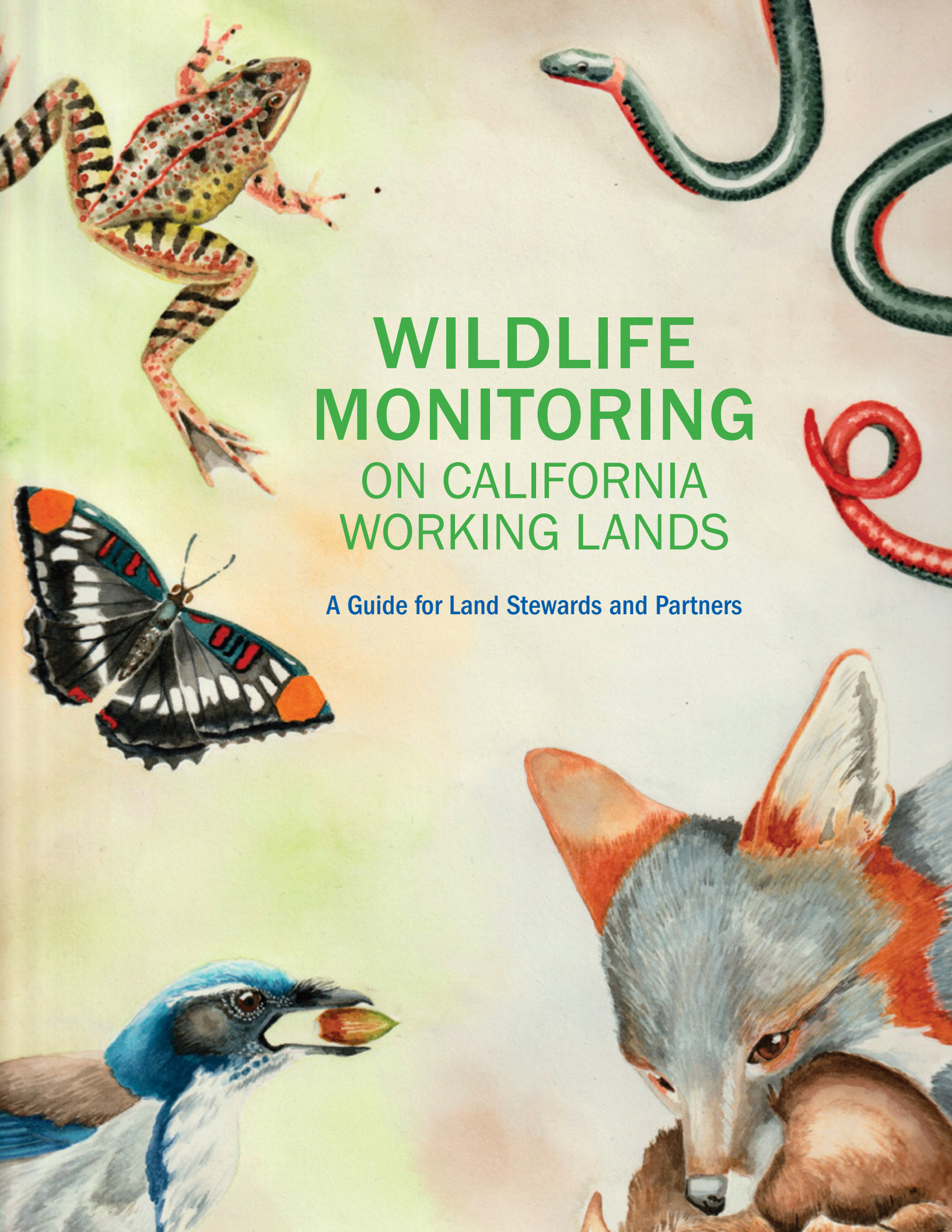


The background of the cover is a light, textured cream color. It features several detailed illustrations of California wildlife. In the top left, a frog with a yellow body, black stripes, and red spots is shown. In the top right, a green snake with a red stripe and a red snake are coiled. In the middle left, a butterfly with black, white, and orange wings is depicted. In the bottom left, a blue and white bird is shown in profile, holding a green seed in its beak. In the bottom right, a close-up of a fox's face with grey and orange fur is visible.

WILDLIFE MONITORING ON CALIFORNIA WORKING LANDS

A Guide for Land Stewards and Partners



Monitoring for bees and butterflies along a hedgerow in Yolo County. Corey Shake

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TABLE OF CONTENTS

Overview	2
Why did we put together this guide and who is it intended for?	2
What experience is needed?	3
What are we trying to monitor?	3
Wildlife habitat practices	4-5
How to choose a monitoring objective	6
Monitoring Special Status Species	7
Mammals.....	8-9
Birds.....	10-11
Amphibians & Reptiles	12-13
Bees & Butterflies	14-15
Riparian Restoration Case Study	16-17
Farm Hedgrow Case Study	18-19
Best Practices for Wildlife Monitoring	20
Glossary of Terms	21
Weblinks for Monitoring Resources	22



Biologists in a field of chaparral collecting bird and vegetation survey data. *Sophie Noda*

In our work with land stewards and agricultural producers, we find that many are curious about wildlife on their land and want to learn more about how to manage their lands with a wildlife focus. They may have ideas on how to manage species but they are unsure about how to systematically test their hypotheses or find out more about how to inventory the wildlife on their land. Land stewards are also looking for ways to assess the impacts of their management activities. By monitoring key species, land stewards are provided with an idea of the ecological health of their land.

California working lands hold immense habitat value for wildlife and pollinators. These agricultural landscapes include annual and perennial cropland, orchards, livestock ranches, dairies, as well as lands stewarded for cultural foods, including oak woodlands, riparian corridors and traditional gathering grounds. Wildlife species utilize these lands for nesting, foraging, denning, breeding, resting and generally living their lives. Working lands are vital to their continued existence and flourishing.

