THE FORESTS AND TREES

By Joshua Smith

Though not often understood or appreciated, we humans owe our existence and continued survival to the earth's fabric of ecosystems. Insects and spiders are ecosystems! Your body and elephants are ecosystems! Thanks to microbiology, we now know that microbes of differing species work together to form genes and the nucleated cells that house them. They organize themselves to form organs, they are essential for digestion, they live in mass on the bodies' surface and among other things, fight off invasive microbial pathogens that can harm the body. This is an ecosystem.

The earth's biosphere is the largest self-sufficient ecosystem in our solar system. A rare treasure composed of an infinite array of increasingly smaller ecosystems all overlapping and all in relationship with the next.

TREES

So it is with the forest, so it is with the tree. Both are ecosystems of different scales. Aside from all the microbes, the tree offers food and shelter to a host of creatures large and small. Chewing and sucking insects feed on the tree and predatory insects and birds feed on them. Bears, birds, squirrels and others eat its fruit and seeds, and defecate into its root zone, fertilizing the tree. Birds may nest in the tree while mice and other creatures may nest beneath it. Beetles and borers drill into it. Flowers, grass, shrubs and mushrooms may shelter under it. Often these critters die and become food for the roots.

The roots of trees develop ahead of the above ground parts because the roots must supply food and water to the above ground portion, and anchor the tree against the elements. Feeder roots grow just below the soil surface and fan out in all directions seeking food and water. They have the primary responsibility of nourishing the tree. Almost all plants have them. Trees have three basic types of roots, depending on the species:

- Fibrous roots. These form a dense mat of criss-crossing roots at fairly shallow depths. Such trees are usually best adapted to sheltered locations.

- Anchor roots. The tree extends a few extra long roots out in opposite directions, which help stabilize the tree against severe winds.

- Tap roots. Tap rooted trees and other plants send down one deep, sturdy root that anchors the tree and provides wind resistance. Both tap roots and anchor roots liberate deep minerals.

Some trees have tap roots: pine (Pinus species), mesquite (Prosopis species), oak (Quercus species), persimmon (Diospyros species) and hickory (Carya species), for example. Tap rooted trees often are difficult to culture in the nursery because the taproot quickly outgrows its container. In some cases, the root system may abandon its taproot altogether and convert to a fibrous root system. Tap roots of Ponderosa pines (Pinus ponderosa) have been found 60 feet deep, Mesquite roots were found almost 200 feet deep. Mesquites appear to have the deepest rooting habit of any North American tree.

Surprisingly, the bulk of a living tree is made up of non-living material. For example, on the trunk, the bark is made up of dead wood, and provides a defense against adversity. Over time, a dense layer of bark builds up that protects older trees against fire, beetles and borers, etc. Beneath the bark is the inner bark, which is composed of dead cells that are stacked to make 'pipes' which transport nutrients in solution down from the leaves to feed the rest of the tree. Next is the cambium layer, which along with the feeder roots and leaves is the only living part of the tree. The cambium layer is squeezed between the inner bark and the sapwood. Sapwood is also made of dead cells stacked up to make 'pipes' to transport minerals and water from the roots up to feed leaves, flowers, and seeds in the canopy. The sapwood is found at the center, or core of the tree.

A mature Giant Sequoia (Sequoiadendron giganteum) may weigh 6000 tons, yet grew from a tiny seed. Such is the mystery of the manifest world. A Coast Redwood (Sequoia sempervirens) can reach a height of 350 feet, with a trunk diameter of 27 feet. The Giant Sequoia can reach a height of 330 feet (thought to have once grown to 400 feet), with a trunk diameter of 30 feet. A single plant, a shrubby species of Gaylussacia, covering over 100 acres of ground was found to have a clonal age (a clonal colony is a group of plants in a single location that have originated vegetatively, but not sexually, from a single ancestor) of 13,000 years old. A Giant Sequoia can live 3800 years, a Bristlecone pine (genus Pinus, subsection Balfourianae) can live 4600 years, a Creosote bush can live 11,700 years (age of clonal colony), and an Aspen (clonal age) can live possibly over 1 million years!

