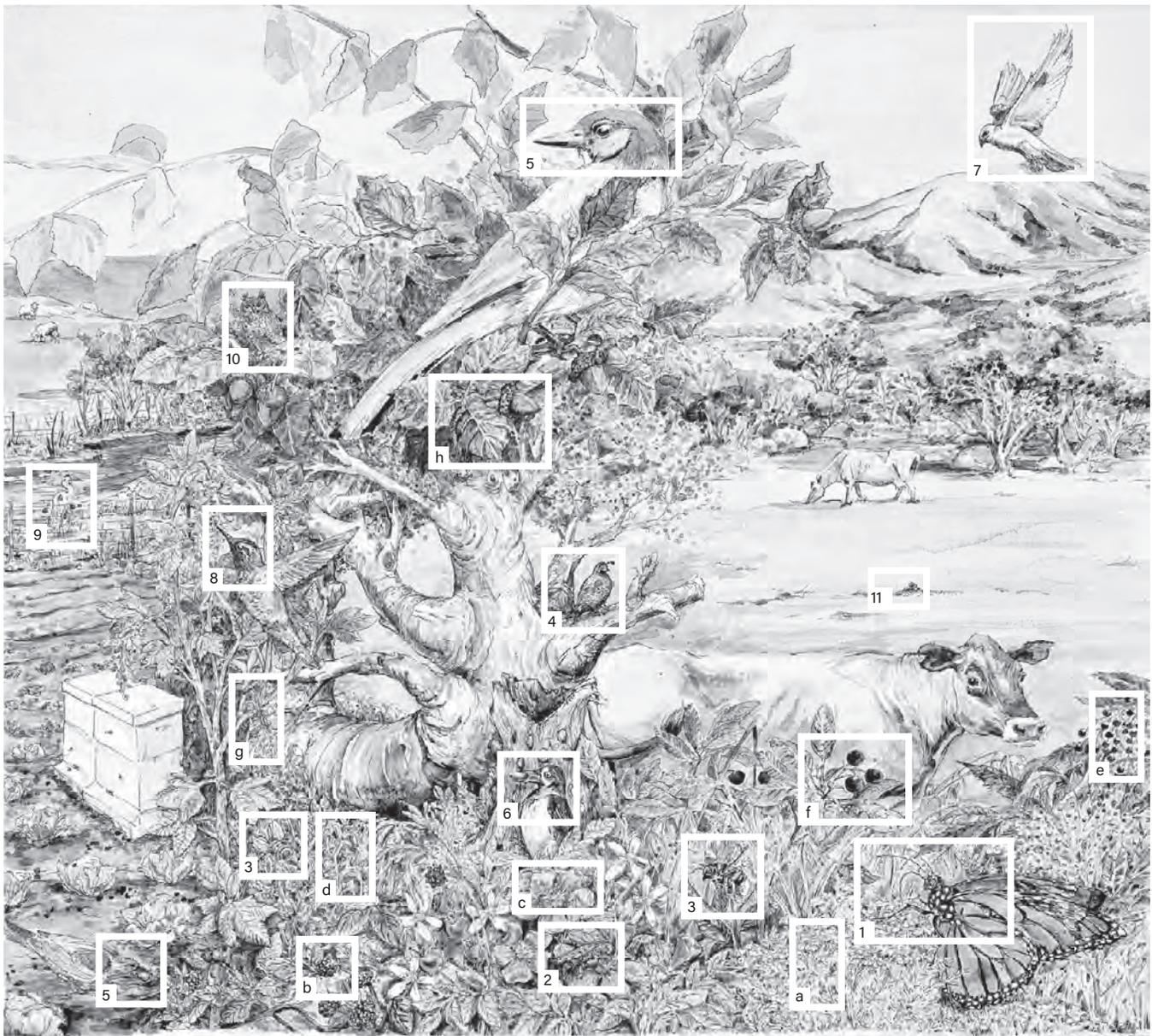




TENDING THE EDGES:

The Benefits of Hedgerows on Bay Area Working Lands



SPECIES DEPICTED

FLORA

- a. Yarrow (*Achillea millefolium*)
Native perennial herb
- b. California blackberry (*Rubus ursinus*)
Native vine, shrub
- c. California wild rose (*Rosa californica*)
Native shrub
- d. Coyote brush (*Baccharis pilularis*)
Native shrub
- e. Blue elderberry (*Sambucus nigra ssp. caerulea*)
Native shrub
- f. California coffeeberry (*Frangula californica*)
Native shrub
- g. Flowering currant (*Ribes sanguineum*)
Native shrub
- h. Coast live oak (*Quercus agrifolia*)
Native tree

FAUNA

- 1. Monarch (*Danaus plexippus*): Native butterfly
- 2. Ultra-green sweat bee (*Agapostemon texanus*): Native bee
- 3. Western honey bee (*Apis mellifera*): Introduced (non-native) bee
- 4. California quail (*Callipepla californica*): Native bird
- 5. California scrub jay (*Aphelocoma californica*): Native bird
- 6. Acorn woodpecker (*Melanerpes formicivorus*): Native bird
- 7. White-tailed kite (*Elanus leucurus*): Native bird
- 8. Anna's hummingbird (*Calypte anna*): Native bird
- 9. Great blue heron (*Ardea herodias*): Native bird
- 10. Great horned owl (*Bubo virginianus*): Native bird
- 11. Botta's pocket gopher (*Thomomys bottae*): Native gopher

TENDING THE EDGES:

The Benefits of Hedgerows on Bay Area Working Lands



Cattle and wildlife benefit from the shelter and food resources provided by a coyote brush (*Baccharis pilularis*) and blueblossom (*Ceanothus thyrsiflorus*) hedgerow planted along a windy pasture in coastal Marin. Marin RCD, 2021.

Published 2022

The Marin Resource Conservation District (Marin RCD) works on the unceded ancestral homelands of the Coast Miwok people and the Federated Indians of Graton Rancheria.

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contents

BENEFITS OF HEDGEROWS



3
POLLINATORS
and OTHER
BENEFICIAL
INSECTS



4
BIRDS
and OTHER
WILDLIFE



5
SOIL HEALTH
and CARBON
SEQUESTRATION



6
AESTHETICS



7
PESTS
and WEED
REDUCTION



8
ECONOMIC
BENEFITS



9
SHADE for
LIVESTOCK
and CROPS



10
WILDLIFE
FRIENDLY
FENCES



11
WINDBREAK
and
SHELTERBELT



12
RIPARIAN
PLANTING

RELATED PRACTICES

APPENDIX

13
HOW TO GET
STARTED

14-23
RESOURCES

OVERVIEW

Tending the Edges illuminates some of the benefits of hedgerow plantings, describes related conservation practices, and provides resources for land stewards to get started planting. While this publication focuses on Marin County, many of the concepts are applicable to other Bay Area regions.

