Exploring Foodshed Health Field Guide

Paying attention to nature and how it is doing in and around local gardens, farms, and ranches—a guide to observing, monitoring, and citizen science

HEALTHY COMMUNITY FOOD SYSTEMS

Healthy Land, Healthy Food, Healthy People

Jim Dyer, Healthy Community Food Systems, Updated April 2024

See www.HCFS.org under the "Healthy Foodsheds" link for this Field Guide, updates and online resources, and a version of this guide specifically for the San Juan Mountain region.

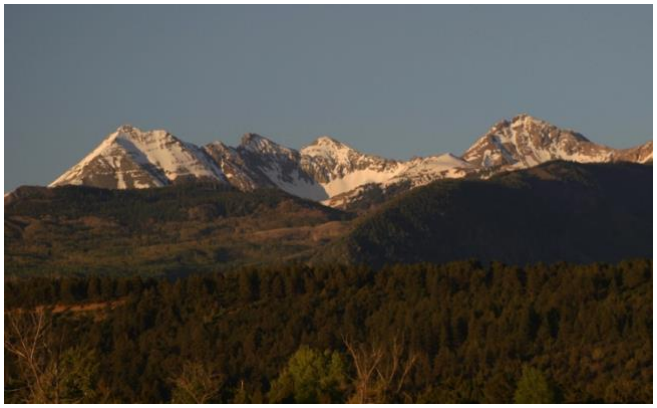
Connecting Food Systems and Ecosystems

1. How can our local food be healthy and abundant if not grown on healthy soils, with healthy water, and in healthy farm, garden, and ranch ecosystems?

Healthy Food

2. How can the soils, water, and ecosystems where this food is grown be healthy if the surrounding lands are not healthy—in other words, without a healthy local foodshed?

(and vice versa!)



Healthy Foodsheds

3. How can we expect local growers to keep producing this healthy local food now and into the future without healthy local foodsheds with rich biodiversity and a reasonable climate?

Healthy Growers, Eaters, & Future

Healthy Foodsheds → Healthy Food → Healthy People → Healthy Future

Why this Field Guide?

The ecological health of our local garden, farm, and ranch ecosystems and their surroundings is critical to our ability to produce healthy local food now and into the future. Ultimately, that health is critical to the overall well-being of our local area, our region, and our planet. To protect, restore, and strengthen these food-producing lands and the surrounding more wild ecosystems, we must be more aware of the health of our local foodsheds and how that health is changing over time.

Observing and monitoring indicators of foodshed health—such as pollinators, birds, earthworms, monarchs, pikas, seasons, and weather—can be a great learning experience, provide enjoyable and therapeutic time outdoors in natural settings, and if shared with scientists through citizen science activities, can contribute directly to a brighter future.

Challenges that farmers and ranchers face in producing the local foods we want call for our support of these growers at the market and in policies. Natural resource depletion, pollinator and biodiversity losses, extreme weather, and a changing climate are critical. We want more local food, and for it to be available into the future, so greater public awareness of these challenges through observation and monitoring can lead to greater local support for these producers and the foodshed health they depend upon.

The purpose of this guide is to encourage and support the exploration, by people of all ages, of local foodsheds in order to become more aware of how and why to protect, restore, and strengthen the health of these foodsheds, to connect more with nature, and to support our local producers as they deal with a changing world. With examples from our greater San Juan Mountain region, it can help guide similar efforts in any region where people care about their local food and foodsheds.

How to Use this Field Guide

Part 1: Understanding the Basics of Observing Foodshed Health—what a foodshed is, why its ecological health is important, and what types of observing and monitoring activities can help you explore your local foodshed. (**Page 4)**

Part 2: Getting Started—defining your local foodshed, learning what indicators you can pick from to observe and monitor foodshed health on your own or with people throughout your community, and making it fun and educational at the same time. **(Page 10)**

Part 3: Learning About Suggested Indicators—17 suggested indicators or topics you can choose from, and for each indicator critical issues related to food, how to observe, where to learn more, and citizen science programs ready to use. **(Page 19)**

Part 4: Making it Local—connecting with fellow observers and finding local partners, growers, local resource experts, best observing sites, and issues of most concern in your local foodshed. **(Page 41)**

Part 5: Developing Local and Regional Projects—project idea examples to help you decide how to connect and collaborate with others in foodshed monitoring and citizen science targeted to issues of local and regional concern. **(Page 47)**

Part 6: Going Beyond Monitoring—use what you are learning to help you engage in protecting, restoring, and strengthening your foodshed, make wise food choices, and support local food and those who grow it. **(Page 52)**

NOTE: Not living in Southwest Colorado? This guide uses many examples from our own San Juan Mountain region of Colorado, but is meant to help communities anywhere in the country. Sections 4 and 5 feature sample organizing suggestions for our local area as examples which should help you pursue local and regional collaborations wherever you may live.

Field Guide and resources online at HCFS.org under Healthy Foodsheds menu
Questions and suggestions welcome: jimdyer30@gmail.com

Part 1—Understanding the Basics of Observing Foodshed Health

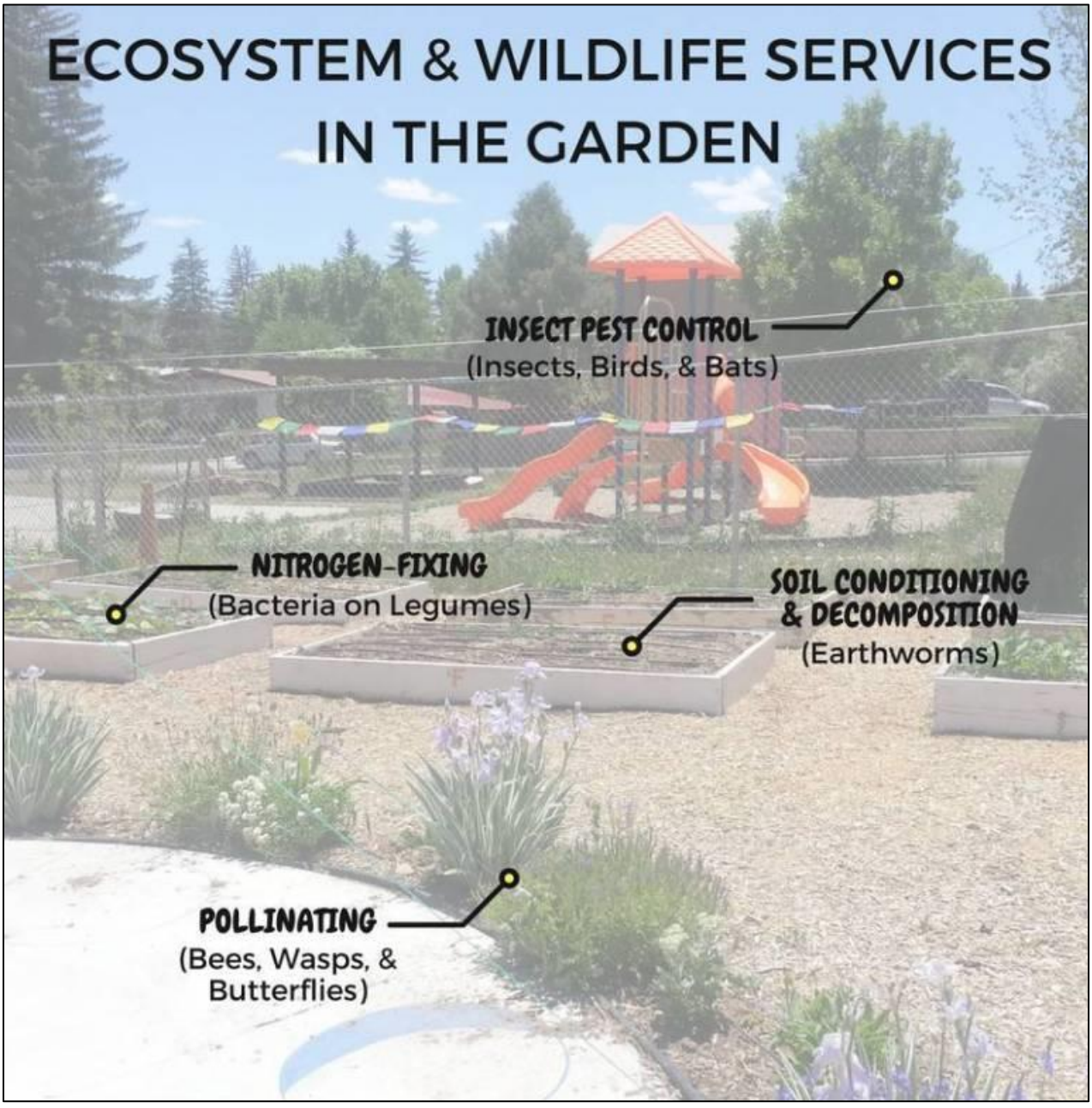
The local foodshed, as we suggest considering it, is the area, perhaps a county or two, 1) that you should look to first for your food and 2) that you should feel most responsible for in terms of its overall health and ability to maintain sustainable food production.

Since the managed ecosystems that we call our gardens, farms, and ranches are so ecologically interconnected and interdependent with their surrounding ecosystems, we actually consider those surroundings as part of the foodshed.

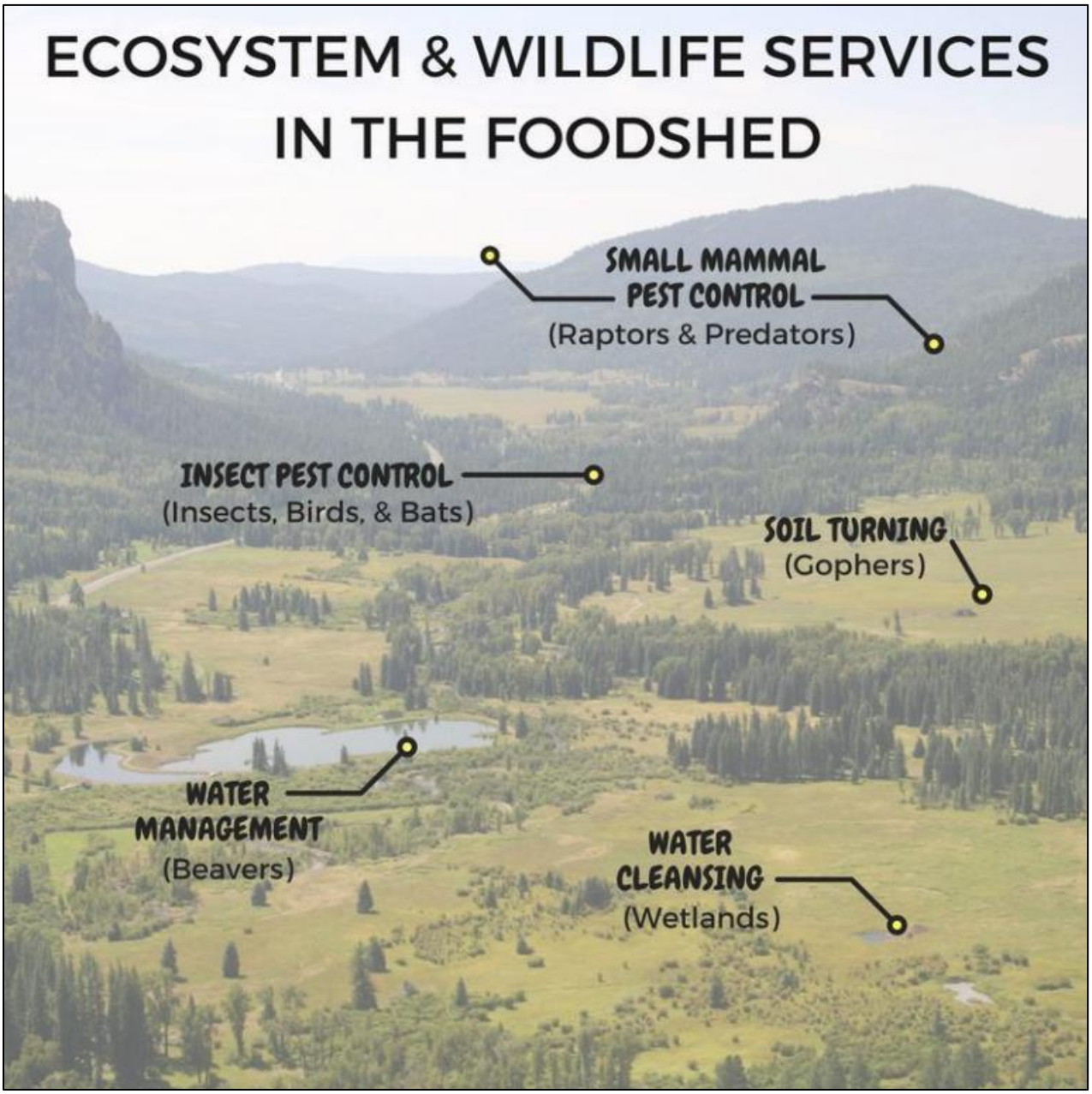
Local foodsheds are obviously nested together into more regional foodsheds, so this can be a bit subjective, which is fine—the point is to actually think about local foodsheds and their health. More on deciding what comprises *your* local foodshed is found in Part 2.