Tree canopies are three dimensional, so the combined surface area of the foliage is five to seven times greater than a building roof of the same. Up to 90% of the sun's rays are intercepted by the tree canopy, yet trees only use 1% for photosynthesis to manufacture food. During photosynthesis, each CO_2 molecule (one carbon atom and two oxygen atoms bonded together) is divided for utilization as food. The oxygen is not used in this process, and is released back into the atmosphere. One acre of vigorous tree growth exhales enough oxygen to support eighteen people. If the leaves are laid side by side, it takes an acre of leaves to provide enough oxygen to support one person.

A mature standard apple tree has approximately 100,000 leaves, a mature maple has 500,000 to 700,000 leaves, a mature elm tree has 6 million leaves, and a mature conifer has 60 million needles, weighing roughly 440 pounds!

TREES AND THE HYDROLOGIC CYCLE

About 15% of all rainfall is intercepted by forest trees. The rain soaks the foliage and then runs off onto foliage lower down, eventually reaching the soil beneath the canopy. The rain also runs over the branches and down the furrows in the bark of the trunk to be channeled into the root zone. As rain reaches the ground after its initial interception by the trees, it's called throughfall. Throughfall rain has changed significantly from its composition as it first encountered the tree canopy, having picked up leaf oils, dust and organic debris on its path to the ground. It enters the soil rich in nutrients it has washed off the tree.

Trees only use a small fraction of this water for its needs, releasing the rest into the atmosphere above the canopy as water vapor. Lighter than air, the water vapor will then rise up to join clouds, where it can nucleate with water molecules. When the combined weight of the water is more than gravity, it falls as rain.

Conifer saps have terpenes (hydrocarbons) they release in the water vapor they transpire. These terpenes are refractory, and scatter and reflect sunlight. Watch for the haze they create. This haze causes temperature inversions, and hilltops become warmer, bottom lands become cooler.

Near noon on clear days, heat builds up on leaves and needles causing evaporation, which creates enough pull to suck sap carried in water up from the roots. The elastic sap rises because of the pressure difference caused by evaporation, which produces 150 times the pressure of the surrounding atmosphere. Sap has a tensile strength (the breaking point of any substance) of

2,250 pounds per square inch. In this way even the tallest tree pumps water into the canopy in great volumes, seeming to defy gravity.

Thus forests play a significant role in the hydrologic cycle. Forests are very efficient moisture collectors and the root zone is an effective water storage system that proficiently captures and holds precipitation for extended use, serving all the species living in the forest. Water released into the ground by forests is very pure and of high quality. The water is released slowly and evenly, acting as a giant filter system.

On a hot summer day, an average mature tree transpires (releases water into the atmosphere when opening its pores to capture CO_2) about 100 gallons of water per day. A eucalyptus tree transpires 82 gallons per day; a birch is able to transpire 700 to 900 gallons per day! Forty standard apple trees on one acre transpire 480 tons of water per month.

Trees also play an important role in the carbon cycle. The physical makeup of trees is about 45% carbon, so mature trees can lock up more CO_2 than they exhale into the environment. Young trees consume more carbon than a mature tree but lack the ability to store it, so most of it is released back into the atmosphere. A Douglas fir must be about 200 years old before it can lock up more carbon than it releases. Some trees can lock up more carbon than they release at about 50 years old, but many more years must pass before carbon storage is significant. More study is needed on this subject. Obviously we can't cut down a mature forest, plant new trees and expect we've had no impact on the carbon cycle.

SOME SERVICES TREES PROVIDE

The California Department of Forestry calculates the worth of each 50 year old tree in ecological services at about $395,750.00. Ecological services include:

providing oxygen, increasing soil fertility, recycling and purifying water, regulating humidity, producing protein, creating wildlife habitat, soil erosion control, controlling air pollution, moderating climate extremes, and reducing high winds.