What are hedgerows?

Hedgerows are single or multiple rows of trees, shrubs, forbs and/or grasses planted along the edges of fields in working landscapes to support one or more goals. By strategically tending the edges, land stewards — producers, agricultural workers, landowners, and others — can support regional ecological health, provide wildlife habitat, sequester carbon, improve agricultural production, and more.

Why is this publication about benefits?

This publication highlights the potential benefits of hedgerows to inspire and encourage plantings in the region. By presenting the suite of benefits in one place, this publication supports land stewards in strategically designing their hedgerows to achieve specific agricultural, social, financial, and/or environmental goals.

Why hedgerows?

Hedgerows are one of over 30 conservation practices that make up "Carbon Farming." Carbon Farming is a full-farm approach to agriculture which involves planning and implementing management practices that are known to maximize the rate at which CO₂ is sequestered from the atmosphere and converted to plant material and soil organic matter and/or implementing practices that reduce on-farm greenhouse gas (GHG) emissions. Technical and financial resources to support land stewards in Carbon Farming are expanding locally, nationally, and globally. One such effort, the Marin Carbon Project, a local collaboration of carbon farming technical assistance providers, researchers, and producers, is highlighted below.

MARIN CARBON PROJECT

The Marin Carbon Project (MCP) is a collaborative hub, working to engage agricultural producers as ecosystem stewards to provide on-farm ecological benefits, improve agricultural productivity, enhance agroecosystem resilience, and mitigate global climate change through a planning and implementation process known as "Carbon Farming." Marin RCD runs a Carbon Farming program as one of the many partners in the hub. Other members of MCP include: the Carbon Cycle Institute, Marin Agricultural Land Trust, Marin County Agricultural Commissioner, University of California Cooperative Extension of Marin, University of California at Berkeley: Silver Labs, and USDA Natural Resources Conservation Service (NRCS).

POLLINATORS and OTHER BENEFICIAL INSECTS



A western honey bee (*Apis mellifera*) pollinates flowering plants on a Marin ranch. This bee may also pollinate the nearby orchard on the way back to the hive. Marin RCD, 2021.



The native Monarch butterfly (*Danaus plexippus*), native ultra-green sweat bee (*Agapostemon texanus*), and Western honey bee (*Apis mellifera*) are three examples of pollinators illustrated on the cover of this publication. Can you find more pollinators in the illustration?

Hedgerows can provide habitat and forage to pollinators such as hummingbirds, bees, and butterflies. Global insect abundance is declining by 1-2% each year, likely caused by habitat loss, climate change, and the use of herbicides and pesticides.⁶ The insect decline likely has, and will, directly impact agricultural production: a third of all crops rely on pollinators to reproduce, and three quarters of fruits and vegetables produce higher yields when pollinated.⁹ Hedgerows can provide habitat and resources including pollen and nectar to a variety of pollinators including butterflies, moths, and bees (fun fact: California has 1600 native bee species⁷). Hedgerows can also provide habitat for other beneficial insects — like parasitoid wasps, ladybugs, and other natural enemies — which feed on common crop pests. Further, a hedgerow can include plants that benefit priority insect species. For example, incorporating milkweed into a hedgerow in appropriate regions (at least 5 miles from the coast) can provide breeding habitat for the western monarch, a butterfly on the brink of extinction.¹³ Be aware: milkweed may be toxic to grazing animals.

How to get this benefit?

To best support pollinators and beneficial insects, hedgerows should be designed to ensure blooms are available all year to provide a steady food source, and should incorporate variation in flower shape and color to attract different pollinators. Groupings of native and/or regionally appropriate plant species encourage pollinators to stay onsite. Limiting pesticide and herbicide use, particularly insecticides such as neonicotinoids, is crucial to supporting beneficial insects. When designing a hedgerow to support on-farm pest management, it is important to be aware that hedgerow plants may also host pests. Plants selected for the hedgerow should be researched carefully. *The resources listed in the Appendix of this publication, especially the online plant species selection tools and technical assistance providers, can provide further guidance.*



A wren tit (*Chamaea fasciata*) nesting in the branches of a thimbleberry shrub (*Rubus parviflorus*) in coastal Marin illuminates the wildlife habitat benefits of plantings like hedgerows. Ryan DiGaudio, 2021.

Shrubs and herbaceous plants can provide forage, cover, and nesting sites for birds. Small birds attracted to hedgerows may feed on agricultural pest insects, thus reducing the need for chemical sprays. Trees and large shrubs that make up a hedgerow can provide perches for predatory birds to hunt from. Some predatory birds (aka raptors) can help keep rodents, voles and/or pest birds at bay— for example, a large hawk or owl can eat over a thousand mice and voles per year¹, and the mere presence of a resident raptor, such as the American kestrel, may deter birds such as starlings, known to eat stone fruit and other agricultural products.¹¹ Additionally, birds and other wildlife can help with native plant regeneration on a farm beyond pollination. For example, the California scrub-jay caches thousands of acorns in the ground each season¹⁴; unrecovered acorns may germinate and develop into oak trees.

How to get this benefit?

Including a diverse palette of trees, shrubs, forbs, and grasses in a hedgerow planting may increase on-farm plant diversity, and thus create a mosaic of habitats for a variety of wildlife. Some important wildlife-minded design considerations include the structural diversity plants may provide (cavities for nesting, perches of varying heights, dense shrubs to provide cover for ground-nesting birds); diversity of food sources (seeds and fruits); and temporality of blooming, fruiting, and/or seed production. Birds may use dead limbs of trees for nest sites and granaries (e.g. the acorn woodpecker illustrated on the cover). By using California native plants (instead of nonnative plants) in a hedgerow, a land steward may insure that the hedgerow appropriately supports native wildlife. *The resources listed in the Appendix of this publication, especially the online plant species selection tools and technical assistance providers, can provide further guidance.*

To augment the habitat value of a diverse native hedgerow, nest boxes can be added. *Point Blue's nest box guide and other manuals listed on page 17 in the Bird Resources section of the Appendix, can provide more guidance. If a fence is needed around a hedgerow or generally on a farm, the Wildlife Friendly Fence section on page 10 of this publication provides important considerations.*

BIRDS and OTHER WILDLIFE



From top-left: white-tailed kite (*Elanus leucurus*), great horned owl (*Bubo virginianus*), great blue heron (*Ardea herodias*), California quail (*Callipepla californica*), Anna's hummingbird (*Calypte anna*), acorn woodpecker (*Melanerpes formicivorus*), and California scrub jay (*Aphelocoma californica*) - pictured twice - are all examples of birds that can benefit from plantings in coastal Marin. What are the illustrated plantings providing to each of these bird species, and what are some of the bird species providing to the benefit of the agricultural operation?



