Ecol 199 Notes, 2/7/06
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Landscape Fire Ecology – a new field occurring in the overlap between landscape ecology and fire ecology. To be a new field, it needs to have emergent properties of its own. Elements of LFE – fire compartment size, ignition rate, impediments to fire flow (firebreaks, fire filters, bottlenecks), topography (land surface form, slope, speed), etc.

Map we received – shows different fire regions across US. In the SE part of NC, 1-3 year fire interval, but that doesn't mean the whole landscape burns at this frequency, just fire-exposed parts of the landscape. Need to look at topographic maps to see whether regions are fire-exposed or fire-sheltered. The Great Plains had a high fire frequency because it's a huge sea of grass; once, fire would start at the Rockies and burn 2 states over to near the Mississippi. By presettlement, this means pre-European settlement; the fire regions take into account burning by Native Americans as well as natural ignitions by lightning.

Lightning ground flash data – really high in the SE US. Highest south of NC; lightning gradient from Florida extending diagonally to the Pacific NW. The West Coast has lots more wildfires because of dryness; although ignitions are rare, when there is one, it will burn very readily.

In the original landscape, incidence of wildfires in the Appalachians of TN and NC – peak in April and May. Spring is fire season because there's a lot of dead fuel from winter, and there can be a dry spell sometime in the spring with the first hot days. Fire season happens earliest in Florida, then to Piedmont, and latest in the Mountains.

Uwharries are in the transition between Sandhills (1-3 yr) and Piedmont (4-6 yr) fire intervals. In the foothills of the GA, NC and VA mountains up to MD and the Hudson River Valley of NY, Native Americans did a lot of annual burning. Probably corresponds to the open savanna that was described by early explorers. The fire compartments might be bigger here than elsewhere in the Piedmont.

Magnolia and beech (also tulip poplar) found in the most fire-sheltered sites. These are indicators of no or light fire, like on north-facing slopes with swamps below (fire can travel up slope, but not as easily down slope).

Great Dismal Swamp NWR – fairly well fire-protected, but under severe conditions, the whole area burned because trees were roughly the same age. A sharp boundary between fire-frequent areas outside and to the west and north of the NWR, but then there's a sharp dropoff into a fire-infrequent zone. Fire is less frequent to the east of that zone than to the west and north of it.

Wet longleaf pine savannas – without fire, would grow up quickly to have trees and shrubs. With fire, is full of wildflowers, pitcher plants, and other rare species.

Ponderosa pine (Pinus ponderosa) – very abundant in the West – the western equivalent of the longleaf pine in the east. Very fire resistant. When they get to about 75 years old, they often get burned and scarred. The fire scars then are a good indicator of when fires were. Fire scar chronology can be done on 15-40 trees. Date all the rings – can go back to 600 years; scars will show up as black lines, or constricted rings. Have to use multiple trees because certain fires will miss some of the trees. People have constructed FS chronologies going back to 2,000 years or more. In the east, our climate is so humid that trees wouldn't sit for 500 years without rotting, and we also don't have trees this old because most of the east has been logged.

A lot of interest in reconstructing original fire regimes and vegetation – one reason is in understanding how these communities will be able to respond to global warming. Another is to restore communities to the natural state. Another comes from the graph of increased acres burned by wildfires. Fire control laws passed by individual states starting in the 1910's, then burned acres decreased until the 50's. However,

burned acres began to increase starting in the 1970's, despite more money spent on fighting fires. Peak of burning in 1988, and in 2000's, virgin stands began to burn. With 70 years of fire suppression, fuels have built up so much that everything burns when they do burn.

There is a federal mandate to figure out on all the public lands in the US what the original fire regime was. Three classes – 1 is pristine condition, 3 is how it's departed from that, and 2 is in between. The Croatan has really natural stands that have been burned very frequently. The woodlands have a 2-layer structure, common in naturally burned areas. Longleaf pine above, and herbs below. Very species rich – 90 species in a 10-ha plot (quarter acre). Forest Service decided to quit burning in wilderness areas, though they can put fires out. Apparently, the land is so fragmented that fires can't move through large enough areas. In one of these stands that haven't been frequently burned, shrubs are moving in, so herb diversity is going down, which is food supply for animals and affects RCW preference for habitat.