One study suggests that if home owners and businesses in the US planted 100 million trees, $4 billion in energy use, through a reduction in heating and cooling costs (climate moderation), will be saved. Siting and species selection is critical though. One acre of beech and maple can capture solar energy equal to the energy used by 50 medium sized homes. Unshaded parking lots can reach 120° F, but with properly sited trees, the temperature can be dropped 30° cooler. As a result, the lot is more comfortable to be in.

Trees can yield fifteen to twenty tons of food such as fruit and nuts per acre each year. Over a tree's lifetime, it can yield hundreds of thousands of dollars of food and yet cost only a little money to plant! Many crop trees do well on marginal land, and require only modest labor.

THE FOREST

A forest ecosystem is a highly organized environment of countless yet inseparable parts, both living and non-living elements interwoven with remarkable precision and complexity. For example, for every essential ecological service or function required for the system's sustainability there are redundancies. That is, there are always two or more species that can perform these duties and fill in if adversity knocks one out. Plants and animals form great assemblies called biotic communities, and all evolve together over eons of time in interdependent relationships. Together these biotic communities engage in a continuous cycle of energy and materials. In this way the whole is sustained, often over long periods of relative stability.

Virgin forests (forests that have not been logged or experienced other human disturbances since Europeans arrived) average 20 to 50 trees per acre. Big, well spaced trees dominate in a virgin forest; in between, younger trees of various ages grow. Virgin Ponderosa (Pinus ponderosa) pine forests were called parks by early Euro-American migrants to the west. This was because the trees were so tall and widely spaced, with a grassy under story dotted with wildflowers. The name Ponderosa parks persists to this day even though the virgin Ponderosa forest is long gone.

Old growth forests have a high diversity of species as a rule, though there are exceptions. Old growth indicates a mature forest, yet nowadays forests still in middle age are being called 'old growth'. A second growth forest is usually very low in species diversity, particularly when contrasted with the original virgin forest. Second growth forests may in some cases have been logged and/or burned repeatedly over the last few hundred years (sometimes known as third growth forests).

Second growth forests (a woodland or forested area that has regrown after a severe disturbance) are typically overstocked and there's a high level of competition. Average density is 200 to 300 trees per acre, but not uncommonly 2000 to 3000 trees per acre. A second growth forest grossly overstocked can result in catastrophic fires, epidemics of pests and disease, and over competition for resources (light, water and nutrients). Second growth forests are often the result of clearcutting, or sometimes from a catastrophic crown fire. Such fires were once used as a tool to remove forests for increasing grasslands for cattle.

Most catastrophic natural disturbances like hurricanes seldom damage a forest more than 5%, humans on the other hand, can and do impact the forest 100%, often repeatedly. Structural changes to the forest occur from logging, mining, overgrazing, roads, development, and wildfire suppression. Although we Americans have been culturally conditioned to be blind to the damage done, sometimes forest degradation is so extreme we cannot deny it.

FOREST AND WIND INTERACTIONS

Forest trees interact with wind in a number of ways. They intercept the dust, organic debris and other particulate matter the wind has picked up and deposits it on the forest floor, where it becomes part of the soil ecosystem. The wind shakes the trees and liberates dust and bacteria from the trees surface. The bacteria are lifted skyward by the wind and bond with water molecules, where they serve as a nucleation point for rain to form around, eventually falling back to earth.

When dry winds blow into a forest, the trees humidify it. On the other hand, when densely humid air enters the forest on the wind, as happens after a rain, the trees wring the humidity out of the wind. The work of forest trees includes moderating extremes of humidity.

When wind first encounters the forests' edge, a dense pocket of stalled air builds up that drives ground level wind up and over the tree tops. As a result, the wind is compressed into streamlines, concentrating nucleating material and water molecules in the flow. This increases the likelihood of rain as well as the volume of falling rain by about 40%. The percentages can be even higher as the wind leaves the forest for open ground. As the unimpeded wind drops again toward the ground, the added pressure creates turbulence in the streamlines. They begin to spin in Ekman spirals (rotating bodies of air or water created by the pressure and direction of the air above them), and moisture is hurled to the ground.