SOIL HEALTH and CARBON SEQUESTRATION

Mature coast live oaks (*Quercus agrifolia*) alongside a pasture in Marin sequester carbon from the atmosphere as they grow: storing the carbon in their trunks, limbs, leaves, and roots, and transferring carbon to the soil as root exudates and decaying plant materials. Coast live oaks can live for hundreds of years. Marin RCD, 2021.

Hedgerows, comprised of herbaceous and woody vegetation, can sequester carbon and build healthier soils as they grow and persist. Plants create their own food and sequester atmospheric carbon, through the process of photosynthesis: with energy from sunlight, plants combine carbon dioxide (CO₂) from the atmosphere with water and nutrients from the soil, to produce photosynthates (sugars). Some of the photosynthates produced by plants are moved to the soil directly, exuding from living plant roots. Photosynthates from plants also indirectly make their way to the soil through soil mycorrhizal fungi, the deposition of plant parts in and on the soil, and the decomposition of the bodies and manures of animals and microorganisms who ate the plants. In addition to photosynthates, other carbon-based plant compounds, such as cellulose and lignin, can be stored in plant parts (such as the trunks of the oak trees pictured above) and in the soil for decades, centuries, or more.

According to COMET-planner (www.comet-planner.com)², an evaluation tool that models greenhouse gas benefits of conservation practices, hedgerows in Marin sequester carbon at an estimated rate of 8.20 metric tons of CO₂ equivalents per acre annually — in other words, a 3 acre hedgerow planting can have about the same benefit as taking 5 cars off the road for the whole year!⁴

As plants in hedgerows sequester carbon, soil organic matter (SOM), which is about 50% carbon, increases. Soils with higher SOM demonstrate improved water holding capacity, hydrological function, biodiversity, soil fertility, resilience to drought and floods, and agricultural productivity. Even marginal increases in SOM can be impactful: for example, the Natural Resource Conservation Service (NRCS) suggests that a 1% increase in SOM may hold 1 acre inch of water, or an additional 27,000 gallons of water per acre.¹⁰ In addition, hedgerows may provide roots and ground cover that can stabilize and improve soil structure, reducing erosion and improving surface water infiltration rates.

How to get this benefit?

As explained above, installing herbaceous and woody plants can improve soil health and increase rates of atmospheric carbon (CO₂) sequestration on-farm. *Local technical assistance providers and organizations listed in the Resources section, can provide technical assistance and advice on funding opportunities for planning, designing, and implementing a planting project with the goal of maximizing carbon sequestration and improving soil health.*



AESTHETICS



Yarrow (*Achillea millefolium*), a feathery low-growing herbaceous species, can be planted in a hedgerow for the multiple benefits it provides, including its beauty. Savannah Smith, Larner Seeds, Bolinas, CA.



Blueblossom (*Ceanothus thyrsiflorus*) in full bloom shows the potential aesthetic quality of a native species hedgerow. Savannah Smith, Larner Seeds, Bolinas, CA.

Hedgerows can add color, variety, and beauty to the landscape. Additionally, as living fences, hedgerows can block undesirable views like busy roads or waste piles. Local native and iconic plants appropriate for hedgerows vary widely, from trees like coast live oaks to flowering plants like California wild rose. Land stewards can get creative about selecting site-appropriate species that suit their aesthetic tastes.

How to get this benefit?

To achieve visually attractive plant palettes and designs, land stewards can work to balance the flowering, structure, textures, size, placement, and layout of plants appropriate to their sites. Many aesthetically pleasing plants can achieve wildlife and conservation goals. Some examples of native plants with showy flowers, for example, include yarrow (*Achillea millefolium*), California wild rose (*Rosa californica*), sticky monkey flower (*Diplacus aurantiacus*), red flowering currant (*Ribes sanguineum*), and blueblossom (*Ceanothus thyrsiflorus*). Local iconic native plants include coast live oak (*Quercus agrifolia*), big-leaf maple (*Acer macrophyllum*), and buckeye (*Aesculus californica*). Be aware: buckeyes can be toxic to livestock and honey bee larvae.

The local organizations, native plant nurseries, and online tools listed in the Resources section can provide further guidance on incorporating aesthetic goals into a hedgerow design.

PESTS and WEED REDUCTION



Dense plantings, like this one on a ranch in Marin, can shade out weed species like poison hemlock and Himalayan blackberry. Marin RCD, 2021.

Hedgerows can provide localized pest and weed control benefits, reducing the need for inputs such as pesticides and herbicides. Hedgerows can provide food sources and habitat for beneficial predaceous insects (parasitoid wasps, ladybugs, etc.), birds, and mammals, which can help control common crop pests. Further, hedgerow plantings can out-compete weedy vegetation, once established.

How to get this benefit?

Land stewards can target a particular pest by incorporating plants or other augmentations (like bird boxes) that provide habitat or forage materials to beneficial insects, birds, and/or mammals that may eat the pest. For example: predatory birds, like raptors, may hunt gophers and small birds that are common pests to crop and orchard systems. Raptors can be attracted to a site if tall trees are present that they may perch on, or, if a land stewards provides species-specific bird boxes (*see the Point Blue nest-box guide in the Bird Resources section of the Appendix for more information*).

Additionally, land stewards can target a particular weed by incorporating plants into a nearby planting that may change site conditions or out-compete that weed. For example, dense plantings of trees and shrubs close to a poison hemlock patch can eventually shade out, and out-compete, the poison hemlock.

The above benefits depend on the appropriate species selection and successful establishment of hedgerow species. Proper planning, design, implementation and maintenance is key. *The tools and local technical assistance providers listed in the Resources section can provide more guidance when choosing plants.* As plants are installed, adding mulch (ideally 6" deep) or biodegradable weed mats can keep weeds suppressed while plants grow to maturity. Note: weeding efforts may need to be directed to the hedgerow side exposed to prevailing winds as wind-carried weed seeds can concentrate there. Until plants are well established, maintenance, specifically weed management within the hedgerow, is important for long-term success.

ECONOMIC BENEFITS



A bumble bee (*Bombus sp.*) is attracted to a flowering plant on a Marin farm. On the same flight, this bumble bee may continue on to pollinate crops, potentially increasing fruiting success. Marin RCD, 2021.

Hedgerows can add value to a farm and minimize costs. Hedgerows may be aesthetically pleasing and thereby increase property value. If herbaceous plants are part of a hedgerow, they may improve water quality by filtering pollutants from run-off, thereby reducing the costs associated with water quality and fisheries protection. In addition, wildlife attracted to hedgerow plants can play an important role in the control of agricultural pests and pollination of commercial crops, cutting down on the cost of inputs and/or increasing on-farm production.^{5, 8}

How to get this benefit?

