



## H19. History of Mixed-severity Fire

**Lesson Overview:** Students use the stand history diagrams that they assembled in the 2 previous activities to learn about mixed-severity fire regimes. They interpret stand history diagrams to check their skill in identifying historical fire regimes. In the assessment, they depict the appearance of a forest with a historical regime of either low-severity, mixed-severity, or stand-replacing fire.

**Lesson Goals:** Understand the nature of low-severity, stand-replacing, and mixed-severity fire regimes. Be able to interpret stand history diagrams showing these regimes and envision a forest stand based on its fire history.

### Objectives:

- Students can identify historical fire regimes from stand history diagrams.
- Students can describe or depict the appearance of a forest that has experienced a specific historical fire regime.

**Subjects:** Reading, Writing, Speaking and Listening, Math, Science

**Duration:** One 30- to 40-minute session

**Group size:** Whole class

**Setting:** Classroom

**Vocabulary:** *mixed-severity fire*

| Standards:             |   | 9th | 10th       | 11th    | 12th       |
|------------------------|---|-----|------------|---------|------------|
| <b>Common Core ELA</b> | Writing   |     | 9, 10      |         | 9, 10      |
|                        | Speaking and Listening                          |     | 1,4,       |         | 1,4        |
|                        | Language Standards                              |     | 1, 2, 4, 6 |         | 1, 2, 4, 6 |
|                        | Writing Science/Technical Subjects              |     | 7,10       |         | 7,10       |
| <b>NGSS</b>            | Interdependent Relationships in Ecosystems      |     |            | LS2.A   |            |
|                        | Ecosystem Dynamics, Functioning, and Resilience |     |            | LS2.C   |            |
|                        | Biodiversity and Humans                         |     |            | LS4.D   |            |
|                        | Natural Selection                               |     |            | LS4.B   |            |
|                        | Weather and Climate                             |     |            | ESS2.D  |            |
|                        | Natural Hazards                                 |     |            | ESS3.B  |            |
| <b>EEEGL</b>           | Strand 1  |     |            | C,E,F,G |            |

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## Teacher Background:

In the 2 previous activities, students used data from a published research study to assemble stand history diagrams that showed low-severity and stand-replacing fire regimes. Both of these patterns were common historically. Another common pattern was the mixed-severity fire regime.

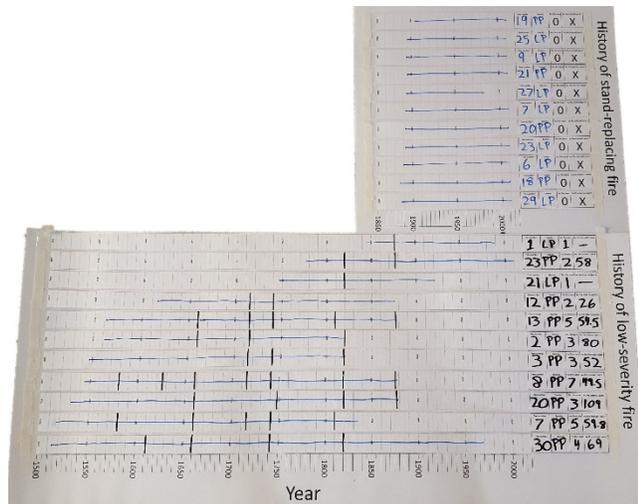
A forest with a mixed-severity fire regime has some places where fires were severe enough to replace old stands with young ones... and other places where some of the big trees were killed but others survived (perhaps with fire scars)... and yet other places that have not burned at all in a long time. A forest with a mixed-severity fire regime may also experience low-severity fires that alternate over time with stand-replacing fires. In other words, its fire history is all mixed up – and that history produces complex forests with a mixture of tree species and ages.

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## Materials and preparation:

- Note that the Study Area projection should still be on display (***PotholesStudyArea.pptx*** from **Activity M18andH17\_High-sevFireHist**).

- Take the stand history diagrams from the previous 2 activities and move them so the one showing stand-replacing fire is above the one showing low-severity fire. Tuck the “Dot Diagram” information on the stand-replacement diagram under the top of the low-severity diagram to make them look more continuous. IF YOU DON’T HAVE THESE DIAGRAMS, YOU CAN JUST START WITH THE PRESENTATION BELOW.



- Download ***H19\_MixedSeverityRegimes\_generic.pptx***.
- Make 1 copy/student of **Handout H19-1. Fire Severity Patterns in Forest Stands**.

