3.a] Monitoring a riparian restoration site

Ecological monitoring is just a systematic way of looking at a piece of land you are interested in, as it changes over time, and comparing it to a vision of how it ought to be. It can be as simple as taking a picture from the same viewpoint every year, or observing the same area consistently over time and taking good notes. There are many straightforward, easy observations you can make that will tell you quite a lot about the ecological status of a riparian area.

Ecological health along southwestern rivers

Most of us would say that our goal or desired condition would be a healthy ecosystem. But what is "healthy," anyway? How do we know what our bosque ought to be like?

It can be easy to recognize what is *not* healthy: a bosque choked with salt cedar that has crowded out most native plants along with many birds and animals, is much less healthy than it was with native vegetation. A riparian area overgrazed and trampled to the point that few plants of any kind can grow is clearly degraded and unhealthy. It is harder to pin down what exactly is ecologically healthy. In many cases it is not as simple as returning to "natural" or "pre-human" conditions, even if these could somehow be known—which often they cannot. The entire Rio Grande, for instance, and almost any other river of any size, has been affected by centuries of human use, with increasing intensity over time. Biological inventories were not made for most places prior to flood control work, or dams, or before the presence of European grazing animals. There are no comparable river systems we can observe unaffected by industrial civilization. There are no reference sites where we can study a southwestern bosque free from human influence.

Key characteristics of a healthy bosque

Few if any invasive plants: An invasive species is a non-native one that tends to crowd out everything else, displacing native plants or animals and reducing biodiversity. Not all non-native species are invasive: for instance, salt cedar, Russian olive, and knapweed are often invasive, while apple, mulberry, or barnyard grass generally are not.

Diversity: Both *structural diversity*, the mosaic of vegetation communities (marshes, cottonwood forests, willow thickets, grassland, and so on); and *species diversity*, the number of different native species present, are good indicators of a naturally functioning bosque.

Micro-habitats: Micro-habitats result from the variety of physical and topographical features. The more physical features and topographical complexity, the more micro-habitats and diversity of plants and animals there will be.

Habitat for sensitive species: Species like southwestern willow flycatchers, meadow jumping mice, or yellow-billed cuckoos require special habitat features. Bosque containing habitat that supports these species is one indication of an ecologically healthy riparian area.

Open water and/or saturated soil: Some of both are needed to support a complete range of wetland and riparian plants and the other living things that depend on them.

Appropriate river disturbance: Some flooding, meandering, and other natural, periodic disturbances provided by the river are essential for southwestern riparian ecosystems to be self-sustaining over time.

3.b] Vigorous, healthy bosque

In addition to these limits on the information we have, the river and its bosque exist in a state of perpetual (if mostly gradual) change, a dynamic equilibrium—quite apart from any human influences. As we have discussed above, the bed and banks of any functional river continually move and rearrange themselves as water and sediment move downstream, and the bosque responds with an ever-changing pattern of ecological succession.

There is no simple, universal prescription for a healthy bosque, or set of numbers that describe a functional riparian area. There are, however, several general characteristics of a riparian area where natural processes are functioning properly and ecological communities are thriving. We can observe whether these characteristics are present, and by monitoring over a period of at least a few years, we can tell whether desirable characteristics are stable, becoming better established, or diminishing. It is difficult to specify hard, numerical targets that define health, but fortunately it is much easier to spot positive or negative trends, and indicators of problems.

Of course how much all these desirable characteristics are possible will be different in different places. Even in the most ideal conditions, an acre of bosque cannot have all the diversity and different micro-habitats that ten or a hundred acres could have. A mountain stream at 8,000 feet will have different ecological communities than a desert river at 3,000 feet. Many places do not have the space or conditions to support habitat for willow flycatchers or other particular kinds of wildlife. Overbank flow may be controlled by a dam, or meandering prevented by flood control levees. So inevitably we have to work with what we have, but the more of the characteristics listed above, the better a riparian area is ecologically—especially if it is getting better over time.

What to look for

We have some idea of the indicators and trends that show whether a riparian area is developing in an ecologically healthy way. Now, what do we go and look for on the ground?

Invasive plants

A healthy riparian area has few if any non-native invasive plants, and that is something we can usually control with some success. It is much easier to get rid of a few small invasive plants than a large, dense, and deeply rooted invasion, so it is extremely valuable to be able to recognize them and to look in the places they are most likely to get established. Often that will be in places that have been recently disturbed, whether by restoration activities, roads, grazing, paths, or even completely natural sandbar formation. In Section 6, Gallery of Common Invasive Plants, you can find a rogue's gallery of the most highly invasive plants found in southwestern riparian settings, along with notes about where they are most likely to occur. Please be sure to look through Section 6 so you can recognize these unwanted plants, and help get rid of them wherever you see them. Techniques for controlling them are discussed in Section 4, Maintaining Ecological Health.

