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WILD HORSE AND BURRO ADVISORY BOARD MEETING

MONDAY, SEPTEMBER 9, 2013, 1:00 p.m. ET

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We'll have a 15 minute late start. Thank you very much.

>> Let's all try to move into position so we get started here. Mike, do you have your recording? We're going, everybody set?

>> BOYD SPRATLING: Welcome, everybody, to the advisory board to the BLM. Welcome to those who are on the Internet watching what's going on here today. And welcome. We've got our crowd placed far back in the room. Welcome to everybody there. I'd like to go around the table if we could. Ant introduce the board members to the public if we could. Joan, would you mind starting?

>> JOAN GUILFOYLE: Sure. I'm Joan Guilfoyle, division chief of the wild horse and burro program.

>> TIM HARVEY: I'm Tim Harvey.

>> JUNE SEWING: June Sewing.

>> Robert Bray, research representative.

>> JULIE GLEASON: Public at large and cochair.

>> Neil Kornze, deputy bureau BLM.

>> BOYD SPRATLING: I'm Boyd Spratling. I'm a veterinarian from Nevada and I represent the veterinary medicine on the board.

>> CALLIE HENDRICKSON: Callie Hendrickson from Colorado. I represent the public.

>> JIM STEPHENSON: Jim Stephenson from Yakima, Washington. I represent natural resources.

>> JOHN FALEN: John Falen. I'm a rancher in Nevada and represent livestock.

>> DR. BOYD SPRATLING: At this point --

>> There's Kathie, right there. We're going to ask Kathie, our facilitator, to step up and make a few announcements.

>> One more.

>> Sorry, had an emergency.

>> RICK DANVIR: My name is Rick Danvir. I'm the wildlife representative on the board. Brand-new. First meeting.

>> KATHIE LIBBY: Well we certainly hope you choose to come back after this one. Good afternoon, everybody. Some of you online, perhaps good morning. I'm Kathie Libby. I'll be with you the next couple days. This is a critical meeting. We're appreciative for the National Academy folks who wrote the report and have come to share information and clarity on its findings and recommendations. I'd like to say a few words. And I'm going to be -- I don't want to turn my back to the board so I'm going to kind of do this. For those of us in the room this is primarily a board meeting so we do have this funny little demarcation line right here. And the folks who are speaking to the board will be at this table. And we ask that those of you with cameras, we have two sections set aside for standup cameras. Feel free to use those.

The viewing is a little obstructed on my right side, your left side of the room. So I see most of you smartly sat on the other side. We'll just do the best we can with all of that. Lovely to see some of you again. It is designed to be a board meeting but we do want to give our guests, the public, the best possible ability to see and hear the proceedings. So we designed these lovely little rules of the room. I think you all got a copy as you came in. Very briefly. So there is this demarcation line so that we -- you know, don't have folks coming up with cameras and pieces of paper and stuff for the board.

We do need everybody's ability or to increase everybody's ability to hear what is being said. So, if you would keep your conversations a little bit quiet. And we all need to make sure our cell phones are muted. And for our speakers and for the board members, you really do need to talk directly into the microphone. So let's do that it for everybody. I mentioned the camera spaces. They are available to everybody until we run out of space. So feel free to use those. We do a 2-hour public comment period tomorrow, two full hours. So we look forward to hearing from you at that time. There is a signup sheet in the back today and tomorrow. As usual, we will allocate time per speaker based on the number of people who wish to speak. There is a group doing a documentary. So there's some special filming going on these couple of days. By your presence here, you are giving permission for a head shot or something if that should occur. If you choose not to do that, would you please see one of the crew members and would somebody raise their hand. Thank you, behind you. Okay. Other than that, it's a full agenda. I'm going to turn it back over to Boyd and the board. Just want to say briefly that this afternoon we are really looking at issues of population. Tomorrow we'll get into AML and other issues. Working team go over that in the morning but we have presentations by Mike Coughenour and Robert Garrott this afternoon as listed in your agenda. We'll introduce them more specifically in a minute. Weaned do get a break for 30 minutes apted as you know, we will try our darndest to keep to our time. So that with we take a break, we hope to leave at 2:15 or whatever it said, 2:45 and we will return at 3:15 and start.

So we'll just try to keep to that so we can get out at a reasonable hour today. Any questions before I turn it back to Boyd? Okay.

>> DR. BOYD SPRATLING: At this point we're very pleased to have I guess it's

acting director -- what is the correct term. Deputy director. Principle deputy director to attend our meeting with us and have an opportunity to provide some remarks to us. And we'll give you that time to do that now.

