

Chapter 6

Mid-twentieth Century Logging and the Beginnings of Modern Resource Management

After World War II, bulldozers, tractors, and trucks replaced the steam railroads. This new technology again expanded the land that could be profitably logged and resulted in the building of many roads into the forests. Clear-cutting was generally the preferred method, and state tax laws encouraged the cutting of 70% or more of the trees in a stand so as to remove standing timber from the tax rolls. The increased soil disturbance and lack of successful growth of redwoods from seeds sometimes encouraged the growth of other associated species such as Douglas-fir and hemlock, so companies sometimes supplemented the anticipated regeneration from stump sprouting by planting redwood seedlings.

The logging industry was extremely important in the redwood region in the 1950s and 1960s, particularly in Del Norte and Humboldt Counties. In 1953, for example, the six largest timber operators paid over 40% of the taxes in Del Norte County, while about half of Humboldt County private-sector employees who had unemployment insurance in the 1950s worked in the timber/lumber industry. In the 1950s, moreover, the per-capita income in Humboldt County was comparable to the rest of California. (Hackett, 2006)

From the mid-1930s to the 1960s, selective logging was tried in the redwood region. With selective logging, a portion of the stand, usually between 50% and 75%, is left for future growth and reseeded, and it was facilitated by the development of logging tractors developed during this time. Since selective logging opens up the forest canopy, there is accelerated growth (or **release**) of the remaining trees. I have seen a section from a log that started to grow about 200 years ago. It took 137 years to reach a radius of less than 4 inches. At that point, the trees around the 8 inch diameter tree were cut, releasing the tree for faster growth. In the next 71 years, the tree grew 24 inches in radius. Its growth rate went from about 3/100 inch per year to about 34/100 inches; the released tree was growing about 11 times as fast as the **suppressed** tree.

Selective logging was tried, but was problematic in the north because strong storm winds tended to blow down the exposed remaining trees in some areas. Selective logging tended to convert some stands to brush and other types of trees such as hemlock and grand fir, at least in the short term. Repeated entry into the forest sometimes caused damage to the remaining trees and soil. For these and other reasons, including economics, selective logging has been replaced by clear-cutting in most areas, especially in the northern regions. However, in *A Review of Redwood Harvesting: Another Look – 1990*, Lowell cautioned that different techniques should be used in different areas.

A major storm in 1959 blew down many redwoods in Humboldt and Del Norte Counties, especially in areas that had been selectively logged. This led to approval of increased clear-cutting. Leaving seed trees was found to be unsuitable for the timber companies because of the tendency of the seed trees to be knocked down by the wind, because

ongoing seed production from the seed tree produced uneven aged stands, and because of the high mortality of germinating seeds due to fungal attack. Planting of seedlings increased, especially where sprouting was inadequate to provide well-stocked stands.

As mentioned above, different harvesting techniques seem to work best in different areas. In the Santa Cruz area, Big Creek Lumber Company often uses selective logging techniques on lands that were first cut a hundred years ago. They are now harvesting logs that are larger than those from the first one or two young-growth cuttings, indicating that the thinning of the forest, coupled with more time, is increasing log size. Whereas 40 years ago it may have taken 25 or 30 logs to fill a truck, it often takes only 12 or fewer logs to fill a truck today. (See Figures 99, 100, and 101.)

(An interesting pair of booklets has been produced by the California Department of Forestry and Fire Protection: *A Review of Harvesting Redwood*, by Verne Osburn and Phillip Lowell, 1972, and *A Review of Redwood Harvesting: Another Look ---1990*, by Phillip Lowell. Both provide before and after pictures of sites that have been logged. They clearly show the ability of the coast redwood to regrow in areas that appear to have been devastated by logging.)

As old-growth forests were harvested, second- and third-growth forests were maturing to a harvestable size, and timber companies began harvesting the young growth stands. New laws and regulations required lumber companies to replant more trees, reduce damage to the land, and provide more protection for streams and wildlife. At the same time, the companies were developing different attitudes and practices.

The face of the timber industry was changing from exploitative logging to management of not only timber, but soil, wildlife, water, and other resources. Management for sustainable growth became the objective. Goals have changed from simply cutting and selling wood to the preservation of land as forest, restoration of redwood forests, and connecting forest landscapes for forest and wildlife health.

Chapter 7

Conservation Concerns and Efforts

The giant Sequoia redwoods of the Sierra (*Sequoiadendron giganteum*) were the first to be protected. Their range was, and is, much more limited than the coast redwood, and they were heavily exploited during the gold rush. The Lincoln-Mariposa grove received protection in 1864, and in 1890, groves in Sequoia-Kings Canyon and Yosemite received protection.

In 1885, California's State Board of Forestry (now the California Board of Forestry and Fire Protection) was created to both regulate and assist the lumber industry. Most of its efforts centered on fire prevention and how to deal with slash. This was the first state forest regulatory body in the nation, and its creation was partly due to concern about the redwoods.

Public concern about the coast redwoods continued to grow, especially in the San Francisco Bay Area. In 1901, Big Basin State Park was created, largely through the efforts of the Sempervirens Club (now the Sempervirens Fund), led by Andrew P. Hill. To the 2,500 acres purchased by the state were added 1,300 acres donated by lumberman Henry Middleton. In 1902, William and Elizabeth Kent purchased Muir Woods, in Marin County, to protect the old-growth redwoods there from being logged. In 1908, they donated the area to the nation and it became Muir Woods National Monument. These parks were created in the area that had been first heavily impacted by coast redwood logging, which was also an area where they could be easily visited by urbanites from San Francisco and San Jose. The effort to protect the redwoods was one of the rallying cries of the national preservation movement of the early twentieth century. (Figure 93.)

In the early 1900s, preservationists in the north coast counties tried to get the federal government to purchase redwood lands for a national park, but the government failed to act. During World War I, logging of the redwoods increased, and preservationists became more concerned. In 1918, the Save-the-Redwoods League was formed with the purpose of protecting both the coast redwoods and giant Sequoias. Using private donations, the League purchased redwood lands and contributed them to the State Parks System. (Figure 94.)



Figure 93. An expedition to the Big Basin area of the Santa Cruz Mountains in 1900 resulted in the formation of the Sempervirens Club, which worked for the creation of the world's first redwood park, in 1902. (Now named the Sempervirens Fund, the organization has raised funds to preserve over 20,000 acres in the Santa Cruz Mountain area.) (Photo courtesy of the Sempervirens Fund.)



Figure 94. Founded in 1918, the Save-the-Redwoods League has used more than \$100 million to purchase over 130,000 acres of redwood land for California State Parks, Redwood National Park, Sequoia National Park, and other parks and preserves. (Photo courtesy of the Save-the-Redwoods League.)

There were several instances in which lumber companies refrained from logging prize parcels until the state or private organizations could raise the money to purchase them for parks. This is even more significant when one considers that the companies continued to pay taxes on the land and to provide fire protection and insurance. In the 1920s and 1930s, with support of the League, the federal government did some studies of the feasibility of a national park, but legislative action to establish a national park was not taken.

In the mid-1940s, a number of forestry bills were passed by the state legislature. In 1945, the Forest Practices Act established four Forest Districts, including one for the coast redwood region. The 1945 Forest Practice Act, however, was essentially toothless. It relied on education and persuasion to try to get the timber industry to regulate itself...with voluntary compliance. Fire protection statutes were sometimes used to try to get the industry to improve its management, but little was done besides sending letters (Arvola, 1976).

In the early 1950s, logging permit systems and other statutes were enacted, providing some tools for regulation of the industry, but they mostly applied to publicly owned land. In the mid- and late-1950s, the Forest Practices Act was further strengthened and clarified. At the same time, laws to protect streams and fish resources began to be enacted. In the mid-1950s, the Sierra Club and other environmental organizations began to criticize the law because of its lack of effective regulation of the timber industry.

In the 1940s-1960s, timber owners were taxed on the amount of standing timber, which encouraged them to cut the trees, especially the larger ones. (Since the 1970s, taxes have been based on the amount of wood harvested.)

When considering and discussing the logging of the redwoods (or any other type of tree) it is important to keep in mind that most logging is done to fill a demand for lumber. If people weren't buying the wood, the companies wouldn't be cutting it. We all use wood products in many ways. In some cases, using wood is environmentally preferable because wood is renewable, recyclable, decomposable, and a vigorously growing young forest provides many environmental benefits. (See Chapter 9.)