Foodshed health in its broader food system sense encompasses not only ecological health, but economic and social aspects as well—fair compensation for farmers and farm workers, resilient community economies, humane treatment of all animals, healthy foods, social justice in wages and food access, and much more. In this guide we focus on ecological health, but always in the broader food system context of everything that contributes to healthy local food for all community members and fairness and compassion for all beings, human and otherwise—now and sustainably into the future.

Ecosystem & Wildlife Services for Food Production: Wildlife and ecological processes in gardens, farms, ranches, and surrounding ecosystems can provide a number of services essential to food production. Many industrial agricultural attempts to "improve" on these services by overreliance on synthetic fertilizers, pesticides, herbicides, and fossil fuels have proven unsustainable and often destructive of these natural processes. Biologically based food production, on the other hand, depends on these natural services and will be more and more important in the future as the climate changes and fossil fuels decline. The health of the garden, farm, or ranch ecosystem can be indicated in part by the abundance of several easily observed organisms involved in providing these ecosystem services as seen below.



Seeing the Big Picture: While it is practical, as seen below, to focus on observing and monitoring over time a number of specific**,** readily observed, and easily measurable observation targets, it is essential to take time to view the farm, garden, or ranch ecosystem as a whole. Equally critical is viewing these food producing ecosystems in the context of the surrounding ecosystems—what we call the greater foodshed. Taking time to do so, as described more fully in Part 2, will put your more specific observations in a more useful and revealing perspective.



Indicators of Health for Gardens, Farms, Ranches, & Beyond: Within this "big picture," the presence and numbers of many of the ecosystem service providers mentioned above can be seen as indicators of the health of those growing areas and of the whole foodshed. In addition, some wild species may not aid us directly as much in growing food as they indicate the health of the overall ecosystem on which our food production depends.

For example, dragonflies certainly eat agricultural pests, but are better known as good indicators of the quality of the water in an area. Watching for indicators *beyond* the garden, farm, or ranch can provide clues to the health of the whole foodshed—an example being the pika in the high mountains, which indicate how much warming is happening up where the snowpack that our irrigation supplies come from actually accumulates.

Modes of Observation—for gardeners, farmers, ranchers, and community members depend on the observer's age, objective, observing target, time, and personal preference.

1. **Unstructured observing**—driven by curiosity and aided by quiet time in the setting. (Our choice as the most basic skill to develop for a lifetime.)

2. **Structured observing** as above with an objective specified.

3. **Measuring or counting**—skill-building for students of all ages.

4. **Monitoring**—measuring or counting over time.

5. **Sharing observations** with others informally.

6. **Sharing with scientists** and others through national citizen science programs to increase scientific knowledge and solutions.

7. **Developing local observing programs**—sharing observations among observers, scientists, and organizations in a local citizen science project with a specific local objective.

All these modes of observation are valuable, and we suggest that you strive for a balance between structured and unstructured, and formal and informal sharing.

Observing and Support Options for All Ages:

- **Everyone:** Observing casually as in #1 and 2 above is well suited to and highly recommended for all ages as a therapeutic, learning, and awareness-building life skill.
- **Preschools:** Simple observing, measuring, and counting can readily start in preschool. If the teacher serves as the photographer, recorder, and communicator, even some citizen science programs are appropriate for young students. See Cornell's Bird Feeder Watch for example.
- **Elementary and middle schools** can be involved, especially if the teacher or coordinator provides some technical support.
- **High school students** can get involved further by designing projects, analyzing data, interviewing, and more.
- **Farmers and ranchers**, especially those selling to schools can serve as technical resource experts for school projects and can do parallel observations on their land to share with students.
- **Adults** from all backgrounds can act as casual or citizen science observers, technical resource experts (ornithologists, entomologists, naturalists, etc.), or support for school projects.

A habit to develop and enjoy for a lifetime.

Citizen Science—monitoring and reporting observations to the scientific community—can provide an opportunity to learn about serious issues in a positive and constructive way. We see that simply hearing about serious issues such as climate change and wildlife losses can lead to ignoring them or feeling helpless to address them. In citizen science, the acts of learning and then contributing to solutions are elegantly combined in the process of observing and reporting those observations to the scientists. These activities can also elevate the field of science in the public's eye, which is sorely needed today especially in regard to climate change.

Note: In no way does the use of the term "citizen" here indicate anything about immigration status. The term is meant to be completely inclusive, international in scope—best thought of as "earth citizen" or "planet citizen."

Many citizen science projects already online and ready to use—we have included in Part 3 dozens of national citizen science programs you can participate in. Data can usually be submitted by smart phones as well as computers, or recorded in notepads for later entry (especially if you want to avoid phone use outside).

For schools, many citizen science programs are designed to meet curricular standards in several fields of study. Prestigious science organizations such as Cornell University, Chicago Botanic Garden, National Phenology Network, and the Xerces Society run these programs. Ideally, schools, farmers, ranchers, community science experts, nature centers, and others would be involved together, sharing findings locally, regionally, as well as nationally. Local groups also can collaborate with scientists on designing their own citizen science monitoring programs to address issues of special concern to the local community.

In citizen science, the acts of learning and then contributing to solutions are elegantly combined in the process of observing and reporting those observations to the scientists.

budburst
a project of the Chicago Botanic Garden

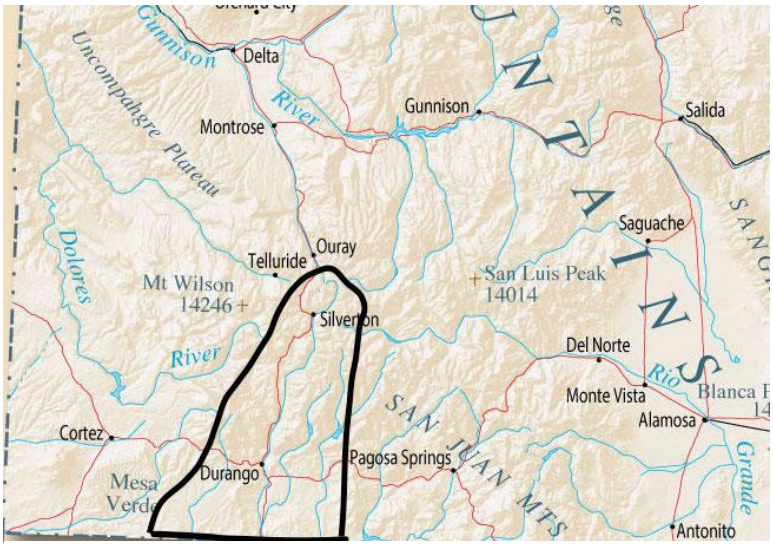
Part 2—Getting Started

Step 1—Determine What is *Your* Foodshed: The local *food system* can be considered everything done in your area that contributes to what people eat—local food production, importing food from elsewhere, distribution, processing, marketing, consumption, and "food waste" management. A more tangible way of considering these activities is the local *foodshed*, which is simply the landscape where these activities happen and clearly emphasizes the connection between healthy food and healthy land or, in other words, between healthy food systems and healthy ecosystems.

a) Envision your local foodshed: This is up to you and your community partners, but we suggest that the local foodshed be considered:

1) the area that you look to *first* for your food, and 2) the area that you feel most responsible for.

From this you could conclude that your own garden would be your local foodshed, but for practical purposes and community action, we suggest you consider your county (or tribal chapter or small reservation) and perhaps one or two neighboring counties as best fits your specific needs. You need not follow county lines though—boundaries may take into account many influences including:



Sketch of area we at HCFS see as our most local foodshed

- **Watersheds** since water quantity and quality are so critical.
- **Political boundaries** since the ability to affect policy is essential.
- **Ecosystems surrounding food production areas** since the health of both are intertwined.

b) Consider where food system activities are occurring: Where are gardens, farms, and ranches located? Where are the prime farmlands and irrigation, if needed? Where do processing, transport and distribution, and marketing take place?

c) Consider the overall landscape: What land uses and ecosystems surround your food production areas? Where are the headwaters, rivers, lakes, reservoirs, groundwater sources? What is your airshed? What wild and natural areas are nearby? We strongly suggest that you consider the ecosystems that surround or are included within your food-producing ecosystems be considered part of your overall foodshed.

Don't overthink this—we all know that we rely on neighboring and overlapping or "nested" foodsheds at times for different seasons and different products. Just select an initial area as best you can, given the two criteria above, and get started.

d) Mapping: You may want to create a map of your foodshed, which can be helpful, but beware of getting bogged down in too much detail and missing out on getting started with your observing. A simple sketch of your foodshed on an existing base map can be all you need, leaving any additional mapping as a future option. For more on creating a more detailed layered map of your foodshed and including broader food system data as a context for your observations, see our Mapping Your Local Foodshed guide.

Our Local Foodshed—the Southern San Juan Mountains in Colorado: We at HCFS like to consider La Plata and San Juan County, Colorado as our most local foodshed. The boundaries are a combination of watershed, state, and county boundaries. We include the high altitudes of San Juan County not so much because of food production, but since it is the source of much of our water. We exchange food with neighboring counties, but we have plenty to do to be responsible for this area. We also exchange food with New Mexico, right next door, but politically, we have much less influence there. We are blessed with many surrounding natural ecosystems and wild areas that we feel responsible for as we do for our agricultural areas. The photo below shows a representative part of what we see as our local foodshed from our small farm.

