

## **PRINCIPLES OF ECOLOGICAL LANDSCAPING: A Primer on Environmentally Sensitive Design, Installation and Care of Our Landscapes**

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Whether it is called "organic lawn care", "xeriscaping", "edible landscapes", "plant health care" or "integrated pest management", new approaches to designing, installing and caring for our lawns, trees, gardens and landscapes are part of a growing movement away from conventional landscape practices. More and more the public realizes that our human built landscapes tend to use too much water, energy, pesticides and fertilizers. Our lawns and landscapes are also a major source of pollution of both our groundwater and our surface waters. Finally, they often do not serve us as well as they could or should.

One concept that helps define ecological landscapes is the "*sustainable landscape*". Robert Thayer, Professor of Landscape Architecture at the Univ. of California, Davis, defines this as "those landscapes which tend toward ideal conditions by conserving resources (i.e., soil, energy, water, air quality, wildlife, diversity, etc.), as well as those which actually achieve a long-term regenerative capacity." Sustainability, then, means landscapes that are more self-managing and lower maintenance, more in tune with nature, and more drought, pest and stress resistant. They use fewer inputs, such as fertilizers, water and toxic pesticides that can have serious impacts. To do this we use principles learned from our study of natural ecosystems and practices learned from the latest research and years of experience.

Key to development and management of an ecological landscape is *knowledge*. With the right information we *can* reduce inputs and adverse impacts, while enjoying attractive landscapes that are more interesting and enjoyable. In other words we can "have our cake and eat it too". This may require the use of knowledgeable professionals, as well as books, the web and other guides to ecological design and plant selection, best lawn and landscape practices, natural fertility and least toxic pest control.

This guide is an outline of important concepts to improve the health, sustainability and beauty of our landscapes, while reducing adverse impacts on us and our environment. These concepts can help policy makers, homeowners, amateur and professional designers, gardeners, landscapers and caretakers.

**1. Ecological Design and Plant Selection** starts with an understanding of our site, the surrounding environment, our present and preferred uses and management options, and an appropriate design or restoration plan based on this information. Here are some key concepts of ecological design:

- **Assess your landscape and choose appropriate plants and components:** This is a principal concept of ecological design. Assess your site thoroughly, including: *site characteristics* (sun, shade, wind and salt exposure, condition of existing plants), *soils* (texture, structure, depth, drainage, pH), and *microclimates and other site variations* (frost pockets, protected sites, special ecological features, natural areas). Determine your landscape's present and future use and care (amount and type of maintenance, amount and type of play, use by pets, traffic patterns). Assess landscape areas with different characteristics separately. Then choose plants, turf, paths and other landscape components better suited to those site characteristics. Plants and lawns, when grown where appropriate--a concept known as "right plant, right place"--are more sustainable and require less maintenance because they grow where conditions favor their health and vigor. This includes locating managed turf in areas where lawngrasses are more suited, such as in deep, moist, slightly acid, well-drained loams and not on hot, south-facing slopes or in heavy shade.