It is also important to keep in mind that different people have different interests and priorities, and that society's values change over time. In the 1800s, redwoods were logged with little regard for the environment. Some refer to the early practices as "mining" the forests – cut down and get out. Today, redwood logging companies are heavily regulated and many also have learned the importance of minimizing environmental damage to their land by practicing sustained yield management. In the 1700s and 1800s, the vast expanses of redwood forest must have seemed limitless to many, especially when logging was done with a hand axe. Today's increased population and modern technology have "shrunk" the world so that the remaining stands of protected redwoods seem to many to be inadequate.

A preservationist, a logger, a home builder, a park department employee, and a county tax collector might all view the same stand of redwood trees very differently. Today, much of the redwood lumber goes to building decks and fences, and almost all of it comes from young-growth forests. A hundred years ago, in 1906, the redwood lumber came from old-growth forests and went to rebuilding San Francisco and other cities devastated by the 1906 earthquake. Decisions about resource management are a complex balancing act of social, environmental, economic, aesthetic, and spiritual values.

In some cases, a "not in my back yard" sort of attitude exists. Whereas California was recently self-sufficient in meeting its lumber needs, California now imports 70-80% of the wood consumed here. (The redwood that we use here comes from California, but efforts to grow coast redwood commercially began in New Zealand in 1901, and commercial-growth experiments are being conducted elsewhere.) In Oregon, clear-cuts of up to 120 acres are allowed, and Washington allows clear-cuts of up to 240 acres. California's regulations limit clear-cuts to 40 acres, and most are limited to 30 acres or

less. Is it preferable to import clear-cut pine or Douglas-fir from Oregon or Washington for use in California? Is it acceptable to cut young-growth redwood but not old-growth? Many people who oppose the logging of redwoods also use redwood lumber to build their decks and fences and panel their offices. Some people get upset when they can see the clear-cuts along a roadside, but say nothing when the logging is out of sight.

From the perspective of the timber industry, redwoods on private land are a crop to be harvested and regrown in an ongoing, sustainable way. Crops of carrots and corn are harvested after a season; crops of redwood trees are harvested in cycles that are decades long. While a corn field or carrot patch doesn't usually provide habitat for wildlife, a growing redwood stand provides habitat and other benefits. Unlike some alternatives, redwoods are a renewable resource. Furthermore, there are land ownership questions. Why should land owners be prevented from running a business and making a profit from timber on land that they own? What about a private land owner who has grown trees for 30 or more years, anticipating harvesting them, only to have the regulations change?

A young growth forest is not, of course, the same as an old-growth forest, and the logging of redwoods, whether young growth or old-growth, impacts many more species than just the trees being harvested. While a backyard garden may regrow in a few months, a tract of clear-cut redwood trees covers up to 30 acres, will usually be covered with a variety of new growth within a few years, and after some decades will regrow a forest of large trees, providing wildlife habitat in the meantime. The harvesting of the redwoods is heavily regulated, and a stand of healthy redwood trees provides wildlife habitat and other environmental benefits. On the other hand, cutting of the forest to make way for houses, roads, and other development eliminates wildlife habitat and results in other environmental problems, such as runoff and pesticide pollution.

Teaching idea



If you can obtain old high school science text books, it is interesting to compare what is written about conservation, ecology, the environment, etc. in different eras. Students can try looking up such words as conservation, ecology, ecosystem, land management, etc. When I went to high school in the early 1960s, our biology text discussed conservation as contour plowing and fire prevention, and the term "ecology" wasn't even used in the book. By the mid-1970s, high school texts had expanded "ecology" to include many other issues. Today, in the early twenty-first century, texts may discuss global environmental issues such as global warming, but emphasis on standards often precludes much emphasis on ecology and the environment.

Older encyclopedias can be interesting for students to explore, too. The 1962 World Book Encyclopedia, for example, includes an article on "Conservation," authored by J. Russell Whitaker. In that article there are sub-headings for "kinds of conservation," including soil, water, forest, mineral, wildlife, and human conservation. The 2002 World

Book Encyclopedia "Conservation" article, by Daniel Simberloff, includes subheadings for soil, water, forest, and mineral, but has added biodiversity, ocean, grazing lands, energy, and urban. The 1962 edition classifies the coast redwood as in the pine family, while the 2002 classifies it in the Taxodiaceae family.

Criticism of the logging industry continued in the 1960s, especially with regards to protection of fish habitat and breeding grounds. In 1963, a study was begun in the redwood region to assess the damage caused by the 1954 -1955 flooding in the Rockefeller Grove in Humboldt Redwoods State Park (Barbour *et al.*, 2001). As a result of that study, the California Department of Parks and Recreation acquired additional land along Bull Creek.

Another disastrous flood hit the redwood region in December 1964—the second "once in a hundred years" flood to hit in a decade. In November, rainfall in Eureka was 160% of normal. The rain melted snow packs in the Siskiyou and Trinity mountain ranges, and in coastal Oregon. The ground was too saturated to absorb more water, and creeks became hundred-foot-wide rivers carrying trees and boulders downstream. Unfortunately, the storm coincided with high tides, which contributed to the flooding. The Eel River carried a million cubic feet of water per second – 40 times the average flow of the Sacramento River and three-fourths that of the Mississippi (Nixon, 1966). Highways and bridges were washed out as water levels rose over ninety feet in some places. (Figure 95.)

See the activity "The Root of the Matter" in Section IV.

Critics of redwood logging claimed that the floods were worsened by clear-cut logging practices (Nixon, 1963). Timber industry supporters pointed out that huge floods had repeatedly hit the region before significant logging had occurred in the area, and that some flooding would probably have occurred even without logging. Streamflow data from the U.S. Geological Survey shows that, after 1964, streamflow rates were only slightly elevated as compared to before 1964.

Teaching Idea



Streamflow data can be obtained from the U.S.G.S. for hundreds of measurement sites throughout California. The data for the Eel River at Scotia, for example, goes back to 1911. The data can be downloaded in both numerical table format and as a graph. Students can learn to read the tables and graphs, and discuss the implications of the data. Go to: < <http://waterdata.usgs.gov/nwis/peak> > (note the lack of "www")

See the activity "Flood Math" in Section IV.



Figure 95. The Eel River flood of 1964. (Photo courtesy of Pacific Lumber Company.)

Flooding is a natural occurrence in the redwood forest; it brings nutrients to the trees that live in the bottomland of the streams and kills some competing plants. The 1964 flood deposited 36 inches of silt in some areas. A soil pit dug at Bull Creek Flat showed an accumulation of thirty feet of silt from about fifteen floods over a thousand year period. Critics of the timber industry claimed that, although flooding is natural, the logging significantly worsened the impact on the streams and human communities.

Studies of the Redwood Creek basin in Humboldt County have shown that, following logging and the building of hundreds of miles of logging roads, repeated flooding between 1955 and 1975 led to extensive sedimentation and bank erosion. As of 1996, the stream still had not recovered (Ozaki, 1996). Another study, in the Caspar Creek basin in Mendocino County, showed that in the winter following the construction of logging roads, streams sometimes had increased sediment loads of 300-400%, and that for several winters after logging, the sediment loads increased 100-500%, returning to pre-logging levels in 6-7 years after the logging was completed. In general, the flow of

water in the streams didn't seem to have been affected, but sediment load did. These studies were done in areas where 90-year-old second growth stands were logged between 1971 and 1991 (Zimmer *et al.*, 1996).

Determining the cause of increased sediment loads in streams is not easy, though. Comparing sediments before and after logging is complicated by such things as landslides that may or may not be related to logging and variations in weather. At the Jackson Demonstration State Forest in Mendocino County, there has been an ongoing study in the Caspar Creek watershed since 1962. In that study, they are comparing different logging techniques and their impacts on the streams. Those studies (Lewis, 1998) indicate that:

- 1) While all methods of logging increased sediment loads in streams, old methods such as building roads near streams, yarding by tractor, and not protecting streams produced 2.4-3.7 times as much increase in suspended sediments as modern practices produced.
- 2) Much of the increased sediment load was due to increased runoff during storms, which would be expected to decrease as the forest grows back.
- 3) Old logging roads ("legacy" roads) continue to be a factor in producing landslides and, therefore, increased sediment loads, for many years after the logging has ceased. Roads located on upper slopes didn't seem to be a "significant source of sediment reaching the channels."

Another finding of the Caspar Creek Watershed study has been that salmonid (trout and salmon) abundance declined after logging but returned to pre-disturbance levels after only 2 years (Caspar Creek Experimental Watershed, 2006).

Throughout most of California and the nation, it was the preservationists' message about the 1964 floods that was heard. The flooding further focused public attention on the clear-cut logging practiced in many redwood drainages, and public outcry increased. One lumber company, following its normal harvest plans, clear-cut alongside the major highway in the region, Highway 101, the "Redwood Highway," which further fueled public concern.