THREATS TO OUR FORESTS

Clearcutting is roughly equivalent to having thugs beat you with lead pipes. You may not survive the beating, and even if you do you may be handicapped the rest of your life. The violence the current economic paradigm commits against our forests is considered by government and the timber industry as good stewardship. Clearcutting results in massive habitat destruction, down slope erosion and flooding, the destruction of riparian ecosystems, residual culls and slash start forest fires. Such are the bi-products of the forest industry's resource extraction process.

Strip mining literally tears down hills and flattens them, discharges poisons into the ground and riparian ecosystems. The forest ecosystems that grew on these hills are gone forever. With the military's appetite for uranium, our habit of generating electricity from coal and our love of gold, strip mining continues unabated.

Smelters kill everything for miles around (not even a blade of grass remains). The first time I encountered one of these smelter towns, I was traveling through endless miles of beautiful British Columbian forests, when suddenly I came out into a huge open area with the bleakest looking town I'd ever seen. Although surrounded by lush forest, no living plant could be seen, not even weeds.

Cities. At first cities grew up haphazardly, but once the automobile became king and the auto industry destroyed our mass transit systems, cities were designed strictly for cars. Not only did the natural environment count for nothing, even the cities' people were but an afterthought of urban and suburban development. Most cities spring up where resources are richest or along important trade routes or ports; in Oregon, Portland is sited at the junction of major rivers Columbia and Willamette, and Eugene / Springfield at the confluence of the Willamette and McKenzie, where the Cascade and Coast range foothills converge with the Willamette valley and wetlands. Eastern Oregon's most populous cities (Klamath Falls, Bend, Redmond and Madras) are situated at the base of Cascade watershed.

Fresh water is always a consideration initially, but many Western cities today are more populous than their resources allow. In the age of transportation, resources are reallocated from one part of the world to another. So cities like Los Angeles and San Diego must pipe water from hundreds of miles away to meet their demand. Bit by bit, peak oil will bring this era to an end.

To build our cities we've had to pave and plow ecosystems, we seal off the soil with asphalt and concrete, which produces heat sinks contributing both to climate change and ozone pollution. We routinely pollute the air and water we need to live healthy lives. Few of us grow up learning much of anything about the earth's natural environments and how they relate to us and our existence. What were you taught about how to utilize our natural resources so they continue to maintain ecological integrity? What did you learn in school about how to restore the ecological integrity of the natural systems that we've needlessly ravaged? Did you learn any of this in grade school, in middle school or in high school? How about college or the university? Odd as it may sound, it can be empowering to know that you don't know. It's often a prerequisite for the dawn of wisdom and the enlightened state. Too often we blindly blaze ahead, confident anything we do will be alright. A good designer will sit quietly alert on the land, without expectation and let it speak to them in its own way and time.

<u>Wildfire Suppression: The Smokey the Bear syndrome</u>. The forest fuel load increases to catastrophic levels and the natural fire cycle is disturbed. The number of low intensity fires decreases quickly, while the number of high intensity fires grows dramatically. Don't trust George W Bush though, the Bush Healthy Forest Initiative is anything but. Here again we see corporate government twisting facts to justify the ecologically destructive practices of industrial forest extraction practices.

Our forests are more vital to our survival than our system of economics would indicate. Now with global warming, our forests, especially the old growth remnant, are exponentially more connected to human survival than ever before. To continue forest industry practices is the equivalent of trying to put out a fire by soaking it down with gasoline.

Global warming, ozone pollution and acid rain threaten a massive ecological failure of forest ecosystems. Our system is ever adding fuel to this catastrophe, while many who work to reverse the calamity are thwarted by the system. We can soften this blow significantly by switching to a combination of means practiced synergistically through eco-forestry: ecological rehabilitation and restoration, wildfire mitigation and controlled burns, and ecological harvests of special forest products, as well as some methods common to permaculture!