- **Design plantings that use nature’s “plant communities” as a guide:** Start by using more native plants. Many native plants are attractive and are generally well adapted to local pests and conditions. Equally important, design plantings the way nature does using “plant communities”-plants all similarly adapted to the same site, soils and management conditions you find. “Succession” in the forest ecosystems of North America is the process where natural areas evolve from a pioneer community of grasses and forbs (after a major disturbance) to a community of pioneer shrubs and trees to forest environments with “layers” of herbaceous plants and grasses, groundcovers, shrubs, understory and sapling trees, and canopy trees. A truly ecological design plans for the succession of a landscape through these stages, creating beauty, habitat for a variety of wildlife, and long-term regeneration and sustainability.
- **Seek more diversity in the landscape:** In nature biodiversity is an essential feature of most thriving ecosystems. In ecological human landscapes diversity may be the most important principle, and we can start by increasing the diversity of plant species. Diversity in a landscape can range from having many varieties and species of turf in your lawn seed mix to replacing as much lawn as possible with diverse plantings, to incorporating more mixed plantings of trees, shrubs, groundcovers, meadows and food-producing plants. A variety of plantings will make our landscapes more interesting and will attract a diversity of wildlife, including birds, butterflies and “beneficial organisms”. Avoid monocultures, especially with plants that have potentially serious pest problems--what IPM professionals call “key plants” (more below).
- **Include a range of "natural habitats" and edge environments into your landscape:** Biodiversity in nature includes not only diversity of species but also the variety of habitats that exist in our region of the world. To enhance diversity include, wherever feasible, a variety of landscape plantings and gardens that create woodland, shrubland, meadow, wetland and other habitats. For example, a planting of mixed native, ornamental grasses and wildflowers, or even a lawn area left un-mowed, reflects a meadow environment that can attract butterflies and other wildlife and add beauty and interest at a time of year when landscapes can look worn. Add plants to a single-species hedge to create a more attractive and multifunctional screen or buffer, while adding habitat for wildlife. Understory plantings and groundcovers beneath shade trees recreate the vertical layers of our forests, which enhances beauty, habitat value and reduces maintenance. Edges, which are areas where two different habitats meet, are the most productive and diversified environments of all. In your landscape you can maximize edge environments by weaving different habitats and plantings among each other. If not disrupted by humans, pets or heavy pesticide use, this diversity of habitats and edges will attract a variety of beneficial animals, such as birds, insects, pollinators, reptiles and pest-eating spiders, to our landscapes.
- **Choose plants that need fewer inputs:** This important concept of ecological landscaping uses low maintenance, drought, stress and pest resistant species or cultivars of trees, shrubs, perennials, vegetables, flowers and turfgrasses. Reduce or eliminate high maintenance, irrigated turf. Seed lawns with lower maintenance tall and/or fine fescues. Avoid drought sensitive plants or those with serious pest problems, such as non-native birches and pines, tree dogwoods (unless properly sited), many cherries, roses and crabapples, and bluegrass or bentgrass lawns.
- **Design your landscape to enhance its natural ability to keep pests in balance:** More and more we understand the value of natural pest control organisms, such as beneficial insects, mites, birds and spiders. While a variety of habitats and edges will entice a diversity of beneficials into your landscape, also include plants and features that provide food, shelter and habitat for important predators and parasites of pest organisms. Flower families that attract beneficials and pollinators include umbellifers (dill, yarrow, carrot family) and the aster family (daisy, goldenrod, coneflower.) Attract beneficial birds with habitat plantings, feeders and nest boxes. Water is very important for attracting and supporting most beneficial organisms. Incorporate a water feature into your landscape, even if just a bird bath. Composts enhance

biological activity in poor soils; organic mulches and groundcovers, including clover, add habitat for beneficials. Most importantly, *conserve* beneficial organisms by reducing or eliminating the use of more toxic, broad-spectrum insecticides and fungicides.

- **Design for air circulation to reduce diseases:** Avoid crowding ornamental plants or plants too large for the site. Prune and maintain good air circulation through exotic plants and lawns.
- **Entice people into your landscape:** Finally, and very importantly, design your landscape to encourage people there to stroll, observe, pick or even just sit on a bench and enjoy. As you entice people into the landscape they may take a greater personal interest and role in its ecological management--and the more satisfying and pleasurable our landscapes will be! Landscapes should not be sterile looking and a source of hassles, but a source of joy and peace.

**2. Soil Improvement:** This is very important for a sustainable lawn and landscape that has exotic (non-native) or high maintenance plants--on the other hand there are native plants suited to even the poorest and driest soils. A rich, biologically active soil, with a proper pH and mineral balance and good structure and texture, will grow more sustainable, drought and pest tolerant lawns, vegetables, flowers and other plants. Removal of or damage to topsoil by poor construction practices, soil compaction and soil-depleting maintenance practices are often the underlying cause of plant and lawn problems. On the other hand, preserve intact native soils whenever possible. Appropriate plants can then be planted directly in such soils with minimal soil amending. Here are some practices that can enhance our soils:

