Fire & Fuels

Integrating Fire, Resources, and Science: Estero Burns a Success

POINT REYES NATIONAL SEASHORE HAS BEEN conducting prescribed burns since 1978. These burns have ranged from 1/2 an acre to 200 acres, in treatment areas up to 800 acres in size. Prescribed fire is used as a resource management tool on National Park Service lands to accomplish the following goals:

1) Reduce hazardous fuels.
2) Restore native ecosystems.
3) Control non-native plants.
4) Maintain cultural landscapes.

A lot of time is spent planning a prescribed burn to ensure the number one fire management goal is achieved:

Provide for public and firefighter safety and the protection of property.

The Estero Prescribed Burn Plan includes eight burn units totaling 423 acres. Dividing a treatment area into small burn units that can be burned in a single day provides for risk management with maximum control. Wind, temperature, relative humidity and air quality conditions are critical factors determining whether or not a burn will be conducted.

From November 5–9, 2001, the Estero Prescribed Burn Plan was implemented. Four units totaling 336 acres were successfully burned. This was the fifth time this area had been burned since 1993. The prescription for the Estero burns was temperatures from 45–85 degrees Fahrenheit, 30–80% relative humidity, and 3–12 mph wind speed. No burning was conducted on November 8 due to low relative humidity which was out of prescription at 26–29%.

There were no air quality problems during the burns. Smoke columns generally rose 1,000–2,000 feet and dispersed south along the coast.

The Estero burn units are located on the hills above Drakes Estero and consist primarily of grazed annual grassland with coyote brush dominated coastal scrub on slopes and ravines. Patches of iris, blackberry, rush, and scattered Scotch broom are distributed throughout. The purpose of these burns was to reduce hazardous fuels and eradicate non-native Scotch broom.

These goals were further defined by three objectives:

1) Reduce broom that has been cut and dried by 80%.
2) Achieve 60% mortality in live broom plants.
3) Provide an opportunity to conduct research on the effects of burning Scotch broom.

All three objectives were met. Mortality in live broom was dependent on fire intensity being great enough to scorch basal stems and destroy the growth tissue in the plants. The extent to which the broom mortality exceeded 60% will be determined with further post-burn fire effects monitoring.

A prescribed fire team from Yosemite National Park assisted Point Reyes Fire Management with conducting the burns. Additional support was provided by local firefighters from Marin County Fire Department and Inverness Volunteer Fire Department. These enhanced support measures adhere to changes in National Park Service policy established after the Cerro Grande Fire in New Mexico. The new guidelines require additional engines and personnel during all prescribed burns, significantly increasing fire safety standards.

Fire & Fuels Management 2002
Point Reyes National Seashore and
Golden Gate National Recreation Area

Fire Safety, Working Together

Safety is a top priority throughout the National Park Service. In standards for equipment use and protective gear, as well as proper training, communication, and visitor advisories, "Safety First" should be part of every employee's day-to-day decision making.

Firefighters regularly work in dangerous conditions and are particularly aware that safety is not just a personal choice. Safe practices protect not only oneself, but coworkers and neighbors as well.

The National Fire Plan emphasizes interagency cooperation and ecosystem management. Point Reyes National Seashore and Golden Gate National Recreation Area are working with local fire departments, residents, partners, and other land managers to reduce wildfire risk on park lands and surrounding communities.

Our greatest fire threats are from unplanned, human-caused ignitions. Wood stoves, cigarettes, fireworks, campfires, sparks from electrical equipment and automobiles, or even rocks bouncing on pavement can ignite an unplanned fire. Sadly, malicious intent also plays a hand in a significant number of wildfires caused by arson.

In addition to loss of human life and property that may occur during a wildfire, suppression tactics can cause enormous impacts to the natural and cultural resources that national parks were established to preserve.

Planned prescribed fire during controlled burns is one of the ways we can prevent large, catastrophic fires. Mechanical thinning of vegetation and creating defensible space around structures and roads are other ways to reduce risk.

At the same time, fire is also a natural part of our ecosystems which we need to better understand.

Please join us in efforts to be FireSafe and FireWise in and around Point Reyes and Golden Gate!

Don Neubacher
Superintendent
Point Reyes NS

Brian O'Neill
Superintendent
Golden Gate NRA

Hazardous Fuels

Prescribed Fire

Partnerships

Community-Based Projects in the Wildland-Urban Interface

THE WILDLAND-URBAN Interface Initiative authorized by Congress in conjunction with the National Fire Plan, was legislated to reduce hazardous fuels on federal lands and assist communities with wildland fi re protection.

Partnerships, community involvement, and interagency cooperation are critical to reduce wildfire risk in places where residential areas border large expanses of vegetation. Point Reyes and Golden Gate are part of a complex mosaic of wildlands composed of national parks, state parks, county open space, water district lands, and private nature preserves. These lands are adjacent to many communities, sharing with them both the benefits and the wilfire risk inherent in large, natural areas.

Meeting with local fire districts was the first step to identifying community protection projects. Within the Point Reyes-Golden Gate wildland-urban interface, $769,000 was allocated to community-based projects in Fiscal Year 2001 and $653,000 in Fiscal Year 2002.

Community fire-hazard assessments are conducted to identify needs for defensible space, shaded fuel breaks, fire hydrants, escape routes, and road improvements.

The community-based projects focus on hazardous fuels reduction through vegetation management around homes and roads and along park or neighborhood boundaries. The projects are based in the communities of Inverness, Inverness Park, Olema, Bolinas, Muir Beach, Marin City, Marin-view, Sausalito, Homestead Valley, Nicasio, Point Reyes Station, and Mill Valley. All of these communities are located in Marin County, California.

A cooperative agreement with FIRESafe MARIN, a fire safe council founded in 1992, has allowed 40 project task agreements to be administered efficiently. FIRESafe MARIN is a non-profit corporation whose members include representatives of fire agencies, utilities, vegetation management professionals, county governments, land management agencies, insurance companies, neighborhood organizations, and others who share common interests in reducing wildfire hazards.

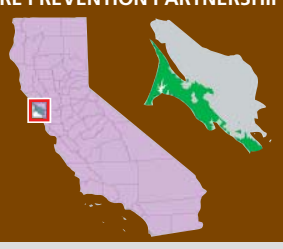
Fire-Hazard Assessment: **A defensible space survey was conducted for a neighborhood near Inverness Park. Each property received a color-coded hazard rating, ranging from safe to extreme hazard, based on the condition of vegetation around homes.**

Chipping: **Chipping programs, like this one in Muir Beach, provide residents with a means to dispose of vegetation removed from around homes to create defensible space.**

Composting: **In addition to chipping, the Resource Recovery Project in Bolinas composts vegetation debris.**

Mapping Fuels: **A county-wide map of trees affected by Sudden Oak Death is being developed to help manage the fire hazard posed by dead trees.**

NATIONAL PARK SERVICE-
FIRESAFE MARIN
FIRE PREVENTION PARTNERSHIP



The National Park Service preserves special places to leave them unimpaired for the enjoyment of future generations.

FIRESafe MARIN is dedicated to reducing wildland fire hazards and improving fire safety in Marin County, California.

