Changes in Fuels Across the Western Juniper and Pinyon-Juniper Successional Gradient and Implications for Effective Use of Fire Treatments

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Genie MontBlanc: Hello, everyone, and thank you for joining us today. My name is Genie MontBlanc. And on behalf of the Great Basin Science Delivery Project PIs, Mike Pellant from the BLM, Jeanne Chambers from the Forest Service Rocky Mountain Research Station, Brad Schultz from the University of Nevada Cooperative Extension, Randy Sharp from the Forest Service, Beth Leger from the University of Nevada Reno, and Kurt Pregitzer from the University of Idaho, I would like to welcome you to this webinar on Changes in Fuels Across the Western Juniper and Pinyon-Juniper Successional Gradient and Implications for Effective Use of Fire Treatments, presented today by Steve Bunting from the University of Idaho.

Before we begin, I would like to let you know that our next webinar is scheduled for March 21st. The topic is Conservation Issues Related to Sage Grouse and Other Species and Approaches for Prioritizing Management, and will be presented by Steve Knick with the USGS Forest and Rangeland Ecosystem Science Center.

01:04 If you have questions during the presentation, you may type them in the question box at any time. I will field the questions to Steve Bunting after his presentation. If you have questions specific to me, I can type responses during the presentation.

If you are a returning webinar attendee, I thought I should let you know that the Wildland Fire Lessons Learned Center finally changed the account holder name from 'Paula Nasiatka' to 'Wildland Fire Lessons Learned Center', which in the case of today's webinar is me. So if you type me a question and you get a response back from Wildland Fire Lessons Learned Center, that's me.

Let's see... On Friday, the GoToWebinar system will automatically send you a link to the recording of this webinar, and it will also be posted on our website. And I also wanted to let you know that past webinars from our project, as well as from other consortia within the joint Fire Science Knowledge Exchange Program, will be posted on the FRAMES website within the next few months. And I'll send out an email on the LISTSERV when that happens. And please feel free to email or call me any time with additional questions or comments.

02:13 Without further ado, I would like to introduce our presenter today. Steve Bunting is a professor of Rangeland and Fire Ecology at the University of Idaho.

His current research addresses sagebrush steppe and western juniper woodland vegetation at widely varying scales from individual plant response to watershed scale effects, and has utilized both wildfires and prescribed fires. The overall goal of the research is a better understanding of the function of disturbance, and particularly fire, in the dynamics of rangeland ecosystems.

Thank you for being here today, Steve.

Steve Bunting: I'm glad to be here.

Genie MontBlanc: Great! I'm going to now switch you over to the presenter. OK!

03:04 **Steve Bunting:** And now I can show my screen?

Genie MontBlanc: Yes.

[Pause]

Genie MontBlanc: So right now we see the launch software window.

Steve Bunting: OK. I'm already launched. Do I...

Genie MontBlanc: Let's see... Can you click on the... Down below it, there's a little tab. Can you click on the PowerPoint tab... maybe? Ah! There we go. Great!

Steve Bunting: OK. I think we're ready.

04:00 OK. Well, most of us are familiar with the encroachment of juniper and pinyon-juniper into adjacent vegetation types throughout the Great Basin, so today we're going to talk about some of the implications of those changes in terms of fuels.

Again, as probably many of you know, we have seen this encroachment reflect itself in two ways. One is action and expansion of juniper into what was formerly other kinds of vegetation, as illustrated by this pair of photographs from New Mexico.

And another kind of change that we have seen throughout much of the Great Basin is an infilling of where juniper was in the past but the stands have become much denser, as these photographs from Colorado. In this case, the expansion actually hasn't increased the area. It just increased the density of trees in those areas that were formerly occupied.

05:09 And this pair of photographs here indicates how quickly this can change. Once the juniper has become established, they often occur on the sites for quite a while as small individuals. Often this is 40, 50 years. And then once they become well-established on the site, they go into a rapid growth phase where the characteristics of the vegetation can change quite rapidly.

