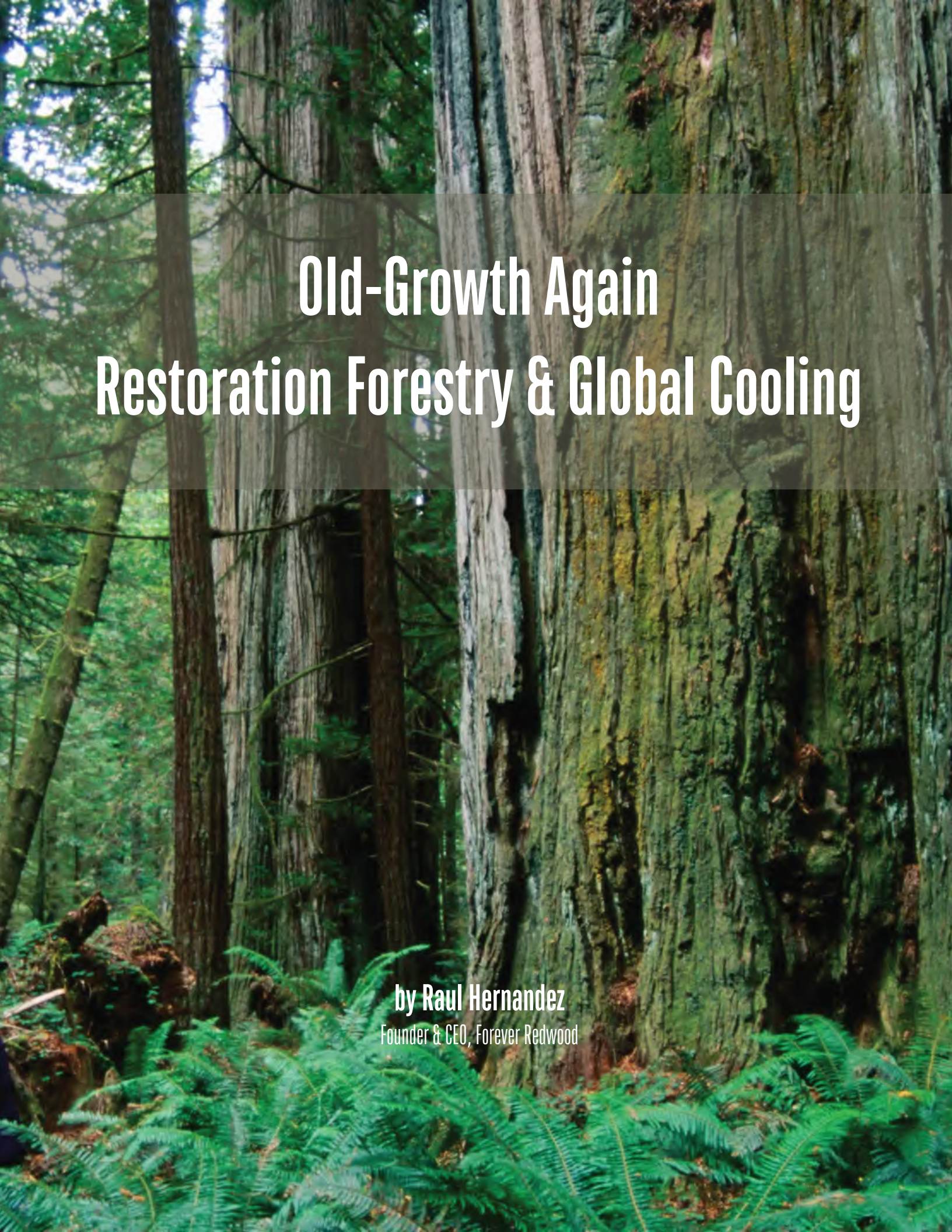
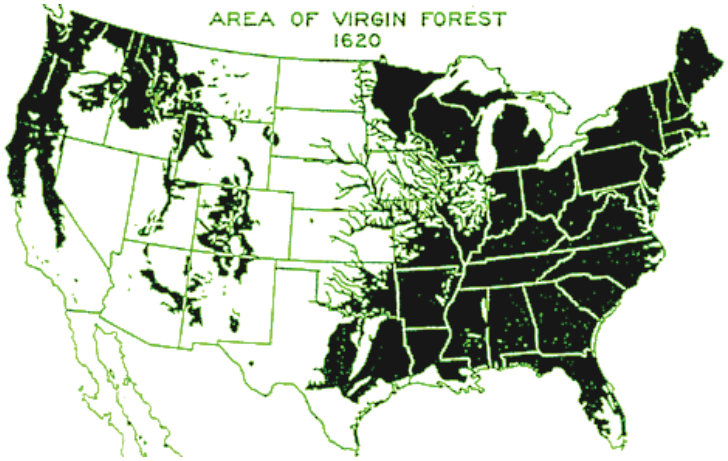


Old-Growth Again
Restoration Forestry & Global Cooling

by Raul Hernandez
Founder & CEO, Forever Redwood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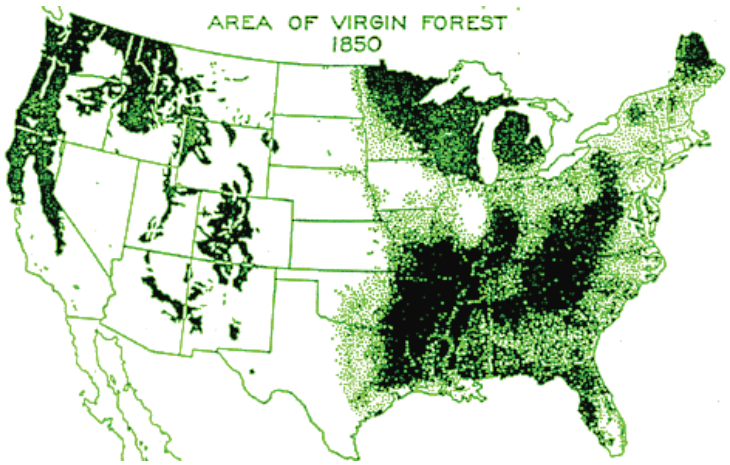
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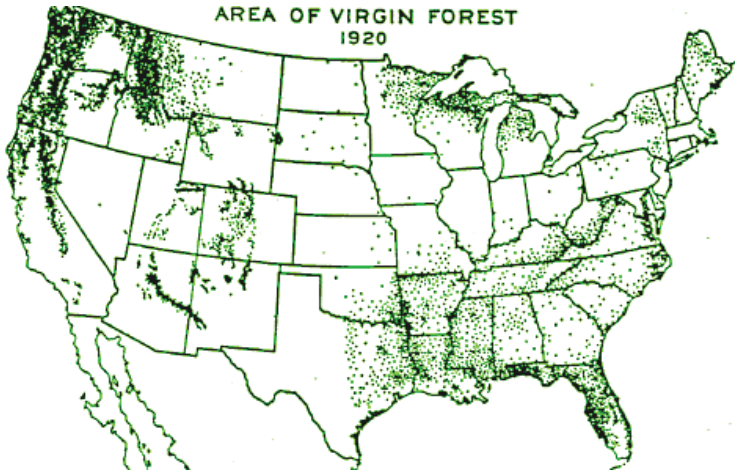
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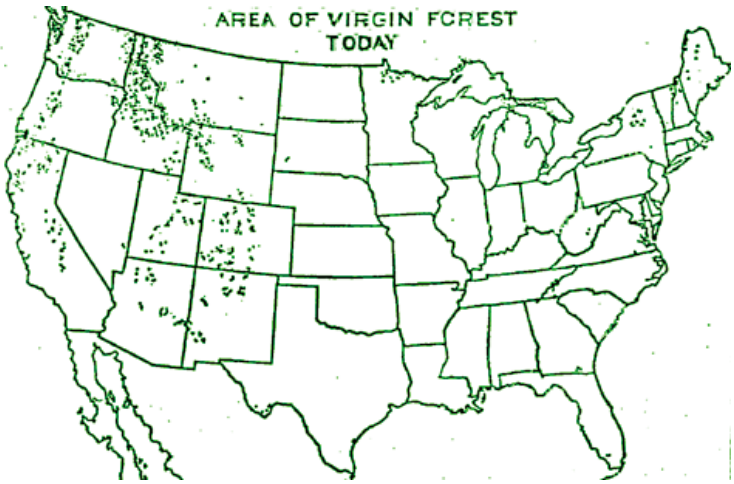
AREA OF VIRGIN FOREST
TODAY

Old-Growth Again
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by Raul Hernandez
Founder & CEO, Forever Redwood

Frontispiece: Historical Maps from 1620 to 1920 published by the U.S. Forest Service in Economic Geography, Volume 1, 1925. The "TODAY" map published in 1990 by the Greater Ecosystem Alliance, Box 2962, Bellingham, WA 98227. The amount of old-growth forest in the U.S. has declined further since the last map was published in 1990. Although these maps accurately depict the range of the old-growth forests, they misrepresent the amount of old-growth trees. Studies of the Pacific Northwest show that old-growth trees before European settlement covered a fraction of the total forestland at any given time. Estimates vary widely, from 5% to 38% of total acreage. In other words, when viewed on a small map, landscapes of endless variety (and age) are condensed into an unbroken forest of old-growth trees that never existed. Trees of all ages make up an old-growth forest. The maps are accurate only when this is kept in mind.

Credits: Thanks to Frank Marrero for editing help and thousands of hours of service in the woods. Thanks also to Warren Linney, Ian Morris, Maria Eugenia Blanco, A. Terry Patten, Ronald Harbin and other friends that helped the project grow over the years. Forest Timeline Art on pages iv-v by Jeff Grove of Petaluma, CA. Photos by author unless otherwise noted. Page 20 drawing by Sky Simard-Hernandez.

www.foreverredwood.com

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“Nobody made a greater mistake than he who
did nothing because he could do only a little.”
—Edmund Burke

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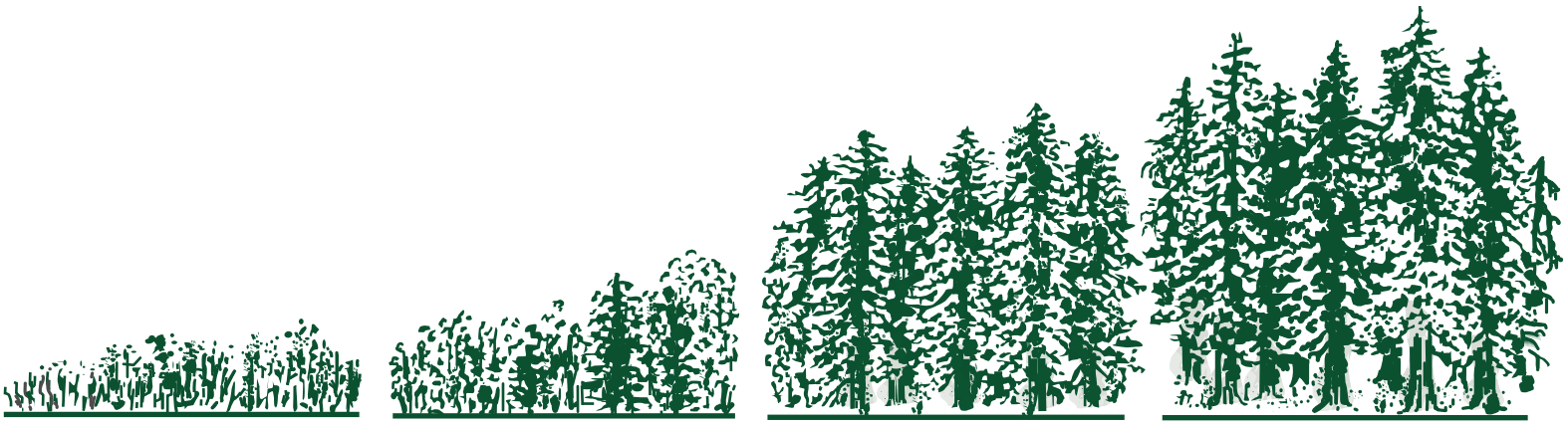

Year 1:
Bare soil, herbs & grasses

15 Years:
Shrubs & seedlings

30 Years:
Saplings & shrubs

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Young forest

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PREFACE

WHAT IS AN OLD-GROWTH FOREST?

The simplest definition is “a forest that has never been logged.” But old-growth forests are more complex than that. At least six components make up an old-growth forest:

1. Trees 200 or more years old
2. Trees of all ages
3. Large standing dead trees (snags)
4. Large fallen trees in streams and on the forest floor
5. Many canopy layers (uppermost branchy layer of the forest)
6. Fertile, textured soil

The old-growth Headwaters Forest *was protected from logging in Northern California in 1999. EPIC, a local nonprofit, continually challenged the state-approved harvest plans in court to prevent its destruction.*

Photo used with permission of Greg King, EPIC Box 397, Garberville, CA 95542.

ABOUT OLD-GROWTH AGAIN AND FOREVER REDWOOD

Old-Growth Again Restoration Forestry (OGA) is a “hands-on” California company restoring logged forestlands to their ancient form while practicing ecologically and economically restorative forestry. OGA is the parent company of Forever Redwood, which builds and sells furniture and structures to support the mission of OGA. (For the purposes of this manual, "Old Growth Again," "OGA," and "Forever Redwood" are used synonymously to refer to the entity carrying out the restoration forestry work described herein.)

The continuing disappearance of old-growth forest habitat accelerates the global decline of wildlife and biological diversity. The large reduction in the standing timber volume of the world’s forests contributes directly to the release of additional global warming carbon into the atmosphere. Restoration forestry reverses this decline by adding standing timber volume consistently decade after decade. This approach recreates old-growth habitat and removes carbon from the atmosphere by adding standing timber volume consistently decade after decade.

The Gualala River Watershed

This manual describes the restoration of 700 acres of Redwood forest in Northern California—mostly within the Gualala River Watershed—and it invites the reader to become involved and participate. It documents a small-scale example that can be applied to forests of any size. After a brief introduction to forest use history and its consequences, Forever Redwood’s “eco-logic” is described—the transformation of a logged land into a beautiful, productive forest where trees become old-growth again.

Restoration forestry knowledge and use is slowly spreading by example. Over time, restoration forestry’s growing track record will make the “jobs versus environment” argument between preservationists and their industry counterparts irrelevant. The manual focuses on going beyond “sustainable forestry” to true forest restoration. Only by adding significant volume to the forests of the world can the prior balance of carbon be restored.

The manual concludes with additional reading references and the business and legal framework to establish and maintain a forest in a restoration model through subsequent ownerships. Educational and investment opportunities for the advancement of restoration forestry in Northern California are also described and made available.

Until one is committed,
there is hesitancy,
the chance to draw back,
always ineffectiveness.
Concerning acts of initiative (and creation),
there is one elementary truth
the ignorance of which
kills countless ideas and splendid plans:
That the moment one definitively commits oneself,
then providence moves too.
All sorts of things occur to help one
that would never otherwise have occurred.
A whole stream of events issues from the decision,
raising in one's favor
all manner of unforeseen incidents
and meetings and material assistance
which no person could have dreamt would come their way.
Whatever you can do, or dream you can, begin it.
Boldness has genius, power, and magic in it.
Begin it now.

—W.H. Murray (inspired by J.W. von Goethe)

Degrading Industrial Forestry Practices in Mendocino County's Redwoods (early 1990's): *The uncut forestland visible in the top of the photo is the Jackson State Demonstration Forest. Photo by Hans J. Burkhardt*

I: ECOLOGY AND ECONOMY

AN INTRODUCTION

Humanity exists within an intricate web of biological/energetic relationships. Over time, this web has evolved seemingly infinite biological expressions on the earth from landscapes to homosapiens.[1] Where forestland develops, the most evolved landscapes are the old-growth forests. At the dawn of history, these forests covered half of the earth's land surface outside of the arctic regions. Since then, over 40% of old-growth forests have been converted to human use or turned into desert. This continues to this day, with a growing percentage of the remaining old-growth forests simplified, fragmented and/or degraded. (A UN study[2] reports that between 1990 and 2015, there was a net loss of 129 million hectares of forest, about the size of South Africa.)

The large biomass of a mature forest moderates the earth's energetic extremes in a variety of ways. For example, mature forests have a tremendous capacity to retain water and influence overall weather patterns. They continually recycle and increase local rainfall. They release large amounts of moisture when the air is dry and reabsorb moisture at night or when raining. They moderate streams by quickly absorbing and slowly releasing water into the watershed. The forest absorbs pollution and also moderates temperature and wind. The larger and more extensive the forest cover, the greater the moderating effect. The larger the biomass of a forest, the greater amount of carbon it holds.

In contrast, the "highest" and "best" use of land economically begins with skyscrapers and moves down in order of economic concentration to suburbs, industrial agriculture and forestry. **By its short-term nature, the market economy undervalues the highly evolved state of "undeveloped" earth-land and its web of biological relationships. As long as equal value does not exist for both ecology and economy, the quantity and quality of the Earth's forests and all related life will continue declining.** Despite the work of environmental organizations, the global trend is toward more population, resource consumption and pollution even as old-growth forests continue to disappear. If you are concerned and want to alter this dangerous course, read on. Otherwise, please recycle.

The tree planting programs of the large timber companies are a good example of economy and ecology not being considered equally. These programs are generally praised—even though they convert biologically complex forests into young tree farms. The tree farms maximize profits in the short-term and maintain tree cover over the land. But, tree farms often alter the forest structure and trigger an interrelated chain of consequences. For example, many tree farms plant only fast-growing genetically-engineered species. Chemical herbicides are used to eliminate the naturally regenerating, competing trees. Because of these practices, industrially managed tree farms reduce the species variety and composition of tree species. Fewer tree species and the logging of trees while young and small (60 years-old) eliminates habitat for some animals and insects and keeps the biomass of the land at a small fraction of its carrying capacity. The relatively small biomass of the young forest limits the moderating effect of the forestland and its capacity to sequester carbon. (The illustration in the table of contents dramatically illustrates the size and structure differences of a 60-year-old tree-farm stand and a mature and old-growth forest.)

Removing tree species that time and evolution selected for a specific environment invites long-term imbalance into the forest. The interrelated chain of events continues to slowly unfold. Because different tree species use and build-up varying amounts of soil minerals, altering species composition eventually causes imbalances in the mineral content of the soil. Chemical fertilizers are then used to compensate for the soil imbalances. Because the predators of certain insects are eliminated with their host trees, insect populations are impacted. Insect infestations become common and widespread. This leads to insecticide use and genetic altering to develop "bug resistant" trees. The regular use of herbicides, insecticides, and fertilizers diminishes the soil's natural productivity because the microorganisms and fungi that are part of the natural, biological web decline. Genetic engineering and the use of chemicals add instability by changing the forest's self-regulating form.[3]

But restoration forestry can halt this chain of events. By considering both economy and ecology, this approach balances the over-emphasized financial perspective that encourages biological degradation.

HOW DID WE GET HERE?

"Those who cannot remember the past are condemned to repeat it." —George Santayana

Aside from the usual chronicles of kings, empires, and the arts, the ecological decimation of the past 6,000 years is well-documen-

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1 Wilson, Edward O. The Diversity of Life, pg. 15, Harvard University Cambridge, MA 1992

2 Global Forest Resources Assessment 2015: How are the world's forests changing? Second edition, pg.3.

3 Lansky, Mitch Beyond the Beauty Strip, Saving what's Left of Our Forests, pg. 111-6, Tilbury House, Gardiner, ME 1992 (Exhaustive criticism of Maine's Industrial Forestry.)

ted. In ancient Greece, the senators of Athens talked for centuries about saving their forests. The woods were so rich with life that it was dangerous to travel between the city states because lions often snacked on the Athenian travelers. The senators continued talking while the forests were cut and grazed to extinction along with the lions and wildlife. Talking has not worked yet. Today Greece is a dry, polluted peninsula:

> *"What is left now of the soils of Greece, is like the skeleton of a body wasted by disease. The rich, soft soil has been carried off." —Plato*

The same decimation has happened to the great forests of Europe, China, the Middle East (the Cedars of Lebanon), and every sector of every continent. Although other factors have contributed (climatic variations, for example), a clear historical land-use pattern exists. The pharaohs of Egypt did not choose a barren wasteland to build their great pyramids:

> *In Topsoil and Civilization, authors Vernon Gill Carter and Tom Dale point to example after example of civilizations rising and falling according to their use and abuse of the topsoil. In western Iran, northern Iraq, Syria, Lebanon, Greece, and many other now-poor countries that once supported flourishing civilizations, the scenario was the same: People deforested their hillsides to plant crops. When the winter rains came, the fertile topsoil on the slopes was washed away, and the land was ruined in a few generations. "When this happened," the authors write, "the people had to move to new land or eke out an existence on impoverished land. These civilizations declined or perished in a few centuries, as they depleted or exhausted the lands on which they were built."*[4]

This "gradual desertification" continues expanding over the earth to this day. A 1983 study inventoried over 2.4 billion acres of once productive lands that have been turned into deserts over the past 6,000 years.[5] In the United States, only 22.4% of the acreage of the great forests of the 1600's has disappeared. But the degradation is much more significant than these numbers suggest. For example, four hundred years ago, there were 950 million acres of forests of all ages where today there are 737 million acres of primarily young forests. When the same figures are looked at more closely, the percentage loss of quality, commercial forestland is actually 43.2% (from 850 million acres to 483 million today)[6]. And, despite the many large beautiful parks and government and industry rhetoric, most of the remaining forestland is not managed to serve economic and ecological interests equally. The overall volume of biomass is a fraction of its carrying capacity with the corresponding loss of carbon sequestering capacity.

In recent decades, the state of California has emerged as a pioneer in environmental law, passing laws that support strong forest practices and establishing large preserves. For example, approximately 22% of the state's remaining 1.6 million acre coast Redwood forest is protected against commercial logging, subdivision, and development; 7% (113,100 acres) are old-growth.[7]

The remaining forest is privately owned and managed by industrial timber companies (560,000 acres) for timber production and small landowners (585,000 acres) for residential uses, timber production, or other uses. Another 193,000 acres are privately held and subject to some development and commercial restrictions.[8]

Until the Forest Practice Act 1973, poor road building and overcutting degraded the Redwoods and led to long-term erosion, countless landslides and near-extinct fish populations. Although these issues have started to be addressed by industry and the state, the long-term ecological outlook remains discouraging as short-term economic decisions continue to dominate forest land management.

The overall Redwood landscape is a fragile patchwork. With regards to forests unprotected by the government, some forest owners do better work than others. Well-managed stands and restoration projects can be found throughout the Redwood region. Yet degraded, very low volume, hardwood-dominated stands are abundant as well. Many forest owners continue to clearcut and high-grade in steep areas, exploitative practices that cause erosion and regeneration problems.

By far the most common forestry practice in the Redwoods is tree farming. Tree farms are maintained as young forests and harvested on 50 to 80 year cycles. Mature or old-growth trees are rarely found on tree farms. "Development" also nibbles away and fragments the Redwood region. Converting forestland into profitable vineyards and/or residential development is a fast-growing trend in Northern California.

4 Robinson, Gordon The Forest and the Trees, A Guide to Excellent Forestry, pg. 85, Island Press, Covelo, CA 1988 (This is Forever Redwood's primary text—an excellent foresters' lifelong research/reference project.)

5 Dregne, H.E. The Desertification of Arid Lands, Academy Books, New York, N.Y. 1983

6 Williams, Michael Americans and their Forest, A Historical Geography, pg. 433, Cambridge University Press, New York, N.Y. 1992 (Thoroughly documented history of U.S. forestland use.)

7 Burns, Emily E, et al. State of Redwoods Conservation Report, pg.13, 14, 17, Save the Redwoods League 2018

8 Burns, Emily E, et al. State of Redwoods Conservation Report, pg. 20, Save the Redwoods League 2018

Historical events give a clear snapshot of the state of the local forests. In 1998, Louisiana Pacific, sold its overcut 224,000 acres and moved out of state in search of "new opportunities in the marketplace." The new owner, the Mendocino Redwoods Company (MRC), lowered the rate of cut and eventually was certified sustainably harvested. In 1999, the purchase of the Headwaters Forest demonstrated the great market value of the remaining ancient groves. The Government paid $495 million for the 9,450-acre forest. Headwaters was one of the last large tracts of unprotected old-growth Redwoods.

In 2008, The Pacific Lumber Company (PALCO) was liquidated and sold to MRC. PALCO had severely over-logged its lands since a 1985 hostile takeover and couldn't pay its debts. (MRC later combined with Humboldt Redwood Company, created through the reorganization of PALCO and related entities.) Although practicing more conservative forestry than their predecessors, a walk through their lands would reveal that "sustainable forestry" is only a modest step in the right direction. More stringent standards are needed.

This 18-foot diameter Redwood was cut near Fort Bragg, CA in 1933. Smaller-diameter old-growth Redwood still trickle into local mills today. Old-growth wood is of the highest quality and durability. Limited supply has made it very valuable today.

(Photo: Savethe-Redwoods League)

FOREVER REDWOOD – ACTING LOCALLY

Prior to logging, an enormous conifer forest of Redwood, Douglas-fir and sugar pine teemed with life. In the shade of these ancient giants, hardwoods like tanoak and madrone made up a smaller second-level canopy. The conifers were up to 10 feet wide and over 250 feet tall. Their lowest branches were usually over 50 feet above the forest floor, creating a shaded, moist, "cathedral ceiling" environment with expansive views of the forest interior. Wildlife habitat was abundant and diverse with many large downed logs and dead standing trees (snags). For example, a Black bear could find a den under a large fallen log or a bird of prey could perch within and easily fly through the tall forest interior.

The forestland managed by Forever Redwood was transformed by "high-grade" logging in the 1950's and 60's. High-grade logging refers to the practice of removing high value, older trees and leaving the immature, diseased and defective trees behind. The tall conifer canopy disappeared when the old trees were cut. The canopy today is about 50% hardwoods (mostly tanoaks) and 50% young conifers. Because mature tanoaks rarely grow taller than 80 feet, most of today's canopy is a fraction of its original heights. Without a tall, closed canopy to gather summer water from the fog (fog drip), the thin soil becomes drier with less ground vegetation and less water in the streams.

Redwoods and tanoaks resprouted around the stumps of larger trees that were logged. Where once a single large tree stood, a ring of small trees filled the space. With little canopy cover, the pines and firs seeded vigorously in the open sun. The land now has over 1000 mostly small trees per acre instead of about 150 trees of all ages. When the canopy is healthy and intact, young trees reach for the small openings and sprout only a few low branches. When the canopy shade logged away, the young trees grew many low branches. These low branches, combined with overcrowding, replaced the "cathedral ceiling" of the old forest with an impenetrable wall of branches, stretching from the canopy to the ground. Instead of walking through an expansive forest, it becomes necessary to push aside branches to walk or even see beyond a few feet.

To access the timber, many wide roads and skid trails were bulldozed into the hillside. Where the slope is moderate, most of the roads are still intact. Above many of these roads, the remaining stumps show signs that erosion has removed several inches of soil. On steeper slopes, erosion was more severe with skid trails collapsing and triggering landslides. This unstable land makes up at least 2% of the acreage. Forty years after road building, this land still frustrates regeneration by continuing to crumble and erode into the streams.

Logs were often hauled out via the creeks because it was convenient to do so. The use of heavy equipment changed the content and structure of the streams. The tractors bulldozed and removed large fallen logs, boulders, and gravel beds that water and time had carved into ideal spawning areas and fish-rearing pools. Logging debris in the streams created large logjams that made fish passage difficult or impossible in some areas. (Experts still argue over how much woody debris is desirable for fish habitat in streams.)

Most of the local creek's shade trees were also removed. Evidence suggests that without sufficient shade, the summer's warm water temperatures increase beyond where most fish can survive.[9] Add to this the large increases in erosion silt—known to suffocate fish eggs—and it is understandable that ***the wild river populations of California Coho Salmon are less than 3% of what they once were***. (We say "evidence suggests" because although fish obviously die at high stream temperatures, little historical data of stream temperatures exists to compare with.)

Despite the degraded state of the Gualala River's forests, applications for logging are regularly approved for stands that have not recovered sufficient volume since the last cut. For example, an attempt to log 41 acres for a quarter million-board feet of timber was approved by the California Department of Forestry in 1994. The logging was stopped when neighbors refused the logging trucks access to their roads. The land was then sold and became part of Forever Redwood's restoration efforts. The land will begin to yield some timber beginning in the year 2015. Twenty years later, Forever Redwood will still cut less than half the volume the state approved for harvesting in 1994.

FOREST WORK OBJECTIVES

RESTORE OLD-GROWTH SPECIES VARIETY AND CANOPY STRUCTURE

Restoration forestry works with the land's biological relationships. Before removing a tree, its relationship with the canopy, soil, slope of the land, erosion, fire hazard, age and species distribution of neighboring trees are all considered. Forever Redwood performs a series of "low-grade" thinnings at intervals of fifteen years to help the forest slowly recreate a canopy and species structure similar to what existed prior to logging. These "low-grade" thinnings do the opposite of what the logging did by removing mostly deformed and crowded immature trees. Every 15 years, the thinning removes up to 20% of the forest's total standing timber volume. Because a young stand adds on average over 50% new volume of wood in 15 years, thinning 20% translates into less than 40% of the 15-year growth rate. As the forest matures, the growth rate slowly declines to match the thinning rate. Growth and harvest figures are measured before and after each thinning by a 10% "timber cruise," a process for approximating volume.

Over the coming decades, the forest will regain its tall, coniferous canopy of about 150 trees of all ages, with several large snags and deformed (wolf) trees per acre. The species composition will slowly rebalance from the present day 50% conifers to approximately 90%.

The landslides can slowly be stabilized and overall erosion reduced so that the forest can naturally rebuild the soil. Once the large erosion sources like landslides, gullies, and poorly designed roads and skid trails are corrected, some of the stream's spawning gravel beds and rearing pools can be rebuilt. This mimics the stream's natural healing, allowing salmon and trout populations to grow in less time.

DEMONSTRATE FINANCIAL AND ECOLOGICAL SUSTAINABILITY

To help recreate a canopy dominated by old-growth and large mature trees, we always thin to improve the stand. This allows a high percentage of the healthiest trees to eventually become mature and old-growth. For example, we set aside an average of five of the largest, healthiest trees per acre to live out life spans of 500 years or more. Redwoods are favored because of their longevity, but all species are represented. These old-growth trees will grow alongside younger trees that are thinned selectively. The stand will eventually have a distribution of trees in declining amounts in the under 20, 40, 60, 80, 100, 120, 140, 160, 180, 200, and over 200-year age groups. By maintaining a diverse stand of old-growth, mature and young trees, the forest will approximate its pre-logging structure. A mature forest

Raul Hernandez and Frank Marrero in 2000 on Forever Redwood land

9 Norse, Elliott Ancient Forests of the Pacific Northwest, pg. 104-6, Island Press, Covelo, CA 1990 (Wilderness Society)

with trees of all ages offers ideal habitat for many different life forms and is a rich biological influence on the surrounding area's atmosphere, water, and wildlife. As the forest matures, it will grow in importance as a wildlife corridor for "mature forest dependent" animals.

In contrast to sustainable forestry, restoration forestry makes long-term, permanent contributions to global cooling by sequestering a large amount of carbon. Sustainable forestry requires only marginal increases in standing timber volume. The rates of cut allowed under certified sustainable management plans lead to minimal carbon sequestration over many decades while restoration forestry's contribution is enormous.

THE RESTORED FOREST BECOMES AN EDUCATIONAL MODEL

The forest's living example of maturing to old-growth while contributing economically will demonstrate the viability of restoration forestry and encourage others to adopt its principles. Once the streams, soils, landslides and the road problems are resolved, a careful and conservative thinning program becomes the long-term restoration tool. Eventually, as the stand matures to over 200 years, it will approach full stocking and growth and will then match the thinning rate. With an average of 150 trees of all ages per acre, each subsequent thinning will only remove one to three mature trees per acre. This is a small portion of the total mature tree volume which can number up to 30 mature and old-growth trees per acre. With trees of all ages and a canopy dominated by mature and old-growth conifers, the forest can be maintained in this state in perpetuity—as long as the thinning rate is not increased. These standards are "restorative" in nature because they move the forest towards its ancient form. Restoration forestry standards significantly exceed the requirements to certify a forest as "sustainably-harvested."[10]

In general, conifers begin to make quality wood between 50 and 80 years, depending on the quality of the site where the tree is growing. By providing rare, mature wood, Forever Redwood can generate consistent income from a fraction of the forest growth. In this way, the ecosystem flourishes and contributes economically.

