46-23

USING DATA ANALYSIS FROM STUDENT FIELD INVESTIGATIONS AND INTERNET SEARCHING TO DETERMINE THE RELATIONSHIPS BETWEEN TREERING DATING, WILDFIRES, AND FLOODS BY ELEMENTARY A MIDDLE SCHOOL CLASSES

By Paul K. Grogger

Department of Geology, Univ of Colorado - Colorado Springs,
1420 Austin Bluffs Parkway, Colorado Springs, CO 80933-7150

pgrogger@uccs.edu.

Abstract

Students from Colorado Springs School Districts 11 and 12 have developed and completed a field and internet investigation to develop an understanding of the complexity of science. Various classes from 4^{th} to 8^{th} grade have traveled to various forested locations in the Pikes Peak region to collect dendrochronology data by coring and counting the tree rings in the cores and in previously cut trees to gain knowledge about both the age of different tree types and to develop a possible drought/wet diagram for the years indicated by the tree rings. Further information was collected by visiting appropriate websites for the collection of climatic data that includes stream flows, flooding events, and precipitation, wildfire episodes, and information about the science of dendrochronology.

This paper will present the data developed, the processes used, and the statistical data determined in a tabular form and

through flow modeling. The relationships between climate, wildfire, and tree rings are shown to be directly related.

General Directions for the Tree-Ring Assignment

GENERAL STATEMENT:

Tree-rings can be used to determine many characteristics of the local environment. Three of the four spheres are represented when studying tree-rings and the trees local environment: hydrosphere, lithosphere, and biosphere. The atmosphere can indirectly be considered when accurate data are available and from the topographical aspect of the location is determined.

PROCEDURES:

Visit the Internet sites listed in your assignment.

Develop an understanding of the following topics:

- Dendrochronology
  - Tree-ring frequency
  - Size of tree-rings
  - Frequency of tree-rings
  - Tree species
- Climatic Changes including:
  - Precipitation (Primary)
    - Drought
  - Temperature (Secondary)
  - Wind (Secondary)
- Wildfire
  - Forest Health
  - Vegetation types
  - Topography
  - Causes

Select locations to be examined.

Determine the data that needs to be collected.

Complete field analysis of the location selected.

Use the following table to determine the samples that need to be obtained and what observations must be considered.

Use the tree-ring assignment outline to record the tree-ring data.

OBSERVATIONS TO BE DETERMINED AND QUESTIONS TO BE ANSWERED:

OBSERVATIONS	QUESTIONS
Type of tree	What species of trees are available for investigation?
Location of tree	How close to water are the trees and what is the orientation of the slope?
Core location	What is the shape and thickness of the tree?
Age of tree	How will the tree-rings help

	determine the age? Is there any other information that can be obtained from the tree cores?
Wet/Dry periods	Determine a method that will help determine the periods that were wet or dry.
Topography	What is responsible for the shape of the land surface?
Health of forest	What characteristics will assist in determining the health of the forest?
Forest surface	What composes the surface of the forest floor? How will this information help to gain an understanding of the interrelationship between climate/wildfires/tree-rings?
Drainage	What does the drainage basin the tree is located in relate to the solution of studying the relationships we are investigating?

THE AGE OF TREES

Use the following table and the formulas included with the assignment to determine the age of trees by their diameter at Fox Run Park.

Procedure:

1. Find as many cut trees as you can with the time you are given.
2. Identify the type of tree.
3. Count the tree rings. There are two rings per year; a light and dark ring.
4. Measure the radius of the tree.
5. Determine the diameter versus age of each tree.
6. Complete question #5 for each type of tree (Hint: total the diameter vs. age for all trees of that type of tree and divide the number by the trees measured).
7. Attempt to determine a way to estimate the height of the cut trees.

$TA = 2(R/r)$ $TA_a = 2(R_a/r_a)$

Where TA = Tree Age by diameter
R = Number of tree rings
r = Radius of tree
TA_a = Average age of trees by diameter
R = Number of rings
r = Number of trees
R_a = Total number of rings for type of tree = $(R_1 + R_2 \ldots R_n)$
r_a = Total distance of all trees radius = $(r_1 + r_2 \ldots r_n)$

Specimen #	**Tree Type**	**Number of Tree Rings**	**Radius of Tree**	**Diameter of Tree**

Look at the size of the individual rings and determine when dry and wet yeas occurred. Are there any long term drought or wet periods evident?

