Conservation Issues Related To Sage-grouse, Prioritizing Management

---

Genie MontBlanc: Hello everyone thank you for joining us today. My name is Genie MontBlanc and on behalf of the Great Basin Science Delivery Project PI's, I would like to welcome you to this webinar on Conservation for Sage-grouse and Approaches for Prioritizing Management presented by Steve Knick from the USGS. Before we begin, I would like to let you know that our final webinar of the season will be on Vegetation Resistance and Resilience and it is presented by Jeanne Chambers.

This webinar will be held sometime during the middle of next month and I will send an announcement to our listserv when the date is set. If you have questions during the presentation today you may type them in the question box at any time. I will field the questions to Steve Knick after his presentations.

Steve will have a live audience in Idaho as well so we'll go back and forth between webinar questions and in-person questions but Steve will repeat the questions from his in-person group so that you guys can hear what the questions are.

01:00 If you have questions specific to me, I can type responses during the presentation at any time. Wednesday, they go to webinar. System will automatically send you a link to the recording of this webinar and I will also post it on our webpage. Please feel free to email or call me any time with additional questions or comments. I would now like to introduce our presenter today. Steve Knick is a Research Ecologist at the USGS Forest and Rangeland Ecosystem Science Center. He has worked in sagebrush systems in the western United States for over 25 years.

His research has focused on the role of human and natural disturbance and shaping ecological systems, the effects of multiscale habitat characteristics on passerine bird communities and the use of GIS techniques and satellite imagery to characterize landscape in semi-arid regions. He was a lead scientist providing information for two listing decisions by the US Fish and Wildlife Service on greater sage-grouse.

02:00 He's an editor and author of the forthcoming book "Greater Sage-Grouse Ecology and Conservation of a Landscape Species and Its Habitat" that will be published this spring by the University of California Press as a volume in the series "Studies in the Avian Biology". Welcome Steve and thank you for being here today.

Steve Knick: Well, thank you. I was thinking earlier this morning about how fortunate we are for those of us who have the opportunity to study sage-grouse and sage brush. It seems that most endangered and threatened species and many species of concern have very narrow habitat requirements who have lived in very specific kind of locations. With sage-grouse and sage brush, we have a lot more opportunities that also present challenges. For example, the species covers a huge range expanding all other parts of 11 states and two provinces and many other conditions across that range differed greatly and not only in terms of the disturbances there but also in the form of the sagebrush, the dynamics, and the resilience of the ecosystem.

03:10 And so, not only is this opportunity but it's also a great deal of challenge and just the very

reasons why sage-grouse conservation is so challenging is because first of all, their broad range-wide distribution. Second of all then, the diversity of sage-grouse environments across this entire range that includes like I said parts of 11 states and the complex dynamics that are within those sagebrush, different components of the sagebrush system itself. There are wide variety of system stressors, depending on where you go. There's livestock grazing throughout much of the area covered by sagebrush. There's also mining that are going on in many places and now there's a more recent push for renewable energy in the form of wind energy and geothermal and solar energy that are also imposing different sorts of impacts and disturbances on the system.

04:12 Compounding the problem is that these large ranges by sage-grouse include multiple land ownerships even though the majority of the area is managed by the public land agencies often time many places we have a checkerboard of say a public and private land. With the large ranges covered by sage-grouse then it involves forming coalitions and different kinds of strategies that are going to include different land ownerships, different objectives with that land, and different kind of land uses.

Not only that, but all sagebrush is not equal and they come as a surprise to some people who would just casually drive across and look out there and see, "Oh, it's just sagebrush out there." but the reality is there are different kinds of sagebrush and then are different kinds of situations and different responses to disturbance based on soils, and the different conditions and this all has a factor in how we might manage these systems.

05:13 So I just want to give you a kind of an idea, a snapshot of one location and the sorts of things that we're up against and the area I've chosen is then Northeastern Wyoming. It's in the part of river basin and the caption is not to be flippant but it's reality and that in many cases, we just simply cannot go back and we set the system and that many of the impacts that are being imposed upon sagebrush right now are not the things that we are going to be able to remove in the future.

And then, even if we could or somewhat reduced the level of development for the use, many of the components have changed such that there's no going back to some kind of situation like it was when the Euro-Americans first started settling in this country in the late 1700s and early 1800s.

06:04 So the reality is the future isn't what it used to be. And this is a sagebrush landscape and it certainly is all of that. It's dominated by sagebrush and it's used by sage-grouse and many of the other sagebrush obligate species. There's also some level of disturbance in there and as we look out across landscape that level of disturbance certainly doesn’t seem to be very much like it has an impact on sage-grouse and that impact can be in the form of either of a direct impact, some kind of a behavioral response to that the sage-grouse have in their movements either on the breeding range or in the wintering range.

For some reasons, sage-grouse just tend to avoid tall structures on the horizon. They didn’t grow up with them and all of a sudden, we're putting these structures on the horizon so there's a behavioral roots that's a direct effect.

07:01 There's also an indirect effect in that much of the coal-bed methane, the process to extract it involves pumping out some of the water. That water then is contained in pools surrounding each of these well situations and the pools provide breeding areas for mosquitoes which then carry West Nile virus. Sage-grouse are extremely susceptible to West Nile virus.

And so, you have both the direct effect as well as an indirect effect mediated through different pathways to the system. The bottom line is that even that low – low numbers of development in the system, there's a huge effect on the sage-grouse populations. The one graph shows you the relationship of the sage-grouse populations both inside gas fields and outside gas fields showing you that even that relatively low levels of development, there is a large impact on the sage-grouse populations.

08:01 But not only on the sage-grouse then but the sagebrush, and again you have the direct effect on sagebrush of removing habitat for the well development as well as the road and then power line infrastructure. But there's also an indirect effect caused by the disturbance alongside these roads that allows an exotic plant species in this case, a Bromus or cheatgrass to get in the system having an indirect effect that's going to alter the fire regimes in that area and overtime can increase the level of fire, increase the amount of disturbance, and ultimately change the whole dynamic of the system.