Ecologically, the key is to consistently harvest lightly and carefully. Economically, the key is to manage land with little or no debt. Forest income is then based on biological factors, not financial demands.

Redwood Stand Before The First Thinning: *40 years after industrial logging, the "cathedral ceiling" has become an impenetrable maze of branches from the canopy to the ground. Branches must be pushed aside to walk or even see beyond a few feet.*

Redwood Stand After The First Thinning: *The young forest is structurally transformed. Thinning and pruning begins to recreate the expansive understory of the old forest. Over the coming decades, some of the pictured trees will be thinned to add growing room for the best formed and most vigorous trees.*

10 The Institute for Sustainable Forestry Pacific Certified Ecological Forest Products, Forester and Landowner Handbook, pg. 6, Redway, CA 1996

WHAT YOU CAN DO

Restoration forestry exists worldwide; unfortunately, its adoption and impact are minimal compared to industry and government practices. If you share the old-growth again vision, here are four possible avenues for your to get involved:

1. **If you own forestland, attach a "restoration forestry" conservation easement.** This enables you to retain ownership and use while restoring and protecting the land in perpetuity. Conservation easements are tailored to the property owner's wishes and outline how the forest can be used. They legally protect the land's biological diversity by allowing the forest's beauty and majesty to increase, decade by decade. Placing a conservation easement on forestland often results in a federal income tax deduction, estate tax relief, and/or annual property tax relief. The easement also ensures that the recreational value of the property grows as the forest matures into an older ecosystem. In time, you and your children will be financially rewarded when the restored forest begins to yield timber harvested with restoration forestry practices. If the land is in Sonoma County or Mendocino County, Forever Redwood can be contracted to coordinate the easement process and/or to manage the long-term forest restoration. For more information, call us at 866-332-2403 or email us at info@foreverredwood.com. Appendix D contains more details about establishing a conservation easement and includes a sample conservation easement agreement.

2. **Learn our restoration forestry methodology and do it yourself.** Forever Redwood accepts a few committed, responsible individuals to participate in a series of 4 day workshops over the course of one year. If you are accepted to the program, you will receive training on all the major aspects of "hands-on" restoration forestry, which you can then apply elsewhere. We don't charge for this, but applicants should be serious so as not to waste our time. If interested, email info@foreverredwood.com with a brief summary of yourself and your background. Also include a description of how and/or where you plan to apply this knowledge.

3. **Become a neighbor.** In the area where we've focused our efforts, forestland is usually available for purchase. Almost all parcels have been logged and are ripe for restoration. Tax breaks are available for investing in forest restoration. Zoning usually allows for two residences per parcel. Parcel size ranges from 2 acres to 640 acres. Roads are usually gravel and electricity is only available in some areas. Solar power and cellular phones are the norm. Water is plentiful via springs, wells, rain collection, and streams. Property taxes in California are generally fixed at 1% of the property's purchase price. Property taxes increase only when new structures are built via the county's building permit process. Property taxes are often decreased when conservation easements are attached to the deed. Forever Redwood maintains a list of available properties.

4. **Own part of a Forever Redwood Project.** If direct ownership is too complicated or liability issues are a concern, co-ownership is another option. For example, you can own shares in a corporation that holds title to the land. This limits liability and eliminates land management duties. Some of the forestland managed by Forever Redwood is co-owned in corporations or in trusts, while other parcels are owned by two or three individuals in partnerships.

   Forever Redwood has grown through hard work and relationships with like-minded friends. The most difficult work is the gradual reduction of the hardwood volume and the slash cutting, soil preparation, and planting needed for the conifers to become dominant again. The hardwoods are cut and removed and most is sold for firewood. Firewood is a difficult business in which to make a profit. But it lowers restoration costs and thus contributes to the bottom line. Our investors-partners have invested over $5,000,000 to date.

   If you would like to be a partner in this vision, please contact us at info@foreverredwood.com. Tax breaks are available for restoration forestry investments. Besides doing your part to restore forestland, the tax benefits and land value appreciation, make forest restoration a handsome financial investment long-term.

Restoration takes time and money. Over the years, we have secured funding from NGO's, government, like-minded individuals and businesses. But the bulk of our operations are supported by the furniture and shade structure business of Forever Redwood.

Forever Redwood is action-oriented. We don't write letters to members of congress or launch petition drives. We are hard-working, tree-hugging business people. We buy forestland, restore it, and practice excellent stewardship. In our experience, talking doesn't get the job done. We prefer to get involved directly and "walk the talk."

A robust community of support is needed. **Please consider this your personal invitation.** There is an endless amount of work to do. Consider showing up and making it happen. Invest funds to restore and protect your own piece of the planet. Revitalize forestland and wildlife habitat, while generating a small profit down the road. If you're so inclined, learn the work and get dirty in the woods in your free time.

Investing the time and money in restoration forestry pays off because forest volume increases as does the quality of the trees. A conservative amount of this growing timber volume is carefully harvested at an ever-increasing premium. At the same time, the overall timber volume increases along with the global cooling capacity of the forest.The diversity and beauty of the forestland continually improves.

Restoration forestry is physically demanding. If you or your children would like to work in the woods, the field tasks are tailored to meet individual abilities. Regardless of the weather, a day in the woods is always sweetened by a reinvigorated mind, body and spirit.

The forest's bounty—Shane Sutcliffe with a Pacific Giant salamander in the rain.

Restoration forestry helps reverse global warming. Large trees have many more growing shoots than young trees because they have more layers of branches. Each branch continues to develop growing shoots like an individual tree. Although a 200-foot tree does not have branches near the ground, it generally has over one hundred feet of large branches. Each of these branches collects sun, absorbs carbon, and creates oxygen.

By limiting the rate of harvest to 1% per year, restoration forestry allows young forestlands to regain almost all the volume of an ancient forest over the course of 120 years. By allowing a working forest to return to volumes close to a climax ancient forest, enormous amounts of carbon are sequestered while at the same time maintaining the forest in production. Sustainable forestry, at a rate of harvesting of 2% per year, also sequesters carbon in perpetuity, but at a fraction of the amount per acre of a forest managed at a rate of cut of 1% per year (see forest volume accumulation charts on page 41).

Although mature forests grow at slower rates than young forests, they add volume at a faster rate decade to decade. The young forests under industrial or "certified sustainable" programs like the Forest Stewardship Council and others are cut at rates of 2.0 to 2.5% per year. This limits the accumulation of volume and carbon sequestration to a fraction of the carrying capacity of the forest. Under restoration forestry, the accumulated volume of a mature forest is left uncut and standing to keep the global warming carbon from being released back into the atmosphere.

Our goal is to restore as much of our Redwood watersheds as quickly as nature, finances, and our backs allow. As this project proceeds, we hope it will stand on its own accomplishments as an example and inspiration for others to emulate. Visitors are welcomed.

The standards on the pages that follow are simple to understand. They are "on the ground" practices for "do it yourselfers." These standards are the foundation for a "Global Cooling Standard" for forestry practices. For more information, contact Raul Hernandez at (866) 332-2403, email at raul@foreverredwood.com or write:

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ARTICLES DISCUSSING THE IMPORTANCE OF RESTORATION FORESTRY TO CARBON SEQUESTRATION

The following two articles were published in Mother Earth News in 2016. They discuss the specific importance of restoring California's Redwood forest in the fight against climate change. Redwoods have the most capacity of any forest on earth to sequester carbon. Wood is mostly carbon and water. The largest trees in the world are the California Redwoods. Restoring the forest to its pre-logging volumes will go a long way towards reversing the worst effects of climate change in this century.

FORESTRY, GLOBAL WARMING, AND THE MULTI-BILLION-DOLLAR CARBON-CREDIT GRAB
By Raul Hernandez, Published 7/9/2016

In November, almost all the countries of the world agreed to what seems like an ambitious plan — to slow the global warming juggernaut. I have been practicing forestry for more than 20 years, and it is clear to me that a critical piece of the global-cooling equation is not being addressed and will not be addressed unless the public is educated.

Global Warming, Then and Now

Al Gore's film in 2006 rang the alarm bells loudest about the threat. In February, he updated his message with a 20-minute Ted Talk that covered the same scary ground but ended on a positive note.

Mr. Gore highlighted the exponential growth of solar and wind energy and how they are now close to matching traditional energy sources in cost. He believes the continuing drop in cost will accelerate the conversion away from fossil fuels and be a major part of the solution.

Mr. Gore focuses on human technology and does not address the two largest natural carbon sink technologies: the oceans and forests. Wood is mostly compromised of carbon, and forests are enormous reservoirs of carbon. They are the original global-cooling technology and can have a huge impact in terms of carbon sequestration if managed differently.

How Did We Get Here?

A comprehensive UN report published in 2000 (Global Forest Resource Assessment, page 14) on the state of the earth's forests breaks down the amount of forest cover the earth had before the ascent of mankind beginning 8,000 years ago. The report concludes that 50% of the land mass was forested then and that it had diminished to 30% by 2000 (40% decline).

At face value, you can conclude that earth today retains 60% of the original forest cover and you would be partially correct.

Yes, we still have 30% of the land mass of the earth forested, but, more importantly, the great majority of the remaining forestlands have a lot less wood volume per acre (think carbon).

Tall forest of sequoias in Yosemite National Park. Photo by Stephen Moehle

Most forests are working forests. They are cut regularly for lumber production and other uses. Only 12.7% of the earth's forests are protected (Global Forest Resource Assessment 2000, executive summary page xxv).

The majority, the remaining 87.3%, is maintained in a state of relatively fast growth and low volume for maximum wood production.

Although we still have magnificent expanses of protected or uncut forestlands worldwide, most of the earth's forests are young forests that average a small fraction of the volume they could have or that they had prior to the ascent of man. For example, in our local Redwood forest region, the working forests amount to nearly 80% of the acreage and have on average less than 25% of their original stand volumes. This is not atypical worldwide.

You can quibble with the numbers a bit, but the conclusion is the same: the largest natural technology at our disposal to quickly sequester enormous amounts of carbon has given up most of its carbon reserves and there is no plan to truly reverse this.

Setting sun in the redwood forest.
Photo by Open Heart Designs

Efficient Global-Cooling Technology

Today, an opportunity exists to accelerate forest sequestration because of the billions of dollars in carbon credits being developed. As these credits are defined, a central theme is being ignored.

The credits are not focused on permanent volume and inventory growth per acre of trees but rather on agreements to protect the forests from further degradation. Minor improvements in habitat, riparian issues and other forestry concerns are often part of the mix, but the primary issue of significantly increasing the volume of standing wood is largely ignored.

I manage forestland in Northern California's Redwood forest. In terms of scale, our company is a guppy in the forest industry surrounded by big fish that own tens and hundreds of thousands of acres around us.

We are not alone in the restoration game, and what can be practiced on hundreds of acres can be practiced on millions. If a huge carrot is carefully crafted, most forestland owners will convert to a more conservative approach, because it is in their interest to do so.

Since 1994, our company, Forever Redwood, has continued to harvest a conservative amount of lumber from our lands while allowing the forest to increase in volume decade by decade. We specialize in custom made pavilions and pergola kits as well as a wide range of patio furniture.

Beyond harvesting Redwood and crafting furniture, we also do soil-building work, thinning of the stand for species composition, and overall tree quality improvement. But, the most important point in our restoration efforts is to permanently limit the rate of cut below 20% in any 15-year period.

Wood Volume = Amount of Carbon Sequestered

When we began managing our heavily cut-over lands, the volume per acre was under 7,000 board feet (bf), on average. Today, despite at least one harvest on all our parcels, the average volume per acre doubled to 14,000 board feet per acre and will again double to 28,000 bf per acre before the year 2050.

Most foresters will tell you that if you limit the rate of cut and do some stand improvement work, you can accomplish dramatic volume increases and improvements in overall tree quality for almost any natural forest stand anywhere.

At Forever Redwood, we use the limited amount of wood harvested to make a value-added line of products that pays for the forestry work. Our model works, but for industrial-scale forestlands, this is not viable. They are in a commodity business where they sell logs or lumber at thin margins and must cut substantial volume to survive.

The enormous carbon credit market being formed is an opportunity to change this industrial model permanently.

Logs harvested from Sanctuary Forest.
Photo by Forever Redwood

If the carbon credits are tied to pledges that significantly increase and maintain much greater standing timber volumes, then quick progress will be made to sequester carbon on an enormous scale as a major part of the global warming solution.

As the example of our small holdings show, it took us 22 years to double volume and another 35 years to double it again. And, while these figures will vary according to local conditions, the basic principle applies worldwide.

To do this does not require a preservationist plan where the forests are left alone. On the contrary, forests that have already been cut in most cases should continue to be worked to produce employment, improve stand quality and good-quality lumber in perpetuity.

The key is to tie carbon credits almost exclusively to verifiable and retained volume increases and to limit or eliminate credits for projects that do not.

The Carbon Credit Market is Throwing Away Billions

The carbon-credit market is not being developed to double or triple the amount of carbon sequestered in coming decades. Instead, only relatively small volume increases are being agreed to and the focus is on secondary, beneficial projects that avoid the main point that needs to be addressed.

The credits are developed in conversation with or by industry. It is a short-term financial sacrifice to leave the wood in the forests. Most forest interests will not do so unless they cannot access the huge carbon credit market without it.

It is a dream to think most forestland owners will craft carbon credit programs that insist a portion of future harvests be left in the woods by scaling back the rate of cut. Yet, from our experience, doing so increases the quality of the wood harvested (and its market value) and eventually results in higher revenues.

But, it takes a few decades to accomplish this. The carbon credits should be used partially to help bridge that difficult financial gap.

If used as an incentive to lower the rate of cut, forestland owners can still make money and make huge contributions to global cooling during the transition to higher-quality, lower-volume forestry. But, they will not do this on their own.

Increased Public Understanding is Needed

Do not be fooled by secondary issues. Wood is carbon.

Carbon volumes sequestered in the woods need to multiply to significantly contribute to global cooling. Without this, the carbon credit market is mostly wasted as a tool for significant global cooling.

Delve into the carbon credit debate. You will only see tangential references to volume. No commitments to permanent, huge-volume increases. The main point is being obfuscated and set aside and this not by accident.

We have the technology. It was developed hundreds of millions of years ago: Photosynthesis. Carbon credits tied to volume increases maintained in perpetuity is a win-win for all. Huge fines need to be part of the equation for those that violate the agreements. Billions of dollars are on the table and the minor issue of global cooling is also.

Once the credit market matures and is commodified, the game is set and will not be altered. This opportunity is likely to not come again, but the bright side is that we still have time to save our forests.

The harvester working in a forest. Photo by Kletr

NEVERMIND THE POLITICS, FORESTS CAN HELP COOL THE PLANET

By Raul Hernandez, Published 8/26/2016

I have received many informed, some not so informed, but some real heartfelt responses to my first blog post for MOTHER EARTH NEWS: Forestry, Global Warming, and the Multi-Billion-Dollar CarbonCredit Grab.

Forestry and global warming are complex and emotional issues. In this follow-up article, I'd like to focus on the forests themselves and how they can contribute if forest management practices can be adjusted through the incentives in the multi-billion dollar carbon credit programs being formed.

I've seen too many politically motivated reports from all spectrums of the debate claiming that the kind of forestry I've described and advocate — called "Restoration Forestry" — is irrelevant or cannot be done because of much supposed science.

But, I stand behind the main points in the article. Let me discuss several issues that were not fully mentioned in my prior blog post.

The Pacific Northwest is the Key

First, I reviewed an alarming report showing that significant acreage of boreal and other lower volume forestlands may not contribute as much to the global cooling equation in the coming decades and beyond as prior expectations and studies have shown:

Although the facts are sad and not reversible in the short-term, these relatively low volume per acre forests are not the large forest carbon sinks of the world and their distress is not a strong argument to discount what greater forests can contribute.

The studies also do not take into account the tremendous capacity that exists to multiply the carbon held by the more carbon-dense forests if an economic incentive is set to do so.

The number one carbon sink on the planet, measured by capacity per acre to retain carbon, is located on the west coast of the United States and Canada. The same North American forest report mentions that these forests may actually contribute more than prior reports suggested. And, this note does not take into account the incentives that can multiply this contribution.

Considering this, the headline must be adjusted to say that the marginal forests in all probability will make a smaller contribution to the solution but the more important forests may actually make a much greater one.

The Redwood, Cedar, and Douglas-Fir forests of the Pacific Northwest have a capacity to retain carbon (think board feet per acre) that is wildly greater than the boreal forests mentioned in the article or the still expansive rainforests of South America and Africa. The average stand in the Pacific Northwest has a carbon carrying capacity that is a factor of 5 to 7 times greater than the Amazonian rainforest or the typical boreal forest. They are not in the same league. The trees can grow to enormous height and girth like nowhere else on earth if allowed to do so.

No other forest in the world can retain anywhere near as much carbon per acre as the forests that stretch from Big Sur in California into British Columbia. It is THE forest carbon sink of the earth. However, it is not alone. Some other forests have the capacity to contribute significantly per acre also.

For example, the Alerce Forests in Chile and others. But, the Redwoods, Cedar and Douglas-fir forests of Northern California and Oregon that stretch north to Alaska are the kings of carbon per acre sequestration capacity on the planet hands down. No other forest comes close.

While the forests of the tropics are the biodiversity fountains of the world, the Pacific Northwest, on its own — if managed to multiply standing timber volumes on all the working forests of the area — will contribute enormously to carbon sequestration. Receiving news that more marginal stands are being slowed and in some cases killed off by the effects of changing climate is a sad and alarming consequence of the issue at hand.

But, there is no reason to neglect the help that the large carbon-sequestering forests of the world can and should contribute if managed differently using the carbon credits being developed.

The great majority of the forests in the Pacific Northwest are managed for timber production, either privately or by government. The U.S. Forest Service under option 9 in 1994, significantly reduced the rate of cut on most of the Pacific Northwest lands under their management.

The public lands have been adding volume consistently since then. Problems of fire danger still exist from a lack of thinning these relatively young stands in recent decades, which should be addressed, but the overall curve in terms of carbon sequestration on public lands is positive.

Where dramatic improvements can still be made is with the privately owned lands or the lands owned by the crown and other public agencies in Canada that are being more aggressively managed. Their stands are more depleted in general and have levels of standing trees volume per acre that is many times below the forest's natural capacity.

Triple the Volume of Sequestered Carbon in Working Forests in a Century

Second, the bottom line is that we can at least triple the carbon removed from the atmosphere and held in the form of trees just in the Pacific Northwest over the next 100 years if we choose to. This alone will make a huge contribution in the global cooling equation despite losing growth rates in the less carbon dense stands. This can be done while still managing these lands for timber production and healthy employment.

I agree that the climate situation is going to deteriorate significantly in the short term. I also agree with the critics who say that offsetting and other carbon trading schemes are partial or inadequate solutions. But, the politics is beyond the scope of what I'm addressing in these posts. Let's establish the baseline reality first, then deal with the politics.

The public in general is not aware that the forests of the world today hold a small fraction of the carbon they once held. The studies to quantify this are numerous and our prior blog post mentioned some of the main statistics. The working forests of the world represent the bulk of the earth's forest. Most of them are well below 30% of their carrying capacity. Some are below 10%.

Yet the carbon credits are being defined now and the market is huge. Whether we like it or not, this is going to happen. Big money is lined up for this and so are the politics and international agreements. What is not lined up is the will to tie these carbon credits to substantial permanent carbon sequestration, which can best happen by targeting the major forests of the Pacific Northwest. This area represents our biggest leverage point, a golden opportunity for maximum global cooling results.

On average, the great majority of the forestland of the planet can be at least tripled in terms of volume in less than a century. There is a large percentage of overcut and severely understocked forestlands that can be substantially restored to mature trees. All is needed is an incentive to do so.

Trees are mostly carbon. Multiplying standing inventories as a primary goal for granting carbon credits will encourage private landowners to do the right thing for climate and their pocketbooks. But, if they don't have to, they won't. The forest products industry and politicians are writing these rules. If the public does not demand significant and permanent sequestration, only minor improvements will occur and the main point will be obfuscated for short-term economic gain.

We can go on endless tangents about how larger forest inventories will be purchased by polluters to keep up the status quo, etc. But, let's keep our eye on the ball. Those of us that know this basic reality need to raise our voices and let everyone know. If the public is aware that the great carbon sinks of the world are mostly not being utilized and that no plan exists to change this in any dramatic form, the debate may finally change.

The typical stand in the working forests of northern California, for example, has on average less than 10,000 board feet to the acre today when most averaged well over 40,000 prior to being cut. The most productive acreage in the area holds hundreds of thousands of board feet per acre still today in parks. There is room to grow dramatically.

The lands we manage have doubled their volume in 22 years and will double again in the coming decades despite several conservative and careful timber harvests. They are average quality Redwood and Douglas-Fir stands in the southern end of the Pacific Northwest forest. If we can achieve a 4 fold increase in less than 60 years, a 3 fold increase in less than 100 years forestwide is a reasonable goal that will also protect and create additional jobs in the industry.

I have received straight faced responses that say that collecting and permanently storing enormous quantities of carbon permanently will make no difference because of trade offs with huge polluters, etc. Yes, if the sequestered carbon is used to allow huge polluting interests to buy offsets, it is a wash, but this consideration cannot be a zero sum game.

The science says we must lower the amount of carbon in the atmosphere substantially, not just get to no net more carbon added to the atmosphere. If the goal then is to quickly stop the accumulation and begin to lower the amount, the forests are key to making this happen. They are willing and able now. They can triple their contribution in less than a century if we go about this in a constructive manner.

Give the forestland owners the incentives in the carbon market for volume increases. The more volume increases, the more carbon credit dollars. The increases must be permanent. You just need to lower the rate of cut permanently. Less wood quantity will be harvested, but better quality. The credits will bridge the gap financially in the first few decades until the forests are transformed from low volume stands that produce quantities of low quality lumber to high volume forests that will produce ever higher quality lumber at a premium.

Get involved. If you are in the industry and understand this to be true, please spread the word. Insist on huge and permanent standing inventory increases as a requirement for the carbon credits and no substitutes or half measures. It is the proven technology and like a factory sitting mostly unused, we have huge manufacturing capacity sitting idle. The forests can sequester a lot more carbon if we let them and in and of itself, this is a big step in the right direction. Stay informed and spread this news!

Degrading Industrial Forestry In Our Backyard: These 1998 clearcuts are in the Fuller Creek watershed next to Forever Redwood's lands. Other adjacent clearcuts were completed in 1999. The cuts are California Department of Forestry (CDF) approved to remove the dominant hardwoods in an effort to re-establish the conifer canopy. Once cut, the site was burned and partially re-planted. To help the conifers compete with the fast-growing hardwoods, several broadleaf herbicides were used. In contrast, Forever Redwood restores degraded, hardwood-dominated stands without clearcutting, brush burning, or the use of chemicals.

For Our Children's Children...

I know of no more encouraging fact than the unquestionable ability of man to elevate his life by a conscious endeavor... If one advances confidently in the direction of his dreams, and endeavors to live the life he has imagined, he will meet with a success unexpected in common hours.
—Henry David Thoreau

There are 3 types of individuals; those who see, those who see when shown, those who do not see.
—Leonardo da Vinci

II: ECOLOGY

IN-THE-FIELD RESTORATION NOTES

"You don't have to know the names of plants or animals to have a mystical experience in nature."
—Phil Arnot, Wilderness Guide

These notes introduce the ideas we keep in mind while working in the woods. Although written for our Redwood/mixed conifer restoration, most of the issues discussed are relevant to other forest types. For a complete treatment of these subjects, see the footnotes and additional reading section.

LOWERING FIRE RISK

Each year in the United States, millions of acres of forestland are destroyed by wildfires. A large percentage of these losses can be avoided. The main reasons forests are lost is human alteration of the forest structure and the accompanying fire suppression policy:

> *To understand the present day forest, we must look back to pre-white settlement time. The forests were continuously shaped by disturbance regimes, most notably fires, storms, and insect outbreaks. Fire has probably had the largest role in determining and maintaining forest composition and structure here. Native Americans used sophisticated burning techniques in the region for thousands of years. Lightning also started many fires. These frequent fires were mainly gentle ground fires that killed young seedlings and kept ground fuels from building up to dangerous levels. The forests were open and parklike with widely spaced trees. Many early settlers reported the ability to easily ride horseback crosscountry through forested areas. Meadow areas were also much more extensive, as can be easily seen by examining forest age structure. Severe fires were rare.*
>
> *It is important to have this image of how the forest looked when considering what to do about the problems facing us today. Not only do we have to deal with the fact that virtually all of the region's old-growth Redwood and Douglas-Fir were cut during the last 50 years, but we also need to consider that the natural stand-shaping fire regime has been replaced by a policy of fire suppression that has traded frequent, low-intensity ground fires for infrequent, devastating stand-replacing fires. Lack of understanding of this second point has led to much confusion. Corporate forestry has ignored the increased fire danger being created by its even-aged clear-cut plantations. On the other hand, many landowners and environmentalists have the idea that it's best to leave cutover-forested areas alone to "heal themselves." While laudable in intent, this strategy does not deal with continuing changes in forest structure and composition caused by the exclusion of the natural fire regime. The large acreage burned each year in catastrophic wildfires is a reflection of this fire suppression policy. But we face a very serious dilemma. Reintroduction of fire in its traditional role is largely not possible because of the extreme fuel buildup and also because it is not socially acceptable. A fire hazard reduction strategy that mimics the effects of mild ground fires by pruning lower branches and thinning [should be implemented]. Eventually, prescribed burns can be carried out.*[1]
>
> *—Bill Eastwood, The Institute for Sustainable Forestry*

Logged forests are vulnerable to stand-destroying fires. The conditions are ripe because "slash" from logging is highly flammable and the small fragmented canopy can not retain moisture or stop the wind from blowing through the forest. Crowded young trees grow slowly and their thin bark does not resist fire. Also, small trees and low branches create a fire ladder that helps ground fires reach and destroy the canopy.

If the logged forest is left to recover untouched and the stand survives fire, it eventually will thin itself somewhat. But structural problems will linger for hundreds of years. The forest will tend to have overcrowded, relatively thin trees and more low-quality trees. Without active restoration, gullies and other erosion problems will persist, slowing the rebuilding of the soil. The canopy will include more hardwoods; a step backward in the evolution of the coniferous forest. The lower hardwood canopy will create a less stable understory microclimate that is drier and hotter during the summer's fire season.

The best protection against stand-destroying forest fires is a predominantly mature or old-growth forest that is regularly thinned and/or managed with a prescribed burn. The lower fire hazard is a natural part of a mature forest. For example, the tall canopy limits the amount of branches that grow near the ground, which makes it difficult for ground fires to climb limbs and burn the canopy. The thick bark of healthy, big trees protects them from most intense fires. And the enclosed understory is moist and limits air movement, which keeps fires from heating up to dangerous levels.

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1 Eastwood, Bill Forestree News pg. 4, The Institute for Sustainable Forestry, Redway, CA 1994

Moving the stand in stages toward the form it held prior to logging lowers the risk of a stand-destroying fire. The first step is to thin and prune. Thinning eliminates many dead, overcrowded, deformed, and flammable trees. It also gives the remaining trees growing room to add bark thickness and height in less time. For example, we often find crowded, 25-year-old fir trees that are only five feet tall. With less competition for water and sunlight, dominant 25-year-old firs can exceed 50 feet.

By initially pruning the lower branches of most remaining trees to at least 10 feet (but not more than one-third of the way up the tree), the “fuel” that helps ground fires climb the canopy is reduced. An important final step is to thoroughly cut up the downed tree’s "slash" to below one foot above the soil. This provides a structural web to the soil that fights erosion. It also accelerates decomposition, which further reduces the slash fire risk.

Some stands may benefit from a prescribed burn. After a few rounds of thinning, pruning, and slash cutting, the stand is ready for a prescribed burn. A carefully supervised burn imitates a ground fire, consumes the fuel otherwise available for a “hot,” devastating fire, and releases nutrients for plant growth. Thinning achieves many of the results of a prescribed burn and is often preferable.

Redwoods have genetic protection against fire. *After a 10-acre fire, most trees were "salvage logged." Among the burned trees left standing, many Redwoods resprouted branches and tops. No other tree species that died in the fire came back. A fire’s intensity determines how many Redwoods can grow new limbs. In the two photos, five Redwoods are growing new branches and two are also growing new tops. The burnt branches will eventually fall off and the fire scars on the trunks will shrink over time as the tree grows. Most Redwoods that cannot grow new limbs sprout new trees from their roots within months to regenerate from the ground up.*

PRUNING NOTES

Pruning the lower branches of most trees opens up the forest. It begins to re-create the expansiveness of the ancient forest for better wildlife habitat and human enjoyment. When pruning, cut as close to the bark as possible. Do not leave stubs. Stubs devalue eventual lumber (knots) and flush pruning allows the bark to grow over and heal the cut in a couple of growing seasons. Machetes may be good for slash cutting, but if used for pruning, they often scar the thin bark of young conifers because it is difficult to make consistently clean branch cuts. Large pruning shears are the preferred tool up to 10 feet above the ground. The power and manual pole saws can trim up to 20 feet above the ground.

When pruning live branches with a pole or handsaw, make an initial cut under the branch so its weight will not tear the bark when falling. The exception to flush pruning is the swollen collar of larger branches (fir, pine and tanoak). This collar protects the tree against disease and should not be pruned. Depending on how much time and energy you have, conifers can safely be pruned to one-third of their height. Large pine and fir branches are best pruned in fall and winter when the sap is not running to avoid bleeding trees. Redwood branches can be pruned anytime because they are generally thin and do not seem to bleed. Most conifers are pruned unless near large open spaces, like wide roads, where lower branches are left as windbreaks. Some tanoaks are partially pruned to about 8 feet to make human movement in the woods easier. Otherwise they are not pruned because they tend to grow thick, fire-resistant branches. Tanoaks selected for future lumber can be pruned of small branches as high as is practical.

MANAGEMENT OF TANOAK RESPROUTS

Vigorous tanoak re-sprouting will occur when the canopy is opened up after logging. all bushes of dozens of competing stems usually form within a couple years. These bushes use the old tree's existing root system to compete aggressively for water and nutrients with surrounding trees. This is why industrial foresters commonly use herbicides to give conifers a competitive edge.

Forever Redwood does not use chemical fertilizers, insecticides, fungicides, or herbicides regardless of application method or dosage. Although the effects these substances have on the soil structure or the water table are constantly argued over, we take a conservative approach. When we thin an area, we leave the canopy mostly intact. By not opening up the canopy, the tanoak re-sprouting is not as vigorous. When an area is thinned again, most tanoak bushes are cut. One or two of the straightest, most vigorous stems are left untouched. We let the brush develop for the same reasons of economy and ecology already mentioned—the brush slows the growth of surrounding conifers (economic loss), but provides food and cover for wildlife and keeps chemicals from the soil (ecological gain). As the canopy grows taller and thicker, it will slow future tanoak growth and encourage more shade tolerant species like Redwood.

PROTECTING AND BUILDING THE SOIL

Forest topsoil is a symbiotic web of thousands of living organisms. For example, at least 25 different species of fungi/mycorrhizal mushrooms help the roots of the Douglas fir tree assimilate minerals and exchange nutrients with other trees. In 1816, the well-known German forester Heinrich Cotta wrote in Advice on Silviculture:

> *Formerly we had no forestry science and enough wood... Germany contained immense, perfect, most fertile forests. But the large forests have become small; the fertile have become sterile. Each generation of man has seen a smaller generation of wood. Here and there we admire still the giant oaks and firs, which grew up without any care, while we are perfectly persuaded that we shall never in the same places be able, with any art or care, to reproduce similar trees.*
>
> *The grandsons of those giant trees show the signs of threatening death before they have attained one-quarter of the volume which the old ones contained, and no art nor science can produce on the forest soil which has become less fertile, such forests as are here and there still being cut down... Without utilization, the forest soil improves constantly; if used in an orderly manner it remains in a natural equilibrium, if used faultily it becomes poorer. The good forester takes the highest yield from the forest without deteriorating the soil; the poor one neither obtains this yield nor preserves the fertility of the soil.*

ROADS AND THE SOIL

The soil does not have to erode or be damaged because humans work in the woods. For example, logging roads can be redesigned for small equipment and to create more growing room for trees. Most skid roads that Forever Redwood has reopened are one-way and are kept to less than 10-feet wide. Road lengths can also be kept short to limit the loss of soil.