We can help facilitate the restoration of 2nd growth to old growth ecosystem characteristics, structure, services and functions faster than it can be done if left alone, and save more of it. This is only possible if clearcutting and industrial forestry is outlawed, and instead the combination of methods outlined above is practiced in its place.

The Effects of Civilization

About 40 years ago, one Sunday Edition of the NY Times consumed 252 acres of trees (it may be three times that now). One commercial jet flight from LA to NY needs 100,000 old growth trees to offset the pollution generated.

ECO-FORESTRY

Never treat a forest like a cornfield. Timber corporations and the State and Federal governments often plant mono-crop timber plantations after clearcutting old growth. These plantations do not provide natural ecosystem functions such as habitat. In addition, they are highly vulnerable to wildfire, and pest and disease epidemics that they spread to neighboring natural forests.

Eco Forestry Principles & Management

“ *Develop a forest stewardship management plan”*

Our tax money pays for infrastructure like logging roads that destroy our own (public owned) forests and land. Oregon, for example, is rich in resources, yet high in hunger, joblessness, poverty and probably homelessness compared with the national averages. With the hunger lust of a mutant beast, big business and corporate owned government has accelerated the rate of destruction of our resources and our social integrity in Oregon, and throughout the US and the world.

One of the most important places to begin to protect and restore is our forests. They are on the front lines. A well crafted, ecological and economic stewardship plan is needed. Our forests are rich in untapped resources that lend well to ecological stewardship and would provide a dramatic increase of jobs. Instead of ecosystem destruction by big timber, profiting the few and providing a small number of modest paying temporary jobs, we can restore old growth forest, create more jobs that are permanent, pay a living wage and build solid local communities.

The goals of eco-forestry are to manage the forest to move it toward old growth characteristics, to minimize or eliminate destructive practices that cause environmental impacts, to increase practices that can benefit forest rehabilitation and to generate a continuous supply of quality forest products. These practices are based on the following:

1. Collect historical data of the site, for example: clearcut 1910, fire 1941, flood 1993, etc.

2. Do a stand analysis: see what's there and where it is. Include a botanical grid survey. The analysis tells you what tree species are where, their age, size, stand condition, etc. The survey tells you all the other plant species present, their variety and location. This is valuable information for both good stewardship and rehabilitation purposes.

3. Locate and identify various niches in the larger environment, like riparian corridors, canyons, rock outcrops, unique habitats, etc. Develop contour

maps and include solar exposures. Identify species and niches to preserve that are rare, fragile, or provide important habitat.

4. When drawing up stewardship plans, the first priority is to protect the watershed. Protect riparian corridors in their entirety, no timber harvesting, thin carefully if at all for the health of the ecosystem only.

5. Observe and document forest conditions as a reference for the evolution of good stewardship on the site. Good stewardship requires awareness and flexibility, a willingness to adapt as conditions warrant, to see interrelationships between organisms, and between organisms and their environment. Planning, harvesting and stewardship are always concerned with the whole system, as well as all its parts.

6. All cuttings are managed for diversity because the forest generates its own sustainability and stability through complexity. The four basic components of diversity are *indigenous* species diversity [excluding adventives (introduced but not fully naturalized) and exotic species]; management for a diversity of ages and sizes of residual trees; structural diversity such as multiple biomass layers, sufficient snags and deadwood on the ground, for example; and genetic diversity relating to expanding the gene pool, for example keeping venerable old trees that are yielding large numbers of genetically superior seedlings.

7. Emphasize what timber not to harvest. Before cutting a tree assess its value as habitat, forest structure, and other eco-functions such as reproduction (as in an all ages stand). During thinning or logging operations, the focus of management is to keep (not cut) trees, and keepers are determined in the following ways:

A. If they are the tallest in the stand

B. If felling represents a high level of danger to people or horses.

C. If it cannot be felled without damaging more valuable timber trees.

D. Trees are not cut if the canopy is already open.

E. Trees aren't cut if they are a cavity nester (birds that nest inside tree cavities or hollows) site or provide nesting for raptors.