So on a very short series of slides here, I've managed to talk about not only direct and indirect effects but also local and landscaping effects to put spatials and different temporal scales. This all factor into the ways in which we need to look at conserving sage-grouse and sagebrush systems and how we design our strategies for long-term conservation.

09:05 Again, this isn't just an isolated incident but rather this kind of effects are occurring in a different form virtually across the entire area that's currently occupied by greater sage-grouse. Most of this is happening on public land within the range occupied by sage-grouse then. Approximately 70 percent of that area is managed by a public land agency and in all about 50 percent of the area is managed by the Bureau of Land Management.

The black areas in these were through the National Parks are really the only areas that are set aside that has some kind of management or protection from different land uses and different kind of human-caused disturbance. Reality is that parks cover less than one percent of the area occupied by sagebrush and with the parks do a good job as we save and protecting rocks ice.

10:03 But we don't do a very good job of protecting sagebrush. What this means is that the future of sagebrush is going to be largely determined by public lands and the mix of public and private lands and it's going to be managed with the different uses going on in those landscapes as well. My objectives today then in this presentation are first of all, to illustrate the need of why we have to prioritize regions and that may seem intuitively obvious.

First, we simply don't have the resources that are necessary to do everything at once but it helps me at least to be able to kind of visualize the resources we might have relative to the area that we might have to work with. Then I want to describe the organization of sagebrush systems. The reason for that is because understanding this hierarchical nature of sagebrush can help focus how we look at our conservation strategies in the level of which we might design conservation strategies whether we're looking at a range-wide distribution, whether we're looking at a population level, whether we're looking at a landscape, or with individual site within that landscape. We need to understand how that system operates.

11:16 Finally then, I'll detail a strategy for conservation actions that is based on some work we've done for the last several years that involves some spatial modeling not only to delineate sage-grouse distributions but also as a means to focus the restoration in areas where it will do the most good. Throughout then, I want to kind of mirror the theme that's been adopted by the Western Association Official Wildlife Agencies.

It developed a different focus group as an overall strategy for what we should do for long-term conservation sage-grouse and it basically distills down to conserve what we have and to improve or restore what has been lost.

12:06 So how do we do that? First of all, we need some way to prioritize the landscape and the system that we have and to do that, I've chosen which was a healthy lands initiative. This was an initiative that came out a few years back and never really got any traction but I really liked it. The reason I liked it for a number of reasons is one is that its focus was in the right place.

The highest priority was to maintain Sagebrush Steppe Habitat followed by strategically restoring fragmented habitat. As a result to doing that then it would conserve habitat for species such as sage-grouse which depend on the communities but it also emphasized the sagebrush communities that include up to 350 other species of wildlife that are dependent on this system. And this strategy or the initiative also had some real dollars tied with it and the very definite area that could be treated in restoring in an area in which they want to focus.

13:12 I want to use that and to put into perspective just why we need to prioritize it and what we're up against. And so, I'm switching a little bit of the areas and the statistics and things like that but you'll get the idea. I've also changed the area into a square because that was easier for me to model but the total area that we were talking about was something on the nature of 29 million hectares.

Of that, and within that region a Bureau of Land Management is responsible for about 62 percent of that area which is roughly 18 million hectares. Within the area about almost 9 million hectares is dominated by sagebrush. Of that, over half of the area is at either moderate or high risk to cheatgrass invasion. And then recent years, the area burned and has monitored about 506 thousand hectares.

14:13 I think you can see where this is going. The area that would have been able to be treated under this healthy lands initiative was about 9,380 hectares. It was very small and relative to the entire area that we're dealing with. And so, when we look at the real world situation in which sagebrush is distributed across this area occupied by greater sage-grouse and sagebrush again is different. We have different levels of sagebrush. We have different levels of fragmentation.

The question I asked is where are you going to put that little blue square and why would you do it? This is really a topic that interests me a great deal and the opportunity to in many years help would be a lame restoration class. At that class, we work through a case study. The case study is beautiful in that the students are given the opportunity to conduct one restoration project any place throughout the Western United States.

15:19 But they have to give a reason why they would conduct that restoration project and where they would do it that essentially forms a basis of what we're doing, what are our conservation strategies. And so, to understand all this then we need to look at the way the sagebrush in many ecological systems are organized. If we look at it in terms of a hierarchal organization at the local scale then with relatively short time dynamics and within relatively small spaces, we're looking at individual shrubs as well as individuals within the sage-grouse population. Most of our management doesn't happen at this level and most of us aren't overly concerned when an individual sagebrush went dies or an individual sage-grouse dies as well.

16:08 But those shrubs collectively make up sites, or landscape terminology they make up patches, habitat patches and the individuals collectively make up the population. The sites then collectively make up the landscape with the landscape collectively makes up ecoregions and

ultimately through the biome or the range-wide distribution of the species.

And so, understanding that these have interactions within different levels can help us try and focus the restoration at the appropriate level which is going to do the most good but also understanding how it fits in the whole scheme of things. And if we look at sage-grouse for instance, most of these things in which we're focused on are some place larger than site level but some place less than landscapes.

17:01 At those spatial and temporal dimensions, we're going to be focusing on certainly more than distributions of individuals but maybe a bit less than what individual sage-grouse populations. The key then is to take these concepts, develop some kind of a strategy so that we aren't creating just a checkerboard of individual treatment areas or individual conservations areas but rather one that works within this interaction of different hierarchal levels, such that ultimately by restoring or conserving individual stands and sites, we create functioning landscapes and ultimately have an impact on individual populations and ultimately on the soil and sage-grouse distribution

So as part of the strategy, some of the things that we've been working on are first of all to delineate sage-grouse distributions and this fits in to, you know, what is it that we have and where are things located?