WHY DID WE PUT TOGETHER THIS GUIDE AND WHO IS IT INTENDED FOR?

This guide is geared towards land stewards, agricultural technical service providers, and community scientists who are interested in pursuing wildlife and pollinator monitoring on lands managed for resources such as food and fiber. We reviewed common inventory and monitoring protocols to potentially include in this guide, focusing on those that give information about multiple species that range in cost, time allocation and expertise. We focused on four groups of wildlife and insect species – birds, mammals, and herpetofauna (amphibians and reptiles), as well as bees and butterflies. Many land stewards appreciate the diversity of wildlife on their lands and keep species lists that may include important data such as migration and nesting dates. Completing such an inventory is often the first step in thinking about a monitoring program to help guide the effectiveness of

wildlife habitat projects. A wildlife survey not only gives you information about the land, but it also can contribute to the bigger picture of species health across the state, especially if you are participating in a landscape-scale monitoring program. The foundation of any monitoring program is having current and accurate information about a species population, and without monitoring on private lands, it's difficult to have a clear understanding of trends. For example, planting a hedgerow on your farm may show a boost in nesting birds, however, when information is pooled across multiple projects, we can understand how regional or even global events (e.g., climate change or a grasshopper invasion) could lead to large-scale declines. For this reason, we encourage you to not only participate in a monitoring program, but be willing to share your information with trusted partners.



Tree Swallow on a nest box in Sonoma County. Ryan DiGaudio

WHAT EXPERIENCE IS NEEDED?

Wildlife monitoring can require substantial technical expertise and time commitments; although modern equipment can help identify species, reduce time spent surveying, and reduce the challenges of difficult field conditions. Utilizing resources such as online databases, song and call identification software, and pursuing partnerships with community science organizations can streamline your wildlife monitoring program. However, it may be easier to contract with a university or organization that specializes in a particular technique. You can also rent gear to reduce expenses and eliminate the need to store equipment. Using a standardized protocol that other agencies and partners use may help you pool data and understand region-wide patterns. Working with volunteers and community members and utilizing programs such as iNaturalist can help leverage your data collection and build a simple species list for a particular area. Don't be discouraged - any level of monitoring can be valuable and some can be conducted with minimal time and expertise.

WHAT ARE WE TRYING TO MONITOR?

Identifying your monitoring objectives will help narrow down species and techniques to focus on as different types of data are more effective at addressing certain questions. For instance, collecting baseline data before implementing your wildlife practice can help you understand cause and effect. Narrowing down your monitoring technique to a specific habitat type can help you understand the effects of a specific restoration practice but casting a wider net by setting up game cameras or song recorders across an entire ranch can help you understand broader landscape changes. Common indicators to measure the effectiveness of a wildlife practice include species presence or absence (occurrence) and species richness (number of species detected). If the objective is to increase the density of certain species or groups, such as riparian nesting birds, then counting individuals and determining their abundance over time will be more informative. Measuring habitat attributes such as shrub or tree cover and height or snag density before and after a practice is implemented can help determine a cause and effect relationship between the practice and wildlife occurrence.



Mountain and Western Bluebirds perched on range fencing in northeastern California. *Ryan DiGaudio*

WILDLIFE HABITAT PRACTICES

Working with a conservation planner can help you create a whole farm or ranch approach to conserving and creating wildlife habitat, while reducing disturbances and negative effects to wildlife populations. Working directly with a trained wildlife biologist and agencies such as the US Fish and Wildlife Service Partners Program can provide advice and technical assistance with designing projects. In the following section we will outline some common practices that can be beneficial for wildlife on working lands.

Wildlife Structures are intentionally designed and built as nesting, roosting, basking or cover for any wildlife and insect species. Nest boxes can be constructed for nearly any cavity-nesting species such as bluebirds, swallows, Wood Duck, Barn Owl, and kestrels. Nest boxes, bat houses, and raptor perches can work in tandem to reduce damage to crops, orchards and vineyards by insects, birds, and ground-dwelling rodents. Other structures such as artificial Burrowing Owl burrows or western pond turtle basking structures can provide key habitat elements when they are absent on the landscape.

Hedgerows are generally planted as a linear border along farm fields, fence lines and property boundaries. Species chosen are generally perennial, woody shrubs or small trees that can grow to a height of 10-12 feet tall and are planted to create a dense hedge. Landowners often choose shrubs that provide pollinator resources for their crops, and can thrive in full sun and hot/windy conditions. Native species provide the largest benefit to wildlife and pollinators. Hedgerows can function as connectivity corridors for pollinators and provide cover from predators for birds, small mammals, and reptiles (although predators may use them as hunting routes!).

Silvopasture is a farming practice that integrates trees and grazing livestock on the same land. Farmers can diversify and increase production of their land by planting native trees and shrubs to support livestock, create value-added products, and feed wildlife and insects reliant on the flowers, nuts, berries, and seeds. Trees also provide shade and fodder for livestock and habitat for wildlife.



Barn Owl box located on cropland in Butte County. *Carrie Wendt*

Pollinator plantings is a catch-all term for planting native species that provide nectar and pollen for insects, and may be specifically for bees that pollinate nearby crops. One example is planting California buckwheat (*Eriogonum fasciculatum*) for mason bees, as they are industrious pollinators in orchards and perennial crops. Many farmers are recognizing the value of a diversity of pollinators for their crop production. Seeding native and non-native annual and perennial wildflower and grass species provides nectar, pollen, nesting, and resting areas for bees, butterflies and many other insects. Choosing species that bloom throughout the year will support a diversity of pollinators.



