



California Department of Fish and Wildlife Wildfire Resiliency Initiative

2024 Monitoring Methodology Report

Background/Purpose of this Report

Since 2021, the California Department of Fish and Wildlife (CDFW) has dramatically increased the pace and scale of activities related to wildfire risk reduction as a result of one-time funding provided to address the increase in catastrophic wildfires across the state. Public Resources Code § 4137 (PCR § 4137) was updated in 2022 to expand obligations of state agency reporting on the outcomes (related to vegetation removal and other activities conducted to reduce risk. The updated code section requires CDFW to post information pertaining to the wildfire resiliency work that it conducts annually on its lands on its website. One of the provisions requires CDFW to develop a monitoring plan to evaluate the ecological impacts and fire behavior changes of vegetation management undertaken to decrease catastrophic wildfire risk. Monitoring alone is insufficient to reduce risk and must be coupled with a strategic framework and process that allows for modifications to activities to optimally leverage resources.

The CDFW Wildfire Resiliency Initiative is administered by the Wildlife Branch Lands Program in headquarters and is guided by the "MARC" (Maintenance, Adaptive Management, Restoration, Capacity) implementation framework. This monitoring report focuses on the 'Adaptive Management' component of the framework; more information about CDFW actions to reduce wildfire risk can be found on the Department's [Wildfire Resiliency Initiative webpage](#).

Adaptive management¹ is an iterative structured decision-making process that helps guide land management activities through time (Figure 1). It emphasizes the use of the best available science and on-the-ground knowledge to help make decisions under uncertain conditions. Adaptive management is particularly useful when uncertainty

¹ State of California, *Fish and Game Code* Section 13.5 "Adaptive management, unless otherwise specified in this code, means management that improves the management of biological resources over time by using new information gathered through monitoring, evaluation, and other credible sources as they become available, and adjusts management strategies and practices to assist in meeting conservation and management goals. Under adaptive management, program actions are viewed as tools for learning to inform future actions" (Added by Stats. 2012, Ch. 559, Sec. 3. (AB 2402) Effective January 1, 2013.)



(i.e., of the extent and benefits of treatments) is high, and management actions are well controlled.

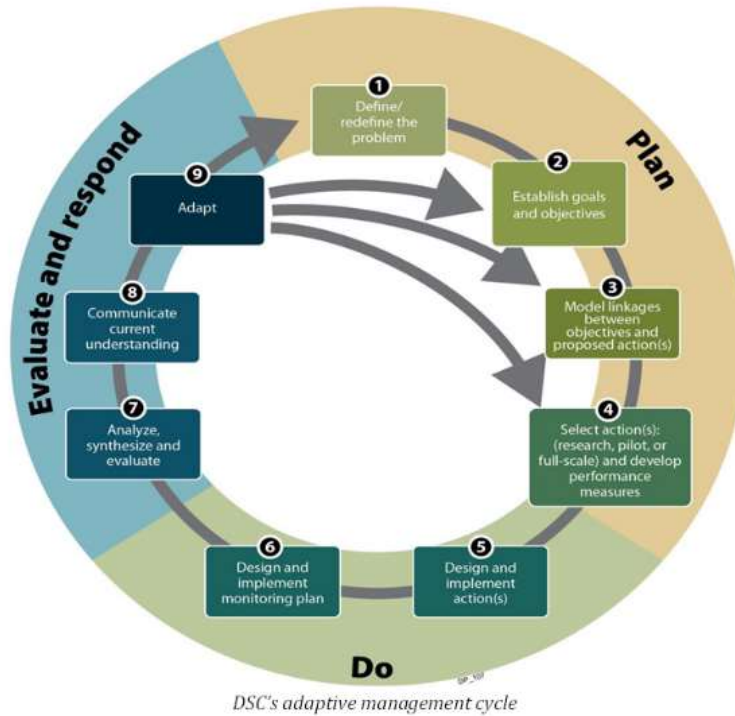


Figure 1: Adaptive Management Cycle²

The Department attempts to use the best available monitoring methods for data ² collection, recognizing that staff resources and budget constraints preclude the use of intensive methods across all treatments. In most cases, monitoring to meet the requirements of PRC §4137 will also meet the monitoring needs for informed adaptive management on treated CDFW lands. In certain cases, such as when new methods or a combination of methods is used, specific wildfire resiliency treatments may have greater monitoring needs to determine if changes to management are needed. Regional staff will make the decision if additional monitoring is needed, factoring in staff capacity and other regional priorities.