National Park Service - www.nps.gov
FIRESafe MARIN - www.firesafemarin.org
FireSafe Council - www.firesafecouncil.org
FireWise Program - www.firewise.org

Marin County Projects

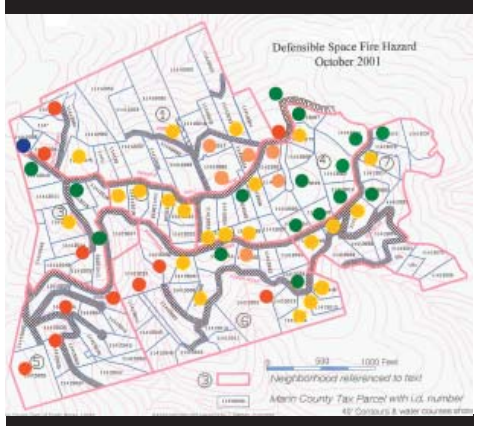
"These projects are part of a comprehensive plan to treat interface lands from Sausalito to Inverness." Ken Massucco, Chief, Marin County Fire Department

Bolinas
Resource Recovery Project, $52,500
Wish Creek Watershed Fuel Reduction, $46,000
Bolinas Mesa Defensible Space Survey, $20,000
Homestead Valley
Hazardous Fuel Reduction, $60,000
Inverness
Keith Way Fuel Break, $15,000
Seahaven Fire Management Plan and Implementation, $172,000
Vision Road Fuel Buffer, $46,000
Inverness Defensible Space Program, $12,000
Inverness Public Utility District Chipper, $20,000
Shell Beach Wildfire Protection, $47,700
Inverness Park
Paradise Ranch Estates Fire Management Plan and Implementation, $167,500
Emergency Access & Fuel Reduction, $90,000
Marin City
Headlands I & II Fire Protection, $132,000
Alta Fire Road Fuel Reduction, $25,000
Pacheco Fire Road Fuel Reduction, $15,000
Marin County
Sudden Oak Death Map, $25,000
Mill Valley
Camino Del Canyon Fuel Reduction, $60,000
Remote Automated Weather Station, $16,400
Muir Beach
Muir Beach Chipping Program, $68,500
Defensible Space Program Equipment, $16,400
Muir Woods
Panoramic Highway Fuel Reduction, $30,000
Nicasio
Volunteer FD Firehouse Renovation, $25,000
Olema
Water Pump System Upgrade, $61,000
Point Reyes Station
Chipping Program, $20,000
Sausalito
Sausalito-GGNRA Shaded Fuel Break, $60,000
Alexander Ave. Fuel Reduction, $18,000

Shaded Fuel Breaks: **Understory vegetation is removed or thinned to reduce potential fire intensity. Roads also act as fuel breaks which can slow and sometimes stop a fire. This capacity is enhanced by roadside vegetation clearing.**

Emergency Access & Egress: **Road conditions affect response time of firefighters and the ability of residents to evacuate. California fire code calls for 10' of vegetation clearance on each side of roads, and 14' vertically. Turnouts are also important for safe transit, especially during an emergency.**

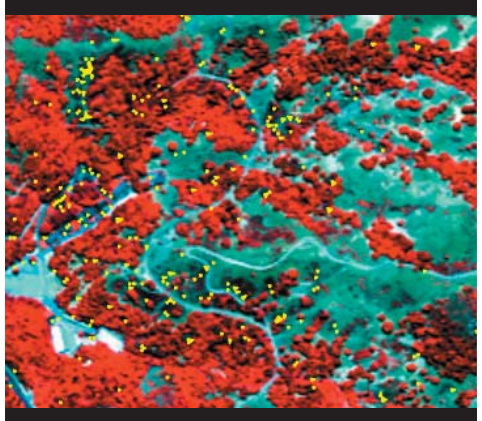
FIRE-HAZARD ASSESSMENT



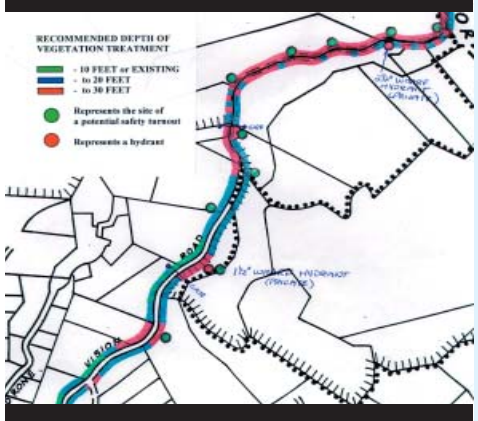
CHIPPING

COMPOSTING

MAPPING FUELS



SHADED FUEL BREAKS



EMERGENCY ACCESS & EGRESS

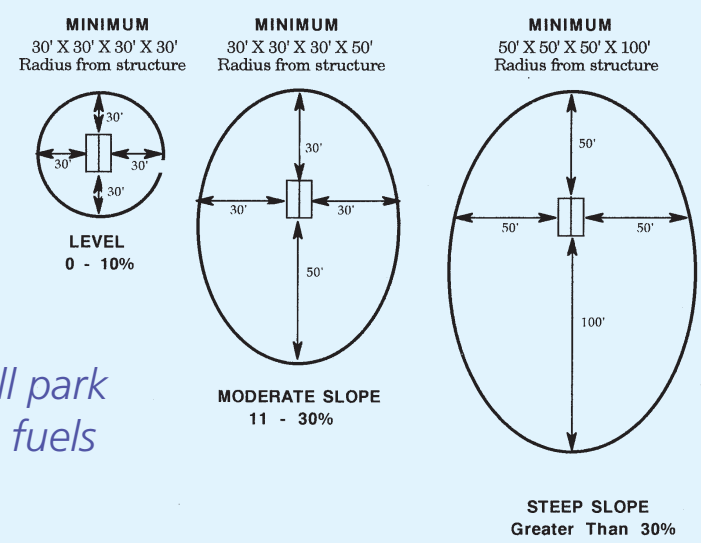
HOMES, FACILITIES & HISTORIC BUILIDINGS

Defensible Space
FOR STRUCTURE PROTECTION

Park structures, like nearby homes need defensible space for fire protection in the wildland-urban interface.

