The University of Georgia
WARNELL SCHOOL OF FORESTRY & NATURAL RESOURCES OUTREACH
Pub. No. 44
October 2016

Ecological Renovation In Communities

by Dr. Kim D. Coder, Professor of Tree Biology & Health Care
Warnell School of Forestry & Natural Resources, University of Georgia

The places where we live remain connected to natural life support processes. With land development, safety, and cultural issues, these lifelines become more strained. As we cleanse and sterilize our environment, connections with other life, and associated sustaining processes, diminish. Our interconnections with the ecological framework around us is supplanted by artificial resource concentration and delivery systems.

Loss Equation

As resource concentration (R) doubles in our support, our interconnectedness (I) with surrounding ecosystems diminish by four times ($R=1/I^2$). As ecological processes are strained and allowed to become damaged, we grow ever more addicted to the cultural mechanisms which distance ourselves from our ecological base of support. Our connections to supporting processes become more tenuous, and may be overlooked as having any connection at all by citizens and decision-makers.

A growing portion of the urban / suburban population have perceptions of ecosystems as collections of individual parts. Many nature walks, environmental education classes, ecological trainings, and regulatory ordinances view natural systems as numerous individual, clearly divisible parts contained in a conglomerate within a bag called the environment. For community natural resource management, the important ecological things are not the parts, nor the bag.

Connections & Changes

It is connections between discreet parts which must be inventoried, measured, and affected through management. Connections between parts determine future values, change rates, and management needs. The state of something is not nearly as important as its rate of change. In addition, the moment a rate or state is measured or inventoried, these measures represent the past. We are always managing our community resources a few steps behind reality -- hopefully, not many miles behind.

Natural resource managers in communities must deal with dynamic and chaotic changes. Change is the only thing certain in an ecological system. It is change which drives the system, not the existence of static parts or things. Understanding constant change, and the interconnections between ecological components, is critical to effective management. Active management is essential for community sustainability and livability. Our lives are bound tightly to accessible essential resources. As we concentrate and deliver these resources through community infrastructures, ecological connection lines are woven, wrapped, and carefully bundled together -- like a woven cloth or twisted cable.

Living With Ourselves

Ecologically our communities are isolated from ecosystem functions by fewer but more important resource concentration lines. Only a few biological units survive and thrive under these conditions. In the most extreme ecosystem isolation, only humans and our pests survive. Fewer, concentrated connections are prone to chaotic failures and system disruptions with catastrophic results. Livability in communities come at a great ecological cost with great potential liability problems. We have agreed as a society to continue to pay the costs, and accept associated risks. As long as our technology inputs can continue to keep ecological systems away from equilibrium, some of us will have a great quality of life.

Values generated by the natural world, its parts, and their interconnections are substantial. Community development represents an attempt to shorten and simplify ecological connections, hide resource concentration infrastructures, and attain a short-term reduction in human psychological stress and physical needs. Recovery and use of ecological values are dependent upon location, human economic class, and impact of education.

As populations grow, more pressure exists to move, change, or further modify supporting ecosystems. Ecosystems are broken into, used, exhausted, and cast-off like old clothes. As with old worn-out clothes, a simple cleaning or time hanging in a closet, will not significantly change any values remaining. An example of this is a ignored and neglected urban brown-field area in a city center.

Ecosystems

Ecosystem productivity and sustainability depends upon maintenance of proper structure and function. Systems that are declining and exhausted from long or overburdened use can not be made new again. Renovation is a partial recovery and restarting / rebooting process. Site renovation and natural resource management in communities must concentrate on treating causes of environmental problems instead of reacting to symptoms.

How ecosystems work, and how we extract values, requires continuous review. Early concepts of wildland ecology become strained and dysfunctional in city centers. New concepts which hybridize older ways of thinking and bend to meet community natural resource needs are required. We need to understand how things work and what can be done to effectively and efficiently change the interworkings of our life support systems to produce values we want. Many of our current reaction- (overreaction-) based management systems are prone to adversarial and threshold based approaches to the environment. An informed consensus, proactively making ecological investments, and making appropriate responses incrementaly are the required alternative.

Connecting Threads

To help visualize an ecological system declining, exhausted, and becoming extinct, a two dimensional textile model is valuable. In the wilds, ecological processes can be represented by threads of a closely woven cloth. Figure 1. Most threads are held tightly in position by interconnections with other threads. Everywhere two threads cross represents a discrete piece of an ecosystem, like a tree. As ecosystems develop under increasing stress, the cloth (both connections and things) is stretched, pulled, and eventually some threads break. Figure 2. Where threads are broken and pulled out, a whole line of connections are disrupted and the whole cloth is diminished. Depending upon pressures developed on the cloth, threads may shift to new positions. The functions and values generated by the entire cloth remain nearly the same for some time.

As more pressure is put on the whole cloth, more threads are stretched, broken or rearranged. The more threads (connections) which do change, the more this cloth can change. Eventually, if pressure on the cloth is constant and not so strong as to rip everything asunder, threads reach stable positions which again hold the cloth together. Figure 3. This equilibrium holds until added pressures, or new types of pressures, arise. More threads are then stretched, broken, or moved, and the cloth becomes more prone to catastrophic changes and failures. Change becomes more than realignment and reorganization. Change brings loss of connections and connection points.