OBSERVATIONS IN THE FIELD

PRESENT	1ST Location	2nd Location	3rd Location	4th Location	5th Locatio
BIOSPHERE					
Animals					
Plants					
ATMOSPHERE					
Moisture					
Wind					
HYDROSPHERE					
Surface					
Sub-surface					
LITHOSPHERE					
Rock Type					
Structures					
PAST					
BIOSPHERE					
Animals					
Plants					
ATMOSPHERE					
Moisture					
Wind					
HYDROSPHERE					
Surface					
Sub-surface					
LITHOSPHERE					
Rock Type					
Structures					

INTERNET SITES FOR THE TREE RING STUDY

CLIMATE

http://www.science.gmu.edu/~yvikhlya/data/precip.html Precipitation Data for the World
http://ccc.atmos.colostate.edu/ Colorado Climate Center
http://www.cdc.noaa.gov/Boulder/index.html#Colorado Climate Diagnostic Center
http://www.ncdc.noaa.gov/oa/ncdc.html National Climatic Data Center
http://ingrid.ldeo.columbia.edu/ IRI/LDEO Climate Data Library

TREE RINGS

http://www.ngdc.noaa.gov/paleo/streamflow/ NOAA Paleoclimatology Program, TreeFlow
http://www.treeringsociety.org/ Tree-Ring Society
http://www.ldeo.columbia.edu/res/fac/trl/ Tree-Ring Laboratory of Lamont-Doherty Earth Observation
http://vathena.arc.nasa.gov/curric/land/global/treestel.html Tree Rings: A Study of Climate Change
http://www.ltrr.arizona.edu/dendrochronology.html The Laboratory of tree-Ring Research

WILDFIRE

http://wildfires.nwcg.gov/colorado/archives/index.shtml Colorado Wildfire Archives
http://www.firewise.org/ General Wildfire Site
http://csfd.springsgov.com/ Colorado Springs Fire Department
http://www.ppwpp.org/ Pikes Peak Wildfire Prevention Partners
http://www.fs.fed.us/database/feis/welcome.htm Fire Effects Information
http://www.bt.cdc.gov/firesafety/index.asp CDC Emergency Preparedness and Response

INTERNET WEBSITES FOR THE WILDFIRE EXERCISE

www.firewise.org/pubs/WHAM/nfpal Fire hazard assessment in the wildland/urban interface.

www.firewise.org/www/on/ihepubs.shtml All online publications.

www.cnr.colostate.edu/FS/westfire/finalReport.pdf Effect of fuels treatment on wildfire severity.

www.firewise.org Click LINKS and select the program you want to use

www.nifc.gov/news/intell-predserv-forms/season-outlook.html Seasonal wildfire outlook.

www.fema.gov/regions/viii/fires.shtm Hayman fire.

www.fs.fed.us/r2/fire/rmacc.html Rocky Mountain fire management.

www.famweb.nwcg.gov/pocketcards/default.htm Wildland fire assessment.

www.fs.fed.us/fire/fuelman Small-scale spatial data for wildfire and fuel management. A series of U.S. maps and data tables concerning wildfire.

OTHER SITES:

