Managing Land Ecologically
Using Perspective of Scale

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Land is a commodity. It shouldn't be, but it is. Not for everybody, but for a lot of people. With enough bulldozers, you can make virtually any place flat, pour concrete, and build houses, a mall, roads . . . anything you want. Or, if that's not your thing, you can take a wetland, drain it, dry it out, and build houses, etc., etc., etc. It doesn't matter. It just takes a little time, lots of money and equipment, and the determination to do it. Along with the necessary permits and variances.

These are extremes. Short of them, the world is slowly but surely getting developed - individual homes, small housing units, an Amish factory on a country road, fields devoted to corn for ethanol and corn syrup, soybeans for TVP and animal feed. The forest is being divided into smaller and smaller parcels, for homesteads, drill pads, more corn and soybeans. The bigger stands are not just woods, but woodlots, timber resources, some managed for sustainable regeneration, others high-graded for maximum short-term profit.

Land is not money, but neither is it not financial. There is always an economic dimension to land. If you have enough resources independent of the land, you may be able to hold at bay the financial demands of a tract. If not, you may be kept awake at night, driven to decisions you don't want to make. You may be forced to seek money from the land to keep it, or keep most of it, or maybe just a corner of it.

Commodification, division and fragmentation, development, financing all come to bear on land, but land is, or can be, something else. Laying those perspectives and concerns aside for the moment, as legitimate as they are, another way to think of land is as an Ecology, a *place* where many different forms of life live together in an interdependent way with one-another and with their surroundings.

On this point, Aldo Leopold comes to mind. In two ways. First, he used the term, *Land*, to denote not just the soil, but the whole Biotic Community of organisms living in proximity and conjunction with one another. We'll follow Leopold's lead and use *Land* in a similar broad, all inclusive sense. Second, Leopold coined the term *Land Ethic* to anchor a philosophy or theoretical framework in which human beings are not at the center of the universe - or the plot of land - but share a symbiotic and ethical relationship with the land and the kingdoms of living things therein. These range from the microscopic inhabitants of the soils and waters to the plants that depend on them to the insects, birds, and animals further up the food chain.

The notion we will explore here is what it means to manage land ecologically and, should we desire to do so, how might we go about it? We can't, of course, answer those two questions fully, but we hope to provide a framework that can be applied to many different situations. This framework is offered as a starting point and as a way of looking at a plot of land ecologically. The goal is to *improve* the land ecologically to better support the many different life forms that live there or could live there. To make it a healthy, diverse environment that can withstand biological stress and adapt to inevitable changes. We assume human beings will live in many of these environments, but they will do so in ways that are mutually beneficial with the other inhabitants. We also assume that financial concerns must be considered but we also assume that the land has *intrinsic* value in and of itself, apart from its financial value. Our aim, then, is the interplay of ecologically-based ethical concerns, with financial concerns, with the pragmatics of care.

The framework we will explore is looking at land with the goal of ecological maintenance and improvement through the prism of *scale*. It makes a world of difference if one is managing a one-acre lot in a subdivision as opposed to a hundred acre farm transitioning out of agriculture. The two present different options and, consequently, one needs to look at them differently, think about them differently, and approach them with different strategies and expectations.

The specific framework we will use is *order of magnitude* of the parcel size. Many disciplines use this concept. Two of our favorites are astronomy and computer science. If you've never seen the Charles and Ray Eames film, *Powers of Ten*, made for IBM and completed in 1977, take a look now: https://www.youtube.com/watch?v=0fKBhvDjuy0.

We'll begin with parcels of 0-1 acre, then 1-10, 10-100, 100-1,000, and, finally, 1,000-10,000 acres. Anything over 10,000 acres we will consider as falling in that last interval. We'll characterize how parcels of a particular size are likely to be used, what kinds of things an owner might and might not be able to do within them, and what constraints or practices might apply. These will be gross approximations, but we hope they will give a starting point for an endeavor that can give pleasure as well as observable benefit.

0 - 1 Acre

A one-acre tract of land, as a square, would be a little more than 200 feet on a side, whereas a quarter acre lot - common in many suburban subdivisions - would be just over a 100 feet square. Focusing on the full one-acre lot, it could be a vacant lot, a community garden of a dozen or so plots, but it is likely to be a residential lot or one used for a small business. We'll focus here on one-acre lots used as residences.

So, if you want to improve your land ecologically or convert it from a conventional residential lot to a more natural environment, how should you think about it and how might you go about it? Relative to other tract sizes, you have both more constraints but also more options.

Your largest constraint will be the small size of your plot. To develop a variety of types of land areas, you need space. For example, it would be hard to develop a meadow, a wetland, a small forest, as well as specific habitats for, say, butterflies as well as birds. At the same time, the small size of your plot can increase your options. It is always a good idea to identify basic ecological conditions on your land - the type of soil, the amount of water, the slope, the amount of light, the geographic orientation, the plant and animal life already there, etc. But if you are bound and determined to have a particular type of area, you can probably make it happen.

For example, if you really want a small wetland but your plot is flat and dry, you can probably with enough effort and resources, create a swimming pool sized wetland. Dig it out, line it so that it will hold water, plant native aquatic and wetland plants around it, stock it with a few fish. Soon you will have frogs, other amphibians, and reptiles move in; wildlife will come, including birds to drink and bathe. Maybe even herons to eat your fish.