Although the establishment of a Redwood National Park was proposed by the first Secretary of the Interior, Carol Schurz, in 1879, it wasn't until the early 1960s that public concern and outcry about redwood logging created enough support to make it happen. In 1963, the National Geographic Society funded a survey to locate the remaining old-growth redwoods and suggest the location for a Redwood National Park. The survey showed that only about 15% of the original two million acres of virgin redwoods were uncut. Of those 300,000 uncut acres of redwood forest, about 50,000 were already in state parks (Rasp, 1989).

Discovery of the three largest known trees, in the "Tall Trees Grove," along Redwood Creek, in Humboldt County, further fueled the public demand for a Redwood National

Park. Needless to say, various stakeholders had vastly differing ideas of how much land should be included in the proposed park. The timber industry promoted the idea that most of the park should be made up of land already protected in Jedediah Smith, Del Norte Coast, and Prairie Creek Redwoods State Parks. Many of the citizens of Humboldt and Del Norte Counties opposed the creation of a national park, not only because of the logging or other related jobs lost due to the designation of timber land as park land, but also because of the taxes that would have been received from the timber sales. Those taxes, it was maintained, were needed to support city governments, schools, and fire districts. Some claimed that the creation of a national park would bring about a new "Appalachia" Ronald Reagan opposed the creation of a redwood national park and supposedly said, "If you've seen one redwood, you've seen them all." (I have been unable to confirm that he actually said that, but, in a speech to the Western Wood Products Association on Sept. 12, 1965, he did say "A tree is a tree. How many more do you need to look at?" (Snopes, accessed June,2006)).

Teaching Idea



*If possible, obtain a copy of the July, 1964, National Geographic Magazine (Vol. 26, No.1). * It includes articles by Melville Grosvenor and Paul Zahl about the discovery of the Tall Trees Grove. Have the students read and discuss the article.*

- *Discuss the meaning of the term "hyperbole."*
- *Discuss the photograph on pages 2-4, which shows logging just across Redwood Creek from the grove.*

The article includes a map showing the ranges of the coast redwood and giant sequoia, the measurement of a tree's circumference/diameter, various redwood forest organisms, sprouting from a fallen tree, logging operations, growth rings, and many other aspects of the coast redwood's human and natural history.

(The same issue has an article on the 1964 Alaskan earthquake, which caused a tsunami in Crescent City.)

** Libraries, flea markets, and used book stores often have old National Geographic Magazines, as do students' parents and grandparents. A parent might be willing to take on the task of finding a copy of this issue.*

Park advocates, on the other hand, maintained that money lost from the lumber industry would be made up by increased tourism. Loggers could be retrained to work in the tourist industry. More park employees would be needed. The federal government would provide economic aid to the counties to compensate for lost tax money. The federal government would also pay for the land.

The National Geographic study recommended a Redwood National Park of 53,600 acres. The Sierra Club promoted a 90,000-acre national park in the 280 square mile Redwood Creek watershed. It was not until 1966 that President Johnson sent a bill to Congress, and the creation of the park was not authorized until 1968. The final

authorization was for a Redwood National Park of about 55,000 acres, with about 28,000 coming from private owners, including about 11,000 acres of virgin redwood forest. In order to close the deal, federally owned forest was traded to lumber companies in order to lower the cost and also reduce opposition. Today, the Redwood National and State Parks in northern Humboldt and Del Norte Counties are managed cooperatively by the California Department of Parks and Recreation and the National Park Service (Barbour *et al.*, 2001).

In spite of the optimistic hopes of the park advocates, personal income in Humboldt County has not kept pace with the rest of the state. A factor in the reduced personal income in the redwood region has been a shift from well-paying wood product manufacturing jobs to lower paying service industry jobs. As timberland was protected in parks, it was hoped that tourism would replace some of the jobs lost in the timber industry. Not only do tourism/service jobs not pay as well as timber industry jobs, but they have not materialized as was once hoped.

According to Hackett (2005), environmental regulations have played a role in job losses in the lumber industry, but other factors, such as mill consolidation, have played a greater role.

Teaching Idea



It is interesting to look at magazine articles about the redwoods and the proposed park from the mid-1960s. Local libraries, bookstores, or online sources may have old issues of National Geographic, Saturday Evening Post, Life, Time, or Newsweek. The April 22, 1967, Saturday Evening Post, for example, has an article titled "The Battle of the Redwoods," which does a good job of presenting both sides of the controversy.

If you can obtain the actual magazines, many students will enjoy looking not only at the Redwood National Park articles, but also at the fashions and other advertisements. The Post issue referenced above, for example, has 8 full-page automobile ads, only one of which (Volkswagon) mentions mileage. The tobacco and alcohol advertisements are also interesting.

The Interim Professional Report of the National Park Service, published in 1964, also makes interesting reading. See Hartzog in the Works Cited section.

The original national park boundary extended only nine miles upstream from the Tall Trees Grove. In the 1970s, the Redwood Creek watershed above the park was intensively logged. About 36,000 acres were clear-cut, and 300 miles of roads and 3,000 miles of skid trails crisscrossed the landscape above Redwood Creek. By the mid-1970s, less than 25% of the old-growth redwoods remained in the Redwood Creek watershed. Erosion from the logging operations was said to threaten the park trees along Redwood Creek as thousands of cubic yards of soil eroded. (Redwood, 1997?)

Amid much controversy, in 1978, President Jimmy Carter signed a law adding 48,000 acres to the national park (Rasp, 1989).

About half of the world's remaining old-growth redwoods now are in Redwood National Park and the three state parks associated with it. When the other parks and reserves are included, about 95% of the remaining old-growth is protected. The parks also contain thousands of acres of second-growth forest land. Millions of dollars have been spent to try to rehabilitate the logged areas of the parks and to reduce erosion and fire danger.

Throughout the second half of the 1960s, the Forest Practices Act was further modified and somewhat strengthened, and the Department of Fish and Game continued to press for more involvement in the regulation of logging practices because of their impact on streams.

In 1982, writing in the book *Logging Practices*, Steve Conway noted that:

"Although the preservationists are relatively few, they have been able to arouse the public merely by focusing attention on industry's mistakes. They look at the burns, poorly stocked lands, ugly clear-cuts, erosion, and misplaced forest roads and point an accusing finger. It does not matter who is actually to blame – the logger, a governmental agency, or a careless tourist – the entire wood products industry gets the blame. This is a contention that is easy for much of the public and many legislators in urban and non-timber-producing areas to accept.

The environmentalist and preservationist have a point; the industry has not been doing the best job possible. Yet as a result of the hard-hitting attacks begun during the sixties and continuing into the present, industry leaders have begun to solve some of the problems. At times the solutions are painful, requiring industry to accept the full responsibility for some glaring errors of judgment. However, there are numerous examples of how the overall effect of these attacks has been good for both the public and the industry."

In the early 1970s, the Forest Practices Act was significantly strengthened, largely due to public concern about logging in redwood forests near urban areas. Even though the laws became more strict and inspections more frequent, compliance with the laws steadily increased from 80% compliance in 1950, to 96% in 1975, the last year for which my source (Arvola, 1976) provides data.

An important event occurred in 1970. In 1969, the Bayside Timber Company had sought to begin logging redwoods in San Mateo County. The County imposed such restrictive rules that Bayside sought relief from the courts. The courts eventually ruled not only that San Mateo's restrictions were unconstitutional, but that the 1940s-era Forest Practices Act itself was unconstitutional because it called for self-regulation. For a while, the timber companies were essentially unregulated. Fortunately, these companies acted with restraint (Barbour *et al.*, 2001).

In 1973, the Z'berg-Nejedly Forest Practices Act became law, further regulating logging practices. Over the next couple of years, various agencies worked to try to establish new forest practices and laws. In 1975, it was determined that the Forest Practice Act fell within the realm of the California Environmental Quality Act of 1970, and that Environmental Impact Reports would be required for logging operations. In the mid-1970s, Governor Edmund G. Brown, Jr. directed several state agencies, including the State Board of Forestry, Department of Fish and Game, and the State and Regional Water Resources Control Boards, to work together to develop effective rules and regulations. Meanwhile, California's population continued to grow, further increasing demand for wood, wood products, recreational areas, and living space. Policies and laws were, and are, often influenced by the political climate as well as by science (Barbour *et al.*, 2001).