Step 2—Make Unstructured Observation a Priority

Being outside, observant, curious, and "connecting" with nature: Far from being a nice side-effect of observation and monitoring, we should acknowledge upfront the fundamental value—for people of all ages—of being outside, alert and curious, away from "screens", preferably quiet, sometimes alone, sometimes in small groups, sometimes moving, sometimes very still, paying less attention to oneself and equipment and more attention to nature. While we give plenty of attention here to structured observations, data collection, and focused citizen science projects, we can't emphasize enough the importance of quiet time outside in natural settings. That's why my favorite additions to food gardens are benches, shade, observing towers, hideaways, and spots for afternoon naps.

Writers—from Thoreau to John Muir to Ed Abbey (some of my favorites) and many in between—have proclaimed the value of these activities to our psyches, to our mental and physical well-being, and to no less than our personal worldviews. Reading such authors can bring rich insights to your time outdoors—and even better if read outdoors!

Opportunities abound for all ages for connecting with nature, and we simply are suggesting that this can happen as well in garden, farm, and ranch ecosystems that retain some significant natural elements.

For children, a number of exciting and innovative programs, initiatives, and movements reflect the opportunities:

- Natural Start programs including design of natural spaces for kids around schools
- Forest schools
- Forest kindergartens or "waldkindergartens"
- Nature preschools
- Young garden naturalists
- —as well as our own Wild School Gardens program

Step 3—Take Time to Observe the Big Picture

Here are some questions to help you look broadly but carefully at the overall issues involved in foodshed health—at least those that are apparent visually. The answers to many of these questions tend to be subjective, and rightly subject to interpretation by experts (growers, scientists, etc.). Nevertheless, it is important for anyone concerned about the health of their food and of their foodshed to be aware of these issues. It is critical for those who value local food and foodsheds to support funding of scientists and agencies, to talk to growers, and to get involved in observing and monitoring some readily observable indicators—and if possible, contribute their observations to scientists.

Take a close look: As you look at a farm, garden, or ranch, look for signs of ecosystem service processes, wildlife, and general indicators of health:

- Do the crops look healthy and well-watered?
- Are the livestock healthy looking, able to be outdoors, and socializing?
- Do you see a healthy level of complexity and diversity or mostly uniformity (monocultures)?
- Are invasive weeds prevalent?
- Can you hear or see bees and other pollinators?
- Are there nectar sources for pollinators and insects (needed through the growing season)?
- Do you see raptors at work?
- Do you see field margins or hedgerows where beneficial insects, birds, bats, and other animals can live and forage?
- Is most of the soil covered by vegetation?
- Are there signs of soil erosion by wind (dunes, drifts, etc.) or water (gullies, deposits, etc)?
- Are irrigation ditches eroding?
- Is there visible salt build-up on the soil?
- Can you tell if the water leaving the farm looks as good, or even better, than that entering the farm?
- What else do you see that you could ask growers and resource experts about?

(See the Appendix for this list as a worksheet.)

Eyes on the broader landscape:

Find a convenient vantage point to view the whole landscape:

- Does the watershed around the farm, ranch, or garden appear healthy, well covered with vegetation, and not overgrazed or eroding? Are there abrupt differences at fence lines that indicate possible problems? Are there visible contaminants in rivers, ditches, or ponds.
- Are birds prevalent and moving freely across the landscape?
- Are there suitable corridors around the food growing areas so that wildlife can travel across the landscape?
- Are there human activities on lands around the farms, gardens, and ranches that appear disruptive to water flow, soils, wildlife, air quality, and healthy food production?
- Do you sense a level of coexistence and mutual dependence between the human-managed ecosystems and the wilder surrounding ecosystems or more of an imbalance?
- What else do you see that you could ask growers and resource experts about?

(See the Appendix for this list as a worksheet.)

Step 4—Learn How Key Indicators of Foodshed Health are Observed and Monitored

Key indicators: There are many indicators, or observation targets, that professional scientists observe, study, and monitor that reflect the health of ecosystems—including those where our food is grown—but most fall into the following categories.

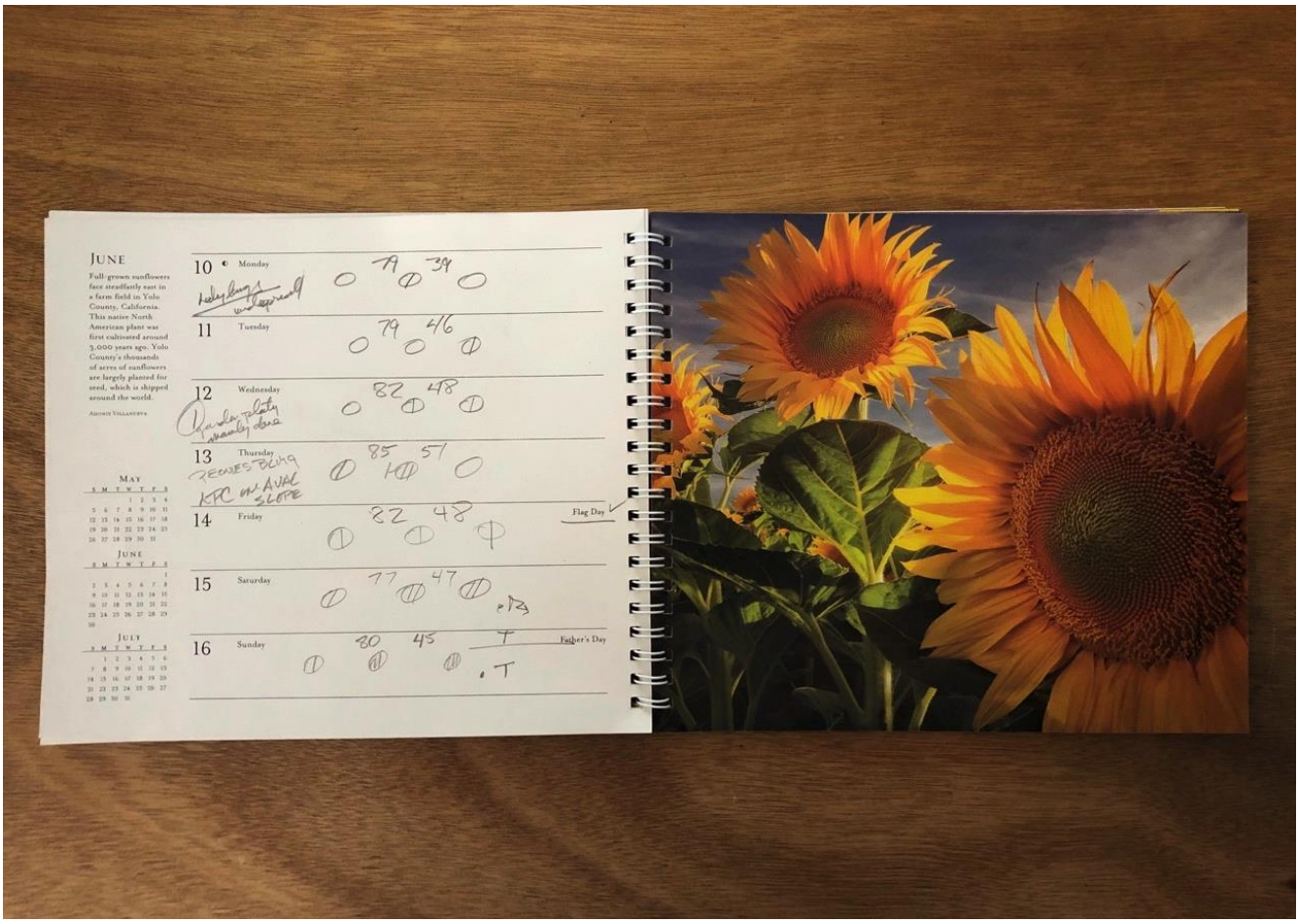
1. Abundance of beneficial, problem, and indicator insects and other wildlife
2. Seasonal occurrences and timing or "phenology"
3. Weather, extremes, and climate variability
4. Water quality and quantity
5. Soil erosion and other soil health indicators
6. Air quality including visibility
7. Ecosystem functions, disturbances, recovery after disturbances, and structural changes
8. Agriculture and food production reports

Citizen scientists can help fill in the geographic gaps in professional monitoring: Many indicators, especially those in categories 3-7, are routinely monitored by scientists and agencies and much of their data is available online, for example stream flow and snowpack reports, temperature and precipitation, larger scale food production censuses, etc. The opportunity for citizen scientists is to add finer detail geographically and data from more remote areas.

For example, government agencies monitor precipitation at official sites across the region, but there are gaps between those stations where citizen scientists can observe and report much-needed snow and rain totals especially for storms of a scattered nature such as thunderstorms that are critical for individual growers. Similarly, water quality data is commonly reported by schools and others to augment professional observations as part of programs such as River Watch. Citizen scientists can report frost and freeze dates—so important to growing food—that vary greatly in between official stations due to microclimates in fields and gardens across the landscape.

Citizen scientists can help with targets less frequently monitored by agencies, such as the first two target areas above: insects and other beneficial wildlife, and phenology or seasonal occurrences such as fruit or vegetable blossoming and pollinator arrival dates. Many organizations, such as the Xerces Society for pollinators and other insects, Cornell and Audubon for birds, and Nature's Notebook for tracking phenology provide plenty of support for citizen scientists with these observations.

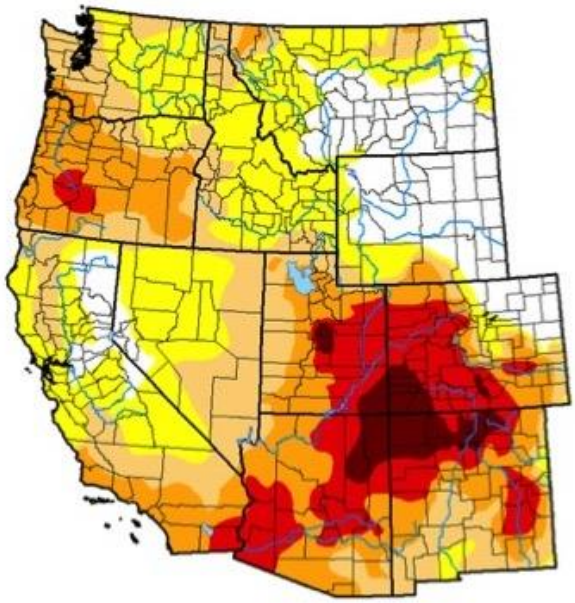
Make recordkeeping a habit—Many people keep records, so incorporating some of these indicators into your daily journal, diary, trip notes, or photo files is a great way to keep track a bit more precisely of what you are seeing. Farmers, ranchers, and gardeners are urged to keep detailed records of planting and harvesting dates, critical weather events, crop yields, and much more, so incorporating some of these foodshed indicators is an easy start. I typically record in my desk calendar our daily temperatures, cloud cover, rain, snow, eggs gathered, special animals seen, and first occurrences in the year of blossoms, birds, harvests, and more—some of which I report formally, but all of which I keep to make comparisons year to year.