This document lays out the framework that will guide monitoring of wildfire resiliency treatments on CDFW lands, as well as a summary of regional monitoring workplans for calendar year 2024. A subset of monitoring results from each Region will be posted as a

² Delta Science Program. (2019). *Delta Conservation Adaptive Management Action Strategy*. <https://deltacouncil.ca.gov/pdf/science-program/2019-09-06-iamit-strategy-april-2019.pdf>



Wildfire Resiliency Initiative
2024 Monitoring Methodology

standalone document once data is finalized for the year. For specific questions about these results please email james.mcbride@wildlife.ca.gov.



Photo 1: Prescribed burn on Ash Creek Wildlife Area.



CDFW Wildfire Resiliency Monitoring Framework

The Wildfire Resiliency Initiative has expanded the scope and intensity of fuel load reduction treatments on CDFW lands, and monitoring is needed to assess the effectiveness of wildfire resiliency treatments in reducing risk of ignition and impacts to biodiversity from catastrophic wildfire. It is important for the Department to track changes to the landscape through time to inform decisions on adapting future treatment design and maintenance. Adaptive management is one of the four pillars of the M.A.R.C framework, which guides the work of the Wildfire Resiliency Initiative. This monitoring framework provides guidance to CDFW regional staff, ensuring that wildfire resiliency treatments are effective through time.

Monitoring Goals

Monitoring of wildfire resiliency projects fulfills two goals: 1) meeting the requirements of PRC § 4137, and 2) providing information to support adaptive management by adjusting specific treatments, as needed.

Monitoring for Fire Behavior Changes and Ecological Effects

PRC §4137 requires CDFW to monitor and analyze wildfire resiliency projects for any positive or negative ecological impacts, and any fire behavior changes due to vegetation management. The Department has developed a tiered monitoring system that will meet these requirements. The following sections provide an overview of monitoring scales and indicators relevant to CDFW monitoring efforts.

Monitoring Scale

Data collection to support the management of wildfire resiliency treatments can be performed at multiple geographic and temporal scales. The appropriate scale should be determined by treatment needs, monitoring metrics and methods chosen, and local expertise. Where appropriate, monitoring may be performed outside of the project footprint. It's important to note that CDW lands are not temporally static and shifts in vegetation characteristics and geomorphology can be common in certain landscapes. The temporal scale for monitoring should reflect this temporal variability.

Wildlife Presence and Biodiversity Changes

Wildlife species can be a useful indicator for monitoring ecological impacts of wildfire resiliency treatments. The specific species selected should be consistent with the scale of the treatment, and local habitat values both within and adjacent to the project site. Monitoring can be used to evaluate the presence/absence of species, or changes in use of habitat post-treatment. This metric should also include any wildlife species that are detected on the treatment site after implementation that may not have been present before the treatment started.



Wildfire Resiliency Initiative 2024 Monitoring Methodology

Special-Status Species

If special-status species are known to occur in the area where the wildfire treatment is located, Regional staff should coordinate monitoring with the [Wildlife Diversity Program](#) in Wildlife Branch to develop appropriate monitoring protocols.

Vegetation, Habitat, and Rare Plants

Monitoring changes in vegetation, including metrics such as plant cover and species diversity, is critical for understanding not only the effectiveness of the wildfire resiliency treatments, but also the ecological impacts to other species on the sites. Specific indicators selected for monitoring should be consistent with the location and scale of the project. [The Vegetation Classification and Mapping Program](#) (VegCAMP) is a useful resource for the most up-to-date vegetation maps and field assessment methods.

Invasive Species

Many non-native plant species increase the fuel load and fire risk of an area, and the removal and management of invasive species is a major focus of the CDFW Wildfire Resiliency Initiative. Monitoring efforts for this metric should focus on early detection of non-native species on recently treated fuel reduction project sites. The Department has an Integrated Pest Management Program that can provide field monitoring resources and treatment options for specific invasive species.