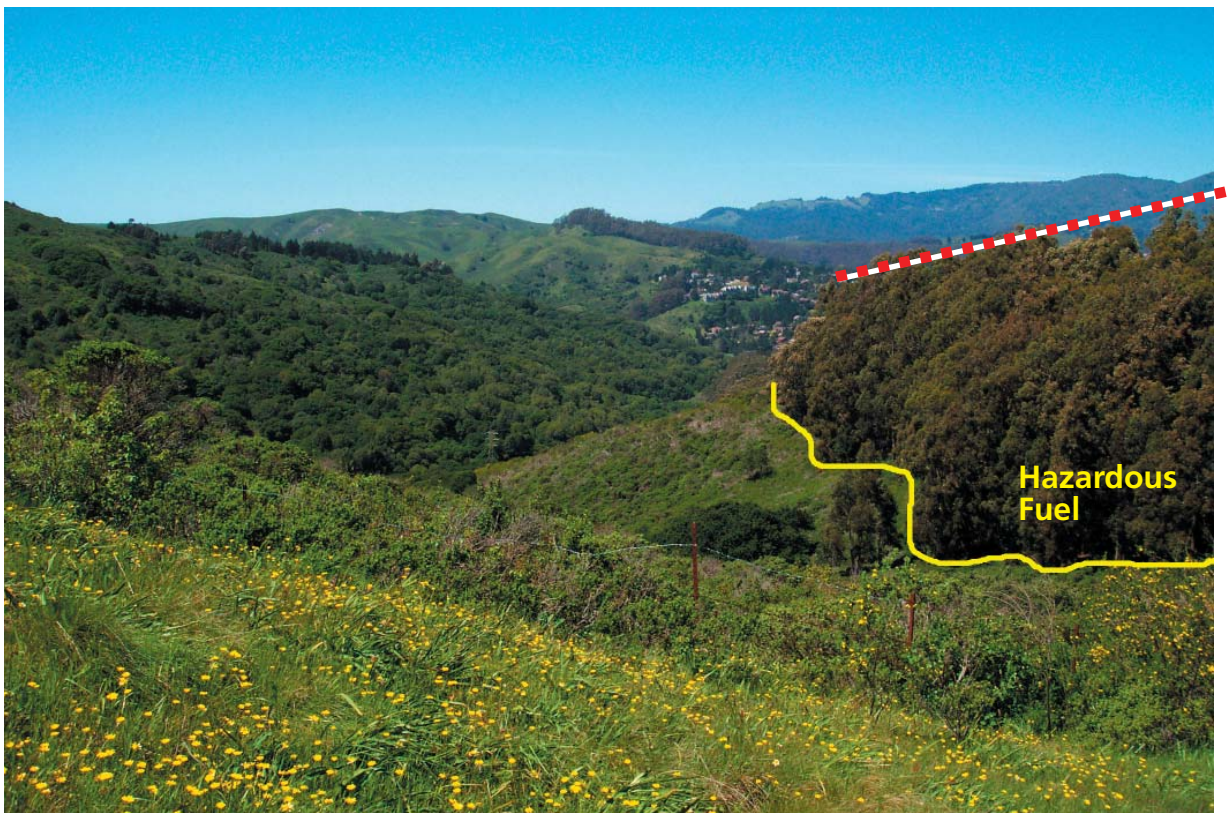
Defensible space is a choice a property owner makes, that will affect choices made by firefighters during a wildland fire. Firefighters must decide which structures have a chance of surviving, which can be safely defended, and how to best allocate limited firefighting resources.

Defensible space is also required by California law. A minimum 30 feet and up to 100 feet of vegetation management is required around structures, depending on the slope.



Maintaining defensible space around all park structures is the first job the hazardous fuels crew tackles each summer.

Reducing Hazardous Fuels on Park Lands: Alta Avenue



NEIGHBORS, VISITORS, PARTNERS

Reducing fuels through vegetation management reduces wildfire risk and helps protect homes located in the wildland-urban interface.

Non-native plants increase fuel loads and displace native species. The National Park Service and Golden Gate National Parks Association are partners in fuel reduction and ecosystem restoration.

THE ALTA AVENUE CORRIDOR WITHIN GOLDEN Gate National Recreation Area (GGNRA) is an important fire access road as well as a high visitor use area. A cooperative agreement between GGNRA and Golden Gate National Parks Association (GGNPA) was established to reduce fuels along the corridor and restore native plant communities.

GGNRA's Alta Avenue Fuel Reduction Project includes non-native broom and eucalyptus removal, followed by native plant restoration managed by the Site Stewardship program of the Parks Association. The project will reduce wildfire risk to neighborhoods in Marin City. The Sausalito Fire Department and Marin County Fire Department in Marin City both believe this project addresses one of the biggest fire hazards they face.

The broom removal portion of the project began in December 2001. A nine person crew consisting of local residents, both adults and high school students, was hired to work on weekends and holidays to remove broom from along the southern end of Alta Avenue. The crew removed approximately one and a half acres of broom, more than 25,000 plants. With support from Marin County Fire Department, the broom debris was chipped and broadcast onsite as mulch.

The eucalyptus removal portion of the project began in August 2002. Eucalyptus trees, introduced to California from Australia, are extremely flammable due to the large amount of leaf litter they produce and the volatile oil in their leaves. In addition to posing a wildfire threat, eucalyptus threaten the health of native plants and wildlife by changing soil composition and reducing habitat. A total of ten acres of eucalyptus will be removed in two phases

Marin County Fire Department assisted with the Alta Avenue project by providing the use of a chipper with supervision.

during the Alta Avenue project. The sites will be revegetated with native plant species such as oaks and coyote brush.

Follow up work will also be conducted to remove additional non-native plants that move into the fuel reduction zone. The native species planted will be more fire resistant than the non-native species removed.

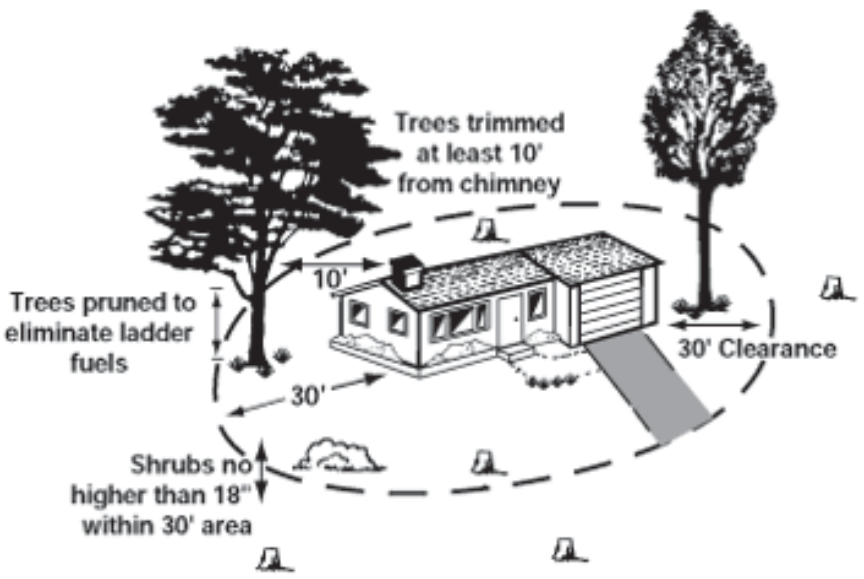
Top: **1) The project site, showing roadside broom removal nearly complete, and the eucalyptus grove scheduled for removal. 2) An untreated area of broom on the other side of the eucalyptus grove to be removed in Phase 2 of the project.**

Middle: **1) A group of weekend bicyclists passing by the drying broom piles. 2) The project crew, celebrating their broom removal accomplishment.**

Below: **Many homes in Marin City are surrounded by dense vegetation which is susceptible to wildfire.**