Whether you are mostly a curious and concerned observer or one who regularly submits what you see to professional scientists as a citizen scientist, you are contributing critically to greater awareness and understanding of the need for healthy foodsheds, for now and into the future.

Step 5—Keep Up-to-date on Professional Monitoring and Research:

It is very useful to follow what the professional scientists and agency personnel are monitoring in all these targets above—monitoring the monitors in a sense. Bookmarking your favorite websites to check on daily, weekly, or monthly can allow you to easily see indicator trends, things that may affect local growers, and provide a context for your own observing and monitoring.



Drought Monitor 21 August 2018

To find monitoring data from scientists and other professionals for your area, search online for data, agencies, and groups such as these:

- Your "State Climate Center" and the "Regional Climate Center" for your state
- Agricultural weather, climate, drought, and crop evapotranspiration data for your state
- CAP/RISA Teams for your region—for current climate, drought, and water supply data and outlooks
- Snotel—daily snow data for many sites in western states from NRCS
- Your state's department of water—for river, reservoir, and other water data
- Western Snowpack and Water Supply
- Regional scientific nonprofits—for key foodshed-related issues in your area
- Your state departments of biology, conservation, and wildlife—for info on species of concern, regional conservation issues, and other data
- Regional and national scientific birding groups—for rare bird alerts, migration data, and species of concern
- Forest health groups—for pressing local issues facing your forests and watersheds
- Local and regional college and university departments of natural resources, biology, conservation, and agriculture—for scientific data and research

Step 6—Pick a Few Indicators and Get Started:

Decisions, decisions—The most important thing is to decide on what will work well for you—there are so many different targets to choose from and so many different ways to observe. You may already be observing or monitoring now, so deciding what more you can do is the pertinent question for you. We suggest considering:

- **What to start with?** To begin, pick just one or two items to observe and monitor—things that you are curious and passionate about. Not too many things to start.

- **Formal or informal observing?** Decide whether you will observe in a more informal manner or—if you are inclined—monitor over time more systematically.

- **Formal or informal reporting?** Decide if you will share what you see with friends informally, or also report observations to colleagues, fellow observers, or to scientists through citizen science projects. Whichever method you choose is a contribution.

- **Alone or with others?** If you would like to actively work with others in your area on observing and monitoring:

    - Find out what is happening in your area now

    - Check out Part 4 on the many ways you can work with others

Mix it up & keep it fun—Keep in mind that you most likely will do a combination of the above. You might, for example, simply keep an eye out for those aphid-eating ladybugs in your garden and record them in your garden log while committing to monitoring bumblebee pollinators through the Bumblebee Watch citizen science program. Keeping an eye open for specific birds, insects, wildlife, or other targets can be part of your daily routine while walking, running, gardening, driving (no texting), hiking, or sitting in the garden at the end of a long day. Such routine observations can help you monitor trends over time quite easily—which can be very useful to scientists if reported as well.

We do recommend a mix of formal and informal observing and reporting that suits your time, passion, and personality. With enough people involved, all with varying interests, community knowledge and awareness increases broadly, and scientists get the help they need. Starting slowly with one or just a few targets and increasing your observing and reporting over time as you see fit is best. As you get to know fellow observers, your opportunities will likely multiply.

Part 3—Learning About Suggested Indicators

We have compiled details for these specific indicators or target areas that we suggest you consider—including why they are important, their relationship to food production, suggested observing activities, sources of more information, and already established citizen science programs that you can join if you wish. So far, we have this guidance for:

- **Insect Pollinators—**a wide range of pollinating insects with bumblebees highlighted next
    - **Bumblebees—**an especially easy pollinator group to identify
- **Birds**—as beneficials and indicators of foodshed health with hummingbirds highlighted next
    - **Hummingbirds**—primarily as non-food pollinators
- **Weather & Climate**—weather conditions year-to-year and climate trends
- **Phenology (Seasonal Happenings)**—timing of natural events through the seasons
- **Ladybugs**—as beneficial insects
- **Monarch Butterflies**—as indicators of agricultural impacts and other stresses
- **Dragonflies**—especially as indicators of water quality
- **Pikas—**as indicators of changing high altitude temperatures and snowmelt timing
- **First Occurrences—**during a season, or simply "Firsts"
- **Fruit & Vegetable Varieties**—suitability under year-to-year growing conditions and a changing climate
- **Monitoring Migrations & Seasons**—on the local as well as large scales
- **Soil**—physical, chemical, and biological characteristics as indicators of soil health
- **Water**—quantity and quality indicators
- **Wildlife**—in addition to other specific animal targets in this section
- **Extreme Events**—extreme weather, especially flood, drought, and extreme heat; beetle kill; and other events usually related to a changing climate

Insect Pollinators

Observation Target: A wide range of pollinating insects with bumblebees highlighted on the next page.

Importance to Food & Agr: Many foods are dependent on pollinators rather than wind and other mechanisms. ***Bees are responsible for every third bite of food!!!***

Issues: Domestic honeybees, imported and raised by humans, are in decline most likely due to pesticides, stress from moving, and diseases. Alternate pollinators—solitary bees, bumblebees, etc—are also impacted by domestic bees, pesticides, habitat loss, and more—and will be needed even more as domestic bees decline. Warming temperatures may put pollinator arrival timing out of sync with blossoming.

Observing Options: Types of pollinators seen—domestic bees, native and solitary bees, wasps, butterflies, flies, and beetles—including numbers seen, plants pollinated, and arrival and departure dates especially in relation to blossoming of plants to be pollinated. Build bee boards for solitary bees and monitor egg laying.

Citizen Science: Great Sunflower Project—Watch and submit simple counts of pollinators (especially bees) visiting flowers (especially sunflowers) to help scientists study and protect these diverse pollinators. One of the easiest pollinator projects to start with. Also see "Bumblebee Watch" in the Bumblebee section.

Getting Started Tip: Being able to recognize the basic difference between a bumblebee, a carpenter bee, and a western honey bee will help you submit your observations to the Great Sunflower Project or just be a better observer. See this slideshow to tell flies, wasps, and these three basic bees apart. You can also go to iNaturalist's Observations page and select a species and your location or state to see photos of what has been observed in your area, and you can use their app for submitting your photos and getting help with identifying what you have seen.

Additional Resources: For more background see Great Sunflower Project site above, and Xerces Society website, which also has pollinator conservation info including how to attract and support pollinators with native plants.

Bumblebees

Target: Bumblebees as key insect pollinators that are especially easy to identify as a group

Importance to Food & Agr: Pollinators of wild and agricultural plants. One of the easiest bees to recognize due to their size and "bumbling" movements.

Issues: Many species rare and endangered, so reports from citizen scientists are very helpful to scientists. Pesticides and habitat loss are threats.

Observing Options: Species types and arrival and departure dates relative to blossoming dates of crops.

Citizen Science: Bumblebee Watch helps you identify species in photos you submit online which are then used to track rare and threatened species. You simply submit your photos, use their online key to make your best guess as to species, and the scientists will confirm or correct it.

Getting Started Tip: Check the observation key on the Bumblebee Watch site above so you know the basics of what to look for in identifying species, whether you post sightings or not.

Additional Resources: More background can be found at the Bumblebee Watch website above and see Xerces Society's Bumblebee Conservation for creating and restoring bumblebee habitat.

Birds

Target: Birds as beneficials and indicators of foodshed health—with hummingbirds as pollinators highlighted on the next page

Importance to Food & Agr: Birds are critical in eating a wide variety of pests affecting crops and livestock including insects and small mammals. They can also indicate the quality of the garden, farm, and ranch ecosystem and the broader foodshed especially in relation to pesticides and habitat.

Issues: Birds are threatened by many factors including agricultural pesticides and habitat loss due to monocultural agriculture and elimination of hedgerows and wild margins around fields. Climate change can add to these stresses on birds.

Observing Options: Watching for birds eating insects on specific crops and noting the time of their activity in the growing season can be very instructive. It is not uncommon for large numbers of insect-eating birds to descend on the garden or field for a short time when insects are abundant. Recording these occurrences from year to year can indicate trends. As indicators of ecosystem health, specific birds of conservation concern can be monitored, or simply the abundance and diversity of birds and sightings of uncommon species.

Getting Started Tip: Joining a local bird club can help you with identification, finding birding hotspots in your area, and company on your bird outings. Cornell's Merlin ID helps you identify birds with species descriptions, sound recordings, photo ID, maps, and more.

Citizen Science:
Cornell University Citizen Science sponsors a number of programs that help scientists study and conserve birds. eBird allows you to submit your sightings of specific birds very flexibly—such as every bird you saw on a birding hike, or just a favorite or rare bird you happened to see, and to sign up to receive alerts of rare birds seen in your area.

Project Feeder Watch is for all ages, but well suited to a schoolyard setting and can even been used by preschool children who point out birds seen that match pictures on their classroom walls.

Audubon's Climate Watch volunteers survey three species of bluebirds, four species of nuthatches, two goldfinches, Painted Buntings, and two towhee species twice a year. You can join experts in these surveys, or simply look especially for these climate-sensitive birds and report on eBird.

Bird watching events that you can participate in include The Great Backyard Bird Count each February, and Audubon's Christmas Bird Count.

One of our favorite birds, the American Dipper or ouzel is a wonderful bird to watch for (and report on eBird) as it forages on invertebrates underwater in rivers. As such, it can indicate river water quality after floods, fires, or pollution events.

Additional Resources: See Cornell Lab of Ornithology and Audubon for bird identification apps, webcams, and much more. Wild Farm Alliance's **free pdf** "Supporting Beneficial Birds and Managing Pest Birds" connects birds directly to foodsheds and food production.

Hummingbirds

Target: Hummingbirds as primarily non-food pollinators and indicators of general foodshed health.

Importance to Food & Agr: Hummingbirds generally pollinate non-food plants, but are so fascinating, noticeable, and vulnerable that they are useful as indicators of healthy foodsheds as a whole.

Issues: Habitat loss and destruction threaten many species of hummingbirds, both here and in countries that they migrate to. Climate change is causing earlier blooming of flowers and may result in hummingbirds arriving at the wrong time for pollination.

Observing Options: Arrival, departure, numbers, and flowers that they feed upon. Sugar water feeders are popular, but in some areas such as here in Durango, they may attract bears creating human-bear conflicts which can result in bears being euthanized. Native flowering plants are a good alternative.

Citizen Science: eBird can be used to submit sightings of hummingbirds and all other bird species.

Getting Started Tip: Get to know which hummers are common in your area to narrow things down. In our Four Corners area, learning the wing sound of the Broad-tailed Hummingbird helps a lot.

Additional Resources: See the Smithsonian Migratory Bird Center, the Hummingbird Learning Center, and Audubon's website above for background on hummers as well as hummer-friendly native plants.

Weather & Climate

Target: Weather conditions year-to-year and climate trends.

Importance to Food & Agr: Few things are as important to growing food as temperatures, precipitation, and other weather variables. Day length and weather are the main determinants of the life cycles of our food crops, and of many ecosystem services to agriculture.

Issues: Climate change is increasing variability in weather and bringing weather extremes and longer term trends that are and will continue to disrupt agriculture, by posing severe challenges to food producers.