The original 1945 Forest Practices Act was implemented in 1947 with the first edition of the Forest Practices Rules. Published in pocket-sized booklets, the 1947 rules were the equivalent of about fourteen 8.5" x 11" pages of 10-point type. The Z'berg-Nejedly Forest Practices Act of 1973 made significant changes and added much more protection. By 1980, the rules were the equivalent of about twenty standard pages. The current (2005) Z'berg-Nejedly Forest Practice Act would take over one hundred standard pages to print. (Source: email from a Legislative Analyst with the California Department of Forestry and Fire Protection.) Of course, as the volume of the Forest Practices Act has grown, so, too, have the difficulties and costs of complying with the various regulations.

It is easy to see that compliance with new laws has required a major change in thinking and planning in the forest products industry, and has added greater expense to the timber management process. One study, reported by Thompson and Dicus (2005), indicates that the average annual per acre cost of preparing a Timber Harvest Plan rose from \$0 prior to 1974 to about \$100 in 1992 to over \$600 per acre in 2004. Not only is this a huge increase, but it occurred in a very short time.

As it is now interpreted, the California Forest Practices Act allows the logging of old-growth redwoods, but not if it will affect endangered species. Even though 95% of the remaining old-growth redwood is protected in various county, state, and national parks and reserves, whether to log or protect the remaining privately owned old-growth forests remains an issue. (Of about 1.3 million acres of privately owned redwood forests, nearly 0.77 million are owned by the lumber industry and almost 0.54 million are owned by private landowners.)

Much of the second-growth timber is over a hundred years old, and it has developed some characteristics of "old-growth" forests, including trees of considerable size. Harvesting of those older second-growth forests is sometimes contentious.

As our understanding of natural systems has increased, the emphasis in forest protection has changed. In the 1920s, the emphasis of the conservationists was on

protecting stands of trees. By the 1960s, the importance of protecting watersheds was understood. Now, we are beginning to look to protection and management of whole ecosystems, seeking to encourage development of forests with old-growth characteristics even as areas are logged, and trying to find ways to include connecting forested areas between preserves to provide corridors for animal movement. More attention is also being paid to areas that may not be as visually appealing as a stand of big trees but may be ecologically important to many species for a variety of reasons.

Another major battle was fought in the redwood region in the 1980s and 1990s. Pacific Lumber Company (PALCO) is a major redwood logging company, started in the 1860s when its founders bought 6000 acres of redwood forest along the Eel River for \$1.25 per acre. The company continued to grow and became one of the largest redwood logging companies in the world. It became the largest employer in Humboldt County, even having a "company town," Scotia. For years PALCO had practiced sustained yield forestry, including selective logging and limited clear-cutting. Many environmentalists viewed PALCO as a relatively "good" company in terms of logging practices and willingness to donate or sell old-growth land. By the 1980s, the price of redwood had increased to the point that a single large old-growth tree might produce \$100,000 worth of wood. PALCO's forests of valuable old-growth redwood and the low price of its stock made it attractive to investor Charles Hurwitz's Maxxam Corporation, which purchased the company in 1986 (Barbour *et al.*, 2001).

PALCO soon significantly increased the harvesting rates of the trees. One of the areas to be logged included the headwaters of Salmon Creek and the Little South Fork of the Elk River. This area became known as the "Headwaters Grove," and the proposed logging sparked a battle that pitted Earth First, the Environmental Protection Information Center, the Sierra Club, and other groups against Maxxam (Barbour *et al.*, 2001).

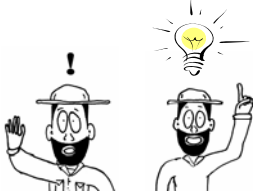
More than 20 lawsuits were filed against Maxxam, and the Headwaters battle resulted in some requirements for increased scrutiny of proposed logging operations by state regulatory agencies. Protection of endangered species such as the marbled murrelet was a major contention in the Headwaters Grove area. The preservationists' goal in the Headwaters was not just to protect a stand of trees. Objectives also included protection of endangered species, wildlife corridors, and streams. Also of major concern were timber harvests on adjacent properties. With the battle for the Headwaters Forest, the focus was on protection of a large redwood forest ecosystem, not just the trees (Barbour *et al.*, 2001).

Battles in the courts and in the forest waged for years. Preservationists wanted to establish a 60,000 acre Headwaters Forest Preserve. Eventually, a deal was reached to protect about 10,000 acres, at a cost of \$380,000,000, or \$38,000 per acre (Barbour *et al.*, 2001).

The "Headwaters Battle" saw some environmental activism evolve to environmental extremism. Activists blocked roads, climbed and sat in trees, and held protest marches. Lumber company equipment was vandalized. Spikes were driven into trees. "Spiked"

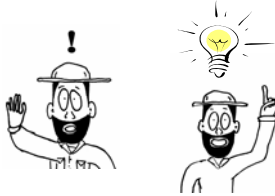
trees are dangerous to cut and mill. Some called these extreme tactics "ecoterrorism." While most environmental activists sought to make their case peacefully, the ecoterrorists made headlines.

Teaching Idea



If you choose to discuss extreme tactics with students, do so with caution. Merely discussing such tactics can be seen as endorsing them.

Teaching Idea



The Lorax, by "Dr. Seuss," is a story about greed and abuse of natural resources. Some teachers have used it in classrooms to promote preservation of resources and to paint the logging industry as "bad guys." When done in communities in which many of the parents are employed in the logging industry, this has, of course, caused problems.

If you want to use The Lorax, be aware of, and sensitive to, possible conflicts with the local community, including the students' families. It is important to keep in mind that we all use resources. While nobody is in favor of pollution or waste of resources, we all produce some pollution and use our share of resources. The Lorax can be useful in teaching the difference between "wants" and "needs." Indeed, the story focuses on the destruction of the environment to make "thneeds," which are things that people don't really need. The book and movie also end with the positive notion that individuals can help protect the environment through personal choices. They can also be useful in teaching about the complexity of decisions about resource use and management.

Older students may be able to understand the use of emotion to make a point in The Lorax, especially the movie version. Discussion could include separation of fact from insinuation, critical thinking vs. emotional response, and generalities vs. specifics.

Teaching Idea



The Man Who Planted Trees, by Jean Giono is an interesting story about a man who planted trees and restored a forest.

The conservation movement in the redwoods has evolved over the years. Early efforts focused on purchasing land for such parks as Big Basin and Muir Woods so that they could be visited and enjoyed by people seeking recreation. As logging continued and

accelerated through the 1950s, so, too, did efforts to protect the remaining stands of pristine forest. Groups such as the Save-the-Redwoods League and the Sempervirens Fund have raised millions of dollars to purchase redwood forest land, which was subsequently donated to the California Department of Parks and Recreation. They also pressured state and national governments to both purchase additional lands and to regulate logging on the remaining prime potential park land. Sometimes redwood landowners were cooperative in saving the lands, even donating or selling the lands at discount prices. Sometimes they hastily logged the lands prior to their being purchased, or threatened to do so in what some saw as an apparent effort to drive up the price. Modern conservation and preservation efforts focus on cooperation and collaboration among environmental groups, landowners, and governmental entities.

Teaching Idea



Have students either send for brochures about the parks in the redwood region, or use the Internet to find out about them. Many forest product companies also have information that they are happy to provide. Students can then prepare posters and/or give oral presentations.

Students can also find out about such organizations as the Sempervirens Fund and the Save-the-Redwoods League.

See Appendix III for addresses.

The actions taken to manage private, commercial, and park lands have also evolved over the years. Early logging practices resulted in erosion, damage to wildlife habitat and other problems; modern forest management strives not only to avoid such problems but to help damaged forest land heal. Early preservation efforts have protected some redwood groves from the chainsaw only to see the trees threatened by human-induced damage such as soil compaction, paving over, introduction of non-native species, by natural plant community succession as fire and flood have been kept out of the forest. Modern park management strives to allow humans to enjoy the parks while seeking ways to protect the groves from both human and natural impacts.

Chapter 8

The Modern Forest Products Industry: Resource Management

The exploitive logging of the 1850s through the 1950s is no more. A combination of dwindling old-growth stands, better understanding of the need for forest management, public outcry, and regulation have resulted in a very different industry than previously existed. Where loggers once cut and got out, modern companies manage their resources for long-term benefits. Companies have come to realize the economic necessity of not only harvesting trees sustainably and caring for their resources, but also of maintaining good public relations, lest laws become even more restrictive and compliance more expensive. Today's timber industry generally seeks to practice sustained yield forestry, with at least as much new wood grown each year as is harvested.