## Procedure:

1. Explain: The increment cores and tree cookies that we’ve studied were sampled in different ways, but all of them came from the same research study and the same area in central Oregon. Let’s combine them to see if we can learn more about the fire history of the area. Look at the combined stand history diagram on display. What new information can we get from putting the 2 diagrams together? **Open discussion. Answers are suggested within the slide show (see Slide 2).**

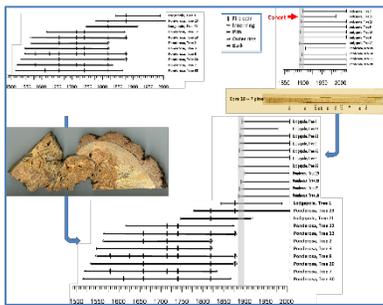
2. Go through and discuss the slides. Take as much time as you need on Slides 3-5, so students can begin to visualize and describe forest stands at different times through their history.

Slide 1



All of the increment cores and fire-scarred tree cookies that we've looked at came from the same study area in central Oregon. Let's see what happens when you have a mixture of low-severity and stand-replacing fire over time and space.

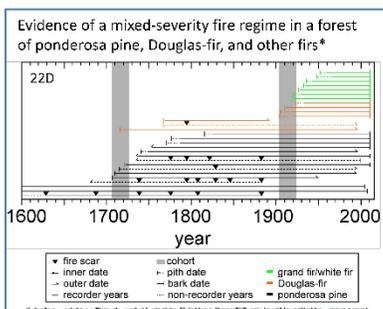
Slide 2



The top diagrams here are like the ones we constructed in class. The diagram based on fire scars – showing a history of low-severity fires - is on the left. The diagram based on increment cores – showing a history of stand-replacing fire - is on the right. When we combine them to describe the whole area and all of the variety it contains, what can we say about the history of the whole, big area?

Over the past 500 years, the area has experienced both low-severity and stand-replacing fire. The cohort that started in the late 1800s (mostly lodgepole pine) probably started after the 1877 fire. This fire also scarred 5 ponderosa pines, and 3 of them died the next year. So the 1877 fire must have had some low-severity areas and some stand-replacing areas. When we put all of our data together – from fire scars and increment cores - what can we say about the area's fire regime? Perhaps the area has had a mixed-severity fire regime. Or perhaps the fire regime changed from low-severity to stand-replacing in the early 1900s.

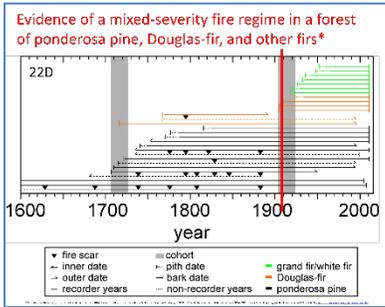
Slide 3



Let's look at more information about mixed-severity fire regimes. They are pretty common. Here's an example from a stand with ponderosa pines, Douglas-firs, and other firs. The design of this diagram is just a little different from the ones we put together: First, the fire scars in this diagram are shown with black triangles rather than straight lines... and second, the different tree species are shown with different colors. So... what is the story of this forest?

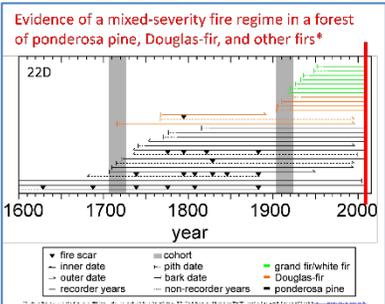
The forest had a lot of low-severity fires until around 1900 but has had none since then. There was a stand-replacing fire in the early 1700s. It didn't scar any trees that we know of, but it led to establishment of the oldest Douglas-fir tree on the site. There was another stand-replacing fire around 1900, which led to the establishment of lots of Douglas-firs and other firs but no ponderosa pines.

Slide 4



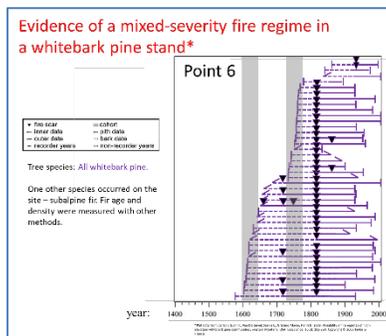
If we draw a line through the year 1910, can you picture what that forest probably looked like then? There were a lot of big old ponderosa pines and a couple of big Douglas-firs. There may have been a lot of dead Douglas-firs too, killed by a recent stand-replacing fire. There were probably also a lot of tiny Douglas-firs and other firs, the beginning of that new cohort.