Soils

There are some treatments, such as creating fuel breaks in steep terrain, that may cause increased erosion of soil within the treatment footprint. While erosion is a natural process, excessive erosion may cause negative impacts and so should be monitored to ensure it is minimized.

Wildlife Mortality

Any deceased wildlife should be identified by species, and if possible, a cause of mortality should be noted. If a pattern of mortality is noted that could have a connection to wildfire treatments, then treatment activities may need to be modified or halted.

Wildfire Risk Reduction Metrics

The following metrics are commonly used to assess the reduction in wildfire risk by CalFire and others. These are key indicators and should be part of all regional monitoring of wildfire treatments.

Fuel Loads

Monitoring fuel loads will ensure that wildfire resiliency treatments provide effective wildfire risk reduction on CDFW lands. Indicators for fuel load monitoring should be selected based on the specific treatment used. [Cal Fire](#) has resources on field



Wildfire Resiliency Initiative
2024 Monitoring Methodology

monitoring methods for fuels and can be a resource for evaluating vegetation within a defensible space matrix.

Ignition Sources

Department staff work with their local fire department, of Cal Fire unit to identify and track ignition locations and sources of wildland fire that impact Department Lands. Department staff may also identify if there is a pattern of ignitions within a specific vegetation type, or physical feature that may warrant a change in treatment activity. Future projects and treatments can be directed at areas that have been identified as having increased risk of unintended wildfire ignitions

Post-fire Assessment of Intensity and Severity

This metric is specific to wildland fire, prescribed burns, and cultural burns. Post-burn monitoring should be performed to assess the intensity of fire and effects on vegetation, wildlife and soil health.

Wildfire Resiliency Monitoring Palette

The following table represents a 'monitoring palette' that was developed to provide a flexible approach to monitoring wildfire resiliency treatments across diverse CDFW lands. The methods were chosen to provide a range of intensity in effort level and skillsets needed to effectively use the method. Both qualitative and quantitative methods are represented within the palette.

There are many monitoring efforts underway on Department lands to meet the goals of various CDFW Programs and projects. Regional wildfire staff are encouraged to request data or results from those project leads to prevent duplication in effort and increase efficiency by leveraging staff time and resources.

Monitoring Methods			
Monitoring Metrics	Monitoring Method	Source	
Biodiversity and Wildlife Presence	Avian	Point Count	Coonan et al. 2000
		Acoustic Monitoring	Darras et al. 2018
		Nesting Surveys	R5 methods
	Butterfly	Transect Identification	Kadlec et al. 2010, Morantz et al. 2012
	Reptile and Amphibians	Time-Constrained searches	Graeter et al. 2013
		Artificial Cover Objects	Lemm, Tober 2021
		Surveys of coarse woody debris	Graeter et al. 2013
Pitfall trapping		Graeter et al. 2013	



Wildfire Resiliency Initiative
2024 Monitoring Methodology

		Trail Camera drift net surveys	Terrestrial Field Methodology Protocols: CDFW Cannabis and Wildlife Diversity Program
	Mammals	Trail Camera	Terrestrial Field Methodology Protocols: CDFW Cannabis and Wildlife Diversity Program
Wildlife Mortality		Mapping using GIS	Big Game mortality form/ rate of mortality (mortality per visit, etc....)
Special-Status Wildlife Species	Numerous	Numerous	
Vegetation and Habitat, Rare Plants and Soils	Vegetation and Habitats	Vegetation Cover by Plot	BLM: AIM Monitoring Methods for Grassland, Shrubland, and Savanna Ecosystems
		Drone Imagery	Hamylton et al. 2020
		Timelapse photogrammetry (Phenology)	Seyednasrollah et al. 2019, Motohka et al. 2010, Chianucci et al. 2021
		Point-Intercept Transects	BLM: AIM Monitoring Methods for Grassland, Shrubland, and Savanna Ecosystems
		Combined Vegetation Rapid Assessment and Relevé	CDFW-CNPS Rapid Assessment and Relevé Field Protocol
		Belt Transects for Measuring Fire Severity, Species Richness, and Vegetative cover	USDI National Park Service. 2003
	Rare Plants and Communities	Ground or Field-Based Comprehensive Surveys	MSCP Biological Monitoring Plan, CDFW Protocols for Special Status Native Plant Population and Communities
		Drone Imagery	Hamylton et al. 2020
		Direct Count (small area of occupancy)	MSCP Biological Monitoring Plan, CDFW Protocols for Special Status Native Plant Population and Communities
		Multispectral Remote Sensing (large area of occupancy)	MSCP Biological Monitoring Plan, CDFW Protocols for Special Status Native Plant Population and Communities