>> NEIL KORNZE: Thank you, Boyd. Well, I appreciate being here with the board and everyone else who is able to join us today. This is a wild horse and burro program is one that the BLM invested a lot of time and passion in and something we care about a great deal. We have a tremendous number of very hard working people that care about these horses here and our Washington, D.C., staff and also across the country. So proud to be here on their behalf and just to say very briefly that I know you're going to be spending a fair amount of time talking with folks from the National Academy and folks would worked on the report issued in June and I'm so pleased that you're taking the time to do that. We've been digging into that report and we've got our team leads here in D.C. to interact with you on those discussions and also so that we can further attempt to really take the value that we can out of that report. So we will be excited to hear your reflections and thoughts and things you want to encourage us to focus on. We're very open to those ideas.

I will say that NAS study that came out in June, it came out and it is here at a critical time. We're seeing notable budget constraints. And there are also issues with drought across the west and range conditions and we're also seeing tightening of our long term holdings. So there are limiters. They're very real on the system. So we need to chart that course forward for positive future here. And I am proud that some progress has been made and some important areas notably. Earlier this year we put out a few policies related to humane care and we've got some additional policies that we're working on and improving. And that's something that we take very, very seriously. So we're taking important steps in that arena. And so I've had a little bit of time to visit with the board over lunch today and that was a pleasure to see all of you. And I will do my very best to get back over here potentially throughout your visit. I will have to leave shortly here but hope to see you all again before you leave, thank you.

>> DR. BOYD SPRATLING: Thank you. At this point we'll have the assistant director of renewable resources for the BLM.

>> thank you, I am Ed Roberson, assistant director of BLM for renewable resources and planning and as such one of the important programs that I oversee and get to work with at the wild horse and burro program and I was not able to be -- as the board members know, except for Rick who was not a board member at that time, welcome, I was not there. He might have been there. So I -- I was working on sage grouse issues. And Joan read a letter from me into the record for that meeting. And we are still challenged by the same challenges that we had at that time. As Neil mentioned, we have unprecedented budge the issues and issues where we've reached limitations on offerings holding and limitations and continued population growth on the rank. The challenges that we have that relate to keeping a thriving, healthy, productive natural environment while we work with wild horses and ensure their long-term viability and provide for uses, other uses of public land and provide for the wildlife that also depends on those resources. Those are our objectives. Those are our destination goals of trying to find that balance. And we continue to work on that balance as Neil said, we've made some continuous

improvements in the program but we're still challenged by some of the fundamental aspects of the population growth and the declining economy, the reduction in our adoption program. So there are less places that we are finding as homes for the animals and more challenges on the range as more and more people move close to our public land. As we look forward to these challenges, we have some guiding principles, I think, that that we are following and that I want to make quick because I know we started a little late. But we want to achieve our land health standards while attaining the appropriate management levels on range. We want to reduce the cost of managing Wild Horse and Burros at least the offerings cost and put more funding into on range management which is where we really need to focus and bringing science -- and that's what the next two days are about with the board and with the National Academy of Sciences representatives who will be presenting to the board and also the public who will be presenting their understandings of what is in the National Academy of Sciences has presented to us. That science and evidence-based management of the wild horse herds and the other resources that we manage, we want to promote partnerships for trained animals and Joan will talk a little bit about that. And how we can find a way to find more good homes for animals. If we do need to move them off range. Something that we continue to work on, I mentioned in my letter back in March we'll be working on transparency. We have to continue to improve communications and that's with the public, with ourselves and with the board. Those are the basic principles that we're trying to work on as we try to work towards success and will success look like? I believe I believe success to me is when we have obtained and we can maintain appropriate management level. We found that balance on the range. When horses that are gathered from the range do not need to go into long-term holding facilities. We found homes for those horses, again, trying to bring more science-based management on range, we hope to be able to balance that. And then most critically, especially in terms of declining budget is that the program becomes fiscally sustainable. Some of the challenges that National Academy of Sciences highlighted reflect back upon that fiscal financial sustainability. We'll explore this, Boyd and board members over the next two days and we'll explore with you after that. We look forward to hearing from the public tomorrow afternoon and thank you for coming all this way. We decided to have relatively low humidity in the area while you're here. For those who have trouble in the weather in the eastern states. Thank you.

