

THE FORCE OF FIRE



Teacher Resource '04

Lesson plan and support materials
SECONDARY

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Cover: Steve Grimaldi, Forest Protection Branch, MoF
Kamloops Fire Centre Staff, Forest Protection Branch of BC
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THE FORCE OF FIRE

National Forest Week 2004

ATTENTION TEACHERS

FIRE IS EVERYONE'S BUSINESS!!!!

Please take time to present this lesson plan to your students.

WHY?

- All predictions lead to another potential fire season for 2004. It is imperative that all students and families develop an awareness of the nature of fire and its' outcome.
- Help students become aware of the "FireSmart" scenario encourage them to take responsibility in their homes, camping, grad ceremonies, etc.
- **Careers** expose students to the variety of careers in forestry and in forest fire fighting.

THE FUTURE OF THE PACKAGE:

- After 2004, this package can be used where forestry and/or fire ties into the curriculum (see curricular connections).

THE FORCE OF FIRE

National Forest Week 2004

SECONDARY LESSON OVERVIEW

Learning Outcome:

- Fundamentals of fire
- Variables affecting fire behaviour
- Positive/negative effects of fire
- Safety
- Wildfires and urban interface

Setting the Stage:

Introduction: (5 minutes)

- Overhead: Fire Fundamentals Triangle - discussion
- Overhead: Fire Behaviour Triangle - discussion
- Photo: Lightning Strikes cause fire

Lesson: (DVD 35-40 minutes/Video 15 minutes)

DVD: "Wildfire A Force of Nature"

- Introductory statement
- View DVD to find answers to question sheets 2 versions
- Discussion of DVD content

Video: "Wildfire Preventing Home Ignitions"

- Questions
- View Video

Conclusion: (2 options - 2-15 minutes)

- Forest Fires of 2003: a discussion
- Overhead: Fire Ranking - key points review

Extensions:

- CD: FireSmart - "Protecting your Community from Wildfire"
- Additional lesson plans and fire behaviour lab

Materials:

- Overheads:
 - The Fire Fundamentals Triangle
 - The Fire Behaviour Triangle
 - Fire ranking
- Photo: Lightning
- Lesson plan, question and answer activities
- Teacher background information with fire facts, glossary, summaries for DVD and Video
- DVD: "Wildfire - A Force of Nature"
- Video: "Wildfire - Preventing Home Ignitions"
- CD: FireSmart - "Protecting your Community from Wildfire"
- Other Photos - look to websites in background information

THE FORCE OF FIRE

National Forest Week 2004

SECONDARY LESSON PLAN

Objective:

Students will:

- Learn about the fundamentals that are required for a fire to occur.
- Assess the different variables that affect the behaviour of a fire.
- Determine how fire affects the ecosystem (positive and negative).
- Fire facts and urban interface.
- Learn about the importance of safety when fighting forest fires.

Curricular Connections:

- Science 8 - Applications of Science/Life Science: Global Ecosystems.
- Biology 11 - Plant Biology Gymnosperms, Angiosperms.
- Resource Science: Forests 11 - Forests and Society, forest ecology, plants.
- Resource Science: Forests 12 - Management perspectives, fire management.
- Geography 12 - Resources of the Earth Management of Resource.
Resources of the Earth Sustainability of Resources.
- Socials 10 - Resource and Environmental Management.
- Socials 11 - Environmental issues.
- CAPP 11 and 12 Career Exploration - possible career paths.

Materials

- Overheads:**
 - The Fire Fundamentals Triangle
 - The Fire Behaviour Triangle
 - Fire Ranking
- Photo:**
 - Lightning
- Questions and answer sheets**
- DVD:** "Wildfire - A Force of Nature"
- Video:** "Wildfire - Preventing Home Ignitions"
- Lesson plan**
- Teacher background information:** fire facts, summaries for DVD and video, glossary
- CD:** FireSmart - "Protecting your community from Wildfire"

LESSON PLAN

A) Introduction (5 min)

QUESTION: What is required for a fire to occur?

- Overhead: Fire Fundamentals Triangle**
 - fuel:** a combustible material that results in gases or vapours from solid or liquid substances.
 - heat:** a hot surface, hot air, a spark, or an open flame giving off enough heat to ignite gases.
 - oxygen:** the combination of fuel, heat and oxygen creates fire.