Observing Options: Recording of precipitation daily is probably the easiest observation, followed by maximum and minimum temperatures for each day. The date of the last spring freezing temperature (32F), and the first date in the fall allow you to determine the growing season and compare year-to-year with crop yields. If observations on site are not possible, you may find a nearby observing site that you can obtain data from. Soil thermometers are readily available for measuring soil temperatures that relate directly to optimal planting times and crop development.

Citizen Science: Colorado State University's National CoCoRaHS network (Community Collaborative Rain, Hail, and Snow Network) of volunteer weather observers is one of the best networks around. Check their site to see if they already have a volunteer very close to you, or hopefully become an observer yourself. Best suited to older students and adults, there are easy training materials on the site. The approved rain gage that they offer costing about $30 is all that is needed.

I See Change allows you to post what changes you are seeing around you as weather and climate change. This can include numerical observations, but especially how the changes you see affect you and the world around you including fires, extreme or unusual weather, growing conditions, drought, "first of season" events, and much more. You can also see posts from others in selected areas nearby.

Start-up Tips: Get an inexpensive manual rain gauge first ($15 or less is common). The top of a rain gauge should be level and, in most cases, as far from any obstacle (building, trees, etc) as that obstacle is high (and above the top of the post it is mounted on of course).

Google "Max-Min thermometer" for recording high and low temperatures and "soil thermometer" for soil temperatures. With children it's best to get spirit-filled/alcohol-filled thermometers rather than mercury. Thermometers or temperature sensors should never get direct sun, should be about five feet off the ground if possible, and get good wind ventilation.

Additional Resources: HCFS's Jim Dyer is a meteorologist who can provide technical advice and educational resources as needed.

Phenology (Seasonal Happenings)

Target: Phenology—timing of natural events through the seasons.

Importance to Food & Agr: Phenology refers to seasonal happenings with respect to climate, plants, and animals. The timing of fruit blossoms year-to-year and the arrival of pollinators, pests, beneficial insects, and birds are all examples of phenology. Timing of these occurrences is critical to food production.

Issues: Besides variations from year-to-year, long-term changes, disruptions, and mismatches in timing due to climate change are of increasing importance, often requiring adaptations in our growing systems.

Observing Options: Recording (and celebrating) dates of first leaf, blossoming, and fruiting are common activities as well as arrival dates of pollinators, beneficials, and pests (see First Occurrences section).

For an established recording site, such as a home, garden, or school, having weather observations of max and min temperatures and precipitation—from onsite or from a nearby observer—is very useful in making sense of the variations from year to year (see Weather & Climate section).

In mountainous regions, blossoming dates of alpine plants from year to year can illustrate interesting and critical trends in high-altitude climate.

Citizen Science: There are a number of excellent programs to chose from, including:

Nature's Notebook: A very comprehensive program with detailed guidance for reporting seasonal occurrences for many plants and animals, including domestic fruits and vegetables.

Journey North: Allows you to submit arrival dates of several key migrating species, and view maps of their movement north in the spring. Special activities for kids included.

Project Budburst: Share your observations of blossoming of any one of hundreds of plants, mostly wild, but a few crops.

Getting Started Tip: Look for "First Occurrences" and report some of them on Journey North. Then pick out a favorite target and dig deeper with one of the citizen science programs above.

Ladybugs

Observation Target: Ladybugs (or lady beetles) as beneficial insects

Importance to Food & Agr: Ladybugs are very beneficial insects controlling harmful aphids. A ladybug can eat 5000 aphids in its lifetime.

Issues: Many native species are becoming rare—especially the nine-spotted ladybug, and scientists are trying to find out why.

Observing Options: Presence, absence, species (if possible), numbers, larvae and adults, presence of aphids, arrival dates, and dates last seen.

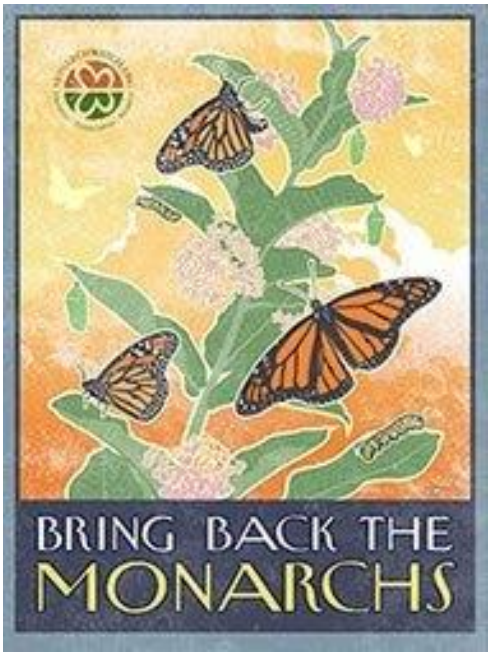
Citizen Science: Send photos to Cornell's Lost Ladybug Project for identification and to help scientists protect them. We are hesitant to recommend chilling them, as advised by some, for photography—try burst mode on your smartphone instead for a moving bug.

While the Lost Ladybug project is one of the best projects, they are having some funding issues, so it may not always be available for posting. You can also report ladybugs on Journey North under Sunlight and Seasons and on Nature's Notebook, you can report the convergent lady beetle, which is a pretty easy one to identify.

Getting Started Tip: Practice taking photos of these quick little creatures so you can capture good photos for yourself and ones that will allow the Lost Ladybug experts to identify them.

Additional Resources: See All about Ladybugs From Cornell.

Monarch Butterflies



Target: Monarch Butterflies as indicators of agricultural impacts and other stresses.

Importance to Food & Agr: Indicator of excessive herbicide use and removal of hedgerows causing loss of their host milkweed plants. Monarchs have the best-known long-distance insect migration—from Canada and the US to Mexico, and numbers are dropping dramatically.

Issues: Milkweed loss as above is aggravated by GMO crops allowing increased spraying. Migrating populations are imperiled by wintering habitat losses in Mexico and California and winter weather impacts. There is much uncertainty and concern about monarchs that winter along the US Pacific Coast, and where they migrate, so observations in our region are important for those populations as well.

Observing Options: Arrival and departure dates, numbers, presence of milkweed species host plants.

Citizen Science:
Journey North's Monarch Butterfly Project allows you to report Monarch sightings and track their progress on maps, population status, weather, and much more.

The Western Monarch Milkweed Mapper focuses on declining monarch populations across the Western US and seeks postings of your monarch and milkweed observations.

The Southwest Monarch Study gives you several ways to report your sightings in an effort to better understand monarchs and their migration in this area, and even help tag monarchs for tracking.

Getting Started Tip: Become familiar with locations of milkweed in your area so you can be on the lookout for monarchs as they emerge or move into your area.

Additional Resources: Monarch Watch promotes planting of milkweed species where needed and has many conservation and education activities. See Monarch Conservation site from Xerces.

Dragonflies

Target: Dragonflies—especially as indicators of water quality

Importance to Food & Agr: Prey on mosquitoes, midges, and biting flies that can affect livestock as well as humans, but also a good indicator of water quality including mercury. Because they are mobile and like warmth, they are indicators of climate changes as well.

Issues: Impacted by loss of wetlands, poor water quality, and pesticides—all associated with industrial agriculture.

Observing Options: Types, arrival and departure dates for migrating species, emergence dates in spring for resident populations, and occurrence of swarms (due to unknown causes).

Citizen Science: Odonata Central has a fairly technical citizen science observing app for your phone or you can go to iNaturalist's Observations page and select dragonflies and your location or state to see photos of what species have been observed in your area, and you can use their app for submitting your photos and getting help with identifying your dragonfly.

Getting Started Tip: Start simply by looking for dragonflies and you will begin to see differences between species in your area which will help you over time learn to identify species with the help of the web resources above.

Additional Resources: More background info at websites above.

Pikas

Target: Pikas as indicators of changing high altitude temperatures and snowmelt timing

Importance to Food & Agr: A key indicator of a warming climate in high elevations which determines whether the snowpack accumulates sufficiently for irrigation supplies through the growing season. Pikas can die if temperatures reach 78F.

Curiously, pikas are the hay farmers of the alpine zone, cutting grasses and forbs, drying them in overhangs, and then storing the hay for winter use.

Issues: Warming temperatures in high elevations threaten pikas that cannot move to higher, cooler areas.

Observing Options: Presence or absence determined by sighting the animal, its hay piles, unique way of cutting grass, urine-stained boulders, or by its characteristic call—which is the first way you will probably find them.

Citizen Science: PikaNet collects data according to strict protocols from volunteers monitoring critical sites selected by scientists. Trainings are available.

Getting Started Tip: Becoming familiar with the pika's call may be the easiest way to locate a pika, and then you can look for them visually and for their signs.

Additional Resources: National Park Service: Pikas in Peril

First Occurrences

Target: First Occurrences during a season—or simply "Firsts"

Importance to Food & Agr: One of the easiest things to notice and compare year to year is the first date that a species is seen, or an event happens. A part of phenology (seasonal happenings) observations, this is singled out due to its simplicity and usefulness. For farmers and gardeners, such records relating to crop and livestock occurrences are an essential part of recordkeeping—providing insights into changes in growing conditions over time.

Issues: As mentioned in the Phenology section, besides variations from year-to-year, longer term changes, disruptions, and mis-matches in timing due to climate change are of increasing importance, often requiring adaptations in our growing systems.

Observing Options: Either at home, at work, or in the classroom, simply record on a calendar when a bird or insect is first seen in the year, a plant flowers, a vegetable is first ready to harvest, young are born, the first frost occurs, the first snow falls, or any similar phenomenon. Sharing this among neighbors, fellow growers, and others is a great way to follow trends in growing conditions and climate change.

Celebrate Firsts: Many of these occurrences are worth celebrating—especially when local foods become first available—think asparagus, strawberries, corn, and more!

Citizen Science: Journey North has many observation categories such as Hummingbirds, Ice-out, Bald Eagles, Leaf-out, and more that are well suited to reporting firsts and seeing similar reports on maps across the country. In addition, most of the other citizen science programs for indicators in this section allow you to post "Firsts" and note "First Occurrence" in their comments section and compare with other observers in your area or nationwide.

Getting Started Tip: Simply start recording first occurrences of any type on your calendar (or your garden, farm, or ranch records). A desk calendar often has room for such notations, and you can enter those notations at the end of the year into a summary table to compare yearly dates.

Fruit & Vegetable Varieties

Target: Fruit & Vegetable Varieties—suitability under year-to-year growing conditions and a changing climate. (*See note at bottom about other agricultural products.)

Importance to Food & Agr: We all know that different varieties of fruits and vegetables grow better in some places than others and in some years than others, so site-specific reports are useful. A greater diversity of crops can reduce overall production losses due to insects, disease, and weather variability. Different varieties of the same vegetable species can have different nutritional content, flavor, and can generate greater interest and acceptance among eaters. This all underscores the need for domestic biodiversity.

Issues: Many varieties of vegetables have been lost as seed production companies concentrate on a few strains. Some seed companies are bucking this trend and promoting diversity. Similarly, fruit growers are looking for forgotten varieties from the past which may be more resilient in today's changing climate. Time-honored seed saving techniques are hampered if too much emphasis is put on hybrid seeds.

Weather extremes, variability, and a changing climate put stress on fruit and vegetable production, and call for keeping records year-to-year, sharing info as well as seeds and fruit cultivars with other growers, and developing climate-adapted fruit and vegetables over time. Recordkeeping is key to this process.

