Module five discusses the importance of using quantitative data when available in Rangeland health assessment. The instructors are Mike Pell and, Jeff Herrick, Pat Shaver and Dave Pike.

What we'd like to do now is go to Jeff; he is going to discuss the uses of quantitative data relative to protocol. Jeff.

Thanks Mike. I'm gonna talk about four issues today, the first is why quantitative data, the second relationship to attributes and indicators and I'll move on to talk a little bit about the difference between accuracy and precision of qualitative and quantitative indicators and finally selective measurement with a very brief overview. Why do we use quantitative data?

Well there are a number of reasons. Number one, we use them where it's necessary to document the assessments and this is becoming increasingly important as people become and agencies become challenged on these assessments. If you can go out there to make the assessment and then collect even a hundred points pace transect. With a hundred points pace transect, you can actually document about four of the indicators quantitatively, you can get a litter cover, you can get a bare ground, you can get that composition by cover at a minimum for your functional structural groups, you can get invasives if they're a significant part of the site. Another reason to collect quantitative data would be to make a direct comparison with another location. For example, if you do have a

reference site available that you can go to some time that same month, that same week ideally and make some measurements, it helps make that point much stronger than if you just say, yeah I went out there and they look pretty similar or they looked a lot different. Finally, we use quantitative data where monitoring data are required to determine trend. So, basically what you're doing is as long as you're out on the site, why not collect 100 points based transect or stretch out a line. That provides a baseline then to come back a year later, five years later and determine trend. On page one; we spend a lot of time focusing on what this technique is not to be used for. In this case, I'd like to just read through this paragraph on what it is to be used for. It can be used to provide early warnings of resource problems on upland rangeland and again, if you've got some quantitative data to support this assessment, it's gonna make your case a lot more convincing. However, the protocol is not to be used to monitor land or to determined trend. Qualitative assessments are not to be used to determine change; you wanna have some quantitative data to do that. On page 12 then, we talked about how the qualitative data can be used to help design a quantitative monitoring program. Qualitative data are used to select the best indicators for each of the three attributes rather than selecting and equivalent quantitative indicator for each qualitative indicator and the reason we do that is that for particular attributes there are a different set of optimal qualitative indicators than quantitative indicators. For the next slide, where gonna talk a little bit about accuracy versus precision. Quantitative data tend to be more precise. If you look at the average value of this group of points, it's actually not

very accurate, we didn't hit the Bullseye, but, we were very precise, we, we hit a point somewhere outside the Bullseye repeatedly a number of times and quantitative data tend to be much more precise than qualitative data because of the qualitative data everybody is seeing something in slightly different ways, although the reference sheets help us a lot with that. Either qualitative or quantitative data can be more accurate and that's where in this case, perhaps, we've got a qualitative indicator, it's not particularly precise, we've got a good scatter around there, but, if you think of those qualitative data as those, each of those points as three or four or five individuals to go out and do an assessment, what we've found with the research we've done is that particularly to get a number of folk together doing that assessment, they tend to circle in on the same point on that Bullseye and that's where these qualitative indicators can help. Now, the other thing is that there are some things that you can detect more accurately using qualitative data and there's been a fair bit of research has been done on qualitative versus quantitative indicators. The first two references and please do contact us if you'd like us to send you these references. The first two references were research, based on research that we've done on these interpreting indicators through Rangeland health process and in both cases, they found fairly substantial significant relationships between the qualitative and the quantitative data, again, when you're looking at it in general. The last one was a study that was done on qualitative soil quality indicators. Indicators like what does the soil smell like? Well, soil smell is closely related in most cases to the decomposition process and if anybody has ever been out in the garden or in a, in