QUESTION: What factors change the way a fire behaves?

- Overhead: Fire Behaviour Triangle** - overhead - discuss.
 - The behaviour and severity of fires are linked to the type of **fuels**, the **topography** of the land and the **weather** conditions at the time.

QUESTION: How are forest fires started? (human and by nature)

- Photo: Lightning strike:**
 - What percentage of fires are started by lightning or other natural causes? (approximately on average: 50% by nature, 50% human cause)

B) DVD - "Wildfire - A force of Nature" (35-40 minute for DVD and questions). *DVD Summary located in teachers background information.*

Introduction:

- "Wildfire is an ecological process within the rhythms of nature that plays a vital role in the balance of all forest life of plants and animals".**

Lesson: (time will determine style and length of lesson)

- Prior to viewing DVD, place questions (**short version - one lesson block or long version - 2 blocks**) on overhead or distribute copies to students.
- View DVD
 - Option: view entire DVD and discuss questions following that.
 - Option: stop at natural breaks and discuss questions one section at a time.
 - Option: students take notes; questions or notes become classroom discussion.

C) VIDEO - "Wildfire - Preventing Home Ignitions" (15 min.)

Summary of Video located in teachers background information

- Students listen for answers to the following questions:

Note: Show first 11 minutes of video only

- How do fires spread? **Ignition to ignition**
- What are the 3 components of combustion? **Fuel, oxygen, heat**
- What are the firebrands? **Burning embers**
- What are some fuels for fire? **Twigs, needles, grasses branches and needles**
- What are some ways to protect your home from wildfire? **Flame resistant roofing, thinning, clear zone of dry materials**
- Why do some houses burn during a wildfire and others do not? **Variable answers**

NOTE: Materials for home construction are intended as guides when living in the urban interface due to the lack of fire protection and the difficulty in getting a quick response from fire fighters.

- Discuss answers to the questions

D) CONCLUSION: (2-15 min. depending on length of class time)

Choose one or more of the following:

1. Talk about the forest fires of 2003

- More than 2500 wildfires destroyed approximately 265,000 hectares in B.C. - the previous year average was 21,000. The corporate goal is not to exceed 150,000 burned hectares over a five year period.
- In the Southern Interior alone, 5.6 billion dollars of lumber was lost.
- The estimated cost to BC for fighting these fires is \$550 million dollars.
 - **OKANAGAN MOUNTAIN PARK FIRE**
 - The fire was ignited by a lightning bolt.
 - 27,000 residents were evacuated.
 - The fire spread to 20,000 hectares and destroyed 223 homes and 6 of the railway trestles in Myra Canyon.
 - The estimated residential destruction costs were \$160 million.
 - This fire was one of the most expensive fires for suppression costs and infrastructure damage.
 - **MCLURE-BARRIERE FIRE**
 - The fire was ignited by a cigarette.
 - The fire spread to 4,000 hectares and destroyed the Tolko sawmill, transmission power lines and most of the community of Louis Creek.
 - The estimated residential destruction costs were \$8.2 million.

2. Overhead: Fire Ranking

Review key points:

- The 3 requirements for fire are: heat, fuel and oxygen.
- Weather, topography and fuel determine fire behaviour.
- Fires can destroy yet renew the forest.
- Canadians rely on the forest for their livelihood, therefore are concerned about catastrophic wildfires.
- Continued research is important for increasing the success of preventing wildfires and protecting our homes.
- You can decrease fire spread in urban interface areas by having a “fire smart” home and property.
- Share some of the fire facts provided in the teacher background information.**

Extensions

- CD: FireSmart - “Protecting Your Community from Wildfire” - interactive - create a “FireSmart” environment.**
- In depth lesson plans on website (www.learnforestry.org or www.riverside.bc.ca - education)...look for these in the fall of 2004.**
 - Fire and the ecosystem
 - Fighting Forest Fires
 - Fire Behaviour Lab

Additional Information for Secondary Students:

www.learnforestry.com/lessons/nfw/force_of_fire/additional.shtml

Fire Triangle



Sources of heat include:

- Lightning
- Matches
- Discarded cigarettes
- Untended camp fire
- Spark from a passing truck or train

Sources of fuel include any material that can burn:

- Dry vegetation
- Dead branches, needles, brush on the forest floor
- Standing dead trees
- Wooden structures
- Trees stressed by drought or insects