When considering the costs of installing and maintaining a hedgerow, a land steward may consider the benefits listed above and throughout this publication. Grants and cost-share programs — such as the Natural Resource Conservation Science (NRCS)'s EQIP Program, CDFA's Healthy Soils Program, Zero Foodprint's Restore CA Program, and other funding opportunities — may cover some or all of the costs of installing a hedgerow. *For more information on funding opportunities, contact your local Resource Conservation District or NRCS office. For Marin land stewards, these are listed in the Resources section of this publication.*



A row of mature Monterey cypress (*Hesperocyparis macrocarpa*) provide shade to sheep on a ranch in Marin County. Marin RCD, 2021.

SHADE for LIVESTOCK and CROPS



An Angus bull on a Marin ranch finds shade under a pasture-side willow (*Salix sp.*). Marin RCD, 2021.

Hedgerows consisting of large trees and shrubs can provide shade to livestock to reduce heat stress, and can provide shelter during wind and storm events.¹² Similarly, tall and/or dense plantings can protect crops from the drying effects of wind, allowing downwind crops to grow later into the summer (however, shade may limit sunlight to crops, and thus potentially hinder growth).

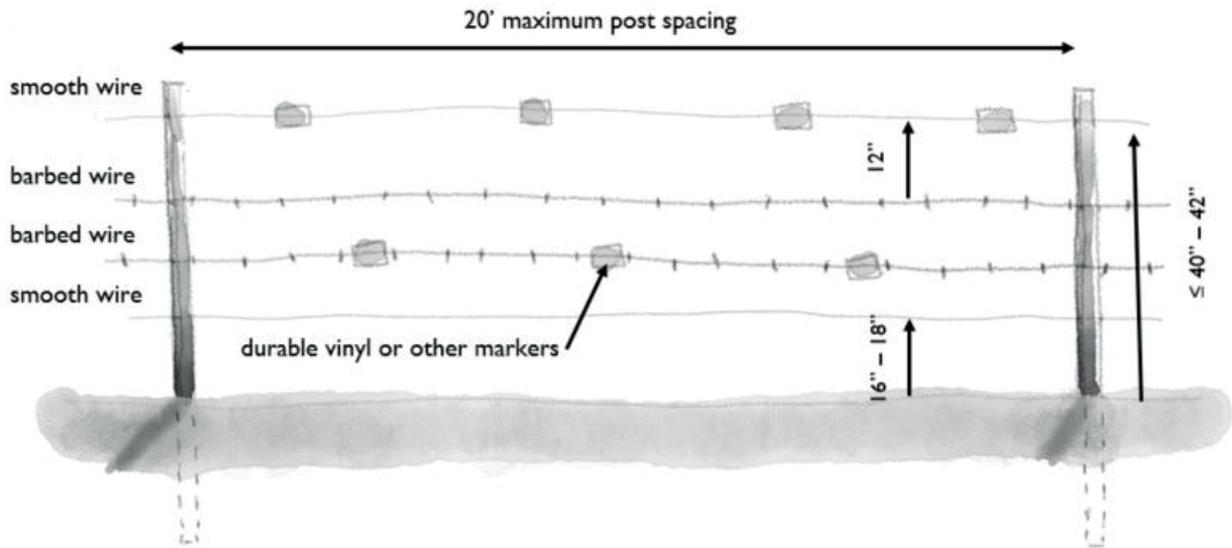
How to get this benefit?

For shade, a land steward may consider planting trees that will reach a sizable height and will prosper within the site conditions. A mix of deciduous and evergreen trees can ensure shade year round. Some native trees adapted to Marin include valley and coast live oaks (*Quercus lobata* and *Q. agrifolia*), Oregon ash (*Fraxinus latifolia*) and big-leaf maple (*Acer macrophyllum*), to name a few. *The tools and technical assistance providers listed in the Resources section of this publication can provide further guidance on appropriate species selection. The "Related Practice" section on Windbreaks and Shelterbelts, found later in this publication, also contains more information.*



WILDLIFE FRIENDLY FENCES

Hedgerows can create habitat corridors or habitat islands in the landscape, which are especially important in cultivated, cleared, or developed areas. However, the fences often needed to protect hedgerows from browsing pressure may also create barriers to wildlife movement, limiting access to important habitat resources or separating young from adult wildlife. When fences are needed around a hedgerow or farm, a land steward may consider incorporating “wildlife-friendly” elements into the design. Note: each agricultural operation has different livestock requirements and other needs, and thus fence designs may differ from the one outlined here.



Design specifications for an ideal 4-wire, smooth and barbed-wire wildlife-friendly fence for areas with livestock and wildlife pressure. Fences should be designed to meet the agricultural and livestock needs of the operation. For example, this fence would be suitable for cattle, but likely not sheep or goats. This diagram is based on the 2012 USDA NRCS Specifications for Conservation Practice 382D. Created by: Oia Walker-Van Aalst, Marin RCD, 2021.

What are the elements of wildlife-friendly fences?

- Less is more for wildlife. Specialty barrier fences or field fencing (steel mesh) should only be used where absolutely needed.
- Smooth top and bottom wires can prevent injury to wildlife when they jump or crawl under a fence.
- Total fence height should be as low as possible ($\leq 40\text{--}42''$). Note: slope of land increases the effective height of fence.
- Bottom wire should be $\geq 16\text{--}18''$ above the ground, so wildlife can move under as needed.
- There should be $\geq 12''$ between the top two wires so deer or other animals don't become entangled when jumping over.
- Fences should not be placed in travel corridors or other areas heavily used by wildlife; if not possible to avoid, visibility of the fence can be increased by adding vinyl siding trim or small diameter PVC tubing to the top and middle wires.

WINDBREAKS and SHELTERBELTS

What are windbreaks and shelterbelts?

Like hedgerows, windbreaks/shelterbelts are single or multiple-row plantings of trees and shrubs. Yet, windbreaks/shelterbelts are specifically designed to lessen wind or provide shelter in a given area. Windbreaks/shelterbelts can reduce wind speed by up to 75%, especially when plantings reach a density of 60-80% and are planted perpendicular to the prevailing wind.¹²

Example benefits of windbreaks and shelterbelts include: reducing soil erosion, improving air quality, altering a microenvironment to enhance plant growth, providing noise and visual screens; improving irrigation efficiency and/or providing shelter to livestock or living areas. Windbreak protection can significantly reduce stress and feed requirements of animals, resulting in better animal health, improved gain, lower mortality, and lower feed costs. Many livestock owners also have reported that shade provided by windbreaks and other tree plantings helps animals on hot days.