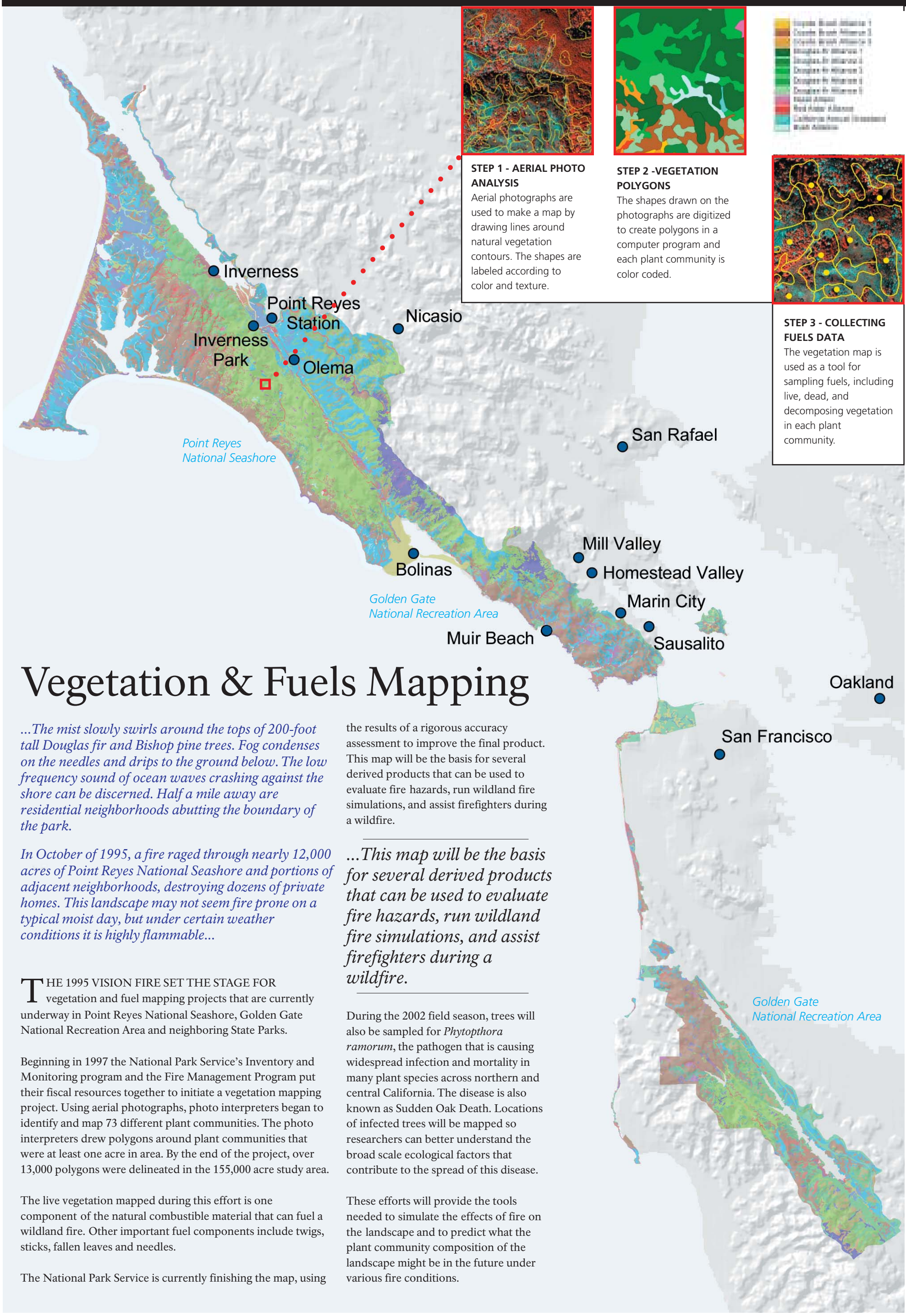
Reducing Hazardous Fuels on Around Homes

Nearly 300 truckloads of vegetation debris removed from around homes was dropped off at a transfer site on National Park Service land in Olema. This site is being made available to the community to support local defensible space efforts.



Defensible space separates vegetation from structures and helps protect homes from wildfire.

Mapping and Modelling



STEP 1 - AERIAL PHOTO ANALYSIS
Aerial photographs are used to make a map by drawing lines around natural vegetation contours. The shapes are labeled according to color and texture.

STEP 2 -VEGETATION POLYGONS
The shapes drawn on the photographs are digitized to create polygons in a computer program and each plant community is color coded.

STEP 3 - COLLECTING FUELS DATA
The vegetation map is used as a tool for sampling fuels, including live, dead, and decomposing vegetation in each plant community.

Vegetation & Fuels Mapping

...The mist slowly swirls around the tops of 200-foot tall Douglas fir and Bishop pine trees. Fog condenses on the needles and drips to the ground below. The low frequency sound of ocean waves crashing against the shore can be discerned. Half a mile away are residential neighborhoods abutting the boundary of the park.

In October of 1995, a fire raged through nearly 12,000 acres of Point Reyes National Seashore and portions of adjacent neighborhoods, destroying dozens of private homes. This landscape may not seem fire prone on a typical moist day, but under certain weather conditions it is highly flammable...

THE 1995 VISION FIRE SET THE STAGE FOR vegetation and fuel mapping projects that are currently underway in Point Reyes National Seashore, Golden Gate National Recreation Area and neighboring State Parks.

Beginning in 1997 the National Park Service's Inventory and Monitoring program and the Fire Management Program put their fiscal resources together to initiate a vegetation mapping project. Using aerial photographs, photo interpreters began to identify and map 73 different plant communities. The photo interpreters drew polygons around plant communities that were at least one acre in area. By the end of the project, over 13,000 polygons were delineated in the 155,000 acre study area.

The live vegetation mapped during this effort is one component of the natural combustible material that can fuel a wildland fire. Other important fuel components include twigs, sticks, fallen leaves and needles.

The National Park Service is currently finishing the map, using the results of a rigorous accuracy assessment to improve the final product. This map will be the basis for several derived products that can be used to evaluate fire hazards, run wildland fire simulations, and assist firefighters during a wildfire.

...This map will be the basis for several derived products that can be used to evaluate fire hazards, run wildland fire simulations, and assist firefighters during a wildfire.

During the 2002 field season, trees will also be sampled for *Phytopthora ramorum*, the pathogen that is causing widespread infection and mortality in many plant species across northern and central California. The disease is also known as Sudden Oak Death. Locations of infected trees will be mapped so researchers can better understand the broad scale ecological factors that contribute to the spread of this disease.

These efforts will provide the tools needed to simulate the effects of fire on the landscape and to predict what the plant community composition of the landscape might be in the future under various fire conditions.

Vegetation and Fuels

Developing a Fuel Model for *Baccharis* (Coyote brush)

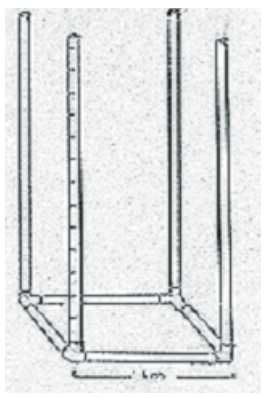
...Currently, there are no accepted quantitative methods for assessing fuel loading in shrub vegetation types...

GOLDEN GATE NATIONAL Recreation Area and Point Reyes National Seashore are linked by contiguous vegetation and share an extensive wildland-urban interface. Efforts are currently underway to complete mapping and classification of vegetation within the two parks. Quantitative vegetation data is critical for fi re management in order to manage fuels, protect communities and accomplish other resource management objectives. Once the vegetation data set is compiled, the parks will translate the vegetation data into fuel load information.