As human land development intensifies in communities, thread-bare tatters of our ecological cloth barely symbolize connections at all. Single threads and a few connections can be carefully stretched and rearranged, but there is little connectivity or strength with which to work. Figure 4. A "cloth with holes" declines into "some threads." As the ecological fabric disintegrates, values quickly decline, and any hope of future reversals in value production fade. Any ecological values, their means of generation, and any individual organisms present can become functionally damaged and may become extinct on-site.

Ecological Management Units

In the geometry and engineering of resource concentration structures within our communities, the concept of an ecosystem looses both it symbolism and functionality. The ecological management units we live among are bounded by the extent, access, and potential for colonization of biological units. Any biological island among our built framework is a refuge which must maintain itself with little exterior resources. Any ecological corridor, depending upon its height, width, diversity, and soil surface attributes, can only transmit limited resources, has a large ecological resistance to transmission, and is easily blocked. Fortunately, life is tenacious and ingenious, transporting genes across large expanses of developed desert. A single tree, weed, or patch of open soil can be a residual opportunity for humans to appreciate nature, but can also ecologically support or reconnect a few threads.

Ecological systems do not arise and decline simply as random parts and processes are mechanically inserted or removed. Change continues forward in time with continuous equilibrium solutions being sought through biotic means. Community natural resource systems are not composed of interchangeable pieces that can come and go -- inventoried and valued as individual parts.

An ecological system devolves with development pressure, and its pathway to decline and exhaustion is different than any reverse path to be followed in restoring functions and values. Renovating systems involve attacking resource problems and connectivity issues at the most basic ecological levels, not simply moving in a 30 inch diameter tree with mulch.

Concentrate

Our communities concentrate resources to the point of ecological damage and sustainability loss. Urban natural resource management can renovate many damaged components to again provide values. Innovation and creative thought are needed in renovation because every site is different in its ecological and social context. Patience is required in renovation because sites, and any humans involved, will take time to develop. The passion of ecological renovation must be tempered by reality, because not every site is saveable from a cost-effective standpoint. Urban natural resource managers can not save everyone and everything, but can make a difference in attempting to better understand and participate in the renovation of community natural resource systems.

Defining Units

The world is visualized through objects and processes of change. Some changes are so slow or so fast that we can not see them. Some changes cover global scales, while other changes influence one drop of water. Change involves a myriad of interconnected and interacting processes. Key to understanding and managing changes around us, is appreciating each individual process and its limits or boundaries.

To simplify our world, we delineate space and time into discrete, countable, understandable units. Setting boundaries is important with property lines, fences, walls, and political jurisdiction edges, as examples. For effective ecosystem management generating sustainable values, a definition and delineation of an ecosystem are required. Without a management unit with an edge or boundary, incorporating a framework of key processes, managers have difficulty formulating planning, work, and evaluation activities.

Eco-Management

Ecosystem management has been formulated in some organizations as a political concept to assist in demonstrating relevance in changing times. Ecosystem management has also been a romantic derivation and artifact of societal remorse concerning quality of life and explotation of natural resources. Ecosystem concepts conveniently fit large-scale, world-view generalities of preservation, conservation, and management.

Intellectually, the nebulous boundaries which delineate a set of biological units and associated resources, which seem to have structural and functional characteristics, as well as some level of interactions, can be summarized in the term "ecosystem." An "ecosystem" remains an elusive concept for many people. Without a defining, explicit societal word concept, it is difficult to craft clear management objectives and actions.

System Control

In many ways, the term "ecosystem" has become jargon in our society, as wholesale use and misuse of the term blurs accurate and precise definition. It is the psychological concept, in both a mythical and general form, which remains for most people and is tied with natural areas, with connections between living things, and with the environment.

The standard definition of an ecosystem is one of an infinitely nested, overlapping, and interacting set of processes and things without a defined boundary. Classically, a cup of water left on a windowsill, and a fog-bank, redwood-covered valley could both be ecosystems. As ecosystems become larger and include more processes, living things and volume, managers have a more difficult time controlling inputs and outputs to meet preset objectives.

Being Discrete

One concept which must be developed and appreciated in ecological renovation of community sites is how we delineate space. Where are the edges of a management unit? We must clearly understand the impacts of defining and visualizing biotic islands, corridors, and ecological connections. Things which we manage all have discrete physical limits within an ecosystem. These limits can be (i.e. should be) the edges or boundaries used in management. Edges do not lend themselves well to the intent nor letter of ecosystem definitions.

What is needed for effective management is a construct which represents the interconnected ecological grid of biological units and their interactions among themselves, and with their environment, placed within space and time limits. This construct could represent a diverse tapestry of biotic threads, individuals, clumps, and patterns laid across (around and beneath) hard, dense, ecologically sterile and managerially barren human development areas. These human development areas are required to facilitate the concentration and delivery of goods and services to a populations of humans.

In renovating ecological functions on community sites, identification and delineation of ecological management units are required. There has been a tendency for managers to speak in extremely loose and general ways about ecosystems, while concentrating upon discrete, limited patches of soils and plant materials. Both semantically and conceptually, this can lead to over-focusing on a park, a street, or a planting pit as individual systems, ignoring how they fit into the overall community landscape.

By Any Other Name

The Western term "ecosystem" represents a nebulous and infinitely nested, scaled and overlapping ecological concept. This intellectual concept has great value, but lacks clear mental imagery and handles for easy application to field management and education. In other words, concepts without firm limits or edges are difficult to describe to decision makers, workers and other managers, as well as citizens.