www.nps.gov/yell/nature/fire/undex.htm

www.fs.fed.us/land/wfas — Principle site for just about all wildfire information

whyfiles.org/018forest_fire/index.html

www.fire.ca.gov

www.colostate.edu/Depts/CSFS/homefire.html

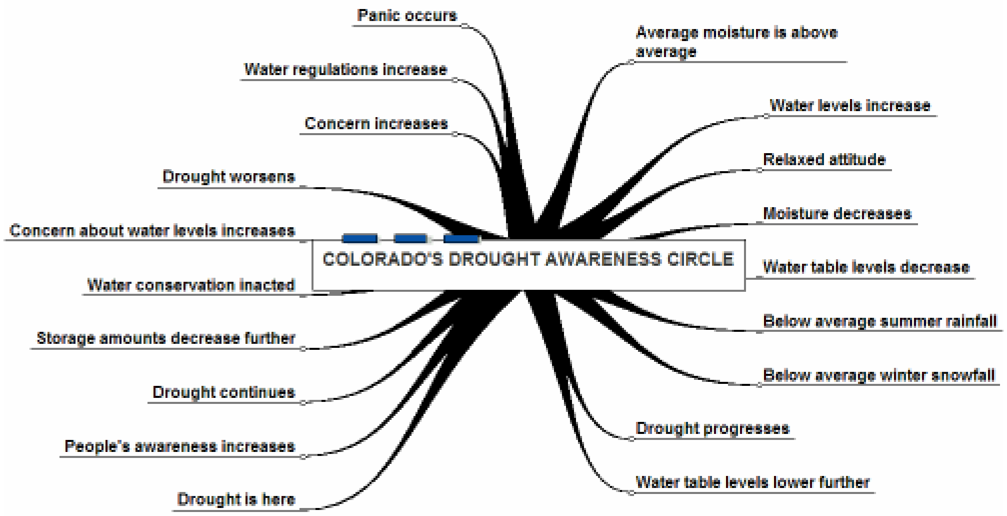
www.wildfirenews.com

www.fs.fed/r2/psicc/pp — Local regional situation.

Location	Number of cores	Pondorosa Pine Beginning Year	End Year	Average Dry Year	Average Wet Year	Douglas Fir Beginning Year	End Year	Average Dry Year	Average Wet Year
Fox Run Park	12	1880	2003	1898-1903	1895-1900				
				1916-1922	1910-1915				
				1930-1941	1942-1953				
				1951-1958	1965-1972				
				1960-1965	1980-1988				
				1976-1980	1990-1998				
				1989-1990					
				2001-2003					
Waldo Canyon	7	1875	2003	1878-1890	1895-1901	1865	2003	1866-1875	1877-1879
				1899-1902	1904-1912			1880-1894	1894-1898
				1914-1920	1925-1929			1899-1901	1903-1907
				1929-1940	1941-1951			1910-1912	1914-1917
				1953-1964	1967-1972			1918-1926	1927-1931
				1975-1981	1982-1987			1932-1941	1943-1950
				1999-2003	1990-1997			1953-1958	1959-1962
								1963-1968	1969-1973
								1975-1977	1980-1985
								1986-1989	1990-1992
								2000-2003	1995-1999
Section 16	10	1864	2003	1865-1874	1876-1879	1852	2003	1865-1874	1853-1860
				1880-1893	1894-1898			1882-1890	1876-1881
				1897-1903	1904-1909			1908-1910	1892-1895
				1911-1915	1915-1919			1914-1918	1902-1907
				1931-1942	1927-1930			1923-1925	1911-1912
				1955-1965	1942-1950			1933-1942	1919-1922
				1975-1978	1957-1962			1951-1958	1941-1950
				1988-1993	1966-1973			1962-1966	1968-1974
				2000-2003	1981-1986			1975-1977	1980-1986
					1994-1998			1988-1990	1991-1993
								1994-1996	1997-1999
								2000-2003	

Palmer Park	5	1898	2003	1913-1920 1930-1941 1953-1958 1962-1966 1974-1980 1986-1990 1999-2003	1898-1910 1925-1930 1941-1950 1958-1961 1966-1972 1983-1985 1992-1997

COLORADO'S DROUGHT AWARENESS CIRCLE



1 Average moisture is above average

2 Water levels increase

3 Relaxed attitude

4 Moisture decreases

5 Water table levels decrease

6 Below average summer rainfall

7 Below average winter snowfall

8 Drought progresses

9 Water table levels lower further

10 Drought is here

11 People's awareness increases

12 Drought continues

13 Storage amounts decrease further

14 Water conservation inacted

15 Concern about water levels increases

16 Drought worsens

17 Concern increases

18 Water regulations increase

19 Panic occurs

DROUGHT FACTOR MODELLING

A key component of the MacArthur Forest Fire Danger Meter is the modelling of the dryness of the fuel. This is expressed by the Drought Factor, which ranges from 0 to 10. If this is multiplied by 10 and called a percent, it gives the percentage of fine fuel that would be removed by a fire under the current conditions.