A better strategy might be, if your plot is largely open, turn it into a meadow. Replace lawn with native plants suited to the soil and water characteristics of the area - see, for example, Ernst Seeds (http://www.ernstseed.com); they offer various naturalizing mixtures for dry, wet, north-east, south-east, etc., conditions; they will also custom blend mixes that include your favorites. (You will, of course, need to check with your municipality or owners association to be sure they don't have lawn care ordinances or covenants that would preclude such.)

Another option would be to start a small woodland. For example, if you live in the north-east, you might plant eight or ten native hardwoods selected from oaks (red, white, chestnut) maples (red and sugar), hickory, and/or cherry (black and bird). Other selections would be made for other regions. Ten large trees will be enough for a one-acre lot, but while you are waiting for them to grow, you can fill in with shrubs and mid-canopy trees. These might include Viburnums, Spicebush, perhaps Willows, Alders, and Aspens if the area is suitable. Also Dogwoods, Redbuds, Serviceberry, Hornbean, and other mid-canopy species.

Even a small copse can provide numerous benefits. Doug Tallamy (The Living Landscape, 2014, and Bringing Nature Home, 2007) points out that in addition to providing significant cooling as well as conversion of carbon dioxide to oxygen, trees and shrubs are essential for enabling bird populations. Most people are familiar with the benefits trees and shrubs provide as food sources through nuts, seeds, and berries. Perhaps less familiar is their importance as providers of insects, especially caterpillars, during birds' brood period, from hatching to fledging. Tallamy points out that some species will require as many as 400-500 insects a day to nourish their young and as

many as 8,000 to 10,000 for the brood to fledge period. And, as he also notes, oaks and cherries are particularly important in this role.

A final option we will mention, and perhaps the easiest, is developing a supportive environment for butterflies. They require nectar plants as food sources for adults, host plants where adults lay eggs and emergent caterpillars grow and feed, water, and if you are really serious, a place to leave rotting fruit and dead animals on which beautiful, delicate butterflies love to feed! You will want multiple kinds of plants and shrubs since different species require different nectar and host plants. These can be clustered in a bed or they can be scattered throughout a landscape. There are numerous books on developing butterfly gardens as well as multiple sources for butterfly-useful plants. One online site that we have had good personal experience with that offers a very helpful and beautifully illustrated book as well as a wide range of both nectar and host plants is Rose Franklin's Butterfly Perennials (http://www.butterflybushes.com/).

Stepping back, several generalities can be seen for ecological enhancement at this scale. First, projects at this scale are largely *landscaping* projects. Whereas some may require some construction, such as creating a small wetland, most can be done by the land owner with a minimum of equipment. This is particularly true if the overall project is viewed as an ongoing effort and one the doer derives pleasure from. Second, emphasize native plants. In general, they are likely to require less maintenance and provide greater benefits to wildlife and the overall environment. Third, effort will be rewarded, but it will not change the world. On this scale, the transformed tract is likely to attract more birds, perhaps more or different butterflies and other wildlife, and a more pleasing aesthetic appearance. But most of the benefits will be local - that is, within the scope of the tract or close-by. If adjacent landowners become engaged in similar projects, one's efforts will be leveraged, but they are not likely to have significant impact on a broad area. The scale is just not sufficient for that. Finally, the effort is likely to be both educational and pleasing. You will learn a lot about individual plants, trees, and wildlife species. You will make friends with specific plants that you will visit repeatedly, to see how they are doing, how they have grown or changed. And you will probably learn something about yourself.

1 - 10 acres

A tract of 1-10 acres will be, for many, an ideal size to learn and practice ecological principles, as well as to enjoy their benefits, without getting overwhelmed. Such a tract will often be residential within a rural area. As a square, it would be 660 feet on a side, or just over two football fields in length per side or a total area between 8 and 9 fields laid side to side.

Take your time. If you have recently moved to a new property and/or are considering a project to enhance the ecological health of your land, ease into your plans. If your previous frame of reference was a residential lot, such as the 1-acre tract discussed above, projects you might undertake there were likely to be of the scale of a lawn or plots several garden areas in size. For a 10-acre property, you have the option of projects that may involve areas equivalent to several football fields in size. That's freedom, but don't let it overwhelm you. Like empty space in a new house, once you put something in it, it's there and awfully hard to remove it. So, take some time to get to know your property, get to know what you like to look at and where you like to be. In different seasons. Let ideas emerge and let them gradually coalesce into goals and plans.

You are in luck in one respect - you are at the center of the *Woods in your Backyard* focus. Over the past 10 or 15 years, a small industry has grown up around the notion of turning large suburban or rural residential lots - those 10 acres or less - into more natural, biodiverse environments in contrast to traditional landscaping that emphasizes lawns and commercial horticultural plantings. As the name implies, they emphasize creating woodlands on tracts of this size, but they also address protecting and enhancing riparian areas along streams, developing wetlands, creating grasslands and pollinator areas, often made accessible through trails and bridges. Shrubs trees, and herbaceous plantings are selected from native plants suited to the particular geographic area and local conditions, such as soils, water, light, slope, and orientation. Most of the Woods in your Backyard activities are located in the Mid-Atlantic and New England areas primarily in the form of workshops, seminars, and webinars offered through university extension programs.