One easy solution reached across multiple scales is to allow decision makers arbitrary limits on ecological management units based upon a political / fiscal unit's land and resource holdings. Because of public and private monetary responsibilities and policies, spending of resources under this concept must be focused on a defined management unit. Political boundaries remain a primary way (i.e. an easy way) of setting management limitations. The setting of ecological management unit boundaries by political lines remains severely problematic because is has to do with human perceptions and social interactions, not resource presence and functions.

New Old Ideas

An alternative which places walls on ecosystems but not along political boundaries is similar to a Russian ecological concept called biogeonose, a human defined and bounded ecosystem. This concept establishes edges and walls on ecosystems. This idea is more appropriate for urban and community natural resource managers than political boxes. An ecological management unit must have a set size for planning, manipulation, renovation, budgeting, and evaluation. Without this limiting definition, management activities which improve quality of life and instill positive behavior changes will be difficult to design and evaluate.

Ecoplex

The summarizing concept used here is "ecoplex." Ecoplex literally means "interwoven houses" and sets distinct spatial limits on ecological units for management. An ecoplex is a human-defined, area-limited, relatively structured, homogenous area of dynamic matter and energy interchanges between and among biological and non-biological components. In ecological renovation, we can work with one portion of an ecoplex (i.e. an ecological management unit (EMU)), or a complete community ecoplex. Many times urban watershed units can represent an effective ecological management unit.

An "urban/suburban ecoplex" can be further defined as an ecoplex influencing, and being influenced by, human attitudes, human behaviors, regulatory policies, and a sense of resource control throughout areas where humans live, work and recreate at moderate or high population densities and concentrated social scales. It should be noted that more than 75% of our population in the United States is considered to live in an urban/suburban ecoplex. See the attached handout entitled "Ecoplex: Components & Concepts."

Ecoplex Features

An ecoplex has many identifiable characteristics when functioning properly. Features of an ecoplex should be recognized and incorporated into resource and process inventory, renovation procedures, and management evaluations. The six primary features of an ecoplex can be summarized as:

A. Discrete structure for handling inputs, outputs, and internal maintenance (energy pathway, soil functions, water cycling, biological unit interactions, and atmosphere resource changes)

B. Identifiable functions (exchange of energy, exchange of materials through biotic and non-biotic means, disturbance regimes, successional patterns)

C. Interconnectedness (loose federation of interactions -- some more closely tied together than others, but not a supra-organism. A chaotic system where small changes lead to new equilibriums and new interactions.)

D. Complexity (strong biological integration which allows multiple outcomes from many different inputs, from a diversity of organisms, and from system behavior which will remain chaotic)

E. Temporal change (highly dynamic, not static, with continuous adjustments to input / output states, and to energy and material flow rates and transformations)

F. Spatial limits (size of individual organisms, genetically related individual groups, ecological communities, geophysical / climatic interactions with gene systems)

Genesis and maintenance of an ecoplex is dependent upon climate, landforms (watersheds / physiography), soils, organisms available to reach and colonize an area, and homogenous interactions of components across space and time.

Science & Politics

It is critical within an ecosystem management system (ecoplex), from an educational and managerial standpoint, to separate ecological science from social, cultural and economic decisions. Physical, chemical, biological and structural facts need to be clearly separated from human feelings, needs and value judgements. Ecology is apolitical in the natural world. Politicizing ecology can destroy objectivity in decision-making and allow misuse / selective use of scientific information.

Assessment

Once an ecological management unit has been defined, and we understand how it functions at the most basic level, we can then begin a site assessment process. To ecologically renovate an ecological management unit within an ecoplex, an assessment process must be used that can identify resource inputs and outputs, internal and external cycling of resources, and individual organisms present.

One type of assessment guide is presented in the attached handout entitled "Damaged / Exhausted EMU / Ecoplex Assessment Outline.." The items listed can place a site and its ecological resources into context for planning and application of renovation activities. This ten step assessment process for damaged or exhausted EMUs within an ecoplex can help guide future renovation steps.

Definitions

The first assessment step is defining, delineating, and describing the site. It is important you know what resources (living, dead, never-living) are present. Maps are a great way to visualize resources, changes, and results. Quantify all the states and rates of change possible. Some are, or will become, baseline data for demonstrating management impacts.

Size and Diversity

The second and third assessment areas concern size. Size of an area should be examined to determine if it is big enough to sustain outputs and values expected. One small planting pit will not generate the values of a botanical garden. Size considerations include examining the scale of any renovation on the site, the genetic variability already present for the limited space, and the regeneration spheres of any organisms on the site (or from outside). Knowing actual available physical space, and where everything is physically located, can help in effectively designing a renovation process. Determine the amount and extent of interconnectivity between organisms, resource cycles, and the outside world.

One of the most commonly used renovation activities is the maintenance or managed increase in diversity at the individual, species, and higher levels. Physical and biological diversity of habitat areas can be cultivated. Introduction of native genes and elimination of competitive exotics can help broaden site diversity.

Time and Disturbance

Time must be a component of any assessment. Living things age and die, taking a while to reach energy equilibrium with the environment. Assessments must map individual and species life spans, age classes, and any periodicity involved with disturbance and colonization. Successional patterns are essential to understand and use to move sites into new managerially stable positions.

Disturbance and Fuel

One of the processes most quickly destroyed in land development is natural disturbance events. The type, intensity, and timing of disturbance can have many different effects upon individuals, species, and site resources. Disturbance regimes are processes important to renovate for recovery of historic and low maintenance cycling systems for energy, hydrology, and nutrients, for example.