3.c] Purple loosestrife is a highly invasive plant

The best way to monitor for invasive plants is simply to walk over as much of your site as possible, as often as you can, paying particular attention to the places they are most likely to occur. Unless you are sure to remember, it is a good idea to flag the location, make a note and sketch a map, or take GPS coordinates of any outbreaks you come across , so you can come back and do something about it. Otherwise you may not recognize them again when they are not flowering or at different times of the year.

Diversity

If you could have a good, clear aerial photograph of your bosque taken every year, it would probably be easy to keep track of how many different kinds of vegetation communities there are and how they change over time. If your site is fairly small and you can climb a tree or sit on a canyon wall above it, you can also perhaps simply watch over time, and take photographs. However, if you do not have a situation like that, you may want to observe and record these changes in other ways.

With a GPS unit and compatible software, you could make a map by walking with the GPS recording the places where new emergent plants are sprouting along the river, or willows form dense thickets, or whatever different kinds of vegetation communities you have, and downloading it to a computer. Also be sure to walk along and record what you see at the river's edge. Then, if you make a similar map after say three to five years, you can see how things have changed. The drawing on the left, below, shows such a sketch map.

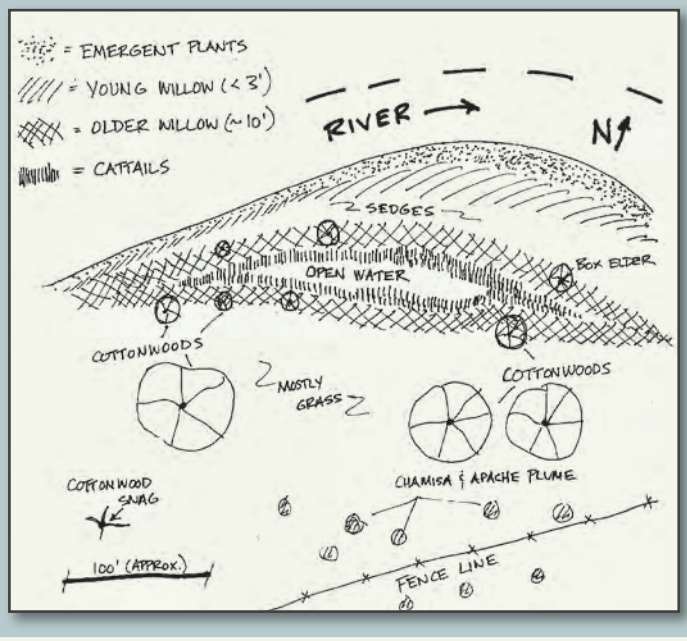
You can also do some simple transect sampling of your site to record which plant communities you come across. This technique will probably give you a clearer picture if you can combine it with even a simple sketch map of the site. Follow a compass bearing or sighting of a distant landmark as you walk in a straight line across the width of a riparian area, writing down which communities you are walking across, and how many paces it takes to cross them. The line that you walk is called a *transect (TR)*. You can, of course, also set up a long tape measure and record distances across community types in feet or meters. Then walk another transect some distance up or down stream of the first transect, and do enough transects to walk across all the major plant communities there are. Sources of aerial imagery like Google Earth® can help you draw a useful sketch map, even though the images themselves may be too fuzzy and low-resolution for you to see many features of the landscape. They are a great help in sketching out the basic outlines of a site, and you can fill in the details and distances on the ground with your transect notes.

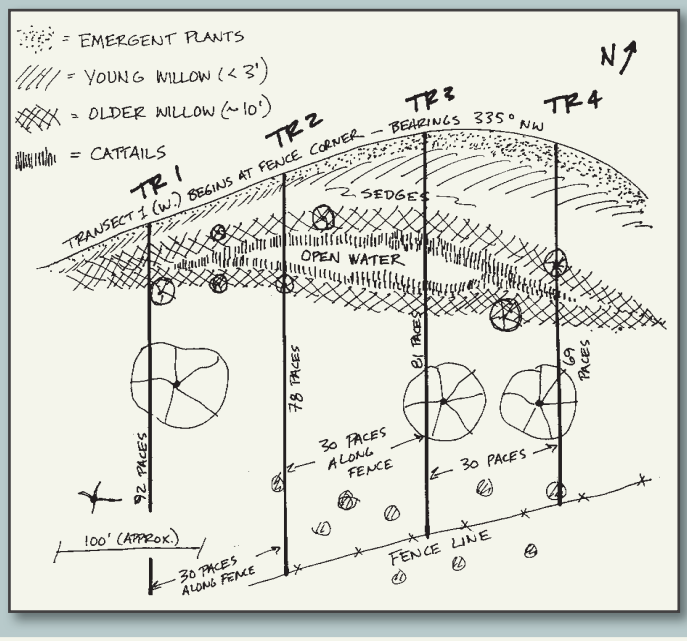
The drawing on the right, below, illustrates how transect sampling and a sketch map could be used to record the size and locations of different vegetation communities or micro-habitats in a bosque.