>> DR. BOYD SPRATLING: Thank you. And be sure we reflect to Neil Kornze we appreciate his taking time to come across the creek and visit with us. At this time I assume everybody has read the minutes from our last meeting in Oklahoma City. I'll ask the board if they have any questions or revisions to those minutes.

>> Not at this time.

>> Seeing them we'll assume approval on those minutes. Joan, at this point, we'll get the response to our recommendations from the last meeting.

>> JOAN GUILFOYLE: Okay, you bet. Ask you to turn to tab 3 which is where they're outlined. I believe we did send these to you at the end of April so they shouldn't be new to you. These are the recommendations you gave us at the March meeting and our responses to those recommendations. So Rick and John, you may not have seen them. But here we go.

I'll just run through them quickly since you've seen them already. But the first recommendation was that the BLM become more involved in ecotourism and consider things about how that would look on the range. And our response was that we do accept that recommendation. We do plan to look at some HMAs that might be more appropriate for kind of locally community-based ecotourism as an opportunity. We think that's wonderful. We have our first sanctuary that opened up in Wyoming that is a model de facto because they're doing public tours and public information in concert with the local community.

So we accept that recommendation. And we will have a report for you after the Wyoming private eco sanctuary has a little more time under its belt doing these things. We're going to activate this more readily with you and one of the working groups.

Recommendation number 2 was that we establish nonreproducing herds and existing HAs and HMAs. Again, a lot of detail in that recommendation which you see there. And our response to this was that we also accept that recommendation and we would like the advisory board to form a working group to work with us on this.

And help us develop some criteria for that would look like, nonreproducing herds in certain HMAs or HAs and once we have that criteria from you, we would view that and bring it back to the board where we think that might work.

Recommendation number 3 was that we increase our focus and success on adoptions in the east. We completely agree with that. Accepted that recommendation as well. And I can share with you that we have decided to do an internal program review by some other directorate in the BLM on our whole adoption and sales program that has not had a serious evaluation of it, I think. And it's time to do that and we launched that about a month ago. I'm looking forward to the results of that from our own internal look. There are many, many ways we can think about doing various things on adoptions. And we wanted to have kind of an external party look at the system we have in place and help us figure out the inefficiencies, efficiencies and how to shape and adapt it. Because it's -- for reasons some in our control and some not in our control, the numbers of course have been dropping in terms of adoptions and sales in years.

Ed made a quick allusion to this and I'm going to give you my normal update on Wednesday because of the schedule today but we do have someone who is focus a lot on expanding our inmate training program which has been very successful in 6 to 7 prisons out west. Bringing some of those out east and trying to look at infrastructure in the east that we can more readily facilitate the adoption and sales of animals out east to good homes.

Recommendation number 4 was that the board form a working group on a resources working group. This would be a board-formed resource working group the purpose of which was to look at the resource itself meaning everything out there on the public lands. The interaction of the horses and burros and the habitat and make recommendations to us. We accept that recommendation as well and I don't know that the board has actually taken action on who would be on that yet.

>> We've actually got some names for that group. Except two of them have just termed out. So we'll probably have to have a recommendation on Wednesday to refill the names on that.

>> JOAN GUILFOYLE: Yes, actually, you're right. Two who were already off the board and one position that expires in March. So yep. Thank you, Boyd.

Recommendation number 5 was that the BLM look at the ovariectomy proposal you gave us as a population suppression tool. And I will say we have been looking at it quite seriously. We do have a request for information that is going out probably this week which asks for ideas, the whole gamut of ideas for really any population growth suppression method whether it be permanent or temporary through surgical pharmacological or chemical means. So we're looking -- actually, the research committee met -- I'm forgetting which month we met. But they recommended heavily that we kind of open the opportunity for people who may not have been involved with our work previously to submit ideas and proposals, so we're doing an RFI, which is a request for information, until we have the funds hopefully in 2014 to do an RFP which would enable us to fund any proposals that we felt were going to help us with that exploration. So we have made some progress on that. Not as quickly as I would have wanted. But it is progress in going the right direction. The last recommendation was that you recommended to us that ecosanctuaries not be considered on public HMA lands where horses currently exist. And our response to you on that is that when the new leadership is fully in place in the Department of Interior, we do know that you feel that way. And we will bring it up to that new leadership when it's in place. Right now we do have a new secretary but we don't have an assistant secretary. I don't know that we have a deputy secretary. I don't think we have that either, yet. And we don't have a BLM permanently appointed director yet. So our promise to you is that that idea will not be lost and it will be brought forth with the new leadership when they're in place.