- **Establish adequate depths of good topsoil:** Turf and most exotic ornamentals prefer four inches of good topsoil; six inches is better. Use loam-compost mixes, which are superior to what is often sold as loam, when adding topsoil. Avoid heavy, clay soils over sand and mix added soil with existing soil to avoid poor drainage. Better yet, till in 2 to 4 inches of compost into the top 6 to 8 inches of existing soils--even a very sandy soil can then grow many plants.
- **Soil examination and testing:** Take soil samples from different areas of your lawn and landscape and assess them. Mix and send samples to a good soil-testing laboratory for detailed soil analysis (i.e., your Cooperative Extension System). Use this information to...
- **Establish the proper soil pH and calcium-magnesium balance:** *This may be the most important, yet often overlooked, step in improving the sustainability of turf and other plantings.* Use your soil test results to determine the pH (acidity) of the soil. Learn the preferred pH ranges of your landscape plants and take steps to bring the soil pH in line with those preferences. Use lime to raise pH (use calcitic lime for turf, not dolomitic lime, where magnesium is high) and garden sulfur and iron sulfate to lower pH. *Over-liming lawns can be worse than not liming--* always test soils before adding lime. Turf and most flowers, fruits and vegetables prefer a pH of 6.4 to 6.8; rhododendrons, azaleas, hollies, dogwoods and blueberries want a pH less than 6.0.
- **Enhance the mineral content of your soils:** Again, a complete soil test is your guide. The addition of compost and/or rock minerals, such as rock phosphate and Jersey greensand, are good ways to enhance mineral deficient soils and increase plant health. A balance of eight parts calcium (as measured by “percent base saturation”) to one part magnesium is best for turf soils; once pH is optimal switch from lime to horticultural gypsum (calcium sulfate) on lawns, which benefits many plants by adding available calcium and sulfur without raising the soil pH.
- **Improve soil drainage:** This can be very important for plant and lawn sustainability. In areas that do not drain well, you must either improve drainage or grow plants tolerant of poor drainage; this excludes turf and many ornamentals but includes many attractive native plants.
- **Enhance the biological health of your soils:** We have come to understand that a humus rich, biologically active soil (like most native and forest soils) not only grows healthier, more drought tolerant plants, but helps prevent pest problems with less added fertilizer. Follow the steps

outlined above and adopt the best management and site preparation practices--and a natural fertility program--to improve the biological balance and organic matter of your soils.

**3. Environmentally Sensitive Maintenance and Use of Our Landscapes:** Many of the recommendations made under this category are just “best management practices” (BMPs). Proper care of our lawns, plants and soils, which encourages sustained growth and vigor, is the first and most important line of defense against insect and disease pests, against weed competition, against drought and other environmental stresses, and against stressful uses of our landscapes, such as heavy play.

- **Proper mowing is critical to ecological turf management:** Mow cool season turf as high as possible (at least 3 inches; 3.5 inches is better) and leave lawn clippings on the lawn to recycle. Proper mowing practices produce healthier, more attractive lawns at no additional cost to you. Returning lawn clippings improves the color, density, and weed and pest resistance of turf and reduces the need for fertilizer. Mowing lawns higher increases drought, stress and pest tolerance, while enhancing root growth and *significantly reducing grub damage and weed infestations without pesticides*--including crabgrass and broadleaf weeds. Mowing high and mowing often encourages a naturally healthy, pest-and-weed-resistant lawn over time. Mow irrigated lawns in summer and the last mowing of the season at 2.5 inches to maximize irrigation effectiveness and reduce disease. Sharp mower blades also enhance turf and reduce diseases.
- **End excessive use of fertilizers and apply properly to protect ground and surface waters:** Excessive fertilizer use--including most of the 4, 5 and 6 application lawn fertilizer programs--tend to reduce a plant’s natural ability to resist pests and stress, while polluting our ponds and estuaries. Fertilize lawns in spring after the first mowing and/or in late summer only. *Never* apply fertilizer before heavy rain, when soils are saturated or frozen, or when turf is not actively growing. *Never* apply fertilizer on roads, driveways or other hard surfaces without cleaning it up. These are all leading causes of nutrient pollution of and algae growth in ponds, streams and bays. Trees and shrubs that are stressed or in poor soils may benefit from slow release fertilizers applied in the early fall; healthy, mature plants often need no feeding at all. Half or more of the nitrogen in your fertilizers should be “slow release” or “water insoluble nitrogen”, which can be slow-release synthetic nitrogen or, preferably, natural-organic sources of lawn or plant nutrients.
- **Feed the soil and the soil will feed the plants:** This is an important principle of ecological land care and natural-organic fertility. Composts, organic mulches, rock minerals and natural-organic or natural-based fertilizers work to enhance soil mineral balances, biological activity and water-holding organic matter. When fertilized this way plants tend not to grow too vigorously or overly lush--conditions that make plants more vulnerable to drought and pests. Slow release and natural-based fertilizers feed longer and significantly reduce the amount of fertilizer needed--you can cut fertilizer use on lawns by half or more with organic fertilizers versus cheap, synthetic fertilizers, while enhancing overall lawn and plant sustainability.
- **Proper watering, and reducing the need to water, is a critical ecological goal:** *Forty percent (40%) of municipal water now goes to watering lawns!* This is not sustainable or ecological. If you establish an organically rich, moisture retentive soil, use appropriate, drought resistant plants with mulch, where appropriate, and mow your drought resistant grasses high, you can greatly reduce or eliminate the need for irrigation in a mature landscape. On the other hand, irrigation is vital to properly and quickly establish new lawns (keep soils moist till established) and plantings (watering deeply as needed during dry periods until established for 2 to 4 years).
- **Reduce or eliminate human stress factors--“People Pressure Diseases”--that may be damaging the landscape:** Often, decline in lawn or plant health is caused by human behavior, such as damaging use or play, compaction, improper use of heavy equipment, and poor pruning, pesticide use, mowing, mulching, watering, or fertilizing. Use “best practices” described here.