Hedgerow planting providing pollinator and wildlife habitat on a diverse vegetable farm. *Alissa Fogg*

Oak woodland enhancement can include a variety of practices to support the ecosystem function of habitats associated with California oaks. Oak woodlands have been stewarded since time immemorial by Indigenous communities for food and fiber primarily using intentional fire. While Indigenous communities continue to use fire on their lands, fire is mostly absent on non-Native lands as a stewardship tool. Oak woodlands are under many threats including encroachment by Douglas fir, low seedling recruitment, and poor acorn production. Enhancement practices include prescribed fire, thinning encroaching Douglas fir, caging seedlings from deer, elk and livestock browse, and planting acorns where recruitment is very poor. In some areas, firewood gathering and removing shrubs has depleted habitat for wildlife. Building brush piles while thinning ladder fuels can create cover for quail and girdling trees where they are too dense can provide snags for nesting woodpeckers.

Riparian (stream-side) Restoration can be one of the most effective ways to enhance or create wildlife habitat as these areas are extremely species-diverse and function as key wildlife corridors through the landscape. Water is life in California, and a meandering stream corridor can provide a buffer to the increasing intensity and length of heat waves. Removing invasive species, following up with planting stream-side trees and shrubs and implementing a grazing strategy with fencing and off-stream water troughs are several strategies to improve the health of riparian areas. Incised creeks can greatly benefit from low-tech process-based restoration such as beaver dam analogs, post-assisted log structures, willow weaves, and one-rock dams. These restoration techniques help store water in the soil, allowing for cooler flows to drain slowly through the dry season.

Wetland restoration can be completed alongside riparian restoration, or it can be specific to seasonally or year-round wet areas such as vernal pools, meadows, bogs, fens and springs. These habitats are rare in our Mediterranean climate and support many uncommon and declining species, such as California tiger salamander and Willow Flycatcher. Wetlands may require major earth-moving restoration efforts to re-water a drained

floodplain but they can also be managed with a prescribed grazing strategy, invasive species management, herbaceous plantings, or prescribed burning.



Riparian plantings and exclusion fencing along a stream. Song Sparrow and Red-winged Blackbird were found to be nesting in the area within a few years of planting. *Alissa Fogg*



Bolander's phacelia (*Phacelia bolanderi*) planted along a hedgerow with drip irrigation and discarded sheep wool for mulch. *Alissa Fogg*

HOW TO CHOOSE A MONITORING OBJECTIVE

Wildlife monitoring can be as simple as assessing the presence of common wildlife at one location on a property using a single camera trap. Monitoring can also be highly complex and focus on a specific species of regional conservation importance targeted by experimental restoration projects across several properties. Before you dive into understanding which birds, mammals, amphibians, or bee and butterfly species call a farm

or ranch home, first you need to identify goals and objectives for monitoring a property. Taking a step back and assessing why monitoring is needed guides how broad or specific of methods are necessary to meet project goals. The SMART goal-setting framework is an effective way to create clear, measurable targets to guide the monitoring process.



WHAT TO MONITOR

Working lands support an incredible diversity of ecosystems and wildlife across California. A foundational aspect of creating monitoring goals is understanding what wildlife call the ranch or farm home and which habitat characteristics provide resources for these species on the property. It is important to look at the landscape across a variety of time and spatial scales. Consider the various aspects of animal behavior such as when they are foraging, resting, reproducing and raising young, and the habitats that support each of

these needs. Consider if a bird or butterfly is a year round resident or a migratory species. For example, in one small corner of the farm a small mammal or bee can live their entire lives. In that same corner, a hedgerow can provide valuable breeding habitat for one species of bird to nest and feed its young, and provide valuable non-breeding habitat for a different migratory species of bird to overwinter.

MONITORING SPECIAL STATUS SPECIES

Special status species include those protected at the state and/or federal level. These species are provided different levels of protection depending on their listing designation (i.e. Endangered, Threatened, Proposed, or Candidate). Many special status species reside on working lands in California and these landscapes can provide critical habitat for these species. You may be interested in monitoring special status species because you are interested in what lives on a given property or because monitoring for special status species is required prior to implementing a project on the land. When the latter is the case, there are typically specific protocols that need to be followed, especially when providing

sufficient evidence that a species is not present on a property. Some of these surveys need to be conducted by individuals that have certifications, licenses, or other agreements with the CA Department of Fish & Wildlife (CDFW) or the US Fish & Wildlife Service (USFWS) due to sensitivity and protection surrounding species of concern. Whatever monitoring is conducted, it is important to be cognizant of how a survey may impact a special status species. If you do find protected species on a property there is no requirement to report it to a federal or state agency unless you are working with them for approval on a project.

RESOURCES

Online resources that can help you determine what special status species may be in the area are <https://ipac.ecosphere.fws.gov/> (federal website for the Information for Planning and Consultation with the USFWS) and <https://apps.wildlife.ca.gov/bios6/> (state website that has the BIOS (Biogeographic Information and Observation System) and CNDDB (CA Natural Diversity Database) where you can view species observations.

Website devoted to established protocols for monitoring California special status species: <https://wildlife.ca.gov/Conservation/Survey-Protocols>

A reminder: Just because a species is listed in an area on a map, does not necessarily mean that the species is likely to occur across that entire area. Understanding the habitat requirements of these species can help determine where monitoring should occur.

Finding your local CDFW regional office: <https://wildlife.ca.gov/Regions>



MAMMALS

The following pages include tables and resources for different monitoring approaches targeted towards various species and taxa. Many mammals call agricultural lands home - from tiny

mice to mighty mountain lions. Many have adapted to living in farm and ranch environments and even thrive in these settings.