For example, we coordinate skid road reconstruction with neighboring parcels to avoid unnecessarily reopening roads. To minimize erosion in previously logged steep lands, only the most stable roads are reopened. On steep hillsides, some of the old roads can be rerouted along stable soils and generally kept to a grade of less than 10%. In most areas, the contour of a forest road can be slightly outsloped with rolling dips to facilitate water drainage. Large culverts, bridges and rocked fords can be over-engineered to minimize erosion. Where in-board ditches are necessary, they can be drained at short distances to limit water build up during storms. Stream crossings and road reopenings in creek areas are kept to a minimum. Since the new roads are narrower than the original ones, young trees are kept and/or planted on the edges of the old road bed to protect against sliding and erosion. (For a thorough treatment on forest and range roads, write the Mendocino County Conservation District for their Forest and Ranch Roads Handbook, 405 Orchard Avenue, Ukiah, CA 95482.)

Our inherited roads, like most logging roads of the 1950's, were designed to get the timber out cheaply. The big bulldozers were amazing new tools that could go almost anywhere and do almost anything. The result was lots of bulldozing with little understanding of the consequences. The bulldozed lands are in varying stages of recovery. The steeper hillsides are the most damaged. **Road building on steep terrain created many gullies and landslides.** The landslides are often difficult and expensive to stabilize. Some landslides have reached bedrock or an angle of repose over the past 40 years and do not have significant amounts of new sediment to deliver to the streams. Other landslides can use immediate attention.

While some slides require heavy machinery and lots of capital to stabilize, others can be slowed or stopped by taking a few low-cost steps. For example, to slow erosion in the short-term, we reroute and/or dissipate the water flowing into the slide. Some landslides can then be stabilized by securing the base (toe) with boulders, logs from thinnings, or other large slash (thinned branches). To slow surface erosion above the base of the slide, we add hay and small thinning slash to the bare soil areas and around the top edges of the slide. To help root some of the soil in place, we spread organic fertilizers and seed using native variety seeds and/or mixes of rye, clover, and fescue with some wildflowers. Once an organic layer is established, pines, firs or any other shade-intolerant seedlings are planted to speed up natural regeneration. Seeding and planting has better results early in the rainy season (December to February). When planting, our first choice is to use seedlings from nearby trees. Nursery stock, even if the same species, can have uneven results because the tree's genetics are often adapted to a different latitude, altitude and/or microclimate.

Many of our ridge skid trails were bulldozed down the hillsides in the 1950's. They are recovering very slowly. They have compacted, dry, poor quality soil with small and sparse trees. The only "cure" for compacted soil is to dig it up and turn it. This "cure" is not practical once a stand exists because it kills or injures many trees. To build and restore the soil on these trails, carry slash from nearby thinning and pruning work, spread it over the bare soil areas (mulching) and let time do the rest. The slash will help hold the soil in place. As the slash decomposes, it adds needed nutrients and structure also.

The skid trails that were carved parallel to the contour of the land are in better shape. Over time, they have accumulated leaf litter from the surrounding forest creating a growing medium atop the compacted soil. These trails are now mostly overstocked with 10-to-20 year-old Douglas-firs with some sugar pines, Redwoods and hardwoods. Soil building on these semi-level skid trails is mostly about thinning and mulching the firs.

THINNING AND THE SOIL

Restoration forestry is labor-intensive. Heavy equipment is used cautiously and only where light equipment or labor can't do the job. Many of our skid trails have been permanently closed to machinery to let the soil rebuild itself. Chainsaws, power pole saws, pruning shears, hand saws and machetes are the thinning, pruning and slash cutting tools of choice.

When thinning conifers, give preference to vigorous, disease-free, undamaged dominant and co-dominant trees and remove many of the smaller competitors growing under their crowns. Step back and look at the entire tree to make certain that it's the right tree to keep. Check for animal and bird nests before cutting. Look for visible signs of disease or insect damage. The trunk may be rotten, crooked or forked or its top may have snapped off in a recent storm. Sometimes a tall conifer has a thinner crown and is less vigorous than its smaller neighbor you were about to cut.

Take your time and be alert when working in the woods. Mistakes and accidents occur mostly from not taking a relaxed approach. Once a tree is selected, bring it down so that its fall will cause the least amount of damage to surrounding trees. For example, when cutting big trees, sometimes it makes sense to climb and remove the large branches first. A falling ***trunk*** causes much less damage to nearby trees than a tall tree with large branches.

After felling, remove the tree's branches (limbing) and cut up the tree trunk into useable lengths (bucking). Because most trees being cut are young, the logs are often moved by hand. If it is a firewood tree, we cut it to lengths that one person can manually roll downhill to the nearest skid road. If a lumber tree, depending on its size and the terrain, it is cut in lengths suitable for the mill (from 6 to 16 feet plus 6 inches for trim). Small logs up to 15 inches diameter and 12 feet long are pulled out with a light 6-wheel drive rubber-tire ATV with a balancing arch to minimize dragging. For larger logs, we use a small bulldozer. Some "sensitive"

and/or steep areas are not harvested or thinned, while other steep areas are lightly harvested by “long-line” cable to limit soil compaction and movement. When the terrain is difficult, sometimes the best option is to take a portable mill to the log. The Lucas brand of mills can be assembled almost anywhere you can walk to.

While cutting up a downed tree, it is a common mistake to also cut small conifers that may have been tangled in it. To avoid hurting the young trees, first cut the downed tree’s branches around any tangled young trees and spread the slash. Once the young tree is released and clearly visible, return to cutting up the entire downed tree. Cut the slash so that it lies no more than one foot above the ground. Slash in contact with the soil decomposes faster. We also do not remove or burn the branches or leaves of fallen trees because many of the usable soil nutrients from a fallen tree are found in its branches and leaves. By chewing up the branches, we help create rich, textured soil compost. Before moving on, we clear debris around the stump and cut it close to the ground to eliminate the “stumpsville” look.

Some trunks over 18 inches diameter are left in the woods in long lengths for wildlife habitat and to protect the soil from erosion. The trunks are cut as long as possible and are either left as they drop or, in some cases, laid parallel to the contour of the land (perpendicular to the flow of water). They are held in place by old stumps, large rocks, the base of snags or living, low-vigor trees. The logs house wildlife and help with walking on steep slopes. They also hold soil in place and enrich it as they decompose. The larger the logs (both in terms of diameter and length), the greater the habitat value. When harvesting valuable redwood timber, it is financially difficult to choose to place high-quality logs as erosion aids and habitat. Redwood logs that are difficult to remove or that have visible defects can be left for this purpose. Also, the logs of less valuable species (pine, fir, hardwoods) can also contribute to habitat and the soil.

Many of the tanoak logs are hauled out and dried for firewood. In some areas, to limit soil movement while removing the firewood, we use 20-foot sections of 15-inch diameter plastic culverts that are sliced in half and placed on the forest floor. Firewood logs up to 15-inches in diameter are de-limbed, cut to manageable lengths and slid on the culvert “slides” down to the next skid trail.

If done only for economic reasons, thinning removes snags, hardwoods and small trees to make room for valuable conifers. The goal becomes to create enough space between the crowns of the dominant conifers to maximize their growth rate for a future harvest. Most other trees are cut to limit competition.

Tanoak-dominated stands: Before and after first thinning: The “before” photo shows a tanoak-dominated stand 30 years after logging. The tanoak’s dense understory and canopy suppresses the young conifers struggling in their shade. The “after” photo shows a similar stand after the first thinning and pruning. Removing some tanoaks gives the young conifers growing room. This helps the forest take a step towards re-establishing its ancient conifer-dominated canopy. If there are not enough healthy conifers growing under the tanoaks, we clear brush and plant. This process is repeated after each thinning as necessary.

In contrast, Forever Redwood thins to increase diversity in the stand. We lower tree crowding only enough to maintain healthy growth until the next thinning while restoring the forest's species and age composition. If overly thinned, fast growing trees produce average quality lumber. We prefer to keep competition in the stand and grow denser, higher-quality wood. Because our lands have a moderate to steep slope, this conservative practice keeps the canopy as closed as possible to protect the soil. While thinning, we also retain or create snags for wildlife. Since all the pieces are interconnected, restoring the original tree age and species balance helps the soil structure return to a high level of fertility.

Thinning on unstable or understocked steep areas (over a 70% grade) can be counterproductive. Even when a full canopy exists, walking on steep slopes requires vigilance to avoid soil movement. Crumbling sections of steep skid trails should also be avoided, but if the trail is the only entrance to an area, building small log bridges can limit sliding.

WILDLIFE HABITAT AND THE AGE DISTRIBUTION OF THE TREES

Forever Redwood thins and plants to help the forest become an all-age stand with trees in each 20-year age group. In the 1950s and 60s, at least 10% of our forestlands had their topsoil bulldozed away to build roads, skid trails and log loading sites. In the remaining 90% of the land where the soil was not removed, many saplings were left standing because they had no financial value. They are now up to 60-year-old trees.

Underneath these young trees, many new seedlings and saplings struggle for sunlight. We remove mostly small, deformed, diseased and crowded trees and favor large, well-formed and vigorous trees. We leave more young conifers because they do not take up much space. Natural mortality and subsequent thinning will lower their numbers. Some acreage is left unthinned to maintain thickets for small animal cover. We also leave some irregular-shaped trees, dead and dying trees, and downed wood to support the forest's natural structural diversity.

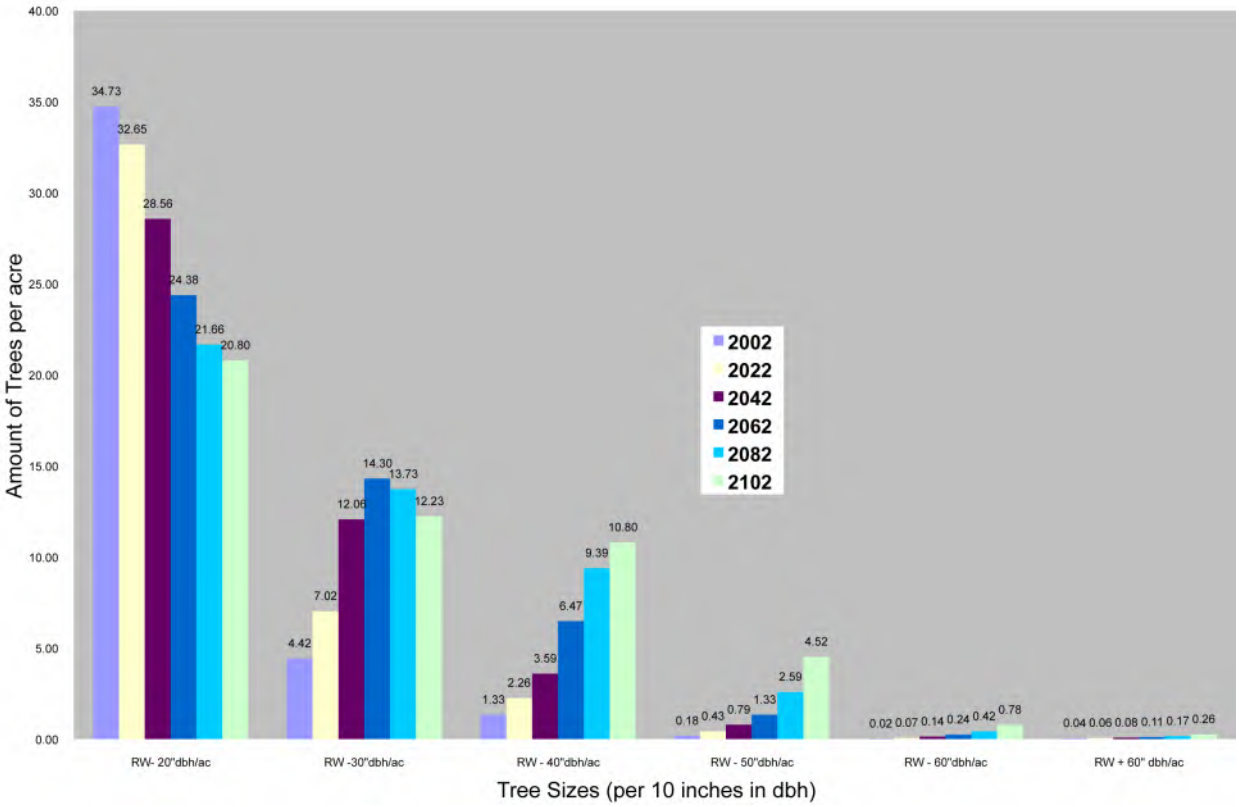
But to move towards a diverse, all-age stand, snags, old deformed trees, and the best saplings and seedlings must also be kept. In some areas, saplings and/or seedlings are the only canopy cover.

Forever Redwood sets aside at least 5 trees per acre to grow to old age and die undisturbed. The goal is to have each acre of the forest eventually be dominated by mature and old-growth trees as it once was. The graph on the next page illustrates the estimated changes over 100 years of the Redwood portion of a 45-acre parcel managed by Forever Redwood. (The graph accounts for redwoods only—if the other tree species were included, the number of trees per acre would increase by approximately 80%.) For example, the number of redwood trees over 30 inches DBH increases from 1.57/acre in 2002 to 11.51/acre in 2102.

Standing dead or dying trees make good wildlife habitat. Unless there is an overabundance, we do not thin them. It is desirable to have several large dead trees (snags) per acre. The snags can stand nearly as long as they took to grow and they are wildlife "condos" that attract insects, birds and mammals. For example, eagles and ospreys prefer to nest in tall broken tree tops or tall cavities of dead or dying large trees. Screech owls like to live in broken-top snags (see photos at the bottom of page 20).

To create a "habitat" tree, girdle it by completely cutting into its bark with an ax or a chainsaw in a 6-inch tall ring around the trunk. This breaks the spongy inner bark layer that supplies nutrients from the leaves. The tree will then slowly die. We choose conifers (mostly firs) for "girdling" that are at least 12-inches DBH and that are broken-top, crowded, deformed and/or diseased. Tanoaks are difficult to girdle successfully, but they have a shorter life span and are relatively plentiful as snags.

45 ACRE STUDY: CHANGES IN TREE SIZE DISTRIBUTION OVER 100 YRS USING POI 1



Color camouflage: These two pictures of the same snag were taken seconds apart. In the close-up photo on the right, a screech owl is barely visible as it sleeps away the day in the brokentop of a Tanoak snag.

"Time is a Great Teacher. Unfortunately, it kills all its students."
—Bumper Sticker

The forest's natural rate of tree mortality is less than 1% annually. When mature or old-growth trees die and/or fall, many are left as snags or fallen habitat. About a third of the volume of old, downed logs have sound, high-quality wood. Many of these are salvaged and made into furniture to help finance the restoration work.

RESTORING SPECIES COMPOSITION

The tanoak is an important link in the biological chain. It grows quickly in direct sunlight and has deep extensive roots to hold on to erosion-prone steep slopes. It has a symbiotic relationship to edible mushrooms like Black Trumpet Chanterelles, and it feeds and houses wildlife. Tanoak makes good firewood, and it has a small market for hardwood floor and furniture lumber.

After logging, the tanoak aggressively established dominance in many areas of the stand. The large conifers were almost all removed while many tanoaks were undisturbed. Without the tall canopy above them, the remaining tanoaks grew bigger and denser. Trunks can reach five feet in diameter. Height averages 60 feet with exceptional trees up to 110 feet. Before logging, they made up less than 10% of the old tall canopy. Today, they occupy up to 50% of the new smaller canopy and the conifers often face significant tanoak competition to reclaim previously logged areas. To help restore the canopy to its ancient form of mostly conifers, many tanoaks will be removed over the next few decades. Slowly opening the dense tanoak canopy allows more young conifers to grow between and past them. Local conifers usually grow between 120 and 150 feet tall. In the lower elevations near streams, local Redwoods will grow over 250 feet tall. When thinning, keep in mind that even though they were a small part of the tall old-growth canopy, a tanoak canopy was abundant and well distributed throughout the forest in the shade of the conifers.

Open the canopy conservatively at each cutting interval. Forestry manuals usually recommend that degraded sites be clear-cut on a small scale of up to five acres and planted to start over. There are other alternatives. For example, contrary to industry and most forestry school teaching, the Pacific Lumber Company maintained a sustainable selection cutting plan in the Redwood region from the 1920s to 1985 with excellent results. ***Forever Redwood selectively cuts at all landscape levels and does not clearcut***. If a conifer stand is degraded with poor quality trees and/or is hardwood-dominated, it can slowly be converted to a conifer-dominated site over a few decades via gradual thinning and planting. It has been our experience that on our average-quality, redwood-dominated lands, it is best to open the canopy very lightly (no more than 20% in most cases) to maximize the survival and growth rate of the planted redwood seedlings.

While thinning, a tanoak is usually removed in preference to a competing conifer if it is not a straight, upright, high-quality hardwood. When logged, the tanoaks tended to re-sprout in tight groups of young trees. When thinning a regenerated group of tanoaks, remember that eventually only one or two trees will remain at most sites, as it was before. Depending on where the crowns are, we leave the healthiest and straightest trees. We retain most tanoaks over 18 inches in diameter (DBH) because of their habitat value and as shade for the seedlings to be planted.

When thinning, we work to protect the soil from too much unfiltered sunlight in summer and direct wind and rain in winter. If the tanoak is in an open space or borders a canopy opening, it is usually not removed or pruned. Most thinning is done from ***below the canopy*** by cutting small and intermediate sized trees. In this way, most of the canopy cover is retained after each thinning is completed. In areas heavily dominated by tanoak, the canopy is opened up more. Redwoods (and sometimes sugar pine) are then planted in the small openings. As the forest matures, future canopy openings will be smaller.

Redwoods are less abundant than they once were. For example, our stands averaged 50% Redwood tree volume prior to logging versus below 20% today. In Sonoma and Southern Mendocino counties, Redwoods produce seed in their natural setting about once a decade. Propagation mostly occurs via self-sprouting from the existing roots and stumps. In the first decade or two after logging, fir and pine regenerated well in the partial shade of the remaining stand while the shade-loving Redwoods concentrated around stumps. Resprouting was minimal along roads and skid trails or on the old log landing sites (at least 10% of the land) because the stumps were bulldozed and the soil was compacted.

Around large old stumps where once a magnificent tree stood, many saplings now compete for dominance. We reduce the number of saplings by leaving the best formed and most vigorous. Saplings that resprouted from the stump are susceptible to breaking at the stump in high winds (windthrow). If a stump's resprouted saplings are competing with saplings growing in the ground, we favor the in-the-ground saplings (if all else is equal).

Since the canopy cover has grown denser over the past decade, more Redwood seedlings have survived outside of the original stump areas. To help reestablish the tree's dominance and distribution, we take extra care of these seedlings. Sometimes only inches tall, they compete with other Redwood seedlings or try to grow through brush, slash or hardwood competition. The competition is eliminated and the most vigorous and upright of the seedlings is released to grow. Sometimes we find a surviving Redwood seedling that is several feet tall but has poor vigor and/or form. We usually cut it at ground level. Within a couple months, it will resprout several shoots. With less competition and relying upon the old root system, the new sprouts will usually grow over two feet per year and be a model of good form and vigor!

Old-timers tell us that many firs over 70 years old had "conks" or rot when the local old-growth forests were logged. While thinning, we find that some of the young firs have visible, early signs of disease when they are overcrowded. It is a black-colored deforming growth on the bark or inside the bark that changes the shape of the trunk. Sometimes it is more visible on young trees where the limbs meet the trunk or on the limbs themselves. The older firs that do not have the disease usually grew up with less competition. Because of this, firs with visible deformations are thinned unless left as snags. In general, overcrowded fir stands are thinned a little more than Redwood or sugar pine stands to lower the percentage of deformities. These steps will tend to make the fir stands somewhat younger overall than the other conifers.

In contrast, the old-timers say the sugar pine was historically favored because of its excellent wood and minimal decay. The local old-growth Redwood had some rot (up to 10%), but less than the fir (up to 30%). All things being equal, when thinning conifers, we favor Redwoods first (because they are underrepresented), pine second and fir third. While thinning, if stands are opened too much, winter storms will blow over the remaining unprotected trees. Consider the site and its exposure to prevailing winds, rain, etc. If the remaining conifers are not strong, well established and vigorous, they will need many nearby trees to survive. A tall thin fir (less than 6 inches DBH) released in the open will ***definitely*** blow over.

The altitude, angle of sun exposure, and the height and structure of the canopy create different microclimates from acre to acre. Microclimate variations influence species structure. Redwood is dominant in lower elevation stream areas with fir and pine more abundant at higher and drier elevations (up to 2200 feet). Overall, the upper canopy before logging was approximately 90% conifers with some hardwood concentrations on the south facing slopes and riparian species in the year-round streams.

At least seven other species are on the land (not counting riparian species). Most abundant is the smooth and bright, reddish-brown, barked madrone. This hardwood can be a large extraordinarily beautiful tree (over 300 years old, five feet in diameter and over 100 feet tall), but a recurring blight kills many young madrones on our lands in Sonoma County. With this in mind, we do not thin most healthy madrones. In Mendocino County, large madrones are more abundant and are thinned lightly. The madrone fruit is a food source for wildlife.

Manzanita is bushy with a tough wood and a beautiful wine-colored smooth bark. It existed sparsely prior to logging and is a fire hazard because it ignites easily. They cling to difficult soil areas and are relatively scarce even after logging. We rarely cut manzanita unless they are abundant amongst other trees in a specified area.

The California nutmeg tree is a light-brown barked conifer with prickly leaves similar to Redwood. They grow slowly and have not recovered well from logging. Most are now only 10 to 20 feet tall and not straight. They exude a strong sap odor when pruned and the rare mature California nutmeg is beautiful and prized as lumber (to 70 feet tall and 20" diameter).

The least abundant trees are the giant chinkapin, California bay laurel, coast live oak and California big leaf maple. The chinkapin is a beautiful straight-growing hardwood. Its bark and form resembles a tanoak, but its leaves are shiny and are not serrated like the tanoak. The chinkapin often grows to 100 feet in height. The laurel and maple are found in the lower elevation stream areas. The laurel is a pleasant smelling evergreen while the maple's leaves turn a blazing orange to yellow in the fall. These beautiful hardwoods can grow up to 80 feet. Coast live oak is usually found on the drier and most exposed hillsides. Because the nutmeg, chinkapin, laurel, liveoak and maple are rare, healthy trees of all sizes are favored when thinning.

PLANTING NOTES

There are several factors that increase the survival and growth rates of Redwood seedlings:

On south-facing slopes, our experience is that Redwood seedlings do best with approximately 80% canopy cover to protect them from excessive wind and sun. Too much canopy cover stifles growth. Seedlings seem to need less canopy on most north facing slopes. Another factor in survival is deer browsing and rodent digging. We have lost over 50% of unprotected seedlings this way.

We have experimented successfully with keeping seedlings in two-gallon pots for an extra year before field planting. The one-year old seedlings have very small roots and are susceptible to drying out if spring rains are too sparse. The larger trees can survive the dry springs better and deer damage to the larger trees is much less (when damaged in this way, the trees often recover new tops and do not die). The two-year-old container seedlings are 15 to 20 inches tall while the two-year-old seedlings that were planted in the field a year earlier are usually only 8 to 10 inches tall (if they survived). The two-year-old container seedlings are planted fourteen to sixteen inches deep to maximize protection against the long summer dry spells.

Results for the first 3 years were encouraging, with most trees surviving and growing six to twelve inches per year. While in the nursery, two-year-olds grew best when they were in partial sun during the day (morning or evening only), and when they received generous amounts of water on those days when rainwater was lacking, until the arrival of planting day. By making the two-year-olds grow vigorously from day one, the fast and healthy growth we have seen so far in the forest justifies the higher labor costs.

We plant when the soil is moist in December and January to give the trees maximum soil moisture. We cover the soil around the seedlings with available leaves and small branches to create mulch to hold in moisture. The trees are planted so that they are a couple inches below the contour of the land. This allows the mulch to create a moisture pocket. To moderate competition, we do not plant next to existing trees. The two-year-old seedlings are usually planted using a shovel. We dig the holes about 12 inches deeper than necessary to loosen the soil for the plant's early growth in the woods. We plant some seedlings within the drip-line of existing trees with success. As long as the seedlings are not too close to the trunk of other trees, they seem to like substantial (but not total) shade. Wherever possible, place plantings directly uphill of downed logs. Downed logs retain moisture and collect nutrients from their own decomposition, from tree duff, and from soil that washes downhill. Seedlings that are protected from direct sunlight from the south and west seem to grow better. When planting in exposed areas, “hiding” seedlings behind logs and other barriers to the southern sun helps them survive the harsh summer rays.

The relation between economy and ecology is etymologically poignant. Eco is Greek for home. Nomos is Greek for law or rule. Economic then, is the rule of the home. Logos is more than the modern "logical". It is Greek for the harmonic gathering, the incarnate word, and it is associated with Apollo's lyre. Ecology then, is the harmony of the home. When harmony and the rule of the home are one, true speech and rich economy coexist. Economy and ecology must be confluent. They must lie upon one another like a couple sharing the same home. When economic rules and ecological harmony are divergent, the law is not "logical". When harmony is sacrificed for a dollar, the home receives no blessings and catastrophe will certainly follow.

—Excerpted from "The View From Delphi" by Frank Marrero (Tripod Press)

III: ECONOMY

WALK THE TALK

Consider and experience the entire affair yourself. And be humored by the realization that the popular communications media are fundamentally motivated by the necessity to propagandize and entertain through fascinating and alarming messages. This is how they make their money and achieve their power.
—Da Free John, Scientific Proof of the Existence of God Will Not Be Announced by the White House

These are critical times. The historical decline in the quantity and quality of the earth's forests is still accelerating. Humanity's economy continues to be in conflict with the ecology of mature and old-growth forests. The media consistently dilutes the severity and implications of this decline and the associated deterioration of wildlife habitat, drinking water quality and biological diversity. The issues are worldwide. Most forested areas outside of parks and preserves are fragmented, over-harvested or in the path of future development. For example, the standing timber volume of our local forests is approximately 20% of what it was before logging began. This is similar worldwide. This 20% figure represents the lost carbon sequestering capacity of these forests. Most of the carrying capacity of the world's forest is not being used! Take a low altitude flight over non-park forestland. The fragmentation and devastation will astound you:

California law limits clearcuts to 40 acres at a time. *This 1998 photo was taken in the Gualala watershed near Forever Redwood lands. The ten to twelve clearcuts visible create a "checkerboard" effect. Although trees occupy most of the area, they are small and young. Each piece of this checkerboard tree-farm is clear-cut every 60 years.*

(Photo: Sherry Glaser)

Landslide erosion control: mulching bare soil with sterile hay, Terry Patten and Raul, 1997. (Photo: Jason Johnson)

MONEY AND SUSTAINABLE FOREST MANAGEMENT

To address the deteriorated condition of most industrially managed forestland, the term "sustainably-harvested forest products" and "sustainable forestry" has come into wide use by the timber industry and wood retailers worldwide. It is described as the solution to overcutting, but only one organization that certifies forestland as "sustainably-harvested," the Forest Stewardship Council, has relatively rigorous standards that are a good first step towards forest restoration. Most other standards for "sustainably-harvested" are only minor improvements in the field combined with lots of marketing. Even the FSC is coming under increased scrutiny due to evidence of loopholes, bureaucracy, and weak enforcement of standards. In a 2018 piece in YaleEnvironment360, referring to FSC practices, Richard Conniff writes:

> *These certifying agencies often display a lack of expertise on visits to logging operations, says Counsell, along with "the systematic downplaying of problems that are identified, and inadequate attention to fraud and misreporting of information." That leniency may result partly from being paid directly by the companies they are supposed to audit. The certifiers also "know they can get away with issuing certificates even to companies that are flagrantly breaking the law, without any major repercussions from FSC," he says. Carstensen counters that FSC takes action based on independent audits of its certifying companies, and that the payment setup is no different from a corporation paying an accounting firm to audit its finances.*
>
> *Money questions also handicap FSC in other ways, according to its critics. The organization's decision-making structure consists of environmental, social, and economic (or industry) chambers, each having an equal vote. But many issues get farmed out to working groups, which can take years to reach a consensus. And the reality, says Counsell, is that environmental and social groups typically cannot match the resources and staff hours that logging companies with a financial interest at stake can devote to the process. (Carstensen [director general of FSC International] counters that the environmental and social groups hold their own, in part by their ability to bring media attention to bad behavior.)*[1]

SUSTAINABLE FORESTRY: A FIRST STEP TOWARDS RESTORATION

The Forest Stewardship Council (FSC) administers the strictest "certification standards" for sustainably harvested forests that are in widespread use today. **Certification is a positive step for forest management, but sustainability is only a step towards**

restoration. Restoration forestry standards necessarily must be much higher in certain areas.

Two examples:

1. FSC certification has been granted in the Redwoods to companies that continue to use chemicals in their forests. In contrast, restoration forestry does not use chemicals in the forest.

2. FSC certification requires only modest wood volume restoration over time and the protection of ***existing*** old-growth only. Restoring large numbers of mature and old-growth trees is not a requirement of certification. In contrast, restoration forestry actively works to ***restore and then maintain*** old-growth trees and high timber volumes (30,000 to 60,000 board feet per acre) for most Redwood-dominated parcels. Without mature and old-growth restoration, forests are permanently maintained at a fraction of their ecological potential with only small to intermediate sized trees. Among many consequences, the lack of mature and old-growth trees significantly limits habitat value for wildlife and lowers biodiversity and watershed values. The lack of volume limits the forest's natural moderating influence to the local climate and limits its global cooling capacity. Most certified forests in the Redwoods are cut at a rate equivalent to 20% to 30% of the wood volume per decade. This rate of cut allows the oldest trees to mature to between 70 and 100 years. This compares favorably to industrial tree farming standards of 40 to 70 years, but is a fraction of restoration forestry's 200+ years.

FSC's certification sustainability standards are exhaustive and rigorous. They were initially created by environmental activists to bring ecological standards into the timber business. Unfortunately, they have been diluted moderately over the years to permit chemical use and higher rates of cutting in order to attract large commercial interests. Our board decided to not pursue certification because we demonstrate a significantly higher standard. Forever Redwood hopes to create a set of rigorous, quantitatively measurable restoration forestry standards. We hope this manual is a first step in developing such standards. The complete FSC standards can be found at https://fsc.org/en/page/forest-management-certification for those who may be interested in the most vigorous standards widely in use today. Below are the original guiding principles set in the mid 1990's. Some of these standards are no longer (in practice) being applied:

THE TEN ELEMENTS OF SUSTAINABILITY:

1. Forest practices will protect, maintain and/or restore the aesthetics, vitality, structure, and functioning of the natural processes, including fire, of the ecosystem and its components at all landscape and time scales.

2. Forest practices will protect, maintain and/or restore surface and groundwater quality and quantity, including aquatic and riparian habitat.

3. Forest practices will protect, maintain and/or restore natural processes of soil fertility, productivity, and stability.

4. Forest practices will protect, maintain and/or restore a natural balance and diversity of native species of the area, including flora, fauna, fungi and microbes, for purposes of the long-term health of ecosystems.

5. Forest practices will encourage a natural regeneration of native species to protect valuable native gene pools.

6. Forest practices will not include the use of artificial chemical fertilizers or synthetic chemical pesticides (or herbicides).

7. Forest practitioners will address the need for local employment and community well-being and will respect workers rights, including occupational safety, fair compensation, and the right of workers to collectively bargain, and will promote worker-owned and operated organizations.

8. Sites of archaeological, cultural and historical significance will be protected and will receive special consideration.

9. Forest practices executed under a certified Forest Management Plan will be of the appropriate size, scale, time frame, and technology for the parcel, and adopt the appropriate monitoring program, not only in order to avoid negative cumulative impacts, but also to promote beneficial cumulative effects of the forest.

10. Ancient forests will be subject to a moratorium on commercial logging during which time the Institute for Sustainable Forestry will participate in research on the ramifications of management in these areas.

AN ECONOMIC BLUEPRINT FOR RESTORATION

The remainder of this manual is a detailed argument for the economics of restoration. Restoration is rarely practiced because it requires a long-term commitment and substantial physical and financial resources short-term. The economics of Redwood forestry are discussed from several angles, including:

- What the large companies that control over half of the forest are doing and why.
- What Forever Redwood is doing to finance the necessary restoration effort.
- Factors usually not considered that lead to large, long-term financial rewards for investing in restoration.