To measure and keep track of species diversity, you need to count how many plants there are in a manageable area, usually in a sample plot of a square yard or square meter. It is ideal to be able to identify the plant species you find, and with a little practice and a good plant identification book—or even better, with someone who knows plants—you may be surprised just how easy it is to recognize many bosque plants. But don't worry if you are not a botanist. Most people can accurately tell how many different kinds of plants they see in a given area even if they have no idea of their names. It helps to separate the plants into woody plants (usually seedlings or small shrubs, in a small plot), leafy plants (forbs), and grasses or grass-like plants (grasses, sedges and rushes). Most people are pretty reliable at telling different plants apart, even without identifying them. If you find eight different kinds of plants in a plot this year and twelve when you come back in five years, there probably really are about 50% more plant species present in the plot.

It is a good idea to sample a few, or even several, different plots for species diversity in each of the different kinds of plant communities there are. The more plots you have time to sample, the better idea you will have of what is really going on over your whole site. It is also a good idea to sample in the early to late summer when many plants are in flower and easier to identify.

Examples of monitoring sketch map (left) and transect locations (right)





Micro-habitats

You can easily determine the distribution and relative abundance of microhabitats by using the transect method described above. You can record wildlife mounds and burrows, rocks and logs, river side channels, tree-fall holes, floodplain scour pools, and the general unevenness of the ground. These hydrologic and physical landscape features may coincide with your plant communities or not. Micro-habitats set the stage for more plant and animal diversity by providing different conditions for the many life stages of plants and animals in your bosque.

Sensitive species habitat

It takes a lot of training to find and monitor most sensitive species of plants or animals. However, it not nearly as difficult to understand the kinds of habitat they need. Southwestern willow flycatchers are the principal, and most widely distributed, endangered species found in southwestern riparian areas. They are endangered almost entirely due to habitat loss. The habitat they need is the kind of dense thicket (often willow) that develops as a fairly early stage in bosque ecological succession, perhaps 10 years after a new sandbar or flood-scoured riverbank is first created. Their lack of habitat is a clear indication of how much the patterns of flooding and sandbar creation needed to maintain healthy riparian ecology have been disrupted throughout the southwest by dams and river channelization.

Some of the best information about southwestern willow flycatcher habitat can be found at the US Fish and Wildlife Service Arizona Ecological Services web site at *fws.gov/southwest/es/Arizona/*, by clicking on Document Library, then Recovery Plans, and then Southwestern Willow Flycatcher Recovery Plan, and finally by downloading Appendix D on Southwestern Willow Flycatcher Habitat.

Southwestern willow flycatchers are the legally protected species, but the habitat they need benefits countless other plants and animals as well. The meadow jumping mouse, for example, is a candidate for protection under the Endangered Species Act that needs similar habitat, and hundreds of other migratory songbirds, raptors, water birds, amphibians, rodents, insects, and fish need it as well. Unless your site can offer perhaps an acre or more of open water and saturated soil, and conditions where the kind of nesting trees (usually willows or box elder) will grow densely and vigorously, it will probably not develop into flycatcher habitat as such. However, the kind of dense, wet thicket flycatchers need is still very valuable for migration and foraging, even in patches too small for nesting. It is worth looking to see if you have this kind of habitat, or places where it could develop, and keep watching them over time to see if it does. You can easily do this at the same time you are looking for invasive plants and observing other kinds of vegetation structural diversity. You may also be able to encourage it by planting additional willows and other plants.

Key requirements for southwestern willow flycatcher breeding habitat

Dense, early-successional native riparian vegetation, with significant areas dominated by coyote willow or similar trees/shrubs from ground level to a height of 6 to 15 feet and including some taller trees used as higher singing perches.