TARGET SPECIES GROUP	MONITORING OBJECTIVE	TECHNIQUE(S)	NOTES	WILDLIFE PRACTICES
Carnivores Ungulates Medium-size mammals	Occurrence Species richness Abundance	Wildlife game cameras	Cameras strategically placed on site and routinely checked for camera card and battery. You can use a grid pattern across a defined area or monitor a wildlife corridor such as a log that spans a stream or a wildlife structure, such as a brush pile. Equipment and batteries can be expensive, but you can work with volunteers or students to process images.	Riparian restoration Oak woodland enhancement Wildlife structures
Bats	Occurrence Species richness	Ultrasonic microphone & Automated Recording Units (ARUs)	You can set up passive or active recording units and pair them with free programs that will identify bat species. Equipment and batteries can be expensive, but rentals are available. Best in areas near a water source.	Riparian and wetland restoration Oak woodland enhancement
Small mammals (voles, mice, pocket mice)	Occurrence Species richness Abundance	Live traps Footprint tunnels Camera traps	Small mammals have typically been monitored using a live trap grid and PIT (microchip) tags to mark individuals and estimate population sizes. For a non-invasive approach to monitor occurrence and species, you can build footprint tunnels or use tiny motion-sensor cameras on top of rectangular boxes.	Hedgerows Riparian restoration Oak woodland enhancement
Aquatic mammals in freshwater systems (beaver, river otters)	Occurrence	Scat and lodge surveys	Trained observers can walk a stream corridor and record visual observations of beaver sign (chewing, dams, lodges) and otter slides or scat. Inexpensive and can engage landowners.	Riparian restoration Meadow restoration
All mammals	Occurrence Species richness	Scat and sign survey	Simple area searches for mammal scat and tracks can give you valuable information about use of your habitat projects. Inexpensive and can engage landowners and volunteers.	Oak woodland enhancement Riparian restoration



Bat acoustic recording unit with an ultrasonic microphone being deployed in a forested setting. Zack Steel



A wildlife game camera captures an image of a mountain lion using a wildlife-friendly livestock trough on a ranch in central California. TomKat Ranch

RESOURCES

Wildlife game cameras have exploded in popularity and range in price from \$50-\$700 depending on weather-proofing, battery life and settings. Some cameras can record video, while others can transmit photos via cell service. Most will require regular visits to change batteries and download photos. The [Reconyx Scouting Series](#) is suitable for most wildlife practices.

[Pathways for Wildlife](#) offers assistance on monitoring wildlife connectivity corridors and identifying those using wildlife cameras.

[Wildlife Insights](#) is a free or low-priced resource for storing, processing and identifying species wildlife camera photos.

[California Department of Fish & Wildlife](#) (CDFW) maintains a Terrestrial Field Methods website that outlines protocols for traditional camera trap monitoring and will help you utilize Wildlife Insights for your photos.

[North American Bat Monitoring Program](#) offers protocols and data tools for acoustic monitoring and roost counts.

[Bat Conservation & Management](#) has bat houses for sale, in addition to ultrasonic microphones and the SonoBat software that identifies and analyzes bat data. Best to collaborate with an agency or university that has a software license and computer capabilities.

[Wildlife Acoustics](#) makes sound recording units that can be used for bats, birds, and even frogs. They have a grant program for educational and non-governmental agencies.



BIRDS

Birds are some of the most noticeable wildlife on a farm or ranch. They respond quickly to changes in management, are easy to see and hear, and have a diversity of nesting, foraging

and roosting strategies that make them strong indicators of ecosystem health. Many online tools exist to help with identification and tabulating bird occurrence data.

TARGET SPECIES OR GROUP	MONITORING OBJECTIVE	TECHNIQUE(S)	NOTES	WILDLIFE PRACTICES
All birds	Occurrence Species richness Abundance	Area searches	Timed auditory/visual search in a defined area. Can include all species or focal species (e.g., grassland, oak woodland). Best for a specific habitat type. Equipment costs are low, bird ID expertise is required. 1-3 visits per year. Utilize Avian Knowledge Network for data entry and analysis.	Hedgerows Riparian restoration (< 1000ft stream length) Wetland restoration
Breeding Birds	Occurrence Species richness Abundance	Point count surveys	Experienced observers identify and count all breeding bird species. Best for large areas of contiguous habitat. Equipment costs are low, bird ID expertise required. 1-2 visits each spring. Utilize Avian Knowledge Network for data entry and analysis.	Oak woodland enhancement Meadow restoration Riparian restoration (> 1000ft stream length)
Singing and calling birds	Occurrence Species richness	Audio recording units (ARUs)	Deploy ARUs in a habitat area that periodically records sounds (e.g., turns on for 5 minutes every hour). Equipment costs and time in the lab to identify birds could be substantial. Can engage volunteers and use computer programs that will identify birds for you.	Hedgerows Riparian restoration Oak woodland enhancement
Nesting birds	Nest success Number of chicks	Nestbox surveys	Songbird nest boxes are checked regularly through the breeding season (March-August) for signs of nesting and number of fledged chicks. Raptor and owl boxes can be monitored visually.	Nest box wildlife structures
Marsh and water birds	Occurrence Species richness Abundance	Secretive Marsh bird Protocol	Experienced observers use a combination of a passive listening survey with playbacks of marsh bird calls. Sunrise or sunset surveys 3-5 visits per year.	Wetland restoration Flooded agriculture (rice) management



Left - Male Wood Duck perching on a nest box with a female Wood Duck poking her head out. Wood ducks nest in cavities near ponds and waterways. They lay 10-15 eggs at a time. Right - Within 1-4 days of hatching, their chicks exit the box by jumping into the water.

RESOURCES

[Avian Knowledge Network](#) (AKN) offers tools for collecting, entering, uploading, managing, accessing and summarizing bird monitoring data. AKN has robust protections in place to ensure data privacy.

[Cornell Lab NestWatch Program](#) is a monitoring program designed to track status and trends in nesting birds, including nesting dates, and number of eggs, hatchlings and chicks that survive to fledge. They have an online data entry portal, a phone app, and nest box resources.

Sound Automated Recording Units (ARUs) can be purchased or rented. The Audiomoth, created by [Open Acoustic Devices](#) are relatively inexpensive and batteries are long-lasting but you'll need a weather-proof case. Wildlife Acoustics makes a higher tech version

that is weather-proof and has an app to program the settings. You can also rent devices and they have a grant program for tax-exempt organizations.