Fuel and Management

An often overlooked feature of an ecological system is the ecological fuel available for use in the detritus energy cycle. Old fallen trees can be significant biological legacies. Organic material on the soil surface, large woody debris, and soil flora and fauna are important components to many EMU / ecoplex functions.

Any assessment is not complete without determining and prioritizing anticipated management responses. Management dedication in the light of natural systems being messy, unkept, and chaotic is critical. Managers must have resolve to make the system work. Allowing failure of interrelated parts will cause systems to collapse. A manager must be willing to accept dynamic change and incomplete resource information in a decision-making process.

Projecting Processes

Assessments for ecological renovation of sites should include a check list of processes and resource levels to examine. The principle means of renovating an area includes five general change expectations: successional process reinstitution, disturbance regime reinstitution, genetic resources (living things) enrichment, site resource improvements, and minimizing stress.

The enrichment of genetic resources (living things) is one useful way of improving system function, if the correct fuel and feedstock resources are available on-site. Concentrate beginning steps of renovation on "key" species. For resource control and values generated, key organisms for an urban site would be trees, ground covers, fungi, arthropods, and worms. You should renovate toward a target of a "modified" native system by continuing to add major resource controllers, and more selected resources to a site.

Resources Come and Go

The site resources improvement portion of a renovation checklist should include: soil and litter layer organic matter; soil exchange capacity which aids in element cycling and holding; continued soil genesis and health including pore space conservation, structural improvements, and horizonation; water availability for cycling, use, flow, and accumulation; nitrogen availability and cycling; and, light management where various photosynthetic arrays are tuned for effective and efficient use of incoming energy and outgoing water.

The stress minimization portion of a renovation checklist should include: presence of heavy metals, organic toxins, and/or other damaging legacies; pollution control; heat control (including advected heat); control of exotics; physically protect the site from mechanical and chemical damage; and, control oxygen availability and water drainage trade-offs.

Renovation Process

Once an assessment has been properly completed, a renovation program can be designed to restart, accelerate, or broaden ecological processes, enrich or maintain biological units, and conserve life-essential resources. EMU renovation in an ecoplex will only be effective over long periods of time when managers clearly define and recognize the foundations of basic major problems.

Major Problems

In highly developed areas there are consistantly three major ecological problems:

#1) Hard surface increases (i.e. more non-evaporative / non-infiltrating surfaces, more concentrated water flows, higher water velocity flows, larger water volumes, shorter water pulse rates, more erosion, less biologically available water, greater heat generation, and wider fluctuations in heat / humidity);

#2) Decline in total ecologically active volume (i.e. more surface area per volume (more edge effect), more isolated islands, narrower corridors, greater distances across hardscapes, less open soil surfaces, more soil compaction, smaller number of biologic energy capture systems, less eco-diversity, and less connectively);

#3) Changes in past and current ecosystem functions and processes (i.e. disruption and destruction of ecological processes, large scale intense disturbances, inadequate mitigation and renovation, inadequate resources provided, and essential resources removed or destroyed).

Appropriate Responses

For each ecological problem listed above, there are some appropriate renovation responses which will fundamentally change present and future EMU values within an ecoplex.

Appropriate responses for #1 (hard surface increases) — developing more active evaporating surfaces, more canopy volume, more crown coverage, more low density organic mulching, more soil infiltration areas, more shade structures, more shading or blanketing of hard surfaces, and greater active shade versus passive shade.

Appropriate responses for #2 (decline in total ecologically active volume) — developing more canopy coverage, correcting soil limitations, more accessible biologically active volume, larger areas of soil and organisms conserved, more readily usable organic materials on soils, and help reconnecting system components.

Appropriate responses for #3 (changes in past and current ecosystem functions and processes) — improving soil health (aeration, organic matter, no erosion, etc.), careful water conservation and use, developing more biological volume (open soil surface areas, plant canopies, more composted organic material covered with low density, organic mulch, etc.), conserve and enrich ecological diversity, and keep essential resources on-site.

Generic Renovation Activities

Every site needing renovation is different from every other site. The functions and values from each site varies by management objective and by all the resources present and interacting. Using a careful assessment process, many appropriate responses are possible for renovating structures and functions of individual EMUs within an ecoplex. All responses should be targeted at key development indices of an ecoplex which include an energy (trophic) distribution grid, biological diversity, and effective and efficient material cycling. Ecological fuel to power EMUs and ecoplex, and its renovation, comes from sunlight and from decaying organic matter.

The principle means of renovating an ecoplex would include: A. Succession process reinstitution; B. Disturbance regime reinstitution; C. Genetic resources (living things) enrichment; and, D. Site resources improvements include providing organic matter inputs, improving soil exchange capacities, assisting with soil genesis process and health, and assuring soil water drainage, availability and associated aeration. Expected long-term outcomes arising from EMUs / ecoplex renovation activities, as well as a test of excoplex sustainability for natural resource managers, would include:

1. Viable native species populations;
2. Biotic / abiotic interactions approaching a normal variation distribution;
3. Facilitation of successional and ecological processes;
4. Long periods (multi-generational -- at least 3 human generations) of time; and,
5. Accommodate human use and occupancy.

Remember renovation processes are about individual quality of life and community sustainability and livability, not about a museum-like preservation of resources.