Woods in your Backyard resources are readily available, from how-to publications to participant workshops. Since they incorporate many of the principles discussed by Doug Tallamy, the books referenced in the preceding section are a good place to start for both basic principles and inspiring images ot natural landscapes (thanks to Rick Darke's photos). A detailed workbook is available for download at http://host31.spidergraphics.com/nra/doc/Fair%20Use%20Web%20PDFs/NRAES-184_Web.pdf. It extends from planning to recording your progress through some 20 different activities that add up to an extended Woods in your Backyard project. A second edition of the workbook is available through Plants and Life Sciences Publishing (PALS), located at Cornell University, http://palspublishing.cals.cornell.edu/nra_order.taf?_function=detail&pr_id=202&_UserReference=892DB00BEBE05149575853EA. A number of universities offer both Web and onsite workshops. An example video seminar from several yeas ago can be seen at https://www.youtube.com/watch?v=8H1mHUIYWQw. For current on-site as well as webinar workshops, see extension listings for Penn State University Extension, University of Maryland Extension, Virginia Tect Extension, and Cornell University. If none of their offerings are convenient, a Google search will usually turn up others. Most, if not all, of them include copies of the *Woods in Your Backyard* second edition workbook as part of the registration fee and address the activities included in it.

Since the workbook and seminars offer an easy-to-follow methodology for planning and carrying out a project of this scale, we will not duplicate that information. Rather, we'll offer one or two comments and a perspective. First, the Backyard Woods folks move very quickly to your identifying goals for your property and then incorporating them into a plan. We suggest a prior step. *Get to know your property!* Take time to walk around every nook and cranny, get to know the striking or unusual plants, trees, rocks, whatever strikes your eye. Spend time in different locations to see which ones feel especially good to you. Do these things in different seasons. Once you begin the actual project, things take on a momentum of their own. It's a bit like moving into an empty or sparsely furnished house: the most valuable contents you have is empty space. Once you fill a space, whatever you put there is likely to never leave. How can you throw out that comfortable old couch that you love to lounge on but hate to look at? So, be careful what you change, what you plant, cut down or move on your property. Know it throughly including imaging it in different ways before you commit. Once you plant a tree, even if you come to see it as the wrong tree or as in the wrong place, it is very difficult to cut it down!

Second, look for problem areas; that is, areas that would be problems if you were doing conventional landscaping. Do you have a wet, boggy area? a stone outcropping? a steep slope, a clearing in a patch of woods? a dry knoll? These are likely to be irregular features that differ from their surroundings. And, they may be perfect spots for an extended wetland, a stone garden, a cool north-facing planting of shade-loving herbaceous plants and shrubs, a woodland meadow, or a grassland or pollinator field. They could become points of interest - destination points that you will visit on a system of trails.

Finally, what does a project on this scale add up to? First, let's hope it will become a source of great personal pleasure. You will experience your land in a way you could not otherwise do. Second, you will learn a lot. If you emphasize natives in your project, you may get to know some really interesting new plants, trees, and shrubs. They, in turn, may introduce you to unfamiliar wildlife, including birds, butterflies, amphibians, maybe fish and reptiles, mammals. You will see more because you know more. Third, understand that most of the benefits will be local. That is, you and others who live on or visit your property will share these pleasures. There will be some carry over beyond the bounds of the tract, but at this scale the impact on the ecology beyond will be limited. Should your neighbors join you in similar projects, then your efforts will be leveraged. Finally, a look at the statistics: in Pennsylvania, those who own tracts of 1-10 acres constitute some 60% of all forest landowners, but their combined holdings comprise only about 7.5% of the total acreage. The major reward will likely be in what you learn and experience, rather than impact on the enivironment as a whole. However, if you come to see the value of your efforts on your own property. you may come to support more general ecological efforts. If this should happens and other similar owners, the benefits of projects at this scale could become as much political as environmental.

10 - 100 acres

A 100 acre tract is a sizable piece of land, but probably not large enough to be financially sustainable through conventional agriculture or timbering. As a square, 100 acres would be a little more than 2,000 feet, or four-tenths of a mile, on a side. Many are likely to be old farms that have gone out of agricultural, tracts that have been subdivided from larger ones, forested areas sold off following a timber harvest, or tracts of less financial value to some larger agricultural or forest entity. In Pennsylvania, there are approximately four times as many farmers 65 and older as 34 and under, and the disparity is increasing. Consequently, more and more such parcels are likely to be available in the future.

In the preceding section, we saw that owners of forest lands of 1 to 10 acres comprise some 60% of total owners, but their combined lands comprise only 7.5% of the total acreage. For owners of 10 to 100 acres, the numbers are very different. They comprise 35% of the total owners but 43.5% of the total acreage. This is a sizeable fraction of total lands and means that ecological enhancement on these tracts could have a substantial physical impact on the overall environment. The main thing, of course, is to get these owners to participate.

Our own property falls into this interval. It is an old 68-acre farm that we took out of agriculture 15 years ago. We will try to keep the discussion general so that it can apply to many different kinds of properties, but we will fill in some of the specifics with details from projects carried out on this tract. For more information, see our Web site, http://www.chicorylane.com.

As we have recommended for all of the tract sizes, get to know your property. If yours is on the high side of this interval - upwards of 100 acres - this is a more formidable task. But no less important - in fact, probably more so. You need to walk it to make your knowiedge intimate, but as the size gets larger and, perhaps, as you age, this will become a more formadable task/pleasure. Our first suggestion is a rather strange one. Buy a Utility Vehicle (sometimes referred to as a side-by-side UTV).

These vehicles look a bit like a golf cart on steroids. That is, they are a little larger, heavier, and more rugged. Some come fitted out with various accessories, such as running lights, winches, engines that will propel then at high speed. Avoid these and get one that is built for work. Our personal preference is the John Deere Work Series Gator 6x4, meaning it has 6 wheels total, with power applied to 4 of them. It also has a power lift on its large rear bed; this is surprisingly useful for any number of tasks. Another popular one is the Kawasaki Mule, but many of the other tractor and recreational vehicle makers have UTV lines. The one thing to look out for is that many of these are flashy trail-riding vehicles; stick to the slower, more functional ones intended for work. They can also be picked up used at considerable savings., but if you buy a used one, don't buy it too cheap. You may end up paying more for repairs on a lower priced used vehicle than a more expensive, low hours one at a higher price.