ARUs can be paired with a bird vocalization program like [BirdNET](#) but you will want an expert in bird identification to verify your most common species.

[The North American Marsh Bird Monitoring Program](#) was developed by the US Fish & Wildlife Service and the US Geological Survey and is used across the U.S. and Mexico. You can enter and visualize data using the Avian Knowledge Network (AKN).

[Merlin app](#) for mobile devices (free). You can use it to identify birds by sound and sight while in the field.

AMPHIBIANS & REPTILES

Working lands provide habitat for many ‘herps’ (amphibians and reptiles), especially in areas where there is available water, burrows and downed wood. Common species include

Ensatina and slender salamanders, tree frogs, western toads, fence lizards, western pond turtles and garter snakes.

TARGET SPECIES OR GROUP	MONITORING OBJECTIVE	TECHNIQUE(S)	NOTES	WILDLIFE PRACTICES
Terrestrial Salamanders Snakes Lizards	Occurrence Species richness Density (mark-recapture)	Cover board array or grid	Cover boards, often made of untreated plywood varying in size, but larger than 12x12", can be constructed and set up in a grid or transect to check regularly for salamander presence. With permits, you can mark individuals, and sample for population size and density.	Riparian restoration Oak woodland enhancement Hedgerow adjacent to forest or woodland
Frogs and toads	Occurrence Species richness	Automated Recording Units (ARUs)	ARUs range in cost from \$50-200 and can be deployed during the breeding season when species are calling. You can survey for many taxa, including birds.	Riparian restoration Wetland/pond enhancement
Aquatic and terrestrial amphibians Western pond turtle	Occurrence Species richness	Visual Encounter Surveys (VESs)	Observers conduct a timed area search in a defined area, such as along a riparian corridor, meadow, pond or any terrestrial or wetland habitat and look for adults, juveniles or egg masses for frogs and toads, and signs of pond turtles. You can use the VES protocol to search for any terrestrial reptile, such as lizards and snakes, and also by turning over logs and rocks. Safety is paramount!	Riparian restoration Oak woodland enhancement Wetland/pond enhancement Meadow restoration
Aquatic amphibians and reptiles (and any species that uses a waterway)	Occurrence Species richness	eDNA	eDNA (environmental DNA) is parts of an organism that have been shed in water, air or soil. It can be analyzed using water samples sent to a lab. Best for evaluating whether a species occurs in a stream reach or pond and monitoring trends over time.	Riparian restoration Wetland/pond enhancement





Volunteers using cover boards to monitor amphibians, reptiles and invertebrates at a working cattle ranch in Tulare County. *Bonnie Eyestone*

RESOURCES

[California Herps](#) is a web resource dedicated to identification and natural history of California snakes, lizards, turtles, frogs, toads and salamanders. They have photos, videos, and range maps of all native and non-native species that occur in the state.

CDFW developed a Terrestrial Field Methods ArcGIS Story Map which has a [Drift Fence and Camera Trap Survey](#) with photos, protocols, and equipment list to survey for amphibians and reptiles. Pepperwood Preserve, located in Sonoma County, is actively using their protocol as well as [cover board monitoring](#).

[eDNA fact sheet](#) and [eDNA Resources](#) have protocols, videos and tutorials about how to sample for eDNA and where to find analysis services.



Yellow-spotted millipede (*Harpaphe haydeniana*) found under a cover board in the redwood forests of northwest California. *Alissa Fogg*

BEES AND BUTTERFLIES

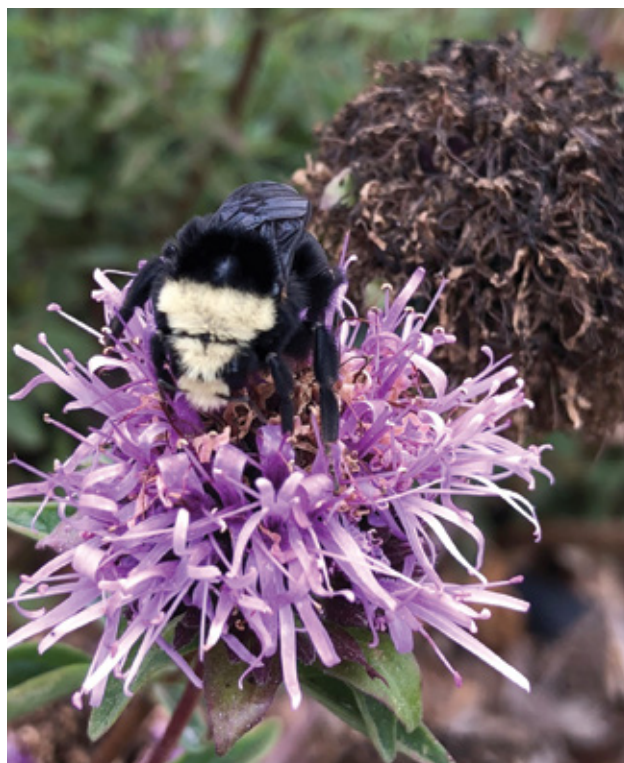
Pollinating insects, such as bees and butterflies, are important to farmers and ranchers to help boost production, and to provide essential ecological services such as pest control. Insects are not well-studied compared to other taxa, especially

on working lands. Taking part in a monitoring program would go a long way towards understanding long term trends and declines in bees and butterflies.

