frog presence or absence in the natural and artificial ponds on C-CD, nocturnal visual surveys for amphibian eye shine will be performed (Fellers & Kleeman, 2006). During the breeding season, an auditory survey for frog calls will be conducted in addition to this visual surveying. If either eye shine or frog calls are detected at a pond, a dip net survey will be performed to more conclusively identify the species present in that pond.

Unmanned Aerial System monitoring could be incorporated to establish a determined aerial survey transect for monitoring specific ponds, to provide detailed measurements including the surface area of each pond under evaluation.

Timing: During the breeding season, monthly visual surveys for egg masses will be conducted at each pond starting in November until March. In known breeding ponds, monthly dip netting or seine netting will take place from March to August to count larvae. From August to October, dip netting and seine netting will be done to count transformed neonates. Observers will also record whether any potential invasive species are encountered during these surveys.

Habitat that appears to be suitable habitat for CRLF based on physical characteristics (i.e. hydroperiod, pools, etc.) but are devoid of breeding adults will be examined more closely for potential poor water quality or the presence of Taricha newts, which have been observed predating on CRLF eggs in a pond on Cotoni-Coast Dairies (unpublished data). All suitable

habitat will be monitored long-term in alignment with the USFWS Recovery Plan's goal of identifying any recolonization (USFWS, 2002).

Data Analysis: All data will be curated by BLM resource specialists and saved using an online data depository. An annual report will be produced describing the pattern of presence and abundance of CRLF across C-CD. For each breeding site the report will state at what stage breeding progressed to: Courtship (=calling) -> Eggs -> Larvae -> Transformed juveniles. Any indications of major downward shifts in total population abundance or similar metric will be reported to BLM management.

Steelhead trout and Coho Salmon Monitoring

Indicators monitored: Salmonid Species Distribution and Abundance

Methods: Continue supporting fish surveys of steelhead and/or coho salmon by National Marine Fisheries Service, the City of Santa Cruz and other agencies as appropriate. Manual data collection. These agencies have undertaken work in Laguna, Liddell, San Vicente, and Molino creeks as one component of their overall regional salmonid work, using their established methods and protocols.

Timing: Enable this work at any time throughout the year that the representatives of these agencies are interested in collecting onsite data as part of their regional salmonid recovery efforts.

Equipment and Personnel: BLM's continued support of these regional efforts, including all BLM representatives' time in enabling access to streams onsite. Funding/contract to external agencies if work in addition to the workload undertaken by these agencies is needed, such as within the streams not currently surveyed.

VI. Recreation

Indicators monitored: Parking

Methods: Monitoring of parking issues at BLM-managed parking sites

Timing: Incidental/monthly monitoring, quarterly reporting

Equipment and Personnel: BLM Park Ranger observations

Indicators monitored: Trail Condition

Methods: Monthly monitoring of trails for ruts, holes, braking bumps, and other damage to the trail tread. Identification of any erosional features leading from trail tread to an adjacent drainage

Timing: Incidental/monthly monitoring, quarterly reporting

Equipment and Personnel: BLM Park Ranger observations in partnership with Santa Cruz Mountains Trail Stewardship

Indicators monitored: Social Trails

Methods: Monthly monitoring for social/unauthorized trails

Timing: Incidental/monthly monitoring, quarterly reporting

Equipment and Personnel: BLM Park Ranger observations in partnership with Santa Cruz Mountains Trail Stewardship

Indicators monitored: Sensitive Habitat Areas

Methods: Monthly monitoring of sensitive habitat areas for evidence of unauthorized entry. Use of trail cameras

Timing: Monthly data collection, quarterly reporting

Equipment and Personnel: BLM Park Ranger

VII. Emerging Technologies

Unmanned Aerial Systems (UAS)

Multiple indicators possible to monitor: Wildlife, botanical, aquatic, recreational, and infrastructure resources.

Background: UAS is quickly becoming a valuable component of monitoring biological resources, and possibilities to improve biological monitoring will grow going forward.

Methods: BLM works towards employing UAS technologies as one more tool in the monitoring toolbox, which will aid in evaluating project sites routinely and collecting information and data to monitor for changes for multiple resources onsite (botanical and wildlife), including changes in ecosystem conditions and habitats. This technology may also be utilized to monitor geological changes such as shifts in hydrology (water flows and the water cycle).

UAS will enhance remote sensing capabilities for local biological resources since aerial in-situ measurement of onsite conditions will complement surface measurements and photomonitoring imagery, as well as less refined geospatial imagery available from other sources.

- In the short term, initiate aerial photodocumentation of red-legged frog pond restoration project(s) quarterly to evaluate water volume during different seasons.

- Establish baseline imagery and data for areas of interest for long-term ecological research (LTER) and monitoring.

- The following two powerpoint presentations provide examples of potential applications of UAS, several of which would advance onsite monitoring:

https://rmgsc.cr.usgs.gov/outgoing/UAS/presentations/sloan/latest_uas_nupo/

https://www.usgs.gov/mission-areas/land-resources/science/nupo-data-research?qt-science_center_objects=0#qt-science_center_objects

- Current autopilot software allows for customizable, repeatable flight paths, which aid in monitoring specific areas and transects over time. Flight patterns can be optimized for data collection. All imagery would be geotagged to provide orientation/location.

- UAS will enable less accessible areas to be surveyed more easily and frequently, such as areas with steep topography and thick brush, and during seasons when administrative roads are muddy.

UAS would enable working towards increasing monitoring effectiveness, and providing improved data and potential for BLM to increase responsiveness for adaptive natural resource management.