Different people, of course, have differing opinions as to what is the best use of a forest. Some favor ever-increasing amounts of protection and preservation in parks. Even those who favor preservation sometimes disagree. Such things as how much and what kinds of human use should be allowed, how much development should occur, whether cutting of some trees should be allowed, whether fire should be used to try to replicate natural conditions, whether invasive species should be removed and, if so, how, are important issues. How much regulation of privately-owned forest land is appropriate, and how much access to public forest land timber companies should have, are questions for which answers are not easy to develop.

Teaching Idea



Project Learning Tree has an activity titled "A Forest of Many Uses" in which students discuss and role-play making forest management decisions. See Appendix IV.

Others focus on harvesting of timber to meet the demands of California's growing population. The worldwide average for wood products consumption is about 0.7 cubic meters per person per year. We in the United States average almost three times that much, and the average for Californians is higher than the U.S. average. Meeting that demand, now and in the future, requires the modern timber company to carefully manage its forests, especially since timber harvests from public lands are down more than 90% from what they were in the 1980s (Dekker-Robertson, 2004). Modern timber management involves development of new tools, new methods, new knowledge, and new attitudes. California's laws and political climate provide more environmental protection than most other places. Since we are going to use wood products, a case can be made for using California-grown wood, which is a renewable resource grown under heavy regulation.

A growing concern is the subdivision of large blocks of forested land into smaller units that are more difficult to manage for timber or to protect. There is increasing pressure to sell forested land for development, especially in the central redwood region. This is due both to attractive profits to be made from land sales and to the increasing costs of taxes and complying with regulations. Landowners have rights and obligations with regards to how they use their lands. Those rights and obligations must be balanced with societal needs.

Whether logging old-growth or young-growth trees, the redwood logging industry has changed tremendously over the years. Some modern practices are described below.

Planning and Permits

Logging in the redwood region generally requires the filing of a **Timber Harvest Plan (THP)** or, if the landowner has "small" holdings (less than 2,500 acres), a "Non-Industrial Timber Management Plan" (NTMP) with the California Department of Forestry and Fire Protection (Berger, 1998). The plan, which must be prepared by a registered professional forester, is intended to ensure compliance not only with the Forest Practices Act, but also with the California Environmental Quality Act, the Water Quality Act, and the Endangered Species Act.

The major elements of a Timber Harvest Plan are listed below, not necessarily arranged as they are in the THP forms. Many of them require contracting with trained professionals such as soils specialists, hydrologists, wildlife biologists, archaeologists, and various governmental agencies.

- A. Introduction, including the location and boundaries
- B. General Physiographic Features: climate, geology, slope, soil types, etc.
- C. Forest Description: type of forest, description of the site and previous cuttings, roads
- D. Cumulative impacts on such things as wildlife, water quality, wood supply, soil, recreation, and visual impacts
- E. Management Objectives: wood products, range, water course and lake protection, wildlife protection, recreation, and economics
- F. Silvicultural Treatment: site preparation, logging practices, erosion control, pest protection, reforestation, etc.
- G. Forest Regulation: cutting cycles, allowable cut, future cuts, planning for sustainability
- H. Other Management Factors: road development, fire protection, impacts on neighboring properties, cultural and archaeological resources, unusual circumstances

Just completing all of the required steps for filing a Timber Harvest or Management Plan is a major task. After the plan is filed, there is opportunity for public input, but if the company has followed all of the required procedures, they are generally allowed to proceed with their cutting.

As part of the planning, surveys of the plants and animals present in the area are required. Special attention is paid to "listed" species, *i.e.*, those that are considered endangered or threatened.

Also as part of the planning, the area is marked or "flagged." This means that the boundaries, roads, trees to be cut (or, alternatively, those to be left), and areas for the operation, such as yarding and landing areas, are marked. As part of the approval process for the plan, changes may be required.

In addition to the state rules and laws, some counties have adopted their own Forest Practice Rules which have stricter standards than the state regulations. Most of these counties are in the southern redwood region and, as of 2003, included Marin, San Mateo, Santa Cruz, Santa Clara, and Monterey Counties.

Having a plan is not, of course, the same thing as following the plan. Nature does not always cooperate, accidents do happen, and corners are sometimes cut. It is noteworthy that the California Department of Forestry (CDF) is now called the "California Department of Forestry and Fire Protection." Fire protection and suppression receives 85-90% of the department's budget, leaving only a fraction for enforcement of the Forest Practice Rules. In fact, a law has been passed saying that the department may now be officially referred to as CAL-FIRE.

On the whole, though, redwood logging is a much different proposition than it was only a couple of decades ago. Should a logger or company be found to be in violation of the rules or laws, or not follow the plan, they can be made to take corrective action, be fined, have the operation stopped, be put in jail, or be put out of business. A forester who repeatedly submits inadequate plans can lose his license to practice forestry.

According to the CDF office in Fortuna, a typical timber harvest project will include a pre-harvest visit by a CDF inspector, one or two inspections during the active harvesting phase, another inspection upon completion, and an inspection of the restocking portion of the project. Given the numerous aspects of a typical project, it is not uncommon to find minor, easily corrected violations. Major violations are uncommon, especially for projects done by larger timber companies. In the Humboldt/ Del Norte county region, for example, there are about 14 CDF inspectors overseeing about 900 active Timber Harvest Plans in a given year, but only two to four infractions are typically taken to court each year. Those infractions are often by operators working on small projects in which a small landowner is cutting a few trees, often without a TMP or THP. Overall, the timber industry, especially the larger companies, does a good job of complying with regulations. (McGrath, 2006)

Falling (Felling)

Using chain saws to fall (or fell) the trees is faster and easier than using axes. (See Figures 78-80, 96, and 97.) Mechanical de-limbers have further streamlined the work in the woods where small trees are being harvested.

Some operations, especially the larger ones, use such modern machines as mechanical harvesters or feller-bunchers. Mechanical harvesters can cut the tree down, remove the branches, and cut the tree to desired lengths, and the entire process is controlled by a computer so that the maximum volume of lumber is harvested from each tree. Feller-bunchers can cut and bundle several small trees at once, or can fell a single tree and carefully control where it falls. Use of these machines in the redwood region is limited, however, by the steep terrain and large size of even young growth redwood trees.

Part of the management plan indicates the type of harvest—clear-cut, single tree, small group or other. (If the harvest is more than 2.5 acres, it is considered a clear-cut.) A goal of modern management of clear-cut (or "even aged") areas is to sort of mimic natural disruptions such as fire, flood, or landslide. Uneven aged stands require more frequent re-entry for subsequent harvesting, and that, too must be taken into consideration in the plan.

Management plans require Watercourse and Lake Protection Zones of varying widths, depending on the situation. These "buffer zones" are intended to protect fragile aquatic habitats and vary in width depending on such things as the presence of fish and the slope of the hillside. Some trees can be harvested from the buffer zones, but, depending on the stream and types of fish that live in it, 50-85% of the canopy cover must be left to shade the streams.

Some maintain that the required buffer zones are inadequate to effectively protect the streams from silt eroding from soil loosened and exposed by logging operations. Increasing stream buffer zones to 200 feet has been proposed. In the redwood region, a stream or watercourse need not have water in it year-round, or have fish in it, so a 200-foot buffer zone would greatly reduce the amount of area that would be available for harvesting timber.

Yarding or Skidding

The practice of bringing logs to a landing where they are gathered for hauling is called yarding or skidding. As previously noted, early methods of yarding were extremely destructive, especially when logs were skidded or "gulched" to the streams. Another major impact of yarding was the disruption of the soil, both from logs digging up the soil as they were dragged across it and from compaction by the tires or treads of the equipment, especially where the soil was damp. Modern practices seek to avoid damaging streams and a variety of methods are used to reduce soil disruption.



Figure 96. To cut the huge redwoods, extra-large chain saws were created. Compare to Figure 97. (Photo courtesy of Humboldt State University Humboldt Room collection.)



Figure 97. Most redwoods currently harvested are much smaller than those of 60 or 70 years ago. The modern chain saw enables faster cutting with less waste. (Photo courtesy Mendocino Redwood Company.)

Road building is one of the most potentially damaging aspects of logging, especially on steeper slopes. Modern timber plans include not only where the roads will be built (often on ridge tops, away from streams), but how they will be built to minimize erosion. Standard practices even include planning where to fell trees with regards to the roads—or planning where to build the roads or skid trails with regards to where the trees will be felled.

Various types of skidders are used today. Tracked skidders enable logging on steep slopes, while rubber-tired skidders are faster. Since the weight is concentrated on a smaller area, though, tired skidders tend to compact the soil more, especially where the soil is wet or exposed.