F. Trees on steep slopes are not cut.

G. Tree species that are least common in a stand are not cut.

H. Snags (standing dead trees) are never cut, except where they pose a danger to humans. Keep about eight snags standing per acre as wildlife habitat.

I. Trees are not cut when a stand is not overstocked or over crowded, and a healthy multiple layered canopy exists.

8. To maintain regeneration of tree species that are intolerant of shade, it is appropriate to remove three to five dominant (canopy) trees occasionally, mimicking a naturally occurring opening from a storm that allows sunlight to reach the forest floor.

9. Keep no less than 50% of overstory trees when doing the first cut for a selective thinning, you can return in six to twelve years for a small second cut. Keep the oldest trees as first priority, all ages as a second priority (to maintain good forest composition and structure).

10. Thinning and timber harvests are almost exclusively taken from the understory rather than the canopy. The goal of tree removal is to support old growth development first, and to perpetually harvest high quality logs and other forest resources second.

11. Use only low impact harvest methods to minimize environmental impact. No clearcuts! Utilize a permanent on-site small-scale logging operation rather than transitory contracts with logging companies.

12. Build as few logging roads as possible; more trees are cut during road construction than in the harvest zones they're built for. The Forest Service, BLM and timber companies have built 2½ times more logging roads than comprise our national highway system, about 400,000 miles.

13. No slash and burning. Chip and spread cut materials or compost it, or use to make contour bunds and check dams as ways to return carbon and organic matter to the soil and reduce fire danger. Often times if you pick through the debris piles, you will find raw materials for a variety of products. A few small to medium sized piles left here and there in the open (never under tree canopies) per acre make good wildlife habitat.

14. Construct water catchments like contour bunds and check dams from low value saplings that have been thinned (See Water Management in Water for more information). Catchments function as coarse, woody debris that provide nutrients and habitat, increase moisture infiltration into the soil, improve water quality and minimize erosion and flooding. Catchment systems can be inoculated with edible and medicinal decay fungi to increase nutrient deposition and beneficial microbial habitat (See Fungi).

15. No chemical herbicides or pesticides for any reason. Use bio-controls possibly as a last resort. Plant eco-types (plants from a similar habitat) that harbor beneficial insects. In healthy ecosystems, pests and disease are a natural part of the system of checks and balances.

16. No use of herbicides or mechanical uprooting to control unwanted brush. Use domestic animals like goats, or the hedge bar on a chainsaw for

brush control. Synthetic chemical herbicides, pesticides or fungicides are never used.

17. Add value to harvested wood by upgrading and developing products from raw logs rather then wholesaling them.

SUSTAINABLE HARVESTING AND LOGGING

Logging today, even sustainable logging, brings a crew onto a site, which they log and then leave. They learn little about the forest they're working. An on-site forestry crew that practices value-added harvesting and product development for light industry can work the same forest all year, every year. They develop an intimate knowledge of this forest and how to maximize good stewardship for it by their presence. A hybrid operation could include draft horse logging, small skid steer with a power winch, a travois (to haul logs), a pickup or flatbed truck, a portable mill, a solar or dehumidification drier, a chipper/shredder, a chain saw winch, a traveling skyline crane, etc....

Horse logging, the gentlest and quietest skidding operation (an old craft), can minimize environmental damage to the soil like compaction, rutting and erosion, and can utilize narrower skid trails so fewer trees need to be removed for skidding. However, horses can skid only 800 feet maximum and are slow, as well as being more dangerous in rugged terrain. On the other hand, horses can work in tight places mechanical skidders can't.

A mechanical skid steer with a power winch is faster than horses and not limited by the distance of the skid. I've used a big “Bobcat” mounted with a power winch. It had cattracts for off-road, giving it stability in rough terrain and minimizing compaction, wheels for roads, and also a front end loader, forklift, grading blade and backhoe attachments.