18:04 So how do we delineate sage-grouse distributions and understand the spatial network of greater sage-grouse? The next component that I would talk about then would be ways to identify optimal areas for sagebrush conservation and restoration. What this means is that if we take the concept that all these areas across the entire sagebrush range are not created equally. That there's some areas in which we can have a better return for our effort.

If we can focus on those areas as opposed to a fairly just hit or miss process of "OK, we're going to do some work here and hope that it works.", I think there are ways that we can optimize the efforts that we do by focusing those efforts in the places that fit within a set of criteria and finally then, a goal to increase or maintain the connectivity of sage-grouse populations.

19:02 We'll get into a little bit of the metapopulation structures of sage-grouse as part of this first section. With that then, I think we can help understand why it is we need to focus in certain areas to improve our chances not only of preserving the existing sage-grouse distribution but also to connect some of these isolated populations that maybe in greater danger of local extinctions.

And again, keeping within this overall strategy or concept of the highest priority to maintain what we have and to improve or restore what has been lost. So if we look at the range-wide distribution of greater sage-grouse, and this is really one of the maps that started the whole conservation process for greater sage-grouse and it was developed by Mike Schroeder and published in "The Condor" in 2004.

20:01 What it shows is the light blue areas then are the historical distribution of sage-grouse based on the kind of habitat conditions. It was developed from citing records of the early explorers and a bunch of other kinds of records to outline this distribution. It's probably the best map that we would have of knowing where sage-grouse were.

And then, the dark blue area is the current distribution of greater sage-grouse. Couple of things

to notice first of all, that if you already did the statistics, the total area currently occupied by greater sage-grouse is about half 56 percent of the area that was once currently occupied by sage-grouse. The other thing is that the shrinkage hasn't been entirely even from the edge of the sage-grouse the historical range, and that the shrinkage has been greater in some areas. You can see that many of the smaller areas have started to be curved up and isolated.

21:12 In particular, we have the two populations in Washington as well as an area on the border, straddling the border populations between California and Nevada, Mono Lake populations. There's genetic evidence that this has been isolated long enough now that those populations are distinct from the main core populations of the sage-grouse range.

And so, what we're looking at is an uneven distribution of sage-grouse across the range but also some kind of structure within that population itself. If we think about sage-grouse populations in terms of that hierarchal organization, we have not only the range-wide distribution but also smaller components or breeding populations within that. And these little leks or that little dots which are sage-grouse leks are breeding locations for sage-grouse.

22:09 Sage-grouse every spring congregate on these areas. The males for breeding and they go through a fairly elaborate display and of course the whole purpose is to attract males do some breeding. These leks have been monitored for many years, in some cases as many as 80 years and longer.

Every year, a biologist go to these leks and sage-grouse set had been drumming and doing this display at lek. From that then, we have a fairly accurate estimate of not only how many grouser at each of this little black dots with the leks but also then population trends overtime at each of these areas. We also get an idea looking at this map that within the population themselves are individual little breeding is the leks themselves, and that we need a way to be able to describe how these populations are connected in order to focus management that's going to help us not only in areas where there are a lot of sage-grouse and these leks are fairly closely aligned with each other but also those spaces in between.

23:22 To do that then, we need to think of this whole distribution in some kind of a metapopulation structure. If you go back to your metapopulation schooling back in college and how metapopulations work, it's basically a function of how large you are and how well you're connected to each other. And so, if we think of those different populations these different gray circles as the population units, and that it's important to have some kind of exchange among these individual populations and that exchange through the form of dispersal allows for maintaining genetic diversity within the population but also in the event that some of these populations become extinct for whatever reason then there is a recolonization through dispersal from adjacent populations.

24:26 And so, it becomes a function of not only how big you are but how well connected you are and if some of these smaller populations are wiped out for whatever reason then you need to have some kind of way to recolonize them or to recover them and those areas that don't have dispersal are ones that are simply lost. That means that what we need to focus on is not only the large balls but also those areas that connect this as well. We need the means to be able to describe that as well.

And so, in work that Steve Hatzer and I have done in looking at this distribution of leks, we've used principles of connectivity to map the distribution in this collection of leks in a way that tells us a sign some kind of importance to not only leks but the cluster of leks that gives us

some kind of an estimate that's based on how big the lek is and the groups of the leks as well as the distance between the leks themselves.

25:34 And so, we take this map that we had earlier which was the individual populations the little black dots that were leks and using kind of fancy mathematical connective dots, we come up with this kind of linkages among the different constellations of the leks within the sage-grouse network. And if we group those into areas that are connected based on a certain distance that sage-grouse tend to disperse, we can map them kind of the breeding network of sage-grouse across the entire range. These individual components represent clusters or constellations of leks that are connected to each other within a dispersal distance of individual sage-grouse.

26:29 So that initial large kind of range-wide distribution that you saw that was made even smaller in the dark blue area might in reality be even smaller than that and consist of a number of fairly large important kind of core regions dominated throughout the center of the sage-grouse range. But that the rest of sage-grouse distribution is composed of fairly small clusters of leks that have very little exchange with neighboring clusters.

27:07 And if you look at kind of the size and the area of these polygons or clusters if you will, by and large 90 percent of these breeding units consist of groups of leks that has a polygon that includes less than 20 leks and the area within these constellations again is quite small. If you go back to kind of your metapopulation dynamics, one of the things that allows you to persist overtime is to be large and relatively connected. In reality within the sage-grouse distribution is that many of these components are really quite small and maybe relatively isolated from each other.

The next part of what we've been doing in addition to delineating sage-grouse distribution, and just keep in mind we're going to put all these things together at the end, is to identify optimal areas for sagebrush conservation and restoration.