Observing Options: Recording what varieties do well in a given year, along with the growing season weather from onsite or nearby (precipitation, departures from normal high and low temperatures, and for fruit, the lowest winter temperatures) is essential for planning future plantings and sharing with others.

Citizen Science:
Vegetable Varieties for Gardeners allows gardeners to submit their own reviews of vegetable varieties in terms of taste and production, and explore ratings submitted by other gardeners.

Vvi or Vegetable Varieties Investigation guides young people in interviewing gardeners and submitting these findings online for others to use.

Local areas and regions can develop their own citizen science projects to document the success of different fruit and vegetable varieties in different weather years and share results among growers. Seed saving, seed libraries (sometimes even at public libraries), heirloom fruit grafting programs, and winter sharing of seeds and information are common associated activities.

Getting Started Tip: Start by simply recording what varieties you plant each year, then add notes in the fall of how they did and how you liked them. Once you have this recorded, sharing this info with others comes rather naturally.

***Note:** Similarly, keeping track of production successes and failures for grains, forage, other crops, and livestock are important as well.

Monitoring Migrations & Seasons

Target: Monitoring Migrations & Seasons—on the local as well as large scale.

Importance to Food & Agr: Migrations of birds, pollinators, and other insects are directly applicable to food production. In addition, migrations of other iconic species such as whooping cranes, hummingbirds, monarchs, and robins give a sense of the progression of the seasons and potential food production impacts in surrounding areas and across the continent.

Issues: As mentioned in the phenology section, besides variations from year-to-year, long-term changes, disruptions, and mis-matches in timing due to climate change are of increasing importance, often requiring adaptations in our growing systems.

Observing Options:
Recording "First Occurrences" (see that section above) on your calendar is one way to compare year-to-year migrations in your area.

Journey North is one of the best websites for monitoring migration and seasonal changes of many types whether you contribute data or not. See their latest maps here.

Citizen Science: As part of a citizen science project such as Journey North above, your data can help scientists track the march of the seasons, and specific species critical to food production.

Besides Journey North, many of the citizen science programs in this section allow you to record the first occurrence of a bird, insect, bloom, or fall frost, etc., and compare with other observers in your area or nationwide.

Soil

Target: Soil physical, chemical, and biological characteristics as indicators of soil health.

Importance to Food & Agr: Soil is the foundation of food production and ecosystems of all sorts. The physical, chemical, and biological characteristics of soils are common indicators of a soil's overall health. In turn, soil health is critical to the quantity and the quality of the food produced, and to the resilience of ecosystems of all kinds to extreme weather, a changing climate, and other pressures.

Issues: First, wind and water erosion—often due to industrial agriculture practices—is depleting the amount of agricultural soils in many areas to critical levels. This is essentially irreversible in human time-scales due to the slow rate of new soil being formed.

Besides soil loss, industrial growing practices, including synthetic pesticides and fertilizers, heavy equipment, monocultures, and overwatering often lead to soil compaction, salinization, loss of organic matter and natural fertility generation, increased vulnerability to pests and disease, and loss of many beneficial soil organisms that are key to healthy soils.

Agriculture has caused great losses of soil and soil quality, but regenerative and similar production systems—in gardens, farms, and ranches—focus on soil health to help reverse this trend.

Observing Options—Monitoring these indicators over time can reveal recovery after damage from ag practices or extreme events, results of improving soil management, and degradation or improvement more broadly:

- Erosion—look for tiny to large gullies forming on slopes due to water running over bare soil. Small deltas of eroded soil at the bottom of slopes and muddy creeks and rivers indicate erosion. Wind erosion is best seen in action or where the soil particles settle in sheets or drifts and dunes.

- Salinization—look for white crusty salt deposits on the soil due to excess water and resulting evaporation at the soil surface.

- Soil quality—one subjective clue to overall soil health and good treatment is healthy diverse vegetation on the land without excessive pests, diseases, or invasives. Healthy soil structure is indicated by good drainage of water into the soil and soil breaking into small clumps when dug up and which don't just fall apart. Standard soil tests through Extension can reveal organic matter levels and fertility as indicated by chemical nutrients, acidity (pH), and more.

Alternative soil tests focus on the more intricate, but more meaningful biological indicators.

- The NRCS (Natural Resources Conservation Service) has a excellent comprehensive website on soil health indicators, resources for educators, and much more on soil health observations.

Citizen Science:
Journey North allows you to submit first sightings of earthworms as part of their vertical migration in the soil—more of a monitoring of seasons than of soil health, but this does increase awareness. Monitoring earthworm presence in gardens and fields is one good indicator soil health and worth tracking whether part of a reporting program or not.

There are a number of local citizen science programs across the country that monitor soil health, and you can start your local program—simply Google "soil citizen science."

Getting Started Tip: Observing and monitoring earthworms over time is one of the easiest ways to start and suitable to all ages—and a very important indicator. Sending your soil for testing every year or so can be very useful for monitoring how your garden, farm, or ranch soils are doing. Paying attention to soil erosion and salinization across the landscape is easy and very informative.

Water

Target: Water—quantity and quality indicators.

Importance to Food & Agr: Water is the lifeblood of ecosystem functioning—whether for our food producing ecosystems or the surrounding ones.

Issues: Irrigation diversions and pumping from the ground for agriculture are major human interventions in the hydrologic cycle that can have serious impacts on surrounding and often very distant ecosystems.

In terms of quantity, high, low, and rapidly changing river flows are critical. Especially in the arid West, snowmelt from mountains puts a focus on winter snowpack and snowmelt timing and speed. Climate change is creating major disruptions in these cycles.

Agriculture is not only affected by water quality issues, but also can cause such issues. The quality of water: suspended solids, dissolved chemicals, dissolved oxygen, acidity, as well as living organisms—from microscopic to vertebrates—are important to water health and often useful indicators of that health.

Observing Options:

- **Water Supply:** Many aspects of water supply are monitored extensively by government and other agencies, so paying attention to reports on river flow, snowpack, dust on snow, drought severity, and reservoir levels—and associated forecasts—can keep you well informed. These reports can back up your own observations of water supply indicators.

- **Water Quality:** Without resorting to rigorous testing, your visual observations of sediment (turbidity) and changes in color (such as the mine waste that turned our Animas River yellow) suggest potentially harmful water quality issues.

- **Animal Indicators:** Those who fish may see changes in fish species abundance as well as aquatic insects, and birders may see similar changes in bird abundance. Ouzels, or American Dippers, are dependent on aquatic insects that in turn are affected by water quality.

- **American Dippers:** One of our favorite birds, the American Dipper or ouzel is a wonderful bird to watch for year-round as it forages on invertebrates underwater in rivers. As such, it can indicate river water quality after floods, fires, or pollution events.

- **Beavers** have been managing water flow for eons, until we removed many of them—ushering in more flooding and associated sediment in rivers and creeks, less groundwater infiltration, and more late season drought. Fortunately, as climate changes create more droughts and floods, many people are protecting, introducing, and learning to co-exist with beavers. Monitoring beaver activity and abundance over time is a key observation of watershed and foodshed health.

Citizen Science:
CoCoRaHS (Community Collaborative Rain, Hail and Snow Network): volunteer reporting of rain, snow, hail, and associated data.

Colorado River Watch is an example of a program that allows volunteers to assist in river water quality monitoring.

Use e-Bird to report sightings of American Dippers or Ouzels as noted above.

Getting Started Tip: One of the most useful and insightful things you can start with is to install your own rain gauge, keep daily records, and compare to reports from surrounding areas. See the Weather & Climate indicator section for more on this.

Wildlife

Target: Wildlife—in addition to other specific animal targets in this section.

Importance to Food & Agr: Wildlife is an essential component of any ecosystem, and in agriculture, animals of all types are essential in delivering ecosystem services, and for proper ecosystem functioning. If out of balance, animals can become pests creating disruption and losses beyond acceptable levels. Diversity of wildlife on and around agricultural lands is a good measure of overall health.

Issues: Synthetic chemical use by agriculture, water diversions and contamination, and wildlife control programs have adverse effects on wildlife, and along with habitat loss due to agriculture, have had dramatic effects on wildlife populations and species diversity. Regenerative and wildlife-friendly gardening, farming, and ranching are approaches designed to reverse these effects. In the broader landscape level, farms and ranches can be situated and managed to enhance the ability of far-roaming and migratory wildlife to move between suitable habitats.

Observing Options: Any type of wildlife is worth observing, especially ones of special local concern. In particular, we recommend:

- Beavers—as described in the Water indicator section
- Bats
- Threatened and endangered species
- Birds, pollinators, dragonflies, ladybugs, and pikas as described elsewhere in this section

Citizen Science:

State wildlife agencies often have reporting systems for species of interest such as Colorado's Wildlife Reporting Forms

Nature's Notebook has protocols and support for monitoring a large number of animals.

See all the other specific wildlife targets in this section.

Getting Started Tip: Check with your state wildlife agency online or in person to find out what wildlife spotting reports they are looking for from the public in your area.

Additional Resources:

Farming [and Ranching] with the Wild book from the Wild Farm Alliance
The Wildlife-Friendly Gardener book by Tammi Hartung

Extreme Events

Target: Extreme events—extreme weather—especially flood, drought, and extreme heat—as well as beetle kill and other events usually related to a changing climate.

Importance to Food & Agr: Extreme events can adversely affect the ability to grow, transport, and market food. Floods, droughts, and extreme heat clearly impact food production**.** Fires can drive customers from farmers markets and keep tourists away from affected areas completely. Beetle kill and fires can have short- and longer-term impacts on irrigation water supply from local watersheds. Floods can contaminate crops, and along with winter storms, they can complicate farm supply and food shipments. The prospects of more frequent and more severe droughts can discourage new and established farmers, gardeners, and ranchers.

Issues: Just as food-producing ecosystems are severely impacted by extreme events, surrounding and more natural ecosystems are impacted as well, which in turn affects our agriculture. Climate change is a clear driver of many if not most extreme events, including extreme heat, increased droughts and floods, greater variability, and conditions more conducive to fires and beetle kills. A failure to acknowledge that the climate is changing, and that humans are the major cause, hampers progress in reducing additional climate change and further impacts on agriculture and our world.

Observing Options: Air quality, water quality, precipitation, drought, wildlife, crop and livestock impacts, forest beetle kill, and forest health are key items to observe before, during, and/or after extreme events.