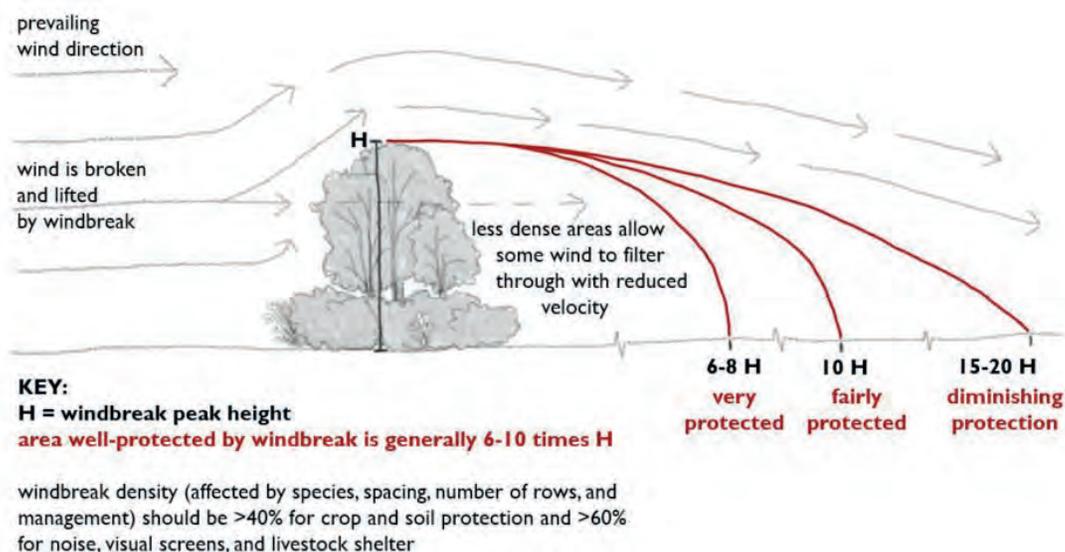


Diagram showing a windbreak's potential capacity to reduce wind velocity over a given area, as a function of windbreak height (H). Created by: Oia Walker-Van Aalst, Marin RCD, 2021.

How to create beneficial windbreaks?

Windbreak designs should be site and purpose-specific. A dense, single row of plants can provide an effective windbreak over a short distance; multiple rows are best in harsher conditions or if increased protection is desired. If planting in a highly exposed area (to wind or storm events) land stewards should consider the hardiness of the plant species for the windbreak/shelterbelt. Land stewards can start by looking at what plants are already occurring in an area of similar condition, and may want to choose evergreen species if wind protection is desired year-round.

Some of the hardier wind-and-cold-resistant-plants commonly occurring in Marin County include California bay (*Umbellularia californica*), coast live oak (*Quercus agrifolia*), wax myrtle (*Morella californica*) and coyote brush (*Baccharis pilularis*). Although not native to the area, Monterey cypress (*Hesperocyparis macrocarpa*), can also be a good windbreak species. All are evergreen. Windbreak plantings can be done in phases with hardy plants being established first to create shelter for a more diverse second phase of planting. Or, land stewards can plant in the understory of existing established vegetation to get the same plant-protecting-plant effect. Note: non-native trees like eucalyptus (*Eucalyptus globulus*) are generally **not** advised for planting as they may change site conditions so that native plants are deterred from growing, thus diminishing native habitat.

Land stewards can design a hardy windbreak by planning for 3 rows of planting: low, medium, high; or 5 rows: low, medium, high, medium, low. As a rule of thumb, a windbreak will protect a field for a distance equal to 6-8 times its height or more¹²; thus, for large fields, land stewards should consider periodic windbreak placement. Multiple windbreaks, especially a tall back windbreak on the leeward side of a field, can keep air pressure high, so that wind is held above the field. The above figure shows a simplified example of how wind currents can interact with a windbreak planting.



RIPARIAN PLANTING

On a Marin ranch, a mature riparian planting dominated by willows (*Salix sp.*) and California bay (*Umbellularia californica*) provides wildlife habitat, water quality improvement, and shade for livestock. Marin RCD, 2021.



What are riparian plantings?

Riparian (meaning bank or streamside) plantings involve establishing trees or shrubs by a creek, stream, river, or other water body. Riparian plantings, like other planting types, can augment carbon sequestration, wildlife habitat, aesthetics, pest and weed suppression, and more. In addition, a riparian planting may also achieve waterbody-specific benefits such as: bank stabilization, erosion control, food, habitat, and/or shade for terrestrial and aquatic wildlife, reduced water temperatures, decreased evapotranspiration, and improved water quality by filtering run-off. Riparian habitat created by plantings can support native special status species, like salmon, and agriculturally-beneficial predators like owls, raptors, and herons (which prey on gophers and other rodents).

According to COMET-planner (www.comet-planner.com)², an evaluation tool that models greenhouse gas benefits of conservation practices, riparian plantings (“riparian forest buffer” practice on COMET) in Marin sequester carbon at an estimated rate of 1.77 metric tons of CO₂ equivalents per acre annually — in other words, a 5 acre riparian planting could offset 1 household’s energy use for one year!⁴

How to get this benefit?

Land stewards should consider using native, regionally-adapted plant species in riparian planting projects. A good first step is looking around to see what plants are already occurring and thriving in nearby riparian areas, and if native, cultivating more. Willows (*Salix sp.*), for example, can be easily propagated from branch cuttings.

Designing a riparian planting with locally adapted plants may increase the chances of plant survival and best support native wildlife. Depending on the site, some common plants suited to riparian corridors in Marin are native willows (*Salix sp.*), sedges (*Carex sp.*), California bay (*Umbellularia californica*), white or red alders (*Alnus rubra*, *A. rhombifolia*), and red elderberry (*Sambucus racemosa*), to name a few. *The online planting tools, technical service providers, and local nurseries listed in the Resources section can provide further guidance.*