Moving the logs by cable is common today, especially on steep terrain. The cable might drag the logs along the ground (ground lead...usually most disruptive to the topsoil), drag the logs with one end elevated on a "high lead" cable, or move the log while it is suspended above the ground with a "skyline" (the least disruptive method). Sometimes logs are pulled to the tractor, rather than the tractor driving to the log. Logging inevitably disturbs the soil. Modern management seeks to keep the disturbance to an "acceptable" level.

Where the terrain is especially steep or other circumstances warrant, helicopters are sometimes used. This is a very expensive proposition, however, and is only economically feasible when other things such as too many streams, steep terrain, or exceptionally valuable wood exist.



Figure 98. The use of a cable yarder operating from high on the hillside or on the ridge enables logs to be pulled uphill rather than dragged through stream beds. Compare this picture with Figure 84. (Photo courtesy of Mendocino Redwood Company.)

Hauling

Most hauling is now done by trucks driving on roads that are engineered to minimize erosion. Erosion still occurs, but much less than in earlier times. In areas that have already been logged, old roads or railroad beds are sometimes re-contoured to reestablish the original slope, and old stream crossings are sometimes removed or replaced to improve fish habitat and reduce erosion. Modern operations often build roads on ridges to facilitate cabling operations and effectively reduce sedimentation of streams.



Figure 99. A one-log truck load. Since the old-growth timber has almost all been cut, most loads now consist of 10-20 logs. See also Figures 100 and 101. (Photo courtesy of Pacific Lumber Company.)

Milling

As noted elsewhere, early logging operations sometimes left about a third of the wood in the forest as chips, slash, or other waste. Of the two-thirds that came to the mill, half was often wasted as sawdust, trimmings, or other waste. In the 1940s and 1950s, this mill waste was generally burned in "tipi burners."

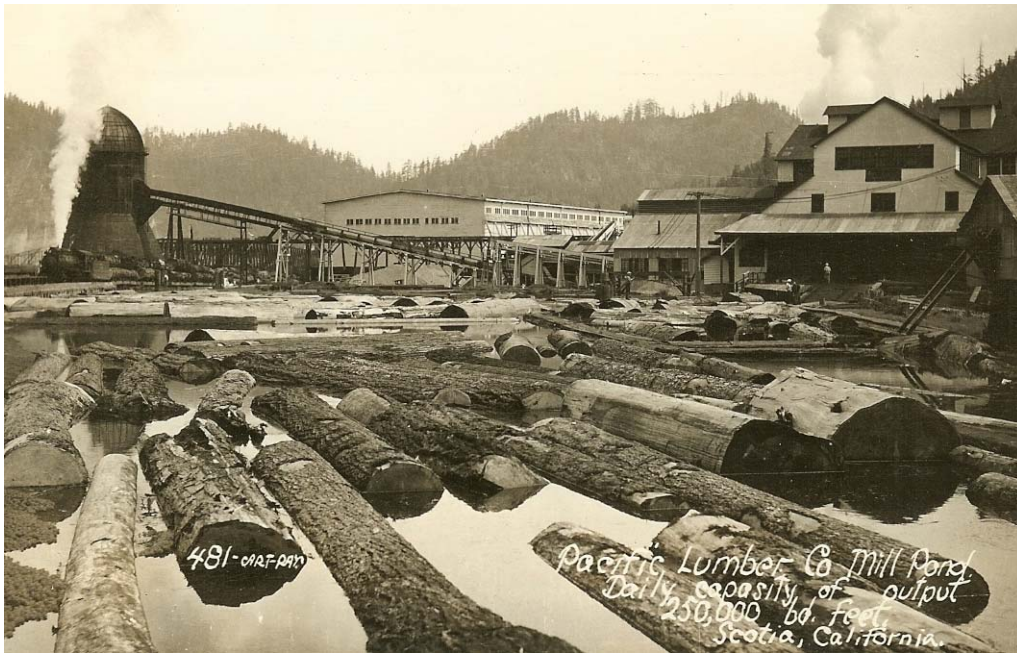


Figure 100. Large logs in the Pacific Lumber Company mill pond, probably taken in the mid-1950s -1960s. (Photo courtesy Clarke Museum collection.)



Figure 101. Pacific Lumber Company logs in 2006. Compare the size of the logs with those in Figure 100. Note also the automation, which is one of the causes of the decline in employment in the industry. (Photo by Michael Roa.)



Figure 102. Aerial photograph of the "Arcata Bottom" taken in 1948. Note the numerous "tipi burners" used to burn mill waste. See also Figure 103. (Photo courtesy Humboldt State University, Schuster Collection.)



Figure 103. Abandoned "tipi burner." Such burners, once used to dispose of sawmill waste, were common until the 1970s. Now the wood that was formerly wasted has many uses, and the air pollution from burning waste is not allowed. See also Figure 102. (Photo by Michael Roa.)

Modern computer-controlled mills waste little. Bark, chips, and sawdust are used in a variety of ways, including landscaping materials, livestock bedding, pulp for paper production, nursery products, filters, and others. Small pieces of wood that used to be burned are glued together to make larger boards. Shavings from producing surfaced lumber are used to make fiber board. Sawdust can be compressed to form fireplace logs or glued to make particle board. Some companies use mill residue to generate electricity to use on-site. Some mills even generate excess electricity which they sell to the Pacific Gas and Electric Company. The table below shows the "disposition of sawmill residue" from north coast (Del Norte, Humboldt, Mendocino, and Sonoma counties) in 1992 (Ward, 1992).

Pulp	Boards	Fuel	Miscellaneous	Total used	unused
22%	23%	41%	13%	99%+	<1%

Teaching Idea



Some mills or timber management companies welcome students and other groups for tours. See the Appendix III and IV for some contacts.

See the activity "Paper Making" in Section IV.

Cleanup and Mitigation

Various regulations govern what a logging operation has to do after the timber has been harvested. Depending on the situation, slash might be removed, chopped up to reduce its volume, burned, or, in most cases, simply be left in the woods to decompose. Potential pollution of streams from sediments/silt, slash, chemicals such as oil, or other materials, is a major consideration in the post-logging cleanup operation, and all forms of pollution are illegal. The timber harvest plan must include pollution prevention and mitigation plans.

As noted above, roads are a major concern. Preventing erosion is important, and the plans must include both locating and building the roads to try to minimize erosion. **Waterbars** or other means such as ditches are used to reduce erosion. Some companies even cover the road with the slash and drive tractors over it to crush it so that there is a covering to further reduce erosion.

Redwoods are famous for their ability to sprout new trees from their base or root crown. This sprouting is an important way that new trees are produced, both in nature from fallen or injured trees and from stumps after logging. (See Section 1, Chapter 2.) Modern timber companies don't rely solely on stump sprouting, however. They generally replant with seedlings, often grown in their own nurseries and selected for such characteristics as rapid, straight growth with branches that grow at 90 degree angles to

the trunk, thereby reducing the impact of knots on the finished lumber. (Some are concerned that replanting with such cloned trees reduces the diversity of the timber stock, making it more susceptible to possible diseases. Forest geneticists make recommendations about how many different clones to use in restocking cut stands, and sprouting from the original stock adds to the genetic diversity.)



Figure 104. Millions of redwood seedlings are grown in nurseries for planting in cut areas. As early as the mid-1800s, nurseries were producing 4.5 million redwood seedlings for restocking cut stands annually. (Photo by Michael Roa.)



Figure 105. The Scotia Inn (Hotel) in 1907. Compare the hillside in the background to the regrown hillside circa 1970s-1980s (Figure 106). (Photo courtesy Pacific Lumber Company.)



Figure 106. Scotia Inn, early 1970s. Compare to Figure 105. Note the regrowth of the redwoods on the hillside behind the Inn. (Photo courtesy Pacific Lumber Company.)

The days of massive cutting and waste in virgin redwood stands are over. Over 95% of the original redwood forest has been logged, and 95% of the remaining old-growth is now in parks or reserves. Redwood logging companies have learned that their survival depends on sustainable management practices, both to ensure a continued supply of redwood products and because of regulations and the public concern that result in political pressure.

There are now certifications available to lumber companies that harvest timber "sustainably." In California, certification is done through the Forest Stewardship Council or the Sustainable Forestry Initiative. According to the California Redwoods Association (2002) about 80% of the commercial redwood acreage is now certified. The main criteria are:

- 1) timber is harvested "sustainably," i.e., growth equals or exceeds harvest
- 2) the forest ecosystem is maintained and protected
- 3) socioeconomic impacts are such that the area has financial stability

To receive certification, companies must show that their land use practices meet current environmental protection standards. One study showed that among the reasons that the landowners sought certification were:

- To gain access to or create markets that only sell wood from certified forests
- To reduce criticism from environmental organizations
- To develop a constructive dialogue with environmental individuals and groups

That study also showed that landowners were more likely to seek certification in areas where "environmental activism" was high (Dicus and Delfino, 2003).