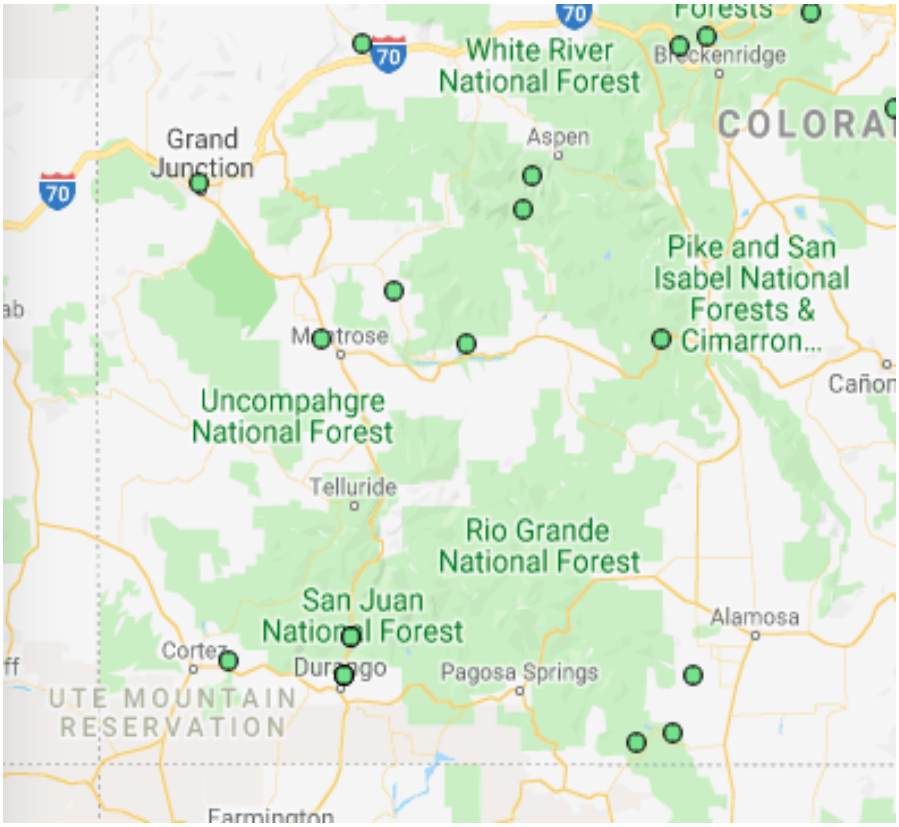
Citizen Science: Many of the citizen science programs for other indicators in this section can be used to monitor conditions that may lead to extreme events, conditions during these events, and those during recovery. For example, monitoring precipitation can reveal drought conditions that may lead to a major fire; air quality observations can indicate how farmers market customers may be driven away by the fire; and water quality monitoring can show how quickly sediment loads in rivers recover after a fire. Local agencies may recruit volunteers as citizen scientists especially in the recovery stage of river and forest ecosystems.

Part 4—Making it Local

Observing and citizen science programs lend themselves very well to local and regional collaboration in addition to enriching data collection on a national scale. Beyond simply sharing observations formally through established citizen science projects or through informal conversations and postings, cooperating with fellow observers and groups—on a local level—can lead to training, mentoring, learning, and collaborative projects to fill in the gaps and provide local area or region-wide coverage—especially on key local issues. This section describes the many exciting possibilities.

1) Connect with Other Observers and Citizen Scientists Already Active in Your Area: To start, sharing what you see with friends and colleagues can be fun and informative even if not part of a formal citizen science program. Beyond this, in many citizen science projects you submit observations to a national database which allows not only scientists to see, but for other observers across the whole network to see them as well. You can often view maps on these citizen science websites that show other observations in your area so you can both see your efforts in a larger context, and, perhaps start connecting with other local observers (if the observers name is available).

For example, this map of the Bumblebee Watch sightings in Southwest Colorado shows a number of observers, and in this case the observers' names are available upon clicking.



NOTE—Many citizen science programs have plenty of useful background information available in addition to data from others in your region to inform your observing even if you don't submit your observations formally.

2) Find Your Potential Local Partners: Local organizations and individuals of all sorts are potential partners (and some are already engaged in citizen science), and connecting with them can move beyond sharing of observations to at least coordinating and perhaps actively collaborating on:

- **Training**—such as for identifying key pollinators
- **Mentoring** by more experienced observers—with experienced birders for example
- **Identifying key targets** to monitor in the local area—such as concentrating efforts on one or more indicators of key local importance
- **Designating observing locations or observing trails** (see below) to better focus efforts and gain more comparable data
- **Developing a local citizen science project** with experts to address a critical local issue (see below)

Seek out possible partners throughout your local area and region for possible collaboration and for their subject matter expertise and information resources:

Potential Organizational Partners	Potential Resource Partners
Local farm & ranch groups	Farmers
Garden clubs	Ranchers
Extension & 4H	Gardeners
Environmental groups	Beekeepers
Nature groups	Soil, weed, & land use scientists
Bird clubs	Ornithologists, entomologists, & other biologists
Natural Resources Cons. Service (NRCS)	Meteorologists, & climatologists
Forest agencies & support associations	Hydrologists & water quality experts
Schools—PreK-12	Ecologists, foresters, etc.
Colleges & universities	Agronomists
Hiking, mountain, biking, & boating clubs	Educators of all kinds
Service groups of all sorts	
Science & natural history museums	
and…	and…

3) Recruit More Observers: Help people be more observant in their everyday activities—as part of their daily routine—and urge them to share or post observations if possible:

- While gardening, farming, ranching
- While commuting (no texting while driving please; work on memory skills)
- While hiking, biking, skiing, snowshoeing, boating, hunting, etc
- While drinking ice tea (or beer) on the deck toward the end of a long day

4) Connect Researchers, Agency Professionals, and Citizen Scientists—especially to find out how citizen observers can help the professionals, and vice versa. There are distinct ways that the public can help the professionals:

- **Filling in the gaps geographically**, as mentioned earlier, such as volunteer rain, hail, and snow observers in the CoCoRaHS program situated between official weather observing sites.
- **Alerts forwarded to scientists and agencies** of a species or occurrence of concern—an example being the Colorado Wildlife Reporting Forms for select species.
- **Observations of such widespread and varied nature** that citizen scientist observations are the most feasible way of gathering data. Sightings of specific insects, birds, or other species are examples.
- **Short-term observing assistance** on specific research projects over a limited amount of time rather than an ongoing basis, usually initiated by a local research scientist.

5) Connect Observers with Growers: One very obvious and essential connection for furthering understanding and monitoring of foodshed health is connecting citizen scientists with farmers, ranchers, and gardeners. Here are some possible interactions:

- **Growers as observers/citizen scientists:** One of the best options is if many growers actually participate as observers and citizen scientists, and that they are connected to each other to share what they see. Nearly any citizen scientist can become a grower as a gardener—backyard, school, or community—and hopefully the observing experience encourages them to do so.

- **Consumers ask growers** at farmers markets, CSA pickups, or farm visits what production challenges are they seeing relating to extreme weather, climate trends, pollinators, etc. How can citizen scientists help? This goes for private consumers as well as institutional buyers such as schools (and their kids as noted below).

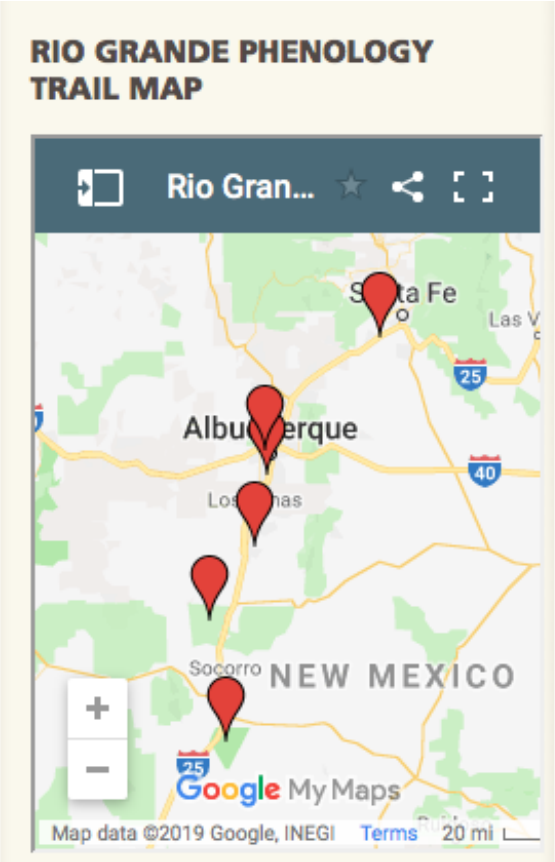
- **Commercial growers**, when asked by consumers how they can help, can enlist them to join in monitoring on the farm or ranch to help them understand the production challenges they face and to engage them as loyal customers and supporters willing to pay a fair price for their food.

6) Consider local community-developed citizen science projects—designed to investigate specific issues in the area. Communities may take the initiative and design an observing and citizen science project around a specific issue or interest, utilizing their unique local resources, and generating much more "ownership" and participation. Nature's Notebook, from the National Phenology Network, has many comprehensive resources for developing a local citizen science program—useful resources whether you are strictly targeting phenology (seasonal happenings) or some other observing targets.

Pinyon Jay, USFW Service, Public Domain

Such local projects could use readily available citizen science programs, such as e-Bird for example to monitor specific birds that are threatened in the local area, or that indicate some aspect of foodshed health. For example, in our area of Southwest Colorado, the Pinyon Jay is of concern since we have lost many of our beloved pinyon trees to drought and beetles—trees loved by us as well as the Pinyon Jay.

7) Develop Community Monitoring Stations, Local Walks, and Regional Trails and Projects—set up with suggested targets for citizen scientists to observe and monitor. A community effort to designate observing stations along a public trail for specific birds and other wildlife, or good sites to see pollinators or blossoming plants could involve a number of local environmental education groups. This is best done with a specific issue or topic to be investigated over time. This is a very tangible way to involve a number of partners and focus community efforts on a community-developed issue.



Natures Notebook, mentioned above, also has specific resources for what they call "walks" and "trails." Walks would be a series of observing stations with specific things to observe and report, something that perhaps a single organization or two could develop, provide training, and compile posted data. A virtual "trail" is made up of a network of walks in a region that provide citizen scientists a variety of agreed-upon things to observe and links the organizations as well.

Linking local projects into regional projects—An excellent example is the Rio Grande Phenology Trail in the Albuquerque region of New Mexico linking two wildlife refuges, two botanical gardens, and other groups monitoring cottonwoods and elms as well as other species along the bosque corridor of the Rio Grande River.

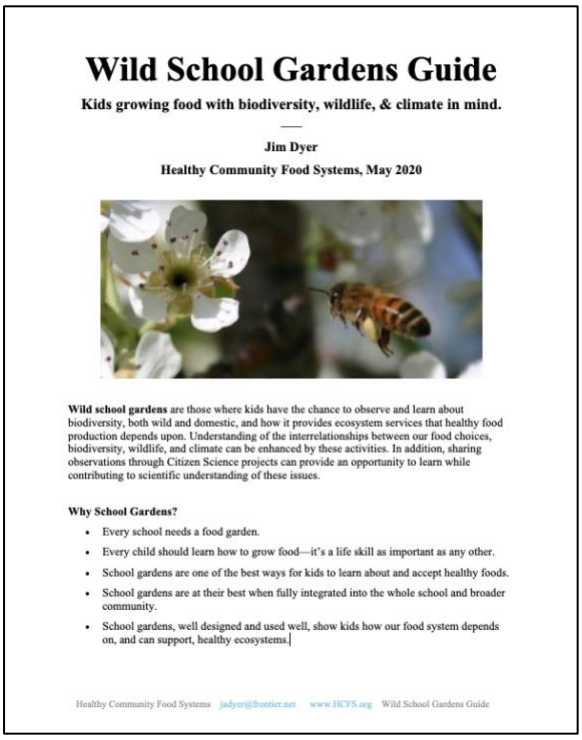
Such regional projects can more readily address ecological issues on a landscape level—things such as pollinator corridors, wildlife migration, watershed-wide concerns, air quality, and more.