Restoration forestry achieves dramatic long-term ecological and economical returns. For example, a relatively small 80-acre parcel of young forest purchased today for $550,000 can be transformed in two or three decades into a beautiful forest with over a million dollars in standing timber and a vastly increased land value. This happens because Redwood is valuable and even a young forest can be cut for substantial profit. It happens every day—Redwood land is being clear-cut and developed for housing and/or vineyards in Sonoma and Mendocino counties because it is profitable to do so. The large timber companies contribute to this trend because many are slowly and quietly disposing of their over-cut parcels.

Our mission is to restore forestland and demonstrate its viability economically. This is a difficult task. To begin with, Forever Redwood places a conservation easement on most parcels of land it owns or manages before restoration begins. The easement limits development and subdivision of the land. The forest's restoration and long-term uses are permanently detailed in the easement. Enforcement clauses in the easement ensure that the easement's provisions are adhered to. The easement allows the long-term economics and ecology of restoration forestry to develop by eliminating the possibility of a change of heart by a future owner; or a sale followed by a "cut and run" operation (see conservation easement, Appendix A).

A good example of a large-scale "cut and run" operation is the 1985 hostile takeover of the Pacific Lumber Company (PALCO). Since 1869, its 205,000 acre forest was the leading example of truly sustainable, "selective" logging. PALCO cut trees far more slowly than they grew. The forest had a large percentage of old-growth and mature trees. Between 1957 and 1985, PALCO's timber volume nearly doubled. The company was consistently profitable by cutting a small amount of high-quality mature and old-growth wood. It offered its employees long-term stability and excellent benefits. Once sold, its rate of cut was more than doubled to cover the junk bonds that financed the sale. The result was a deterioration of the forest, the wood quality, and the watersheds. PALCO clearcut and high-graded for 22 years, after which they filed for bankruptcy and were purchased in 2008.

The largest obstacle to making restoration happen is getting the short-term economics to work. Forever Redwood's short-term economic business plan has four parts:

1. Work with investors that need tax relief to purchase forest parcels and secure conservation easements to protect their land. This generates substantial charitable tax breaks for the investors that significantly lower the investor's capital tied up in the property (see detailed example on page 54).

2. Per the standards detailed in this manual, harvest small amounts of Redwood to make the Forever Redwood furniture line to finance restoration work (for more information visit us at www.foreverredwood.com).

3. Sell limited amounts of lumber and firewood.

4. The forestland's restoration vastly increases the aesthetic beauty of the land which in turn increases its market value as recreational land. The landscape of forest management in the Redwoods is fragmented, with examples of all types of forest management from preservation to extensive clearcutting. Some small forestry companies do excellent work, while most large companies continue to manage their lands as young tree farms and/or to sell off parcels. To understand the factors that cause large industrial corporations to degrade their forest holdings, the following excerpt was reprinted with permission from author Ray Raphael from his book "More Tree Talk" from Island Press. The article carefully explains some of the surprising economic assumptions used by timber companies that cause forestland to be over harvested.

INDUSTRIAL OWNERSHIP: TIME IS MONEY

FROM MORE TREE TALK PGS 161-9, RAY RAPHAEL

The virtues of holistic forestry seem obvious; it is really just thoughtful, sensitive stewardship of the land. It treats nature as an ally, not an adversary. It considers each site according to specific needs. It is, quite simply, forestry that cares about the future. Why, then, is holistic forestry so rarely practiced?

Often, the fate of the forest is determined by managers in distant offices who are not necessarily guided by sound silvicultural criteria. These managers live in a world driven not by sun, wind, earth, and rain but by economic and political realities. Forestry is not practiced in a social vacuum. All the scientific knowledge—and all the best intentions of on-site workers—will come to no avail unless we understand, and can change, the economic and political factors that interfere with good forest management.

There are three basic types of forest ownership in this country: public, private, and industrial. Each type has its own set of blinders, infrastructural forces that encourage short-sighted, exploitative practices while discouraging farsighted forestry. What are these forces? How do they operate in everyday affairs?

The timber industry owns approximately 15% of the timberland in the United States (over 60% of the Redwoods). This figure varies significantly by region, ranging from 9% in the West to 19% in the South. The reason the industry owns land is obvious: to provide a source of timber and pulp for its processing plants. Although the mills will always be partially dependent upon other sources of raw material, their future is more secure to the extent that they can grow their own trees.

On the surface, it would appear that the industry should invest heavily in its growing stock. In practice, however, the timber companies spend only a small percentage of their revenues on reinvestment in the resource base. Perhaps timber is a "renewable resource," but the forest products companies are not in fact renewing it as vigorously as they could. The annual net growth of softwood trees on forest industry land is only 77% of the amount harvested: on non-industrial private land, by contrast, the net growth of softwood trees is 127% of the annual harvest; on government land, softwood growth is 146% of the harvest. The timber industry, in other words, does not seem to be providing for its long-term interests.

Don't the companies care about their future? Don't the mill owners want to maintain their resource base to provide employment for their children and grandchildren? Of course they do, but from a strictly economic point of view, it is difficult to grow and maintain real forests on their own lands. To understand why timber companies do not find it feasible to make long-term investments, we must examine the peculiar interrelationships among time, timber, and money.

When a corporation chooses to invest money in timber, it effectively chooses not to invest that money elsewhere. Money invested in another field will earn interest or pay dividends on a regular basis; investment in trees, on the other hand, will have to wait several decades to return a profit. When a profit is finally realized by harvesting the timber, the returns must approximate the profits that could have been made from other forms of investment. The revenue from a single crop of trees must be high enough to justify tying up capital for so many years. In other words, part of the cost of growing trees is the interest accrued to the initial investment.

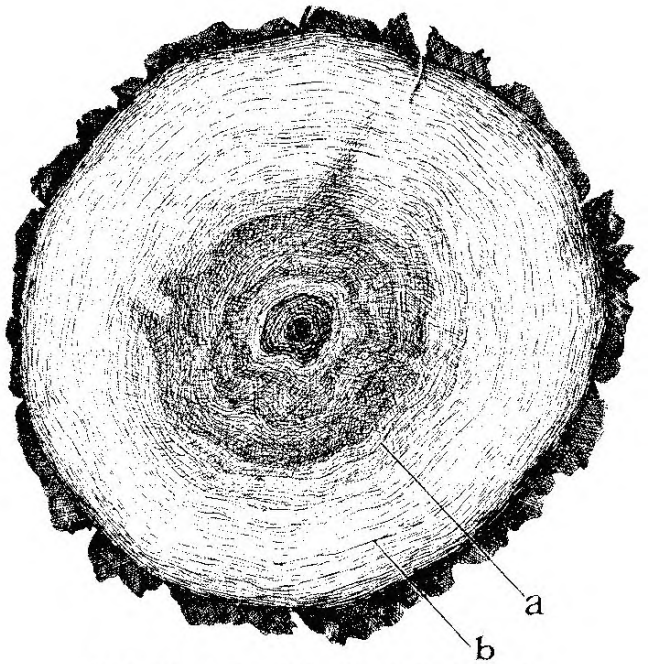
In economic terminology, we speak of the opportunity cost of capital: there is always an opportunity to do something else with your money. The opportunity cost of timber is extremely high because the capital is tied up for such a long period of time. Depending on the interest which could be made in other investments (called the guiding rate of interest, the hurdle rate, or, misleadingly, the discount rate), the opportunity cost can become a prohibitive factor in any long-term forest investment. For every dollar initially invested, a tree that takes 80 years to mature will have to return $23 at 4% interest, $224 at 7% interest, or $2,048 at 10% interest. If the guiding rate of interest is high, investments in the future resource base become financially untenable, since they won't be able to compete with other capital investments. When the cost of interest is taken into account, there is no genuine "long-term" in the practical world of business.

To demonstrate how interest rates render long-term planning financially unsound, one study calculated the soil expectation value (SEV) of a hectare of land that was to produce a crop of trees every hundred years. (The soil expectation value is an economic measure of the capacity of unstocked land to produce timber—adding the revenues, subtracting the costs, and accounting for interest.) Strangely, the guiding rate of interest had a far greater impact on the SEV than the actual productivity of the land. If the productivity remained constant, the land was worth $56,723 at 1% interest but only $7 at 10% interest. A loss of productivity, on the other hand, had only a minimal impact. If the soil deteriorated to the point that the volume of each succeeding crop of trees decreased by 10%, the SEV (figured at a constant 5% interest rate) declined from $741 to $740.43—a loss of only fifty-seven cents. If the land lost 100% of its productivity after the first generation of trees was harvested—if it literally fell into the ocean—the SEV would diminish by less than 1%.

The implications of these figures are profound: when measured in crude dollars and cents, the future of the forest is not economically relevant. From a strictly business perspective, the long term fertility of the soil simply doesn't matter. If a company has a chance to invest a mere one dollar per acre on soil improvement that will double the growth of the trees 200 years hence, it is economically foolish to make that investment. Unless each dollar will increase the worth of that future tree crop by tens of thousands of dollars, the company will just be pouring money down the drain.

The length of the crop rotation, like the interest rate, has a significant effect on the economics of timber. With a constant 5% guiding rate of interest, the return on a one-dollar investment will have to be $7 for a 40-year rotation, $30 for a 70-year rotation, or $131 for a 100-year rotation. Naturally, the investment goals for the shorter rotations will be easier to meet. Trees will be harvested earlier in order to avoid the large interest costs that accrue during the longer rotations.

Because of the financial incentive to shorten the cycle, the economic maturity of timber occurs long before the productive maturity. Economic maturity is the point at which a new investment would be more financially lucrative than a continuation of the original investment; productive maturity is the point at which a new crop will produce more timber than the original crop. The time of harvest is determined by the specific goal of the forest managers: Do they want to make more money, or do they want to produce more timber? These are entirely different objectives, and they lead to entirely different management schemes.



When should this tree have been cut? (a) Economic maturity; (b) productive maturity

In a sense, the decision of when to harvest is not left to the timber companies; it is the marketplace that decides. Consumers want more wood, but they want it at the lowest possible price. In order to keep down the price, the companies naturally try to minimize the cost of interest. When a company harvests at economic rather than productive maturity, it is simply responding to the laws of economics—and to the wishes of consumers who want cheap wood. A company that does not respond to the market is unlikely to stay in business.

Economic maturity is of course dependent upon the guiding rate of interest; when a continued investment in timber fails to match the guiding rate, it is time for the trees to be cut. But how is productive maturity determined? Foresters have a powerful analytical tool for relating productivity with time. They calculate the average annual growth of a tree, computed over its entire life span, and call the mean annual increment (MAI). The MAI is used to gauge the productive maturity of a tree: when the yearly growth falls below the MAI, it is time to cut the tree down and start over; the tree cannot meet its own standards for production. Conversely, when the annual rate of growth remains higher than MAI, the tree should be allowed to continue growing; it is doing better than average, and presumably better than could be expected of its replacement. In order to maximize production, foresters need only calculate the time at which MAI starts to decline. The culmination of mean annual increment (CMAI) determines the rotation cycle which will produce the most timber.

Timber companies, however, cannot afford to wait for their trees to produce to maximum capacity. In order to turn a profit, they reap the returns from an early harvest and quickly invest in a new crop. The large annual increment in wood fiber is offset by the interest being charged to the original investment. For a typical Douglas-Fir site, the best economic rotation at 5% interest is to harvest every 36 years, whereas CMAI is not reached until 64 years. Economic maturity is achieved much more quickly than productive maturity. By harvesting the trees in their prime, the timber company ignores approximately three decades of peak growth, but it cuts the rotation time practically in half. Instead of continuing to pay interest on its tied-up capital, it realizes a quick profit on the first investment and moves on to the next. Some of this money will go toward replanting, while the rest can be invested elsewhere. In essence, the company gets two harvests instead of one, as well as the use of the surplus capital for almost thirty years. The end result: revenues for harvesting on a 36-year rotation are approximately twice those of a 64-year rotation.

Ironically, to maximize profits a timber company has to cut corners on production. Worse yet, the wood from early harvests is distinctly inferior to the high-grade lumber fashioned from mature timber. Adolescent trees contain a disproportionate amount of soft and spongy sapwood, as well as numerous knots from the branches that have not broken off; older trees, on the other hand, can be made into clear, strong, tight grained boards. Generally, trees from commercial species such as

Douglas-Fir must be a foot in diameter before they contain even a modest proportion of quality saw timber. If Douglas-Fir is harvested at 36 years of age, the yield from 12-inch-wide or larger trees is less than 10,000 board feet per acre. At 64 years, the yield from a similar site would be about 50,000 board feet per acre. A company that harvests at economic maturity will get less than 20,000 board feet per acre in 72 years (two rotations); if it were to harvest at productive maturity, it could have obtained two-and-a-half times the quality of saw timber in a shorter period of time.

The implications of this discrepancy are serious. It is well known, of course, that economic incentives of private industry do not always coincide with the public interest. We accept the fact that the private sector must sometimes be required by legislation to take actions that are economic liabilities: they must be made to clean up their own wastes, for instance, or to provide safeguards to the consumer. The problem here is even more basic: the timber itself is sacrificed for the sake of profit. The strongest arguments in favor of private enterprise are based upon efficiency and production: corporations may not always act according to the best interests of the environment, but at least they get the job done, they deliver the goods. The private sector, we assume, produces what we want to consume. Not so in this case. The peculiar relationship between time and timber causes private industry to fail at its ostensive task: maximizing production.

The problem is not with the companies themselves, but with an economic system in which interest rates are pitted against the time it takes to grow trees. Private enterprise, operating according to economic necessity, is simply not suited to the job of producing the most and the best timber products. When the guiding rate of interest exceeds 3%, as it does in the current economic landscape, sound economic practices on the part of timber companies are literally counterproductive. Quality saw timber cannot be produced on corporate lands, except at exorbitant prices that offset the cost of interest—and which the consumers, at least so far, are unwilling to pay.

The same economic reasoning that favors shorter rotations causes the timber companies to shorten the natural cycle of forest succession. By bypassing the pioneer stage, they also bypass many years of interest. And in their choice of methods for eliminating unwanted brush, any savings they can make will be greatly enhanced by the guiding rate of interest, since they can take the money saved and invest it elsewhere. Area-wide treatments such as the spraying of herbicides are preferred to the more personalized (and generally more expensive) site-specific treatments such as manual release. Any extra input during the early years of the cycle must produce a much-magnified output, or it simply isn't worth the money. If the application of herbicides is $10 per acre cheaper than hand-clearing, the savings will amount to several hundred dollars per acre by the timber they tree is finally harvested. If the companies don't think that the end product from hand-clearing will be several hundred dollars more valuable than the end product from spraying herbicides, then they do not feel justified in making that extra $10 investment.

As the guiding rate of interest gets larger, silvicultural decisions become increasingly dependent on economic criteria. At 1% interest, every dollar saved now will result in a $2 savings seventy years down the line; at 10% interest, every dollar will result in a $790 savings. Although these are extremes, the fluctuation in the guiding rate of interest enters significantly into real-life decisions. Forest economists speak of the net present value (NPV) for a given site over a defined planning period—the sum of the revenues minus the sum of the costs, taking the guiding rate of interest into account on both sides of the balance sheet. If the NPV falls below zero, the project becomes an economic liability; if the NPV remains positive, the project is worth undertaking. But the NPV hinges upon the guiding rate of interest. At a 3.5% rate of real interest, manual release and precommercial thinning on the Hoopa Valley Indian Reservation lead to a positive NPV; at 4% interest, these same projects generate negative values and would lose money for the tribe. Similarly, interplanting Douglas-Fir stands with green manure tres such as red alder might make economic sense at low rates of interest, but at high rates this investment in the future forest cannot be justified.

How can the magical guiding rate of interest, or "discount rate," be determined? This is no easy task. Basically, it is no more than the projected rate of real interest that is expected to prevail throughout the economy in the years covered by the planning period. Needless to say, the exact rate of interest forty years hence is anybody's guess. This uncertainty makes economic planning exceptionally difficult. Timber company managers, in order to avoid being devastated by high interest rates in the future, must make their projections reasonably high; they are safer if they assume the worst. But the assumption of a high rate of interest both limits investment and increases the importance of time as a determining factor in management decisions. Less money can be spent on the future, while rotation cycles become even shorter.

Why, one might ask, would anyone want to invest in timber? If the investment is so sensitive to the guiding rate to interest, and if the interest rates of the future are so hard to predict, isn't it just too risky?

If timber had no economic value prior to harvest, the risks would indeed be too great. In fact, however, timber is traded on the open market long before harvest; it has economic value even as it grows. Timberland buyers and sellers are speculating in a future product. The speculation can be worthwhile because the investment appreciates in three distinct ways. (1) With each passing year, a tree grows upward and outward. The annual increase in volume varies by species and site, but it is generally of significant magnitude for several decades. (2) As the tree matures, its end product takes on greater value. At first it can be turned only into pulp, then into low-grade lumber, and finally into high-grade lumber or veneer. This change is

called ingrowth. (3) Available resources become more scarce, price increases tend to outstrip the overall rate of inflation. With timber values increasing in three ways simultaneously, timber owners can realize healthy and competitive profits. From the 1960s though the 1980s, nominal returns on timber investments were approximately 12%; real returns ranged from about 5% to 8%.

These last two factors—ingrowth and price increase—encourage timber owners to wait rather than cut, serving as partial checks against early harvesting. The effects of high interest rates, however, are potentially more significant than the increased price of wood products. It is hard to imagine, for instance, that the real price of lumber will be 131 times higher in a hundred years than it is today, although that in fact would be the effect of a 5% real interest calculated over a century.

The ultimate test of profitability for timber owners, as for any capitalist enterprise, is the ***internal rate of return*** (IRR): the compounded annual interest rate earned on the initial investment. If the IRR compares favorably with the guiding rate of interest—what capital could generate if put to some other use—then the project is worthwhile. Today, growing trees can produce a respectable IRR and is therefore a good investment—but only with short rotations. The shorter the cycle, the more predictable the results. Frequent harvests generate capital for repeated investments, whether in timber or in some other field. Just as second-growth trees are more manageable than old-growth, so too are investments that last only 30 or 40 years easier to control than those that take twice as long to turn a profit.

In order to shorten the rotations as much as possible, investors are increasingly moving toward producing pulp instead of saw logs. The pulp can then be pressed together, simulating old-fashioned lumber. Without an understanding of economies, we might suspect that it makes more sense to produce real boards than to glue wood pulp. But pulp can be grown much more quickly, bypassing the incredible impact of time on forest investments. Pulp plantations produce marketable merchandise in a small fraction of the time it takes to grow real timber. From an economic standpoint, the time frame for growing pulp—say 15 to 30 years—can be handled within a capitalist economy; the time frame for regenerating a real forest—say 70 to 300 years—is incompatible with capital investments that must produce competitive rates of return.

Time, in the terms of forest economics, is measured in years or decades but never in centuries. With no economic incentive to plan beyond the next crop or two, investments in soil structure or erosion control cannot be justified financially. Any notion of spending money to repair a damaged ecosystem is ludicrous from a business point of view. Environmentalists claim that the timber companies are acting unethically by ignoring the distant future, but the problem is actually fiscal, not moral. The problem is created by a system in which we all play a part, consumers and producers alike. Given the fact that a corporation is an economic entity, why should it invest in activities that show no financial reward? Perhaps it will make token gestures, but these amount to no more than charitable contributions or affirmations of good will. There is no structural reason for a corporation to practice the kind of forestry that will lead to a healthy, productive stand of trees 200 years from now.

The whole economic edifice is entirely rational—but it is based on a logic that has nothing at all to do with silviculture or ecosystem management. Financial reasoning leads the companies to cut trees more frequently than they should, lessening the total production of quality saw timber. It leads them to ignore the principles of forest succession that should form the basis of sound forest management. It leads them to harvest timber from areas that are too sensitive to withstand the onslaught of heavy equipment, too steep to avoid subsequent erosion, or too exposed to generate a new crop of trees. It leads them to pay little heed to nontimber values such as water quality, fisheries, and wildlife habitat. And it leads them to skimp on investments that would benefit tomorrow's timber, since the nature of interest rates renders long-term, slow-return expenditures fiscally unwise.

Corporations at the close of the twentieth century, however, do not operate exclusively according to economic principles. Increasingly, they function as public entities that are legally responsible in some respects to furthering the good of society. Whether willingly or not, they are subject to regulatory constraints which tell them to act against their immediate economic self-interests. The purpose of regulations is to account for "externalities"—factors which do not show up on the balance sheet.

Ironically, the preservation of the resource base for the distant future constitutes such an externality. Whether or not the future productivity of the site is economically significant, timber companies must preserve the integrity of the soil in order to satisfy legal requirements. If reforestation expenses were treated as discretionary investments, they would be hard to justify financially; but by defining reforestation as a necessary expense charged to the previous harvest, the regulatory agencies are able to make sure that trees get planted—even though tree planting might not be profitable if interest rates are taken into account. In a sense, these regulatory restraints help the companies think about the future, since they have little economic incentive to do so on their own.

Some timber companies go a step further: They take nonecnomic factors into account voluntarily, not just because they are forced to comply with the laws. In particular, family-controlled "dynastic" companies are more likely to take future productivity into consideration, even though there is no profit to be made by doing so. While the impact of interest

favors short-term investments, "dynasties" sometimes view time more leniently. A healthy future for the forest means jobs for the children and grandchildren. Although employment opportunities for unborn offspring do not appear on the balance sheet, family or community-oriented businesses operate as if this type of human variable has value. Harvesting timber, to some executives, represents more than just a way to get rich; it's a way of life worthy of being preserved.

Volume per Acre of young-growth Redwood/Douglas-Fir/Sugar Pine
(All Tree Species with Redwood at least 50% of Basal Area)
Stands at least 60% stocked, Site Index 120, 10.5 inch DBH and larger[13]

Age (Yrs) Periodic of Trees	# of Trees (over 10.5 in)	Height (ft)	Basal Area,ft²/ac	BF/Ac Mean Annual Increment	Gross Yield (BF)	Gross Annual Increment (BF/ac)
20						
30	73	48	91	103	3,100	250
40	99	62	145	220	8,800	570
50	121	73	198	330	16,500	770
60	135	84	250	455	27,400	1,090
70	142	94	295	578	40,400	1,300
80	145	104	333	671	53,700	1,330
90	147	113	371	748	67,400	1,370
100	146	120	402	813	81,300	1,390

FOREST PRODUCTIVITY

In the 1920's, Dr. Willis Linn Jepson, Professor of Botany at the University of California and President of the California Botanical Society wrote:

> *Magnificent bodies of Redwood, as yet untouched by the axe or only partially exploited, occur on the main Eel River, South Fork Eel River, Van Duzen River, Mad River, Redwood Creek, lower Klamath River and Smith River. The trees in these splendid forests are mostly mature or past maturity, 6 to 16 feet in diameter, 100 to 200 feet in height or taller, and yield 125,000 to 150,000 feet board measure (BF) per acre. Limited areas have produced as high as 200,000 to 500,000 feet board measure per acre and yields of 1.5 million feet to the acre are on record. On hill slopes, as in Mendocino and Sonoma (counties), the cut is about 20,000 to 50,000 feet to the acre.*[2]

Local logging removed most of the conifer volume and approximately half of the hardwood volume. For example, In the past Forever Redwood's 700 acres averaged 9,000 BF/acre in conifer wood volume today versus approximately 40,000 BF/acre that existed before logging. Hardwoods now make up approximately 50% of the total volume versus approximately 10% before logging. Over the next few decades, the living volume per species will return to its pre-logging composition of approximately 55% Redwood with 30% Douglas-fir and sugar pine and 15% hardwoods. Although their volume will slowly be returned to approximately 15% of the total, the hardwoods will continue to dominate the lower understory with smaller trees.

The yield table on page 33 approximates the average rate of wood growth of our upland forests. To understand this chart, the following terms are defined: Site Index 120 means the dominant trees will average 120 feet in height at age 100. Mean Annual Increment is the average growth since year 1 and periodic Annual Increment is the average for the 10-year period. Basal area averages the total square feet of tree trunks over 4.5 inches in diameter at breast height per acre. Gross yield measures total growth per acre since year 1. Gross yield overestimates total volume at any age because it does not account for natural mortality.

The table's growth rate peaks at 1,390 board feet per acre per year. Compared to forestland anywhere in the world, this is an extraordinary growth rate, yet for Redwoods it is average:

> *Redwoods produce wood at a phenomenal rate. In 1923, University of California forestry professor Emanuel Fritz established the "Wonder Plot" on an acre of second-growth redwood near Fort Bragg; by 1995 it had produced 343,000 board feet of timber (4,760 board feet per acre/year). Of all the world's vegetation types, mature redwood forest produces the greatest biomass per unit area—more than 1,400 vegetation metric acre according to one study.*[3]

PRACTICING PROFITABLE RESTORATION FORESTRY

The public is repeatedly told that industrial forestry methods must be used to make money managing forestland. Considering the state of most forestland and the short-term reality of the marketplace, this is true. **However, if helped along and given a few decades to rest and grow, most mature forests will significantly out-produce industrially managed lands decade after decade.**

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2 Jepson, Dr. Willis Linn The Trees of California, pg. 108, Cunningham, Curtis and Welch Publishing Company San Francisco, CA 1909 (Early botanical study of California Forest Trees.)

3 Lanner, Ronald M. Conifers of California, pg. 244, Cachuma Press Los Olivos, CA 1999

One reason this happens is that most forestland grows more timber in its second fifty years of life than during its first fifty years. For example, from the yield table, age 50 gross yield = 16,500 BF/ac growth in the first fifty years. Age 100 gross yield = 81,300 BF or 64,800 BF/ac growth in the second fifty years.

Old Growth Again's founders first purchased forestland in the Gualala Watershed of Sonoma County in 1994. At that time, like every year, demand for wood products was degrading forests in every corner of the globe. We could not separate our forests from what was happening around us. If we restored forests only to protect them, other forests would be logged more extensively to meet the large wood demand. Creating another pretty forest preserve is not our mission. **The only way our forest work can grow into a permanent and significant contribution to the earth is to maintain a sustainable accommodation with the needs of the human society around it.**

After 5 years of learning on 42 acres, Old Growth Again was incorporated in 1999. New partners purchased or co-purchased adjacent lands which Forever Redwood manages by contract. Forever Redwood's future harvest income is set aside to increase the breadth of the restoration work. In this way, land purchases and restoration become self-financing and, in time, the project will make a significant impact by growing along with the trees.

Forever Redwood lands are located in the magical Coast Range, 5 miles from the ocean and a 3-hour drive north of San Francisco. Examples of the magic are everywhere. The tallest trees on earth, the Redwoods, live only in the Coast Range. An old-growth Redwood forest has the most biomass of any forest on earth. It has 7 times more biomass per acre than the Amazon rainforests. The local forest is home to the black bear, the mountain lion, bobcat, golden eagle, osprey, hawk, a variety of owls including barn, spotted and screech owls, wild turkey, several species of woodpeckers, snakes and salamanders, foot-long lizards, feral pig, fox, deer, hare, quail, river otter and rainbow trout, and many other animals. Recent studies show the watershed is recovering from the logging-related damage. If this continues, we expect the near-extinct, wild populations of Coho Salmon will start to return to our creeks within 10 years.

Short-term versus long-term legal protection: Some Forever Redwood lands are protected from logging in the short-term. For example, after the old-growth forest was logged in the 1960's, our Fuller Creek lands were sold as a subdivision of 40-acre parcels. The subdivision's Covenants, Conditions, and Restrictions (CC&R's) do not allow commercial activities. The CC&R's are extended every twenty years by a majority vote of the parcel owners. But, forestland is being conventionally logged and/or converted to vineyards all around us (see photo on page 36). The future extensions of the CC&R's will be increasingly difficult because owners are tempted by the high value of vineyard development and timber on their lands. For permanent protection, conservation easements should be attached to the parcel's deed.

Many people believe that the best thing to do for a logged forest is to leave it alone. We understand this sentiment because it took us years to realize that the "leave it alone" philosophy works only to a degree and it does not address many structural problems and stand-destroying fire risks. A logged forest's species composition, canopy structure, road-and-logging-caused erosion problems, stream damage, fire danger and other structural problems will take centuries to return to something like it was before being transformed by man. An effort that combines excellent forestry practices with years of hard work helps the forest correct the structural imbalances ***caused by man*** in a few decades. We welcome anyone curious about our work to schedule a visit. Words cannot substitute for a walk in the woods. The first-hand impressions gained while walking in the forest quiets the chattering mind and resolves ideas into experience.

As the preceding article clearly explained, timberland managers, like most business people, place a premium on profits and the time value of money. The time value of money severely discounts the value of future harvests. (In many forests, long-term harvests are also discounted for anticipated fire and/or insect damage over time. In the Redwood region, fire and insect damage is not a major issue.) When profit maximization and the time value of money are combined, the arrow consistently points to young-tree harvesting.

For example, most of the forests we manage are primarily made up of 30-to 40-year-old trees that have regenerated since logging. The timber companies also left young trees that were not valuable at the time along with a few mature and old-growth trees that were either difficult to get to or less than perfect in form. Most landowners would log our forests now because those young trees are currently 65 to 75 years old and the few mature and old-growth trees are valuable. Clearcutting or high-grading would entice most landowners to take a hefty profit. The regulatory agencies would protect the stream zones from overlogging but would allow the hillsides to be cut very heavily. These practices typically leave the forest structure degraded significantly. The hardwood volume becomes even more dominant. Although the bare land would be replanted with seedlings, the steep slopes would again have significant erosion leading to landslides. Starting over, the land would struggle with further degradation compounding the structural problems that were slowly rebalancing before the logging recommenced.

Forever Redwood comes to the forest from a different perspective. Degraded or destroyed forestland is available anywhere in the world. Most degraded forests can be restored by working with the land for as long as it takes. Forever Redwood invests the time and money to return degraded or destroyed lands to highly productive and biologically diverse forests by permanently practicing restoration forestry. It is worth the wait. The maturing forest delivers the financial bottom line.

The issues are similar everywhere—over-emphasized economics has caused ecological degradation all over the planet. **On the other hand, ecological work done outside the realities of economics leads to governmental/charitable dependence or eventual failure.** But it does not have to be an either/or proposition. The economy and ecology reality is not difficult to implement on the ground. The difficulty, sad to say, is convincing investors to limit short-term financial returns to pay for long-term ecological and productivity gains that mostly their children and grandchildren will benefit from.

• **Give the land time to heal.** After logging, most stands will regenerate to varying degrees on their own. We plant extensively to help increase conifer stocking and lower erosion in areas that did not recover well. The young forest is thinned of damaged and lower quality trees along with other restoration prescriptions. Thinning creates wildlife habitat and lowers forest fire hazards. It also helps restore the pre-logging species composition of the forest while increasing overall productivity and the quality of trees.

• **Practice selective harvesting.** Selection harvesting is an excellent management prescription for most forests. By approximating the forest's pre-logging structure and its natural fire regimen, the forest can be managed on a rotation of over 200 years because the probability of large losses from fire or insects is significantly lowered. Under long rotations, the yield table's gross periodic annual increment (GPAI) is well past its peak. But, GPAI only measures the forest's production of wood over time. It does not measure quality. GPAI is important if you are in the pulp, firewood, low-quality lumber or fiberboard business. Forever Redwood produces quality lumber. Long rotations give the forest time to grow large trees. Value per board foot increases dramatically when logs are large and knot-free. Dense old-growth is the highest quality wood available. In coming decades, mature timber will become even more valuable because it will be increasingly difficult to find at any price anywhere.

• **Restoration work increases forest productivity without chemicals:** To control insect populations and/ or hardwood trees that compete with conifers, most industrially managed forests still use herbicides and insecticides regularly. Chemicals damage soil building by killing insects, microorganisms and fungi essential to the soil building process. Labor-intensive thinning achieves the same results as chemical use by mimicking the forest's tree selection process. By entering the forest every fifteen years, the natural loss of trees to disease and mortality is reduced by harvesting and selling a portion of them before they deteriorate. This adds periodic income and increases the GPAI. Soil building also helps improve conditions for future timber and non-timber uses of the land. Although the common financial wisdom in the timber industry is that forestry is only profitable if practiced on short rotations, when the following factors are taken into account, restoration forestry is a very good investment. To calculate the standing timber value and sustainable revenues into the future for a parcel of forestland, Forever Redwood uses several conservative assumptions:

• **Inflation and timber prices continue to climb.** Although prices and inflation fluctuate significantly year to year, timber prices have consistently increased an average of 2.5% annually after inflation since 1940. Forever Redwood forests are mostly Redwood and Douglas-fir. The price appreciation of these species is even more pronounced. As of 2019, the wholesale market value today of quality Redwood boards starts at $2.90 per BF for conheart beams. In order to remain conservative in our future projections, we project only a 6% annual increase in overall timber prices (not adjusted for inflation). Inflation has averaged approximately 3% annually over the past century, so our assumptions use 3% when calculating the after-inflation return.