28:13 Sage-grouse, I haven’t mentioned it yet by I thought it was obvious that sage-grouse depend on sagebrush and despite what some of the previous administration might have wanted you to believe, sage-grouse do depend on sagebrush. Although on the one hand it may be true that if you have sagebrush, you may not have sage-grouse. If you do not have sagebrush, you will not have sage-grouse.

So it really becomes a matter of identifying areas in which we can maintain and conserve the existing distribution of sagebrush but also to focus our restoration areas where we're really going to have the most success of restoring sagebrush and to do it in those areas that need a certain set of environmental conditions as well as ultimately can benefit sage-grouse.

29:10 And so, if we look at a couple of different kinds of snapshots of sagebrush distribution across the entire sage-grouse range and this is just a fancy GIS way of kind of depicting different views of sagebrush, kind of if you were in an airplane flying at a relatively low level and then a higher level and then ultimately from space or something like that, and it gives you a little different idea of kind of how sagebrush might appear on the landscape with a different kind of connectivity and worthy of what regions are. It presses at the five-kilometer panel. What we've mapped here is the amount of sagebrush within a five-kilometer radius of each of the GIS cells of this GIS map.

30:01 It gives you much more of the salt and pepper effect through the mosaic of individual sagebrush patches as well as those areas that do not have sagebrush itself. As you move in to the 18-kilometer range which might be at their perspective that sage-grouse have more in terms

of the way it did look at this landscape. You start to see a broader pattern of sagebrush appearing on the landscape.

By the time you get up to a 50-kilometer distribution what you're really doing is mashing again this percent of sagebrush within the landscape into a larger and courser resolution. You see that some of these core areas of sagebrush showing up and again at a 100-kilometer range, you see again the core areas of sagebrush. Interesting that those core areas of the sagebrush also reflect pretty closely those core areas of the sage-grouse itself. But again, this gives us a different perspective of sagebrush distribution, how species, individuals, and populations might respond and at which spatial scale or resolution they might be responded to.

31:13 And so, one of the things we wanted to do in modeling where to optimize your restoration was to delineate first of all where were the large scale distributions? In this case, of Wyoming or basin-based on big sagebrush distribution but also within that small-scale patterns of fragmentation. The rationale behind that was if we're going to do a restoration, we don't want to do it in area where there isn't any sagebrush already. It doesn't do us any good to put that little blue square out in the middle of a large area dominated by thick grass. You aren't going to really accomplish anything. You're not going to track any of the sagebrush obligate species and you're not improving the connectivity or the size of any of the individual sagebrush patches.

32:02 On the other hand, if we can locate the places where we would like to do restoration near this large scale or some place within this large scale sagebrush distribution but located in those areas that have some kind of small scale pattern, a fragmentation. That way we can fit that little blue square within the areas that are in a large scale dominated by sagebrush. In other words, we can start filling in those spaces in between.

We provide a connectivity among the different sagebrush patches. And we can also use those larger scale patches of sagebrush to service seed sources and improve the connectivity and eventually coalesce into a much more homogenous patch of sagebrush across the landscape. So a rationale on this was to first of all identify those areas in which there were the large scale distributions but also to that had a small scale pattern of fragmentation to fit our restoration project within that.

33:09 And I apologized for switching on to a couple of different study areas but this project was done for the Western United States in particularly in the area that at that time was bounded by the Great Basin Restoration Initiative. And so, again this shows you the relative proportion of Wyoming based on big sagebrush at a large-scale distribution. At the same time, we map the amount of habitat edge as a way to look at the fragmentation and to identify those areas that had a relatively small-scale pattern or fragmentation of sagebrush within this distribution.

So we got these two things and we've got them in a GIS map that we're going to use in a model a little bit later on. The other thing is that we need to find places that are suitable for growing sagebrush.

34:04 Again, there are optimal sets of environmental conditions for growing sagebrush. And it doesn't do us any good to try and focus our restorations in those areas that have soils that aren't going to benefit sagebrush or the kind of precipitation that isn't going to work. And so, we can use these factors, soil conditions, precipitation, slope, elevation to model optimal locations where we can grow sagebrush.

Features that we've used were elevation, precipitation, the amount of water capacity within the soil depth to rock soil depth, so on and the PH. And we were able to put this on a statistical model that allowed us to optimize places where we would expect to grow sagebrush and we used as a kind of a foundation and basis for that some of the existing sagebrush on the landscape right now that allows us to do is to model the landscape and say, "Hey these are the places that we're going to have the best success based on environmental conditions."

35:12 The third factor that we wanted to consider was what's the risk of cheatgrass displacement? So I mentioned earlier about half of the area was in a moderate to high risk of cheatgrass displacement. It doesn't do us a lot of good to spend a lot of effort on the restoration or conservation action in a place that's ultimately going to be lost to cheatgrass and fire within the next couple of years, within the next decade, or within a timeframe like that.

So if we can avoid those kind of areas that's certainly going to help us in reducing complication and this going to influence the success of our restoration. And so, using a similar former process that we used for modeling sagebrush, we developed special map of areas that were at high risk and different risk to cheatgrass occupation.

36:08 And these are areas that currently have cheatgrass or following disturbance are highly likely to come back into an area dominated by cheatgrass. So we put all of these together in a spatial model like I said these were GIS maps and they're available on the sage map website if people want to download the individual GIS layers and using this spatial model which is essentially a mathematical function of a way to fit the different layers together, we came up with priority regions, these little blue squares for much of the Western United States on where we could focus our restoration efforts and achieve a reasonable amount of success. As you can see, there's a lot of little blue squares still around the west in areas in which we could focus our restoration.

37:04 And this again is based on a different kind of percentile and things like that so we could further prioritize this into higher and higher priority sites based on given set of priorities that we may choose either based on different kind of variables that would need to be input or different levels of the existing criteria that we put into it.