The DF is based on recent rainfall and on the Byram-Keetch Drought Index. The BKDI is the number of mm of rain needed to saturate the soil, and ranges up to a maximum of 200mm.

On any non-rainy day the heat of the sun increases the BKDI, by amount that depends on:

- Average annual rainfall
- The day's maximum temperature

The calculations are based on an assumption that the terrain is level. If the terrain is not level then there will be differing levels of solar radiation, and thus differing drying rates.

It is possible to calculate the level of radiation, in Megajoules per square meter for the day. This depends on:

- Latitude
- Day of the year (and thus the sun's path through the sky)
- Aspect
- Slope

From month-to-month this varies considerably, but if we accept that this variation is primarily reflected in the daily maximum temperature, then the drying rate on any day for a site can be corrected by dividing the radiation level by the equivalent level on flat ground. This gives ratios that range from 0 for steep south-facing slopes at the Winter Solstice to over 1.8 for steep, north-facing slopes at the Summer Solstice.

We can then state that the daily change in BKDI should be calculated by the standard equation, and then multiplied by the appropriate value from the tables below. If no rainfall figures are available for the site, then use the best local figures, and a month-by month correction should work as a first approximation (e.g. if Canberra Airport's BKDI goes up by 15mm in August, then a 20 degree slope on the north face of Black Mountain probably went up by 15*1.5 = 22.5mm).

North-facing slopes

Slope	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	1.3	1.3	1.2	1.1	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.3
20	1.6	1.5	1.3	1.1	1.0	1.0	1.0	1.0	1.1	1.2	1.4	1.6
30	1.8	1.6	1.4	1.2	1.0	0.9	0.9	1.0	1.1	1.3	1.5	1.8

Northwest/Northeast-facing slopes

Slope	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	1.2	1.2	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.1	1.2	1.2
20	1.4	1.3	1.2	1.1	1.0	1.0	1.0	1.0	1.1	1.2	1.3	1.4
30	1.5	1.4	1.2	1.1	1.0	0.9	0.9	0.9	1.0	1.2	1.3	1.5

West/East-facing slopes

Slope	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	0.9	0.9	0.8	0.8
20	0.5	0.6	0.7	0.8	0.9	0.9	0.9	0.9	0.8	0.7	0.6	0.5
30	0.3	0.4	0.5	0.7	0.8	0.8	0.8	0.8	0.7	0.6	0.4	0.3

South-facing slopes

Slope	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
10	0.7	0.7	0.8	0.9	0.9	1.0	1.0	0.9	0.9	0.8	0.8	0.7
20	0.3	0.4	0.6	0.7	0.8	0.9	0.9	0.9	0.8	0.6	0.5	0.3
30	0.0	0.1	0.3	0.6	0.7	0.8	0.8	0.8	0.6	0.4	0.2	0.0

Basic Concepts of Wildland Fire

The Natural Role of Fire

The Fire Triangle shows the three requirements for fire: heat, fuel, and oxygen.

There is no doubt about it: Fire is a dangerous and powerful force. Fire in wildland areas —areas with very little or no development—is a natural process. Fire is a part of natural systems, just as precipitation and wind are. Fire will continue to burn in wildland areas and, in fact, plays an essential role in many ecosystems. Recurring fires are often necessary to maintain healthy ecosystems. Fire helps to recycle plant nutrients into the soil, for example, and in forests, it can reduce undergrowth and competition from other plants. Wildlands have been changed and shaped by natural fires for thousands of years.

Fire is a chemical reaction requiring heat, fuel, and oxygen—the "fire triangle." The heat source for a fire can be a match, a spark from a machine, or a lightning strike. Fuel for a fire can be anything that will burn—grass, trees, or houses. Oxygen is found in the air around us. A fire can start when all three of these elements—heat, fuel, and oxygen—are present.

Historical and Cultural Aspects of Fire

Native Americans used fire as a tool. Along the east coast, tribes practiced "slash and burn" agriculture—burning to clear the land for crops and then moving to a new area a few years later. Native Americans also used fire to make travel easier, improve hunting, harvest berries and seeds, increase the availability of plants used for medicinal purposes and basket making, and keep prairies and meadows open and free from trees.