Accurate fuel load data is essential to fire management planning. Brown's transects, a standard method for assessing fuels, are used to quantify dead and down fuels in forest vegetation types. Crown fuels in forest types are typically modeled with crown bulk density measures. Biomass clipping and weighing is widely recognized as an accurate method to assess fuel loading in grassland ecosystems. Currently, however, there are no accepted quantitative methods for assessing fuel loading in shrub vegetation types which are very common at Golden Gate and Point Reyes.

The coyote brush (*Baccharis pilularis)* fuel modeling project will address this knowledge gap on a local level by establishing field methods for assessing live fuel loading in shrub-dominated habitats. This study aims to develop a simple model based on a relatively consistent vegetation type. If these methods can be used effectively on a simple model, they will provide the foundation for developing models in more complex vegetation types.

The project will compare the accuracy and efficiency of three indirect methods for estimating live fuels in coyote brush shrub types. The three indirect methods are hemispherical imagery (also known as leaf area index), basal stem diameter measurements, and height estimates. These indirect methods will be compared with a single direct method that will serve as a baseline, and is the most accurate estimate of biomass.

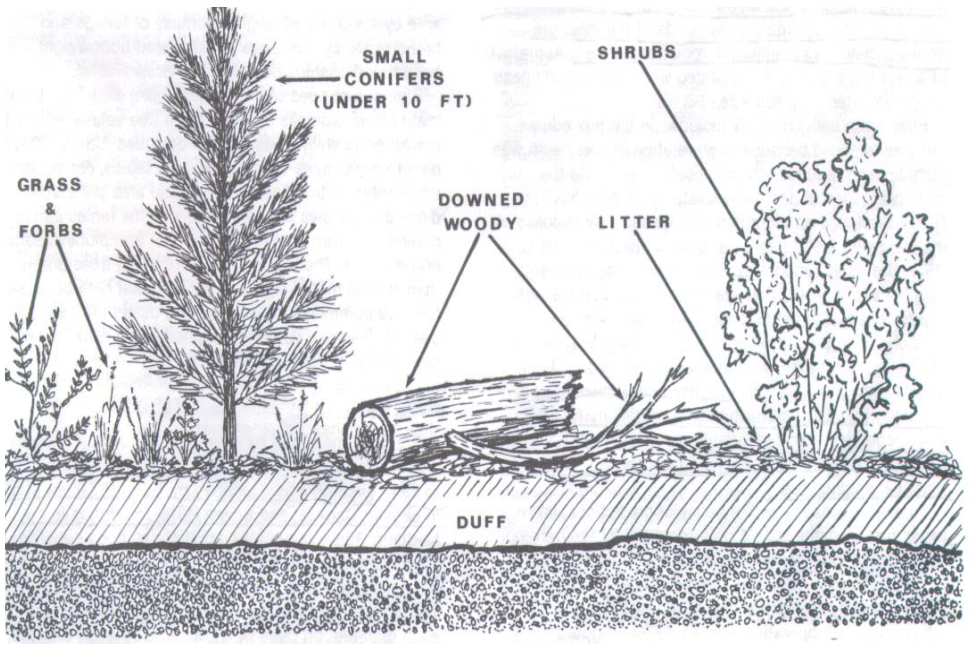


The direct method, known as "destructive" biomass sampling, involves complete removal and measurement of a quantifi ed area of shrub. Data from the three indirect methods will be compared to determine which one provides the best correlation with the destructively collected biomass samples.

The study area is subdivided into two distinct ecological types of coyote brush: 1) early-successional coyote brush-dominated scrub on the Point Reyes peninsula; and 2) the coyote brush-dominated coastal sage scrub in the Marin Headlands.

Forty-five plots will be randomly sampled in each ecological type, for a total of 90 plots across the study area. The data will be analyzed for differences both between and within the two types.

In addition to comparing the three indirect methods of quantifying biomass in the coyote brush shrub type, data on fuel composition and structure will also be collected. The destructive biomass samples will be processed to determine the amount of biomass that is living and dead, and to categorize these fuels into size classes established in fire science literature. The fuel data will then be stratified by height to analyze the vertical structure of fuels. These measures will provide a baseline for building a custom fuel model specific to the coyote brush shrub type, which will enable fire managers to accurately estimate fuel loading and model fire behavior. This, in turn, provides quantified fuels data and accurate model predictions for site specific vegetation types, essential to risk assessment, fuels treatment, fire management and fire planning in Golden Gate National Recreation Area and Point Reyes National Seashore.



Vegetative components included for estimating biomass and fuel loading. ***From USDA General Technical Report INT-129, August 1982. (Brown, Oberheu, and Johnston)***

Fuels Terminology

Biomass - weight of material derived from a living organism

Brown's transects - standard field collection methods used to determine weight per unit area of living and dead surface vegetation (duff, litter, and downed woody)

BTU - British Thermal Unit; the quantity of heat required to raise the temperature of one pound of water by one degree Fahrenheit; these units are often used to describe the potential energy of wildland fuels (BTUs / acre)

Crown bulk density - mass per unit volume of combustible upper tree biomass, including leaves, twigs, and branches

Downed woody - dead twigs, branches, stems, trunks, and boles of trees and shrubs that have fallen and lie on the ground

Duff - partially decomposed vegetative material lying below the freshly fallen litter and above the mineral soil

Fuel loading - the total amount of fuel present in an environment, described quantitatively as weight of fuel per unit area

Fuel type & fuel model - fuel elements of particular plant species, form, size, or arrangement (fuel type) that will cause a predictable rate of fire spread under specified weather conditions (fuel model)

Hazardous fuels - any live or dead vegetation which poses a fire hazard, threatening life or property

Hemispherical imagery - technique using a bowl-shaped tool to measure light underneath a plant in order to determine plant biomass based on the amount of light blocked by the plant

Litter - freshly fallen leaves, needles, fruits, dead matted grass, and other non-woody vegetative parts that have not been structurally altered by decomposition

Mineral Soil - soil layers below the predominantly organic horizons which have little combustible material; generally refers to the "bare soil" below the litter and duff

MEASURING FUEL

Biomass is collected in the field and bagged according to layers defined by height and whether it is live or dead.

Live and dead biomass for each layer is sorted into six fuel size classes.

All processed biomass is then dried at 105° C and weighed to the nearest gram.

VALUES -Coyote brush provides sheltered nesting, and important seed and insect food sources for wildlife species such as Nuttall's white-crowned sparrow which is dependent on coastal scrub. Coastal scrub habitat, dominated by coyote brush, has been reduced by human development. Fire suppression has also led to the encroachment of Douglas fir into coastal scrub, reducing it further.

Fire Effects Monitoring in the Central and Southern California Parks

AFTER NEARLY A CENTURY OF fire suppression and hazardous fuel accumulation on our nation's wildlands, the National Park Service is one of the first agencies to actively manage fi re use and examine its effects on natural resources.

This progressive land management policy led to the creation of the NPS Fire Monitoring Handbook (FMH). The FMH program was developed to "provide a system to document burning conditions and fi re behavior, ensure fi res remain within certain conditions, verify completion of burn objectives, and follow long-term trends." Since its development, the program has served as a model for other land management agencies and organizations to base their fireeffects monitoring systems on.