Wildfire Resiliency Initiative
2024 Monitoring Methodology

		Biennial Monitoring for certain perennial species	MSCP Biological Monitoring Plan, CDFW Protocols for Special Status Native Plant Population and Communities
Soils	Erosion	Visual inspection of erosion	
		Photo point series	
		Silt fence catchments	Kastridis, Margiorou, Sapountzis. 2022
Fuel Loads		Timelapse photogrammetry / Photo points	Inoue et al 2015
		LiDAR- or other 3D imaging methods	Skowronski et al. 2007, Stefanidou et al. 2020
	Forest Stand fuel loads	Forest Health Protocols for field-based monitoring	Cal Fire Forest Health Protocols for field based monitoring
	Surface Fuel	Numerous	Cal Fire Forest Health Protocols for field based monitoring, Keen, Dickinson 2007
Disease and Invasive Species	Forest Disease	Tree Mortality Census	Andrus et al. 2021
		Aerial Surveys	Hicke et al. 2020
	Invasive Species	Visual Inspection	
		Point-Intercept Transects	BLM: AIM Monitoring Methods for Grassland, Shrubland, and Savanna Ecosystems
Intensity and Severity of Fire	Flame Length	Cameras	Martinez-de Dios et al. 2011
Ignition Sources		Historical Patterns	Keeley and Syphard. 2018
		Recent Ignition Data (human caused)	Cal fire Past Wildfire Activity Statistics (Redbooks)
Grazing	Numerous	Numerous (internal guidance currently under development)	



Regional Monitoring Summaries

The following are summaries of regional monitoring workplans. Calendar year 2024 was the first full year of using this unified monitoring approach; adjustments to monitoring design and data collection may occur in subsequent years to better align monitoring to land management decision-making. Monitoring results will be processed and analyzed in the first quarter of calendar year 2025.

Region 1: Northern Region

CDFW properties in the Northern Region include Wildlife Areas (as designated in Title 14, California Code of Regulations) which provide hunting and other recreational opportunities, and provide important habitat for deer, waterfowl and other species. Vegetation to be treated varies widely, and includes habitat types such as redwood and other coniferous forests, oak woodlands, grasslands, and sagebrush scrub. Fuels reduction for public safety and habitat improvement are big components of CDFW's wildfire resiliency projects.

In the Wildland Urban Interface (WUI), we also have numerous public access facilities and properties that are prioritized for fire resiliency efforts to protect our resources, our visitors, and our neighbors. The Northern Region is home to the Tehama Wildlife Area, the largest state wildlife area in California, approximately 44,500 acres in size. Tehama Wildlife Area provides migratory and winter habitat for the East Tehama Deer Herd, and is a popular destination for hunting, fishing, camping, and wildlife viewing. In 2024, the [Park Fire](#) burned the majority of the wildlife area, but fuel load reduction treatments that have been applied, including grazing, decreased the fire in intensity. As a result, vegetation started to recover almost immediately after the fire passed through. There are multiple passive monitoring methods being employed to track the natural restoration progress.

Several Wildlife Areas and Ecological Reserves (ER) are managed for the protection of special status species, particularly ERs. Species protected include but are not limited to anadromous fish, Modoc sucker, and marbled murrelet.

Table 2. Region 1 Monitoring for Wildfire Resiliency - CY 2024

	Photoload monitoring	Photopoint/Timelapse monitoring	Releve vegetation monitoring	Trail cameras
Dutch Flat Wildlife Area	X	X		
Surprise Valley Wildlife Area			X	
Tauhindauli Public Access		X		



Tehama Wildlife Area		X		X
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Photo 2: Park Fire, Tehama Wildlife Area.



Photo 3: Post Fire Monitoring, Tehama Wildlife Area.