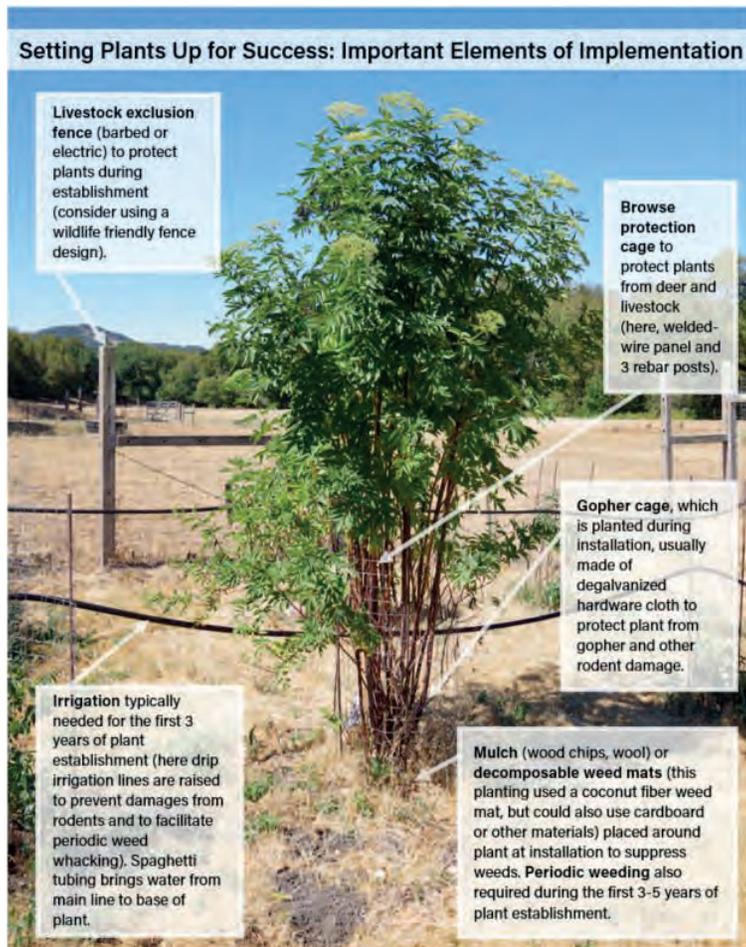
TENDING THE EDGES:

HOW TO GET STARTED

We hope this publication has helped you envision the benefits and design considerations of hedgerows and other plantings, and inspired you to get started planting!

Important to note: Consider using native plants in your project - they have adapted to survive and thrive in the region, provide appropriate wildlife habitat, and may have cultural value. Hedgerow designs should be created with your site's unique conditions in mind, including: climate or microclimate, soil type, wind exposure, water availability, management and maintenance capacity, and overall project goal(s). Local organizations listed in the Resources section can provide site-specific guidance in planning, designing, and implementing your planting project, as well as obtaining funding through various federal, state, local, and private grant or cost-share programs.

Failures in hedgerow establishment often arise from rodent damage, browsing damage, a lack of irrigation, and/or a lack of maintenance during the first 3-5+ years of plant establishment (primarily, a lack of weeding). Set your plants up for success by considering the elements in the diagram below. Planting with browse protection, gopher cages, and weed prevention, like mulch or biodegradable weed mats, can improve plant survival and lessen labor requirements. The creation of an irrigation plan for the first 3 years (4+ years may be needed in drought conditions) and a maintenance and weeding plan for the first 5+ years is highly recommended. Monitor your plants and be prepared to adapt irrigation and maintenance methods, or seek guidance, if they are exhibiting signs of stress.



A two-year-old elderberry (*Sambucus sp.*), part of a young hedgerow, with call out boxes highlighting the important components of plant installation and maintenance for successful hedgerow establishment. Marin RCD, 2021.

Check out the subsequent Resources section to find:

- 1. Local carbon farming organizations and agencies** that provide planning, design, implementation and/or funding assistance for planting projects in Marin and beyond.
- 2. Native plant nurseries:** local and regional; contact information and description of services.
- 3. Hedgerow how-to manuals and other resources:** technical guides on hedgerow design and establishment with additional resources for plant species selection, pollinators, birds, and indigenous stewardship.
- 4. List of native plant species** adapted to Marin County (not exhaustive).
- 5. Sources** used in the writing of this publication which also serve as good references to learn more about the ecological benefits of hedgerows and related practices.
- 6. A Generalized Planting Project Timeline** for Marin County

Happy planting!

RESOURCES

I. LOCAL CARBON FARMING ORGANIZATIONS AND AGENCIES

These local organizations provide planning, design, implementation and/or funding assistance for carbon farming planting projects in Marin and beyond.

**This list is not meant to be an endorsement, and is not exhaustive. Please reach out to marinrcd@marinrcd.org with any recommendations and/or additional local resources.*

Carbon Cycle Institute (CCI)

Phone: (707) 992-5009

Web: carboncycle.org

Location: Petaluma, CA

Fibershed

Web: fibershed.org

Location: Bay Area, CA

Marin Agricultural Land Trust (MALT)

Phone: (415) 663-1158

Web: malt.org

Location: Point Reyes Station, CA

Marin Resource Conservation District (MRCD)

Phone: (415) 663-1170

Web: marinrcd.org

Location: Point Reyes Station, CA

Students and Teachers Restoring a Watershed (STRAW) Program, Point Blue Conservation Science

Phone: (707) 781-2555

Web: <https://www.pointblue.org/our-work/education/>

Location: Petaluma, CA

University of California Cooperative Extension (UCCE), Marin

Phone: (415) 473-4204

Web: cemarlin.ucanr.edu/

Location: Novato, CA

USDA Natural Resources Conservation Service (NRCS), Sonoma and Marin

Phone: (707) 794-1242 ext 3

Web: nrcs.usda.gov/wps/portal/nrcs/site/ca/home

Location: Petaluma, CA

2. NATIVE PLANT NURSERIES

**This list is not meant to be an endorsement, and is not exhaustive. Please let us know if an agency or organization should be added by emailing marinrcd@marinrcd.org.*

LOCAL:

California Flora Nursery

2990 Somers St, Fulton, CA 95439
(707) 528-8813

Larner Seeds

PO Box 407, Bolinas, CA 94924 235 Grove Rd., Bolinas
(415) 868-9407

Seeds of California natives available by mail order. Shop, demo garden and nursery open for both retail and wholesale.

Mostly Natives Nursery

54 B St, Point Reyes Station, CA 94956
(415) 663-8835

Can search plants on the “[Plant Selector](#)” tab of their website by characteristics such as “California Native” or “Hedgerow”. Good pictures to visualize what plants will look like at maturity.

O'Donnell's Fairfax Nursery

1700 Sir Francis Drake Blvd., Fairfax, CA 94930
(415) 453-0372

Wild Garden Farm and Nursery

2710 Chileno Valley Rd. Petaluma, CA 94952
(707) 769-9114; Email: roanne@wildgardenfarm.com

Call or inquire by e-mail for seasonally changing hours, contract propagation, and current inventory. As the successor to North Coast Native Nursery, in the same West Marin location, Wild Garden Farm propagates a diverse selection of native species for wildlife habitat, water and soil conservation, pollinator hedgerows and other functional and ornamental landscaping purposes. The owner prefers custom orders ahead of time.