But again, it give us a way of looking at this wide distribution and saying, "Here's where I think we can have the best success for focusing the efforts not only to conserve what's already there but to focus on restoration in areas themselves." We can see in the inset we've done a good job of avoiding those areas that are going to have a fairly high likelihood of cheatgrass coming into the area and well as put it within areas of existing sagebrush distribution and kind of fill in those spaces.

38:09 The third part of that is to kind of put these two components together in a way that increases or maintains the connectivity of sage-grouse populations. And so, we'll go back to that original map that we had of the different breeding components and again in the GIS overlay those high priority areas and sure enough, this fits the strategy very nicely in a way that we have the existing breeding areas of greater sage-grouse with those demarked in gray in which we can focus conservation to maintain what we have but those areas that we should focus on when we can do treatments or if we need to for instance get into fire reduction or control fires natural or human-caused fire operates things like that.

39:08 These are areas that we could focus on and that would allow us not only to coalesce and start building some of those areas for sagebrush patches but also start to increase the connectivity among these core areas of the sage-grouse distribution but also to create sagebrush that's going

to be used as travel corridors among the different breeding units of sage-grouse themselves.

And so, then just in conclusion and following which then I think there's plenty of time for some questions just note that the available resources that we have simply do not permit us to do everything at once. And so, there needs to be some form of prioritizing the regions for sagebrush and sage-grouse.

40:01 How we prioritize that can be different in different kind of regions. I've set up one kind of a model with different kind of conditions and priorities leading to different kind of priorities. We may in different regions have various model looking at plan, disturbance, or development, things like that to look at how that development is going to influence these priority areas, how it might influence the sagebrush distribution and components.

But again, the approach would be that we have different factors that we look at. We look at those factors in a way not only to look at the existing level of the distribution but also in terms of the organization of the system itself. Are we going to be influencing individuals? Are we going to be influencing sites themselves or are we actually had a point where we're going to influence populations in the population structure within the sage-grouse distribution.

41:05 Spatial modeling is a very important tool that we can use given some examples for that not only for modeling the distribution of sage-grouse but also how to delineate sagebrush and to develop prioritizing those areas where we can focus future actions and conservation actions. And also, lay down I think that this kind of approaches do rest and fit well with this strategy that is based on conserving what we have and also give us the opportunity to restore what has been lost.

And so, just before I take the questions in, I'd like to acknowledge the people that have supported myself as well as the projects that I've been working on US Geological Survey, Idaho Department Fishing Game, and Fish and Wildlife Service, The Bureau of Land Management, Western Association of Fish and Wildlife Agencies which is the individual state agencies responsible for managing the sage-grouse populations.

42:13 A lot of the connectivity work has been focused in and encourage to the Erica Fleissman and Nevada CAD Project as well as the Wilburforce Foundation and of course I'd also like to acknowledge my long time friend and colleague, Jack Conway who has worked with me in many different sage-grouse and sagebrush issues. So with that then, I left a fair amount of time that I think we can have some questions and I'll see if I may be able to answer.

Genie MontBlanc: Thank you very much, Steve. I will now field the questions for Steve. Before that, I wanted to address the two people who emailed and said that their audio was dropping in and out and I tried to look into that problem and I'm not sure what was going on. So I'm very sorry if that was happening to you and we'll have the video. The video will be sent to us and I can send the audio and video of this presentation to you or the presentation itself so let me know and please email me and let me know if you want me to send you the video directly. And I apologize for that.

43:21 All right, so now if you have any questions for Steve, please type them in the question box and I will read them to Steve and I'll do my best to pronounce their names correctly. Right now, Steve, do you want to start with the question from your live audience?

Steve Knick: Live audience, do you have any questions?

[Laughter]

Audience: [Unintelligible 43:47]

Steve Knick: OK. The question was how would I cast the kind of recommendations I made in the prioritization and the modeling in terms of one of the conservation reserve design series of having a single large area in which to focus efforts or having several smaller areas to interact with and the relative success it might be achieved from these different kind of strategies. And I guess in thinking of this, my original focus would be on some of these large areas initially because these are predicted in the long term both with the climate change effects and things other land development thing to have the most stability and we need to retain those over the long term.

45:07 And then as a lower priority, try and include some of these smaller populations that are already are at risk but the reality is that some of the factors that are influencing these small populations are ones that we're not going to have much influence on whether it's a land used development, whether there's some kind of an isolation by distance already but that within some of these smaller areas, we may not be as successful as conserving some of this large areas.

Having said that, there's an intermediate area as well that if we can get enough of these clusters within a fairly consolidated area that we could focus some of the effort and maximize a number of these groups and essentially create a large area. I think that would work as well but again conserving what we have is the main priority and that's going to be these larger areas.

46:04 **Genie MontBlanc:** OK, thank you very much. Now, a question from the webinar audience, Dexter Dong asked, "What is the sage map website that you said we could get data from?"

Steve Knick: Question is what is the sage map website that I said you could get data from and it's a USGS sponsored website and it's on the Web and if I remember the Web address right, it's http://sagemap.wr.usgs.gov. You can also just do a Google search on sage map and we actually do sage map programs. One is for genetics and you know what that one but the other one is sagebrush in grassland ecosystem site. There are a lot of things on that site including many data layers that are free for download as well as the documents that you can download.

47:04 The book that Jack Conway and I have an edition coming out as Studies in the Avian Biology until that book appears in print in the next couple of months, you can download free publication chapters of each of those for the book itself and get the data for many of those chapters as well. So it's a tremendous resource. It was originally sponsored by the Bureau of Land Management and now has maintained by the US Geological Survey.

Genie MontBlanc: Thanks. Do you want to go with question from your group?

Steve Knick: Yes, we have a question in our group.

Genie MontBlanc: OK.