A Prescribed Journey

For any site, a number of simple, low cost treatments can be used to begin the renovation process. These treatments are listed in the attached handout entitled "Checklist of Ecoplex / EMU Renovation Activities & Treatments." Activities range from habitat modification to fencing. The bottom-line is treatments must be cost-effective for a given management plan, but they must also try to halt or reverse processes leading to individual EMU and whole ecoplex decline and exhaustion. Renovation is a prescription process where there is not an endpoint, only way-stations which allow coarse corrections. In renovation, it truly is not the destination which is important, but the journey utilizing ecological fundamentals.

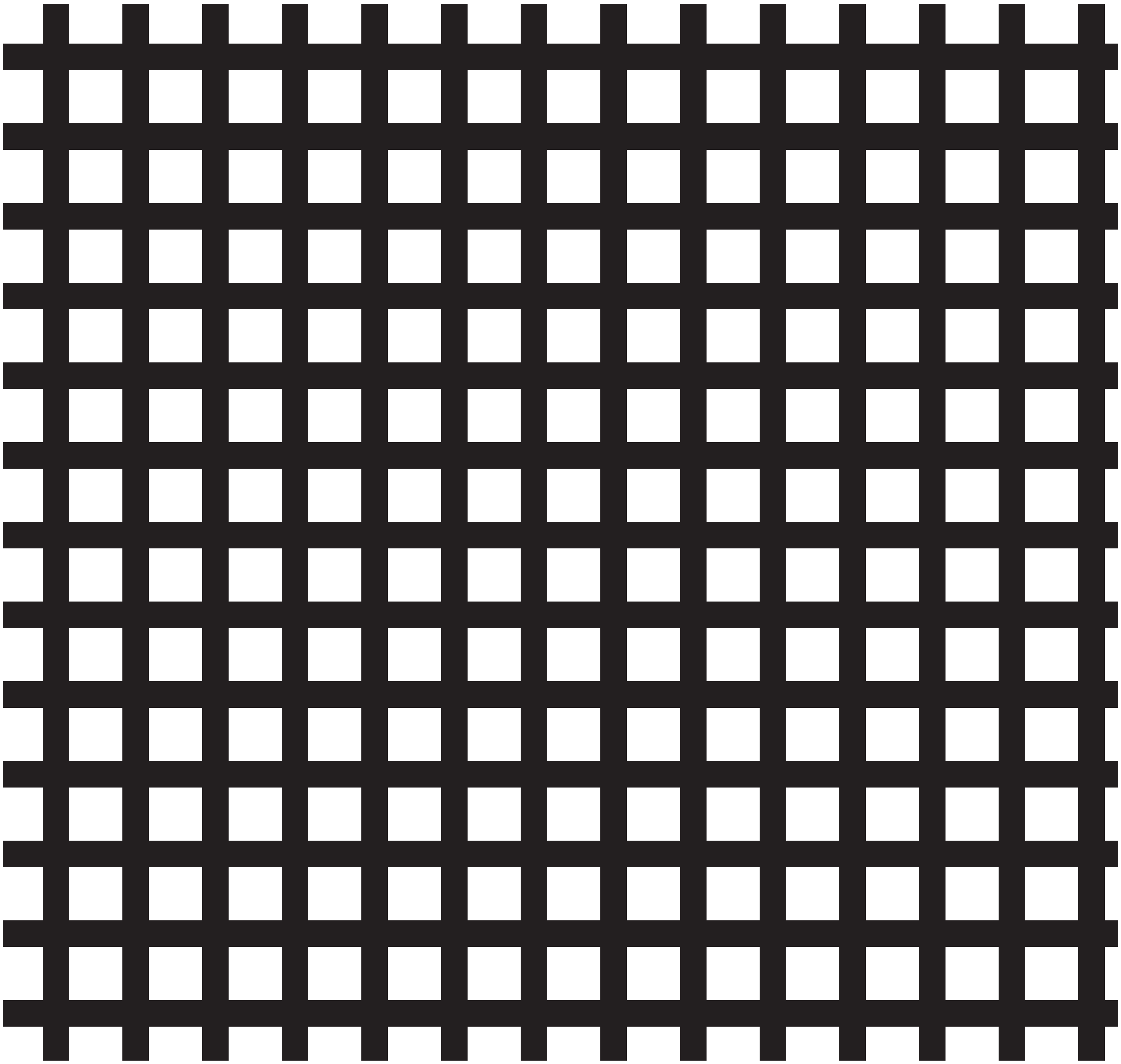

Figure 1: A two dimensional textile cloth model of ecological structure in a limited area where all of the system's structure and functions are intact sustaining many different biological units. The threads (lines) represent processes, and where threads cross represent individual biological units.