And this photograph here indicates one of those areas that is currently undergoing expansion of, in this case, western juniper into mountain big sagebrush. As we see in the background, a much older stand, and in the foreground, the younger stand that's becoming established into the sagebrush steppe stand.

06:04 The line going across through here is actually the edge of an old fire perimeter that occurred in the area probably 40 or 50 years before the photograph was taken. And again, this change from sagebrush steppe to western juniper, in this case, has some dramatic effects on the fuel-loadings that are found within these stands, as illustrated here by this Phase 3 stand of western juniper.

And when I refer to Phase 1, 2 and 3, that's in reference to Rick Miller's 'Stages of Juniper Encroachment'. And for those that were present at his webinar about a month ago, he discussed those extensively.

And I'll be drawing a lot upon the Sage Steppe Project, which is looking at both sagebrush and woodland sites throughout the Great Basin and also some areas that are dominated by sagebrush and perhaps cheek grass. Today I'll be focusing only on the woodland portion of the sagebrush woodland network.

07:24 And there actually occurs three general types. We have western juniper up in the eastern Oregon/southwestern portion of Idaho, we have the single leaf pinyon one-seed juniper, which occurs throughout much of central Nevada, and then the Colorado pinyon-Utah juniper, which is in our... within the network occurs mostly within the state of Utah.

And just some examples of these three phases I will be referring to throughout the talk, here are some examples from different locations within the network showing some of the structure of these vegetations in this earlier stage of juniper or pinyon-juniper encroachment into the stands.

08:14 In all cases within the study, the encroached vegetation is some sort of sagebrush steppe, and then for the most part it is mountain big sagebrush.

Here are some examples of Phase 2, a portion of the encroachment process. And you can see that as the trees become larger, it starts to have greater and greater impact on the previous vegetation. And so we start to see a thinning of the sagebrush and also a thinning of the understory herbaceous layer, which has tremendous influence then on the fuels on that site, which we're going to focus on in this webinar.

And finally, here are some examples of Phase 3. You will notice, by this time the woodland really is dominating the site and we have lost much of the former sagebrush steppe component from these sites.

09:15 Well, what does this mean in terms, then, of fuel-loading? These are from our sage steppe sites. And across the bottom you can see we have the three different regions that we've talked about, and then the three phases within each of those regions, and then the fuel-loading, etcetera associated with those different sites we found across the Great Basin.

And if you look at that, we see very, very characteristically... we have this decrease in the live herbaceous component, and certainly in this kind of vegetation, this is a very primary fuel in terms of allowing the fire to perpetuate across the site or across the landscape. And obviously, as we have decreasing amounts of live herbaceous fuel, the bad herbaceous fuel also decline very consistently.

10:14 And switching to the woody fuels, we see the same kinds of trends. This is the sagebrush component. It's also declining as this increase in Juniper expresses itself on the landscape, and of course with that, then we get an increase in the total woody fuel component.

It's interesting that throughout this encroachment process, if we look here in the bottom portion of this right-hand set of bar graphs, we can see that the 10-hour portion really doesn't change a great deal.

And that's fairly consistent with lots and lots of sites. Most of that size class is still living material, and it's not until we get into the later stages of very mature woodlands that we start to see an increase of this portion of the fuel complex.

11:15 Now Maryknoll, in their publication from 2005, talk about the encroachment process and showing the increase in juniper and the subsequent decrease in shrub component within these sites and also the relative growth rates of juniper. And you'll notice that at the junction of Phase 2 and Phase 3, they have a threshold indicated.

And the threshold generally is that portion of this process where things start to change. And I like to think of it as kind of some of the ecological rules and the games start to change. And we see here that, for instance, relative to the juniper growth rate, they really slow down.

12:01 And this also shows where prior to that stage we could look at restoration of these sites back to the flower vegetation. They actually prevent the establishment of the woodlands where at Phase 3 we're looking more at a restoration mode.