UTV use as work equipment will quicly become obvious. Perhaps less obvious but no less important is its use as a travel vehicle. They will go almost anywhere (unless the trees are just too thick or there is snow on the ground). They will get you around your property as part of the all-important getting to know your property phase. And that phase never ends. For a 100-acre property, you need to know every part of it, in different seasons, and you need to spend time in each. Go there and sit for a while. We have found that almost invariable, if we go sit for 15-20 minutes in a spot, we will almost invariable see something interesting. Yesterday, I spent time with 3 very large, very fresh Monarch butterflies moving from yellow Goldenrod to purple New England Asters, getting ready, I imagined, for their migration South. Another time, I watched for a half-hour an adult Green Heron teaching by example her chick how to fish from logs on a vernal pool. See the video I shot from a tripod resting on the floor of our Gator (https://www.youtube.com/embed/_AOHk3NJNC4?rel=0%26autoplay=1). They make good blinds, too!

As you learn about your place, also learn about ecological principles and practices. In the section, above, on 1-10 acre tracts, we discussed several resources for increasing your ecological knowledge. These included books, workbooks, and several varieties of online and onsite workshop. All of these will be useful for larger projects, particular their discussions of basic principle, although you may need to modify some practices to scale them for larger tracts.

Two additional resources that are not just useful but probably essential are people and services, particularly those available from government agencies. This is especially true for larger tracts, where the scale of some projects may be beyond the effort, expertise, and resources of the individual landowner and the informal help available to him/her by family and friends. In discussing these resources, we will reference state and local resources for Pennsylvania, but analogous services exist in many other states.

Probably the most import resources for projects of this scale are those available from the USDA's Natural Resources Conservation Service (NRCS: https://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/). Since most of their conservation programs are dependent on so-called Farm Bill funding, the emphasis and levels of support change fairly regularly. Three of their most helpful offerings are people, conservation plans, and financial support. The have biologists and other trained technical personnel. If you request their help and a visit to your property to talk with you, they are likely to comply. Our experience has been that these individuals have universally been informed, friendly, and willing to help in any way the could. One of the products you may request is a conservation plan. If your application is accepted, this will be a technical document that includes maps, soils, and area breakdowns that outline options appropriate for your conditions and steps you may choose to take to improve results. The third resource could be financial. Depending on available funding and the characteristics of your particular property, you may be eligible to apply for financial help in carrying out one or more ecologically beneficial projects. Examples include planting trees, creating grasslands, improving riparian buffers along streams, controlling invasives. Financial support could take the form of annual rental payments, cost sharing, and incentive payments.

Another very helpful Federal agency is U. S. Fish and Wildlife (FWS: https://www.fws.gov/). What makes them unusual is the flexibility they have to assist and the broad range of services they can provide. For any project involving a body of water, particularly streams, you should talk with your local FWS office. They can help on a number of different levels, ranging from design, to permitting (when required), to coordination with other agencies and organizations, to implementation for some types of projects, to oversight of construction. For example, if you should decide to convert a wet area to a small vernal pool, they can do engineering design to assure proper depth and water level control, assist with any permits that may be required, coordinate with other agencies or organizations to provide funding and construction. During construction, they can keep an expert eye on the work, and afterwards, advise and help with any additional planting needed to enhance the pool and area. They also help with forest restructing projects, stream-bank restoration, riparian buffering and protection. Another service is providing hands on help with controlling invasive species using both chemical and mechanical means. Even with all of the services listed here, this is just a sample. If you begin a project that has something to do with water, get in touch with them.

Resources are also available at the state level. We will reference those for Pennsylvania, but analogous services are available in many other states. The Pennsylvania Game Commission (http://www.pgc.pa.gov/Pages/default.aspx) employ wildlife biologist who may be available to come out to your property, particularly for tracts of 50 acres or larger, and work with you to create a wildlife conservation plan. As the name implies, their study documents will identify different habitat areas on your property, different plants and animals that are likely to be found within them, and steps you could take to improve ecological conditions. Whereas the emphasis is on habitats that are beneficial to game species, observations and recommendations are not limited to them and the landowner incurs no obligation, either with regard to implementing recommendation or to allowing hunting on the property.

Another Pennsylvania agency that can offer help is the Pennsylvania Department of Conservation and Natural Resources (PA-DCNR: http://www.dcnr.pa.gov/Pages/default.aspx). They have on staff service forester for each county in Pennsylvania. They are available to help landowners with a range of services related to sustainable forestry, from writing Forest Stewardship Plans, to planting plans when establishing a new forest, to trouble-shooting forest diseases and other problems.

In the remainder of this sections, we will look briefly as several kinds of enhancement projects that might tale place on a tract of this size. They are intended as a representative sample, not an exhaustive list. Similarly, illustrative details are suggestive of typical values; costs and other factors will vary with any number of circumstances. There's an old forestry saw (sorry) that says you can do three things to a tract of land: plant

something, cut something, or do nothing. These examples illustrate all three options. Except, with all of the invasives around, you can't really *do nothing* if you don't want to be run over by something.