Pristine condition forest – species-rich, 2-layer structure. Fire-suppressed forest – species-poor (most diversity is in the herbs), and multi-layer structure. Also, a departure in fire frequency in the fire-suppressed forest. Fires used to be small enough that people could hop across the fire line, but now they rise so high due to so much fuel that people could get killed doing this. In these changed forests, shrubs have taken over and hardly even any grasses. A hot wildfire going through would kill even the fire-resistant trees.

As we work with others, we should teach them what we know about the fire regime since these are relatively new to ecology.

Venus flytrap (Dionaea muscipula) – a very fire-dependent species, so a good indicator species for places with 1-3 year fire frequency. Originally 21 counties in NC and SC where it was found. Now, only found in 10 NC counties and 1 in SC. All the NC counties are in the SE part of NC. In Beaufort county, only as many individuals as could fit on our table, so there's not that many there. Plants found with the Venus flytrap are often only found on the most fire-exposed areas of the landscape.

Shoestring Savanna, 1981 – longleaf pine savanna next to pond pine pocosin. In between, there's a sunny sandy zone where Venus flytrap and other rare species occur. Nature Conservancy monitors this area. They took a while to get their burn regime up to speed. In 1995, they did a prescribed burn. Went to resample the plots before the burn – saw lots of pine needles and matted wiregrasses, and thought the Venus flytraps were gone. However, there were some there, but they were extremely tiny. Need an annual fire frequency, but without this (4-6 yr frequency instead), they grew really small (smaller than a dime).

Venus flytrap is more abundant if mean fire interval is less than 3 years. Longer than 4 years and they die out – this is mean fire frequency. The flytrap is an ancient species. Grow in very nitrogen-poor environments, so need to eat flies. Have 3 trigger hairs on each leaf surface – fly has to touch 2 in close succession, not 1, or 2 in long succession. Took a long time to evolve. The flytrap is a good indicator of lightning-driven fires going back for millions of years. Back to the Devonian, there were fire-scarred tree trunks.

How is it possible to have such frequent fire intervals in nature? A fire compartment is a unit of the landscape with no internal firebreaks and fairly continuous fuels so that if an ignition started in one spot, the entire area would likely burn (unless it rained or something). One side of the river – 10 100sqm plots; on the other, 1000sqm plot. On the more fragmented side, the best we can have is a 10-yr fire interval if we had random lightning strikes – 10 ignitions in 100 years; a 10-yr interval in any one of the 10 plots. However, in the larger plot, we would have a 1-yr fire frequency if there's 100 lightning strikes in 100 years.

When plotting the location of Venus flytrap and Lissa machia in SE NC, did 200 random ignitions in 100 years, then calculated where fire compartments were, and found that these two species were all in the largest fire compartment. In reality, there are 232 fire compartments, and 229 populations of Venus flytrap ever known, in the SE NC landscape. 220 of those populations occur in the largest fire

compartments of the landscape, adding to the validation of the model. The mean size of the plots with flytraps was 1560 sq km, whereas the mean size of the plots with no flytraps was 83 sq km, showing a huge difference in size. In Fort Bragg, there are some populations due to frequent fires from white phosphorus and ordinance burns. These areas have some of the most diverse plant life due to this.

Lightning ground flash data map again – the red pixels indicating 8-16 lightning strikes per year are in Florida, and there are also some in the Dismal Swamp area between NC and VA too.

Canebrake, a fire frequency indicator community – a dense stand dominated by cane. Indicates a fire frequency of 2-8 years. If it drops below 8 years, it gets dominated by woody things, like trees in pocosins. Canebrake community has pond pine and cane dominating the community. With frequent fires in wet soils, almost always pond pine. In drier soils, can have natural mixtures of longleaf (and sometimes loblolly) pine with pond pine over cane. Just 6 weeks after a spring wildfire, cane gets knee high and even waist high at times. Historical maps of canebrakes gives a hint of a 2-8 yr fire frequency.

Second prescribed burn at Mineral Springs Barrens – the first burn helped to perk up the grasses. It was a shortleaf pine savanna – just as fire dependent as longleaf pine, but shortleaf pine tends to colonize old fields more readily. Doing better than longleaf pine, which has only 3% of the original range left.