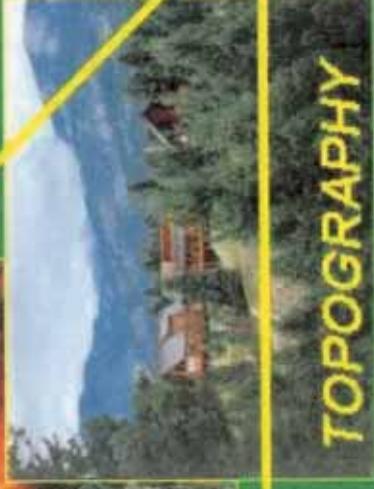
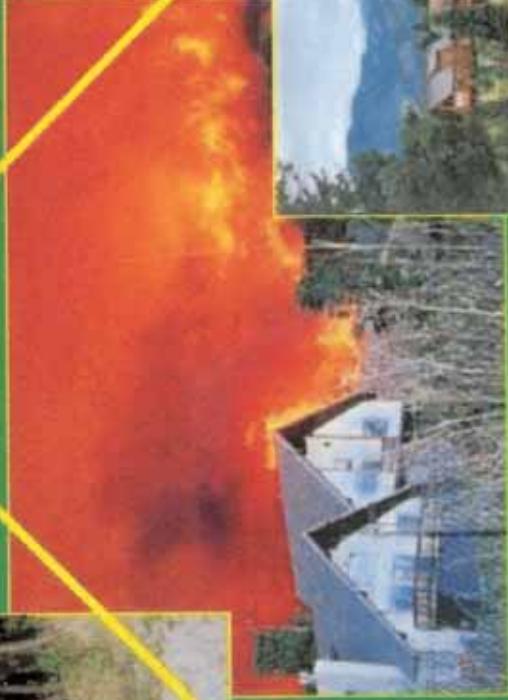
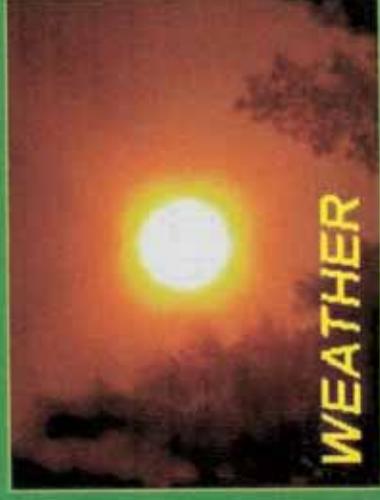
Air provides the oxygen that is needed to have fire.

Remove any of the 3 requirements (fuel, heat, air) and a fire cannot occur.



FireSmart: Protecting Your Community from Wildfire

Fire Behaviour Influences





FIRE RANK

A Fire Description

RANK 1	RANK 2	RANK 3	RANK 4	RANK 5	RANK 6
NO OPEN FLAME WHITE SMOKE SMOLDERING GROUND FIRE	VISIBLE OPEN FLAME SURFACE FIRE ONLY UNORGANIZED FLAME FRONT LITTLE OR NO SPREAD	ORGANIZED SURFACE FLAME FRONT MODERATE RATE OF SPREAD VIGOROUS SURFACE FIRE	ORGANIZED SURFACE FLAME FRONT MODERATE TO FAST ROS ON THE GROUND SHORT AERIAL BURSTS GREY TO BLACK SMOKE	ORGANIZED CROWN FIRE FRONT MODERATE TO LONG RANGE SPOTTING INDEPENDANT SPOT FIRE GROWTH BLACK TO COPPER SMOKE	ORGANIZED CROWN FIRE FRONT MODERATE TO LONG RANGE SPOTTING INDEPENDANT SPOT FIRE GROWTH PRESENCE OF FIRE BALLS AND WHIRLS
					
					
					

DEFINITIONS:

Ground Fire - A fire that burns in the ground fuel layer.

Surface Fire - A fire that burns in the surface fuel layer, excluding the crown of trees.

Crown Fire - A fire that advances throughout the crown fuel layer.

Head - The portion of the fire having the greatest rate of spread and frontal intensity.

Flanks - Those portions of the fire that are between the head and the base.

Base - That portion of the fire perimeter opposite the head; the slowest spreading part of the fire.

Rate of Spread - The speed at which a fire extends its horizontal dimensions, expressed in terms of distance per unit time.