And so we have this threshold. I'd like to talk a little bit today about whether or not we have a threshold related to some things related to fuels and fire behavior that occurs more or less the same in this same zone, this junction between when the site passes from a Phase 2-type of stand to a Phase 3-type of stand.

And so how, then, does this encroachment really affect the fuel load and, consequently then, fire behavior? These data are from some of our work in the Owyhees, and in here we actually include fuel-loadings from just pure sagebrush steppe and also looking at the mature woodlands.

13:06 So we're looking at the whole successional sequence if we were to think very long-term from an area being dominated by sagebrush steppe going through the three different phases of woodland development, and eventually, given enough time, become a mature woodland.

And then in our area that we've been looking at, this process probably takes several hundred years to go from sagebrush steppe into a mature woodland, and we can see the changes in the fuel complex then as it goes along this gradient.

Some things to note is that at the top, we have this change really of this line up here where the herbaceous and the finer fuels start to decline, and up to this part in Phase 2, and then we start to go back up. That's mostly a result of the portion on the left. They are primary those fuels associated with grasses, forbs.

14:04 As we get into the later stages, we start getting more and more woodland developed that we start having more tree litter fuels that are contributing to this. But if we look at the dash line below that, the herbaceous line continues to decline throughout most of this process as it develops into mature woodlands.

Same kind of thing happens with our 100-hour fuels. Initially, we have most of the area... these fuels are contributed by the stems of sagebrush. Sagebrush, as you saw in the photograph, declines in those stands. And then later on in this successional sequence, we start having this class of fuels being contributed mostly by the tree component.

If we look at how, then, taking some of these fuel-loadings and putting them into a fire behavior program such as BehavePlus, we get these kinds of results.

15:01 Now I should emphasize that these are for moderate fires, or fires burning under moderate conditions, and we're modeling the surface fire. And so you can see that as we go through this

successional sequence, we get decreasing fuel bed depths and decreasing flame lengths that are produced under the same fire conditions. We used the same identical weather conditions in order to model these fires.

So what we find is that at a time when our flame lengths are decreasing as succession occurs, we also have increasing tree height. So we're finding it more and more difficult then to get an adequate scorch as we go farther into the encroachment process, adequate enough to kill the encroaching trees.

16:03 Well, it certainly is happening more than at the site level; it's happening fairly broadly. And this is one of the watersheds that we've been working in extensively. And we can see here that the dark green areas are the western juniper woodland stands of the later stages of encroachment, plus the mature woodlands. And we can see how greatly they have increased on this landscape in the past 100 years, and if we roll back time to 1800, even more so.

So we have the 1800 juniper stands that are indicated there, really the ones that are very, very old stands. And so everything else and the subsequent ones are relatively recent, at least in terms of the development relative to the ages needed to develop mature western juniper stands.

So how does this affect at the watershed level that really translate back to the kinds of things that we might see related to fire behavior?

17:08 In order to test this, we used FARSITE. And so we put in many, many fires. Several hundred fires we burned in FARSITE where, again using identical weather conditions, we let these fires burn for six hours. And we ignited those fires within areas that were 90-by-90-meter polygons of different phases.

And so we would then take the results after six hours. We would take the end results and compare then to the size of the fire to the percent of some of the earlier stages of succession, the shrub, the grass, and in some cases we had meadows included in there as well, and you can see that, certainly, as we have an increase in those vegetation types, we get an increase in fire size.

18:11 But our relationship was really very poor. We had an r-square of only 0.13. And so lots and lots of variation within this and really low predictability.

So it was curious that even at relatively high amounts of these, what we consider to be the most flammable vegetation types, we still had a lot of variation in terms of the fire size that we saw produced by these Behave-modeled fires.

However, we looked at the abundance of the late succession stages. Once it's phase 3, then the mature woodlands, we get quite a different picture. At a much higher predictability, an r-square of 0.76, and much less variability. And it seemed to indicate to us, and I think it was confirmed by our observations of fires, that really it's these later stages of the Phase 3 and the mature woodlands stages that really control how fire occurred on the landscape.