Convert a former farm field into a hardwood forest. Assume you have a 15 acre field that is adjoined on several sides by woodlands. How might you convert it into a hardwood forest, or at least have a hardwood forest at some time in the future? Since there are established forested areas nearby, efforts here should be leveraged by those tracts. What type of forest will you plant? that is, what specific species of trees? The place to start is Jean Fike's *Terrestrial and Palustrine Plant Communities of Pennsylvania* (http://www.naturalheritage.state.pa.us/fikebook/Terrestrial_Plant_Book.pdf). There, you may come to suspect that the *Red oak - mixed hardwood* community would be suitable for your project (since it is the predominant hardwood forest community in PA). One thing you might do is get in touch with your nearest service forester with PA-DCNR. He/she will come out, go over your project and work with you to make a number of decisions ranging from preparation of the field before planting to deciding on the particular species to be planted to writing a planting plan. Ideally, you will be beginning a long-term relationship because after planting, you will want to check in with this person from time to time to confirm that everything is going along smoothly or to help you work through problems that arise and answer questions. But, back to planting, one of the decisions to be made is spacing. A common grid is 20-foot centers, resulting in about 100 trees per acre. Other grids are 15x20 down to 10x10. Assume for now you go with 20x20. At 100 trees per acre, that's a total of 1,500 trees for you project. That's a lot for you and your friends to plant, so you are likely to need help.

Contractors are available that can come in on a project at this stage and take it all the way through actual planting. That is, once you provide a planting design and a list of species and the numbers for each, the contractor will purchase seedlings, any protective structures you will need for each tree (stake, tree tube, ties, and perhaps a protective mat), and arrange for the actual planting. Costs per tree will vary, but currently should run between $12 and $15 per tree. For 1,500 trees, that's $18.000 to $22,500 total.

If that's in line with your budget, fine; if not, let's go back to the beginning. You can still start with the service forester, but you may wish, instead, to start with your local NRCS office. They, too, will come out and go over your place and your plans and desires. It may turn out that your field is suitable for their Conservation Reserve Enhancement Program (CREP), a program that attempts to take marginal farmland out of agriculture and place it in conservation reserve status. Different programs address different kinds of lands and outcomes. If your plot looks suitable, they will develop a comprehensive conservation plan for you and, assuming you wish to continue working with them, they may be able to enroll you in a 15-year contract that will pay you a generous rent on your enrolled land. For some programs, they may also be able to cost-share certain expenses incurred in establishing a project. That is, they may be able to reimburse you for a substantial portion of the tree planting costs. If you decide to contact NRCS first, they will most likely make the connection with DCNR during the process, if you haven't already done so by that time.

Once the trees are planted, which may be phased over several years, you will need to provide on-going maintenance. It is a not particularly burdensome task, but it is essential if you want to eventually have a healthy, closed canopy forest. The first few years, in particular, you will need to mow between rows several times a year, both to provide access and to control any invasives that appear. You will also during this establishment period need to spray around the base of each tree to discourage rodents. For the first five or ten years you will need to make several passes through your planting yearly, such as spring, mid-summer, and fall. The purpose of these passes is to repair any damage that has recently occurred, such as a tree getting blown over or a protective tube being damaged. You should also keep an eye out for any aberrant growth that you may wish to remove. If a branch is going to grow back into the middle of the tree, you may wish to remove it early so that all that energy and growth goes into the main structure of the tree that you want to develop and not into a limb that you remove later. After your new forest is well on its way, you willwant to go through it from time to time to control invasives. These may range from plots of poison ivy to incipient thickets of Honeysuckle. Catching these early is always a good idea.

Before we leave this new forest project, let's circle back around one again to the begining of the project. One early decision that you will be faced with is what approach to use to protect your trees from predators, especially deer. They can be devastating to new tree plantings and the problem they pose must be addressed. In the

discussion above, the decision was to use 4- or 5-foot tree tubes attached to stakes for each tree. Doing so results in $3-5 per tree and was included in the original cost estimate. An alternative, and the one favored by most foresters, is to protect the field as a whole rather than each individual tree. This is usually done by erecting an 8-foot wire mesh fence around the entire field. Doing so not only protects the trees but usually results in much quicker and fuller growth of herbaceous plants and shrubs as well as less tree maintenance and higher success rates for the trees. Costs for deer fencing, as it is usually called, range between $2 and $4 per linear foot for combined materials and installation. Thus, a 15 acre field if it was in the shape of a square would be approximately 3,500 linear feet; other shapes, such as irregular or long, narrow shapes, are likely to have longer perimeters. Thus, minimal estimates for fencing could be expected to run some $7,000 to $14,000. Obviously, a trade-off to be considered.

We have gone into much more detail for this particular practice to give a realistic sense of the many steps and decisions that would be involved in actually carrying it out. Other practices are likely to include similar levels of detail and complexity. For the rest of this discussion, we'll go back to the more compact discussion mode we have used earlier, but you should assume a similar level of thought and effort will be required for all practices than is actually described here.

Convert a farm field into a native grassland. Again we'll assume a 15 acre field, such as a former agricultural field. The goal is to turn an open field into a grassland of native grasses and wildflower/pollinator species. Again, the place to start is your local NRCS office. They can provide both advice, and they also have CREP rental and cost-sharing programs for grasslands. They will help you develop a plan identifying both the particular native seeds to use as well as the amounts of each appropriate for your project. Your plan might include all warm season grasses, such as Big Bluestem, Switchgrass, and Indiangrass or you might mix in some smaller ones, such as Little Bluestem. The large ones grow six or seven feet high and put down very deep, drought-resistant roots. The plan may also include shorter, earlier cool season segments - often as a protective border around the warm season grasses - as a fire break should the warm season grasses burn.