Candling - A single tree or a small clump of trees is said to candle when its foliage ignites and flares up, usually from bottom to top.

Spotting - A fire producing firebrands carried by the surface wind.
A fire whirl and/or convection column that falls beyond the main fire perimeter, and results in spot fires.

Flame Front - The strip of primarily flaming combustion along the fire perimeter; a particularly active fire edge.

Organized Front - A flame front exhibiting all the same characteristics, ROS (Rate of Spread), flame height and length.

**DVD “Wildfire A Force of Nature”
Version 1
Question Sheet**

1. At times wildfire is a _____ of the natural world and plays an intricate role as the predominate factor in the _____ process of new life that has evolved over thousands of years.
2. At other times fire can be an _____ to plants and animals as one of the most devastating and powerful forces of nature.
3. _____ is the relationship between fire, biology and the interaction of organisms with their changing environment.

---DVD BREAK---

4. Previous burns are very effective _____. They limit the size of fires. It is nature's way of protecting itself.
5. After a fire there is an explosion of _____ and creatures like moose depend on this _____.

---DVD BREAK---

6. Forests are not _____ systems. They are always changing.
7. The better we understand the importance and natural _____ of wildlife and its' _____, the more effective we can be as good stewards of the forest.

**DVD “Wildfire A Force of Nature”
Version 1
Answer Key**

1. At times wildfire is a **friend** of the natural world and plays an intricate role as the predominate factor in the **ecological** process of new life that has evolved over thousands of years.
2. At other times fire can be an **enemy** to plants and animals as one of the most devastating and powerful forces of nature.
3. **Fire ecology** is the relationship between fire, biology and the interaction of organisms with their changing environment.

---DVD BREAK---

4. Previous burns are very effective **buffers**. They limit the size of fires.
It is nature's way of protecting itself.
5. After a fire there is an explosion of **new life** and creatures like moose depend on this **young growth**.

---DVD BREAK---

6. Forests are not **static** systems. They are always changing.
7. The better we understand the importance and natural **benefits** of wildfire and its' **behaviour**, the more effective we can be as good stewards of the forest.

DVD: Wildfire A Force of Nature
Version 2
Question Sheet

1. Two things that fire is responsible for are _____ and _____.
2. How many hectares of forest does Canada have? _____
3. At times wildfire is a _____ of the natural world, and plays an intricate role as the predominate factor in the _____ process of new life that has evolved over thousands of years.
4. At other times fire can be an _____ to plants and animals as one of the most devastating and powerful forces of nature.
5. _____ is the relationship between fire, biology and the interaction of organisms with their changing environment.
6. What were 2 unexpected results that were discovered in the crown fire studies?
A. _____
B. _____
7. Historically, when is fire considered bad?

8. What do you call fires that are set on purpose?

9. What are most fires caused by?

----Break-----

10. How many communities across Canada depend on forestry as their main source of income? _____

11. What is ALPAC's ecosystem based management approach when harvesting?

12. Previous burns are very effective_____. They limit the size of fires. It is nature's way of protecting itself.

13. Landscape level fire management can be performed by forest companies to reduce the likelihood of _____ fire events.

14. Logging burnt forest is called _____.

15. After a fire, there is an explosion of _____ and creatures like moose depend on this _____.

16. _____ and rain are also the most important natural influence effecting the _____ of wildfire.

----Break----

17. Fighting wildfires is a constant battle through a _____ process.

18. Part of the learning process is understanding the _____ of fire fighting.

19. What is essential to the existence of all forest life?

20. _____ is' the best way to help sustain Canada's Boreal forest.

21. Forests are not _____ systems. They are always changing.

22. The better we understand the importance and natural _____ of wildfire and its _____, the more effective we can be as good stewards of the forest.