Early pioneers and settlers used fire much as Native Americans did. However, with the increase in the size and number of communities, fire became more of a threat and less of a tool for managing land. In the early 1900s, wildland fire suppression activities were organized. A national fire prevention campaign signaled a new emphasis in fire prevention. This program was begun during World War II to reduce human-caused fires, and Smokey Bear soon became its popular icon.

Learning to live with fire goes beyond fire prevention. It means understanding the role of fire in ecosystems; that fires are sometimes necessary; that firefighters cannot suppress all fires immediately; that some fires should be "managed" rather than suppressed; that individuals can take steps to protect their families, homes, pets, and other structures from wildland fires; and that we must live "carefully and compatibly" in fire-prone areas.

The Wildland-Urban Interface Zone

The wildland–urban interface is more than a geographic area. It is anywhere homes exist among flammable vegetative fuels. Three elements that are present in the wildland–urban interface zone are: wildland fuels (trees and shrubs), urban fuels (homes and landscape plants), and limited fire protection resources. The zone can be a house in the woodlands, a subdivision on the edge of a community, or a home with a combustible roof surrounded by large amounts of landscape vegetation.

As people move into areas where fire plays a role, homes become a possible fuel source and the potential for human-caused ignitions increases. Because wildland fire is an essential component of healthy ecosystems, people need to live compatibly with wildland fire.

Communities and wildland fire managers need to work as partners to protect communities from wildfire while maintaining healthy ecosystems. Firewise practices increase the likelihood that homes, office buildings, and other community resources will survive wildland fire damage. Firewise practices include: using fire-resistant building materials, especially on the roof; removing flammable materials from around homes; creating fire breaks with lawns, driveways, and walkways; and many other steps.

Homes can be made safer! Work done around a home before a fire starts can save property and lives. Homeowners and communities, working as partners with firefighters, can effectively reduce losses caused by wildland fires.

Fire Management—Fuels Treatment and Prescribed Fires

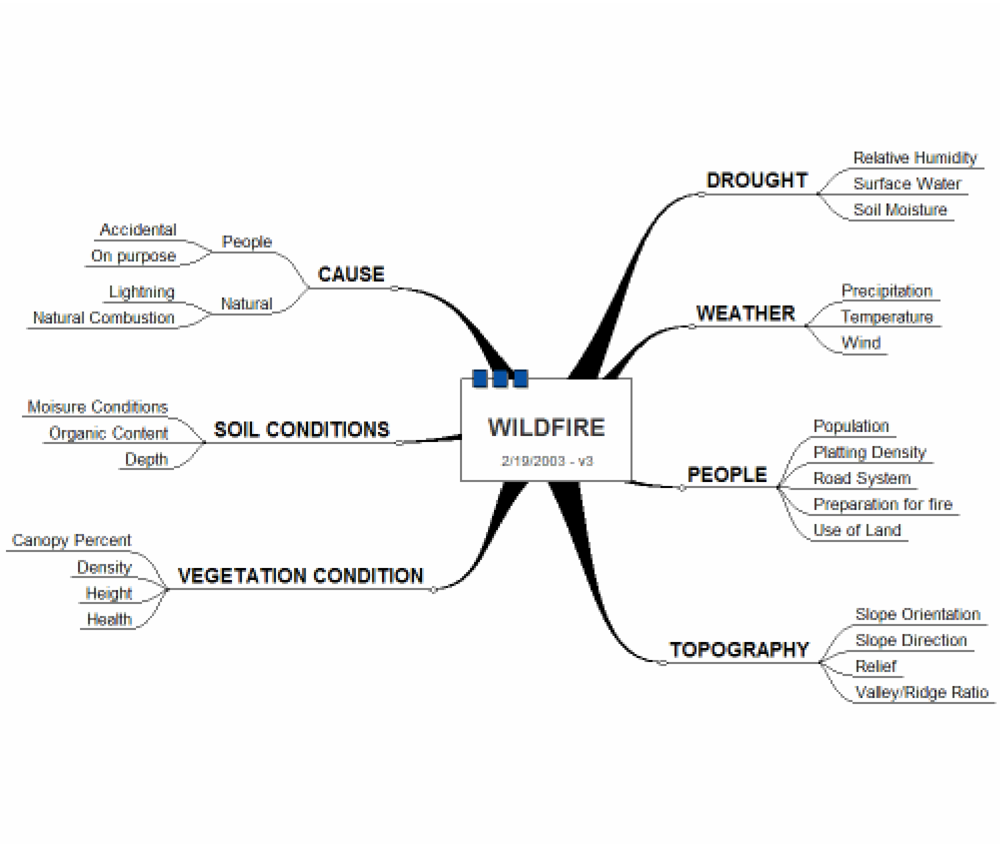
Wildland fire suppression is not always the objective of fire management. Fire suppression is an effort to put out the fire. Fire management may include fire suppression, but it also involves fire prevention and fuels treatment, including prescribed fire, research, and monitoring, to protect communities and provide for healthy ecosystems.