Chapter 9

The Redwood Empire Today

The Redwood Empire continues to evolve. While redwood harvesting remains important throughout the region, changes in the forest industry, increased population, and economic diversification have resulted in a Redwood Empire that is much different from 75 or even 40 years ago. Teachers generally have a good idea of what's happening in their community and county. Visits to local museums can provide information about local history.

Economics

In the 1950s and 1960s, redwood logging was the major industry in Del Norte and Humboldt Counties. In 1960, prior to the creation of Redwood National Park, lumber and wood products accounted for 38%, 31%, and 23% of the total employment in Del Norte, Humboldt, and Mendocino Counties, respectively. In all three counties average yearly income was lower than the state average, and unemployment rates were higher than the state average. The predictions in the interim report (Hartzog, 1964) were that annual attendance in the National Park would exceed 2.5 million by 1985, and that park visitors would spend millions of dollars, leading to expansion of the private resort industry outside of the park. The report also predicted increased income from sales and use taxes. However, the hoped-for tourism has not materialized. According to an article written by William Stewart in *California Forests* (2004), redwood park visits in Mendocino, Humboldt, and Del Norte counties have decreased by 14 percent since 1990.

According to a booklet titled *The Forest Products Industries in California: Their Impact on the State Economy* (McWilliams, 1994), the general decline of lumber production in California (not just the redwood region) is due "in part" to withdrawal of public lands from timber production to other uses and to new policies created to protect wildlife. McWilliams also attributes the decline in net volume of saw-timber inventory from 1952-1977 primarily to the reduced cutting of large trees, with the percentage of timber coming from old-growth trees falling from 78% in 1968 to 47% in 1988.

In the late 1990s, the average per capita income in the north coast region was only about 73% of the state average, but the "well being" in the region was rated as about 110% of the state average, indicating that residents liked living there even though their income was below the state average. (Lower housing costs may have made the lower incomes more palatable.) (*The Changing California*, 2003).

As a percentage of the total employment, jobs in the lumber and wood products industries in Humboldt and Del Norte counties have steadily declined, at least between 1982 and 2001:

Percentage of Population Employed in the Lumber and Wood Products Industries:

	1982*	1990*	1992**	1996**	2001**
Humboldt Co.	16.5%	12.0%	6.3%	7.6%	5.8%
Del Norte Co.	22%	10.2%	3.1%	2.0%	1.3%

*Source of 1982 and 1990 data: *The Forest Products Industries in California: Their Impact on the State Economy* (McWilliams, 1994).

**Source of the 1992, 1996, and 2001 data: *The Changing California* (2003)

These declines reflect both percentage and actual number of employees, although the change in actual numbers of employees is not as great as the percentages would indicate. For example, in Del Norte County, between 1982 and 1990, the percentage of employment in the wood products fell by over 50%, but the actual number of people employed in the industry fell by about 35%. Similarly, in Humboldt County, the percentage of people employed in the woods industry fell by 27% but the actual number of people employed in the industry fell by less than 4% (McWilliams, 1994).

When land and trees were inexpensive and logging and milling processes were relatively unregulated, many small mills were able to turn a profit. With increased regulation and competition from larger operations that are able to use more of the tree, many of the smaller mills have gone out of business. Consolidation has had a major impact on employment in the forest products industry.

The Western Wood Products Association produces an annual *Statistical Yearbook*. The 2002 and 2004 *Statistical Yearbooks* yield the following information, with my interpretation in parentheses:

"While employment in the western lumber industry (not just the redwood industry) declined by 16% between 2000 and 2004, the production of lumber per plant employee has increased significantly...increasing by 11% between 2003 and 2004 alone. Thus, changes in technologies and efficiencies seem to account for much of the loss of employment...and for much of the increased production. Production of redwood seemed to have stabilized at around 500 million board feet between 2001 and 2004, which is down somewhat from the 1996-2000 period. "

This conclusion is supported in *The Forest Products Industries in California: Their Impact on the State Economy* (McWilliams, 1994). That report points out that labor productivity in U.S. sawmills increased by almost 60% between 1973 and 1991, and by about 30% between 1982 and 1991. Each worker is producing more lumber per hour.

In 1968, the annual cut of timber in Humboldt County (more than 1.3 billion board feet) exceeded annual growth by 270%. This was largely due to the slow growth of trees in the old-growth stands. In fact, an old-growth stand can actually have a net growth of zero or even negative net growth as branches and tops die on the slow-growing trees. Now that there is little old-growth being cut and the harvest comes from more rapidly growing young growth, many timber companies have annual growth exceeding what is cut, or have that as a goal for the near future.

According to a study by the Center for Economic Development at California State University Chico, personal income (adjusted for inflation) from the lumber and wood products industry in Del Norte County has declined steadily and very significantly since 1969. Income from hotels and lodging is now about the same as it was then, and income from federal government employment has increased somewhat.

The southern counties in the redwood region have generally been more diversified in their economic base, but the economic role of redwood logging is diminishing in all areas. Because the economies of the counties in the redwood region aren't as dependent on the redwood industry as they once were does not however, mean that the timber industry is not important.

Timber

At one time, logging companies didn't worry much about where the next trees were coming from; there seemed to be an almost infinite supply. As stands were cut, some companies began to replant trees so that, as Kramer Adams points out in *The Redwoods* (1969?), "The business of growing trees was now part of the business of making boards." The California Redwood Association (CRA) points out that there are now more redwood trees growing than there were before logging began. The trees, of course, aren't as large as the old-growth trees were; the modern industry depends on harvesting trees in 50-70 year cycles rather than letting them grow for hundreds of years. Such trees grow very rapidly in areas that have ample sunlight. According to the CRA, an acre of 40-60 year old trees can add 2000 board feet of wood per year, which is enough to build an average sized house every five years. Other estimates range from about 150 board feet per acre per year in the poorest site to over 3,500 board feet per acre per year in the best sites (Lindquist and Palley, 1963).

The California Redwood Association points out that a fully stocked 80 year old stand of trees averages 114,000 board feet of timber per acre, with some stands having 200,000 board feet.

Concerns: Competition

Factors affecting the redwood logging industry include a lack of available old-growth timber, changing attitudes within and without the industry, regulations, mechanization, development of alternative materials such as decking made from recycled plastics, metal grape stakes, vinyl plastic fencing, posts and other ground-contact wood made

from treated fir, sales of land for parks and development, and fragmentation of redwood forestlands. Cedar fencing, largely from old-growth forests in British Columbia, has become a common substitute for coast redwood from California.

Synthetic decking material is in direct competition with redwood. Both the redwood industry and the makers of the synthetics claim that their products are better for the environment. Synthetic materials generally are made of recycled plastic and wood particles. The makers of the synthetic decking claim that staining and sealing chemicals are not needed, trees are not cut, the boards don't rot, and plastics are recycled. On the other hand, producing the synthetic products uses a lot of energy, and produces water and air pollution. Redwood growers point out that trees are a renewable resource that helps to reduce air and water pollution. They claim that using redwood for decks has a smaller "environmental footprint," *i.e.*, to have a smaller negative environmental impact over the life of the decking.

As a building material, studies have shown wood to have less negative ecological impact than concrete or steel from a number of perspectives (Dekker-Robertson,2004):

	Wood	Steel	Concrete
Total Energy Use	Lowest	140% more	70% more
Greenhouse Gases	Lowest	45% more	81% more
Air Pollution	Lowest	42% more	67% more
Solid Waste	Lowest	36% more	96% more
Ecological Resource Use	Lowest	16% more	97% more

Teaching Tip



The California Forest Products Commission has produced an interesting booklet titled We Care for the Forests (2003). While not specifically about coast redwoods, the booklet contains some useful information, including graphs comparing water pollution and energy use of various building materials. Students can study and interpret the graphs and other information.

Concerns: Development, Urbanization, Fragmentation

A current hot topic in the forest products industry, including the redwood industry, is the breakup of large tracts of forest land into smaller parcels, especially when the smaller parcels are developed for real estate or other "urban" types of development. While large tracts of timberland are regulated to protect water and wildlife resources, small residential parcels are relatively unregulated. Development not only results because of trees lost for the house or shopping mall, but also from the building of roads. While logging a forest tract for lumber removes the trees, they eventually regrow. Cutting trees for development replaces them with pavement, lawns, and structures. Deer, skunks,

bears, and raccoons can roam in a tract managed for lumber; they can't in a developed neighborhood. Water runs off of pavement and rooftops into storm drains; a forest allows water to enter the natural ground or surface water systems. Furthermore, breaking up large forested tracts results in loss of uninterrupted forests that may be essential for wildlife. Santa Cruz County, for example, has had more than 12,000 acres broken into smaller parcels with homes since 1990, and nearly 60% of the former forest land has been **urbanized**.