TARGET SPECIES OR GROUP	MONITORING OBJECTIVE	TECHNIQUE	NOTES	HABITAT PRACTICES
Bees (general or morphometric group)	Occurrence Availability of pollinator habitat	Streamlined Bee Monitoring Protocol	Two visits per year, timed searches during May-August. Focused on native and honey bees, not differentiated by species. You can also document bees in 'morphometric' groups (differentiated by shape or size).	Cover crop Range seeding Hedgerows Pollinator planting
Bees (to species)	Species richness Abundance	Pan trapping Target netting Flower visitation counts & netting	Netting and trapping require skills that are best utilized by trained observers. This would be a good opportunity to collaborate with a university or conservation science organization tailored towards a research study.	Cover crop Range seeding Pollinator planting
Bumble bees	Species richness Occurrence	California Bumble Bee Atlas	Adopt a grid cell within CA or submit point observations of bumble bees and plants they occurred on.	Any practice where bumble bees may occur
Butterflies	Species richness Abundance	Pollard transect 'walks'	Establish a fixed transect appropriate to your site. Count and identify all butterflies within 5 m on each side of the transect. Only visit during warm months and times of day.	Cover crop Range seeding Pollinator planting
Butterflies	Species richness Occurrence	North American Butterfly Counts	Join local butterfly counts or start your own to establish a count circle at a project site. You will need to recruit at least four observers and devote six hours of time to counting.	Any practice where you're able to host a public count
Monarch butterflies	Abundance Habitat availability	Integrated Monarch Monitoring Program	The IMMP is a national survey to collect milkweed, nectar plant, and monarch use data. You can choose different activities based on your capacity. For best results, plant surveys are recommended monthly when monarchs are in your area.	Any practice where there are blooming plants and you may expect monarchs.
Monarch butterflies (overwintering)	Abundance	Western Monarch Count	You can participate in the western monarch count at overwintering sites. You will need binoculars and devote at least 10 hours per year.	Monarch habitat in coastal CA



Bee and butterfly surveying along a hedgerow in Yolo County.
Corey Shake



Yellow-faced bumble bee (*Bombus vosnesenskii*) visiting a coyote mint (*Monardella villosa*) flower. Alissa Fogg

RESOURCES

The [Streamlined Bee Monitoring](#) protocol for assessing pollinator habitat was developed by [Xerces Society](#) for Invertebrate Conservation. Xerces offers periodic trainings and technical assistance for land stewards interested in this technique.

The [California Bumble Bee Atlas](#) is a collaborative community science effort supported by state and federal agencies. They offer training, support and a data entry platform for you to enter bumble bee observations which contributes to a larger effort to understand their conservation.

The [North American Butterfly Association](#) (NABA) hosts butterfly counts and will help publicize your count circle to interested observers in your area. This technique may be best for publicly-accessible lands and paired with other community science efforts, such as a bioblitz.

While California does not have a coordinated butterfly monitoring system, you can follow the [Butterfly Transect Counts](#) resource developed by Butterfly Conservation Europe that has protocols, example datasheets and analysis tips for conducting a Pollard ‘walking’ transect.

The [Monarch Joint Venture](#) hosts the [Integrated Monarch Monitoring Program](#) (IMMP), provides trainings, protocols, datasheets and an online data entry portal that can generate reports and results. They have a team in California dedicated to the western monarch butterfly population and can help tailor monitoring to your specific site.

Xerces Society also coordinates the [Western Monarch Count](#) for overwintering habitat at coastal sites. They provide trainings and technical support for observers conducting the counts.



BEFORE RESTORATION

RIPARIAN RESTORATION CASE STUDY

Welcome to a working cattle ranch in the Sierra Nevada foothills. This ranch is home to a 2000 foot riparian corridor that is dominated by invasive Himalayan blackberry and thistles. **Although it is near a forested upland slope, there is a lack of overstory trees, snags, and downed wood in the riparian corridor.** The ranchers care deeply about migratory birds and have also found

Ensatina and slender salamanders on the ranch but they've seen fewer over the years. They are concerned about removing the blackberry because it did have an abundance of birds but only a few species. They are interested in monitoring data to see if the bird diversity increases and if adding downed wood to the stream can provide habitat for salamanders.

WILDLIFE HABITAT CONCERNS

- 1 Invasive Himalayan blackberry is the only riparian plant species present. More plant species should support a higher number of wildlife species.
- 2 Channelized stream corridor that is eroding with reduced water quality.
- 3 High grazing pressure in riparian area as this is where the cows have their water source and there are limited shady areas.
- 4 Lack of snags and downed wood for cavity-nesting birds and amphibians.

OUR WILDLIFE HABITAT PRACTICES ARE TO:

1. Remove the blackberry mechanically.
2. Replant with native willows, cottonwoods, valley oak, CA blackberry, elderberry, sedges and rushes.
3. Fence the riparian area to allow for prescribed grazing during times of the year when livestock impact is low.
4. Add large woody debris to the stream, anchoring it in place, to slow the stream flow, and provide cover for amphibians.
5. Install nest boxes for Wood Duck and songbirds.
6. Install bat roost boxes to reduce the amount of mosquitoes in the area.



MONITORING RECOMMENDATIONS

- 1 Area searches for birds during the breeding season before and up to 15 years after project completion. Point Blue has protocols and data can be entered and analyzed using the free Avian Knowledge Network.
- 2 Nest box monitoring for Wood Duck and songbird presence and chick survival using Cornell's Nestwatch Program.
- 3 Salamander and reptile cover board monitoring to study occurrence and species richness as well as provide increased woody habitat on the landscape.
- 4 Bat monitoring for species richness using an Wildlife Acoustics Song Meter Mini Bat paired with a ultrasonic microphone.

The Cornell Lab of Ornithology
NestWatch

Nest check data sheet

Use this form to describe your nest site and to record data from each visit. Use a separate form for each nest monitored and each new nesting attempt. See back for explanations of codes and fields. When finished, please enter completed forms online at: www.nestwatch.org.