Audience: [Unintelligible 47:45]

48:05 **Steve Knick:** The question kind of was a variant of when is a white horse become a black horse and how do you measure those grades of white and black in between and what level of

fragmentation is it a mosaic and what level is it fragmented and the answer to that is not a simple one because we used simply in measuring what we did as a measure of edge, of sagebrush versus non-sagebrush and all edges not created equally.

You can have sagebrush that's next to your friends and it's a grassland that's not nearly as harsh in the edge as an area of sagebrush that might be next to riparian area or urban development or something like that. So there are different grades of edge, different species perceived that edge differently as well.

49:01 And for instance sage-grouse probably perceived fragmentation much differently than does a Brewer's sparrow. A Brewer's sparrow may look at the collection of sagebrush itself and see fragmentation essentially as within the individual shrubs. Sage-grouse absorb that edge with the individual patches, within their annual range but if the distribution of sagebrush within their annual range is separated by 20 to 40 kilometers, they're not likely to cross it.

So the way we treated sagebrush edge was that kind of that intermediate level for sage-grouse at the 18-kilometer resolution and looking at if you had patches within that but no sagebrush within that that would kind of define the level of sagebrush and the patches that were in there for fragmentation. What that level allowed us to do is look at, for instance we can have sagebrush fragmentation at a level, for instance in parts of Northeastern Nevada, parts of Southern Idaho, and Eastern Idaho as having a level of fragmentation that still sage-grouse but for instance that level of fragmentation is too great if you try and cross Snake River Plain. The sage in those populations are essentially isolated.

50:27 **Genie MontBlanc:** Thank you. All right, I have a question from Chris Cromwell, "What are the methods you propose to conserve areas of optimal habitat especially from fire?"

Steve Knick: So the question is what are the methods that I would propose to conserve optimal areas of sagebrush from fire? And that's very difficult one because fire is a natural part of this system and always has been. The problem right now is that the incidence of fire is either too great in many areas that have been taken over by cheatgrass or the incidence of fire is too rare in some of the higher elevation areas currently experiencing woodland encroachment into these areas.

51:22 So we have essentially two different situations, one in which there is too much fire, one in which there isn't enough fire. The conundrum is how do we conserve these areas still at fire be a part of this system but now one in which it's devastating itself? And in many cases, I have to admit I don't know the answer because cheatgrasses and filtered many of these areas and it's going to make it difficult to suppress fires once they get going in there.

There's a push in many cases to kind of break up the larger patches of sagebrush and create fire breaks. I'm not really in favor of that because many times the disturbance, at least in the areas we've done that in the past, has not resulted in a very good set of needed plants that have come in to that area instead of taken over by cheatgrass or other exotics.

52:21 And it hasn't had the kind of desired effect. Really the best thing we can try and do now is try and manage for systems that have a good overstory of sagebrush with an understory of native perennial grasses and forbes and try and use fire suppression as best we can within many of those areas and try and reduce the size of fire within those areas as best we can.

Genie MontBlanc: Thank you. OK, your turn.

Steve Knick: Yes.

Audience: [Unintelligible 52:56]

Steve Knick: The question is how you build flexibility into this kind of priority models that we have and what kind of factors do we need to include and how do we wait with different factors in a new kind of evaluation of where we might prioritize areas? That the models that we views are multi-variant models ultimately and even though the individual models have different inputs into them, they can be rearranged and new factors added ultimately into a new system. Ultimately, what you get in the output is some probability of success or probability of growing sagebrush or probability of maintaining the system itself.

54:02 You can include new factors, where do we need the human footprint for instance as a disturbance? A development factor within that and the challenge for that is to give it some kind of a numerical value that tells you, is this a total effect? Is it a kind of an indirect effect? Is it a partial effect? And how does that factor weigh in among the other variables in your system.

To give an example of that, if you have kind of a fragmented area that you're working on and you want to cite a power line to that. The effect to that area is probably not going to be as great then already fragmented areas. If you're putting it in a previously undisturbed sagebrush area, how do you weigh those different kinds of factors?
And that's where a lot of the work we're doing right now is going at and trying to estimate the area effect of the different kind of habitat relationships that are surrounding that effect and the time lags as well as spatial distribution of that decay function or effect away from that.

55:12 So we've gone the first step of being able to look at different factors and knowing which ones we'd like to include whether it's development, whether it's climate change. The next step is to incorporate those ultimately into the model which we can do in the mathematical sense and regenerate the different priorities.

Genie MontBlanc: OK, thank you. Next, I have a question from, and this is embarrassing I have a French name and don't say French. So I hope I'd say your name right Louie, but Louie Prevanche and he asks, "You said that Wyoming Sage and Basin Big Sage will be used for the distribution model, why not include Mountain Sage that is heavily used by grouse in Nevada sometimes more than Wyoming Sage.

Steve Knick: The question was why models showed only Wyoming and Basin Big Sage and yet sage-grouse particularly in Nevada and other areas used Mount Big Sage as well?

56:07 And the final model actually did include Mountain Big Sagebrush as well. I showed the initial delineation for Wyoming Big Sagebrush and Basin Big Sagebrush but in the paper that Cara Maignkey wrote we did it both for Wyoming and Basin Big Sage and then for Mount Big Sagebrush as well and then on the results I showed today with the blue squares that was combining results both for Basin Mount Big Sage and Wyoming Big Sage. So they all were included in the final model than it should.

Genie MontBlanc: OK, great. Thanks. Do you have another question over there?

Steve Knick: Yes.

Audience: [Unintelligible 56:46]

Steve Knick: The first question is how much area needs to be restored to meet population goals? I don't know the answer to that because populations range over different sizes and can be up to 2,700 square kilometers. If you're doing a restoration or treatments in a critical area for instance in the wintering area, you can have a fairly big effect on that population itself as opposed to other areas within that and your range.