19:23 So we generally find increasing amounts of the advanced juniper woodland stages then, it reduced our flame length, it reduced our scorch height, rates of spread were down, and the fire size was down.

Well, this led us to think now this previous work only looked at the amount of different stages that were present on the landscape at the time the fire was modeled. So our next question really from that led to, does the arrangement or the pattern of these stages on the landscape make a difference?

20:02 So we get some other work related to that where we then modeled again fires within a landscape and many of these fires to see how these fires would burn. And we used a very similar approach.

This is one of our watersheds again. It's the Smith Creek. And within that, we used three watersheds. Within each watershed, we randomly ignited 100 fires. They burned under identical weather conditions for six hours.

After that was done, then we looked at how many times and individual places had burned within this watershed. And that's what this map on the right-hand side is showing is that how many times after these hundred fires were out there and burned for six hours, how many times that an individual place burned.

21:03 And so then we took locations of a particular phase and we looked at then how much fire occurrence was at that location, and then we quantified using some landscape ecology metrics the pattern of a 450-by-450-meter area around this location. And then of course, as shown here on the left-hand side, we had these areas scattered throughout our whole watershed.

And if you remember back to the first one, we had relatively high occurrences up in the upper right-hand portion of the landscape. And we can see in this map, then, that this was an area that still had a lot of sagebrush in the earlier stages of the encroachment on it.

22:10 But embedded within it were also very, very old stands. And in fact, we had some very mature stands of juniper that were scattered in this portion of this watershed.

In the lower left-hand corner was much more dominated by the later stages. And it's kind of a reverse situation where we had mostly Phase 2, Phase 3 mature woodlands present in there and the early stages Phase 1 sagebrush steppe were embedded within this woodland matrix.

What we found was that the strongest relationships, the most consistent relationships were found with the distribution, again, of these Phase 3 mature woodlands, and that fire occurrence was possibly related to such things as patch density, Simpson's landscape diversity, Simpson's landscape evenness.

23:02 And all of these, then, as these were changing to becoming more and more dominated by juniper, what we find is that we're having a landscape, a watershed that is becoming less and less heterogeneous. It's becoming more and more increasingly dominated by these later stages, and they're affecting these landscape metrics in this way.

And with that, of course, is that in the early stages the patch areas of any type were generally pretty small. But as the patch area increased, and that increase was usually reflected in greater and greater abundance of these later stages of juniper encroachment, we would find that fire occurrence was certainly negatively related to these increases of the patch area.

24:10 Now, in 2007, the Tongue Complex fire burned, and this is a fire that burned under very, very high temperatures, low growth of humidities, very high wind speed, and burned across this

portion of the Owyhee Plateau. Well, this in some ways was fortunate for us because one of our watersheds, Red Canyon Creek, was mostly burned by this wildfire.

And we had 152 sample plots that had been sampled prior to the fire. Now, not all of these plots burned, but about two-thirds to three-fourths of them did burn under varying times. This fire burned for several days under varying conditions.

25:05 So we had this opportunity, then, to look at the effects of fire in this area where we had lots and lots of pre-burn data. And it's something that we often don't have a chance to have because we don't know where the fire is going to occur. We don't generally have very often very much data collected before these intense wildfires occur.

And as one would expect, it burned under varying conditions. It was a very, very hot fire in general but it burned under differing conditions depending upon the fuels and the time of day and slopes and aspects, as we often see.

And so in this photograph here, the portion in the foreground was mostly sagebrush steppe in Phase 1, and as we get back onto the ridge below, we see this mosaic or what was a mosaic of the different phases of the more advanced encroachment of western juniper within this watershed.

26:08 Here's in the older stand. This was what was a very mature old stand of juniper, and this is now the end of the first drying season. So these old stands burned very, very intensely.

And it's kind of interesting when you're out there to see how the fire burned across this landscape in that many times it seemingly selected out these old stands and burned them, and in some cases even the inner spaces between the old stand which in sagebrush steppe or something else were not burned.