In our case, we see value at looking at all the foodsheds—nested and overlapping of course—in the San Juan Mountains and surrounding areas. This is what we call the **"Greater San Juan Mountain Ecosystem"** and is roughly depicted here.

8) Don't Forget the Kids: One of the most promising ways of starting a community-wide observing and monitoring project is starting with kids! Nearly everyone sees the importance of educating our children about healthy local food, who grows it, how it is grown, how nature plays a role, and keeping our foodsheds healthy—and nearly everyone can get involved to help.

Wild School Gardens is HCFS's project promoting and supporting students of all ages paying attention to nature in their school food gardens—and beyond, throughout the foodshed. We have gathered many informational resources to assist schools and their partners in adding this emphasis to their garden programs.

Not only students and teachers, but garden coordinators, fellow gardeners, farmers and ranchers, local science experts, parents, community organizations of all sorts, and volunteers must be involved for this to have the greatest benefit for our children.



Wild School Gardens Guide

Kids growing food with biodiversity, wildlife, & climate in mind.

—

Jim Dyer

Healthy Community Food Systems, May 2020

Wild school gardens are those where kids have the chance to observe and learn about biodiversity, both wild and domestic, and how it provides ecosystem services that healthy food production depends upon. Understanding of the interrelationships between our food choices, biodiversity, wildlife, and climate can be enhanced by these activities. In addition, sharing observations through Citizen Science projects can provide an opportunity to learn while contributing to scientific understanding of these issues.

Why School Gardens?

- Every school needs a food garden.
- Every child should learn how to grow food—it's a life skill as important as any other.
- School gardens are one of the best ways for kids to learn about and accept healthy foods.
- School gardens are at their best when fully integrated into the whole school and broader community.
- School gardens, well designed and used well, show kids how our food system depends on, and can support, healthy ecosystems.

Healthy Community Food Systems jadyer@frontier.net www.HCFS.org Wild School Gardens Guide

See our new Wild School Gardens Guide online

What if?

- **Every school and preschool had a garden** onsite or nearby for their children.
- **Every school child in school and preschool had time in the garden** to help grow food and see nature at work in the garden.
- **Schools incorporated age-appropriate observing, monitoring, and citizen science** programming into school gardens.
- **Local farmers and ranchers** who sell into Farm to School and Farm to Preschool programs hosted field trips and visited the schools in the off-season.
- **Community experts, fellow gardeners, parents and grandparents**, and others volunteered to help.
- **Science, gardening, nature, environmental, and service organizations** helped provide educational activities in the school gardens and provided training for school staff and volunteers.
- **Schools** in the community and the broader region shared their observations and data—as part of **Wild School Garden networks**—to help students see the bigger picture, see how growing conditions and food production varies over elevational transects—from mountains to lowlands, forests to deserts—and how growing food is affected by and affects surrounding natural ecosystems.

Not only is this a good way to jump-start a community-wide program, but the focus on kids will help ensure they will carry these lessons throughout their lifetimes.

Part 5—Developing Local and Regional Projects

Drawing on the community collaboration ideas above, here are four potential projects designed to stimulate thought about what is possible on a local or regional basis. These examples rely on our experiences and knowledge in the southern part of the greater San Juan Mountain region and are intended to help you promote discussion among groups and individuals wherever you may be.

1—River to Tundra Observation Trail Network
—a South San Juan network that could spread region-wide

2—Wild School Gardens Networks
—connecting schools to each other, their farmers, and their foodsheds

3—Observing Along Corridors
—highways, byways, and wildlife pathways

4—Greater San Juans Pollinator Network
—monitoring a critical resource for food production and ecosystems on a region-wide basis

River to Tundra Observation Trail Network
—a South San Juan network that could spread region-wide

We might begin with observing stations along the Animas River Trail in Durango—for example—set up and supported by several local educational and environmental groups. Perhaps some sites to watch for dippers which indicate water quality of the Animas, best spots to see monarch butterflies on milkweed planted by school children, side trails to nearby school and community gardens, birding hotspots pointed out by the Durango Birding Club, and more.

Then, walkers, bikers, and hikers could be alerted to special observing spots and things to look for along the surrounding trails like Smelter, Horse Gulch, or Perins Peak for specific plants, wildlife, and other indicators.

For longer trips, the whole network of trails into our canyons and mountains of Southwest Colorado would open up a wealth of observing opportunities and indicators to take notice of, check on repeatedly through the season, and even report to citizen science projects.

Wild School Gardens Networks
—connecting schools to each other, their farmers, and their foodsheds

First, more and more schools and preschools would have school gardens to learn about local food, and they would be Wild School Gardens, where the students would learn about nature at work in, under, over, and around those gardens.

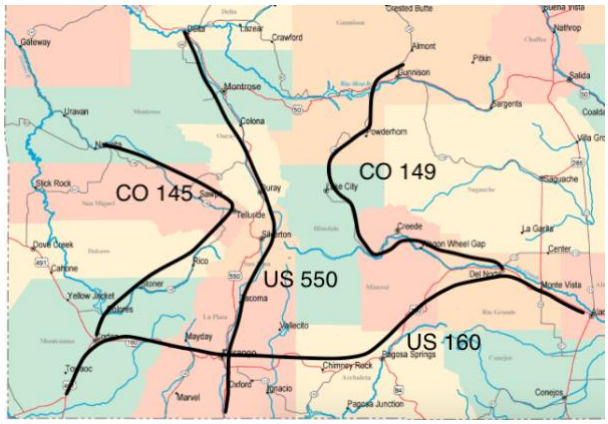
Next, the children connect with the farmers and ranchers who provide healthy local foods to those schools through Farm to School programs and they invite the growers into their gardens. In turn, the children visit those farms and ranches to see how the growers are observing some of the same things the children are—pollinators, beneficial birds, rainfall, ladybugs, and more.

Schools and preschools then connect with each other to share what they are observing, monitoring, and contributing as citizen scientists. They share student projects based on these observations. Schools along elevational gradients up and down the slopes of the San Juans partner on observing weather, pollinators, migrating beneficial birds, and other foodshed indicators.

Observing Along Corridors
—highways, byways, and wildlife pathways

Observing in the Greater San Juan Mountain Ecosystem is all about elevation, temperature and moisture gradients, and paths through the mountains for our people, our food, our water, and our wildlife.

Riparian areas are critical to healthy foodsheds—as irrigation sources, habitat for a large part of the region's biodiversity, prime farmland and ranchland, and as areas subject to intensive human impact. Observing indicators of foodshed health and sharing this information with others along these corridors is a useful way to organize collaborative projects aimed at better understanding and foodshed protection.



Highway corridors often follow rivers and link them over passes. Sharing of observations of foodshed indicators along some of these longer highways in our part of Colorado is another practical way to form a picture of the foodshed health of our whole region. Since human activity—agriculture, transportation, business, etc.—is concentrated along these corridors, monitoring those impacts on surrounding, often wild ecosystems is critical.

Wildlife movements are common along—*and across*—these same highway/riparian corridors, so impacts on migrating elk, on large carnivores requiring large territories to thrive, and on any wildlife trying to safely cross highways depend on the design of those highways, and on the amount of traffic. Wildlife observations along these corridors, *and in more remote sections of the San Juans* should help inform efforts to maintain these species and keep our ecosystems intact.

Greater San Juans Pollinator Network
—monitoring a critical resource for food production and ecosystems on a region-wide basis

Observing pollinators and other beneficial insects and birds on a regional level, as across the Greater San Juan Mountain Ecosystem, can help answer questions about scarcity of pollinators at the times they are needed for pollination, movements across the region, and impacts from weather events and a changing climate. Including observations of other beneficial insects and birds would be easy and very useful.

Simple weather observations through the season where pollinators and other beneficials are being monitored is very helpful to determining the variations from year to year of pollinator abundance and effectiveness. On the longer timescale, weather records of temperature and precipitation can help us see what climate change trends are occurring.

Mismatches in timing between the arrival of pollinators and blossoming dates of the plants they pollinate are becoming more common as the climate changes. The more observations we have of pollinator presence, blossoming dates, and weather, the more scientists will understand the situation and identify potential solutions—including pollinator plantings and habitat improvements that the community can implement.

Part 6—Going Beyond Monitoring

It is our belief that the more people know about local food, who grows it, how is it grown, and especially about the health of their own local foodshed, the better decisions they will make regarding their food and their foodsheds.

We hope that as a result of participating in whatever ways you can in monitoring the health of your own local foodshed, the more engaged you will be in:

1. **Growing some of your own food if at all possible, with the foodshed and the future in mind. See** Gardens for the Future

2. **Supporting local producers as a loyal customer, willing to pay them a fair price considering the work they do and the challenges that you know they face. See** Producers Need Our Help.

3. **Making the most sustainable food choices—including that food you can't get locally. See** Foodprint website.

4. **Supporting scientists, agencies, educators, and citizen science projects aimed at understanding and protecting the health of your own foodshed.**

5. **Supporting conservation programs and policies that protect and restore local foodsheds—from local, to national, to global efforts. See** Addressing Climate Change with Local Food and Addressing Biodiversity with Local Food

Appendix 1: "Take a Close Look" Worksheet

As you look at a farm, garden, or ranch, look for signs of ecosystems service processes, wildlife, and general indicators of health. (from the Exploring Foodshed Health Field Guide, page 13)

1. Do the crops look healthy and well-watered?

2. Are the livestock healthy looking, able to be outdoors, and socializing?

3. Do you see a healthy level of complexity and diversity or mostly uniformity (monocultures)?

4. Are invasive weeds prevalent?

5. Can you hear or see bees and other pollinators?

6. Are there nectar sources for pollinators and insects—needed through growing season?

7. Do you see raptors at work?

8. Do you see field margins or hedgerows where beneficial insects, birds, bats, and other animals can live and forage?

9. Is most of the soil covered by vegetation?

10. Are there signs of soil erosion by wind (dunes, drifts, etc.) or water (gullies, deposits, etc)?

11. Are irrigation ditches eroding?

12. Is there visible salt build-up on the soil?

13. Can you tell if the water leaving the farm look as good, or even better, than that entering the farm?

14. What else do you see that you could ask growers and resource experts about?

Appendix 2: "Eyes on the Broader Landscape" Worksheet

Find a convenient vantage point to view the whole landscape and let these questions guide your observations. (from the Exploring Foodshed Health Field Guide, page 14)

1. Does the watershed around the farm, ranch, or garden appear healthy, well covered with vegetation, and not overgrazed or eroding? Are there abrupt differences at fence lines that indicate possible problems? Are there visible contaminants in rivers, ditches, or ponds.

2. Are birds prevalent and moving freely across the landscape?

3. Are there suitable corridors around the food growing areas so that wildlife can travel across the landscape?

4. Are there human activities on lands around the farms, gardens, and ranches that appear disruptive to water flow, soils, wildlife, air quality, and healthy food production?

5. Do you sense a level of coexistence and mutual dependence between the human-managed ecosystems and the wilder surrounding ecosystems or more of an imbalance?

6. What else do you see that you could ask growers and resource experts about?