The problem with sage-grouse is that they used different seasonal ranges that don't necessarily overlap. So the size of that can vary not only by the seasonal range but also the relative reports of that seasonal area as well. So I didn't answer that question. The next question was how adequate are our current restoration techniques? I would say that our current restoration techniques tend to be the most successful in those areas that haven't been heavily disturbed that have the native community

58:14 And in other words, we have the shortest distance to go, to get from the place that's disturbed to the place we want to get to. And so, the places for restoration has been successful have been in some of the areas with favorable precipitation, good soils, a good community of native understory to begin with. The areas where restoration doesn't succeed very well are in these low precipitation areas where there's already exotic plants and cheatgrass. So we need to work on controlling them and have a much more massive investment in getting the site prepared to restore sagebrush.

Genie MontBlanc: OK, thank you. We have a question now from Karen Blakemee, "You have delineated several areas e.g., Great Basin East and West, are you suggesting prioritization within each of these sub-areas or among all areas?"

59:11 **Steve Knick:** The question is since we delineated the sage-grouse distribution between and kind of an eastern and the western range, how would we prioritize among the eastern and western and would we do it within the individual areas and how far would we break it down essentially?

The sage-grouse range right now and management of sage-grouse within the entire range-wide distribution is really split into seven management zones that have been delineated by the Western Association of Fish and Wildlife Agencies. Those zones are based on similarities of environment as well as relative connectivity of sage-grouse populations within those zones. So not only east and west but there are also individual management zones.

60:03 The way the prioritization cessation models are set up is you could prioritize across the entire species range. You could do an east and west. You could also develop a prioritization within individual management zones as well and ultimately you could also do it within BLM states or within field offices within states and things like that. And so essentially, if you look at a national prioritization and then you can break it down within that where you might want to focus efforts but you can do the prioritization at different levels.

Genie MontBlanc: Thank you. OK, we have a bunch of questions still more on this end. Do you have more questions over there?

Steve Knick: Yes.

Audience: [Unintelligible 60:53]

Steve Knick: The question is we've seen how populations decline, how nesting success

declines, and we lose individuals as a result of different activities where there's development or infrastructure things like that, do we have any good information on how much we can gain by restoring or focusing on improving areas where there's already existing sage-grouse populations?

Unfortunately, I don't know that we have the answer to that and that's really critical answer and the reason being is that we look at, you know, right now there's a large push to mitigate conservation efforts particularly with regard to energy development. If we lose this much area due to energy development, are there places that we can improve or restore, expect to see a similar or offset kind of what we've lost in those development areas?

62:07 I don't know that we have very good information on the increase in sage-grouse population as a result of this restoration. There's a couple of things that complicate it. First of all, lag periods can complicate population response. But on the one hand, sage-grouse kind of weird in that they almost respond immediately to disturbance at some lag period. Their ability to respond to restoration or to areas that we create is really slow and even areas that have come back in sagebrush in some places like in Oregon after 20 years now even though the characteristics are there, sage-grouse do not use those areas.

So there's species that disturbance hits them hard. The response may not be as immediate and maybe more difficult to quantify, that's really something that's important. Again, as we look at some of the mitigation in the future, how we quantify what we lost and where we can regain it elsewhere?

63:05 I can assure you those are not going to be a one-for-one. It's not that because things aren't created equally if we wipe out this area of good sagebrush habitat or sage-grouse population, we can't expect an equal response to some place else.

Genie MontBlanc: Thank you. Now, I have a question from Steven Bekedam. Have the effects of climate change been considered in your modeling process? Can you comment on the effects of increased fire and drought on your priorities?

Steve Knick: Just a minute. Could you repeat that again?

Genie MontBlanc: Sure. . Have the effects of climate change been considered in your modeling process? Can you comment on the effects of increased fire and drought on your priorities?

Steve Knick: The effects of climate change have been quantified and I can tell you that none of the predictions under any of the climate change scenarios are going to be good for sagebrush or sage-grouse.

64:02 The long-term effects of climate change if the full impact of I think six degrees centigrade by the end of this century are expressed, approximately 20 percent of the existing sagebrush distribution would remain and that's because we would have increased amount of fire. We would have facilitate cheatgrass expansion and we would also have encroachment or distribution of shrubs from the Mojave of Southern Regions coming in to area currently occupied by sagebrush.

On the Northern extreme in the upper elevation, we aren't going to see a similar kind of expansion in sagebrush because that area already is taken over by agriculture or by different

kind of woodland or something, so we aren't going to see this much expansion on the sagebrush end. So again, the effects of climate change if they are fully expressed are not going to be good particularly because of the increased fire, the facilitation of cheatgrass, and just a whole host of factors that contribute to nothing good for sagebrush.

65:16 **Steve Knick:** OK, we have a question from in here then.

Genie MontBlanc: OK.

Audience: [Unintelligible 65:20]

Steve Knick: So the question is kind of a follow-up to the question on mitigation and how do we decide what to conserve and what to restore given that we might have unequal effects of restoration in response to the variables?

One of the ways that we could do that is if we can't do it on a one-for-one basis rather look at how we approve the stability of the long-term system both in terms of providing a larger area of sagebrush increasing the amount the number of leks within that sage-grouse population and increasing population size that ultimately contributes stability. So we may not be looking at necessarily the numbers of sage-grouse that we would increase but rather improving stability by having a larger area to restore.
To do that, the kinds of places we might sweat would be again along the edges, the existing edges of the current areas where we have the larger population of sage-grouse and to connect some of the more isolating ones to that core area.

67:00 **Genie MontBlanc:** OK, thank you. Jennifer Moda asks, this question is from the Eagle Lake Field Office, "What would happen to the treatment model if sage-grouse are listed?"

Steve Knick: What would happen to the treatment model if sage-grouse are listed? Can I ask for a clarification on that?

Genie MontBlanc: Sure. Jennifer, if you don't mind typing in some more details, and unfortunately I'll have to scroll to the bottom. So I'll ask another question and then come back to that. Tracy Allen asks, "What should the priority be for states such as Utah which does not have much high priority areas identified?"