Year _____ Species _____

1. NEST SITE LOCATION		2. DESCRIPTION (see key on back)	
Nest site name _____		Nest is located (circle one) IN ON UNDER	
Address: Nearest street address OR _____		Nesting substrate _____	
Latitude (decimal degrees; ex 47.57932) _____		Cavity orientation (circle one) N S E W NE SE NW SW	
N _____		Cavity opening width _____ in. or cm	
Longitude (decimal degrees; ex -76.45448) _____		Predator guard ☐ None or ☐ Type: _____	
W _____		Habitat within 1 arm length _____	
Height above ground _____ ft. or m		Human modified description _____	
Human modified description _____		Human modified description _____	

3. BREEDING DATA (Eggs or young are present but not countable, enter "x" for unknown)		HOST SPECIES		STATUS & ACTIVITY CODES		COVERED ACTIVITY		BROOD SPECIES	
Mark / Day (1-12; 13-21)	Host Species	Live	Dead	Nest Status	Adult Status	Young Status	Young Activity	Live	Dead
1	05/06	2	0	0	0	0	0	0	0
2	/								
3	/								
4	/								
5	/								
6	/								
7	/								
8	/								
9	/								
10	/								

4. NESTING ATTEMPT SUMMARY (fill in information for HOST SPECIES TOTALS below after the nesting attempt is complete)

NESTING ATTEMPT DATES		HOST SPECIES TOTALS			
Start Egg Date	_____	Went to nest	Clutch Size	Unhatched Eggs	Live Young
Hatch Date	_____				Fledglings
Fledge Date	_____				

Example of a NestWatch datasheet (page 1 only). Their website, www.nestwatch.org, has the full datasheet as a PDF download with explanations for how to fill it out.



BEFORE RESTORATION

FARM HEDGEROW CASE STUDY

Welcome to a diversified vegetable and nut tree farm in the Central Valley. Our farmers care about soil health, pollinators for their almonds, and providing habitat for wildlife. They chose to plant a pollinator-friendly 1200 foot hedgerow along a field border and irrigation canal. The hedgerow will have a diversity of shrubs, wildflowers, and native grasses that bloom throughout the year. They

also put up raptor perches and a Barn Owl nest box because gophers and other rodents can be a problem in their fields. Their farm is near a remnant valley oak woodland with an understory of annual grasses. They'd like to graze the area periodically with a flock of sheep but would like to learn more about wildlife presence before putting livestock on the ground.

WILDLIFE HABITAT CONCERNS

- 1 Few flowering plants available for bees and butterflies.
- 2 No habitat structure (shrubs or small trees) for nesting birds.
- 3 Little to no wildlife cover for resting and foraging (no logs or brushy areas).
- 4 Not enough perches, such as trees or snags, for predators to target rodents in the farm fields.

OUR WILDLIFE HABITAT PRACTICES ARE TO:

1. Install a 1200 foot pollinator-friendly hedgerow.
2. Install 6 raptor perches within the veggie fields.
3. Install nest boxes for Barn Owl and songbirds.
4. Build brush piles near remnant valley oak corridor.



AFTER RESTORATION

MONITORING RECOMMENDATIONS

1 Streamlined Bee Monitoring accompanied with identification of nectar and host plants. Our farmers worked with students from a local university to conduct the surveys and enter and analyze the data.

2 Wildlife game camera monitoring to understand wildlife movement through their remnant valley oak woodland. Using a camera with a long detection distance, they could also be trained on the raptor perches to see if hawks are patrolling the farm fields for rodents or the brush piles.

3 Nest monitoring for the songbird and owl boxes using the NestWatch program. Monitoring helps to ensure birds are using the boxes, and that predators, such as snakes or raccoons, are not targeting the nest boxes.

Bee Monitoring Data Sheet: Linear Planting (See Figure 3)

Site Name: _____ Date: ____/____/____ Observer: _____

Visit #: ____ of ____ Skies (select one): Clear / Partly Cloudy / Bright Overcast Temperature: ____°F

Type of planting site(s): Hedge-row / Windbreak / Insectary Strip / Other (describe): _____

Conduct observations in the afternoon (noon-4 pm), when temperatures are over 60°F, skies are clear (partly cloudy or bright overcast is OK as long as you can see your shadow and wind speed is low to gently breeze or less). Conduct observations on two 100 ft transects along either side of the planting. (2 rows plants in each 100 ft transect for 200 plants). For each transect, record the number of native bees and honey bees visiting flowers (including reproductive structures of flowers within 3 ft of one side of your transect line). You can note flies, wasps, or other social insects in the notes, if it is less than 6 ft wide, considering a single 200 ft transect.

Transect	Start Time	End Time	# Native Bees	# Honey Bees	Notes (describe where transect is located)
Transect 1 (note its length)					
Transect 2 (note its length)					

Observations (e.g., details of the planting, shade-out plants in bloom, proximity of honey bee hives, etc.): _____

Example datasheet from Xerces Society Streamlined Bee Monitoring protocol (see Bee & Butterfly Resources Page).



Point Blue avian ecologist collecting habitat data in a San Joaquin Valley riparian restoration area. Mark Dettling



Audiomoth automated sound recording unit (ARU) deployed in an oak woodland to monitor bird sounds as part of the Soundscapes 2 Landscapes program. Point Blue

BEST PRACTICES FOR WILDLIFE MONITORING

It can be difficult to find the time and budget for wildlife monitoring, much less start a program on your own. Utilizing an existing national or regional program's technical assistance and data management can help you start a successful wildlife monitoring project. **Here are some tips for developing and maintaining a monitoring program:**

1. Include funds for monitoring in implementation budgets. By allocating 10-15% of your implementation funding towards monitoring, you will have dollars for time and equipment or for contracting with a partner organization.
2. Speaking of which... Working with conservation science organizations, colleges and universities can help you leverage support and technical expertise. For example, students need research projects and professional development opportunities and have access to computers and equipment. They can be your best resource for data collection, analysis and up to date technology.
3. Collecting habitat data concurrently with wildlife data will give you a more holistic picture of monitoring response. For example, if you are monitoring bees and butterflies, collecting data on plant floral diversity will help you understand how to design future pollinator plantings.
4. Keeping equipment functioning and clean will reduce disease spread and stretch project budgets. For example, we shouldn't be contributing to the problems associated with white nose syndrome in bats or Chytrid fungi in amphibians - using established protocols to clean equipment, vehicles, boots and clothing will reduce potential harm to wildlife. The CA Department of Fish & Wildlife hosts a wildlife health web page (<https://wildlife.ca.gov/Conservation/Laboratories/Wildlife-Health>) with resources on how to maintain equipment.