One of the results of the long history of wildland fire suppression has been the buildup of the amount of vegetative material available for fires to burn. This material is called fuel. Because of the fuels buildup, fires can burn unnaturally hot, damaging the soil and the ecosystems.

Four methods of controlling the amount of fuel in an area are:
(1) mechanical treatment, cutting or chipping material and removing it from a site;
(2) biological treatment, which relies on the consumption of plants by animals
(3) chemical treatment, such as the use of herbicides and
(4) prescribed fire, a fire intentionally set by professionals. Prescribed fires are carefully planned to burn under the right conditions (fuel moisture, temperature, humidity, season, and wind) to produce the desired results (such as reducing fuel, removing unwanted plant species, or stimulating new growth).

Fire management involves balancing public safety, firefighter safety, fire management costs, the protection of communities and property, and the protection and maintenance of ecosystems.

WILDFIRE


WILDFIRE
2/19/2003 - v3
CAUSE
People
Accidental
On purpose
Natural
Lightning
Natural Combustion
SOIL CONDITIONS
Moisure Conditions
Organic Content
Depth
VEGETATION CONDITION
Canopy Percent
Density
Height
Health
DROUGHT
Relative Humidity
Surface Water
Soil Moisture
WEATHER
Precipitation
Temperature
Wind
PEOPLE
Population
Platting Density
Road System
Preparation for fire
Use of Land
TOPOGRAPHY
Slope Orientation
Slope Direction
Relief
Valley/Ridge Ratio

1 DROUGHT

1.1 Relative Humidity

1.2 Surface Water

1.3 Soil Moisture

2 WEATHER

2.1 Precipitation

2.2 Temperature

2.3 Wind

3 PEOPLE

3.1 Population

3.2 Platting Density

3.3 Road System

3.4 Preparation for fire

3.5 Use of Land

4 TOPOGRAPHY

4.1 Slope Orientation

4.2 Slope Direction

4.3 Relief

4.4 Valley/Ridge Ratio

5 VEGETATION CONDITION

5.1 Canopy Percent

5.2 Density

5.3 Height

5.4 Health

6 SOIL CONDITIONS

6.1 Moisure Conditions

6.2 Organic Content

6.3 Depth

7 CAUSE

7.1 People

7.1.1 Accidental

7.1.2 On purpose

7.2 Natural

7.2.1 Lightning

7.2.2 Natural Combustion

WILDLIFE SEVERITY EVALUATION

Wildfire severity can be evaluated at each plot in terms of forest damage by the characteristics of upward and downward heat pulse components. Forest damage can be rated as follows:

0: No damage - all tree crowns were not scorched.
1: Spotty damage - partial scorch on at least 1 tree, but some trees were not scorched.
2: Moderate damage - partial scorched on all tree crowns, but few trees completely scorched.
3: Heavy damage - nearly all tree crowns completely scorched, but few crowns consumed.
4: Extreme damage - nearly all tree crowns consumed.

The downward heat pulse was estimated with ground char ratings in 4 30-cm x 60-cm subplots located at 90° angles and 17.85 m from each plot center. Ground char was rated as follows:

0: Unburned - no evidence of surface fire.
1: Light - some small twigs or leaves remain.
2: Moderate - all twigs, leaves, and standing grasses consumed, mineral soil charred.
3: Deep - mineral soil altered in color or texture.