Region 2: North Central Region

The North Central Region (NCR) is committed to improving wildfire resiliency across CDFW lands by addressing several high-fire risk properties and monitoring the effects of these efforts. There are active grazing leases on 16 units across 7 Wildlife Areas and Ecological Reserves in the NCR which are managed to decrease fuels and target invasive species in the grasslands. Regional staff are developing a program to further control invasive species such as Himalayan blackberry and removing ladder fuels from within riparian oak forests. Further fuel reduction, including fire breaks and mastication as well as addressing hazardous trees and soil erosion from previous wildfires, are being undertaken at multiple properties. A project focusing on improving montane wet meadow health began in 2024 at Butte Creek House ER and NCR hopes to replicate this type of project at other montane meadows on Department lands in the future. Lastly, the Region is prioritizing efforts along wildland-urban interfaces by addressing illegal use of lands that could result in the ignition of human caused wildfires and working with external agencies to ensure expanded CEQA coverage for further resiliency work in WUIs.

The effects of this work are monitored with several methods. Photo point surveys are used to observe changes in available fuel levels, vegetation changes, and soil erosion. Residual dry matter measurements are taken to further understand fuel loads following cattle grazing. Nesting bird surveys are conducted prior to implementing treatments involving chainsaws, chipping, or heavy machinery to minimize impacts to birds and other wildlife. There are also several trail camera arrays that collect data on local wildlife and recreational use by the public.

Table 3. Region 2 Monitoring for Wildfire Resiliency - CY 2024

	Invasive Species Surveys	Nesting Bird Survey	Photopoint/ Timelapse monitoring	Rare Plant Survey	Residual Dry Matter	Special Status Species Survey	Trail Camera
Antelope Valley Wildlife Area	X	X	X				X
Butte Creek House Ecological Reserve							X
Cosumnes River Ecological Reserve	X	X	X	X	X	X	X



Wildfire Resiliency Initiative
2024 Monitoring Methodology

Crocker Meadows Wildlife Area			X		X		X
Daugherty Hill Wildlife Area		X	X		X		X
Ervin Ranch			X				X
Hallelujah Junction Wildlife Area	X				X		X
North Table Mountain Ecological Reserve			X	X	X		X
Pine Hill Ecological Reserve		X		X			X
Smithneck Creek Wildlife Area							X
Stone Ridge Ecological Reserve		X	X	X	X		
Warner Valley Wildlife Area			X				



Photo 4: Post Fire monitoring, Butte Creek House Ecological Reserve

Region 3: Bay Delta Region

The Bay Delta Region's wildfire resiliency work prioritizes creating defensible space around infrastructure on CDFW lands, including a significant amount of blue gum eucalyptus (*eucalyptus globulus*) removal near buildings and roadways in the past three years. Grazing for fine fuels reduction occurs on properties across the Region. Mowing and discing of fuel breaks near neighbors and roadways may be conducted multiple times per year to reduce the spread of wildfire. Monitoring for wildfire resiliency in the Bay Delta Region is supported by the Statewide Wildfire Resiliency Team based in West Sacramento. Monitoring is focused on tracking the vegetative response to treatment activities, including eucalyptus resprouts, native species recruitment and survival, and invasive species detection.

Table 4. Region 3 Monitoring for Wildfire Resiliency - CY 2024

	Photopoints/Timelapse monitoring	Vegetation transect surveys
Santa Cruz Long-Toed Salamander Ecological Reserve	X	
Santa Rosa Plains Ecological Reserve- Todd Road Unit	X	X
Yolo Bypass Wildlife Area	X	X



Photo 5: Fuel Break Photomonitoring, Santa Rosa Plain Ecological Reserve, Todd Road Unit

Region 4: Central Region

The Central Region's 2024 wildfire resiliency and monitoring efforts focused on analyzing differences between treated and untreated areas. This important research will have broad statewide implications for how CDFW conducts vegetation treatments in the future. Multiple 25m x 25m plots will be established in both treated and untreated areas. A transect will run through the center of each plot, serving as the primary axis for collecting vegetation and pollinator data. Camera traps will be deployed within each plot to monitor wildlife activity. Vegetation surveys will be conducted during the winter and spring, while pollinator surveys will occur in the spring. Additional monitoring efforts will include bird, raptor, and bat surveys, conducted at appropriate times based on species activity.