Immediately adjacent or overlapping marshy areas of shallow, slow-moving open water and/or saturated soil to provide insect habitat needed as a food source.

Diverse surrounding ecological mosaic of healthy native bosque types, including cottonwood gallery forest, grassland, marsh, wet meadow, and thickets of other shrubs in addition to coyote willow.

Dependable surface and ground water supply through the growing season that maintains soil moisture and open water patches, and a vigorous and diverse ground-level herbaceous plant community, to ensure adequate insect populations for foraging.

Protection from disturbance and grazing by buffer zones, fences, and gated access.

3.d]

Water, wetland, and healthy streambanks

Open water is all too rare along southwestern streams these days, and if you have some in your bosque, as ponds, springs, or old oxbows full of cattails, you are lucky. Be sure to include these in your notes, sketches, or maps and keep track of them over time to see if they are stable, expanding, or shrinking. The saturated soil around the edges of these, along the edges of the stream itself, and even in places without actual open water, is equally important for ecological diversity. You can tell if soil is saturated with water by digging a little hole with a stick or trowel and seeing if any water oozes from the soil into the hole. You can also tell if soil has been saturated during the growing season for more than a couple of years because the plants growing in it will be *obligate* wetland plants, plants that require shallow water or saturated soil (and grow vigorously when they have it). Common wetland plants include cattails, rushes ("wiregrass"), bulrushes, sedges, horsetails, and pondweeds. Wetland plants are an important vegetation community worth noticing, and it should be included in any mapping or vegetation monitoring you do. You should also look carefully for invasive plants, especially purple loosestrife and salt cedar, in saturated soil.

Streambank disturbance associated with flooding and meandering is important in streams where it is the driving force behind plant reproduction and ecological regeneration. The higher the gradient of a stream, the less dependent its riparian ecology is likely to be on meander processes. As streams flow out of the mountains and into broader valleys, they become more dependent on sandbar and island dynamics to maintain healthy riparian ecology. The "right" amount of flooding disturbance can be a matter for discussion, and for ecological purposes it is better to look directly for the results: successful plant

3.e] Spikerushes are among the first plants to sprout on a new sandbar

reproduction. The important thing is the presence of young plants and different soil and moisture regimes. In lower-gradient streams with broader floodplains where flooding and sandbars are crucial, you will find most young plants in precisely those places: where there has been sunny, wet new soil in the past few years. If you find none of these places, and in any river ecosystem if you find few or no young plants, there is a problem. As with wetlands and open water, the places where you find emergent young plants are important to be aware of and to track over time.

Notes and photo points

Along with looking for the specific information suggested above, it is very valuable to simply take photographs and write your observations in a notebook (or computer), especially if you keep doing it through the seasons for a few years. Both photos and written notes are even more helpful in understanding trends over time if some of them are taken from the same point of observation. A fixed location where photos are repeated time after time is a *photo point*, and is sometimes marked with a fencepost or stake in the ground, tag on a tree, or other permanent marker, unless it is a natural feature like a rock or major tree that is unmistakable.

Of course repeated photos need to be taken of the same view, facing in the same direction, and during the same season to be most useful. Your observations can similarly be noted from the same points or along the same walking route, through the seasons and year after year.

Photo points

3.f] Before revegetation

3.g] After revegetation

3.h] Species observation, identification and notes

A whole lot of information per hour of (hopefully pleasant) time can be gathered by repeating photographs from photo points, and repeating observations of the same area over time—so while you are looking for the invasive plants that are hopefully not there, set up some photo points and write down all sorts of things you see. Some important information you will want to include are the date and time of day, wildlife sightings and scat, and the weather.

There are many more specialized or intensive observations and kinds of monitoring you can do if you are interested. It may also be that these brief suggestions leave you with questions, or seem less clear than you might have hoped. It is always easier to get started at a new activity with some guidance from someone who has done it before. In any case, there are several sources you may be able to turn to for help, including more information, opportunities to participate in on-the-ground monitoring, and suggestions about how to interpret what you find.

For recent listings of groups and contact information, visit the SWQB Wetlands Program website at *nmenv.state.nm.us/swqb/wetlands/*.

The next section offers some suggestions for what you can do about what you learn in the course of monitoring the ecological condition of your site.

Resources for monitoring information and learning

Local watershed associations and similar groups

Neighbors who have a similar interest and prior experience

Volunteer groups doing river restoration, cleanup, and similar activities

Your local Cooperative Extension Service

Ecological restoration consultants may offer affordable monitoring training and assistance to individuals or groups

3.i]

3.j]

3.k]

3.l]