SERVING SIX PARKS

The Central and Southern California Fire Effects Program serves the fire monitoring needs of Channel Islands National Park, Golden Gate National Recreation Area, Joshua Tree National Park, Pinnacles National Monument, Point Reyes National Seashore, and Santa Monica National Recreation Area. The program is staffed by a crew of biological science technicians that measures vegetation plots in prescribed fire burn units, provides support to operations during prescribed fires, and assists in fire research projects within the six parks.

VEGETATION MONITORING

The primary focus of the Fire Effects Program is to install and maintain monitoring plots in prescribed burn units and areas of alternative fuel treatments.

Within the six parks, the program maintains a network of 388 treatment and control plots. These vegetation plots are classified as grassland, brush, and forest vegetation types, and stratified by dominant plant communities.

The plant communities monitored are very diverse. They include coastal prairie on Channel Islands and the Point Reyes peninsula, redwood forest at Muir Woods, chamise shrubland in Pinnacles, oak woodland in the Santa Monica Mountains, and Joshua tree forest in the high Mojave desert.

The fire effects crew measures vegetation attributes on the plots such as species occurrence, relative cover, density, and fuel accumulation. They also monitor burn severity immediately following prescribed fire treatment and vegetation attributes in subsequent years following the treatment.

The data collected by the fire effects crew is input into the FMH database, a data archive that can be accessed by fire monitors, ecologists, and managers for data analysis. The analysis examines the effects of prescribed fire treatment on attributes of plant communities such as species composition, density, and regeneration. This enables ecologists and managers to evaluate long term effects of fire use on plant community composition and structure. Furthermore, the data analysis assists in determining whether or not the prescribed fire treatment accomplished management objectives. This process provides feedback that helps managers refine goals, objectives, and prescriptions for treatment.

PRESCRIBED FIRE MONITORING

As support staff for prescribed fire operations, the monitoring crew assists with burn preparation by installing and measuring fire effects plots, providing GIS support, and prepping control plots. During prescribed burns, the monitors report hourly weather observations, monitor smoke dispersal, and record fire behavior observations. They also serve as lookouts for firefighter safety. After the burn, the monitors conduct a post vegetation survey, measure burn severity on fire effects plots, and prepare a report for the fire management officer summarizing weather, smoke and fire behavior, and whether vegetation objectives were met.

FIRE RESEARCH SUPPORT

The fire effects monitoring crew also provides fire research support. During the 2001 field season, the monitoring crew worked on three research projects at Point Reyes National Seashore and Golden Gate National Recreation Area. The crew collected the pre-burn data for a velvet grass study, examining the effects of fire treatment on the persistence of a non-native grass. They assisted in post-burn data collection for a Scotch broom study, examining fire effects on non-native shrub eradication. The crew also participated in the design and data collection for a research project comparing four methods of quantifying fuel loading in the *Baccharis* (coyote-brush) shrub type.

The fire effects program bridges the gap between fire and resource management, playing a critical role in the development of prescriptions for fire and alternative fuel treatments.

Vegetation data is collected pre-burn, post-burn, and at 1, 2, 5, and 10 year intervals.

During a burn, weather, fire behavior, smoke, and safety are monitored.

Sediment Cores Reveal Fire History

A THREE-YEAR STUDY OF SEDIMENT CORES FROM two locations at Point Reyes National Seashore completed in December 2001 has substantially broadened current understanding of fire history on the Point Reyes Peninsula.

The investigation, led by Dr. R. Scott Anderson of Northern Arizona University, is an example of the type of research called for in the National Fire Plan, aimed at helping land managers understand the frequency of fire in landscapes over time.

Charcoal particles in an 11-meter core from Wildcat Lake and a 4-meter core from a wetland known as Glenmire demonstrate evidence of fire history in two different plant communities within the Seashore. The study cannot distinguish between lightning and human-caused fire.

Wildcat Lake is surrounded by coastal scrub, dominated by California sage brush, coyote brush and California coffeeberry. Glenmire is located in a closed canopy Douglas fir forest with an understory of California laurel, mixed oak, California hazel, and California huckleberry.

In the charcoal analysis, each core was divided into several zones based on concentration of charcoal fragments. Different levels within each core were then dated to establish a timeline for fire events. When plant fragments were available, a C-14 radiocarbon dating technique was used. Four of the dates were established using Accelerator Mass Spectrometry (AMS). The longer Wildcat core was shown to represent 3,100 years and was divided into 4 zones; while the shorter Glenmire core was shown to represent a period of 7,000 years and was divided into 5 zones.

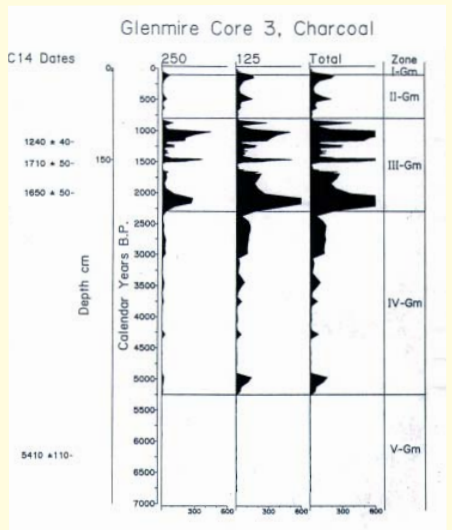
Earlier tree ring fire scar research (Brown, et al., 1999) has demonstrated fire exclusion beginning in approximately 1905 at Five Brooks, 1918 at Limantour and 1945 at Pine Gulch. The upper zone of each of Anderson's sediment cores had the least amount of charcoal, verifying the near absence of fire during the last 100 years.

The Wildcat core showed the highest amount of charcoal in Zone 2 from the period 100–900 years ago, while the Glenmire core showed the highest amount in Zone 3 from 800–2,300 years ago.

Supported by archaeological research demonstrating extensive use of the coastal environment by Native Americans back at least 3,000 years, the sediment study suggests that prescribed fire may have been applied alternately in different vegetation types. Combined with the results of other fire studies, these data further suggest that Point Reyes may have had fire intervals of 7–14 years prior to the period of fire exclusion.

Well preserved pollen was also found within the cores. Analysis of the pollen will provide information on vegetation changes that occurred during the time period the charcoal was deposited.

Dr. Anderson returned in May 2002 with a team of graduate students to collect four additional cores. These cores will also undergo charcoal and pollen analysis.



Charcoal Particles in Microns
250–125 (large); 125–0 (small) & combined total

The charcoal in the Glenmire Core is divided into five zones which represent different time periods in the fire history of the site.