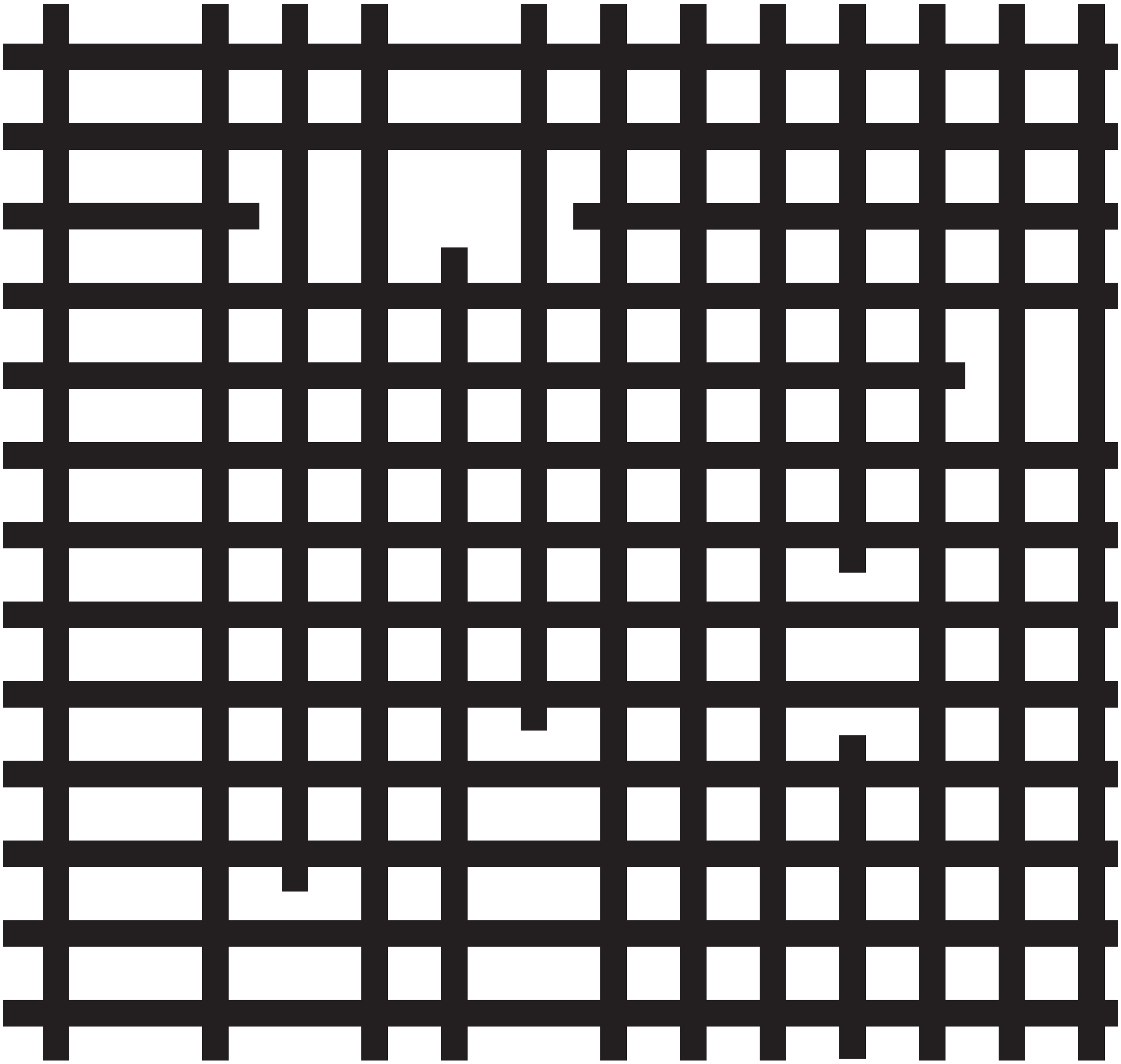

Figure 2: A two dimensional textile cloth model of ecological structure in a limited area where the system's structure and functions have been degraded slightly. The threads (lines) represent processes, and where threads cross represent individual biological units.