Slide 5



If we draw a line through the year 2010, can you picture that forest? There were just a couple of big old ponderosa pines, and there were a lot of Douglas-firs and other firs. They were be grown-up but not nearly as big as the old pines. There would probably be a lot of smaller firs too, since they can reproduce well in shade – unlike ponderosa pines.

Slide 6



Here's another example of a forest with a history of mixed-severity fire. This diagram shows the history of a stand of whitebark pines in a high-elevation forest. What is the story of this forest? There are 2 cohorts – one from the early 1600s and one from the mid 1700s. There seem to be just 3 years with low-severity fire until around 1815, when a fire scarred nearly every tree on the site. That same fire may have helped the 3 youngest whitebark pines (at the top of the diagram) start growing. A few whitebarks died in the 1800s, and

then mortality increased dramatically through the 1900s. By the year 2000, every whitebark pine was dead. Based on student presentations and other things we've learned, can you guess why they died? Many of the trees were probably killed by mountain pine beetles, and many others by white pine blister rust. In addition, the trees may have been too weak to resist beetles and rust because low-severity fire had not killed off the competing fir trees over the past 100 years or so. Draw some imaginary lines for the years 1650, 1750, 1850, 1950... and ask students to describe how this whitebark pine stand looked at these different times.

- Summarize: Now we can look at a stand history diagram, figure out what historical fire regime it shows (stand-replacing, low-severity, or mixed-severity), and describe the "story" of that forest – whether it's a small sample plot or a whole big area. Let's check our skill at identifying the kind of fire regime. Then we'll use a project to tell – or show – how some of forest stands looked at different times in their history.

**Assessment:**

1. Give each student a copy of **Handout H19-1. Fire Severity Patterns in Forest Stands.**
  - Have students complete **Part 1. Skills check** in class or as homework. Check it – possibly in class - to make sure they understand the connection between the stand history diagrams and the 3 kinds of fire regimes.
  - Have students complete **Part 2. Telling or Showing the Story** on their own. This is either an art project or a writing or speaking project.
2. After the projects are completed, make time for students to tell the speaking projects. Provide a way for them to read the written projects. Display the art projects in the classroom, grouped by plot and time. Then have students circulate and discuss the differences among plots and the changes depicted over time.

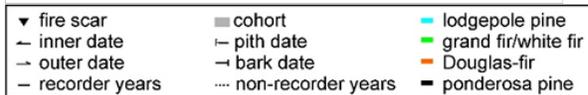
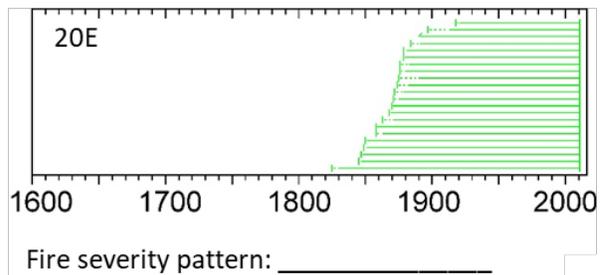
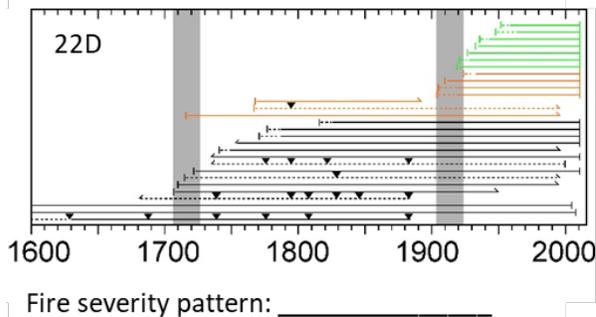
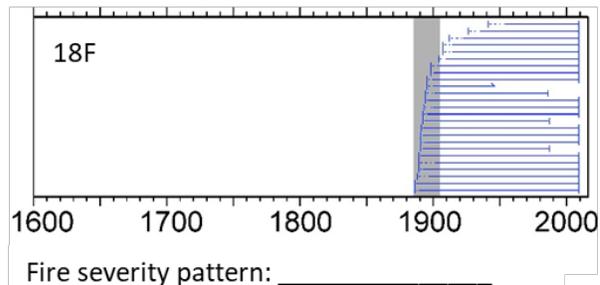
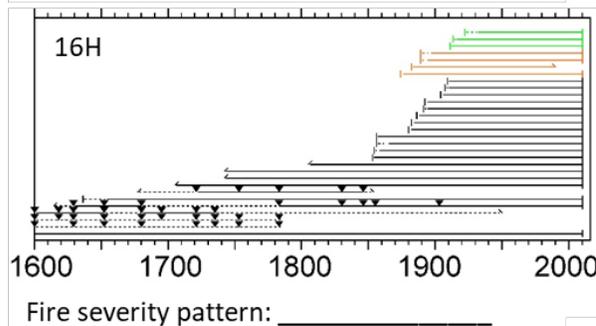
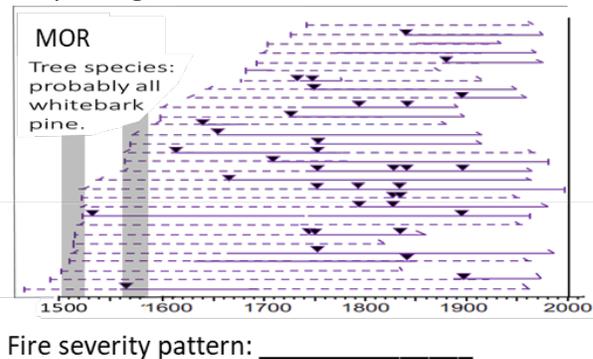
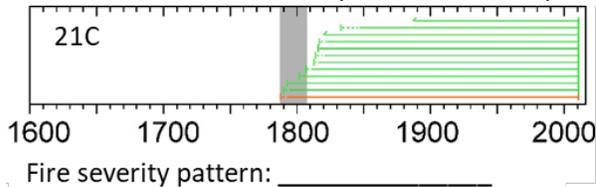
**Evaluation:** Use the **Answer key** below to evaluate Part 1. Evaluate the projects created for Part 2 based partly on how well they met the criteria in the instructions, but also consider creativity, esthetics, and imagination.