**4. Use Ecological Means of Controlling Pest Imbalances:** One of the biggest concerns of people looking to reduce or eliminate pesticide use in the landscape is, "Won't pests damage our landscapes?" Part of this fear is a lack of understanding of how effectively nature keeps most pests in balance.

It is estimated that 90 to 95% of pest control is done by naturally occurring organisms. In an ecological landscape, where pest-prone plants are avoided and natural pest control is enhanced--and not disrupted by improper, toxic pesticide use and other factors--you can approach 100% natural control.

Preventing pest problems is the key: design, establish and maintain your landscape as outlined above. Even then, some serious pest imbalances (pests may be diseases, weeds, insects, mites and vertebrate animals) may still occur. The question is how to manage them in an environmentally friendly way. Here is a brief list of recommendations--contact us for more information or guidance:

- **Adopt Integrated Pest Management (IPM) and Least Toxic techniques:** IPM was developed to reduce pesticide use and its negative impacts; a good IPM program includes the following:
  1. Monitor plants regularly for pests and other problems: monitoring is essential to an environmentally sensitive and safer pest management program. It helps you anticipate pest, drought and other problems, deal with them before serious damage occurs, and allow for the more effective use of "least toxic" treatment techniques and materials. Monitoring also helps determine precisely which pests on which plants or which turf areas require control measures--allowing you to spot treat pests and minimize both pesticide use and their unwanted side effects.
  2. Identify the pest: this is a critical step! Do not try to manage an insect or other pest without first being sure what it is. It may actually be beneficial or cause little real damage. If it is a pest, you cannot legally use a pesticide that is not registered for use on that pest. How can you manage a plant problem ecologically if you do not know what it is? Use whatever resources you need to (the web, books, local experts, your local garden center), but identify the problem first.
  3. Evaluate the amount of damage and determine if action is needed: tolerance levels vary, as some plants are more valuable, more vulnerable, or become much less useful at certain levels of damage--like vegetables, for example. Lawn weeds are an example of an aesthetic pest: they do not hurt turf directly but are a matter of personal taste. Determine what number of which lawn weeds are truly unacceptable to you; then manage only these problem weeds and only when they become objectionable. Treat pests only when they reach a level or "threshold" that pose the risk of enough damage to justify action, *and when no natural pest control organisms are present*. For our landscapes we have specific thresholds for only a few pests, so this is often a judgment call. *However, a "no-spray needed" judgment is the right one to make in many situations.*
  4. Use a "least-toxic" pest management strategy: Once you have determined that some intervention is needed to reduce a potentially serious pest imbalance, use least toxic and least environmentally disruptive means of control first. Then evaluate how this has worked. Only if the control has failed to limit the pest to acceptable levels--elimination of pests is not a sustainable or desirable goal--do you then move on to more toxic and/or impactful pest controls.
- **Least toxic pest management tools:** Here is a list of pest control measures or materials--in order from least to most environmentally damaging and/or potentially unsafe to people or pets:
  1. Cultural Controls: Includes using pest resistant plant species or varieties, and using the best management practices discussed above. *A healthy, well-sited plant is the first line of defense against pest problems* and is key to preventing lawn, tree and plant problems. For example, use disease resistant cultivars of roses, crabapples, apples, cherries, etc. to avoid pest damage from the start. Mowing high and leaving clippings on dense turf is the most effective means of preventing the germination of many weed species and can reduce potential damage from grubs. Applying a corn gluten fertilizer can somewhat reduce germination of many weed species, including about 50% of crabgrass, while improving lawns. The use of "endophytic" grass seed