GLOSSARY OF TERMS

Abundance: Number of individuals of a certain species within a defined area. For example, our data show there is a high abundance of Acorn Woodpeckers (average of 1 per acre) across the oak woodlands on this ranch.

Camera Trap: Refers to a wildlife camera that is set up with a motion sensor to “trap” (i.e. photograph) any wildlife that travels past the camera.

Chytrid Fungus: An extremely contagious fungus that infects and kills amphibians. See link for more info. [Chytrid Fungus | Center for Invasive Species Research](https://cistr.ucr.edu/invasive-species/chytrid-fungus) (<https://cistr.ucr.edu/invasive-species/chytrid-fungus>)

Floral Diversity: The array of flowering species within a certain ecosystem. Often used in reference to a planting list for a restoration project, i.e. “The target floristic diversity for this project includes at least 15-25 species with year round blooming periods.”

Habitat Structure: The physical arrangement of plants and animals within an area. For example, the tree species, shrubs, understory and ground cover within a riparian area.

Herpetofauna: A group of organisms that includes amphibians and reptiles.

Occurrence: The presence or absence of a species in a specific area or habitat. Occurrence can be used to map the distribution of a species.

PIT Tag: Short for ‘Passive Integrated Transponder.’ A PIT tag is used to uniquely tag individual animals to track movement and survival.

Riparian Zone: The area adjacent to a river creek, wetland, lake or other part of the ecosystem that is frequently inundated by water.

Silvopasture: The process of integrating forestry and animal husbandry, i.e. grazing within a timber system.

Snags: Dead standing trees that provide excellent habitat for cavity nesting birds and other wildlife.

Special Status Species: Species that are declining in number and require extra protections at either the state or national level. This refers to threatened, endangered and species of special concern.

Species Richness: The sum total number of species within an ecosystem, biome, or other defined area. For example bird species richness surveyed within an oak woodland would include the number of species counted on a survey. Species richness is an indicator of biodiversity.

Wildlife Practice: An activity that enhances habitat value for wildlife on a farm or ranch. Examples include habitat plantings, invasive species removal, or construction of wildlife structures, such as nest boxes or brush piles.

Wildlife Structure: An artificial structure added to a habitat to enhance the habitat for wildlife. Examples include nesting or roosting boxes for birds or bats, basking structures for pond turtles, and brush piles to provide cover for ground nesting birds and small mammals.

Working Lands: Lands where agriculture in any form takes place, for example, farms, ranches, and woodlots; or places that are stewarded culturally for Indigenous food and fiber, such as oak woodlands for acorn trees and riparian areas for basketry materials.



WEB LINKS FOR WILDLIFE MONITORING RESOURCES

MAMMALS

- Bat Conservation & Management: <https://batmanagement.com/>
- California Department of Fish & Wildlife (CDFW) Traditional Camera Trap Methods: <https://storymaps.arcgis.com/collections/a6a06b22b05f43cd863568b2690b08c1>
- North American Bat Monitoring Program: <https://www.nabatmonitoring.org/>
- Pathways for Wildlife (wildlife camera monitoring): <https://www.pfwildlife.com/>
- Reconyx Scouting Series (wildlife game cameras): <https://www.reconyx.com/>
- Wildlife Acoustics: <https://wildlifeacoustics.com/>
- Wildlife Insights: <https://www.wildlifeinsights.org/>

BIRDS

- Avian Knowledge Network: <https://avianknowledge.net/>
- Cornell Lab NestWatch Program: <https://nestwatch.org/>
- BirdNET for audio identification: <https://birdnet.cornell.edu/>
- Merlin app for visual and audio identification: <https://merlin.allaboutbirds.org/>
- North American Marsh Bird Monitoring Program: <https://cales.arizona.edu/research/azfwru/NationalMarshBird/index.htm>
- Open Acoustic Devices (automated sound recorders): <https://www.openacousticdevices.info>

AMPHIBIANS AND REPTILES

- California Herps: <https://californiaherps.com/index.html>
- California Department of Fish and Wildlife Drift Fence and Camera Trap Resource: <https://storymaps.arcgis.com/collections/a6a06b22b05f43cd863568b2690b08c1?item=1>
- Natural Oceanic and Atmospheric Administration - eDNA Factsheet: <https://oceanexplorer.noaa.gov/edu/materials/environmental-DNA-fact-sheet.pdf>
- Pepperwood Preserve blog post on cover board monitoring: <https://www.pepperwoodpreserve.org/2024/06/18/herpeto-treasure-hunting/>

BEES AND BUTTERFLIES

- Butterfly Conservation Europe and butterfly transect count protocol: <https://butterfly-monitoring.net/sites/default/files/Publications/Butterfly%20Transect%20Counts-Manual%20v1.pdf>
- California Bumble Bee Atlas: <https://www.cabumblebeeatlas.org/>
- Monarch Joint Venture: <https://monarchjointventure.org/>
- Integrated Monarch Monitoring Protocol (IMMP): <https://monarchjointventure.org/mjvprograms/science/integrated-monarch-monitoring-program>
- North American Butterfly Association: <https://naba.org/butterfly-counts/>
- Xerces Society: <https://www.xerces.org/>
- Xerces Streamlined Bee Monitoring Protocol: <https://xerces.org/publications/identification-monitoring-guides/streamlined-bee-monitoring-protocol-for-assessing>