And apparently what happened, in talking to the people that were on that fire, is that we would have these patches of very, very old trees would ignite. They would send off a shower of embers that would land in adjacent patches of old juniper, probably land down in the litter and duff beneath them, and eventually they would develop into and set off, torch off another stand, which would then send up another shower of sparks. And so it progressed across the landscape in this patch and in some of these areas that were dominated by these very, very old stands.

27:27 By the end of the second year, long after the fire, things were starting to come back a little bit. These are mostly annuals coming in, and for the most part in this area they are native annuals.

Areas that were in earlier stages such as this, they had a much greater survival of the species under and certainly between these juniper trees, and so the response here of these areas was quite different.

28:09 So again we looked at an opportunity of say how can we predict what the severity was? Are we able to do that?

So we went in, we used the relative differenced Normalized Burn Ratio, the RdNBR, and looked at it in two different... since we had two different very prominent vegetation types. We had western juniper in areas that had low sagebrush associated with it and we had western juniper in areas that had mountain big sagebrush associated with it.

And so the line at the top is the calculated RdNBR values. And you can see the fire severity, as this is our successional gradient here at the bottom, and our fire severity increased as we went to later and later stages of this development. And that is true for both the areas that had low sagebrush or mountain big sagebrush on them.

29:18 Now an interesting thing that we found the first year is that with the mountain big sagebrush, we had this dip in fire severity at this Phase 3. And there's an example in the lower portion here of one of those kinds of stands.

And people who have done prescribed burning in this vegetation realized that this was one of the most difficult stages to burn. As we have lost the encroachment, has resulted in a fairly continuous overstory of woodland, we have lost most of the herbaceous component of the former sagebrush steppe vegetation, and that, associated with the mature woodland, really hasn't had time to burn yet.

30:09 And so we had the stands, like we could see in the lower here, that have very, very little in terms of one-hour, 10-hour fuels present and are extremely difficult. And this was born out of, I think, by this decline in severity at this stage.

The next-line stands show the one- and two-year post-fire estimates of severity. And you could see in both cases, there's a fair amount of recovery that has happened within this time period, but certainly during these earlier stages of sagebrush in Phase 1. During that period, this area has recovered a great deal already in this time period.

And then going back to my earlier point of looking for this threshold where really in Phase 3 we start to see a very, very different kind of fire that occurs on the landscape, and it has much different kinds of effects than we see in the earlier stages of juniper encroachment or in sagebrush steppe stands.

31:21 Now in the Owyhee Plateau, and in fact much of the western juniper woodland, we don't have these situations that occur very commonly. Certainly cheek grass is present throughout most of these areas, but it comes in and with disturbance and on bare areas and tends to be replaced successionally by something rather quickly.

However, as we get farther south in the Great Basin, we have areas that when it gets into this cheek grass understory, they are suddenly burning and re-burning over and over again just like we often see in sagebrush steppe. And so we can get into this cheek grass cycle in some of these areas in the same way.

32:05 And of course, the fuels in this are quite different than the natural fuels. We have the cheek grass understory, which is a very fine fuel. It cures out very quickly so we have a very, very long time period during the summer season when this fuel is quite capable of burning across the landscape.

Now, many people are interested in looking at fuel treatments, and one of the parts of sage steppe that we're investigating is what the effects of these different kinds of fuel treatments are.

So within the sage steppe, we are looking at two different kinds of treatments across the entire network, and that's prescribed fire and mechanical removal with chainsaws of the overstory juniper. In the Utah portion, we're also looking then at the influence of the bullhog as the

approach to treating these woodland fuels.

33:15 This is not as complicated as it might seem initially if we just look at the red areas are those areas where our treatments resulted in a decrease. And you can see that within most of the decreases, and these are two years post-treatment effects, most of the decreases then fall in burning are in the areas that we prescribe-burned.

The chainsaw, the mechanical treatments generally resulted in increases of different kinds of fuels, both the herbaceous and the woody fuels. And that makes sense if all you're doing is knocking down or killing the overstory, you're going to increase certainly those kinds of fuels on the landscape.