Photo point monitoring will be repeated every four months across approximately XX Ecological Reserves and Wildlife Areas. Drone imagery will also be collected at select sites to enhance spatial analysis. In 2025, native seeds will be collected and used to support revegetation efforts, aiming to restore fire-resilient native plant communities. All data collected will be analyzed to compare ecological outcomes between treated and untreated areas.

Table 5. Region 4 Monitoring for Wildfire Resiliency - CY 2024

	Line intercept surveys	Photopoint/ Timelapse monitoring	Trail camera	Visual Inspection for invasive species
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Wildfire Resiliency Initiative
2024 Monitoring Methodology

Big Table Mountain Ecological Reserve	X	X	X	x
Cottonwood Creek Wildlife Area		X	X	
Elkhorn Slough Ecological Reserve	X	X		
Kinsman Flat Wildlife Area	x	X	X	
Los Banos Wildlife Area		X		x
Mendota Wildlife Area		X		
North Carrizo Ecological Reserve		X		
Pleasant Valley Ecological Reserve	X	X	x	
San Juan River Ecological Reserve		X		
Semitropic Ecological Reserve		X		
Springville Ecological Reserve	X	X		



Photo 6: Fuel Break Photomonitoring, Cottonwood Creek Wildlife Area.

Region 5: South Coast Region

The South Coast Region has many properties that can be categorized as WUI and are a high priority for fuel reduction activities. The South Coast Region is prioritizing defensible space around Department structures, performing fuel reduction activities along property borders within the WUI, and restoring areas from non-native grass species to more fire resilient native shrub and tree species. There have been multiple wildfires that have affected department lands in the Region. Regional staff are currently performing post-fire monitoring on three properties to document vegetation recovery and habitat succession.

Table 6. Region 5 Monitoring for Wildfire Resiliency - CY 2024

	Aerial surveys	Avian surveys	Coverboard surveys	Photopoint/ Timelapse monitoring	Special status species survey	Vegetation transect survey
Ballona Wetlands Ecological Reserve		X	X	X		X
Bolsa Chica Ecological Reserve			X	X		X



Wildfire Resiliency Initiative
2024 Monitoring Methodology

Burton Mesa Ecological Reserve	X		X	X		
Canada de San Vincente Ecological Reserve	X		X	X	X	X
Cienega Springs Ecological Reserve		X		X		
Laguna Laurel Ecological Reserve				X		
Meadow Brook Ecological Reserve				X		
Pilgrim Creek Ecological Reserve				X		
Rancho Jamul Ecological Reserve	X					X



Photo 7: Roadway clearance Photomonitoring, Burton Mesa Ecological Reserve

Region 6: Inland Deserts Region

The Inland Deserts Region has prioritized fuels thinning, invasive species removal, riparian habitat restoration, and post-burn restoration. The Region also has projects focusing on forest health in the Eastern Sierra, and defensible space projects around CDFW infrastructure in the WUI. The Region is monitoring wildfire resiliency treatments to track changes in vegetation characteristics, including height, species composition, invasive species detection, and native species recruitment and survival. Wildlife use of post-burn restoration areas is also a high priority for monitoring and is primarily being tracked by Department biologists and partner organizations.

Table 7. Region 6 Monitoring for Wildfire Resiliency - CY 2024

	Photopoint/ Timelapse monitoring	Trail cameras	Vegetation surveys
By Day Creek Ecological Reserve	X	X	X
Buttermilk Country Wildlife Area	X		X
Coachella Valley Ecological Reserve	X		X
Imperial Wildlife Area	X		X



Wildfire Resiliency Initiative
2024 Monitoring Methodology

Mojave Narrows Ecological Reserve	X		X
Oasis Springs Ecological Reserve	X	X	X
Round Valley Wildlife Area	X		X
San Jacinto Wildlife Area	X		X
Santa Rosa Plateau Wildlife Area	X		X
Slinkard/ Little Antelope Wildlife Area	X	X	X



Photo 8: Photomonitoring, By Day Creek Ecological Reserve.