|   | <b>Excellent</b>  | <b>Good</b>   | <b>Poor</b>                                      |
|---|---|---|--|
| <b>Part 1. Skills check</b>                                 | All 6 answers correct   | 4 or more answers correct   | 3 or fewer answers correct                       |
| <b>Part 2. Telling/ Showing the Story</b>                   | Story/art work is labeled with plot number, year, and fire regime   | The art work is labeled with 2 of these features.                               | The art work is labeled with 1 or none of these. |
|   | Trees of different species (if present) are visibly different.      | 3 or more of these features are present.  | Fewer than 3 of these features are present.      |
|   | Trees in a cohort (if present) are the about the same size.         |   |  |
|   | Fire scars (if present) are visible.                                |   |  |
|   | Dead trees (if present) are shown.                                  |   |  |
|   | Saplings/undergrowth are shown if appropriate.                      |   |  |
| Uses creativity and imagination. Is esthetically appealing. | Uses limited creativity and imagination. Is esthetically appealing. | Uses little or not creativity or imagination, or is not esthetically appealing. |  |

# Handout H19-1. Fire Severity Patterns in Forest Stands

Name: \_\_\_\_\_

**Part 1. Skills check:** Below each stand history diagram, write the historical fire regime that describes it best: low-severity, mixed-severity, stand-replacing, or no fire at all.