According to the California Redwood Association, about 52% of the redwood forests are owned by timber companies, and about 14% is in government ownership, most of which is in parks. The other 34% is owned by ranchers, tree farmers, and other private owners, and those private land owners have to deal with regulations and tax policies that sometimes encourage them to sell their land for development. Taxes, the high cost of meeting logging regulations, and the money to be made by selling land for development all contribute to conversion of timber land to other uses and fragmentation.

An important aspect of urbanization of the forests is that people moving to the newly developed former forest land often don't know very much about forest management or the forest products industry. Sometimes they draw their water from wells that diminish water flow in local streams, but complain that timber companies are affecting the fish. Their property may disrupt the habitat of many animals, but they assume that nearby logging operations are the reason that they see fewer deer, birds, or raccoons. Thus, education of the general public about modern forest management and the impact of development and urbanization is an important issue.

Concerns: Carbon Sequestration and Global Climate Change

Global climate change (a.k.a. global warming or the greenhouse effect) is another topic on which there is some disagreement with regards to cutting trees. There is no doubt that trees help combat climate change by absorbing carbon dioxide, which is a major "greenhouse gas." Obviously, cutting trees immediately reduces the photosynthetic uptake of carbon dioxide. When used as lumber, the carbon is stored or "sequestered," rather than re-entering the atmosphere. Also, studies show that a stand of rapidly growing young trees actually absorbs carbon dioxide at a faster rate than an older stand. Thus, a temporary loss of older trees may lead to replacement by younger trees, resulting in more rapid removal of carbon dioxide from the atmosphere. As is so often the case, the issue is more complex than it first appears to be.

Concerns: Park Use and Management

Another issue is concern about the protection of the magnificent stands of redwoods in the redwood parks. Not only do more visitors expect more accommodations such as parking spaces and trails, but compaction of the soils on trails and around trees threatens both the understory vegetation and the redwoods themselves. (See Figure 107.) Various parks are trying to alleviate the problems through such methods as re-

routing trails, building elevated walkways, and separating visitors from the trees themselves.

Human park users sometimes cause problems for wildlife. Sometimes people feed raccoons, birds such as jays and crows, deer, chipmunks, and other animals. Usually the food is "human food," which is generally not good for the animals, and if the animals become too tame they are more likely to be injured by cars or pets or to become pests.

The presence of people may negatively impact some species, including some endangered species.



Figure 107. Compaction around the base of redwoods can harm the roots, so boardwalks have been built around some of the more visited trees. The Founders Tree, in Humboldt Redwoods State Park, commemorates the founding of the Save-the-Redwoods League. Note that even the presence of the boardwalk doesn't always keep people from walking on the base of the tree. (Photo by Michael Roa.)

Concerns: Introduced Species

Yet another concern is the introduction of exotic species of plants and animals, which threaten the natural ecological communities. Even species that are native to California can be a problem when introduced into different ecosystems. There is some evidence that crows, for example, have learned to follow people into the redwoods to feed on scraps of food dropped by the visitors. Once in the redwoods, the crows may attack the young of endangered species such as the marbled murrelet.

Concerns: Fire and Flood Prevention

As mentioned previously, fire is a natural part of the coast redwood environment, and fire prevention may be favoring other species to the detriment of the redwoods. Even if other species don't invade the stand of redwoods, crowding causes competition and the weaker trees may die. The dead trees, whether redwood or other species, present an increased fire danger. Evidence shows that there are increasingly long dry spells in the redwood region, and that may also result in more severe fires. The elimination from the parks of naturally occurring fires is yet another problem. Even without catastrophic fires, keeping fire out of redwood parks may cause successional changes to other forest types. In essence, we may be over-protecting the redwoods in some parks.

Floods, which are a natural part of the coast redwood ecology, provide nutrient-rich silt and kill competition. Most redwood region rivers have been dammed to prevent flooding. Not only do the dams affect the redwoods, but they also affect salmon and other fish.

Concerns: Funding of Parks

The limited amount of funds available for the purchase of redwood lands requires judicious use of those funds. Few old-growth stands are available for purchase, and decisions must be made about the allocation of funding. Some advocate using available monies to connect currently protected stands. Others suggest purchasing whatever old-growth stands are available, or purchasing large tracts of second-growth trees rather than small groves of old-growth. Funds must also be allocated to provide long-term protection for stands already in parks and other reserves. Such decisions are not easy, and different people and groups have different priorities. While there is no easy answer, it may be useful for teachers to discuss these issues with the students and with park personnel.

Preservation and Conservation

As noted elsewhere, the timber industry has evolved to become a resource management industry, and that management sometimes includes working cooperatively with conservation groups and governmental agencies to protect sensitive areas. Maintaining timberland as forest land rather than urban development is a priority.

Groups such as the Sempervirens Fund and the Save-the-Redwoods League continue to raise funds for the purchase of redwood forest land. Now that little old-growth land is available, the emphasis is on connecting fragmented parcels, protecting watersheds, and purchasing lands that will help expand and protect existing parklands for both the plant and animal species within them and for human recreation, education, and enjoyment.

The large organizations have been joined by many local groups that work with parks to help with conservation efforts, interpretation, and fund-raising. These "cooperating

associations," such as the Stewards of the Coast and Redwoods, Humboldt Redwoods Interpretive Association, and the Big Sur Natural History Association, provide invaluable services to the parks and opportunities for students and others to become involved at a local level. See Appendix III for contact information.

The California Department of Parks and Recreation continues to manage parks and acquire new park land, often in cooperation with non-governmental organizations as described above. Given financial constraints, it is often difficult to balance the needs for maintaining and improving existing facilities and services, developing new facilities and services, and acquiring new land. While these and other issues will not be resolved simply or soon, it is important for students and other park users to be aware of the complexity of the issues.

In *The Redwood Forest*, 2000, Noss sets forth five general goals for conservation planning, including planning for the redwood region:

- 1) protect representative samples of all kinds of natural communities
- 2) maintain or restore healthy populations of all native species in natural patterns of distribution and abundance
- 3) sustain or restore ecological and evolutionary processes to their natural state
- 4) create a network of areas that can withstand natural and man-made changes
- 5) encourage human uses that are compatible with conservation goals while discouraging human uses that are not compatible with conservation goals.

See the activity "Red's Woods: Tough Choices" in Section IV.

Conclusion

The interrelationships between people and the coast redwoods have changed throughout history. Various species of redwood-like trees were common throughout the world long before humans had even evolved, and the coast redwood was here when people arrived from Asia 14,000 or more years ago.

Native peoples not only used redwood in a variety of ways; they apparently actually used fire to manage forests and clearings. While the first Europeans were too few in number and too limited in technology to have a major impact on the vast coast redwood forests, the population explosion that followed the gold rush meant the development of large-scale logging operations throughout the redwood region. The mid-1800s were a time when people thought nothing of rapidly exploiting natural resources with little regard for the future. The redwood forests seemed almost infinite, especially considering the simple technologies available.

The early 1900s brought new technologies and large scale logging as well as the beginnings of concern for conservation and preservation of these majestic trees. By the 1950s, many of the most impressive stands of trees had been either logged or acquired for protection in parks or other types of reserves. Continued demand for redwood lumber and ongoing development of logging and milling technologies increased the

harvesting of the trees. In less than 200 years, 95 percent of the ancient redwoods have been logged, and much of the cut-over land is now covered with stands of second- or third-growth redwood forest. Some has been paved over, built upon, or developed for agricultural uses, and there is constant pressure for more conversion of redwood forest land to other uses. Private landowners sometimes have difficult choices to make with regards to the trees on their land.

Since the 1960s and 1970s, the timber industry has developed a resource management approach that is very different from the cut-out and get-out approach taken by many earlier logging operations. Increased understanding, public concern, and regulation have produced a redwood forest products industry that seeks to manage the land and trees for long-term productivity, habitat protection, and other uses. At the same time, public and private groups seek to protect and preserve remaining groves and stands for future generations to enjoy. Our understanding of how best to meet these goals of productive forests and protected stands continues to evolve. Both scientific research and public education need to be part of the process as decisions with long term consequences for the future of the coast redwood are made.