The height of needle scorch on the coniferous trees sampled at each plot was measured as an indicator of fire intensity. The following measurements contributed to plot averages for scorch height:

1) Scorch heights of all partially scorched trees.
2) Tree heights of completely scorched trees added sequentially by decreasing height until average scorch height was maximized.
3) Bole char heights of unscorched trees added sequentially by decreasing height until average scorch height were maximized.
4) Crown base heights of unscorched trees added sequentially by increasing height until average scorch height was minimized.

Make sure you note the orientation and steepness of the slope for the plot. Attempt to estimate the following factors that would have existed during the fire:

Temperature	Relative Humidity	Wind Direction
Tree species	Drought Code	Fuel Model
Tree Height	Crown Ratio	

Some of these factors can be determined by using the Canadian Forest Fire Weather Index (FWI) handout.

FIREWISE PRACTICES

Excess vegetation on road shoulders is removed.

Cedar shake roofs are replaced with a non-flammable, class A alternative.

Driveways, non-flammable walkways and other pathways can halt the spread of a wildfire.

Careful spacing of trees and shrubs lowers wildfire potential.

Rockeries can interrupt a fire's pathway to a house.

Fuels are chipped and removed immediately after cutting.

Wood is piled away from the house.

Three-foot fire-free area is created on all sides of the house.

Dead leaves and branches are removed from trees, shrubs, and plants within the home ignition zone.

The home ignition zone is free of fallen leaves and needles.

Indigenous wildflowers and native plants are excellent Firewise choices for landscaping.

Green lawns and irrigated areas serve as fire breaks.

Fuels are thinned at the edge of the home ignition zone.

Deciduous trees are carefully spaced within the home ignition zone.

Driveways, non-flammable walkways and other pathways can half the spread of a wildfire.

Careful spacing of trees and shrubs lowers wildfire potential.

RATING CRITERIA FOR WILDFIRE HAZARD

Fire Control Factors

Access/Egress
Bridges
Response Zones
Water Supply
Building Construction
Response Times
Resources
Utilities
Density & Spacing

Slope Hazard Factors

Aspect
Position on Slope
Dangerous Terrain Features
Slope

Fuel Hazard Factors

Building Construction
Defensible Space
Fuel type/models (within and adjacent)
Fuel Breaks
Fuel Loading
Fuel Continuity

Weather Occurrence

Historic Climatological Data
Drought Factor/Index

Total Fires and Acres 1960 - 2002

These figures are based on end-of-year reports compiled by all wildland fire agencies after each fire season, and are updated by March of each year. The agencies include: Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service, USDA Forest Service and all State Lands.

Year	Fires	Acres	Year	Fires	Acres
2002	88,458	* 6,937,584	1980	234,892	5,260,825
2001	84,079	3,555,138	1979	163,196	2,986,826
2000	122,827	8,422,237	1978	218,842	3,910,913
1999	93,702	5,661,976	1977	173,998	3,152,644
1998	81,043	2,329,709	1976	241,699	5,109,926
1997	89,517	3,672,616	1975	134,872	1,791,327
1996	115,025	6,701,390	1974	145,868	2,879,095
1995	130,019	2,315,730	1973	117,957	1,915,273
1994	114,049	4,724,014	1972	124,554	2,641,166
1993	97,031	2,310,420	1971	108,398	4,278,472
1992	103,830	2,457,665	1970	121,736	3,278,565
1991	116,953	2,237,714	1969	113,351	6,689,081
1990	122,763	5,452,874	1968	125,371	4,231,996
1989	121,714	3,261,732	1967	125,025	4,658,586
1988	154,573	7,398,889	1966	122,500	4,574,389
1987	143,877	4,152,575	1965	113,684	2,652,112
1986	139,980	3,308,133	1964	116,358	4,197,309
1985	133,840	4,434,748	1963	164,183	7,120,768
1984	118,636	2,266,134	1962	115,345	4,078,894
1983	161,649	5,080,553	1961	98,517	3,036,219
1982	174,755	2,382,036	1960	103,387	4,478,188
1981	249,370	4,814,206			

Major Colorado wildfires since 1990

August 2000 — 5,240-acre fire swept through Mesa Verde National Park

July 20-29, 2000 — The Bircher Fire destroyed 23,600 acres at Mesa Verde National Park.