34:13 Just a couple of photographs of the chainsaw treatment. This is from Phase 3. And certainly this mechanical chainsaw treatment in Phase 3 will increase those fuels much more than the earlier phases.

And as indicated here in this graph... now this shows the different size fuels, 10, 100 and 1,000 hours, and their relative amounts in the control plots and in the treated plots.

Again, we can see, as we get to later and later stages of this encroachment, we're going to get greater and greater amounts of these three types of fuels created by our treatment from these mechanical treatments.

35:01 These photographs show areas that had the bullhog treatment. Now again, this was only done on the Utah sites. And we get some interesting results from those. Again, with treatment, we get increase in 10-hour, 100-hour, 1,000-hour fuels, but there is a difference between the chainsaw and the bullhog in terms of those fuels.

And in essence what is happening is that the bullhog is different in the sense of how it changes not only the size classes of the fuels as it goes through this machine but also the distribution of these fuels, so it becomes much more compacted on the ground and tends to be taken down to smaller-size classes than cutting below.

36:00 So then in summary, we can look at some things related to individual sites, and in general we find that the woodland development results in a decrease in herbaceous fuel-loading and... let's see what... and an increase in the woody fuel-loading And of course that makes... Something happened here. Oh, there we go.

And the changes in the relationship of fine and woody fuel-loading reduces the window of environmental conditions, under which the site will burn, and particularly under the more moderate conditions. And as we go to the more and more extreme conditions, areas become less and less sensitive to this I believe.

37:01 Prescribed fire is particularly more difficult to perpetuate in the later stages of this as it develops. And wildfires, when they occur in later stages, tend to be more intense and usually more severe.

Looking at the landscape scale, when some prints that developed there with woodland encroachment, you have juniper. And juniper woodland development tends to reduce the heterogeneity of the site. We saw in some of those illustrations that I've provided.

Under low to moderate burning conditions of the reduced landscape heterogeneity, an increase in woodland dominance then tends to reduce fire size, flame length, rates of spread, and fire intensity. The landscape spatial pattern, particularly that of Phase 3 in the mature woodlands, then influences fire occurrence more than that of the early woodland developmental stages.

38:05 Well, that concludes the kinds of material that I had planned to present. I'll just end with this slide here that shows some of the upcoming courses that will be available online at the University of Idaho, and it's part also of this Great Basin Science Delivery Project. So if you're interested in any of those, you can contact me or contact these websites indicated here for these individual courses.

Genie MontBlanc: Thank you, Steve. I will now field the questions for Steve. So please type your questions in the question box and I will do my best to pronounce your name correctly.

The first question is from Louisa Evers, and Steve, I believe this is in reference to that slide of tree cover through time. And it says, "What process was used to estimate landscape composition in 1800?"

39:09 **Steve Bunting:** Well, what we did is we went in... It was kind of a long, involved process, but we went in and we classified the current vegetation within these watersheds.

So we took the watersheds into these classes, and then we went in and sampled the individual samples of these different types of classes and essentially developed a demographic profile of what the typical stand within that class looked like. And then by using drilling, taking increment cores of trees, we were able to age the individual trees within that demographic size.

40:01 So then we were able to roll succession back and say, "Well, 100 years ago, these individuals would not have been present in the site, 150 years ago, these individuals who have not been present in the site," and so on. Certainly we feel pretty comfortable about the 1900 composition. As we get back to the 1800 composition, lots of things can happen in 200 years.

And so we had a new type that appeared that you may have noticed that was... we weren't exactly sure if it was... it could've been either sagebrush steppe or very early stages of woodland development present at that time. But one thing that we did know is that we did not have the later stages Phase 3 or mature woodlands present in 1800 on those sites.

Genie MontBlanc: Thank you. The next question is from Renz Marquez. I believe this is referring to the slide talking about the factors that affected fire occurrence. And it says, "Fire occurrence: starts or size?"