For steep slopes and tough-to-get-at spots, you can use a chainsaw powered winch. Remove the chainsaw bar and tie the winch off to a tree: simple, cheap and easy. With directional felling, you can drop the tree right where you need it to go. A traveling skyline crane is great where you have draws, canyons, or steep slopes. It has a long cable with a pulley that transports logs above the ground without risk of damaging the forest floor or residual trees. You'll want a travois, a wheeled log trailer that hooks to the back of a pickup or skidsteer, or even horses! It transports logs on logging roads to a staging area where it can be milled or transported by truck to the mill.

Portable mills can be set up almost anywhere; older models can be dismantled so they will fit in the back of a pickup truck, newer models usually have their own trailer. Some smaller portables use quiet Honda engines, larger portable mills use Briggs & Stratton. Their advantage over large stationary mills is they can cut trees of various diameters (like small diameter trees.) Even more portable and a lot cheaper (although less efficient) are Alaskan Mills, which are basically chainsaws with log rail guides.

A chipper/shredder can take the branches stripped from timber logs and grind them into small pieces that break down quickly and liberate their nutrients back into the soil. Spread across the forest floor, or if the existing litter is too thick and dry to break it down properly, make compost by layering the chipped material with livestock manure. Or use it alone as mulch for newly planted shrubs and trees. Dehumidification lumber dryers remove humidity from wood without losing heat, because they recycle heat many times, they're more efficient and better environmentally than conventional dryers. In addition to lumber they can also dry fruit, nuts, herbs and vegetables.

VALUE ADDING AND PRODUCTS

Each processing step taken with a raw log adds to its value. For example, in the 1990s, an Appalachian oak log sold for $.60 a board foot. After milling, it sold for

$1.00 a board foot. If then kiln dried, it sold for $3.00 per board foot! In Mexico, the Huichal tribe from the mountains in the north of the country sold raw logs for $1.00 a log. Then they started milling and drying their logs in a solar kiln, and using the lumber to build desks and benches, and made $300 per log instead of a dollar. One company that made walking sticks from waste wood (a bi-product of logging) grossed $90,000 its first year in business.

There are numerous products that can be produced with wood of small diameter. For example, whole poles can be used for post & beam construction, architectural pillars, sign & light posts, sculptures and rustic furniture. Wood of even smaller diameter can be used for fencing and various other articles.

In 1994 sales of nature based crafts in the US were $7.5 billion, probably actually much higher because a lot of crafts are sold off the commercial radar. One company that sells only nature based crafts made $145 million in sales that year. The floral industry grossed $128.5 million in 1994, just in the Pacific Northwest.

In Oregon, salal (Gaultheria shallon) foliage collectors often make about $60,000 a year, some make more if they're very efficient. Salal foliage is very popular in the floral arrangement business.

Also in 1994, edible wild mushrooms grossed $41 million in Western Oregon & Washington. Researchers consider this figure to be quite conservative. Throughout the US, edible mushroom sales are at over one billion per year. In 1998, medicinal herb sales in the US were about $4 billion and growing

Other Non-Timber Forest Products

- Wild and wild-cultured mushrooms and other gourmet products and foods.
- Wild and wild-cultured medicinal herbs.
- Raw materials for the floral industry.
- Seeds and cuttings for nurseries.
- Unused parts can be used as mulch or composted, or as a raw material for biofuel production.
- Materials for crafts, art, dyes, etc.
- Varnish
- Pitch for adhesives.
- Insulating materials.

significantly each year. In 1994, Germany and France earned $500 million from just one herb, the foliage of Ginko biloba.

In a village economy, you can develop many products with raw materials from the forest and field. Worker owned democratic co-ops are the most empowering way to run village economies, and only need one accountant, one web site, one catalog, one retail center, etc (See Invisible Structures for more information).

RECOMMENDED READING:

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