Georgia aster (Aster georgianus) – occurs in sunny oaklands. Indicates a 4-6 year fire interval.

Schweinitz's sunflower – hangs on at the edges of woody stands with sunny gaps. Don't really have any good areas in NC or SC where we can see what these original woodlands were like where they used to live. Really need a poster child for the original Piedmont prairie, which could be somewhere in the Uwharrie.

The majority (over 50% of the endangered and threatened species in the SE) are imperiled because of fire suppression. About 62% of the rare species in NC are fire-dependent species. The animals that use such species for food are also imperiled. It isn't in the public domain of knowledge that the main cause of this rarity is fire suppression.

15 mile long fire compartment at Mineral Springs (5 miles wide). In the Piedmont area. As we head toward the foothills, topographic effects decrease fire compartment size. If the prevailing winds are heading east, the eastern part of the fire compartment should have more frequent fires, given random lightning ignitions all over the site. However, the western edge with fewer fires may have larger fire loads, so fires could burn more intensely. Can predict where rare species will be based on landscape fire ecology, but can't do that from geology alone (geology yields lots of noise). The rare plants are found to the east, near where there is an opening in the fire compartment where fires might start from another compartment.

Evaluating firebreaks and fire filters – qualities of channel, floodplain, floodplain litter fuels, shrub layer fuels, and side slopes, and continuity of firebreak. A canebrake fire will routinely jump since it creates little bits of burning material as it burns that can spread to surrounding areas.

Other evidence for original fire regimes are historical – witness trees and vegetation types on early survey maps; historical herbarium records of fire frequency indicator species; historical references to use of fire by Native Americans; original NA population centers (wherever they were, they tended to use fire), and vegetation types on old aerial photos.

Could be hard to approximate the NA population in different areas because of disease spreading from as early as the 1500's – in some cases, populations would die out before explorers ever reached them.

Early historical land notes – in GA, they made a note of what was on the land, like "pine land," but they didn't describe what kind of pine it was. Still, we can find out what kind of pine it was based on the soil type. Also denotes timber swamp followed by cane brake to the east, and pine land farther to the east –

shows that the fire frequencies were different in these different areas. The pine land had a more frequent fire interval than the cane brake.

Dare county historical aerial photos – lots of peat lands there; whitish areas are cane brake. Can do a lot of interpretation from early aerial photos.

Near the Uwharries – bottomland forest surrounding a longleaf pine stump boxed for turpentine. At a minimum, 65 years old (WWII put an end to turpentine production from these trees). Tells us that there wasn't enough fire for the longleaf pine to regenerate, and to allow the bottomland forest to take over.

Fire suppressed longleaf pine near Roberdo in the Uwharries – just a few herbs like bracken fern; otherwise, most of the species diversity is gone.

Mixed pine savanna – Pleasant Grove tract in the Uwharries – quit doing burning because it was near a house and church.

Blackjack oak woodland with fire has lots of herbs; without herbs, just leaf litter.

Post oak savanna – lots of grasses growing beneath; very beautiful.

In the 1770's, most of the Uwharrie area had been settled; the rest didn't get settled until 1810. Most of the area was still virgin timber as of 1840, when naval stores production reached the area. Sawmills were a little more widespread in 1840, but not in the Uwharries because there was no way to transport lumber out of the area. Rivers weren't big enough, and railroads took a while to get near that area. Many virgin stands persisted into the 20th century. In 1884, Sargent mapped longleaf pine for NC, showing lots of it in the SE part of the Uwharrie. Loblolly pine was almost absent from there in 1887 (Pinchot and Ashe). Shortleaf pine in 1897 – showing lots of shortleaf pine in the Uwharries. Nearly as fire dependent as longleaf pine.

Fire compartments get larger near the coast and smaller near the Uwharries due to topography. The big fire compartments in the Uwharries are in the SE (where lots of longleafs are), but are smaller near the river due to topography and rivers/streams. This hand-drawn map of fire compartments shows a gradient from SE to NW in the Uwharries. From 1-3 yrs in the SE to 5-7 yrs in the NW – more Quercus montana and other trees.

7:30 AM-6:30 PM this Saturday – field trip to the Uwharries.