Steve Knick: What should the priority for Utah which does not have a lot of high priority area listed? There are populations of sage-grouse within Utah. Another priority that is not taken within these models are what you have for the Gunnison sage-grouse in the eastern part of the Utah, state of Utah.

68:09 And so, the priorities then would be to focus on the Gunnison sage-grouse as well as in some of those sage-grouse areas like at South Central Utah where you do have a fair number of sage-grouse remaining and to be able to improve conditions down that region.

Genie MontBlanc: Thanks. Do you have more questions from your group, Steve?

Steve Knick: No, I don't.

Genie MontBlanc: OK. We have more over here. So another question from Louie, "Does your cheatgrass map include areas with less than 10 percent cover of cheatgrass next then with

shrubs?" Landsat imagery does not pick up less than 10 percent without serious ground verification.

69:00 **Steve Knick:** The question is does the map of the cheatgrass distribution include areas in which there's less than a cheatgrass abundance mixed in with sagebrush and the answer is yes, it does. And we developed these predictive maps separately. In other words, we developed the cheatgrass model based solely on environmental conditions.

And so, it can be overlaid with the existing sage-grouse distribution. It's true that land side tour and of the other satellite formats doesn't readily allow you to pick out understories of sagebrush distribution. But again, our model of cheatgrass distribution I think would overlay quite well with the sagebrush in providing an estimate of what the understory might be within the existing sagebrush area.

70:01 **Genie MontBlanc:** OK, thanks. Getting back to Jennifer Moda's question, "The model that you are using to predict priority areas might be changed by mandated priority areas critical habitat by the Fish and Wildlife Service, could the model be changed to account for that?" This is in clarification... listing.

Steve Knick: Oh, I see. Yeah, the question is if sage-grouse were listed how would that and in certain priority areas within mandated, how that change the kind of model that we have or the depiction of the different areas for restoration?

Certainly, there are other areas that and other criteria that may factor into it and those would be either political or administrative decisions on where we might want to focus restoration. Our model at this point was based almost exclusively on environmental variables as well as the sage-grouse distribution. Having said that, I think that even if certain areas where politically mandated that these are places in which we need to conduct restoration.

71:09 These are areas we need to focus our conservation. I think that within that, we could certainly adopt this kind of a modeling approach to look at the areas within that again as a large enough region in which we might do the actions either as conservation or restoration. So it could be readily adopted if sage-grouse were listed in areas where mandated that becomes a different variable and a different driving factor into where and why we do the treatments.

Genie MontBlanc: Thank you. We have three more questions. Next, Larry Zuckerman asks, "Is there a danger of setting up a tree house situation where those areas not in priority areas are allowed to further decline or wipe out by human impacts? If so, might lose some of the important genetic resources found near the fringes of the imperiled sage-grouse range might be shortchanging their chance for recovery by concentrating on the central core areas.

72:09 **Steve Knick:** The question is if there's a danger of a triage approach in which we essentially write off some of the smaller isolated population of sage-grouse and we may lose some of the genetic components and the diversity that's inherent within those populations that could be very valuable in terms of the greater distribution.

Yes, there is a danger of that and in a very large danger, one of the things we're looking at doing is trying to get an estimate for just how much genetic diversity is in these smaller isolated populations. Some of the earlier analysis by Sarah Lera-MacCant in the case that there is sufficient genetic diversity at the range-wide distribution with the exception of the Washington population and the Mono Lake population straddling Nevada and California. But

the rest of these areas at the range-wide scale apparently contained relatively the same genetic information.

73:16 We're looking at using a much finer level of genetic information to determine just how much diversity is contained within these isolated populations. If we can couple that with different dispersal models, we can ultimately come up with an estimate of what we lose by essentially writing off some of these more isolated smaller populations at the fringe. And that would provide us a good answer to your question about the danger of losing those populations and the reality is yes we would lose something by that.

Genie MontBlanc: Thank you. As a follow-up, Larry asked if you could provide the link for the online Chapter for your future Knick and Connelly book.

74:02 **Steve Knick:** The online chapters right now are on that sage map site that I mentioned earlier. It's I think on the front page it just says, "Go to the book," or something. It's pretty clear where it is. Otherwise, the book is going to be published. You can find it either through link at Cooper Ornithological Society, the Studies in the Avian Biology series volumes or it's being published by the University of California Press. It's also on their site.

Genie MontBlanc: Thank you. And again another follow-up to the question earlier he asked about losing genetic diversity on the fringes particularly relating to surviving climate change. I'm not sure if you answer that already.

Steve Knick: Well, OK. The problem with climate change is that most of the areas that are predicted to be lost under climate change are those small populations as well.

75:09 And so, some of the remaining core areas of sagebrush are going to be only in the areas that have currently supporting some of the larger populations of sage-grouse. So under the climate change models, yes, those small areas of sage-grouse populations are predicted to be lost with the shifting distributions.

Genie MontBlanc: OK, thanks. The last question is from Joanne Lauden, "Are the results of the model identifying priority restoration areas available as a sheet file?"

Steve Knick: Yes, they are and the various metadata were actually some of my list of things to do were it should be available and the approach itself is in the paper by Cara Maignkey that appeared in Restoration Ecology in 2009 but the base layers as well as the restoration models themselves will be available on the sage map site.

76:13 **Genie MontBlanc:** Great. Well, thank you very much. That was the last question here. Do you have any more questions over there?

Steve Knick: No, I think that's it.

Genie MontBlanc: OK. Well, if anyone comes up with questions later feel free to email me or Steve and we'll do our best to get back to you on a timely manner. Thank you very much for your presentations today, Steve. We really appreciate it and thank you all for your participation, all right?

Steve Knick: Thank you and goodbye.

Genie MontBlanc: All right, thanks. Have a good day everyone.