41:15 **Steve Bunting:** The fire occurrence, there was... If you recall, we had a hundred random starts within the watershed, and then we modeled their burns for six hours. So then we superimposed all of these burned areas over the top of one another and essentially did a frequency of occurrence of a point-by-point or pixel-by-pixel base.

So the map that you saw of fire occurrence shows how many times that those areas burned with these 100 random starts within this watershed. So the fire occurrences are actually areas that burned and not just starts.

42:04 **Genie MontBlanc:** OK, great. Thanks. The next question is from Louisa Evers. "Did you

look at more severe burning conditions? If not, why not?"

Steve Bunting: I'm not sure if I understand... 'look at' in what context?

Genie MontBlanc: I will wait until she can type up some more detail, and I'll go on to the next question. From Matthew Reedy, "What percent of the 1800 landscape was described as mature woodlands?"

Steve Bunting: I believe that in the three watersheds that we had, we had around an average... well, actually that portion had four watersheds, and we had an average of about 15% of those four watersheds had mature woodlands on it.

Now, it varied quite a bit. The Smith Creek that I showed probably had the least, and interesting, Red Canyon, which you didn't see the map of, but Red Canyon, which is right adjacent to it to the west, had some of the most mature woodlands were the most in there.

43:26 **Genie MontBlanc:** OK. Thank you. Let's see... I don't see Louisa's follow-up. Again, our question before said, "Did you look at more severe burning conditions?" I don't know if you want to try to answer that?

Steve Bunting: I could try. Generally we have had very few fires actually in the Owyhees and this Tongue fire is the only fire that burned under severe conditions since I've been working down there, and I've been working down there now almost 30 years.

44:05 But that was a very, very severe fire. What we don't have probably represented in our data from down there are wildfires that burn under kind of the moderately severe conditions. The low ones, the very low severity ones, those tend to go out, remain very small. Well, they may be the severe locations where the trees burn, they're certainly not very extensive. But we don't have very many fires in between this very, very severe fire that the Tongue fire was and the very low-severity fires.

And when we have lots of information from prescribed fires. We've been doing that a lot down where we were, and so we have a lot of information on very low severity prescribed fires.

Genie MontBlanc: OK. You know what, her follow-up did actually just come through, and it was, "Did you conduct the fire behavior, fire effects, and fire size burn probability analyses under more severe conditions than low and moderate burning conditions?" But I'm guessing that's not the case.

45:11 **Steve Bunting:** That's not the case, no.

Genie MontBlanc: OK. All right. Our next question is from Dexter Dong. "Do you think that expansion of PJ woodlands has ceased for all intents and purposes and that the primary vegetation change is now the transition into Phase 3 development and the canopy closure?" That's the first question.

Steve Bunting: OK. That varies a lot from location to location. In some places, I think it has pretty much occupied the area that it potentially will occupy, and as you say, the changes that we see now will be just the aging of those stands. In other locations, the expansion of the woodland is still occurring, and some of that probably has to do with how much woodland

was in the area at the time.

46:05 Certainly, as you get more and more woodland in the area, especially as it is dispersed across your landscape, you have a lot more uniform seed source. And so the encroachment will happen much more rapidly than if you have a landscape where the mature woodland tends to be much more contagiously distributed within the landscape.

There's also some places that have had... just the past land-use history had a big effect on how much wood is out there and how many trees are out there, and certainly the areas that were within the areas affected by some of the mining industry activities. They actually went through, and we have some places in the Owyhees where we can see that photographically is that with the increase in the mining activity, we actually saw a decrease in the amount of woodland around those areas.

47:08 And then with the decline of the mining activity, we're seeing now a re-development of woodland back onto these sites. So both some of the historical human effects as well as some of the other more natural ecological effects really make this quite variable across the Great Basin.

Genie MontBlanc: Thank you. Next question is from Alicia Reiner. Hi, Ally! "What fuel models did you use to model fire behavior in sage/PJ in FARSITE?"

