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JMLA Forestry/Fuels Meeting
Fire Ecology Presentation

What is fire ecology?

First let's begin by saying that an ecologist is not an environmentalist. He could be, but it isn't the same thing. An ecologist is simply a student; for example, of forests. An environmentalist is an advocate; for example, for protection of the natural environment through changes in policy or human behavior.

Back to ecology – a couple of definitions:

The study of the relationships between organisms and their environments

- Climate (temperature, moisture, light, wind)
- Soil (parent material)
- Disturbances (grazing, wind, fire)

Or

The study of the distribution, abundance, and productivity of living organisms, and their interactions with each other and with their physical environment

Ecology could focus at different scales, such as individual species or population, a community of species, or a landscape of different communities or patches

Poster 1. For example, take an intermediate unit like a plant community. Let's picture in our heads an aspen stand.

So then fire ecology is:

A branch of ecology that studies the origins of wildland fire and its relationship to the living and non-living environment. Fire ecology recognizes that fire is a natural process operating as a component in a system.

Poster 1. For example, in the plant community fire is a disturbance

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Let's look at fire itself for a minute.

Fire is a chemical reaction, a rapid oxidation ($CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$) that requires three things:

- Oxygen
- Fuel
- Heat (or an ignition)

Poster 2. This is the Fire Triangle. Take away any of these 3 things and fire cannot exist.
Or likewise increase any or all of those things and we brace ourselves for the possibility of active fire behavior.

Fire is an event controlled by topography and weather and fuels
Poster 2. We can't really control the weather or topography, but we can usually control the fuels.

So thinking about fuels with respect to fire behavior:

The more fuel there is, the more heat there can be created, and the bigger the flame length. This could mean a bigger fire, or it could mean an intense fire with lots of heat produced per square foot.

Now let's think for a minute how fire spreads and the impacts of each type of fire:
Poster 2.

- **Ground**
- **Surface**
- **Crown (and spotting)**

Back to our imaginary aspen community, we can think about how each of these fires might affect the stand.
Poster 1 and Poster 2.

- **Ground**
- **Surface**
- **Crown (and spotting)**

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Now let's look at plants and how they are or aren't adapted to fire.

Plants can be lumped into three general categories with respect to fire: **Poster 3**

- **Fire-Intolerant**

  These species tend to be highly flammable foliage and are completely destroyed by fire. Juniper is a good example of this, as are most conifers. Most fire-intolerant species have adapted to fire by producing fire-activated seeds, or seed banks, or offspring that compete very well in sites that have burned.

- **Fire-Tolerant**

  These species are able to withstand some types of fire and still grow. Good examples of this are resprouters such as aspen, chokecherry, western wheatgrass, and goldenpea.

- **Fire-Resistant**

  Although most conifers have very flammable foliage and are easily killed by crown fires, most are also very adapted to surviving surface fires. Fire-resistant plants have adaptations such as high crowns and thick bark which physically protects them from damage during fire behavior that is characteristic for the plant community. The most famous example of this is ponderosa pine.

How would fire interval, or years between fires, affect plants with different adaptations? **Poster 4**

- **Fire-Intolerant**

  If fire intervals are too close together, the offspring don't have time to mature and set seed for the next generation. For example, cheatgrass/sagebrush in the Great Basin. Some species have further adapted by producing seed and seed banks quickly.

- **Fire-Tolerant**

  If fire intervals are too close together, the plants might not have time to replenish energy reserves in the roots. Some shrubs or trees may require a few years or more, whereas grasses my only require one or two years.

  Alternatively, if fire intervals are too far apart, the plant may be weakened from competition within the community

- **Fire-Resistant**

  Frequent fire would keep fuel loading lower, and damage would continue to be minimal or nonexistent. At the other end, if fire intervals were far apart, fuels could build up to the point that fire gets into the canopy and the plant is killed.

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We see the importance of fire interval and realize it impacts the structure and succession of plant communities. Looking at our different forest types in the Judiths, with different understory plants, we wonder what disturbances created our landscape, and what were the intervals between disturbances?

Poster 5. Old photos of Judith Mountains for Hilger, from Lewistown, and from Giltedge.

We know that timber was harvested in the late 1800s for mining operations at Maiden, Giltedge, and Kimball. The timber resources were depleted around the towns, and the current forests have developed from that disturbance

There is also evidence that fire had an important role in our forests.

Poster 6.

- **Fire scars on trees**

  When we collected forest and fuels data in the Judith and Moccasin mountains, we also analyzed fire scars to better understand fire interval and fire size. Trees that have multiple fire scars are especially helpful for determining forest community structure.

- **Fire scars on the landscape and ages of the regen**

Research publications also give us helpful guidance. For example, this publication came out of one of our USDA Forest Service Research Stations. It is titled Fire Ecology of Montana Forest Habitat Types East of the Continental Divide, by William Fischer and Bruce Clayton in 1983

The publication groups fuel loading, fire cycles, and fire effects by forest habitat type. In general for the Judiths and Moccasins, we have six Fire Groups.

Poster 7:

- **Three groups (Fire Groups 2, 3, and 4) are warm sites where ponderosa pine is dominant or is a major component along with Douglas-fir**

- **Two groups (Fire Groups 5 and 6) are cooler sites where Douglas-fir is dominant or a major component with lodgepole pine. Ponderosa pine can occur on the warmer sites.**

- **And one of the groups (Fire Group 7) is for cool sites that are dominated by lodgepole pine**

In summary, we recognize that fire and other disturbances alter our landscapes by altering plant community structure, composition, and size. This is most visual in forest types.

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How do we apply this to projects and forest management in general?

Through forest treatments we can reduce fuel loadings so that natural fire might behave as a predictable beneficial disturbance in our forest communities.
We can follow-up our mechanical treatments with prescribed fire to mimic natural fire and further enhance our forest communities.

We understand that after 63 years of listening to Smokey the Bear, we'd like to see him walking around with a drip torch. Or maybe that's just me. Actually, Smokey's message is still clear: we don't want unwanted fire. But we now understand that fire is an integral part of our forest dynamics, and we must manage our vegetation with fire in mind.

And that leads me into my last topic, and one that kind of makes my brain hurt. You've all probably heard about fire regime condition class, or FRCC

FRCC is a way to measure the health of our vegetation with respect to fire. It includes the following measures based on natural cycles on the landscape:

Fire Regime is based on:
- how often a fire would have occurred
- what type of fire would have occurred

Condition Class is based on:
- species composition, structural stages, stand ages, canopy closure, and landscape pattern are functioning:
    1. within their natural range
    2. are moderately altered
    3. are substantially altered
- insects and disease are functioning
    1. within their natural range
    2. are moderately altered
    3. are substantially altered with higher mortality or defoliation

Poster 8:
The three FRCC classes are based on low, moderate, and high departure from the central tendency of the natural regime. Across the landscape, FRCC recognizes there should be all structural stages (and related characteristics) and some insects and diseases should be present.

What we've found is that some structural stages are **overrepresented** on the landscape, so are Condition Class 3, whereas other structural stages are **underrepresented** on the landscape so are Condition Class 1.

FRCC as a measuring tool can help us **monitor** quantities of structural and related characteristics