The process of establishing a grassland is simpler than that for a hardwood forest. Preparation usually involves cutting existing growth, disking to give access to the soil, and, perhaps, spraying with a herbicide to reduce initial competition. It would also be a good idea to do a soil test to see if lime and/or other amendment(s) need to be added. Planting native grasses requires a special planter or *drill*. This is because some of the seeds are very fluffy and others are small and hard, almost like poppy seed. If you want to add wildflowers and/or pollinators, mixes can be obtain from a number of sources, including Ernst Seeds mentioned earlier. These seeds would be added to the drill mix. Once all the preparation is done, planting on this scale can normally be done in at most a day or two. You will most likely hire a contractor to do your custom seeding. Your NRCS office is likely to have a list of such, including farmers interested in wildlife and conservation who are anxious to help pay for their specialized equipment. Often they are willing to supply the seeds and in the desired proportions. Costs for a native grasses grassland of 15 acres, with added wildflowers and/or pollinators, including preparation and custom planting, is likely be in the neighborhood of $4,000 to $5,000. Again, such projects are candidates for both CREP rental contracts as well as cost-sharing.

Maintenance is simpler than that required for a hardwood planting. The main issues are keeping the plot free of invasives including any woody-stemmed plants. This can be done by spot mowing an/or application of an appropriate herbicide. One special problem is to be on the lookout for invasives such as Crown vetch. This and other similar species are often used in highway projects as erosion control. When they spread to other areas, they are as troublesome as any other invasive, and they spread very aggressively. Repeated spot mowing as soon as they show and reshow themselves can be an effective control.

Convert a wet area into a vernal pool. If you are not familiar with vernal pools, as the name implies they are pools often fond in wooded areas deep enough to hold water for most of the year but shallow enough to dry out for some part of most years. There interest lies in the changing habitats they provide during this annual cycle and the changing plant, animal, insect, amphibian, and reptile communities they attract. To gain a sense of how interesting and aesthetic they can be, see the video https://www.youtube.com/embed/_AOHk3NJNC4?rel=0%26autoplay=111.

If you do not have a vernal pool on your property, you may be able to find a suitable location and have one constructed at reasonable cost. The place to start is talking with your local U. S. Fish and Wildlife Service. They will normally send out a fish and wildlife biologist to visit your place and begin the discussion. Together, you'll want to locate a reasonably flat area, ideally with a slight depression, but one that appears to be naturally wet. It needn't be more than an acre or so, it may be a wooded site, or may be in the open, such as a old field that was probably tiled earlier to make it tillable. If it is an old tiled field, you will need to remove the tiles. The basic idea is to create a shallow depression, usually 18 inches to 2-feet deep, that will fill with ground water over the winter and then gradually loose most or all of the water gradually over the summer through evaporation - not leakage - hence the importance of placing the pool on suitable soils that retain moisture.

There are a number of steps that will/would be required to make this basic idea a reality. Your FWS biologist can help you with most if not all of them. You will need to shot levels for your area to get the slope, which will largely determine the size and perhaps the location of the pool or pools. Next, you will need engineering drawings to show precise slopes, dimensions, soil type and fill requirements, emergency overflow, and most, likely, a level control mechanism. The FWS can produce these plans for you. They can also work with you on possible cost sharing. They may be able to help directly, but if not they can also liaise with other conservation groups and/or governmental agencies to seek financial resources. Because of the technical nature of even a small scale project such as this, you are likely to want a contractor who has had similar experience. They can provide you with lists of such. During construction, they are usually able to visit the project to confirm work conforms to the engineering specification and/or to address problems or unforeseen circumstances.

Maintenance is probably best based on the option "do nothing." Creating a new environment with such varied conditions and doing so in a way that will leave extensive disturbed ground is a siren call for all kinds of new vegetation to make themselves seen. Some will emerge from the seed bank in the disturbed soil. Others will be brought in by wind and wildlife, especially birds. Consequently, the plant community will evolve very quickly over the next several years. You'll want to watch this progression. However, there area few things you may want to keep your eyes out for and keep them from getting established. One of the earliest, at least in Pennsylvania, is likely to be Loosestrife. It's easily managed with diligence - early and continued - but much harder to control once it gets a foothold. Another that is usually viewed as attractive early, but later can take over, is Cattails. We suggest deciding which areas you will allow it in and in which it is to be excluded . Perhaps the best way to manage it is to allow the pools to drain fully, cut them at the base, and apply an aquatic rated herbicide when shoots appear. If possible, do this in late summer or fall after the breeding season.

The best way to keep an eye out for things that need your attention is to take your Gator (or other UTV) down to your pool, sit in it for a half-hour or so, and just watch the action. You'll be amazed at what all you'll see - most of which will be fully pleasurable but enough will carry a note of something you need to attend to justify your time spent there. Especially, to those who ask, "Where have you been?"

Improve the riparian area along a stretch of stream. The projects discussed above are fairly sizeable and all have a definite establishment phase followed by on-going maintenance. The last project we will mention is of a much smaller scale, has no obvious beginning or end, and can be scaled as small as you like. Since it evolved over time, we'll describe it as a narrative, although it did not unfold in quite such an orderly way.

A shaded stretch of stream meanders through our property for nearly a half-mile. The stretch we'll describe here is about 100 yards of stream and steam bank that lies North of our farm lane. At the upper end of this stretch is a fairly large clump of Nannyberry Viburnum. It's a clump shrub, 10-12 feet high, multiple stems/trunks, with glossy green leaves and green, olive-like fruit that turn black in the fall. It has a pleasing mushroom-shape. We've been aware of this clump for some time, visiting it often and with pleasure.