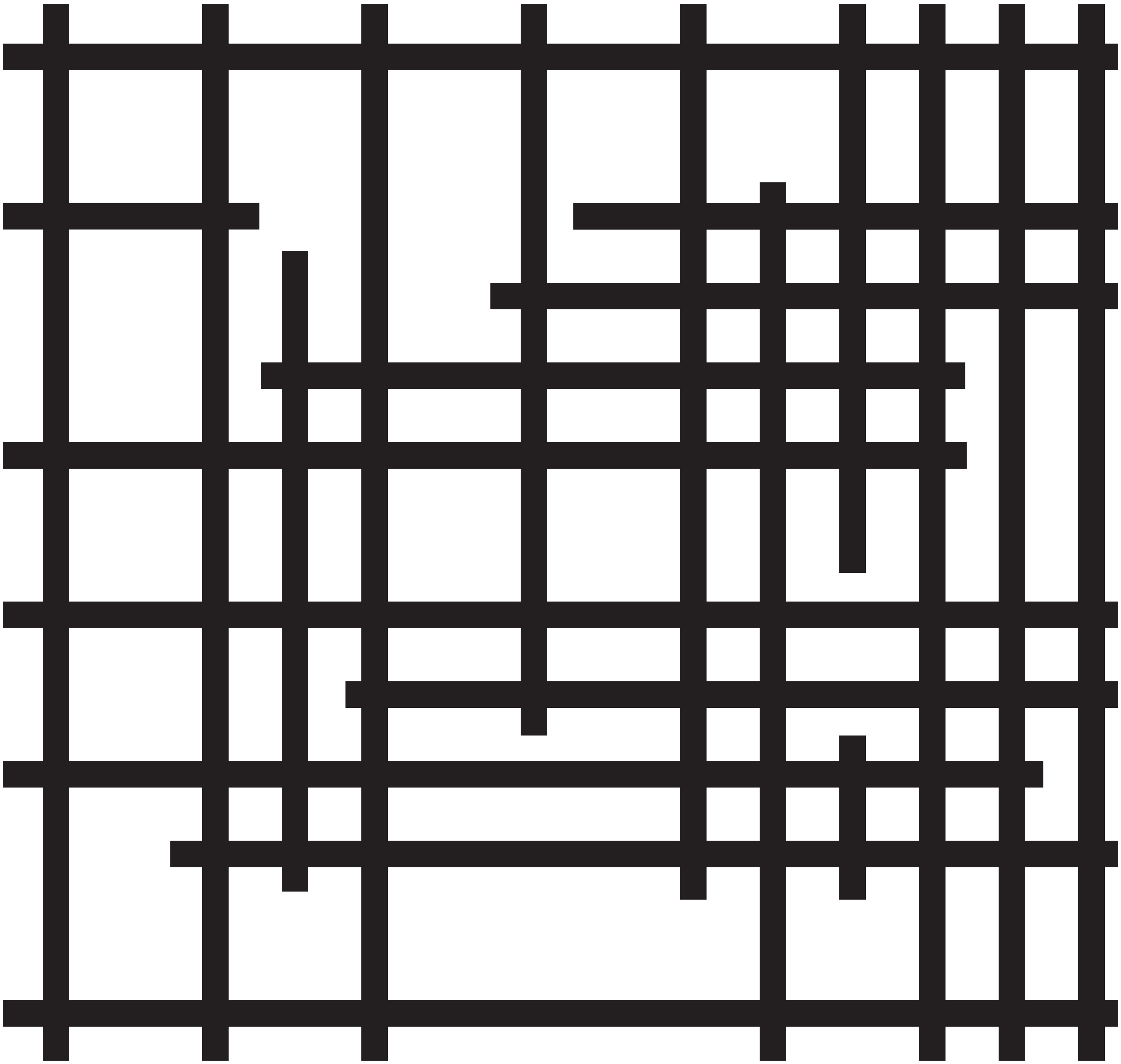

Figure 3: A two dimensional textile cloth model of ecological structure in a limited area where the system's structure and functions have been degraded significantly. The threads (lines) represent processes, and where threads cross represent individual biological units.

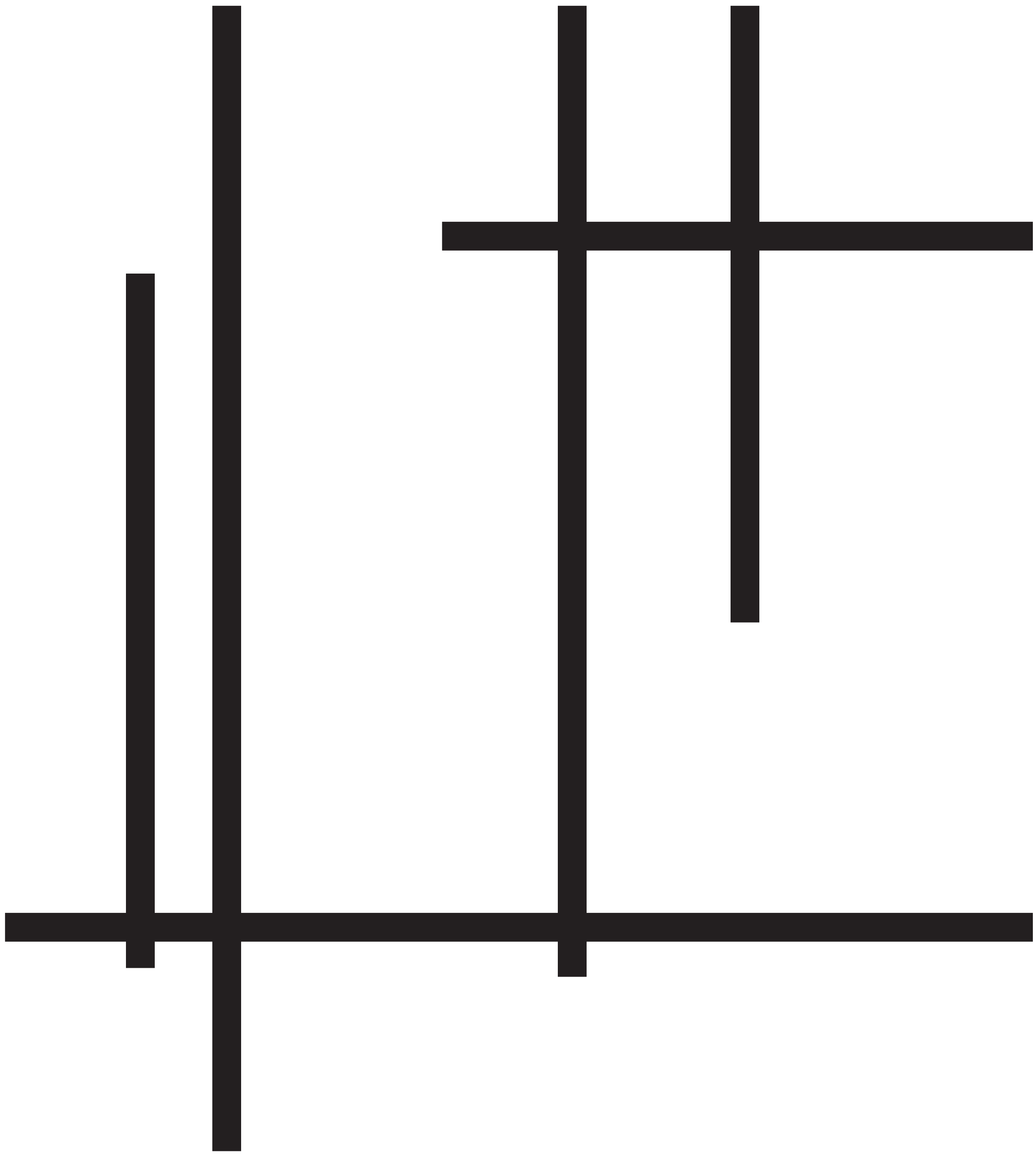

Figure 4: A two dimensional textile cloth model of ecological structure in a limited area where the system's structure and functions have been exhausted and destroyed. The threads (lines) represent processes, and where threads cross represent individual biological units.