a, recently tilled field in the midwest with its fairly high organic matter, you can smell the sweetness of that soil, that means, there's been a lot of fungal activity and that's a good thing for the soil and it tends to be related to laboratory measures that we make. Here is an example of an indicator of a property that I find is much more accurately assessed using a qualitative assessment and that's compaction. You can see here this is a soil that has a compacted layer, the surface is fairly well structured, the roots are growing fairly normally, but, in the subsurface, you've got a fairly massive horizon and you can't see it here, but many of the roots are actually growing horizontally and what we found through a large volume of research that's been done throughout the world, a lot of it in the Midwestern United States of some upland rangeland is that the density of the soil is not as important as the structure of the soil. The density of the soil is something that we can measure very precisely, plus or minus 5%; we can measure the density of the soil. However, soil at the same density can have very different structure. A soil that has a density in units that we use of 1.5 can have very low infiltration rate or a very high infiltration rate depending on whether or not there are pores and fissures in the soil, how well structured it is and what we found is that in many cases a soil with a higher density actually has better infiltration and better root growth because it has better structure. We can observe that structure and if you read the description for the compaction indicator in interpreting indicators of rangeland health, you'll find some good clues to how to assess this indicator. Here is a nice example of a case in the bottom of this slide where the white horizon down there is very dense; however, it's not a

compaction layer. I wouldn't have known that if I'd simply measured the density, I would've said, you know, for this gravely sandy loam soil have got a bulk density of 2.0. As a soil scientist, that tells me that's pretty dense. However, observing it, I can determine that this is actually a natural soil horizon, this is not gonna change, it's not something that I can do anything about. Okay, a few resources that are available to, that described quantitative measurement techniques. The first one is the NRCS pasture and range hand book described a number of vegetation measurements, the second one measuring and monitoring plant population has now been reprinted, I believe in 2001 or 2002, it's available through Blackwell Press, very nice document, very good descriptions of a number of different measurements and also statistical protocol for analyzing your data if you're interested in doing that. The third one is a monitoring manual that recently was published, and I'll also mentioned this is available through the University of Arizona Press and also, you can download it from the Jornada Experimental Range website, if you just put Jornada Experimental Range into your, into Google or one of the other the search engines you'll come up with this and there is also a data base, a field data entry system that can be downloaded that will automatically generate the indicators as soon as you enter the data and that can make things a lot easier if you're out in the field and you happen to have a laptop that you can take out with you or this is also designed for use with tablet PCs. That data base also includes the forms, the evaluation forms from interpreting indicators of rangeland health, so, you can make your evaluations instead of having to copy the individual ratings down into the attribute ratings, it

will do that automatically for you and then hopefully, since you've got that out there anyway, you'll be encouraged to collect a few quantitative data along with it and finally, a reference that I've found extremely useful , the Bureau of Land Management in conjunction with the forest service and NRCS put together a sampling vegetation attributes document and that's a very well written document, it has a number of methods in it as well. I'm gonna switch before my final slide to the overhead projector and just highlight page 13 where we have the, each of the three attributes listed on the left side of the table and the indicators associated with each attribute and then some of the key quantitative assessment indicators and then over on the right side, we've listed some of the measurements that can be used for each of these quantitative indicators and the numbers to the right of those refer to three of the references that I just discussed and these are listed, all three of these references are listed in the technical reference, they're listed up here at the top and they're provided in the bibliography and so, this is a good source to go to. There is also another source in the appendix that can be used. I'd like to finish up just, with a slide showing how easy it can be to collect quantitative data. The bare ground indicator is one that as I mentioned before is very easy to collect data on, do a page transect, count the number of points, point on the tip of your shoe ends up on bare ground. Bare ground also though talks about the spaces between the plants. One of the things that we started doing with ranchers is asking them to walk across their land and count the number of paces in which their boot falls entirely within a bare space. Obviously, the larger number, the higher number of paces that fall in a bare space, the more

bare ground you have in large patches and it's very easy to do, folks actually enjoy doing it and they can see the relevance because they can see that every time their foot land within a space entirely, the devoid of vegetation, the other indicators, water flow patterns, rills, pedestals and so forth are usually associated with those spaces, so, it's a really good way to teach folks about the relationship between the indicators. Now, people always give me a hard time and say well, yeah, but people's foot size vary, well that's true and if you really wanna find a lot of gaps, then put on a very small pair of shoes. We can't do anything about that, but, as a monitoring tool as long as folks are wearing approximately the same size of shoes, it works really well and it works with the rapid assessment protocol as well. I think that's all I've got Mike.