A few years ago while clearing some of the invasive Multiflora rose and Honeysuckle shrubs along the stream bank, we discovered another clump of Nannyberry 50 yards or so downstream. We also discovered nearby a sizeable clump of Arrowwood Viburnum, a more brushy variety with its clusters of blue-black drupes, also favored by birds. The more we began to open this length of stream, the more we discovered: numerous Spicebush, also with glossy green leaves, but smaller and less structured and with attractive red berries; a thicket of American Plum; a Serviceberry tree, one of the first trees to bloom in the spring with small, delicate white

flowers; and numerous Blue Lobelia. After discovering these natives, the first thing we did was to release them by clearing around them to promote natural growth. Next, where populations were sparse, we supplemented with additional plants of the same species. The idea was to create clusters large enough to make an impact but not so large as to appear unnatural.

Later, we added a few obligate species that might be expected to be found in this environment but were not present. They are also species that we are particularly fond of. Especially notable was a clump of a half-dozen or so American Hornbeam (Musclewood) we planted on the banks near the Serviceberrys. Also added were several (very bright red) Cardinal Flowers placed on the very edge of the stream on sandy gravel bars; they are cousins of the deep, sky-blue Blue Lobelia found all around them. Just the other days, we began to think about opening up a narrow path along the West side of the stream to provide a more intimate acquaintance with this area and, perhaps, another place to sit and wait.

We described this area/project for two reasons. First, it is on a different scale from the other projects described in this section. It didn't require a lot of money, time, effort, planning. It just evolved as our awareness and interest in the area evolved. No clear beginning or end. Second, it illustrates a simple, easy approach for a limited ecological enhancing projects. The steps are: know the area, identify native plants of interest, look for nearby plants of the same species, release these by clearing, add multiple plants of same species selected to create more of a presence, add species of personal choice not present but would be welcome in these conditions. Enjoy.

100 - 1,000 acres

1,000 acres will comprise an area of approximately 1.5 square miles or, as a square, one with sides a little less than 1.25 miles each. Such tracts are small enough to be owned by a single individual or a small number of related owners. They may include several residences or residential clusters where the owners live or spend vacation time. Residential clusters, if present, may provide similar accommodations for members of the extended family.

A 1,000 acre parcel is likely to be more fully forested than smaller parcels and have fewer types of habitat such as wetlands or grasslands. Whereas, the owner of a 100 acre, non-agricultural parcel is not likely to expect significant income from the property, the owner of a 1,000 acre parcel with a high percentage of forest may well expect a financial return from the property, most likely from timbering. Such income is likely to be viewed as supplemental, contributing to taxes, maintenance, special needs, and not constitute the owner's primary livelihood. Some may technically be owned or managed by some form of small, closely held business, but primarily for efficiency and not as a true full-time commercial operation.

Another model in Pennsylvania and other states where hunting is popular is the property of this scale owned and/or managed by a hunting club. At one end are clubs formed by a group of hunters who go together to buy a few hundred acres and build a single hunting camp. Some of these have existed over several generations of members. They are likely to be used primarily seasonally and are likely to have few significant improvements, ecological or otherwise. Others may be much larger, perhaps on the order of a hundred members, and involve much larger tracts. Larger hunting clubs are less likely to own the property they manage and, instead, lease it for that purpose from other owner(s). Some of these are quite active in maintaining and developing the property in ways that increase game variety and/or numbers. For example, to favor grouse, woodcock, and other ground nesting game birds, they may plant groves of trees such as Aspen and every10 years or so cut them back to the ground to promote dense thickets, favored by these species.

How does *ecology* fit into the thinking of owners of tracts of this scale? Whereas owners of a 1 acre lot, a 10 acre residential property, or a 100 acre ecological farm may think in terms of how they can extend the number of species on their land or create specific habitats not currently present, the owner of a 1,000 acre tract is more likely to think in terms of environmental or conservation concerns. That is, how to maintain *in perpetuity* what already exists, or how to control infestations that may threaten, or how to prevent deer over-grazing, or how to insure the next generation seed crop. They are not likely to think about how to establish a wetland in order to

increase the diversity of environments, although they may see the value of stream bank restoration or enhancing riparian buffers. Nor are they likely to try to start a grassland of native species with a similar goal in mind, although under the right circumstances, they may see the value of a controlled burn in a forest that will likely open up disturbed areas for a period. Thus, ecological concerns and practices are likely to merge with or morph into sustainable forestry concerns and practices. This is not a fault, but a focusing.

Sustainable forestry as applied to projects on the order of several hundred to a thousand acres is a complex subject with innumerable variations on practices depending on particular circumstances and goals. Owners of such tracts are likely to be familiar with sources of information on the subject. For those not, we'll mention a few here as starting points. Most states will have some agency that provides access to service foresters, such as Pennsylvania's DCNR, mentioned above. They can work with you on-site and help you find whatever additional expertise or type of service you need. Similarly, most states will have some form of forest stewardship program, administered nationally the U. S. Department of Agriculture and state-wide by different local structures. In Pennsylvania, the Forest Stewards Program is supported by four agencies: PSU Centre for Private Forests, PA-DCNR, PSU Extension, and USDA Forest Service, with additional financial support from the Forest Stewards Endowment Fund. The PA program provides 40 hours of training and can lead to a detailed Forest Management Plan developed through a PA-DCNR service forester. A thrid resource are consulting foresters. These are independent professional foresters that work under contract with private forest owners. They provide a wide range of services, from developing plans for long-term sustainable management to planning and overseeing a sustainable timber harvest.