• **The hardwoods are not given any value as an asset or a source of income.** Many tanoaks are thinned and sold for firewood at $350 per cord. But, firewood revenues are used to offset restoration expenses and do not yield a profit. Some of the higher quality tanoaks are retained to be harvested in the future at a premium for the local hardwood flooring and lumber market. Although these post-thinning, higher-quality tanoaks may contribute financially at some point, to maintain a conservative calculation, the assumption of zero value is also used.

• Mathematically, a ft^3 of wood equals 12 board-feet (BF) if the entire log could be cut into1 by 1 inch boards and nothing was lost by cutting. A ft^3 from a saw log actually yields between 5 and 7 BF of useable lumber. BF per cubic foot increases as log diameter increases. Hardwood volumes are usually stated in ft^3. Hardwood volumes are converted to BF only to maintain consistency in the yield table calculations using a factor of 6 BF/ft^3. Although volume-wise this is accurate, you cannot actually obtain 6 BF/ft^3 in lumber from hardwoods because of the irregular shape of most hardwood logs.

• **Forest growth is estimated using the yield table's Gross Periodic Annual Increment for the corresponding volume level and discounted to account for the hardwood component, soil depletion from past abuses and the lower stocking of our predominantly hillside properties.** The rate of forest growth will increase as a result of the increase in standing timber volume for many decades. At some point, the growth rate will level off as standing volume increases beyond a certain level. Since 20% of the overall volume is thinned every fifteen years, both the accumulation of volume and its corresponding growth rate will change at a slower rate than the yield table's figures (see page 48).

• **Timber harvesting costs vary between $0.25 and $0.35 BF depending on average tree size, distance of transportation and topography.** Costs vary inversely with tree size. The larger the trees harvested, the smaller overall costs are in relation

to total revenues. For example, an average 42-inch DBH (diameter measured at breast-height) Redwood yields 2,000 BF of lumber. Four average 24-inch Redwoods yield the same 2,000 BF but produce over twice the amount of slash. Total costs are higher for felling, cutting up the slash and handling four 24-inch trees than for one 42-inch tree. Also, the percentage of valuable heartwood per tree increases with diameter. For example, a 24-inch Redwood has less than 45% heartwood, while a 42-inch tree has over 70%.

• **Transportation and Milling Costs:** The topography of the land, understory vegetation and tree spacing also affect harvesting costs. It takes more time to work in an unthinned forest because they are difficult to walk/drive through. A good road system in a well-managed stand lowers harvesting time and yarding costs. Forever Redwood mills all its own wood. The value added by finished lumber more than offsets the costs. (For example, our milling, transportation and harvesting costs combined averaged $0.65 BF in 2018, while our salvage Redwood boards and beams sold for an average of $3.50 BF.)

• **Additional Costs:** In California, a timber harvest plan (THP) or a non-industrial timber management plan (NTMP) must be approved before selling timber. For example, an 160-acre THP usually costs up to $45,000 and must be approved prior to each harvest. A more economical alternative for the long-term landowner is the NTMP. The more thorough NTMP costs up to $65,000 for an 160-acre parcel. But once approved by the state, it is good forever with no need to reapply each time trees are harvested.

• **Tax breaks make investing in long-term forest restoration economically attractive.** For example, in 1999 we did a conservation easement project on 71 acres. While today's prices would be double or more, the same principles apply. A high-income investor purchased a recently-logged forest for $160,000 ($100,000 down, $60,000 mortgage) and a conservation easement was placed on the property, limiting logging and development in perpetuity and setting aside 15% of the acreage to return to old-growth. Writing the easement required legal help, a certified property appraisal and an NTMP forest management plan with total costs of $40,000. $30,000 was spent cleaning up the logging mess and improving the forest prior to the appraisal. Mortgage and property taxes for the first tax year were $5,000. Total cash invested was $185,000 with $84,000 in tax-deductible expenses (easement costs, improvement expenses, mortgage interest and property taxes).

• **The investor gave up many development and subdivision rights to the property** (retaining one building site on 1.5 acres). The appraisal determined that the easement lowered the property value from $200,000 to $85,000. The difference, $115,000, is a charitable contribution. In the investor's 50% marginal tax bracket (State & Federal), the $84,000 in deductions and the $115,000 in charitable contributions totaled $199,000 or $99,500 in actual tax savings. If the tax breaks cannot be fully utilized in the year earned, the charitable deductions can be carried forward an additional five years. The easement also reduced the property's tax basis from $160,000 (the purchase price) to $68,000. (Tax basis is calculated by reducing the purchase price by the percentage change in the before and after easement appraised values. In this case, $200,000 to $85,000 is a 57.5% reduction which is applied to the $160,000 purchase price.) After the first year, Forever Redwood used firewood and furniture revenue to finance the restoration and pay the property taxes. The building rights to the parcel were sold in 2001 to pay off the property while still retaining 3/4ths of the ownership of the parcel. The investor has little additional cash investment in the property until the first sustainable timber harvest in the year 2021.

• **Investor's Cash Breakdown:** Invested: $185,000 less tax savings of $99,500 for a net cash investment of $85,500. Although the property value is temporarily reduced, the investor understands that the forest management plan will greatly increase the ecological and economic value of the land over time. As Forever Redwood completes certain stages of the restoration work, the owner will deed 1/3rd of the future timber rights to Forever Redwood. By allowing Forever Redwood to share in future harvests, other forestland can be restored. The first harvest and onsite milling in 2021 is estimated to net over $70,000. As forest volume and productivity continues to increase, future harvest values increase dramatically. For example, the second harvest in 2031 is estimated to net over $165,000.

Combine the values of building a home or rental within the restored forest, the recreational value of the land, tax benefits, and the long-term lumber income and you have a strong economic argument for long-term forest restoration on a parcel by parcel basis.

Forever Redwood recovers some restoration costs by selling firewood. Thinned hardwoods are cut into manageable lengths and rolled, slid, or hand thrown to nearby skid trails where they are cut into rounds and stacked for drying. The remaining branches are cut and scattered to decompose back into the soil.

Forever Redwood handcrafts fine patio furniture to finance restoration work. We build heavy-duty picnic tables, benches and chairs that are shipped nationwide. Because we cut a very limited amount of salvage and green redwood, it is better to make a value-added product like furniture than to sell boards or logs. See furniture photos at: www.foreverredwood.com

20 Years Forward, 20 Years Back: A Blueprint For Planetwide Forest Restoration

(Thoughts from Founder, Raul Hernandez)

I began Forever Redwood in 1995. I spent the first 5 years doing forest restoration work and writing this manual about the lessons learned.

We began furniture sales in 2001 as a two-person company. Two decades later, we are on track to reach $20M in sales with over 200 employees. Many lessons had to be learned over the first 20 years to build the infrastructure, product line, website, and reputation for quality needed to become a market leader.

Over the next 20 years, we will focus on significant growth to realize our mission of changing the way forestry is practiced – planetwide. Many more lessons will need to be learned and obstacles overcome. This short essay covers the general steps we will take as a blueprint for operations.

The condition of the majority of the world's forests is poor and not improving. Most forests are privately owned and poorly managed. Carbon sequestration and other shell games are practiced but overall little progress has been made. For more on the carbon sequestration games, please refer to the Mother Earth New articles included in this manual on page 12.

Good forestry is essential to cooling the planet this century. Yet no restoration forestry guidelines exist, anywhere in the world.

This overview was added to this manual in February 2022 to detail our strategy for transitioning from a boutique, purpose-driven company to a Fortune 500 company in 2040 — leading the forest restoration of the planet.

Our Advantage In A Market Adapting To Climate Change

Recently, wood has become the building material of choice for the construction industry because it is much less carbon-intensive than steel and cement. Even skyscrapers are now constructed primarily of wood.

As the demand for wood continues to grow, Forever Redwood is positioned to be a leading supplier. We have access to the best timber available and, because of our restoration forestry practices, this market advantage will only increase over time. Short-sighted management practices are prevalent planetwide with few exceptions (unfortunately, "certified sustainable forestry" companies are included in the long list of short-sighted companies).

Forever Redwood has long been a leader in the design and construction of shade structures. We are now transitioning to cabins, ADUs, tiny homes, and larger dwellings and buildings. Our development team is creating new products in this space. And with our flexible design process, our customers will organically continue to develop our product line as we create new designs based on their input.

Rapid Growth — Expanded Restoration Forestry

To contribute meaningfully to global cooling, our efforts must expand as quickly as we can responsibly do so. Fortunately, the worldwide market for high quality wood products, structures, and buildings is almost limitless.

There are four limiting factors to achieving continuous fast growth of sales and forestry work:

1. Manufacturing expansion speed: Since the spring of 2021, our manufacturing capacity has expanded at 5% per month with numerous challenges. We will continue to professionalize our management team to manage this fast pace in a dynamic culture with minimal bureaucracy and management layers. We can continue the current pace of expansion through the end of 2023 without substantial investment. By the end of 2023, our manufacturing capacity will peak at $4.5M/month with our current facilities.

2. Financing growth: We will balance pricing, management, and cost controls to finance highly profitable growth at 80% per year mostly from ongoing cashflow with minimal borrowing (5%/mo. plus pricing increases). Our goal is to exceed 15% free cash flow per year after plant investments. We are creating effective cost controls and inventory and management systems to support a growing, strong management team to oversee all aspects of operations. We expect to have an operational system in place by early 2023 to then tie into the plant expansion plans in a cost-effective, sustainable manner.

3. Product development and improvement will run hand-in-hand with the growth of our restoration forestry work in other countries and the expanding variety of wood species. We will work with cutting-edge, ecologically-minded architectural firms in designing and building the future.

4. Expand forestland purchases as quickly as possible: Poorly managed forestlands exist in every country on the planet so the opportunities for practicing restoration forestry are endless. Occasionally we are forced to buy lumber on the open market. We do not want to support any bad actors in the forest products industry just because we are not always fully vertically integrated. As an additional strategy for growth, and to ensure the integrity of our timber source, we are working with like-minded folks in finalizing our second crowdfunded forestland purchase. We plan to do many more. We will focus initially on the Redwood and Douglas-Fir forests of Northern California, but will eventually expand to Canada, Mexico, Latin America, and beyond, adding other wood species to our growing product offerings. Managing forestlands within a restoration forestry model will also lower our costs of production over time and — most importantly — contribute to global cooling.

Transitioning From An Exploitative Model To A Restorative Model

Maintaining a growth rate of 80% per year will convert Forever Redwood into a Fortune 500 company by the late 2030s, at which point the company will have expanded our forest restoration projects to over 100 countries. The forestry work is the key to global cooling and to continuing to improve the world's forestlands. Our market advantage of access to the highest quality wood, sourced from consistent, hands-on restoration forestry practices, will only expand. This market success in turn will enable us to increase our restoration forestry impact.

Manufacturing can be focused in Mexico while we develop relatively inexpensive distribution hubs in Europe, Asia, and Oceania. Finished products can be shipped by full containers to our transportation hubs and distributed in our trucks with our installers in each region/country. The milled and dried lumber can be shipped by containers back to Mexico and processed through the port of Ensenada.

By 2030, Forever Redwood's annual sales will exceed $1B and annual free cash flow will exceed $150M after plant expansion investments. A substantial portion of this cashflow will go towards forestland purchase and restoration to support the growth of the company while contributing to a fast-growing, high-impact global cooling effort that will lead the industry's transition from an exploitative or "sustainable" model to a long-term, profitable, restorative model.

Forest Restoration Planetwide

Our growth rate will continue at 80% through the 2030s. By the end of that decade, we will have forestland restoration projects operating in over 100 countries. This widespread application of our restoration forestry methodology will permanently alter forestry. This work will continue to expand in the 2040s and beyond, contributing significantly to the global cooling effort that is so desperately needed, yet barely addressed, as of this writing.

Raul F. Hernandez, CEO **raul@foreverredwood.com**

POI 1: ESTIMATED LONG-TERM EFFECTS ON FOREST VOLUME, GROWTH RATE, SPECIES COMPOSITION AND VALUE: A CASE STUDY

The spreadsheet on the next page is a case study that shows how a stand is transformed over the decades with restoration forestry. This land was first purchased by Forever Redwood in 1994 and has been under our management for over 25 years.

The case study assumes that a fire or a plague will not destroy the 83-acre parcel. The risk of fire is discussed along with the financial implications. The stand is a young Redwood and Douglas-fir forest recovering from heavy logging done in the mid-1960s. This is the typical condition of most Redwood forests today outside of park protection (approximately 75% of the acreage).

The land was thinned initially in 1995 and was logged for 15% of the volume in 1997. In 2012, it was again logged for 15% of the volume. We reduced our typical rate of cut, which is 20% every 15 years, because the trees were still too young and the volume insufficient. In 2027, we will have sufficient volume to increase the rate of cut to 20% of the standing timber volume.

If you study the numbers on the spreadsheet, 3 things will jump out at you:

- The mix of trees and volume will slowly rebalance to more Redwoods and other conifers over time (as it was prior to the industrial logging of the 1960's).

- The amount of standing timber triples from 7,100 Board Feet per acre (BF/ac) in 1994 to 21,345 BF/ac in 2042. It continues to increase under a conservative management regimen until reaching approximately 33,700 BF/acre in the 2080's. It then levels off and remains at this level as long as the rate of cut is adhered to.

- Most of the financial value of the forest is in the Redwoods. Redwood lumber is much more valuable than the Douglas-fir, sugar pine, or the hardwoods that comprise this forest. Given this, if a devastating fire sweeps through Annapolis in the coming decades and kills all the non-Redwood trees, most of the value of the stand will remain untouched since the Redwoods will resprout new branches and the main limbs and trunk will continue to live.

Annual growth in BF/ac increases with standing volume and slows as volume approaches maximum stocking. These numbers are estimates only. Making predictions over many decades is a hazardous business at best—this long-term table was created using generally acceptable growth rates for similar stands to show what is possible by following good principles consistently. Although it is a model for management purposes and not a predictor of future outcomes, it is a living example that we wish to highlight, not a theoretical one. The lands are in Annapolis, California, and can be visited by appointment.

ESTIMATED CHANGES ON 83 ACRES OF LAND MANAGED BY FOREVER REDWOOD OVER A 60-YEAR PERIOD

N. Fk Fuller Ck, 83 acres, parcels 10 & 11, 2015 estimates

Species	$ Value/BF Net of Expenses	Before Thin in yr - 1994 Vol-BF	Vol %	Net $ Value	Thin Vol	Vol %	Net $ Value	After Thin (1995) Vol	Vol %	Net $ Value
Hardwoods	$ -	7700	52.0%	$ -	3080	40.0%	$ -	4620	39.4%	$ -
Redwood	$ 0.50	3451	23.3%	$ 1,726		0.0%	$ -	3451	29.4%	$ 1,726
Fir	$ 0.15	3276	22.1%	$ 491		0.0%	$ -	3276	28.0%	$ 491
Pine	$ 0.10	373	2.5%	$ 37		0.0%	$ -	373	3.2%	$ 37
Tot Conifers		7100	48.0%	$ 2,254	0	0.0%	$ -	7100	60.6%	$ 2,254
Totals/ac		14800	100%	$ 2,254	3080	20.8%	$ -	11720	100%	$ 2,254
Conifer Growth =		231 BF/ac/yr			Thin =	0.0%	of 15-yr conifer growth		0.0%	of total value
Hardwood Growth =		269.5 BF/ac/yr								

Acres: 83.0

		Before Thin in yr - 1997			Thin		Net $ Vali	After Thin		
Hardwoods		7748	49.1%	$ -	0	0.0%	$ -	7748	53.3%	$ -
Redwood	$ 0.55	3910	24.8%	$ 2,150	586	15.0%	$ 323	3323	22.8%	$ 1,828
Fir	$ 0.17	3712	23.5%	$ 612	594	16.0%	$ 98	3118	21.4%	$ 514
Pine	$ 0.11	423	2.7%	$ 46	63	15.0%	$ 7	359	2.5%	$ 40
Tot Conifers		8044	50.9%	$ 2,809	1244	15.5%	$ 428	6801	46.7%	$ 2,382
Totals/ac		15792	100%	$ 2,809	1244	7.9%	$ 428	14548.25	100%	$ 2,382
Conifer Growth =		63 BF/ac/yr			Thin =	131.7%	of 15-yr conifer growth		15.2%	of total value
Hardwood Growth =		209 BF/ac/yr								

Net standing timber value: $ 178,490
Net standing timber value/ac, $: $ 2,343
% increase, net timber value/15 yrs 24.6%
Net log revenues from thin $ 35,485
(2015 dollars)
(4.25 % avg annual growth rate)
Acres: 83.0

		Before Thin in yr - 2012			Thin		Net $ Vali	After Thin		
Hardwoods		12517	50.1%	$ -	626	5.0%	$ -	11891	52.9%	$ -
Redwood	$ 0.61	5986	23.9%	$ 3,621	898	15.0%	$ 543	5088	22.6%	$ 3,078
Fir	$ 0.18	5823	23.3%	$ 1,057	873	15.0%	$ 159	4949	22.0%	$ 898
Pine	$ 0.12	671	2.7%	$ 81	101	15.0%	$ 12	570	2.5%	$ 69
Tot Conifers		12479	49.9%	$ 4,759	1872	15.0%	$ 714	10607	47.1%	$ 4,045
Totals/ac		24997	100%	$ 4,759	2498	10.0%	$ 714	22498.78	100%	$ 4,045
Conifer Growth =		379 BF/ac/yr			Thin =	33.0%	of 15-yr conifer growth		15.0%	of total value
Hardwood Growth =		318 BF/ac/yr								

Net standing timber value: $ 300,566
Net standing timber value/ac, $: $ 3,977
% increase, net timber value/15 yrs 68.4%
Net log revenues from thin $ 59,253
(2015 dollars)
(4.0 % avg annual growth rate - 1.801)
Acres: 83.0

		Before Thin in yr - 2027			Thin			After Thin		
Hardwoods		18528	50.1%	$ -	4632	25.0%	$ -	13896	48.5%	$ -
Redwood	$ 0.67	8838	23.9%	$ 5,882	1768	20.0%	$ 1,176	7070	24.7%	$ 4,705
Fir	$ 0.20	8598	23.3%	$ 1,717	1720	20.0%	$ 343	6878	24.0%	$ 1,373
Pine	$ 0.13	991	2.7%	$ 132	198	20.0%	$ 26	792	2.8%	$ 105
Tot Conifers		18426	49.9%	$ 7,730	3685	20.0%	$ 1,546	14741	51.5%	$ 6,184
Totals/ac		36954	100%	$ 7,730	8317	22.5%	$ 1,546	28636.86	100%	$ 6,184
Conifer Growth =		521 BF/ac/yr			Thin =	47.1%	of 15-yr conifer growth		20.0%	of total value
Hardwood Growth =		442 BF/ac/yr								

Net standing timber value: $ 488,175
Net standing timber value/ac, $: $ 6,080
% increase, net timber value/15 yrs 62.4%
Net log revenues from thin $ 128,318
(2015 dollars)
(3.75 % avg annual growth rate - 1.7371)
Acres: 83.0

		Before Thin in yr - 2042			Thin			After Thin		
Hardwoods		20876	49.4%	$ -	5219	25.0%	$ -	15657	47.8%	$ -
Redwood	$ 0.73	10238	24.2%	$ 7,495	2048	20.0%	$ 1,499	8190	25.0%	$ 5,996
Fir	$ 0.22	9959	23.6%	$ 2,187	1992	20.0%	$ 437	7968	24.3%	$ 1,750
Pine	$ 0.15	1147	2.7%	$ 168	229	20.0%	$ 34	918	2.8%	$ 134
Tot Conifers		21345	50.6%	$ 9,850	4269	20.0%	$ 1,970	17076	52.2%	$ 7,880
Totals/ac		42221	100%	$ 9,850	9488	22.5%	$ 1,970	32732.79	100%	$ 7,880
Conifer Growth =		440 BF/ac/yr			Thin =	64.6%	of 15-yr conifer growth		20.0%	of total value
Hardwood Growth =		465 BF/ac/yr								

Net standing timber value: $ 622,052
Net standing timber value/ac, $: $ 7,747
% increase, net timber value/15 yrs 27.4%
Net log revenues from thin $ 163,508
(2015 dollars)
(3.25% avg annual growth rate - 1.448)
Acres: 83.0

		Before Thin in yr - 2057			Thin			After Thin		
Hardwoods	$ -	21434	44.6%	$ -	5777	27.0%	$ -	15657	42.4%	$ -
Redwood	$ 0.81	12760	26.6%	$ 10,275	2552	20.0%	$ 2,055	10208	27.6%	$ 8,220
Fir	$ 0.24	12414	25.8%	$ 2,999	2483	20.0%	$ 600	9931	26.9%	$ 2,399
Pine	$ 0.16	1430	3.0%	$ 230	286	20.0%	$ 46	1144	3.1%	$ 184
Tot Conifers		26604	55.4%	$ 13,505	5321	20.0%	$ 2,701	21283	57.6%	$ 10,804
Totals/ac		48039	100%	$ 13,505	11098	23.1%	$ 2,701	36940.28	100%	$ 10,804
Conifer Growth =		635 BF/ac/yr			Thin =	55.8%	of 15-yr conifer growth		20.0%	of total value
Hardwood Growth =		385 BF/ac/yr								

Net standing timber value: $ 852,859
Net standing timber value/ac, $: $ 10,622
% increase, net timber value/15 yrs 37.1%
Net log revenues from thin $ 224,176
(2015 dollars)
(3.0 % avg annual growth rate - 1.558)
Acres: 83.0

		Before Thin in yr - 2072			Thin			After Thin		
Hardwoods	$ -	19571	38.8%	$ -	3914	20.0%	$ -	15657	38.8%	$ -
Redwood	$ 0.89	14782	29.3%	$ 13,093	2956	20.0%	$ 2,619	11825	29.3%	$ 10,475
Fir	$ 0.27	14380	28.5%	$ 3,821	2876	20.0%	$ 764	11504	28.5%	$ 3,057
Pine	$ 0.18	1657	3.3%	$ 294	331	20.0%	$ 59	1325	3.3%	$ 235
Tot Conifers		30818	61.2%	$ 17,208	6164	20.0%	$ 3,442	24655	61.2%	$ 13,766
Totals/ac		50389	100%	$ 17,208	10078	20.0%	$ 3,442	40311.56	100%	$ 13,766
Conifer Growth =		636 BF/ac/yr			Thin =	64.6%	of 15-yr conifer growth		20.0%	of total value
Hardwood Growth =		261 BF/ac/yr								

Net standing timber value: $1,086,747
Net standing timber value/ac, $: $ 13,534
% increase, net timber value/15 yrs 27.4%
Net log revenues from thin $ 285,654
(2015 dollars)
(2.5% avg annual growth rate - 1.448)
Acres: 83.0

		Before Thin in yr - 2087			Thin			After Thin		
Hardwoods	$ -	19571	36.7%	$ -	3914	20.0%	$ -	15657	36.7%	$ -
Redwood	$ 0.97	16189	30.4%	$ 15,774	3238	20.0%	$ 3,155	12951	30.4%	$ 12,619
Fir	$ 0.29	15749	29.5%	$ 4,603	3150	20.0%	$ 921	12599	29.5%	$ 3,683
Pine	$ 0.19	1814	3.4%	$ 354	363	20.0%	$ 71	1452	3.4%	$ 283
Tot Conifers		33752	63.3%	$ 20,731	6750	20.0%	$ 4,146	27002	63.3%	$ 16,585
Totals/ac		53323	100%	$ 20,731	10665	20.0%	$ 4,146	42658.68	100%	$ 16,585
Conifer Growth =		607 BF/ac/yr			Thin =	74.2%	of 15-yr conifer growth		20.0%	of total value
Hardwood Growth =		261 BF/ac/yr								

Net standing timber value: $1,309,225
Net standing timber value/ac, $: $ 16,305
% increase, net timber value/15 yrs 20.5%
Net log revenues from thin $ 344,133
(2015 dollars)
(2.0% avg annual growth rate - 1.369)
Acres: 83.0

		Before Thin in yr - 2102			Thin			After Thin		
Hardwoods	$ -	19571	36.7%	$ -	3914	20.0%	$ -	15657	36.7%	$ -
Redwood	$ 1.07	16189	30.4%	$ 17,351	3238	20.0%	$ 3,470	12951	30.4%	$ 13,881
Fir	$ 0.32	15749	29.5%	$ 5,064	3150	20.0%	$ 1,013	12599	29.5%	$ 4,051
Pine	$ 0.21	1814	3.4%	$ 389	363	20.0%	$ 78	1452	3.4%	$ 311
Tot Conifers		33752	63.3%	$ 22,804	6750	20.0%	$ 4,561	27002	63.3%	$ 18,243
Totals/ac		53323	100%	$ 22,804	10665	20.0%	$ 4,561	42658.68	100%	$ 18,243
Conifer Growth =		450 BF/ac/yr			Thin =	100.0%	of 15-yr conifer growth		20.0%	of total value
Hardwood Growth =		261 BF/ac/yr								

Net standing timber value: $1,440,148
Net standing timber value/ac, $: $ 17,936
% increase, net timber value/15 yrs 10.0%
Net log revenues from thin $ 378,546
(2015 dollars)
(1.5% avg annual growth rate - 1.25)
(Growth & Thin in balance)
Acres: 83.0

Log stumpage values over past 50 years for Redwood and Douglas-fir have increased by more than double the rate of inflation
Growth rates begin at 3.5%/yr and decrease to 1.5%/yr over 80 yrs (in balance with thin rate at that juncture)
No added value given to logs for vastly increased timber quality (very conservative)
Growth rates used are conservative for this avg quality Redwood forestland (site III, lower site III)
Hardwood thinnng numbers are not exact - goal is to thin more aggressively to lower competition with conifers but maintain stand at historic levels
Hardwood numbers converted to BF estimates for sake of this spreadsheet. But hardwood numbers usually stated in cubic foot terms.

There exists an extensive body of literature to support Forever Redwood's ecology and economy model. For example, the following article first appeared in the International Journal of Ecoforestry in the spring of 1996. It is excerpted and reprinted here with permission from the author, Mr. Hans Burkhardt, Ph.D

THE ECONOMIC ASPECT OF ECOFORESTRY by Mr. Hans Burkhardt, Ph.D

A PRESCRIPTION THAT MAKES ENVIRONMENTAL PROTECTION AND MAXIMUM PERPETUAL REVENUE FLOW COMPATIBLE

For anyone who is at all aware of our planetary ecological condition, it is starkly clear that our society must stop its current suicidal mode of action, and we must find more sustainable ways to live and do business. While it is critical that we make sweeping changes in several areas, such as population reduction, overconsumption and fossil fuel use, my purpose is to focus on one critical area—our relationship to the native forest resource.

My intention here is to give information that can be adapted and applied anywhere by people who wish to know how one can restore and sustainably use depleted forest resources. I make my recommendations with deference to economic considerations, because in our money-driven society it is economic viability that will bear strongly on the success or failure of whatever changes we plan to bring about. Consensus opinion assumes that high monetary profits from our forests and good ecological protection are mutually exclusive. However, it is my conclusion, drawn from closely investigating several examples of sound forest management as well as my own experience derived from restoring an inventory-depleted forest, that we can have both: what is good for the survival of the forest is good for the well-being of local communities if only we are patient and wise enough to create such a condition.

HOW TREES GROW

Tree growth can be divided into three phases:

- The first phase is characterized by very high, rapidly declining percentage growth but negligible volume production. For example, a pencil-thin tree may double in volume in one year, but the volume added amounts to very little. (Growth rates of 100% declining to about 7%.)

- The second phase is characterized by lower, gradually declining percentage growth, high volume growth and ends when average annual volume growth culminates. (Growth rates declining from about 7% to 2%.)

- The third phase is characterized by continued declining percentage growth and a slowly decreasing high volume growth. (Growth rates below 2%.)

All conifers continue to grow substantially in the third phase, some more and longer than others. Redwoods and cedars increase volume considerably for many hundreds of years after reaching culmination of average annual volume growth (CMAI, culmination of mean annual increment.) Also—and this is most important—all tree species show a significant increase in the quality of their wood during the slower, post CMAI phase of growth. This period—when the forest becomes mature—is also the most important for the creation of high inventory and forest sustainability. For the perpetuation of California's redwood forests, this third phase is especially important since it is needed to allow for natural regeneration and thus continued genetic adaptation to changing environmental conditions. Therefore, if native forests are to be used for perpetual timber production, it is imperative, for reasons that include maximum long-term revenue flow for the owner and the local community, not to eliminate this lucrative component of all native forests.

Current North American forestry practice, with few exceptions, does indeed eliminate this third, most important phase of tree growth. And worse, not only are those older trees being systematically eradicated, but even much younger trees—trees in their most active, pre-CMAI period of growth—are routinely harvested under the current practices of industrial forestry. This level of overcutting has finally made the ongoing destruction of our native forests clearly apparent to everyone who is concerned with our own and other species' survival.

HOW TO RESTORE FOREST HEALTH AND INCREASE PRODUCTIVITY

There is a way to harvest trees for human use that can both increase the future productivity of these depleted forests and at the same time allow them to regenerate and restore themselves. We must do two things. We must harvest, for a considerable length of time, less than is growing, and we must adjust the harvest rate to maintain high inventories of trees in the forests once they are restored. For the few remaining forests not yet damaged by unwise human interference, we need only maintain high inventory, which can be accomplished by harvesting a certain percentage of inventory, as I will explain later.

THE STUDY

A study was conducted designed to simulate various levels of harvest projected into the future to predict the effects on both the sustained health of the forest and its long-term economic productivity. For reliable predictions of future forest growth, one must use the appropriate yield table available, which shows the volume per acre that is likely to be produced for each age class (decade) at a given site. For this study, the yield table produced by Lindquist and Palley (L&P) in 1963 for typical, fully stocked second-growth mixed conifer redwood forest was used as a basis. However, to account for site degradation due to post 1963 liquidation logging, a reduction in the yield table's calculations was necessary: productivity data from a 1985 Federal Inventory Assessment study led to the conclusion that this could be achieved by lowering site quality from average site index 160 to site index 140 (see yield table on page 62). The actual degree of site occupancy or stocking must also be considered. In this study the average values found by the 1985 Federal Inventory Assessment study were used (55%). In addition, to consider the growth lowering effects of long-term inventory depletion as well as growth favoring effect of long-term inventory increases, yield table values of 50% and 60% respectively were used instead of 55% for both types of scenarios.

One special problem with the yield table used was that there are no second growth stands of redwood older than 120 years in existence. Therefore values had to be constructed by extrapolation of the L&P growth curve and comparison with other conifer growth curves that include the higher age classes. The resulting yield values are presented in page 62 in the Yield-MBF/acre column.

To simulate forest growth, various percentages of standing inventories were harvested. This principle is called percent-of-inventory (POI) harvest control: forests are harvested every decade at a chosen rate of inventory eventually develop an age-class structure that includes all age classes up to rotation age. **Regardless of the initial age-class distribution and growth rate, a forest which is harvested at a specific percent of inventory will eventually grow exactly at that rate.** When the forest has reached this condition it is fully regulated. Harvest percentages can be chosen that characterize good or bad forestry, percentages that will result in plenty of age classes, or just a few.

It is important to note that average percentage growth rates **higher**, not lower than those that result in maximum productivity (about 2%), **lead to sacrifices in both productive capacity and forest sustainability.** (See table on page 62.)