is effective at preventing chinch bug and reducing disease damage to turf. With these measures, overseeding of damaged turf is the only "pest management" needed for organic lawns.

2. Mechanical Controls: Includes hand picking insects, brushing scale insects, pruning diseased or insect-infested plant parts, hand weeding and a hard spray of water to control mites. Mechanical controls can often be effective and efficient but are not used enough.

3. Barriers: Includes sticky tapes, copper shields for slugs, deer fences, weed barrier cloths, Reemay® and other plant and row covers, and even groundcover plantings to crowd out weeds (and reduce mulching)--anything that physically prevents a pest from damaging your plants.

4. Traps: Generally effective and useful only for monitoring for the presence of a pest.

5. Biological Controls: natural enemies of pests include predators, parasites and pathogens. Attract and conserve beneficials in the landscape; some can be purchased and released to help manage certain pests. "Predatory" (entomopathogenic) nematodes can manage clear winged moth borers of lilacs, dogwoods and rhododendrons and lawn grubs (use a *Heterorhabditis* species only) and. Low toxic bio-fungicides, such as Serenade®, manage a variety of diseases.

6. Less Toxic Sprays and Dusts: These are "biorational" or low-impact controls, like insecticidal soaps, horticultural oils, diatomaceous earth, Bt, and baking soda and antitranspirants to manage diseases. They are effective at managing many pests, yet spare most beneficial organisms and have little impact on people or the environment. They should be used much more often.

7. Natural/Organic Broad Spectrum Pesticides: Pyrethrum, Neem (azadirachtin) and Spinosads are examples of insecticides derived from plants or other organisms. Sulfur and Copper are effective mineral fungicides. There are a variety of bio-fungicides, such as Serenade® and Actinovate®. These all tend to be less persistent and have a lower impact on "non-target organisms" than most synthetic pesticides--and they are effective against some important landscape and garden pests. There are also a range of organic herbicides best used on young, annual weeds, such as clove oil and citrus oil products. Follow all label instructions carefully.

8. Synthetic Chemical Pesticides: Often the first choice for pest control, these materials should be chosen last--if at all. They are generally more persistent and more damaging to the environment. They can diminish populations of beneficial organisms, leading to more damaging rebounds of the pest later or allowing other pests to become a significant problem. You can manage entire landscapes without synthetic-chemical pesticides--with careful plant selection.

Herbicides are the most commonly used pesticides, and we can do many things, such as hand weeding, spot treatment of weeds, and proper mowing and fertilizing, to reduce the need for herbicides. In our lawns, where weeds are aesthetic pests, we can alter our image of weeds, what they are, what role they play ecologically--and learn to co-exist more with them.

There are certain pests where use of synthetic pesticides may be the only feasible, effective management option. At these times, choose the least toxic pesticide registered for that pest and spot treat only those plants and those areas with significant pest populations--and where there is no evidence of natural control. For example, sterol inhibitors are very low toxic fungicides--affecting fungi only--and provide both protective and curative qualities against many serious diseases. Use synthetic pyrethroids instead of organophosphates (such as Orthene®) or carbamates (such as Sevin®) when a more potent insecticide is warranted. Avoid or minimize the use of more controversial herbicides, such as paraquat, arsenates, 2-4D, MCPP or dicamba.

Preventative or broad-scale applications of pesticides--applications to the entire lawn or landscape whether you need it or not--are seldom necessary. Such applications are increasingly unpopular with the public and often do much more harm than good to our lawns and landscapes. We can significantly reduce or eliminate the use of more toxic pesticides in our lawns and landscapes and have attractive, worry free environments for our families and pets, our communities, and the wildlife and the environment around us. Contact us for more information.