How, then, can particular practices contribute both to conventional requirements for sustainable forestry and to ecological enhancement? The key is managing for diversity while satisfying other criteria, as well. A key requirement for any sustainable forestry plan is managing deer populations. In many areas, such as Pennsylvania and the Northeast, without controlling the size of the deer herd, both the understory and the seedlings needed for regeneration can disappear. This will leave an open area some six-feet high that may be visually attractive but largely barren, except perhaps for fast-growing invasive species and/or other vegetation that fill the void. Allowing native tree species to be replaced by invasives not only reduces diversity but also threatens the basic sustainability of the area. A second practice where the owner may influence ecological diversity in conjunction with maintaining sustainability is in managing seedling regeneration and growth. To state the obvious, seedlings come from and, thus, are dependent upon mature seed trees. In a forest with multiple tree species, there will necessarily be seed trees of these different species. By selecting the seed trees of specific species to encourage followed by managing available light for their progeny, one will inherently influence the eventual mix of mature tree species. Thus, if one wishes to emphasize a half-dozen high value species for regeneration vs. a dozen species that are present but some of which are of lesser market value, then one is making a choice about the long-term diversity of tree species. One preference/strategy may result in higher potential returns on investment, whereas the other may result in greater ecological diversity and, quite likely, ecological health. If one looks back at the last fifty years and thinks about the many infections and infestations if the Northeast forests we have seen, protecting diversity and thereby resilience would seem to be an offsetting strategy to be considered.

1,000 - 10,000 (and above) acres

10,000 acres will comprise an area of approximately 15 square miles or, as a square, one with sides a little less than 4 miles each. In addition to the pervasive forest type, properties of this scale may also include subareas of different environmental types, such as wetlands, steams and riparian areas, clearings, meadows, and perhaps several different forest communities. But they are likely to be managed as forest lands. Some tracts may be owned by private individuals or by hunting clubs, but at this scale most are likely to be owned by some form of corporation and managed as a business or investment. Such arrangements can run from closely held corporations used by wealthy families to control and manage several large properties to woodland investment funds and management groups, such as The Forestland Group (http://www.forestlandgroup.com/), that promote conservation values while seeking an attractive return. Collectively, they are often referred to as TIMOs - Timber Investment Management Organizations. Some of these are responsible for managing millions of acres; so we may have blown through our interval upper limit of 10,000 acres by a considerable margin.

Perhaps the strongest distinction for a property at this scale is its context. A property within a physical ecological context will influence and be influenced by its neighbors. Nurturing ecological diversity on several hundred acres will have impact on habitation within the property but also beyond its borders. But the context of a property held within a portfolio of properties is something different. Its context is less its physical neighbors than its portfolio neighbors.

TIMO portfolios are not usually groups of properties that have evolved in the same location and in similar circumstances. Instead, they are constructed according to abstract criteria including financial and marketing concepts. Holdings for a fund may be all Northeast hardwoods, but they are likely to be more diverse in order to provide a more diversified investment instrument. That is, they may include tracts primarily structured as near term pulp production forests, or "chip" and "saw" stands that may have a more intermediate horizon, or sawtimber stands included for the long term. Whereas, the type of forest or forest goal may focus on the physical characteristics of the forest - e.g., pulp vs. sawtimber - and whereas the fund manager may devise a plan by which optimize growth for a particular forest type, within a portfolio financial context, circumstances may mandate a change in status. Market conditions or cash flow may force premature harvest of a segment of forest not as sawtimber down the road but pulp wood this year. Not the most cost-effective strategy but, in certain circumstances, perhaps a necessary one. Perhaps we'll eventually come to talk about the ecology of the forest portfolio.

But, where does ecology of the common sort fit into this picture? First, as with the 1,000 acre interval, it is likely to be associated with sustainable forestry when applied to any particular tract. The investment fund context suggests that sustainable practices will emphasize more profitable species rather than diversity of species as a goal in itself. Although not optimal ecologically, this is still a worthwhile goal. Second, ecology has strength as a marketing concept. Several Timber Investment Management Organizations (TIMOs) emphasize that integral parts of their whole approach are developing a forest management plan tailored to the needs and conditions of individual tracts and an ecological plan that will maintain the continued health of the habitat within it. So, ecological goals are embedded in their overall management strategy. Increasing interest in and investment in ecology is a worthwhile goal. Third, for some investors, one of the basic attractions of TIMO investments has been their ecological dimension. Many of the TIMO investors have been retirement funds, university endowments, and some public funds that have been seeking a socially conscious investment option that the TIMOs' mix of ecological/conservation/environmental dimensions allow them to fulfill. Finally, Ecology is being turned into Ecological Services and Ecological Services into Capital Assets: carbon sequestration by forests, riparian and wetland mitigation credits, biodiversity indices credits, etc. Turning ecological practices into complex financial instruments may be a positive development on a global scale. But what does it do on a local scale? Mitigation efforts inherently involve ecological degradation in one area, offset by proactive ecological efforts in another. A critical question is: what is being done elsewhere to the environment in the name mitigation some place else? Does it really balance out?

Where does this leave us? Many people in many different contexts have said, "Think globally, act locally." Doing so on one's own property, ideally, his or her place of residence, is sound advice. And doing it or getting started doing it on any scale is to be encouraged. But, no matter on what scale we act ecologically, that may not be enough. We've got to keep and eye on the planet as a whole. No matter what country we reside in - air and water don't respect borders - we can't ignore what is happening in other places. As much as we may want to retreat into our own beautiful, wonderful private environments, we must remain political and active in ecology on a global scale if we are to survive as a species.