Websites

National Park Service Fire Program
www.nps.gov/fire

National Interagency Fire Center
www.nifc.gov

National Fire Plan
www.fireplan.gov

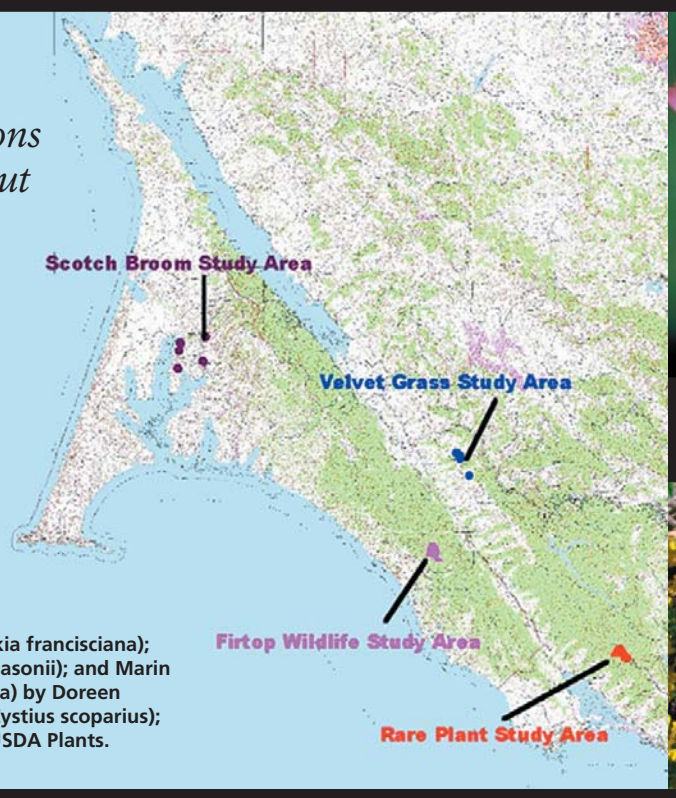
Fire Effects Information
www.fs.fed.us/database/feis

California Association of Fire Ecology
www.ice.ucdavis.edu/cafe

Fire Ecology Database
www.talltimbers.org/feco.html

...Many new questions are being asked about fire and biological resources.

Research is increasingly important to fire management programs...



What are the effects of fire on rare plants?

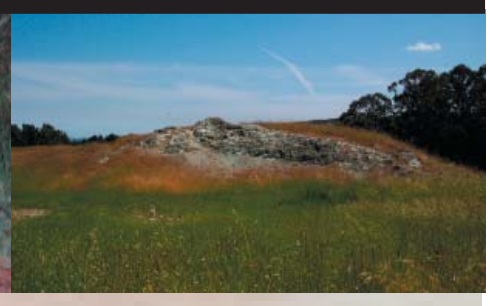
non-native plants?

wildlife?

Plants: TOP- Presidio clarkia (Clarkia francisciana); Mason's ceanothus (Ceanothus masonii); and Marin manzanita (Arctostophylos virgata) by Doreen Smith. BOTTOM- Scotch broom (Cystius scoparius); velvet grass (Holcus lanatus) by USDA Plants.

Fire Research

Wildlife: **Fox with prey photographed at Firtop with a motion triggered camera at night.**



Soils: **Serpentine grassland at Inspiration Point.**

THE USE OF PRESCRIBED FIRE IN national parks presents a number of questions. Can prescribed fire improve habitat for rare or endangered plants? Is prescribed fire an effective treatment for controlling non-native plants or will it increase their populations? How will vertebrate species be affected?

Five fire research projects are being undertaken at Point Reyes National Seashore and Golden Gate NRA based on several criteria:

- Species to be studied occur in areas that would be affected by NPS prescribed burns within the next five years;
- Existing data on fire effects on the species were inconclusive or nonexistent;
- Concerns were raised that prescribed burns may have adverse effects on the species or ecosystem of interest; and
- Studies would be cost-effective (e.g., pre-burn data were already available).

SCOTCH BROOM STUDY - DRAKES ESTERO

Scotch broom is native to the British Isles and central and southern Europe. Cultivation in gardens and along highways as a soil stabilizer has led to its widespread distribution in California, Oregon, and Washington where it now covers more than two million acres. Its aggressive spread throughout the northwestern U.S. is due to its: 1) wide tolerance of soil conditions; 2) ability to fix nitrogen; 3) ability to grow during most of the year given adequate precipitation and a mild climate; and 4) abundant production of long-lasting viable seeds.

Broom seeds can be viable for up to 30 years leading to accumulation in the seedbank. Research will focus on determining fire intensity and frequency required to kill plants and seeds.

VELVET GRASS STUDY - BOLINAS RIDGE

Velvet grass is a non-native perennial, native to temperate areas of Europe and Asia. It was probably introduced to North America accidentally as a contaminant of forage seed or deliberately as a component of seed mixtures for meadows.

Velvet grass has become a major problem in western Oregon and Washington grassland preserves. Control is difficult due to its prolific seeding ability and broad range of environmental tolerance. Velvet grass populations rapidly expand and crowd out native species, causing a reduction in diversity.

NPS fire monitoring data indicates that fire may cause the spread of velvet grass. Lack of control plots, however, on adjacent unburned velvet grass populations prohibits the use of existing data to answer questions about the effects of fire on velvet grass. Consequently, a research project to determine the effects is being implemented.

The study area also includes stands of native perennial grasses that are typical of intact northern coastal prairie such as purple needlegrass, California brome, California oatgrass, blue wildrye, and Hall's bent grass. Less frequently occurring native perennial grasses in the study area include junegrass, Idaho fescue, and tufted hairgrass. The scarcity of coastal prairie and the potential adverse effect of prescribed burning demonstrate the need for studies comparing the rate and extent of velvet grass spread in the presence and absence of fire.

RARE PLANT STUDY - BOLINAS RIDGE

Mason's ceanothus and Marin manzanita are rare coastal chapparal species. Mason's ceanothus is known only from Bolinas Ridge, and Marin manzanita is known only from Marin County. Both species lack the ability to resprout from the base. Species that lack the ability to resprout from under-ground structures yet produce fire-resistant or fire-dependent seeds are called obligate seeders. This describes almost all rare and endangered chaparral species.

Obligate seeding species disperse dormant seeds that accumulate in the soil until germination is triggered by environmental changes related tofire. These species are completely dependent on the germination of dormant seed to reestablish their populations. A high germination response may be expected immediately after a fire.

Fire triggered germination cues include heat scarification of seeds, elimination of toxic compounds, chemicals leached from charred wood, and increased light and space.

Species of ceanothus play an important role after a fire because their roots host nitrogen-fixing bacteria. Research will focus on how Mason's ceanothus and Marin manzanita respond to fire as compared to their better known, fire-adapted relatives.

FIRTOP WILDLIFE STUDY - INVERNESS RIDGE

An Inventory and Monitoring (I&M) Program for amphibians, reptiles, small mammals and carnivores was initiated in the Seashore in 1998. The Firtop burn unit includes a wildlife I&M site in Douglas fir habitat with several years of data.

Pre- and post-burn data will be used to assess the effects of fire on vertebrates, including relative abundance, population age structure, habitat preference and associations, weight-length relationships, reproductive status, and population trends.

Traps installed to monitor vertebrates at Firtop have captured twelve vertebrate species: American robin, bobcat, coyote, dog, fallow deer, gray fox, mule deer, raccoon, red fox, Steller's jay, striped skunk, and turkey vulture. Vertebrates have also been photographed with TrailMaster cameras at the site.

SERPENTINE GRASSLAND STUDY - INSPIRATION POINT, PRESIDIO

One of California's rarest plant communities, serpentine prairie, exists in a small, remnant stand at Inspiration Point in the San Franciso Presidio. At this site, serpentine soils support perennial native bunchgrasses, and serveral rare forbs, including the federally endangered Presidio clarkia, and until its recent extirpation from the site, the federally threatened Marin dwarf flax.