Great, thanks, thanks Jeff. We're going to go to questions now about the use of quantitative data. As we're waiting for that, we did have a question that came in yesterday and this is from Darwin in Idaho Falls, who is a soil scientist and he's using the NRCS soil erosion standard, mentions it on agricultural land, it's five tons per acre per year and suggests that on rangelands maybe two and a half tons per acre per year would be appropriate and it's kind of a two part question. I don't know, Pat, anything you'd like to say relative to the use of these erosion standards on rangelands and some of the models that might be associated with them?

Sure thank you Mike, I will be glad to do that. First of all, I wanna be sure and make the point as the question indicated that the five tons per acre allowable soil loss is on cropland and not on rangeland. The suggestion was made that perhaps two and a half tons would be more applicable to rangeland and talks about this being an NRCS standard and I wanna make sure that everyone knows that on rangeland the whole concept of (t) and the way (t) is measured is using some form of universal soil loss equation is not applicable at all on rangeland and we don't use it as an agency on rangeland, we do use it on cropland, we use what many of you will recognize as RUSSL, we don't use that on rangeland at all. We currently don't have any way to quantify soil erosion on rangeland very well. We're working with the Agricultural Research Service and some universities in the development of a model that is a combination of (WEPPT) Water Erosion Prediction Project Technology and the old spur simulated production and utilization on rangeland models, a combination of both two things to help develop a tool that we can use, but, right now, we don't have a good tool to quantitate soil erosion loss on rangeland.

Now, thanks Pat and just continuing with Darwin's question I guess, what he recommends is the use of the (3F) erosion bridge is a way to quantify soil erosion and Jeff, would you like to address that aspect of Darwin's question.

Thanks Mike, I would and I'd also like to just follow-up on what Pat said, the fact that we don't currently have a valid erosion model for rangeland is one of the

reasons why this process, interpreting indicators of rangeland health is so important, because it at least allows us to say some things about the, whether or not erosion is occurring or is likely to be occurring on a site using some of these soil type stability indicators. Now, there are some more quantitative things that we can do to measure soil loss and soil movement to a site and the erosion bridge is certainly one of them. We use this as a research tool frequently. One of the things that we've found is that it takes an awful lot of erosion bridge measurements to detect changes on a site in a statistically reliable manner. There is a real tendency to go out, at least I find, I always wanna put the erosion bridge down some place where I can see that soil movement is occurring, so, I tend to put it in water flow patterns and rills and sure, at that scale, you can detect change, but, you need to be real careful about where we decide to put these, whether they're randomly located and so forth and find it extrapolates the landscape scale. The other thing is that often there may be erosion occurring at one point in the landscape, deposition at another, we need to think about at what scale are we talking about soil from the landscape, soil loss from the landscape and finally with an erosion bridge, in particular, and I'm sure that the person writing the questions are aware of this limitation as well. It's very sensitive to things like frost-heave that are going to raise or lower the surface of the soil.

Well thanks Jeff. Any questions out here at this point?

I might add one more comment relative to the erosion on rangeland. One of the reasons that erosion on rangeland is difficult to measure and that the current or the old technology based on universal soil equation are difficult to apply is the fact that that technology is trying to measure erosion on a, if you will, a chronic time scale as opposed to an episodic time scale and erosion on rangeland is generally an episodic event and not a chronic event, so, it makes it extremely difficult to apply those technologies to that, to rangeland.

Let me add in also on this discussion about erosion and the different types of ways of which we can actually measure this. We're currently conducting some research where we're trying to put together some monitoring techniques on wildfire rehabilitation areas and one of the techniques that's been recommended is the one that the Forest Service soil engineers have developed, which is using some silt fences, a fairly simple approach as placing the silt fences down slope and actually measuring the amount of soil that is captured down slope from an area that has been treated, so, that's another technique that can be used that incorporates a little more of the whole hillside approach as opposed to very small levels to be able to access information in terms of soil losses and soil movement.