REGIONAL:

Oaktown Native Plant Nursery

702 Channing Way, Berkeley, CA 94710
(510) 387-9744

The Watershed Nursery

601 A Canal Blvd, Richmond, CA 94804
(510) 234-2222

CNL Native Plant Nursery

254 Shoreline Hwy, Mill Valley, CA 94941
(415) 888-8471

East Bay Wilds

28th Ave at Foothill Blvd., Oakland
(510) 409-5858; Email: pete@eastbaywilds.com

A native plant nursery offering a diverse array of natives from throughout the state, as well as unusual garden ornaments. Call ahead to ensure the owner will be there, and check website for open days, directions, and an availability list.

Bay Natives

10 Cargo Way at Jennings, San Francisco, CA 94124
(415) 287-6755; Email: info@baynatives.com

A San Francisco nursery that specializes in CA natives. Retail & wholesale (only with resale license). Delivery available to the home or job site.

3. HEDGEROW HOW-TO MANUALS AND OTHER RESOURCES

“A Guide to Hedgerows: Plantings That Enhance Biodiversity, Sustainability and Functionality,” Oregon State University Extension Service, Webpage article, 2020. [Link](#).

“Bring Farm Edges Back to Life: Landowner Conservation Handbook,” Yolo County Resource Conservation District, PDF, 2001. [Link](#).

COMET Planner, USDA Natural Resources Conservation Service and Colorado State University, Web tool, 2021. [Link](#).

“Conservation Buffers in Organic Systems California Implementation Guide,” National Center for Appropriate Technology (NCAT) & Oregon Tilth & Natural Resources Conservation Service & The Xerces Society for Invertebrate Conservation, PDF, 2014. [Link](#).

“Conservation Plantings on Farms,” Hedgerows Unlimited, PowerPoint PDF, 2018. [Link](#).

“Conservation Practice Standard Hedgerow Planting (422),” Natural Resources Conservation Service, PDF, 2012. [Link](#).

“Establishing Hedgerows on Farms in California,” University of California Agriculture and Natural Resources, PDF, 2010. [Link](#).

Greenhouse Gas Equivalencies Calculator, US Environmental Protection Agency (EPA), Website, Last updated: July 21, 2021. [Link](#).

“Hedgerows (CPS 422): Fibershed Quick Guide,” Fibershed, PDF. [Link](#).

“Hedgerows and Farmscaping for California Agriculture: A Resource Guide for Farmers, 2nd Edition,” Community Alliance with Family Farmers (CAFF), PDF, 2018. [Link](#).

“Hedgerows enhance bird abundance and diversity on farms,” Green Blog - UC Division of Agriculture and Natural Resources, Webpage article, 2012. [Link](#).

“Hedgerows for Biodiversity: A Beyond Pesticides Factsheet,” Beyond Pesticides, PDF, 2014. [Link](#).

“Hedgerows for California Agriculture: A Resource Guide,” Community Alliance with Family Farmers, PDF, 2004. [Link](#).

“Hedgerow Planting, Pollinators: Central Valley, Central Coast, Southern California,” The Xerces Society for Invertebrate Conservation, PDF, 2015. [Link](#).

“Hedgerows turn farm edges into bird habitat,” Audubon California, Webpage article. [Link](#).

“Planting a ‘Living Fence’,” National Wildlife Federation, Webpage article, 2018. [Link](#).

“Resource Page,” Hedgerows Unlimited, Webpage. [Link](#).

PLANT SPECIES SELECTION RESOURCES

Calflora's What Grows Here Tool

Link: <https://www.calflora.org/entry/wgh.html>

Use: Helps one identify native plants occurring in searchable areas of the state, say Marin County. Can use search filters, like growth form and native/non-native status to help narrow down plants that are more likely to be useful in hedgerow plantings, for example. We would recommend against the “riparian” and “low water tolerant” filters, despite the appeal. We have found that in many cases how they define these categories are limiting or inaccurate.

California Native Plant Society, Marin County Chapter

Link: Plant Lists for [Chaparral](#), [Under Oaks](#), [Riparian](#), [Grasslands](#) (linked by ecosystem type).

Use: Native plants, specific to Marin County, listed by ecosystem type.

Marin RCD's “Plant Species Adapted to Marin County, By Practice”

Link: <https://www.marinrcd.org>

Use: Native plants adapted to Marin County that STRAW and Marin RCD tend to use in Carbon Farming projects, separated by practice.

NRCS eVegGuide

Link: www.calflora.org/nrcs/

Use: Must create an account to use. Allows one to search plant lists by NRCS Practice. Then, one can see plant species, spacing, and co-benefits. Make sure to double-check this list with local plant lists, so as not to use a poorly adapted species.

Point Blue's *Climate-smart planting and design tool (Marin and Sonoma Counties)*

Link: <https://www.pointblue.org/climate-smart-restoration-toolkit/>

Use: An excel-based tool that lists California native trees, shrubs, and forbs adapted to Marin County. Also, lists plant soil and sun preferences and wildlife co-benefits associated with each plant. Helps one create a plant shopping list to take to the nursery.

POLLINATOR RESOURCES

“Carbon Farming for Pollinators,” NFWF, WCB and CARCD, PDF, 2021. [Link](#).

“Hedgerow Planting, Pollinators: Central Valley, Central Coast, Southern California,” The Xerces Society for Invertebrate Conservation, PDF, 2015. [Link](#).

“Homepage,” Pollinator.org, Webpage. [Link](#).

“Pollinator-Friendly Urban Spaces and Working Lands,” California Association of Resource Conservation Districts, Webpage article, 2019. [Link](#).

BIRD RESOURCES

“Bringing the Birds Back: A Guide to Habitat Enhancement in Riparian and Oak Woodlands for the North Bay Region,” K. Kreitingrand T. Gardali, Point Reyes Bird Observatory (PRBO) Conservation Science, California Partners in Flight Regional Bird Conservation, PDF, 2006. [Link](#).

“Supporting Beneficial Birds and Managing Pest Birds,” Wild Farm Alliance, PDF. [Link](#).

“Being the Best Nest Box Landlord for Songbirds in the West,” Point Blue Conservation Science, PDF, 2019. [Link](#).

TO LEARN MORE ABOUT INDIGENOUS STEWARDSHIP

“Indigenous Archaeology at Tolay Lake: Responsive Research and the Empowered Tribal Management of a Sacred Landscape,” Peter Andrew Nelson, PhD dissertation, UC Berkeley, 2017. [Link](#).

“Indigenous Uses, Management, and Restoration of Oaks of the Far Western United States,” United States Department of Agriculture & Natural Resources Conservation District, PDF, 2007. [Link](#).

“Indigenous Stewardship Methods and NRCS Conservation Practices,” United States Department of Agriculture Natural Resources Conservation Service, PDF, 2010. [Link](#).