Serpentine soil is derived from serpentinite rock which is found in areas that once were deep ocean plate tectonic spreading centers. These soils often host endemic species due to their unusually high percentage of heavy metals, such as nickel, zinc, manganese, and copper, and their low percentage of micronutrients. These soils typically have a calcium / magnesium ratio of less than one, compared to non-serpentine soils which range from 2-10. A ratio of less than 0.2 is exceptionally rare and characterizes the soils at Inspiration Point.

Presidio clarkia is restricted to serpentine soils in San Francisco and Alameda counties and is the only species of the genus *Clarkia* that is restricted to serpentine. It is most prolific in areas of open vegetation and thin, rocky soil conditions. Non-native annual grasses contribute to the buildup of organic debris which changes soil conditions and promotes the colonization of non-native species. Dead, dry grass also increases fuel loads and is susceptible to wildfire.

The recovery strategy for Presidio clarkia outlined by the U.S. Fish & Wildlife Service suggests creating new habitat by scraping, removing duff, and prescribed burning. A proposed research project to test the effects of prescribed fire on a small section of serpentine grassland at Inspiration Point is currently being evaluated.

Sudden Oak Death - Disease Threatens Park Trees

NATIVE OAK AND TANOAK TREES in Marin County are being killed by a microorganism that produces a disease commonly known as "Sudden Oak Death." This disease is widespread in coastal California and is commonly found in tanoak in the understory of coast redwoods, and in evergreen hardwood forests dominated by oaks, madrone and California bay. Sudden Oak Death (SOD) is a disease of wildlands and naturally occurring trees. There are no known cases of planted trees becoming infected.

Currently, Marin and Santa Cruz counties are considered to be heavily infested by SOD. Areas with heavy infestations of the disease may be at increased risk of fire due to the increase in fuel caused by dead trees. Many mammal and bird species could lose important sources of food or shelter in these areas.

Point Reyes National Seashore has joined a regional effort to determine if SOD is present in the park's forests. Samples collected from trees suspected of being infected by SOD will be sent to a lab for testing, and a map will be created. Data collected in this effort will provide the information needed to develop a management plan.

Researchers at UC Davis and UC Berkeley are trying to learn as much as they can about this new disease. There is currently no effective treatment. According to researchers, treatments that may be developed in the future will not be practical to apply across large areas. Effort at the Seashore will focus on minimizing human-caused spread of this disease.

BIOLOGY

Dying tanoak trees were reported as early as 1995 in Marin County. By June of 2000, a researcher at UC Davis had isolated the pathogen responsible for these unexplained tree deaths. SOD is caused by a newly identified microorganism called *Phytophthera ramorum*. *P. ramorum* is a water mold that acts like a fungus, attacking the trunk of a tree and causing a canker. It is considered a very aggressive pathogen because it can kill a perfectly healthy tree. Other secondary decay organisms such as beetles and fungi often move in after the tree is infected and finish the job. The name Sudden Oak Death is a misnomer. Infected trees may survive for one to several years as the infection progresses. When the tree finally dies, the leaves may turn from green to brown within a few weeks, hence the appearance of sudden death.

The pathogen affects different species in different ways. Tanoaks and oaks are killed by the disease; other species affected are known as "foliar hosts" because their leaves and twigs may be infected, but the disease only occasionally kills the plant.

SYMPTOMS

On oaks and tanoaks, cankers form, appearing as a dark or black area on the trunk, often bleeding a black or reddish ooze. Species killed by SOD are tanoak, coast live oak, California black oak, and Shreve oak. Leaf spots and twig dieback are the symptoms caused on foliar (leaf) hosts, which include California bay, madrone, bigleaf maple, huckleberry and California honeysuckle. The presence of *P. ramorum* can only be confirmed by a laboratory test as many other diseases cause similar symptoms. Infection was recently confirmed in redwood and Douglas fir trees.

GEOGRAPHIC EXTENT

At this time, SOD has been confirmed in thirteen counties in the United States. Twelve of these are in the Bay Area, including Marin county. One county is in Oregon, just north of the California border. It has also been found in several countries in Europe and may have been introduced to the United States on a rhododendron imported from European nursery stock.

REGULATIONS

A federal and state quarantine is in effect, prohibiting the movement of any plant material which may carry SOD.

HOW IT IS SPREAD

There is much still to be learned about how SOD is spread. The pathogen produces spores, which have been found in rainwater and soil. It is known that the spores can travel short distances in water, such as in rain splash or fog drip. Foliar hosts, such as California bay can harbor large quantities of spores. Laboratory testing has found no evidence that SOD can spread from an infected oak tree to another oak tree.

PREVENTION

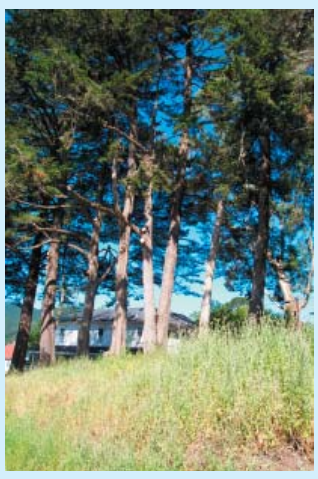
Preventing the human-caused spread of SOD will give forests more time to produce new seedlings that may be resistant to this disease. Preventive actions are especially important when traveling from an infested county such as Marin to non-infested counties, such as in the Sierra Nevada.

Yosemite National Park is requesting visitors from the Bay Area to respect the state and federal quarantine and to take precautions when traveling to Yosemite to prevent the spread of SOD. *(See also, "What You Can Do to Help...")*

WHAT YOU CAN DO TO HELP WHEN VISITING WILDLANDS

- Do not collect or remove any plant material such as wood, branches, leaves or acorns, or any soil.
- Do not bring firewood or any other plant material into the park.
- Stay on established trails.
- Clean soil and mud off shoes, bicycle tires, horse's hooves, pet's paws and vehicles.
- Visit www.suddenoakdeath.org for more information.

Wildfire Prevention
modifying fuels and human behavior



Creating defensible space and fuel breaks involve modifying the structure of fuels, a key principle of wildfire prevention. Vegetation fuels extend horizontally and vertically. Breaking fuel continuity changes the path a fire travels and the way fire behaves.

The fuels reduction project pictured here was completed by the parks' hazardous fuels crew and illustrates the practice of "limbing up", removing lower branches from trees to eliminate ladder fuels that could carry a ground fire to the tree canopy.

The other key to wildfire prevention focuses on human activity.

WHAT TO DO AT HOME

- Clean gutters & chimney.
- Install proper screening on top of chimney or stovepipe.
- Clear vegetation 30–100 feet around structures.
- Install a Class-A, fire resistant roof.
- Install & maintain a smoke detector.
- Create a non-flammable zone around wood stoves.
- Establish escape routes.
- Have an evacuation plan.
- Teach children about fire safety.

WHAT TO DO IN WILDLANDS

- Make sure it's legal to have a campfire before you make one.
- Use established fire rings.
- Have water & a shovel on hand.
- Keep flammable material away from campfire.
- Thoroughly extinguish all smoking & campfire materials, and never throw cigarettes out of a vehicle.
- Carry a fire extinguisher in your vehicle.
- Teach children about fire safety.

2002 Point Reyes and Golden Gate
Fire & Fuels Publication Team

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