**DVD: Wildfire A force of Nature
Version 2
Answer Sheet**

1. **destroying life, renewing life**
2. **~418 million**
3. **friend, ecological**
4. **enemy**
5. **fire ecology**
6. **rapid rate of spread
thinning/pruning to reduce crown fire didn't work well**
7. **when it impacts private and public property and human life**
8. **prescribed burns**
9. **natural (lightning)**

----Break----

10. **over 350**
11. **imitate the effect of fire through logging activities**
12. **buffers**
13. **catastrophic**
14. **fire salvage**
15. **new life, young growth**
16. **snowfall, behaviour**

----Break----

17. **learning**
18. **human dangers**
19. **fire**
20. **shared responsibility**
21. **static**
22. **benefits, behaviour**

Summary of the DVD "Wildfire A Force of Nature":

- Fires destroy yet renew a forest
- Canada has 10% of the world's natural forested landscape (~ 418 million hectares)
- In the 1400's the trend was stop and control wildfires and protect the forest
- The Boreal forest (evergreens) is the most significant forest of Canada
- Fire ecology- the relationship between fire and biology and the interaction of organisms with their changing environment
- Crown fires are the most intense fires and have a rapid rate of spread
- Long term fire trends in Canada:
 - increasing fire occurrence, severity and intensity
 - costs: 1 million/yr, and over 7 million/yr in peak years
 - need good fire prevention
- 80% of Canadians live in urban areas
- Prescribed burns are fires that are set by the forest service/companies as part of the management of the forest
- Forest forensics looks at the cause, origin and responsibility of a fire
- Fire effects local economy
- Fire is caused by nature (lightning) or man (cigarettes, sparks from vehicles...)
- Break----
- The boreal forest is the greatest contributor to the forest economy
- An example of progressive harvesting is when logging practices use past fire information to mimic the natural pattern left by fire
- Previous burns are effective buffers that can limit the size of future fires
- The general fire cycle in the boreal is 100 years
- Salvage logging is the harvesting of burnt wood
- After a fire there is an explosion of new life, which is used by moose, birds etc.
- Canada has lots of clean water which is found in the Boreal forests (watersheds)
- Snowfall & rain are the most important natural forces that effect fire behaviour
- Some species rely on fire, live off of new growth or the cavities created by fire
- Break----
- Main challenges facing forest fighters:
 - Maintain historic and beneficial fire regimes
 - Eliminate negative and catastrophic effects of fires
- Research/technology is done to help fire fighters understand the danger associated with fighting fires (fire ecology and fire behaviour)
- Fire is essential for forest life
- There needs to be a balance between human needs and wildlife needs
- Fire Smart programs set our plans for protecting your home and your community
- There is a need to protect values at risk in forests
- All forest users must work together to share the responsibility for our forests
- Forests are not static systems, they are always changing (fire, water, disease, humans, weather, patterns)
- By understanding the effects of fire we can be better stewards of the forest
- The better we understand the benefits and behaviour of wildfire the better we can be as stewards of the forest

“Wildfire Preventing Home Ignitions” Summary

If you are short of time, you might want to stop approximately 11 min into the video when they start to talk about the Pattie Canyon fire.

Summary: (19 min.)

- Fire is a natural occurrence
- We have choices we can make to avoid our homes being ignited by wildfire
- Fire Forensics
- Most often, it isn't the crown fire that ignites a home, it is the little things
- Combustion, a chemical reaction, requires oxygen, heat and fuel. Without any one of these elements, fire cannot continue.
- Fire can start from radiation or heat, convection (fire directly touches a fuel) or firebrands.
- Fire spreads from ignition to ignition. “High” heat doesn't last that long for each burning tree. A crown fire can burn up its' fuel (ie: the tree) in about 1 minute.
- Home Ignition Zone in the US represents up to 200 feet from the house.

Note: for BC, we talk of 3 zones:

Zone 1 - Is the first 10 meters around a home/structure; keep fuel free.

Zone 2 - Is from 10 - 30 meters around a home/structure; reduce/remove fuel sources to avoid crowning, remove any deadfall, reduce # of evergreens which are more combustible than deciduous trees.

Zone 3 - Is from 30 - 70 meters beyond a home/structure; thin the area so that the fire will remain at a low intensity and can be easily put out.

Things to consider: avoid combustible roofing materials, do a seasonal clean-up yearly, remove flammable objects where possible, grow a mix of deciduous and coniferous trees, keep your lawns well watered.