From the yield table being used, one can calculate average percent annual growth up to and including any given age class (decade) by simply dividing the total volume listed for this age class by the sum of all listed age class volumes and multiplying the result by 10. **For most conifer forests the world over, the average growth rate that results in maximum productivity (CMAI) at full regulation is close to 2%.** To arrive at the harvest rate that leads to the highest value of yield at harvest (culmination of revenue flow) 1.0% and 0.9% harvest rates had to be used. These harvest percentages are compared with those presently being practiced by industry in our area: the two largest local timber companies, Louisiana Pacific (L-P) and Georgia-Pacific (G-P) corporations in their long-range sustained yield plans anticipate harvesting at annual rates of 4-6 percent of inventory in the near future. While L-P anticipates dropping their annual harvests to 1-3% of inventory in the very distant future, G-P anticipates a 4.4% harvest rate until the year 2100.

Therefore, for this study, the forest was "harvested" at five annual rates of POI (6.0, 4.5, 2.0, 1.0, 0.9) until growth rates approached harvest rates (full regulation). This can be done by either simple mathematics or by using a suitable computer program. (For instance "Harvest II" is described in the book ***Maximizing Forest Productivity*** by H. Burkhardt.) Using this procedure, values for inventory, age of oldest trees, productivity and annual harvest were obtained for each scenario. Also assigned is a much-needed value for forest sustainability, which is defined as regulated MBF/acre inventory (= available biomass) divided by the annual percent of inventory harvest (= removal of biomass). The higher the regulated inventory and the lower the annual POI harvest, the higher is the degree of forest sustainability. The accompanying three-dimensional graph and table summarize the most important results of this analysis.

THE MAJOR CONCLUSIONS WHICH CAN BE DRAWN ARE:

1. Revenue flow culminates at a harvest level of approximately 1% of inventory per year (POI 1).

2. Productivity measured in board feet (international 1/4" rule) culminates at a harvest level of approximately 2% of inventory per year (POI 2).

3. Forest sustainability at the levels investigated is highest at 0.9% of inventory per year (POI 0.9).

4. Unsustainable and low present revenue flow (POI 4.5 and 6) could gradually be increased by a factor of 2 to 3 and become sustainable at the same time if a lower POI is used (POI 2, 1, or 0.9). Community impoverishment would slowly but steadily be replaced by community well being. Forest product quality would gradually change from poor to excellent, and forest related jobs could be increased by 180-250%.

5. The average time needed to fully restore our depleted forests' productive capacity and health is about equivalent to the time it took to liquidate inventory and damage forest health: one to two centuries.

6. Industrial forestry, which maximizes short-term profit, leads to annual harvest levels greater than 3 percent of inventory. The consequences of this practice are loss of the following: inventory, productive capacity, potential tax base, permanent jobs, timber quality, community stability, biodiversity and substantial long-term land-owner income.

7. The requirements of Ecoforestry can only be fulfilled at an annual harvest level of 1% of inventory or lower. All other harvest levels reduce too much of the richness, biodiversity and sustainability of the forest.

8. Forest sustainability increases four-fold if the forest is managed for maximum revenue flow (POI 1) rather than maximum yield in board feet (POI 2).

9. Practice of POI 1 harvest control (forest management aimed at maximizing revenue flow) leads to the creation of a secondary forest of near old-growth characteristics, where all age classes are uniformly distributed and the oldest trees are about 200 years old.

In conclusion, one can see that high perpetual revenue flow and good environmental protection are not diametrically opposed. On the contrary, up to the point of maximum revenue flow at approximately the POI 1 harvest level, both seemingly opposing goals of forest management actually improve in synchronous harmony. Harvesting 1% of inventory is the best long-term investment policy for the general public, the local community, the landowner and the forest, when that forest is to be used for timber production while maintaining its ecological integrity.

HARVEST SIMULATOR – STARTING INVENTORY: 8,000 BOARD FEET (BF) YIELD TABLE: L&P SITE INDEX 140 X 50/60%11

POI[2]	Inventory per Acre (at FR)[3]	Age of Oldest Trees Harvested (at FR)	Harvest Level per acre/year (at FR)	Harvest Value per acre/year (at FR) $ per BF[4]	Type of Forestry Practiced[5]	Sustainability of Resource[6]
6.0	4,500	43	270	270	IF	.75
4.5	8,400	57	378	378	IF	1.77
2.0	34,000	108	680	680	MSP	17.00
1.0	67,500	195	675	1012	EF	67.50
0.9	72,200	215	650	975	EF	80.00

1 Actual yield table figures are reduced to account for the depleted condition of the forest soil and the inventory stocking levels. 50% is used when inventory is further reduced. 60% when inventory is increased (see text).

2 POI = Annual harvest as a percent of total inventory.

3 FR = Fully regulated, the condition when growth and harvest are equal and inventory remains constant. For example, full regulation for POI 1.0 is reached at 210 years.

4 Harvest value reflects the current market price of $1.00 per BF for average quality boards (POI 6.0 to 2.0) and $1.50 for mature and old-growth boards (POI 1 and 0.9)

5 IF = Industrial forestry: Net present value maximization leads to low inventory, reduced productive capacity, destruction of biodiversity and to community impoverishment. EF = Ecological responsible forestry; optimizes forest health and revenue flow, respects intrinsic worth of all natural beings; avoids clearcutting and respects the natural aesthetic qualities of the landscape.

6 The ratio of regulated board feet per acre inventory (available biomass) divided by the annual POI harvest (biomass removal) is used as a measure of forest sustainability.

MAXIMIZING POI 1 FOR OLD-GROWTH CHARACTERISTICS

The principle points of Mr. Burkhardt's 1994 study have been adopted by Forever Redwood as the long-term framework of its forest management plan. Forever Redwood's forest management plan is based on the POI 1 study with a few important adjustments:

The original study estimates that maximum productivity will only reach 680 BF/year. This figure is 48.8% of the published table's maximum of 1,390 BF/year (L&P Site Index 140) and 85% of Forever Redwood's estimated peak productivity of 800 BF/year. The discrepancy exists because Mr. Burkhardt's study focused on the benefits of volume recovery and pre-supposed that little or no restoration work would be done to most of the local industrial forests that are now dominated by hardwoods. Many of these lands now grow more hardwoods than conifer lumber. Although this may change somewhat over time, a program of regular thinning and planting would slowly return these degraded lands closer to their previous productivity. Without these additional efforts, overall productivity will remain significantly below historical levels as this study clearly shows. Forever Redwood's harvest rates are set at 1.0% POI. Five trees are set aside per acre to age to full maturity (over 500 years). The combination of extensive thinning and planting to restore conifer dominance and the oldgrowth set-asides helps Forever Redwood achieve the results of Mr. Burkhardt's 0.9 POI plan for optimum sustainability.

The complete study, as originally written in the book "Maximizing Forest Productivity," was an attempt to change the way the industrial forestry companies were managing the Mendocino County Redwood forest. To placate the industry, the study was written to allow the oldest trees to be harvested each decade. Because of the conservative rate of cut, the forest would still mature over time until the oldest trees were approximately 200 years old. But, in the intervening decade, the industrial forest industry in northern California has significantly collapsed from its own over-cutting and these well-thought out studies were primarily ignored by the large companies. Today, Forever Redwood is working to maximize the amount of mature and old-growth trees standing in the forest in the shortest amount of time possible. To do this, we spread the 20% cut over all age classes and no tree over 45 inches in diameter is ever cut. If this change to the 1994 study is overlooked, the forest would still increase in volume at the same rate and eventually achieve old-growth, but at the unnecessary price of losing its best trees each decade.

Trees over 45 inches are left as old-growth and most mature trees are retained decade by decade to maximize mature and old-growth characteristics consistently from day one. A 2002 field study estimated the tree-size distribution changes in a 45-acre degraded parcel that distributes the 20% volume cut every fifteen years across age and size classes. The 45-acre study parcel included remnants of mature and old-growth trees left standing after a 95% volume removal in the early 1960's. This study demonstrated the dramatic changes possible by balancing the economic needs of harvesting the larger trees with the ecological needs of the forest to maintain as many mature and old-growth trees as possible at all times.

Forever Redwood achieves its cut rate by limiting the amount of trees cut under 30" dbh to only the poorly formed, diseased or suppressed. The study translates this into an average of a 5% cut per size class under 30 inches. Trees between 30 and 44 inches dbh are cut at a rate averaging 20% per decade. Many of these larger trees are also chosen among the less valuable in their class (leaning, defects, small growing crowns, or overcrowded with excellent replacements nearby). Vigorouslygrowing, well-formed trees, either atop the canopy or below are usually left to mature to old-growth. All trees over 44 inches are always left as oldgrowth—whether alive or as snags. The conservative cutting of POI 1 allows a much greater amount of smaller trees to grow into each size class in the intervening decade than the amount cut. A consistently growing income stream is created while the amount of mature and old-growth trees increases decade by decade.

The 20% thinning rate is not cumulative in two ways. First, if a forest owner elects to not cut for thirty years, it would degrade the forest to add the 20% per decade allowable cuts of the past and cut 40% now. In other words, if you skip a thinning, the cut should still be maintained at 20% now and in any future fifteen-year period to avoid diluting the restoration of old-growth and its ability to produce high quality wood products. Second, the 20% cut should be distributed in a relatively even manner across the entire acreage. Otherwise, it can be argued that a 10-acre clearcut on a 50-acre parcel is technically a 20% cut. Obviously this or less extreme variations of this scenario are mathematical arguments that undermine real restoration.

Raul Hernandez discussing forestry with Tim Mertz, land manager for New Island Capital, in October 2014 on New Island Capital lands. As part of our mission to restore forestlands, Forever Redwood also purchases Redwood and Douglas-fir logs from New Island Capital.

New Island Capital manages over 20,000 acres in and around Humboldt County. Tim has a long history of practical conservation, excellent forestry practices and forest activism going back decades including working on the fight over the Headwaters Forest in the early 90's. Tim shares our passion for restoring the species composition, standing tree volume and all the other nerdy statistics that go into bringing back the majesty of mature and ancient forestlands. See page 66 for a video featuring Tim Mertz speaking about his work.

Restoration forestry is slowly becoming the new normal in Northern California. Back in the early 90's the common wisdom was that restoration was a pipe dream and that smart money would go elsewhere. Forever Redwood and a few other "idealists" persevered and today, at least in Northern California, a significant portion of forestlands are being managed under plans that were considered impractical just 2 decades ago.

APPENDICES

APPENDIX A

This section includes numerous videos, articles and media resources that offer a deeper understanding of the big picture of restoration forestry and its role in carbon sequestration and global cooling, as well as older articles that cover the Forest Stewardship Council (FSC), the history of Jackson State Demonstration forest, and the work of Old-Growth Again.

APPENDIX B

Additional Reading

APPENDIX C

Maps

APPENDIX D

The Conservation Easement Agreement: explains the legal structure and function of the conservation easement. A template of a simple easement agreement is included.

APPENDIX A

RESTORATION FORESTRY VIDEOS, ARTICLES, AND MEDIA RESOURCES

VIDEOS

- This brief video explains the guiding principles of forest restoration.

- This video features Raul's colleague Tim Metz and his work with Sanctuary Forest. It provides an indepth discussion of restoration forestry management, including the methods and best practices that make this work possible.

- In this video, Raul discusses the relationship between the furniture manufactured by Forever Redwood and restoration forestry.

- This is an older video (2002) and is quite pixelated, but it offers an excellent overview of the origins of Old-Growth Again Restoration Forestry and Forever Redwood.

- Raul Hernandez, Founder and CEO, hosted a live Q&A in January 2019 for folks interested in becoming a conservation-investor in a restoration forestry project.

ARTICLES

Articles by Raul Hernandez, published in Mother Earth News:

- **"Nevermind the Politics, Forests Can Help Cool the Planet"** August 26, 2016

- **"Forestry, Global Warming, and the Multi-Billion-Dollar Carbon-Credit Grab"** July 9, 2016

Additional articles to better understand the big picture of restoration forestry and its role in carbon sequestration and global cooling:

- **"Scientists Propose Restoring Forests to Fight Climate Change"**
December 9, 2018 | **Truthdig**
New research shows that going back to nature through more environmentally conscious land use could help the U.S. could cut a fifth of its greenhouse gas emissions.

- **"The Best Technology for Fighting Climate Change Isn't a Technology"**
December 5, 2018 | **Scientific American**
Forests are the most powerful and efficient carbon-capture system on the planet.

- **"Climate change: Where we are in seven charts and what you can do to help"**
December 2, 2018 | **BBC News**
Where we are in seven charts and what you can do to help. As representatives gather in Poland for talks on climate change, we look at how hot the world has got and what we can all do to tackle global warming.

- **The November 2018 UN Climate Report**
While grim, it lays out a path for us to mobilize and meet the challenge of climate change. A major part of the proposed solution is carbon capture via forests.

- **"Major Trump administration climate report says damages are 'intensifying across the country'"**
November 23, 2018 | **The Washington Post**
Scientists are more certain than ever that climate change is already impacting the United States—and that it is going to be very expensive.

- **"Nature could suck up 21 percent of our greenhouse emissions (with a little help)"**
November 15, 2018 | **Grist** article by Greta Moran
More information on how natural measures—including forests, coastal ecosystems, grasslands, and farmland—have the potential to absorb a significant portion of the world's greenhouse gases.

- **Article on the use of lumber as a building material for skyscrapers:**
April 18, 2022 | **The New York Times**
https://www.newyorker.com/magazine/2022/04/25/transforming-trees-into-skyscrapers

Articles on the relationship between tree thinning and effective, responsible forest management:

- **To Help Prevent the Next Big Wildfire, Let the Forest Burn**
November 29, 2018 | **The New York Times**
California needs to abandon the idea that trees are always worth saving and that fire is always a threat. Instead, it should let modest wildfires burn. Includes interactive graphics dealing with California's forest history.

- **"Facing Deadlier Fires, California Tries Something New: More Logging"**
November, 17, 2018 | **The Wall Street Journal**
This Wall Street Journal article discusses the growing political consensus between left and right to adopt one of the principles of forestry management that Forever Redwood has long practiced—tree thinning.

Articles concerning the devastating forest fires that, in part, motivated Forever Redwood's November 2018 crowdfunding effort to purchase and restore a parcel of forestland:

- **"Number of Camp Fire missing people drops to 25"**
December 2, 2018 | **USA Today**
More than three weeks after the Camp Fire began ravaging Northern California, the Butte County Sheriff announced Saturday the number of unaccounted for has dropped to 25 people.

- **"'Some of these people are not going to be identified.' Naming Camp Fire victims an uncertain task"**
November 18, 2018 | **The Sacramento Bee**
Investigators will use dental records, DNA evidence, motor vehicle numbers and other clues to identify victims of the Camp Fire in Butte County, California. Over 70 people died in the wildfire, the deadliest in state history, as of Saturday. Includes a short video.

- **"Woolsey fire destroys scores of homes, forcing 200,000 to evacuate; flames get closer to Pepperdine"**
November 10, 2018 | **Los Angeles Times**
The Woolsey Fire made a destructive march through Ventura and Los Angeles counties on Friday, destroying numerous suburban homes, closing freeways. Includes slideshow of 77 images.

- **"'Our town has burned': Most of Paradise, California, is lost after wildfire ravages the area"**
November 9, 2018 | **The Mercury News**
Paradise residents fled the fast-moving Camp Fire and now wait to see the likely devastating destruction of their bucolic foothills town. Includes short video, plus an infographic about California's most destructive wildfires for structures.

- **"It's pretty grim': Paradise burns as Camp Fire rips through town"**
November 8, 2018 | **The Sacramento Bee**
Includes a short video.

Older Articles
The following pages include these clipped and reprinted articles:

- **"Restorative Forestry at Little Creek"**
Winter 2001 | **Sonoma Land Trust Newsletter**
This article discusses the work of Old-Growth Again, detailing the restoration forestry easement placed on a 40-acre parcel in Annapolis, CA.

- **"A new start for old growth"**
July 16, 2001 | **Marin Independent Journal**
A humorous piece about OGA's furniture making as a source of funding for its restoration efforts.

- **"Against the Grain: How Home Depot and Activists Joined To Cut Logging Abuse"**
September 26, 2000 | **The Wall Street Journal**
This article introduces the Forest Stewardship Council (FSC).

- **"A Forest to Conserve and Harvest"**
November 23, 1997 | **Santa Rosa Democrat**
Details the 50-year history of the 50,200-acre Jackson State Demonstration forest. The Redwood forest was exhausted and degraded by logging by the 1940's. It was purchased by the state in 1947 and nurtured back to a highly productive, beautiful forest by 1990. In the next decade, the state increased logging and caused some controversy locally. Although they would serve the forest best by returning to a lower rate of cut and eliminating the use of herbicides, Jackson forest is still a good example of the long-term results possible if you practice restoration and sustainable forestry over the long term.

SONOMA LAND TRUST

news LETTER

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Restorative Forestry at Little Creek

However we feel about timber harvest, we can hardly avoid the use of wood products. Reduce, reuse and recycle as we will, there's still the fence or planter box that needs to be built, the dry rot repair that can't be put off, the addition to accommodate a growing family or business. When we use wood products, we want to know that they have been harvested responsibly. Project Manager Aimee Carroll writes here about a new conservation easement which speaks to that concern.

Then and Now

In December 2000, SLT recorded its first "restorative forestry" easement, protecting 40 acres up in Sonoma County's rugged north country near Annapolis. Once an old-growth north coast coniferous forest, the land was heavily logged during the fifties and today is a tangled mass of tanoak, poison oak, and manzanita.

Tomorrow

But the land will look different in the future, thanks to the efforts of Little Creek landowners Warren and Joan Linney. The Linneys and their restoration forestry partners are working to renew the land and restore the forest to its previous glory as a mature and complex native north coast coniferous ecosystem. This restoration project will allow an undisturbed old growth-quality stand to develop in the riparian zone along Little Creek, while other portions of the property will be sustainably harvested.

Little Creek photo by Raul Hernandez

What does "Restorative Forestry" mean, anyway?

"Restorative Forestry is sustainable forestry plus," says Raul Hernandez, a staff member of Old Growth Again (OGA), the nonprofit forest restoration organization that is partnering with the Linneys on the Little Creek project. OGA is currently working its forest restoration artistry on 400 acres in Sonoma and Mendocino counties.

Raul describes the ethic of OGA this way: "We use no chemicals for the thinning process, and we set aside 15% percent of the land to return to old growth. The remaining 85% will be a productive forest with some old growth and lots of mature trees for cover." Thinning of tanoak and other vegetation is done by hand with

see page 5

A matter of long term commitment

When an office survey about the meaning of "old growth" yielded no consensus and we wondered whether we could really talk about restoring old growth, we went to our local forestry expert, Dr. Fred Euphrat, principal of Earth, Soil and Water and host of Native Sonoma. Here's what he said.

Old growth...

It's a subjective, fuzzy term.

Original vegetation may mean what was here when the Euro-Americans showed.

That could be old growth. In that case, it's trees that are 250 yrs old in the West, down to 150 if you like. In the East.... Well... ? 400? years?

Old growth may mean big trees. 250 year-old redwoods are generally big, but sometimes they're smallish. Sequeira [Red Hill Ranch] had small 250 year old trees. Big trees may also be young. Most of the honkin' doug-fir here are less than 200 but more than 36 inches diameter.

Generally, 36-inch diameter is considered 'having old growth characteristics.' These include mossy canopies, dead trees in the stand (aha! now it's a stand! I thought we were talking trees....oh).

The Forest Service uses a term 'roadless areas' which are 'unentered' or limited entry stands. The young trees in these areas may be

see page 4

Restorative Forestry at Little Creek from page 1

chainsaws, and the tanoak is cut for firewood. Proceeds from the sale of this firewood fund some of OGA's operating expenses. Existing conifer seedlings are given maximum light to encourage their growth. Additional conifer seedlings, purchased from a commercial nursery, are planted out during work parties where landowners and OGA staff bring their families together to share food and renew the forest.

This restoration method, while labor-intensive during the first few years, can yield significant returns down the road. According to Raul, "If we fully restore the ecological productivity of this land, we can make a decent return by harvesting only a portion of what grows every 10 years."

Long term commitment from page 1

the results of fire or other successional events. Young trees in an old growth forest....? But all old folks were young once.

SO.. and I do know what you're talking about... Growing old growth is not WRONG or even ODD. It's RIGHT. We can easily grow old growth forests and treees. It's just a matter of long term commitment. See people as a successional element.

Hey, does this have to do with Hernandez and OGA? If so, he's a client. I must say I have preached 'Grow old growth' for years.

Marin Independent Journal

July 16, 2001 MONDAY Marin County, California

A new start for old growth

Painstaking effort restores once-clear-cut plot to bring back redwood forest

By Rick Polito
IJ reporter

RAUL HERNANDEZ wants to give old growth a new spin.

Hernandez and co-visionary Frank Marrero of Fairfax are the sweat and spirit behind a project to restore forest plots ravaged by clear-cut logging to old-growth conditions. On 40 acres of impossibly rugged, ridiculously steep coastal Sonoma County mountainside, Hernandez, Marrero and a handful of day laborers have taken an inch-by-back-breaking-inch approach to forest management.

"We can rehabilitate the species composition and completely transform it in 20 years," Hernandez says.

The work is almost spiritual. Marrero calls it a "gift to this life."

That gift comes at a price, a sweaty, bone-aching, muscle-tearing price. "You've got to manage every inch of it," Hernandez says.

The two men, who met in a San Rafael Buddhist monastery in the mid-1980s, call their effort Old Growth Again and are at-

IJ photo/Marian Little Utley

tracting attention and money from such agencies as the California Department of Forestry.

Hernandez, 42, and Marrero, 49, hope to create sustainable forests that could be logged selectively over decades, producing valuable wood while preserving a healthy, beautiful habitat.

They are passionate about their cause.

Hernandez left behind an executive-track career in newspaper management at the Miami Tribune. Marrero has owned restaurants, written books and taught school but now works part time so he can give back to the land.

They're passionate, but they have to be. As Marrero says, "It is brutal, only-fools-do-it work."

When the land they have just finished "restoring" was logged around 1960, the loggers chopped down everything and took out the best trees. The forest was then left to grow back on its own, re-creating itself as a completely different habitat, overgrown with tanoak trees, a thick tangle of vegetation choking off the firs and redwood conifers that made up the original old-growth environment.

"Instead of these big, spaced-out trees, you have trees everywhere," Hernandez says.

The effort started seven years ago at their Sonoma County site — up a maze of increasingly rocky, rutted, steep dirt roads above Sea Ranch — when the two men built a cabin to live in during the work. The floor and walls came from a single tree left behind by the loggers three decades before. The ceiling they tore out of a chicken coop in Sebastopol. All the materials were carried by hand down a serpentine trail they etched into the steep hillside

"We built this cabin with two hammers and a dull saw," Marrero says.

With the cabin finished, they began educating themselves about forestry. Hernandez devoured books and traveled to seminars, earning himself a dirty-fingernails degree in forest management.

Then they went to work.

Using small hand tools and sweat, the two men crawled over the 40 acres, cutting down the thick stands of tanoak and hauling the trunks out by hand to be used as firewood. The leaves and smaller branches were left on the ground to decay and feed the land. "Each branch was consciously laid down," Marrero says.

Taking it a step further, they climbed on ladders to prune back limbs on the remaining firs and redwoods, lifting the canopy from the choked, bush-like growth they had found.

In the realm of "before" and "after," "before" was a mess. Impossibly thick, Marrero called it "the opacity zone."

"It was good habitat for rodents," Hernandez explains — "and nothing else," he adds.

The restoration, a painful process, took two years to finish what they could of the 40 acres (stream banks were deemed too fragile to work). The result is an open, idealized woodland, free of the tangled underbrush. The redwoods are receiving light. More are being planted.

Animal species long absent are coming back, Hernandez says. "The birds love it."

The work was just a first step. Hernandez and Marrero now plan to manage the plot of land, bringing back the redwood forest that once flourished here. The original old-growth forest was probably 90 percent conifers, Hernandez explains. Even after years of work pulling out the tanoak, the percentage is still 45 percent.

"Hopefully, we'll get it back to 90 percent," Hernandez says.

In time, decades from now, they will be able to carefully harvest good-quality old-growth wood, leaving enough behind that the logging is truly sustainable.

It's a huge departure from what foresters call "the industrial model."

"The industrial forestry model is: Cut and then leave it till you cut again," Hernandez says.

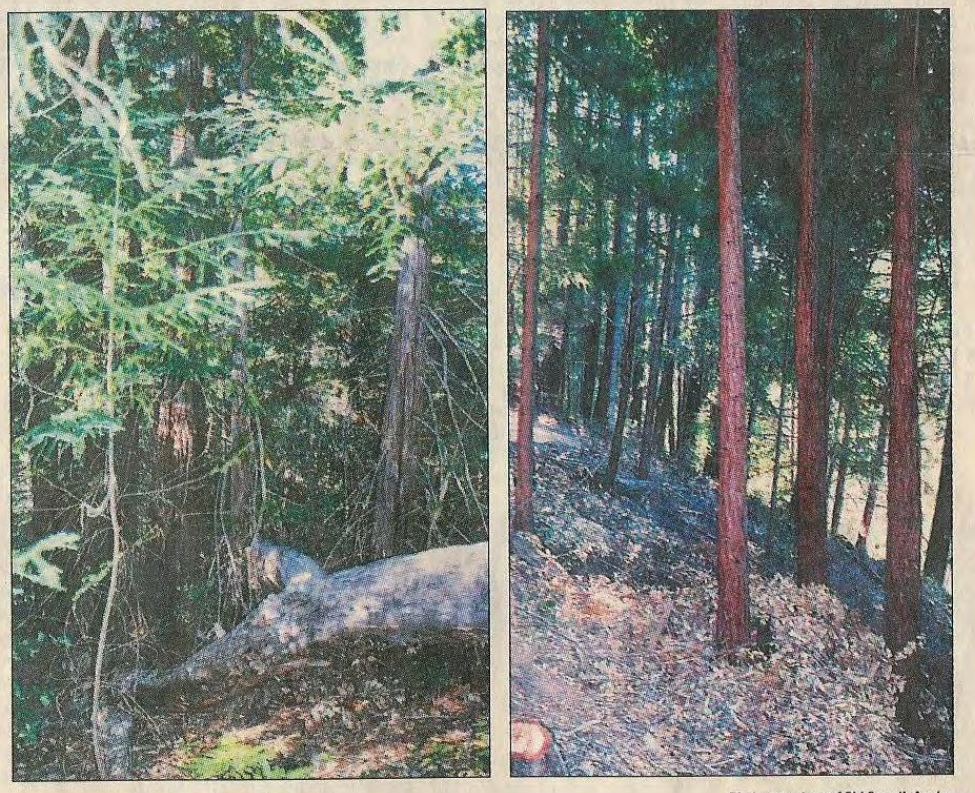
It's a noble aim, but it's no way to make a living.

See Vision, page E2

OFF THE GROUND: Raul Hernandez, left, and Frank Marrero are in business together using old growth redwood trees that are deemed not good enough for commercial purposes. Marrero's 6-year-old son Salem is lifted off the ground atop an old growth redwood bench.

HOW TO HELP

To find out more about Old Growth Again, logon to the Web site at www.oldgrowthagain.org or call 707-495-4955.



Photos courtesy of Old Growth Again

BEFORE AND AFTER: At left, the forest floor as it regrew after clear-cut logging. At right, the habitat restored to encourage old-growth conditions.

Giving old growth a new start

LIFESTYLES E1

Vision

From page E1

Hernandez calls himself a "full-time beggar." Marrero remarks that they live "from grant to grant."

One of their most recent grants came through Jill Butler's office. Butler is a forest assistance coordinator for the California Department of Forestry. She helps landowners who want to improve the woodlands. She's impressed with the Old Growth Again project.

"The work they're doing — we'd like to see a lot more of it done throughout the North Coast," Butler says.

Taking out the tanoak and thick underbrush helps in fire prevention, Butler says, and could restore the old-growth habitat, "allowing the redwoods and firs to regain dominance."

And the big timber and land companies are not going to do it.

The restoration will only be done by people who take it on as a near-to spiritual pursuit, Butler explains. "I see that as where sustainable forestry is really going to happen, on private pieces of property, with landowners who are managing it not just for financial need," she says. "I don't ever expect to see that model on industrial land. You can't justify managing that way on a financial basis."

To plan on a century-long continuum, landowners need the "resources and the vision," Butler says.

Hernandez and Marrero have plenty of vision.

The resources they're figuring out as they go along.

They got a grant last year from the Tides Foundation. The CDF money helps. The cabin runs on solar power and the two men live simply when they are there. Last month, Hernandez paid his laborers with his own income tax refund.

They've also built and sold some furniture milled from the "buckskins," logs left behind by the original logging crews but neither man is getting rich. Marrero still works three days a week as an electrician to support his old growth habit.

The long term outlook is no less austere.

Hernandez wants to find other plots of battered forest land and work the same magic again. The hope is that ultra-patient investors can buy the land and hire Hernandez's sweat and expertise to invest for the long term. Along the way, the property owners would sign conservation pacts surrendering the right to develop or "over-log" the land. Giving up those rights might allow them to depreciate the land and seek income tax advantages, but anybody looking for a tax loophole should come with loftier ideals.

"Nobody has made any money these tax deals yet," Hernandez notes.

They are already working on a neighboring plot owned by an individual and Hernandez is always scouting out more potential purchases. There will always be more land than money.

"There is redwood land that needs to be restored from here to Oregon."

Buyers are hard to come by. Few people in today's market are invested in returns a century from now. The only sure thing now is hard work.

The kind of hard work that turned a tangle of undergrowth and brush on a Sonoma hillside into a canopied space of thriving redwood woodland.

And put a new spin on Old Growth.

Contact Richard Polito via e-mail at polito@marinij.com.

Against the Grain: How Home Depot and Activists Joined To Cut Logging Abuse

If a Tree Falls in the Forest, The Small, Powerful FSC Wants to Have Its Say
Sniffing the Cedar Lumber

The Wall Street Journal - September 26, 2000 Front Page By Jim Carlton, Staff Reporter

On St. Patrick's Day last year, strange announcements began blaring from the intercoms of several dozen Home Depot Inc. stores around the U.S.

"Attention shoppers, on aisle seven you'll find mahogany ripped from the heart of the Amazon," declared one. Flummoxed store managers raced through the aisles trying to apprehend the environmental activists behind the stunt, who had gained access codes for the intercoms. After months of such antics, Home Depot in August last year bowed to their demands to stop selling wood chopped from endangered forests—and, instead, to stock wood products certified by something called the Forest Stewardship Council, or FSC.

If you aren't familiar with the FSC yet, chances are you soon will be. Based in a weathered Mexican mansion with just 15 full-time employees, the seven year old organization has nonetheless amassed extraordinary power within the world's timber industry. With its flair for Hollywood-style self-promotion and world-class diplomatic skills, the FSC has managed to get radical environmentalists and leaders of some of America's most strait-laced corporations to agree on a common agenda.

A Green Agenda

And what an agenda it is: The FSC hopes someday to make it impossible for loggers to sell wood products in the U.S. and abroad if they don't bear the organization's seal of approval. That means the trees can't be harvested in a way that threatens the health of forests, or of endangered plants or animals within those forests. The logging companies mustn't pollute rivers, employ too much herbicide or leave hillsides exposed to erosion. And they must tread carefully on the rights of workers, especially indigenous peoples.

The FSC has already made surprising progress. Other big wood-products chains have followed Home Depot's lead: Wickes Inc.'s big lumber unit embraced FSC standards last November, followed by Lowe's Inc., the No. 2 home-improvement retailer, last month, and window-making giant Andersen Corp. this month. All told, retailers that together sell well over one-fifth of all wood used in America's home-remodeling market have signed on, while the acceptance level in Europe is even higher. Industry executives say the movement is quickly reaching critical mass, and could soon make it a liability for wood products producers not to have the FSC imprimatur:

"There is no question that the FSC has absolutely changed the fabric of the industry," says Catherine Mater, a forest products consultant in Corvallis, Oregon.

Not everyone thinks the change is for the better. Most of the large timber companies in the U.S., worried that the FSC is too extreme, have banded together to create a rival certification group, kicking off a public-relations war. The FSC has responded with advertisements in People and Playboy magazines featuring actor Pierce Brosnan and singer Olivia NewtonJohn as spokespeople. Some environmental groups, meanwhile, complain that the FSC is soft on loggers.

At the center of the storm is an Oxfordtrained forester named Timothy Synnott, who serves as FSC's executive director. Hardly a rabble-rouser, the 57-year-old Mr. Synnott is a soft-spoken Briton who spends much of his time shuttling around the globe, acting as a diplomat for the FSC's controversial policies.