- Over time, BLM will develop collaborative opportunities with remote sensing professionals in the Federal government, external partners, and potentially volunteers, which will lead to increased adoption of UAS monitoring technologies as these advance, and will facilitate utilizing UAS as a manageable tool for BLM.

- Develop partnerships with other the Federal government such as USGS, potentially USFS, as well as with surrounding land management entities (San Vicente Redwoods, State Parks).
- BLM would work with other organizations for assistance with UAS data management, data assimilation, modeling, and synthesis. Over time, increased automation and "artificial intelligence (A.I.)" will aid in data collection, processing, and dissemination.

UAS and Wildlife Monitoring:

- UAS is becoming incorporated into wildlife surveys and monitoring. For example:
    - Thermal imagery collected with UAS is advancing as a means to monitor bird and mammal populations.
    - UAS augments tracking of tagged wildlife, such as pumas and deer.
    - UAS is well suited to nighttime work for monitoring wildlife primarily active at night, such as badgers.
    - Examples of UAS enhanced wildlife surveys: California Least Terns (USFWS), Salmon redds and algae levels (Snake River), seabird and shorebird surveys (Audubon Society Sea Ranch area of California Coastal National Monument).

UAS and Vegetation Monitoring:

- Evaluate invasive species such as French broom, and relative cover of native and non-native species, which would aid in evaluating BLM's invasive treatment effectiveness following treatments such as mowing, treating with herbicide, and/or fire.

- Incorporate UAS into local remote sensing of vegetation (near infrared), which would enable vegetation change analyses over time.

- Evaluate and monitor areas with relatively higher native grass species cover in grasslands. Vegetation cover data can be quantified from UAS imagery to study changes over time, and pre-and post restoration efforts, which is likely important for restoration to have a reasonable chance of success in these highly invaded areas.

- Other potential uses for vegetation monitoring include: riparian habitat surveys, grass height measurement, wetland mapping, forest restoration treatment monitoring, post-fire assessments, forest health assessments (such as tree mortality and water stress), oak species can potentially can be evaluated for sudden oak death, and other species can be evaluated to check if closer investigation for diseases are warranted.

- High resolution LiDAR imagery can be utilized to develop 3D models of the tree canopy, and monitor changes in forest health over time (such as areas of mortality, water availability).

Other potential uses for UAS for management of Cotoni-Coast Dairies (not biological monitoring):

- Search & rescue, routine feature/facility/site inspections, parking lot and trail management, trail management, and flood plain mapping.

- Timing: Initiate related work as soon as feasible, determine timing based on resource monitored.

Requirements: UAS equipment, collaboration with partners.

Stream Gauge Station

Indicator Monitored: Stream flow, and other related measures added with additional sensors to evaluate current conditions of water quality given the land management practices of BLM and upland entities. Potentially measurements of salmonids and other species in aquatic ecosystem.

Methods: BLM can work towards enabling testing of emerging technologies and innovative approaches to enable better biomonitoring, such as incorporating stream gauge stations. One example: USGS Next Generation Water Observing System (NGWOS) - provides real-time data on water quantity and quality in more affordable and rapid ways than previously possible. See reference: https://www.usgs.gov/science/usgs-next-generation-water-observing-system-ngwos?qt-science_center_objects=0#qt-science_center_objects

Timing: Onsite biomonitoring would collect data year-round on ongoing basis.

Equipment and Personnel: * Conduct if all steps in this program are feasible.

All associated equipment. External contract recommended for all stages of the overall process (installation and maintenance of water observing station), possibly by USGS. Determination of

location (first thought, San Vicente creek), though another stream location onsite may also be worthwhile. Initiate if it appears funding could be available for several years (3+) for all steps of program. BLM hydrology/geology resource specialists at State and Field Office level recommended to provide review of program.

VIII. Research and Education

Support Research and Education:

- Continue development of a research consortium of organizations and researchers over time to address the common goal of maximizing our understanding of biological resources on these public lands by enabling each Principal Investigator involved to utilize their research experience in their specific field. This will enable research beyond the ability of any individual organization or researcher, help develop an interdisciplinary approach, and lead to collaborative opportunities for evaluating research with a synthetic perspective that will contribute towards better understanding and adaptive management of these lands.

- BLM will enable research utilizing these lands to advance applied and basic science by the broader scientific community (natural, social, and engineering) which will help improve monitoring efforts.

- Facilitate onsite research - minimize administrative burden or costs for research utilizing public lands. Collaborate with interested researchers to enable and encourage onsite research.

  To include (though not limited to):

  - Develop upon BLM/University of California Memorandum of Understanding (MOU), including developing further collaboration as trails open to advance opportunities for faculty and student research and education.

  - Continuing to enable UC research underway (pumas, peregrine falcons, bats) onsite to advance this research and help inform BLM.

  - Continuing enabling collection of rangeland study plots by UC Agriculture and Natural Resources.

- Enable place-based educational opportunities in relevant fields as this becomes more manageable with increasing public access.

- Development of BLM's biological resource management and monitoring capacity and skills:

Requirements: Includes management support of BLM representatives' participation in relevant external trainings and workshops. This includes opportunities to participate in relevant Federal workshops, external conferences and trainings, and participation in university classes, and opportunities to work and spend time in the field with other specialists from other organizations.

This enables resource specialists to stay updated on current research and technology and in touch with other specialists, which is essential while developing and implementing programs and partnerships that enable the BLM to manage biological resources by leveraging current workloads, funding, and resources in more effective ways.

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