ECOPLEX:

COMPONENTS & CONCEPTS

I. Management Unit Name & Definition
- A) Concept name: ecoplex = interwoven houses
- B) Working definition:
  - "Human defined, area limited, relatively structured, homogenous area of dynamic matter and energy interchanges between and among biological and non-biological components."
- C) Comprised of seperate Ecological Management Units (EMUs)

II. Ecoplex Genesis Depends Upon:
- A. Climate
- B. Landform (watershed)
- C. Soil
- D. Organisms available (to reach & colonize area)
- E. Interactions and exchanges (across scales, space & time)

III. Ecoplex Genesis Generates:
- A. Energy (trophic) structure
- B. Biological diversity
- C. Material / element cycles

IV. Ecoplex Attributes:
- A. Structure
  1. energy
  2. soil
  3. water
  4. biological units
  5. atmosphere
- B. Function
  1. exchange of energy
  2. exchange of materials (some through entities or processes with life-like characteristics & some not)
  3. disturbance regimes
  4. successional patterns
- C. Interconnectedness
  1. not a supra-organism
  2. chaotic system (small changes lead to new equilibriums and new interactions)

ECOPLEX (continued)

D. Complexity
   1. biological integration (multiple outcomes / many inputs)
   2. biodiversity
   3. chaotic
E. Temporal Change
   1. dynamic not static
   2. changes / adjustments to input / output states, flows, & transformations
F. Spatial Limits
   1. individuals
   2. family
   3. populations
   4. species
   5. communities
   6. genetic limits

V. Ecoplex Sustainability Tests
   A. Viable native populations
   B. Biotic / abiotic interactions with normally distributed variation
   C. Facilitation of sucessional and ecological processes
   D. Long periods of time (multi-generational for humans -- at least 3 generations)
   E. Accommodate human use and occupancy

VI. Renovation of Ecoplex Functions
   A. Succession & Disturbance Process
   B. Genetic Resources
   C. Site Resources
      1. organic matter
      2. exchange capacity
      3. soil genesis process
      4. soil health

Damaged / Exhausted EMU / Ecoplex Assessment Outline

(to gauge viability of renovation & management activities)

1) Definition, delineation, and representation.

2) Size appreciation — is it big enough?

3) Spatial (Space) appreciation — interconnectivity / fragmentation / integrity.

4) Diversity — genetic, species, habitats.

5) Time.

6) Disturbance — type, intensity, and timing.

7) Cycles & Processes — recovery of historic & low maintenance cycling systems.

8) Ecological fuel — biological legacies.

9) Management dedication — acceptance and resolve to accept change.

10) Principle means of renovating ecoplex functions include:
   - A. Succession processes reinstitution
   - B. Disturbance regimes reinstitution
   - C. Genetic resources (living things) enrichment
     1. retrieve "key" organisms (native!) = trees, ground covers, fungi, arthropods, worms
     2. move toward "modified" native systems
   - D. Site resources improvements
     1. organic matter (soil and litter)
     2. soil exchange capacity
     3. continued soil genesis and health (pore space conservation)
     4. water availability
     5. nitrogen availability (cycling)
     6. light tuning (shade management and light extinction factors)
   - E. Minimizing stress
     1. contain / eliminate heavy metals and other damaging legacies
     2. control pollution
     3. control heat
     4. control exotics
     5. physically protect site from mechanical and chemical damage
     6. control oxygen availability and water drainage trade-offs

Checklist of Ecoplex / EMU Renovation Activities & Treatments

habitat stuff

— minimize fragmenting of habitats
— assure strong connectivity of habitats
— generate wider, full height corridors and larger natural islands
— generate less edge effect and more ecological volume

tree stuff

— produce variable living tree densities (patches)
— develop multi-age classes
— cultivate multi-species (natives)
— advocate proper plantings and seeding programs
— facilitate general revegetation at all levels
— install a maintenance program

organics

— leave organics, stumps, large woody debris, roots, slash, and leaves onsite
— leave snags and deadwood (clumped in areas)
— bring in composted organic matter under mulch blankets

soil / water

— protect and renovate wetlands and buffers
— protect and renovate streams (beds, banks, and cover) and buffers
— manage surface & ground water quality (control nutrient loads, heat, pollution)
— protect soil fertility and health
— prescribe soil biological enrichment

stress management

— develop “appropriate response use” of pesticides (minimize)
— use Plant Health Care principles
— maintain ecological health and structure of area
— maintain individual health and structure of sites

survival

— manipulate disturbance (including pockets fires, patch clearing, and flooding)
— manage genetic diversity and genetic integrity (natives)

site control

— erosion control
— water runoff control
— fencing and access control
— fire control and prescribed burning
— weed control / exotics control

ecologically-literate management

— pick appropriate size, scale and time frames to work within
— assure continued assessment and monitoring of resources and site changes
— develop and follow a flexible management plan