He is quick to disassociate himself from last year's sneak attacks on Home Depot—although he doesn't criticize them, either—noting that the intercom hijackers were from a group called the Rainforest Action Network. It's easy to understand his ambivalence: So widespread is FSC's reach that both San Francisco-based Rainforest Action and Home Depot belong to the organization.

"Our members operate in the ways they think best," says Mr. Synnott.

That's part of the appeal. When he helped create the group in 1993, he and his colleagues aimed for maximum inclusiveness. That means eco-activists such as Greenpeace and Friends of the Earth rub elbows with the likes of home furnishings retailer Inter IKEA Systems BV and Swedish paper giant AssiDoman AG, whose staff ecologist is FSC's current president. The eclectic mix of 300 members doesn't hurt when it comes to fundraising: Both the European Commission and the World Wildlife Fund, as well as a number of private foundations, contribute to the FSC's $2 million annual budget.

Based in Oaxaca—because of the southern Mexican city's location between forests of the Northern and Southern hemispheres—the FSC operates on a shoestring. Its nine investigators travel extensively, auditing the work of nine independent forestry consulting firms around the globe that do the certification reviews.

It's harrowing work. While inspecting forests, Mr. Synnott has been charged by gorillas and elephants in Africa and flanked by machine-gun-toting bodyguards in a rebel-infested part of the Philippines. He also has lost colleagues in the line of duty. Early last year, a team of three FSC certifiers died in a traffic accident while doing forest work in Cameroon.

"There are many hazards in working in the forest, especially in the tropics, where roads, weather and the quality of driving are all in question," says Mr. Synnott.

Working the boardrooms of corporate America holds its own hazards. An early problem FSC faced was one of credibility. Plenty of companies were happy to mouth support for FSC's ideals, but few were actually willing to take the next step and adjust their procurement policies. This left FSC staffers with few cards to play in trying to persuade logging companies to undergo the rigors—and expense—of obtaining certification.

Home Depot, the nation's largest home improvement chain, was the most important nut to crack. The Atlanta-based retailer

initially balked at implementing FSC guidelines. The lag, say Home Depot executives, was caused by the company's methodical efforts to wean its suppliers and customers from endangered wood species and other environmentally unsound products. Activists, meanwhile, wanted action in days, not years.

"They gave us lip service of all sorts," says Randy Hayes, Rainforest Action's president.

After weighing a boycott call against Home Depot, Rainforest Action opted, instead, for a protest campaign of theatrical hijinks. The reason: So few retailers carried certified wood products that a boycott, without consumer alternatives, would surely fail, strategists reasoned.

So Rainforest Action enlisted celebrities to speak out, bought newspaper ads and dispatched activists in white lab coats into Home Depot stores across America to educate shoppers, guerilla-style, on the evils of tainted wood. Says Mr. Hayes: "It was like a good cop/bad cop. We were the FSC's bad cop."

Home Depot, feeling unfairly treated, bristled. "Our goals are not far apart," wrote Suzanne Apple, Home Depot's vice president of environmental programs, in a 1998 letter to Rainforest Action organizers. "Unfortunately ... our resources have been depleted by the calls and letters that your action has generated."

"Ethical Shoplifting"

The campaign culminated at Home Depot's annual shareholder meeting last year in Atlanta. With the company's directors and major shareholders in town, the activists made big headlines with a self-described "ethical shoplifting" spree at Home Depot's flagship store downtown. As the paparazzi—and store managers—watched, activists, accompanied by Chief Qwatsinas of British Columbia's Nuxalk Indian tribe, filled a cart of Canadian cedar from Home Depot's shelves and tried to wheel it outside without paying. Thwarted by store security officials, they then delivered some purchased timber to the Atlanta offices of the Federal Bureau of Investigation, where the chief, sniffing the boards in full headdress, proclaimed them stolen from tribal lands. An annoyed special agent promised to investigate, but the activists never heard back.

In August last year, Home Depot cried uncle: It announced it would phase out sales of the most endangered species of wood and give preference to FSC-certified products whenever they were available. Home Depot officials insist the protest didn't affect their change of heart.

"It was very much a business decision to say, "Look, we sell a lot of wood and we want to make sure we will have wood to come for a long time," says Ms. Apple, the company's environmental specialist. Home Depot is working the FSC products into its 1,050 stores gradually, citing limited supplies of the certified wood. For example, the retailer says stores in select markets such as Seattle are already selling several FSC-certified products, such as lumber and grill handles, while at least one brand of FSC plywood is being distributed nationally. The company says it hasn't set time or numeric goals on its FSC program, but pledges to back the campaign with advertising, both in the stores and in the media.

For Leo Stolyarov, a retired engineer perusing the lumber aisle in a Colma, California Home Depot, the idea sounds good. "Even if it would cost me more money, I would choose FSC-certified wood, because everybody has to do their own small job in protecting the environment," he says.

Home Depot's embrace of FSC standards has started to ripple far and wide. One telling example: the Montealban door factory outside Oaxaca. A half-mile-long behemoth that churns out more doors than any other plant in Mexico, Montealban sells to distributors around the world, including some Home Depot suppliers.

Toxic Sawmill

Because he gets a better price for the doors that go to Home Depot, factory owner Eloy Borgio Abascal decided last year to expand the relationship by getting FSC certification. But he was told he would first have to lean on his supplier to shape up. This meant paying an extra 15% to lure regional sawmills into the program.

One such sawmill belongs to a tribe of Zapoteca Indians in the nearby Sierra Norte Mountains, home of much of the oak and pine used by Montealban. Although an FSC inspector found the Zapotecas were managing their 50,000-acre forest well, their sawmills reeked of toxic chemicals. What's more, the carpentry-shop workers weren't wearing any protective gear, and sawdust wafted into the air without any ventilation. The inspector gave them a year to upgrade safety conditions, or no FSC certificate. Count on Montealban's Mr. Borgio to keep the pressure on: "If we want to continue our business, we need certification," he says.

Such chain reactions have let the FSC expand the area under its approval to more than 45 million acres—about the size of New England—from two million acres five years ago. The FSC designation can now be found from the vast temperate forests of Scandinavia to the jungles of equatorial countries such as Bolivia and Indonesia. The progress isn't good enough for everyone, and the FSC spends a lot of time toeing the line between radical environmentalists who don't want any logging and the timber industry, which bridles at restrictions that hurt profits.

In the African country of Gabon, for instance, environmentalists howled after an FSC certificate was issued for a tropical rainforest owned by the French logging company Leroy Gabon. The company, a unit of Germany's Glunz AG, wanted to log in a virgin forest that housed endangered lowland gorillas. Friends of the Earth of Britain and Germany's Save the Rainforest branded the certification "betrayal." The FSC investigated, and concluded a contractor had issued the certificate prematurely, although it pointed out that the company was planning to implement a habitat-protection program. Nor does industry always cooperate. Earlier this year, the big Canadian forestry firm J.D. Irving Ltd. Renounced its FSC certification in Canada's Maritime provinces after FSC officials endorsed standards in the region that the company considered too stringent, including a plan to curtail certain chemicals in forest management. Mr. Synnott says only a dozen or so of the group's 200 forest certifications have ever been cancelled for whatever reason.

In the U.S., most of the largest timber companies have created the rival Sustainable Forestry Initiative, or SFI, which covers about 60 million acres of North American timberland. "The problem with the FSC is that their standards are determined by environmentalists sitting in an office somewhere," says W. Henson Moore, chief executive officer of the American Forest and Paper Association, a trade group for the U.S.

timber industry.

But FSC supporters say SFI and similar industry groups lack credibility because they're largely self-policed and have less-stringent standards. For example, FSC standards curtail the use of herbicides, while SFI's do not. "It's the fox watching the henhouse," says Kate Heaton, senior forestry specialist with the Natural Resources Defense Council, an environmental group based in New York that is an FSC member. Though the SFI has 10 times more U.S. acreage under certification than the FSC, the disparity is misleading, environmentalists say, because adherence to the SFI standards is mandatory for members of the American Forest and Paper Association. For their part, SFI supporters argue their standards are just as rigorous as the FSC's.

So far, the big retailers have tilted toward the FSC. Executives of Home Depot and Lowe's Cos. say they prefer FSC certification to SFI's imprimatur because of the FSC''s independence. And FSC has global reach, whereas SFI covers mainly American forests.

The FSC, meanwhile, puts its outside certifiers on the hot seat, too. In California's High Sierra, for example, three burly woodsmen in jeans and work boots fidgeted anxiously recently, as a pair of FSC auditors inspected logging practices in a forest 100 miles northeast of Sacramento. Scientific Certification Systems Inc., an Oakland, California firm, had already determined that Applied Forest Management is running the 22,000-acre forest in an environmentally sound way.

But the two FSC auditors who wended their way over hill and hollow, scanning stumps and streambeds for environmental taboos, such as herbicides and soil erosion, weren't convinced. Rounding a bend into a grove of towering Douglas Fir trees, FSC inspector Cristian Vallejos admired a cutting technique that has culled smaller, more densely clustered trees to benefit taller, sturdier ones. A few miles on, however, he frowned at a five-acre patch where loggers recently cleared a swath of hillside hit by wildfire—a practice FSC discourages in most cases because it can add to erosion.

An Applied Forest Management executive explained that the fire was so intense that it left only charred tree debris, which had to be removed for planting and future fire-control purposes. Robert Hrubes, senior vice president of Scientific Certifications, leapt to his defense. "We don't certify perfect forests," he said. "We certify exemplary forests."

A Forest to Conserve and Harvest

Santa Rosa Democrat - November 23, 1997 By Richard A. Wilson

In 1890, John Muir almost single-handedly convinced Congress to pass legislation creating Yosemite National Park.

Two years later he co-founded the Sierra Club. Then in 1897—exactly 100 years ago—he wrote an article for Atlantic Monthly titled "The American Forests." Our greatest preservationist wrote, "The state woodlands should not be allowed to lie idle, but should be made to produce as much timber as possible without spoiling them." Muir claimed that a wisely managed harvest of mature trees would keep the forests "a never failing fountain of wealth and beauty."

John Muir believed that some lands should be preserved in their wild and natural state. But he also recognized that other lands are most appropriately managed for conservation, through utilization and renewal.

Perhaps California's best example of what Muir referred to as "the state woodlands" is the state forest system. While Oregon has 10 times more state forest acreage than California, and Washington has 50 times the acreage, neither state has anything quite like the crown jewel of California's system: Jackson Demonstration State Forest in Mendocino County.

Jackson Forest celebrates its 50th anniversary this year. Stretching from just west of Willits to within a mile of the Mendocino coast on the Highway 20 corridor, the 50,000-acre forest comprises more than two-thirds of California's state forest acreage. It also comprises some of the richest and best-managed forests in the world.

But it wasn't always that way. In 1942 an alarming report to the state Legislature characterized this land as "cutover, burned over and otherwise denuded in such a manner as to jeopardize its watershed value." The report went on to urge Gov. Earl Warren to acquire the land to rescue it for multiple-use development, "including the preservation of soil and watershed cover, production of future forest crops, protection of wildlife, and development of recreational facilities."

Warren supported a proposal from state Sen. George Biggar of Covelo to allocate $1.5 million to purchase the "depleted" lands from the Caspar Lumber Co. This would prove to be one of the best investments California taxpayers ever made.

Today, Jackson Forest is one of the preeminent public working demonstration forests in the world, unique among publicly owned forests in the redwood region with its multiple use, conservation management approach. It attracts more than 60,000 recreation visitors per year, including 15,000 overnight campers. But it differs from state and national parks in that public access is also permitted for such activities as plant collecting, hunting and the purchase of various forest products, all concurrent with recreation, education and the management of the timber resource.

The guiding management philosophy is to conduct innovative demonstrations, experiments and education in forest management while achieving sustained production of timber through the application of sound forest-management techniques.

Jackson Forest is the site of some of the best-documented and longest-running

watershed and forest growth studies anywhere, and is visited annually by scientists from around the world. It is also used regularly as a field learning laboratory by teachers and students from schools like University of California, Berkeley, Humboldt State University, Sonoma State University, College of the Redwoods, Mendocino College and Santa Rosa Junior College, to name a few.

The forest also provides educational opportunities for family forest owners, as well as for younger learners. For example, in the past 12 years foresters have worked with local elementary school teachers to develop a five-week watershed conservation instructional program in which students receive classroom lessons in ecology and biology, then are brought into the forest to apply those lessons and care for the real, living watershed ecosystems of the Big and Noyo rivers.

The role of state forests as public learning institutions is especially important because too many of the forest lands in California have been poorly managed. Our best hope for reversing this trend is to train tomorrow's land stewards—whether scientists or landowners—in best management practices. Best management practices are needed not only for timber management, but also for maximizing forest health and fire safety; for enhancing wildlife, water quality and stream habitat; and for teaching children about ecosystems and conservation.

To develop best management practices, however, their need to be places where classroom learning can be applied to real forests and watersheds. Jackson Forest is such a place. It is also a place where we can demonstrate the connections between healthy forests, a sound local economy and the role of forestry in the social fabric of rural communities. Of course, all of these good intentions mean nothing unless the forest's resources are sustainable. Sustainable forestry simply means harvesting no more trees than we grow, while maintaining or improving the long term health of the forest ecosystem.

Annual tree growth significantly exceeds harvest. As a result, the forest is able to yield quality timber while growing increasing numbers of mature trees. This approach reflects the very long view we have taken for sustaining the forest resources on Jackson and ensures that the forest is both biologically healthy and economically sound. This management approach has allowed the volume of healthy trees in Jackson Forest to more than triple in the 50 years since the California Department of Forestry began managing these lands, despite an annual harvest of mature timber.

Photographs of these lands taken in the 1940's leave no doubt that the health of this forest ecosystem has steadily improved since the creation of the state forest. There is more vegetative cover, less erosion and better wildlife habitat. One of the most important demonstrations is that sustainable conservation management is also good business. Consider that in the past 50 years, even as growing stocks have more than tripled, timber management activities have generated more than $160 million in public revenues.

This is more than 100 times the original investment, and does not include the economic benefits of an estimated 250 full-time, private sector jobs supported by forest management activities. An additional benefit is the yield tax revenue that is returned year after year to local government. In 1996 alone, Mendocino County received $600,000 in yield tax revenues from the purchasers of Jackson Forest timber. More than half of that total was earmarked for the county's public schools.

Of course there has been controversy. It is a fact of modern life, especially in California, that the harvesting of trees is not universally applauded. But we should remember that these lands were not wild or pristine when the state purchased them. In the words of the Legislature, they had been "exhausted and depleted." When the state purchased the lands in 1947, it was not to preserve them in a cutover state, but to bring them under professional protection and conservation management. The law creating the forest specifically directed the state to "rehabilitate and reforest" these lands, to make them "fully productive."

Thanks to the foresight of the Legislature half a century ago, Jackson Forest today is a prime example of John Muir's vision. By managing for a sustainable harvest while maintaining healthy stands of mature trees, it is a living demonstration of the "never failing fountain of wealth and beauty" that Muir wrote about exactly 100 years ago.

Richard A. Wilson is director of the California Department of Forestry. He owns a ranch in Covelo and has been active in Mendocino County conservation issues for 40 years.

APPENDIX B

ADDITIONAL READING

In addition to the footnoted publications, the following publications were consulted:

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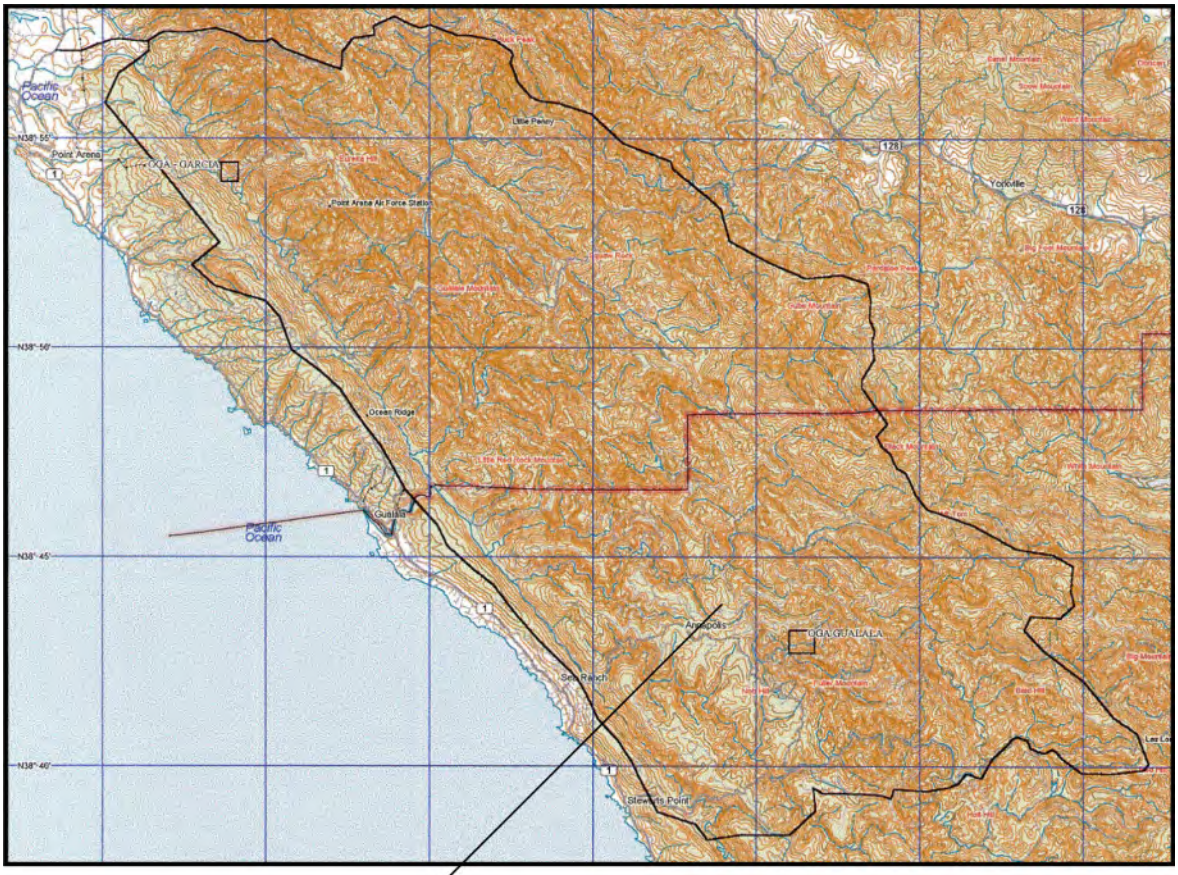
APPENDIX C

MAPS



Gualala & Garcia River Redwood forests: *The above map shows the Redwood forest areas of the Gualala and Garcia watersheds where Forever Redwood lands are located. The small black squares mark the locations of the Fuller Creek lands (labeled OGA – GUALALA) and the lands east of Point Arena, CA (labeled OGA – GARCIA). The red line through the center is the county line. Mendocino County is to the north and Sonoma County to the south. The map area is approximately 25 miles north to south and 10 miles east to west.*

The Redwoods of California: *The green area on the map to the left shows the natural range of the Coastal Redwood forest. It extends from south central California to southern Oregon and totals 1.8 million acres. To give a sense of scale, the arrow highlights the area included in the map above (black rectangle)*

APPENDIX D

THE CONSERVATION EASEMENT AGREEMENT

The Conservation Easement is a binding restriction that a landowner places on their property's deed to permanently define and limit the type of development that may take place there. Generally, conservation easements are donated to a nonprofit land conservation organization or land trust. The donation consists of certain property rights that the owner does not want utilized in order to protect identified forest values. The land trust then ensures that the provisions of the easement are carried out in perpetuity. The creation of the easement is a cooperative process between the grantor (landowner) and grantee (land trust). It is tailored to fit the natural characteristics of the land, the personal vision of the landowner for the property's on-going use, and the goals of the land trust to preserve the "public benefit" values identified on the property. When the terms are satisfactory to both parties, they sign the easement and record it with the deed. Land use restrictions and permitted uses are clearly spelled out. The ownership remains with the grantor, and the land can be operated, sold, willed or otherwise transferred as before, subject to the restriction of the conservation easement. Public access is not a requirement, unless the easement is specifically for recreational or educational uses.

Conservation easements are recognized by federal and state statutes as legitimate resource conservation tools. They have been widely utilized by both government agencies and land trusts for scenic and open space preservation around the country. More recently they have become successful tools to preserve both productive timberland and agricultural land from threats of encroaching urbanization and conversion to incompatible uses. Forestland owners can use the conservation easement to put some of their property rights in trust to permanently protect their forest resources. When donating a conservation easement to a land trust, the owners are often rewarded by the IRS for their forest stewardship with considerable income and estate tax deductions. It is not unusual to reduce the appraised value of forest land by 50% through a combination of giving up some parcel and residential rights, as well as permanently limiting the rate of timber harvest to correspond with the forest management plan. It is important to remember that timber harvesting and other compatible productive uses are allowed under a conservation easement as long as there uses are not destructive of the other natural forest values that have been jointly identified for protection. The degree of timber harvesting permitted on forestlands protected by a conservation easement depends on the characteristics of the property. Silvicultural practices considered to have a negative impact on the overall forest ecosystem, such as clearcutting or harvesting on steep or unstable slopes, are typically prohibited. The foremost practitioners of conservation easement design and acquisition are non-governmental, nonprofit land trusts, of which there are close to 1,000 across the country.

—Connie Best, President of The Pacific Forest Trust of Boonville, California

On the next page is an example of a completed conservation easement. It clearly spells out all the allowable uses and prohibited uses and the legal remedies available to the land trust to enforce its provisions in perpetuity. It is important to include a **strict percentage of inventory cutting limitations in the easement to achieve an old-growth again forest**. For example, although an easement can limit or prohibit cutting in the stream areas and require setting aside a couple of trees per acre to live out their full biological life, the forest management category of the easement should clearly spell out the rate of cut that will be allowed. If it is vague or allows for a "sustainable rate of cut", this can be interpreted in future decades to allow a rate of cut that equals the rate of growth and the forest will only be sustained at or near its present level of stocking and not restored.

If the percentage of inventory allowed to be harvested is spelled out clearly, it would translate into the following results:

- A rate cut of 25% per decade translates into a maximum age of the oldest trees of approximately 80 years. A 20% cut brings the maximum tree age up to approximately 110 years.

- A 20% cut limitation in any fifteen year period translates into a per decade cut rate of approximately 12.5% which allows the oldest trees in the forest to mature to nearly 200 years old.

A last point to make sure is included clearly in your easement is that the cut rate does not accrue. What this means is that if you skip six decades, you cannot add the previous fifteen year period's allowable cuts. For example, if you agree to a 20% per fifteen year period rate of cut and do not cut for 60 years, you can still only cut 20% at that time, not 10% times 4 fifteen year periods, or 60%.

WHEN RECORDED RETURN TO:
The Sonoma Land Trust
1122 Sonoma Avenue
Santa Rosa, CA 95405
AP # _ _ _ _ _ _ _ _ (±40 acres)

DEED OF CONSERVATION EASEMENT
LITTLE CREEK PROPERTY

THIS GRANT DEED OF CONSERVATION EASEMENT is made this 19th day of December, 2000, by_ (“GRANTORS”), in favor of THE SONOMA LAND TRUST, a California nonprofit corporation (“TRUST”).

RECITALS

A. GRANTORS are the sole owners in fee simple of that certain real property (hereinafter “the Property”) comprised of ±40 acres located in Sonoma County, California, and more particularly described in Exhibit A, attached hereto and incorporated herein by this reference.

B. The Property possesses natural, scenic, open space, ecological, and forested values (collectively, “Conservation Values”) of great importance to GRANTORS, the people of Sonoma County, and the people of the State of California.

C. In particular the Conservation Values include significant natural and productive forestland, wildlife habitat and watershed resources. The protection of these conservation values is specifically consistent with and in fulfillment of the conservation objectives of California’s Forest Legacy Program, as set forth in the Assessment of Need approved by the U.S. Secretary of Agriculture on January 2, 1996. In addition, the preservation, restoration and long-term stewardship of these forested lands is recognized by the State of California as providing public benefit in the California Forest Practices Act of 1973, the Timberland Productivity Act of 1982, and the California Forest Legacy Program Assessment of Need approved in 1995.

D. The Conservation Values of the Property are further documented in an inventory of relevant features of the Property kept on file with the TRUST and incorporated herein by this reference (hereafter, “Baseline Documentation”), which consists of reports, maps, photographs and other documentation, that the parties agree provide, collectively, an accurate representation of the Property at the time of this grant and which is intended to serve as an objective information baseline for monitoring compliance with the terms of this Easement.

E. GRANTORS intend that the Conservation Values of the Property be preserved and maintained by the continuation of land use patterns which do not significantly impair or interfere with those Conservation Values.

F. GRANTORS further intend, as owners of the Property, to convey to the TRUST the right to preserve and protect the Conservation Values of the Property in perpetuity.

G. The TRUST is a publicly supported, tax-exempt nonprofit organization and a qualified organization under Section 501(c)(3) and 170(h) of the Internal Revenue Code, as amended, and the regulations promulgated here under, whose primary purpose is the preservation, protection and/or enhancement of land in its natural, scenic, historical, forested and/or open space condition.

H. The TRUST agrees by accepting this grant to honor the intentions of GRANTORS stated herein and to preserve and protect in perpetuity the Conservation Values of the Property for the benefit of this generation and the generations to come.

I. To effectuate the intention of the parties, GRANTORS intend to give to the TRUST a perpetual and irrevocable Conservation Easement (hereinafter “Easement”) in gross over the Property, to create certain restrictive covenants and equitable servitudes for the benefit of the TRUST in gross which will bind and run with the Property.

J. Carbon dioxide in the atmosphere is converted by plants to carbon and this carbon is stored in trees and other vegetation and associated roots, surface duff and organic elements in the forest soil. GRANTORS exclusively reserve all forest-related carbon rights appurtenant to the Property, including but not limited to the right to trade, sell, transfer, or lease these rights, and the right to use, store, sequester, accumulate and/or depreciate forest-related carbon within the property. GRANTORS intend, and GRANTEE agrees, that this Easement shall be interpreted to enhance the security and economic viability of any forest-related carbon rights appurtenant to the Property inasmuch as GRANTORS use of such carbon rights is considered by GRANTEE to be consistent with the terms, conditions, and Conservation Purposes of this Easement.

AGREEMENTS

1. Grant and Acceptance of Conservation Easement and Extinguishment of Development Rights. In consideration of the above and the mutual covenants, terms, conditions, and restrictions contained herein, and pursuant to the common and statutory law of the State of California including the provisions of Civil Code sections 815 to 816, inclusive, GRANTORS hereby voluntarily grant and convey to the TRUST and TRUST accepts, for the purposes set forth in Recitals E, F, and H a Conservation Easement in perpetuity over the Property, subject to the provisions and exceptions set forth in this Easement.

2. Declaration of Restrictions. Subject to the uses that are expressly reserved to GRANTORS or that are expressly permitted hereunder, the GRANTORS hereby declare that the Property shall be held, transferred, sold, conveyed, given, leased, occupied, and used subject to all the restrictions, covenants, easements, equitable servitudes, and affirmative obligations set forth in this Conservation Easement in perpetuity over the Property (hereinafter "Easement") and extinguishes all development rights associated with the Property, subject to the provisions and exceptions set forth in this Easement.

3. Purpose. It is the purpose of this Easement to preserve and protect forever the Conservation Values of the Property and to prevent any uses of the Property that will significantly impair or interfere with said Conservation Values. This purpose, as further defined by the provisions of this Easement, is generally referred to collectively herein as "the Conservation Purposes of this Easement." GRANTORS intend that this Easement will confine the uses of the Property to such activities as are consistent with the Conservation Purposes of this Easement.

4. Affirmative Rights of the TRUST. The affirmative rights expressly conveyed to the TRUST are the following: (a) To identify, to preserve, and to protect in perpetuity Conservation Values of the Property; (b) To enter upon the Property and to inspect, observe, and study the Property for the purposes of: (i) identifying the current uses and practices thereon and the baseline condition thereof, (ii) monitoring the uses and practices regarding the Property to determine whether they are consistent with this Easement, and (iii) and to otherwise enforce the terms of this Easement. Except in cases where TRUST reasonably determines that immediate entry is required to prevent, terminate, or mitigate a violation of this Easement, such entry shall be permitted at least once a year at reasonable times, upon seventy-two (72) hour prior notice to GRANTORS, and shall be made in a manner that will not unreasonably interfere with the proper uses and quiet enjoyment of the Property. Each entry shall be for only so long a duration as is reasonably necessary to achieve the purposes of this paragraph, but not necessarily limited to a single physical entry during a single twenty four hour period; and (c) To enforce the rights herein granted and to prevent or stop, by any legal means, any activity or use of the Property which, in the reasonable judgment of the TRUST, is inconsistent with this Easement and to require restoration to the condition that existed prior to such activities of such areas or features as may be damaged by such activities.

5. GRANTORS' Use of the Property.

5.1 GRANTORS reserve to themselves, and to personal representatives, heirs, successors, and assigns, all rights accruing from ownership of the Property, including the right to engage in, or permit or invite others to engage in, all uses of the Property that are not expressly prohibited herein or are not inconsistent with the Conservation Purposes of this Easement, provided all applicable governmental approvals and permits are properly obtained. Except as expressly provided herein, GRANTORS retain exclusive access to the Property.

5.2 Without limiting the generality of the forgoing paragraph, this Easement shall confine the uses of the Property to conservation management uses as described herein. Examples of uses and practices which are consistent with the Conservation Purposes of this Easement, and which are hereby expressly permitted, are set forth in Exhibit B, attached hereto and incorporated by this reference. Examples of uses and practices which are inconsistent with the Conservation Purposes of this Easement, and which are hereby expressly forbidden, are set forth in Exhibit C, attached hereto and incorporated herein by this reference.

5.3 The uses and practices set forth in both Exhibits B and C are not necessarily exhaustive recitals of consistent and inconsistent activities, respectively. They are set forth both to establish specific permitted and prohibited activities and to provide guidance in determining the consistency of other activities with the Conservation Purposes of this Easement.

6. Approval Criteria. Prior to undertaking any action that requires the TRUST'S approval as provided in this Easement or Exhibits B and C or which could reasonably have a significant adverse impact upon the Conservation Purposes of this Easement, GRANTORS shall solicit the approval of the TRUST. In such cases, the TRUST'S approval or consent shall be based upon compliance with the provisions of this Easement, the capability of the proposed action to preserve and enhance the Conservation Purposes of this Easement, the manner in which the proposed action is to be carried out, the likely effect of the proposed action upon the Conservation Purposes of this Easement, and on any other basis which the TRUST shall reasonably determine to be in furtherance of the Conservation Purpose of this Easement. Approval or disapproval shall be within the sole discretion of the TRUST and may only be granted upon conditions which tend to further the Conservation Purposes of this Easement. TRUST's disapproval shall not be determinative of GRANTOR's right to conduct the proposed use or activity.

7. Approval Process.

7.1 When approval is required or in the event that GRANTORS desire to solicit the approval or consent of the TRUST pursuant to this Easement, GRANTORS shall submit a written notice of the proposed action not less than thirty (30) calendar days prior to the intended commencement date of the activity in question. Such notice shall describe the nature, scope, design, location, timetable, and any other material aspects of the proposed activity in sufficient detail to permit the TRUST to make an informed judgment as to its consistency with the Conservation Purposes of this Easement. The TRUST shall issue its written approval, disapproval, consent, or refusal of the consent, within thirty (30) calendar days of the receipt of GRANTORS' written request. Should TRUST fail to respond to said notice within thirty (30) days of receipt thereof, TRUST shall be deemed to have consented to the proposed action set forth in GRANTORS' notice. Upon the completion of any such action on the Property, the TRUST shall, at the request of GRANTORS, inspect the Property and, if the action was performed in accordance with the terms of this Easement and the approvals or consents issued by the TRUST hereunder, issue a certificate to that effect, dated as of the time of inspection. The TRUST shall be fully reimbursed by GRANTORS for all costs, including but not limited to reasonable professional fees of surveyors, attorneys, consultants, TRUST staff, and accountants, incurred in servicing GRANTORS request. GRANTORS understand that any oral approval or oral representation made by the TRUST, its officers, employees or agents, does not meet the requirements of this paragraph, does not otherwise bind or commit the TRUST and may not reasonably be relied on by GRANTORS to their detriment. To that end GRANTORS agree that no oral approval or oral representation made by the TRUST, its officers, employees or agents, or understood by GRANTORS to have been made by the TRUST, its officers, employees or agents, shall be used by GRANTORS to assert that the TRUST is, in any way, estopped or has made an election or has waived any provision of this Easement.