Glossary

Buffers - A zone of a specified distance around a particular feature

Catastrophic fire - Extremely harmful fire; bringing physical destruction and harm

Combustion - A chemical change accompanied by the production of heat and light

Crown Fire - Fire that occurs in the upper reaches of a tree

Fire Ecology - the relationship between fire and biology and the interaction of organisms with their changing environment

Intensity - Exceptionally great concentration, power, or force

Prescribed Burns - Fires that are set on purpose by forest managers

Severity - The act or an instance of severe behaviour

Urban Interface - Fires that burn forested land located in and around communities, consequently putting many people at risk

Website list

More lesson plans:

www.learnforestry.org - forestry based website

Canadian Forest Association - National Forest Week lesson plans

www.canadianforestry.com

BC Government website with fire information: Look under “About Protection” by B.C. forest service - Flash presentation - View: Protection by B.C. Forest Service” - learn about B.C. as a leader in fighting fires.

www.for.gov.bc.ca/protect/

Alberta website with fire videos: http://envweb.env.gov.ab.ca/env/forests/fpd/external/new_QT.html

Forest fire information and statistics: B.C./Canada Forest Fire Stats - '70-'97, wildfire stats, fire ranking, B.C. fire danger report

<http://www.bcforestryinfo.com/forestry/fires/>

Temperate Forest Foundation:

www.forestinfo.org - fire ecology, wildlife impacts, watershed, soil impact and more

Natural Resources Canada (fire situation reports): National-level fire information/reports/graphs/satellite images/data base

http://www.nrcan-rncan.gc.ca/cfs-scf/science/prodserve/firereport/firereport_e.html

Fire fighting information: - fire fighting services/fire suppression training/prescribed burning/first aid

<http://www.tsuga.ca/Fire/index.html>

Okanagan Mountain fire photos, past and current information

www.castanet.net

North American forests

www.forestinformation.com



FIRE FACTS



- Fires have played a major role in the ecology of the Interior for a long time.
- Fires in the forests of B.C. have been a major influence since the glaciers receded which was about 7,000 years ago.
- Many of the mature forest stands around us in the Okanagan, resulted from large stand replacing fires that occurred in the late 1880's.
- The word “fire” has its roots in the Greek word “pyra” which means glowing embers (pyromaniac, pyrotechnics, pyroclastic flows).
- There is evidence that the First Nations who lived in the interior of B.C. used fire to alter the forest in their traditional territories for hunting and berry picking purposes.
- B.C. is a world leader in fire fighting technology and techniques.**
- Fires come in different sizes and intensities, from cool slow ground fires to hot, fast and explosive crown fires. These fires can move at speeds up to 100 metres per minute. They can travel from 7 kilometers an hour and in open grassy areas can reach speeds up to 17 kilometers per hour.
- The behaviour and severity of the fires is linked to the type of fuels the fire is burning, the topography of the area and the weather.
- Once a forest fire begins to burn, you can tell a lot by the color of the smoke:
 - The darker the smoke, the hotter the fire. Smoke that is billowing or boiling means a hot active unpredictable fire.
 - White/blue smoke that is floating in the air means a cooler less active fire.
- Fires can burn both uphill (heat of the day, upslope winds) and downhill (evening downdrafts, downslope winds from cold fronts).
- Fires are like living things - they want to expand and grow.
- Sparks or firebrands can ignite spot fires up to 3km. away.

FIRE FACTS continued...

- ❑ Large fires can create their own wind and weather patterns that can include mini-tornadoes within the fire.
- ❑ Fires can burn in the roots and stumps for many months and in some cases for many years.
- ❑ Fires can open cones and allow seeds to germinate.
- ❑ Fires renew the forest and landscape
 - help to recycle nutrients back into the soil
 - diversify vegetation and animal habitat
 - balance insect populations and forest age distribution
- ❑ Without fire, our forests become overstocked and susceptible to insects and disease and the quality of habitat is reduced for many animal species.
- ❑ Two types of fires:
 - Stand maintaining - occur frequently (3-15 years) and they are usually cooler ground fires
 - Stand replacing - tend to occur more infrequently (once every 100 years) and consume large areas of forest this starts a new forest cycle
- ❑ The cooler, stand maintaining fires are fires that burn mostly along the ground, consuming grasses, shrubs, small trees and some of the duff layer. They rarely burn hot enough to kill the larger and older trees.
- ❑ The hotter stand replacing fires are fires that burn along the ground and in the canopies of the trees consuming grasses, shrubs, small and large trees and a large amount of the duff layer. These fires usually destroy all the vegetation and trees providing the opportunity for a new stand to begin to establish itself. On occasion, these fires will burn up all of the forest floor duff, exposing mineral soil and rock. This intensity of fire may take many years or decades to recover from.