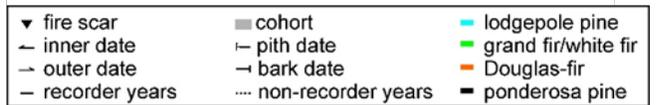
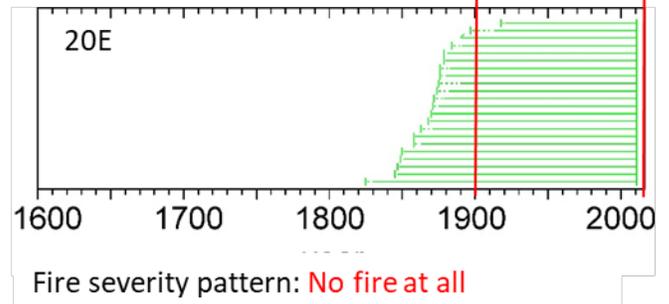
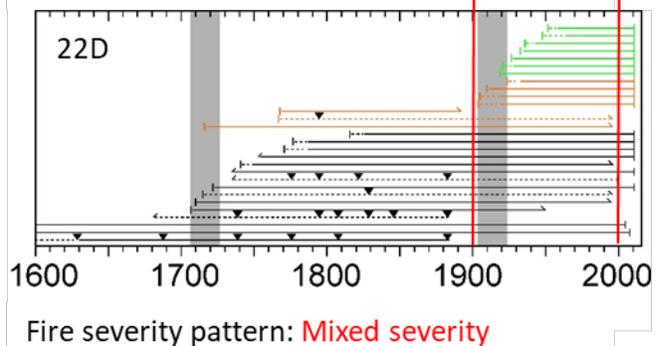
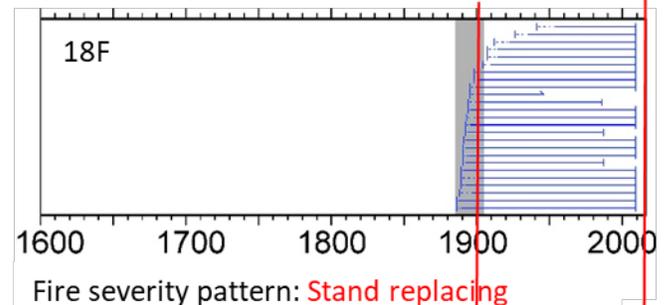
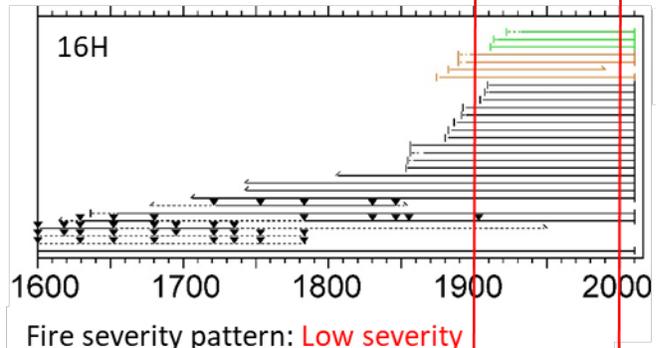
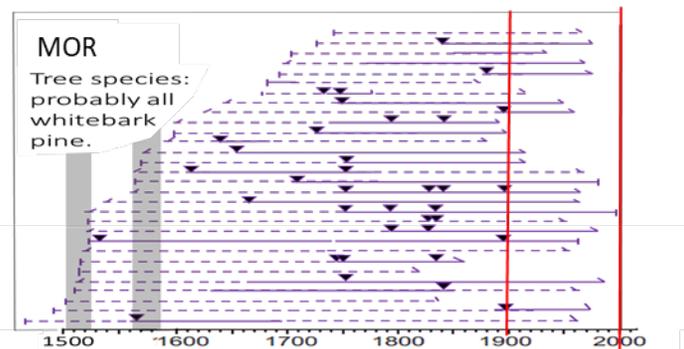
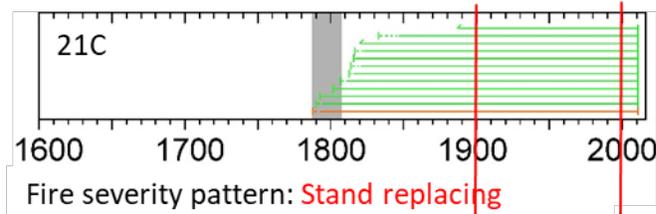


## Part 2. Telling or showing the story:

- Select one of the stand history diagrams above. Select either the year 1900 or the year 2000. In the stand history diagram that you're using (above), draw a vertical line through the year you chose.
- Create an art work that shows what that stand probably looked like in the year you chose. **LABEL YOUR CREATION WITH THE PLOT NUMBER, YEAR, and FIRE REGIME.** You can create a written or oral story, or a drawing, painting, computer graphic, 3-dimensional model, or some other medium. Make trees of different species look different. Make trees in a cohort about the same size if your stand had a cohort at that time. Show some fire scars if trees on your stand had them in that year. Show dead trees if your stand had some in that year. Show some seedling or sapling trees if your stand probably had them in that year. (Those don't show on the stand history diagrams.)

## Answer key to Handout H19-1. Fire Severity Patterns in Forest Stands

### Answers to Part 1. Skills check:



#### \*Sources:

- Data for all plots except MOR were provided by: Heyerdahl, E.K., D.A. Falk, and R.A. Loehman. 2014. Data archived with the International Multiproxy Paleofire Database, IGBP PAGES/World Data Center for Paleoclimatology. NOAA/NCDC Paleoclimatology Program, Boulder, Colorado, USA. Available [www.ncdc.noaa.gov/paleo/impd/paleofire.html](http://www.ncdc.noaa.gov/paleo/impd/paleofire.html).
- Data for MOR plot were obtained from: Larson, Evan R.; Van De Gevel, Saskia L.; Grissino-Mayer, Henri D. 2009. Variability in fire regimes of high-elevation whitebark pine communities, western Montana, USA. *Ecoscience*. 16(3): 282-298. Copyright © 2009 Taylor & Francis.

**Answers to Part 2. Telling or showing the story:** Red lines above show the years 1900 and 2000. Refer to **Evaluation** above for guidelines on evaluating student projects.