7.2 If a dispute arise between the parties concerning the consistency of any proposed use or activity with the Conservation Purposes of this Easement, either party may refer the dispute to binding arbitration by request made in writing upon the other, and GRANTORS agree not to proceed with the use or activity pending resolution of the dispute. Within thirty (30) days of the receipt of such a request, the parties shall select a single arbitrator to hear the matter. If the parties are unable to agree on the selection of a single arbitrator, then each party shall name one arbitrator and the two arbitrators thus selected shall select a third arbitrator; provided, however, if either party fails to select an arbitrator within fourteen (14) days after the appointment of the first arbitrator, or if the two arbitrators fail to select a third arbitrator within fourteen (14) days after the appointment of the second arbitrator, then in each such instance, a proper court, on petition of a party, shall appoint the second or third arbitrator or both, as the case may be, in accordance with Section 1280,et seq., of the California Code of Civil Procedures, or any successor statute then in effect. The matter shall be settled in accordance with the said statute or other appropriate body of rules then in effect, and a judgment of arbitration award may be entered in any court having jurisdiction thereof. The prevailing party shall be entitled, in addition to such other relief as may be granted, to a reasonable sum as and for all its costs and expenses related to such arbitration, including, without limitation, the fees and expenses of the arbitrator(s) and attorneys' fees, which shall be determined by the arbitrators and any court of competent jurisdiction that may be called upon to enforce or review the award.

8. Costs and Liabilities Related to the Property.

8.1 GRANTORS agree to bear all costs and liabilities of any kind related to the operation, upkeep, and maintenance of the Property and does hereby indemnify and hold the TRUST harmless there from. Without limiting the foregoing, GRANTORS agree to pay before delinquent any and all real property taxes and assessments levied by competent authority on the Property. GRANTORS shall be solely responsible for any costs related to the maintenance of general liability insurance covering acts on the Property.

8.2 The TRUST shall have no responsibility whatever for the operation of the Property, the monitoring of hazardous conditions thereon, or the protection of GRANTORS, the public, or any third parties from risks relating to conditions on the Property. GRANTORS shall hold harmless, indemnify, and defend the TRUST from and against any and all damage, liability, claim, or expense (including attorneys' fees) relating to such matters except as such claim, liability, damage, or expense is the result of the TRUST'S direct negligence, gross negligence, or intentional misconduct. Without limiting the foregoing, the TRUST shall not be liable to GRANTORS or any other person or entity in connection with consents reasonably given or withheld hereunder, or in connection with any entry upon the Property occurring pursuant to this Easement, or on account of any claim, liability, damage, or expense suffered or incurred by or threatened against GRANTORS or any other person or entity, except as such claim, liability, damage, or expense is the result of the TRUST'S direct negligence, gross negligence, or intentional misconduct.

8.3 Notwithstanding any other provision of this Easement to the contrary, the parties do not intend and this Easement shall not be construed such that: (1) it creates in the TRUST the obligations or liabilities of an "owner" or "operator" as those words are defined and used in environmental laws, as defined below, including, without limitation, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (42 United States Code, sections 9601 et seq. and hereinafter "CERCLA"); or (2) creates in the TRUST the obligations or liabilities of a person described in 42 United States Code

section 9607(a) (3); or (3) the TRUST has the right to investigate and remediate any hazardous materials, as defined below, associated with the Property; or (4) the TRUST has any control over GRANTORS' ability to investigate and remediate any hazardous materials associated with the Property. GRANTORS represent, warrant and covenant to the TRUST that GRANTORS' use of the Property shall comply with all environmental laws as that phrase is defined below.

8.4 For the purposes of this Easement:

(a) The term "hazardous materials" includes, without limitation, any flammable explosives, radioactive materials, hazardous materials, hazardous wastes, hazardous or toxic substances, or related materials defined in CERCLA, the Hazardous Materials Transportation Act, as amended (49 United States Code sections 1801 et seq.), the Resource Conservation and Recovery Act of 1976, as amended (42 United States Code sections 6901 et seq.), sections 25117 and 25316 of the California Health & Safety Code, and in the regulations adopted and publications promulgated pursuant to them, or any other federal, state, or local environmental laws, ordinances, rules, or regulations concerning the environment, industrial hygiene or public health or safety now in effect or enacted after this date.

b) The term "environmental laws" includes, without limitation, any federal, state, local or administrative agency statute, regulation, rule, ordinance, order or requirement relating to environmental conditions or hazardous materials, otherwise applicable to the Property.

9. Access to the Property. Nothing contained herein shall be construed as affording the public access to any portion of the Property subject to this Easement. This Easement shall not be construed to preclude GRANTORS' right to grant access to the Property to third parties, provided that such access is not expressly prohibited by this Easement, is allowed in a reasonable manner, and is not inconsistent with the Conservation Purposes of this Easement.

10. TRUST'S Remedies for Breach.

10.1 In the event of a violation or threatened violation by GRANTORS of any term, condition, covenant, or restriction contained in this Easement, the TRUST may, following notice to GRANTORS, which notice shall contain a reasonable and specific cure period, institute a suit in a court of competent jurisdiction to enforce the terms of this Easement, and/or enjoin, ex parte as necessary, by temporary or permanent injunction, and/or recover damages for such violation, and/or to require the restoration of the Property to the condition that existed prior to such violation. The notice shall be a general written notification of the condition claimed by the TRUST to be a violation that is mailed or otherwise delivered by TRUST to GRANTORS. If the TRUST reasonably determines that circumstances require immediate action to prevent or mitigate significant damage to the Conservation Values of the Property protected by this Easement, TRUST may pursue its remedies under this paragraph without prior notice or without waiting for the provided cure period to expire.

10.2 Inasmuch as the actual damages which would result from the loss of the values, associated with the Conservation Purposes of this Easement and caused by its breach by GRANTORS, are uncertain and would be impractical or extremely difficult to measure, the parties agree that the damages allowed by Civil Code section 815.7(c) shall be measured as follows:

(a) for an improvement, prohibited by this Easement and which is not removed by GRANTORS, an amount equal to the increase in the value of the Property due to the improvement, as set forth in a written estimate by a qualified person or organization selected by the TRUST, plus interest compounded monthly at the then current rate for post judgment interest for the length of time commencing with the TRUST'S notice until such damages are collected by the TRUST; and/or

(b) for a change in use prohibited by this Easement, whether or not it involves an improvement, an amount equal to any economic gain realized by the GRANTORS because of the change in use, as set forth in a written estimate by a qualified person or organization selected by the TRUST, plus interest compounded monthly at the then current rate for post judgment interest for the length of time commencing with the TRUST'S notice until such damages are collected by the TRUST; and/or

(c) for a change in use prohibited by this Easement, whether or not it involves an improvement or where there is no measurable economic gain realized by GRANTORS, an amount equal to the cost of restoration, as set forth in a written estimate by a qualified person or organization selected by the TRUST, plus interest compounded monthly at the then current rate for post judgment interest for the length of time commencing with TRUST'S notice until such damages are collected by TRUST.

10.3 If TRUST, in its notice to GRANTORS, demands that GRANTORS remove an improvement, discontinue a use or both and claims the damages allowed by Civil Code section 815.7(c) then GRANTORS may elect to mitigate damages by fully complying with TRUST'S notice within the cure period provided therein. In the event of such full and timely compliance, TRUST shall not be entitled to damages for the breach specified in the notice.

10.4 All reasonable costs incurred by TRUST in enforcing the terms of this Easement against GRANTORS, including , without limitation, costs and expenses of suit and reasonable attorneys' fees shall be borne by GRANTORS; provided however if GRANTORS ultimately prevail in a judicial enforcement action or arbitration proceeding brought by either party, TRUST shall bear its own costs and GRANTORS' reasonable costs and expenses of suit, including, without limitation, reasonable attorneys' fees.

10.5 Forbearance by TRUST to exercise its rights under this Easement in the event of any breach of any term of this Easement by GRANTORS shall not be deemed or construed to be a waiver by TRUST of such term or of any subsequent breach of the same or any other term of this Easement or of any of TRUST'S rights under this Easement. No delay or omission by TRUST in the exercise of any right or remedy upon any breach by GRANTORS shall impair such right or remedy or be construed as a waiver.

10.6 The remedies set forth in this section 10 apply equally in the event of either actual or threatened violations of the terms of this Easement. GRANTORS agree that TRUST'S remedies at law for any violation of the terms of this Easement are inadequate and that TRUST shall be entitled to the injunctive relief described in paragraph 10.1, both prohibitive and mandatory, in addition to such other relief to which TRUST may be entitled, including specific performance of the terms of this Easement, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. TRUST'S remedies described in this section 10 shall be cumulative and are additional to and not intended to displace any other remedy available to either party as provided by this Easement, Civil Code sections 815 et seq. or any other applicable law. TRUST may take such other action as it reasonably deems necessary to insure compliance with the terms, conditions, covenants, and purposes of this Easement.

11. *Acts Beyond GRANTORS' Control.* Nothing contained in this Easement shall be construed to entitle TRUST to bring any action against GRANTORS for any injury to or change in the Property resulting from causes beyond GRANTORS' control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken by GRANTORS under emergency conditions to prevent, abate, or mitigate significant injury to the Property resulting from such causes so long as such action, to the extent that GRANTORS have control, is designed and carried out in such a way as to further the Conservation Purposes of this Easement. Nothing contained in this Easement shall be construed to require GRANTORS to take affirmative action to prevent, abate, or mitigate injury to the Property relating to or resulting from such causes.

12. *Easement to Bind Successors.* The Easement herein granted and the extinguishment of development rights shall be a burden upon and shall continue as a restrictive covenant and equitable servitude running in perpetuity with the Property and shall bind GRANTORS and their heirs, personal representatives, lessees, executors, successors, and assigns forever. The parties intend that this Easement shall benefit and burden, as the case may be, their respective successors, assigns, heirs, executors, administrators, agents, employees, and all other persons claiming by or through them pursuant to the common and statutory law of the State of California, including Civil Code sections 815 - 816 inclusive.

13. *Condemnation and Extinguishment.*

13.1 This Easement constitutes a real property interest immediately vested in TRUST, which for the purposes of this section only, the parties stipulate to have a fair market value determined by multiplying (1) the fair market value of the Property unencumbered by this Easement by (2) the ratio of the value of the Property as encumbered by this Easement at the time of this grant to the value of the Property as if unencumbered by this Easement at the time of this grant.

13.2 If all or any part of the Property is taken by exercise of the power of eminent domain or acquired by purchase in lieu of condemnation, whether by public, corporate, or other authority, so as to terminate this Easement in whole or in part, GRANTORS and TRUST shall act jointly to recover the full value of the interests in the Property subject to the taking or in lieu purchase and all direct or incidental damages resulting there from. Furthermore, the fair market value of the interests subject to the taking or in lieu purchase for the purpose of just compensation shall be determined as though this Easement did not exist. The TRUST'S share of the amount recovered shall be determined by multiplying the amount recovered by the ratio set forth in paragraph 13.1.

13.3 If circumstances arise in the future that render the Conservation Purposes of this Easement impossible to accomplish, this Easement can only be terminated or extinguished, whether in whole or in part, by judicial proceedings in a court of competent jurisdiction. The amount of the proceeds to which TRUST shall be entitled, after the satisfaction of prior claims, from any sale, exchange, or involuntary conversion of all or any portion of the Property subsequent to such termination or extinguishment, shall be the stipulated fair market value of this Easement, or proportionate part thereof, as determined in accordance with paragraph 13.1.

13.4 TRUST shall use any proceeds received under the circumstances described in this section 13 in a manner consistent with its Conservation Purpose, which is exemplified by this grant.

14. Assignment. This Easement is transferable, but the TRUST may assign its rights and obligations under this Easement only to an organization that is a qualified organization at the time of transfer under Section 170(h) of the Internal Revenue Code (or any successor provision then applicable), and authorized to acquire and hold conservation easements under California Civil Code sections 815 to 816, inclusive, (or any successor provision then applicable) or the laws of the United States. As a condition of such transfer, the TRUST shall require that the Conservation Purpose that this Easement is intended to advance continues to be carried out.

15. Subsequent Deeds and Leases. GRANTORS agree to incorporate by reference the terms of this Easement in any subsequent deed or other legal instrument, by which they divest themselves of any interest in all or a portion of the Property, including but not limited to a leasehold interest. GRANTORS further agree to give written notice to TRUST ten (10) days prior to the date of any such transfer. The GRANTORS agree to provide a copy of this Easement to any third party acquiring a leasehold interest. These obligations of GRANTORS or GRANTORS' failure to perform such obligations shall not be construed to impair the validity of this Easement or limit its enforcement in any way.

16. Estoppel Certificates. TRUST shall, at any time during the existence of the Easement, upon not less than thirty (30) days prior written notice from GRANTORS, execute and deliver to GRANTORS a statement in writing, certifying that the Easement is unmodified and in full force and effect (or, if modified, stating the nature of such modification) and acknowledging that there is not, to the best of TRUST'S knowledge, any default by GRANTORS hereunder, or, if TRUST alleges a default by GRANTORS, specifying such default. Such certification shall be limited to the condition of the Property as of TRUST'S most recent inspection. If GRANTORS request more current documentation, TRUST shall conduct an inspection, at GRANTORS' expense within thirty (30) days of receipt of GRANTORS' written request therefore.

17. Notices. Any notice, demand, request, consent, approval, or communication that either party desires or is required to give to the other shall be in writing and either served personally or sent by first class mail, postage prepaid, addressed as follows:

To GRANTORS: **To TRUST:**

or to such other address as either party from time to time shall designate by written notice to the other. Notice shall be deemed to have been given upon actual personal service or, if mailed, five (5) days after the date shown on the postmark of the envelope in which such notice is mailed.

18. *Recordation.* TRUST shall record this Easement in a timely fashion in the official records of the County of Sonoma, California, and may re-record it at any time as may be required to preserve its rights in this Easement.

19. *Successors and Assigns.* The terms GRANTORS and TRUST wherever used herein, and any pronouns used in place thereof, shall mean and include the above-named GRANTORS and their heirs, personal representatives, lessees, executors, successors, and assigns, including any person claiming under them, and the above-named TRUST and its successors and assigns, respectively.

20. *Integration.* This instrument is the final and complete expression of the Easement between the parties and supersedes any and all prior or contemporaneous agreements, discussions, negotiations, or understandings, written or oral, all or which are merged into this written instrument.

21. *Interpretation and Construction.* To the extent that this Easement may be uncertain or ambiguous such that it requires interpretation or construction, then it shall be interpreted and construed in such a way that meets the Conservation Purposes of this Easement. It is the intention of the parties that any interpretation or construction shall promote the Conservation Purposes of this Easement. In all matters of interpretation, whenever necessary to give effect to any clause of this Easement, the neuter or gender specific pronouns include the masculine and feminine, the singular includes the plural, and the plural includes the singular.

22. *Severability.* If any provision of this Easement, or the application thereof to any person or circumstance, is found to be invalid, the remainder of the provisions of this Easement, or the application of such provisions to persons or circumstances other than those as to which it is found to be invalid, as the case may be, shall not be affected thereby.

23. *Joint Obligation.* The obligations imposed by this Easement upon the GRANTORS shall be joint and several.

24. *Significance of Recitals.* The Recitals to this Easement are integral and operative provisions of this Easement.

25. *Sufficient Counsel.* The GRANTORS warrant that they have reviewed this Easement and its effects on the Property with appropriate independent legal counsel and financial advisor of their own choosing.

26. *Controlling Law.* The interpretation and performance of this Easement shall be governed by the laws of the State of California.

27. *No Forfeiture.* Nothing contained herein will result in a forfeiture or reversion of GRANTORS' title.

28. *Termination of Rights and Obligations.* A party's rights and obligations under this Easement terminate upon transfer of the party's interest in the Easement or Property, except that liability for acts or omissions occurring prior to transfer shall survive transfer.

29. *Captions.* The captions in this instrument have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon construction or interpretation. TO HAVE AND TO HOLD unto the TRUST, its successors, and assigns, forever. IN WITNESS WHEREOF, GRANTORS and TRUST have executed this Deed of Conservation Easement this 19th day of December, 2000.

GRANTORS: GRANTEE:

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EXHIBIT B
PERMITTED USES AND PRACTICES

The following uses and practices, though not necessarily an exhaustive recital of consistent uses and practices, are permitted under this Easement and they are not to be precluded, prevented, or limited by this Easement. It is further provided that they are undertaken in accordance with the terms and provisions of this Easement and that all applicable governmental approvals and permits are properly obtained. The uses or activities that are expressly reserved to GRANTORS or are expressly permitted hereunder shall be deemed to be consistent with the Conservation Purposes of this Easement.

B.1 To use or lease the Property consistent with the Conservation Purposes of this Easement.

B.2 To maintain, repair, replace, and improve existing fences, roads, skid trails, ditches, pumps, levees, dams, utilities, and other improvements on the Property. In the event of the destruction, deterioration, or obsolescence of any fences, roads, skid trails, ditches, levees, dams, pumps, utilities, or other improvements, whether existing at the date hereof or constructed subsequently pursuant to the provisions of this Easement, GRANTORS may replace same with ones of similar size function, capacity, and location, without prior notice to or approval by TRUST, provided, however, that such replacement is performed or conducted in a manner that is consistent with the Conservation Purposes of this Easement. If there is not already road access to the Building Envelope (hereafter "Building Envelope") as defined in B.4, GRANTOR may construct a new road to the Building Envelope and maintain, repair, replace, and improve said road.

B.3 To develop water wells and springs, to lay or construct pipes and conduits for the transportation of water; to develop water storage facilities such as freshwater and wastewater tanks and reservoirs, provided however, that such facilities are located so as to minimize visual impacts. Such uses shall be necessary or convenient for permitted uses of the Property or adjacent parcels; and shall be developed in a manner consistent with the Conservation Purposes of this Easement.

B.4 To establish a one (1)-acre Building Envelope, the location of which will be hereafter determined by mutual agreement of the TRUST and GRANTORS. The Building Envelope shall be located outside of the boundaries of the Riparian Zone. The delineation of the Building Envelope boundaries will be physically marked on the ground prior to construction. GRANTORS may construct a single-family residence and attendant structures or an educational study facility and attendant structures within the Building Envelope. If any such structure is destroyed for any reason the structure may be rebuilt. In addition, new structure(s) may be built and addition(s) may be made to structures already existing within the Building Envelope providing said structure(s) or addition(s) conform to all applicable zoning, health and sanitation laws and regulations. There shall be no limitation on the footprint, elevation, style, or materials used to build said new structure(s) or addition(s). The total square footage of all new structure(s) or addition(s) must not exceed ten thousand (10,000) square feet.

B.5 To continue use of existing easements of record granted prior to this Easement. Modification of easements of record as of the date hereof and subsequent granting of new easements require the approval of TRUST, and are subject to the restrictions in Exhibit C. Pursuant to this Paragraph, new easements may only be granted when they are located to minimize impacts on the Conservation Values of the Property.

B.6 To undertake conservation practices, such as streambed restoration, that promote native flora and fauna, soil stabilization, or reduce erosion in accordance with sound, generally accepted practices. Approval of TRUST is required when conservation practices involve significant surface alteration or include using material such as rock or concrete in amounts over ten (10) cubic yards in volume at any one time.

B.7 To remove or control invasive, non-native plant species or feral, non-native animal species that threaten the Conservation

Values of the Property, using techniques that minimize harm to native wildlife and plants.

B.8 To utilize the Property for non-intrusive recreational or educational purposes that require no significant surface alteration or other development of the land. Such uses may include, but are not limited to: single-track trail construction and maintenance, hiking, horseback riding, bicycling, fishing, hunting, and nature study.

B.9 To undertake wildfire management plans and to control vegetation to lower the risk of wildfire. Such methods may include, but are not limited to, prescriptive burning (which shall not be undertaken until the Property includes a mature stand of trees) brush removal or limited removal of dead or dying trees. Such plans or actions shall be approved by TRUST and shall be acceptable to the California Department of Forestry and appropriate local Fire Protection Agencies.

B.10 Additional non-residential structures, facilities, roads or other improvements reasonably necessary for the conservation management uses of the Property shall be permitted provided that GRANTORS deliver to TRUST written request for approval of such construction or placement in accordance with the provisions set forth in this Easement. TRUST'S approval shall be based upon its finding that the proposed construction or placement is consistent with the Conservation Purposes of this Easement. Additional fencing deemed by GRANTORS to be reasonably necessary for conservation management and grazing activities may be constructed without the TRUST'S approval; provided however, that the fencing is constructed of open-wire or similar material so as to minimize visual impact and is not inconsistent with the Conservation Purposes of this Easement.

B.11 To prohibit entry upon the Property by unauthorized persons.

B.12 To continue the use of the Property for all purposes not inconsistent with this Easement.

FOREST MANAGEMENT AND HARVEST PLAN(S) (B.13-B.18)

B.13 *Performance Goal.* The Performance Goal (as that term is used herein) for the Property shall refer to the provisions of this Paragraph B.13. The GRANTORS intend to establish a productive, operational timberland, providing for the long-term sustained yield of high-quality forest products while maintaining and protecting other forest values such as wildlife, aquatic, and riparian habitat, watersheds and soils. Thus, consistent with the Conservation Purposes of this Easement, it is the GRANTORS' intent that any forest management activity on the Property be conducted to achieve the enhancement, restoration and maintenance of a mature, complex native north coast coniferous forest ecosystem with distinct old-qualities characterized generally by the following:

a) Approximately eighty percent (80%) coniferous trees and twenty percent (20%) hardwoods. Approximately ninety percent (90%) of the coniferous stand will be Redwood (sequoia sempervirens) and ten percent (10%) of the coniferous stand a mix of Sugar pine (pinus lambertiana) and Douglas fir (*pseudotsuga menzieii*).

b) Approximately 20,000 board feet of timber per acre present at all times;

c) On average, three (3) or more hardwood and/or coniferous Legacy Trees per acre present at all times. For purposes of this Easement, a "Legacy Tree" is defined as live trees reserved from cutting, including old growth trees, which provide important wildlife habitat, a natural seed source, structural diversity to the forest and a source of snags and downed logs;

d) No clear cut areas in excess of one-half acre anywhere on the Property at any time;

e) A multi-story canopy of variable densities but generally with no less than eighty percent (80%) closure, allowing for gaps occurring due to natural disturbances, mortality and timber harvesting;

f) A varied stand containing a mix of trees of different sizes and ages; and

g) Maintenance of such volume of non-redwood standing dead trees, down logs and large woody debris on the forest floor as is commonly found in late seral redwood forests.

Notwithstanding the above Performance Goal, nothing contained in this Easement shall create an obligation on GRANTORS to conduct forest management activity on the Property; provided, however, if GRANTORS do conduct such forest management activities or seek to conduct a timber harvest, the Performance Goal above and the Forest Management and Harvest Plan standards set forth below shall apply to such activities. The Performance Goal shall not apply within the boundaries of the Building Envelope. The Performance Goal is a long-term goal and is not capable of being achieved on a short-term basis. The individual components of the Performance Goal shall not prevent implementation of Harvest Plans otherwise permissible under the terms of this Easement.

B.14 *Conduct of Forest Management.* To conduct forest management on the Property in a manner consistent with the Performance Goal above and with the following terms:

a) To comply with the Forest Practice Rules of the California Department of Forestry (CDF) and maintain sound forestry practices, trees that are dead, dying, diseased, and/or of poor form and vigor will be targeted for removal;

b) During the first fifteen years after this Easement is recorded, thinning of conifers less than ten (10) inches in diameter to encourage growth is allowed. A significant portion of the hardwoods less than twenty-four (24) inches in diameter may be harvested in order to lower both the fire hazard and the intense level of competition with the conifers;

c) No harvest of the existing hardwood trees over twenty-four (24) inches in diameter throughout the Property until there is a size and age class mix that conforms to the Performance Goal and/or on the advice of a professional forester;

d) For purposes of this Easement, The Riparian Zone (the "Riparian Zone") along Little Creek will stretch 100 feet from the streambed on each side of the creek. No merchantable conifers may be cut within the Riparian Zone at any time in order to allow for regeneration of an undisturbed old growth forest. After year end 2015, no trees of any type, hardwood or coniferous, may be cut within the Riparian Zone;

e) Maintenance of such volume of non-redwood standing dead trees, down logs and large woody debris on the forest floor as is commonly found in late seral redwood forests; and

f) Harvest and management practices shall occur only in conjunction with a California Forest Improvement Management Plan ("CFIP"), a Non-Industrial Timber Management Plan (NTMP) or a forest management plan of a similar nature, and any amendments thereto, which are approved in advance and in writing by TRUST. Said approval shall not be unreasonably withheld and shall be consistent with the provisions of Paragraph B.17, below.

g) GRANTOR will notify TRUST prior to any harvesting of merchantable timber according to the approval process described in Paragraph 6 of this Easement.

B.15 *Payment of Harvesting Fees.* Each and every time GRANTOR harvests timber, GRANTOR shall pay two percent (2%) of the mill receipts for any and all harvested timber to TRUST by the end of the year in which the harvesting occurs. GRANTOR's total obligation per harvest in year 2000 dollars shall be a minimum of Two Thousand Dollars ($2,000.00) and a maximum of Six Thousand Dollars ($6,000.00). GRANTOR's total obligation per harvest shall be adjusted annually by a percentage equal to the percentage change of the previous year's San Francisco Bay Area Consumer Price Index, or successor cost of living index. Should GRANTOR harvest any quantity of timber at any time and not mill said timber but still receive income from a sale of said timber, GRANTOR shall pay two percent (2%) of GRANTOR's gross income from said harvest to TRUST by the end of the year in which the harvesting occurs. None of the aforementioned payments represent a sale to TRUST and shall not be construed as a sale of timber by TRUST or as a measure of TRUST's interest in the Property; the sole purpose of these payments is to defray TRUST's monitoring costs of such harvest(s).

B.16 *Use of Professional Foresters and Other Resource Professionals.* It is the intent of the GRANTORS that all forest management activities be conducted in a manner consistent with the terms, conditions and purposes of this Easement. TRUST shall utilize a registered professional forester or other qualified resource management professional to review the following: any and all forest management plan(s) and any and all update(s) and/or amendment(s) thereto; any and all correspondence and/or other documentation pertaining to said management plan(s) and attendant update(s) and/or amendment(s); and any and all amendment(s) to this Easement to ensure that any of the aforementioned are consistent with the Performance Goal.

B.17 *Specific Restrictions on Commercial Timber Harvest.*

a) No harvest at all of any conifers of any size for fifteen (15) years from the date of this Easement;

b) The cutting or harvest of hardwoods as part of the Forest Management under Paragraph B.14 shall not be deemed to be a Commercial Timber Harvest.

c) The total permitted harvest volume will be calculated based on the amount of growth occurring during the decades between the 15-year anniversaries of the date of this Easement. If the timber cruise(s) performed by GRANTOR do not correspond to the fifteen (15) year anniversary dates of this Easement the forester shall be asked to perform an estimate of the existing timber volume on said anniversary date.

d) Each time GRANTOR plans a harvest, GRANTOR shall, at GRANTOR's sole expense, commission a timber cruise by a professional forester and GRANTOR shall provide TRUST a copy of the timber cruise information and any and all related permit(s) and/or other document(s). GRANTOR agrees to complete any timber harvest within a two-year period following

the date of the timber cruise, even though GRANTORS' applicable permit might allow GRANTOR to conduct the harvest over a longer period of time. GRANTOR shall send written notice to TRUST upon completion of the timber harvest. Following completion of a timber harvest GRANTOR shall, at GRANTOR's sole expense, commission a timber cruise by a professional forester and GRANTOR shall provide TRUST a copy of the timber cruise information, which timber cruise is intended to determine GRANTORS compliance with its allowable commercial timber harvest under this Easement and to set a new baseline to establish the inventory to determine future growth of timber volume;

e) Based on the results of the above-referenced timber cruise, fifty percent (50%) of the hardwood volume may be harvested every ten years;

f) Based on the results of the above-referenced timber cruise, the GRANTOR may make the following harvest after January 1, 2010: The lesser of:

g) (i) the greater of: (A)seventy-five percent (75%) of the increase in the volume of coniferous trees (over ten (10) inches in diameter) during the previous ten years or (B) the increase in the volume since the date of last Timber Harvest conducted under this Easement; or (ii) ten percent (10%) of the total coniferous volume;

h) Based on the results of the above-referenced timber cruise, the GRANTOR may make the following harvest after January 1, 2020: The lesser of:

(i) the greater of: (A) ninety percent (90%) of the increase in the volume of coniferous trees (over ten (10) inches in diameter) during the previous fifteen years or (B) the increase in the volume since the date of last Timber Harvest conducted under this Easement; or

(ii) twenty percent (20%) of the total coniferous volume;

This section h) is modified by section i) of this Paragraph B.17 below;

i) When the total conifer volume exceeds thirty-thousand (30,000) board feet per acre, GRANTOR may make the following harvest: The lesser of:

(i) the greater of: (A) one hundred percent (100%) of the increase in the volume of coniferous trees (over ten (10) inches in diameter) during the previous fifteen years or (B) the increase in the volume since the date of last Timber Harvest conducted under this Easement ;or

(ii) twenty percent (20%) of the total coniferous volume;

j) Trees in the Riparian Zone shall not be counted to determine the volume of allowable harvest after January 1, 2030; and

k) At the conclusion of each harvest entry, a sufficient volume of standing non-redwood dead trees, down logs and large woody debris will be left on the forest floor for the purpose of providing wildlife habitat and assisting in erosion control.

B.18 *Non-Commercial Timber Harvest.* GRANTOR reserves the right to harvest, cut or remove trees of all species for personal, noncommercial use on the Property including but not limited to firewood and lumber and/or for fire or disease prevention or control or for personal safety provided that such harvest, cutting or removal be conducted in a manner consistent with the Conservation Purposes of this Easement

EXHIBIT C
PROHIBITED USES AND PRACTICES

The following uses and practices, though not necessarily an exhaustive recital of inconsistent uses and practices, are inconsistent with the purposes of this Easement and shall be prohibited upon or within the Property, except as expressly reserved to GRANTOR or expressly permitted hereunder in this Easement including the provisions of the attached Exhibit B.

C.1 To impair or threaten the Conservation Values of the Property, except as otherwise expressly provided in this Easement.

C.2 To divide, subdivide, or de facto subdivide the Property.

C.3 To construct any structure, road, or improvement.

C.4 To significantly alter the surface of the land, including, but not limited to, the excavation or removal of soil, sand, gravel, rock, and/or sod, except as materials may be required for the repair of improvements on the Property and then only in small quantities from a site approved in advance by TRUST.

C.5 To construct, place, or erect any billboards on the Property.

C.6 To use motorcycles, all-terrain vehicles, or any other type of motorized vehicles off roadways on the Property, except for GRANTORS or others under GRANTORS' control, when reasonably necessary for permitted management activities or emergency uses.

C.7 To dump or accumulate trash, ashes, garbage, waste, fill, dredge spoils, hazardous or toxic materials and/or inoperative vehicles on the Property.

C.8 To install new utility systems, including but not limited to, sewer, power, fuel, and communication lines and related activities and equipment, except according to easements of record granted prior to this Easement; or except for systems serving permitted uses on the Property or adjacent parcels, provide, however, such systems are developed in a manner consistent with the Conservation Purposes of this Easement.

C.9 To establish any residential or commercial uses except within the Building Envelope.

C.10 The planting or willful introduction of non-native plant or animal species, except within the Building Envelope, and/or the introduction of any invasive non-native plant species anywhere on the Property.

C.11 To establish or engage in any agricultural uses on the property, except within the Building Envelope. For the purpose of this Easement, "agricultural uses" shall include without limitation: grazing of any type; agriculture requiring regular or seasonal tillage; agriculture requiring the addition of fertilizer, biocides or other soil adjuncts; agriculture requiring application of water for irrigation; agriculture requiring trellises or other support structures; animal feed lots; wine making; wine storage; barrel manufacture, storage and repair; bottling of wine and other beverages; wine tasting and sales room and associated access facilities; or processing, storage and sale of crops or products.