Steve Bunting: We developed our own models for those. So we sampled the stands and developed our own custom fuel models to run these with.

Genie MontBlanc: OK. Thanks. Another question from Dexter Dong. "On the Smith Creek Watershed, how did you interpolate the map back to 1800?"

48:08 **Steve Bunting:** We interpolated that back, again, by looking... we classified the composition at the... I think we used a, right at that time, 1989 Landsat image. And so we classified that into these different phases, and then we used the demographic data that we had for samples of that stage to give us an idea of how old the typical Phase 1, Phase 2, Phase 3 mature woodland had been on the landscape.

And so then we could kind of roll back time, as it were. And so Phase 1, it generally lasts on the landscape for maybe 50 years or so. So once if it was in Phase 1 in 1989, we knew that more than 50 years ago it wasn't there. It was probably sagebrush steppe.

49:08 And so that's how we used the classification that we had and the demographic information and the age structure of those classes to roll the clock backwards, so to speak.

Genie MontBlanc: Great. Thanks. Next question from Renz Marquez. "Why only six hours? In my experience, it can take several days for a fire in Phase 3 juniper to begin to establish and begin to exhibit the type of behavior you described, i.e. torching and spotting."

Steve Bunting: We used six hours because we wanted the fires to not exceed our landscape. These landscapes that we were working in were approximately 15 to 20 square miles, and we did include a large buffer zone around the watersheds. But we only ran them six hours because we didn't want the fire to run out of the landscape.

50:18 **Genie MontBlanc:** Great. Thanks. Next question from David LaChapelle. "Did you do any

comparison on the impacts to soils between the phases and treatment methods?"

Steve Bunting: There is research going on within sage steppe looking at those effects on soils, yes. I am not personally involved with that, but there are some other folks who are working on the effects of our sage steppe treatments on soils.

Genie MontBlanc: OK. Yeah and David, if you send me an email, we can put you in contact with the people who are doing that, or you can look on the sage steppe website as well.

51:04 OK. Last question, from Dexter again. Oh, not last question. Hold on. Let me get this girl up here. OK. "Could you explain how flame length decreases as PJ woodlands mature but fire severity increases?"

Steve Bunting: The flame length portion was related to surface fires, so that graph was looking at surface fires and not ground fires.

So generally what happens is that surface fires become less and less prevalent, and in fact the fires are burning through... if they're going to perpetuate, they jump from the surface into the grounds. And so then that is an entirely different kind of fire and has very, very long flame lengths, and they burn very intensely.

52:02 So, really, those are two different kinds of fires that I was talking about. One, the graph showing flame length was related to surface fires, not to the ground fire.

Genie MontBlanc: Thanks. The next question, from Louis Provencher. "Were mature woodlands true woodlands on unproductive soils or very old encroachment? True woodlands have a lot of grass and shrubs in the Great Basin."

Steve Bunting: Within most of the areas I've been, you have both kinds. The typical thing that we often think of is that these mature, older woodlands are in these fire-safe sites often protected by some kind of rocky outcrop or something like that. And the soils and the site conditions can be quite different in those areas.

53:03 But we also have areas that for no reason we can have some very, very old woodlands that sit out in the middle of these sagebrush steppe areas. Or in some cases we have a lot of these rims that go around these old lava flows, and up on top we have a pretty well-developed site. But the site is protected from fire by the adjacent topography around it.

So we have both kinds of situations certainly within the Owyhees and I think most of our juniper woodlands where we can have these woodlands that are very, very old in some arid locations where we have good soils and much more productive understories. In some cases, they may have, and still do, almost have a savanna or a shrub savanna kind of appearance to them.

Genie MontBlanc: Great! Well, that was the last question.

54:02 If you think of more questions after the fact, please email me or Steve and we'll do our best to get back to you on a timely manner. And if you have a burning desire for a webinar topic that has not been addressed, please send me your ideas.

Thank you very much, Steve, for your presentation today. And thank you all for your

participation. Have a great day!