Tending the Wild: Native American Knowledge and the Management of California's Natural Resources, M. Kat Anderson, UC Press, Book, 2005. [Link](#).

“Traditional Ecological Knowledge: An Important Facet of Natural Resources Conservation,” Natural Resources Conservation Service & National Plant Data Center, PDF. [Link](#).

The Archaeology of Refuge and Recourse: Coast Miwok Resilience and Indigenous Hinterlands in Colonial California, Tsim D. Schneider, The University of Arizona Press, Book, 2022. [Link](#).

4. SELECTION OF NATIVE PLANT SPECIES ADAPTED TO MARIN COUNTY

This list contain plants that have established successfully within our Marin County planting projects. Not all of these species will be appropriate on each site. Consider soil and site conditions, climate, and purpose. Check with local native plant nurseries for availability.

*Note: this list is not exhaustive.

Common Name	Scientific Name
American dogwood	<i>Cornus sericea</i> *
Arroyo willow	<i>Salix lasiolepis</i> *◇
Bigleaf maple	<i>Acer macrophyllum</i> *
Black hawthorn	<i>Crataegus douglasii</i> *
Blue elderberry	<i>Sambucus nigra ssp. caerulea</i>
Blueblossom	<i>Ceanothus thyrsiflorus</i>
Boxelder	<i>Acer negundo</i> *
California bay	<i>Umbellularia californica</i> *
California bee plant	<i>Scrophularia californica</i> *
California black oak	<i>Quercus kelloggi</i> *
California buckeye	<i>Aesculus californica</i> *
California coffeeberry	<i>Frangula californica</i> *
California/beaked/western hazelnut	<i>Corylus cornuta ssp. californica</i> *
California wax myrtle	<i>Morella californica</i>
California wild rose	<i>Rosa californica</i> *
Coast live oak	<i>Quercus agrifolia</i> *
Coast silk tassel	<i>Garrya elliptica</i>
Common snowberry	<i>Symphoricarpos albus</i> *
Coulter willow	<i>Salix sitchensis</i> *◇
Coyote brush	<i>Baccharis pilularis</i>

Douglas Fir	<i>Pseudotsuga menziesii</i>
Monterey cypress	<i>Hesperocyparis macrocarpa</i>
Northern California black walnut	<i>Juglans hindsii</i>
Oceanspray	<i>Holodiscus discolor</i>
Oregon ash	<i>Fraxinus latifolia</i> *
Pacific willow	<i>Salix lasiandra</i> *◇
Red alder	<i>Alnus rubra</i> *
Red elderberry	<i>Sambucus racemosa</i> *
Red willow	<i>Salix laevigata</i> *◇
Red-flowering currant	<i>Ribes sanguineum</i> *
Salmonberry	<i>Rubus spectabilis</i> *
Sticky monkeyflower	<i>Diplacus aurantiacus</i>
Thimbleberry	<i>Rubus parviflorus</i> *
Toyon	<i>Heteromeles arbutifolia</i>
Twinberry honeysuckle	<i>Lonicera involucrate</i> *
Valley oak	<i>Quercus lobata</i> *
White alder	<i>Alnus rhombifolia</i> *

* Indicates shrubs and trees commonly found in riparian corridors on surrounding ranches in Marin County and that typically thrive in moist/wet sites.

◇ Note: There are many non-native willows available at nurseries that are less adapted to our county. These non-native willows readily hybridize with our native Marin species, changing local genetics. To protect our local native willow populations, plant the native species listed here.

5. SOURCES

1. **“Bringing the Birds Back: A Guide to Habitat Enhancement in Riparian and Oak Woodlands for the North Bay Region,”** K. Kreitinger & T. Gardali, Point Reyes Bird Observatory (PRBO) Conservation Science, California Partners in Flight, PDF, 2006. [Link](#).
2. **COMET-Planner**, USDA Natural Resource Conservation Service, Colorado State University, Web tool, 2021. [Link](#).
3. **“Designing and Installing an Agricultural Hedgerow to Restore Native Pollinator Habitat,”** N. Neumann, University of Washington, PDF, 2016. [Link](#).
4. **Greenhouse Gas Equivalencies Calculator**, US Environmental Protection Agency (EPA), Website, Last updated: July 21, 2021. [Link](#).
5. **“Hedgerow benefits align with food production and sustainability goals,”** R.F. Long, K. Garbach & L.A. Morandin, UC ANR, PDF, 2017. [Link](#).
6. **“Insect decline in the Anthropocene: Death by a thousand cuts,”** D.L. Wagner, E.M. Grames, M.L. Forister, M.R. Berenbaum, D. Stopak, Proceedings of the National Academy of Sciences, PDF, 2021. [Link](#).
7. **“Native bees are a rich natural resource in urban California gardens,”** G. Frankie, R. Thorp, J. Hernandez, M. Rizzardi, B. Ertter, J. Pawelek, S. Witt, M. Schindler, R. Coville, V. Wojcik, University of California Agriculture and Natural Resources, PDF, 2009. [Link](#).
8. **“Pest Control and Pollination Cost–Benefit Analysis of Hedgerow Restoration in a Simplified Agricultural Landscape,”** L.A. Morandin, R.F. Long, C. Kremen, Journal of Economic Entomology, Volume 109, Issue 3, Web article, 2016. [Link](#).
9. **“Pollinators and Climate Change: Climate-Smart Agricultural Habitat,”** A. Laws, S. Jepsen, A. Code, K. Bolte, & S. Black, Xerces Society for Invertebrate Conservation, PDF, 2019. [Link](#).
10. **“Soil Health Key Points,”** USDA Natural Resource Conservation Service, PDF, 2013. [Link](#).
11. **“Supporting Beneficial Birds and Managing Pest Birds,”** J.A. Baumgartner, S. Kross, S. Heath, & S. Connor, Wild Farm Alliance, PDF, 2019. [Link](#).
12. **“Trees against the Wind,”** D. Hanley & G. Kuhn, Pacific Northwest Extension, Washington State University, 2003. [Link](#).
13. **“Western monarch population plummets: Status, probable causes, and recommended conservation actions,”** E.P. Pelton, C.B. Schultz, S.J. Jepsen, S.H. Black & E.E. Crone, Frontiers in Ecology and Evolution, Web article, 2019. [Link](#).
14. **“Western Scrub Jay”** National Wildlife Federation. Web page, no date. [Link](#).

A publication that highlights benefits of hedgerows, describes related conservation practices, and provides resources for land stewards to get started planting in Marin County and beyond!

TENDING THE EDGES:

The Benefits of Hedgerows on Bay Area Working Lands

MARIN RESOURCE



CONSERVATION DISTRICT