June 2000 — More than 10,000 acres are burned and dozens of homes destroyed in the Hi Meadows fire near Bailey.

June 2000 — More than 10,000 acres burn and 16 homes are destroyed in the Bobcat Fire near Drake, east of the Rocky Mountain National Park.

April 18, 2000 — A fire in southern Colorado destroyed three buildings at the Great Sand Dunes National Monument and burned 5,200 acres to the east. The fire began in grass near a highway and was driven by winds gusting to 70 mph.

Aug. 18, 1996 — A blaze started by lightning burned nearly 5,000 acres of Mesa Verde National Park and damaged a 1,000-year-old petroglyph carved by ancient cliff dwellers.

May 26, 1996 — A fire in the Jefferson County foothills near Buffalo Creek caused $960,000 in damage to private property and burned nearly 12,000 acres.

July 6, 1994 — A wildfire overwhelmed firefighters on Storm King Mountain west of Glenwood Springs. Fourteen firefighters are killed.

WILDFIRE FIELD INVESTIGATION IN AND AROUND THE HAYMAN FIRE SITE, COLORADO, USA

Before visiting the Hayman fire area develop an understanding of the many interrelationships that go into the possibility of wildfire (Map 1, 2, and 3). Read the three articles that are made available to you that address wildfires. Also read the Facts and Figures to Ponder handout. Beside a brain storming session, where our class will develop a list of possible factors and characteristics that relate to wildfire, you may use the following handouts to assist you in developing a model of these interrelationships:

The Gift of Fire
Fire is a Natural Part of the Environment
Common terms for National Fire Danger Rating System

In the field today you will visit four varieties of forests: Protected, Thinned, Protected/burned, and Thinned/burned. The area you will visit is in and around the Hayman burn area, within the Pikes Peak National Forest, and includes a variety of topography, water availability, orientation of slope, human occupancy and tree types (Map 4 and 5). You will observe how various characteristics of the forests differ from one location to another. In addition, you will attempt to determine the possibility of a wildfire in each location. In each of these locations we will observe housing structures and the surrounding yards so we can try to develop a wildfire analysis for each home site (Homeowner fire safety practices handout). You will also observe the attempts to lessen the possibility of wildfire along roads and within the forests (Roadside Vegetation and Common forest fuel class recommendations handouts).

You will use the following handouts to develop your understanding of wildfire while in the field:

Rating Criteria for Wildfire Hazard
Fire Cause Classifications
Evaluation of wildfire severity
Fire Weather Indices Defined
Fire Danger Rating and Color Code
Common forest Fuel class recommendations

In the non-burned forests use the following two handouts to develop an understanding of the health of the forests and if possible use the handouts in the burned forests as well:

Canker Sores and Insect Defoliators
Diagnostic & Control Key for Insect and Disease Pests Affecting Evergreens

Use the following handouts to develop an understanding of the negative and positive effects of wildfire after the fire is put out:

Colorado Wildfires

Water Cycle at Rampart Range Reservoir Before and After a Wildfire

Answer the following questions before returning for next week's class:

Are there any positive results of wildfire?
What are the positive results?
Does thinning a forest lessen the likelihood and/or damage by wildfire? How?
What can people do to lessen the affect of wildfires?
Which is more expensive, putting out wildfires or hindering their start? Explain your answer.
What would be the best model for the development of a wildfire? Develop the model.

For more information in developing the answers to the above questions visit the Internet websites listed in the included handout. NOTE: The last handout is a depiction of one of the more important websites. The URL is at the bottom of the handout.

RESULTS

The students developed several results from the investigation of the Internet sites and the data collected during the field investigations.

1. It was often difficult to determine the actual dry and wet periods from the tree cores.
2. The relationships between the tree-ring data and the yearly precipitation determined from Colorado Springs data were not as exact or perfect as was hoped for by the students.
3. The tree-ring data from the four locations and the two species of trees generally agreed but was not exact.
4. The tree-ring data alone was not enough to develop a direct relationship with the past wildfires. The observations of the other characteristics developed at the locations were necessary.

5. The development of an understanding of wildfires and the drought relationship by the students was very beneficial.
6. The development of a further understanding of the interrelationships of the Earth’s four spheres was the most important outcome of the project.