So those are the recommendations, Boyd.

>> DR. BOYD SPRATLING: Any questions for Joan or her staff on that?

>> I have some more questions on the adoption program but what I'd like to do since we're under a tight time frame today is hold those until Wednesday morning when we possibly have more time and keep that item open as an action item.

>> JOAN GUILFOYLE: You bet.

>> JULIE GLEASON: Thank you.

>> JOAN GUILFOYLE: Boyd, would you -- I'm sorry. Is there anything else? I thought I'd quickly walk you through the tabs would you like me to do that as we normally do. Normally as you know, I'd be giving you a full update on this program at this point but since we're doing this board meeting specifically on NAS to focus on the science, I wouldn't do that. I'll give you a brief update on Wednesday morning before you go into discussion. I do have things to share with you. Just in terms of your book, tab 4, reminder, that is where the charter of the board and SOPs are, if you need to refer to those. Tab 5 is where all the guidance is which is any new instruction memorandums that we've issued since our March meeting. There is one in there for our program and one in there for the assistant director program, the renewable resources program about drought. And then the law, the 1971 law is under there as well in tab 5. So, if you need to refer to that. Tab 6 is U.S. Forest Service. There's nothing in there now I'm not sure if Charlie is going to have something to give you about, but it's there if he does. Tab 7 is for all the notes you want to take on presentations, normally we'd have updates but this is a different

scenario. So you have a lot of good paper there to take notes on the presentations from the NAS folks. And tab 8 is the news releases we've issued since our last meeting. Tab 9 is where we reinserted some of our program updates we normally give you. If you're interested in the budget and some other small things, those are in tab 9 and then tab 10 is the possibilities that we've received to date section. So that's all. Just in terms of what's in the book. And I did want to say, I appreciate the fact that the board saw the NAS report and what it said and didn't say and what it recommended and didn't recommend you saw as important and important enough to call a meeting. I'm happy the NAS is able to accommodate us. I don't know if anyone here from the National Research Council. Didn't get a good look at the crowd before but we're happy they were able to get folks who worked on the actual chapter so you can ask any questions you want of them and get more clarity. So that's all I have. Okay, thank you, Joan. That the point we'll move on to the Forest Service update and we'll have Charlie Richmond, the Director of Range Management for national forest system.

>> CHARLIE RICHMOND: Hopefully, this is on. Sounds like it is. Well, good afternoon. And thank you to the board for allowing the Forest Service to come present a very brief update on the Forest Service program.

I think our report is in the sleeve right behind your cover. Does everybody have that? Okay. Good. Well, good afternoon again, my name is Charlie Richmond. I'm the director of range lands management and vegetation ecology for the Forest Service.

And the management wild horse and burro program within the Forest Service lies within my staff area. I have several folks here with me today. Ralph, Barry and Tom manage the program for us in the Forest Service and they're here with me this afternoon and can answer any technical questions you might have throughout the week about our program. I wanted just to start off to say how much we appreciate the work that the board does. You folks have been at this for an awful long time. And we really value your expertise we couldn't do it without you. I've been in my position for about a year and a half. Before that, prior to that, I didn't have a whole lot of experience with the wild horse and burro program you but in that year and a half I learned very quickly how this program is. Conflicting Congressional direction. The downturn in the economy, polarized public opinion about the program, and of course our reduced budget all make it one of the most complex programs in the Forest Service.

While the Forest Service sometimes is in the shadows of the BLM because we have a much smaller program, we really have the same issues in the Forest Service. So you help us tremendously by bringing to the your diverse opinions and hopefully helping us have a more collaborative balanced strategy for this program so thank you for that. Within the Forest Service -- this has been said already -- we really value wild horses and burros as icons of our western heritage and we do understand the importance they play in ecological and economic fabric of many of our western communities.

But what we have -- unfortunately, what we've -- has happened to the Forest Service like I think the BLM also over the past few years is the number of horses has begun to exceed the capacity of the land. Over the last decade we've slowly begun

to notice the deterioration on watershed lands and some of our territories, not all of them but some of them.

I just wanted to give you a summarization of our program. We manage 54 territories within the Forest Service. We have a total of 2.5 million acres within those territories. Our appropriate management level or capacity within those territories is about 2500 animals. Today we have about 6800 animals as an estimate of horses on those territories. And then we have just under a thousand horses that we have removed from the national forest system over the past years that are in holding facilities managed by the BLM.

We are limited with the number of tools we have in terms of population control and especially with the amount of horses that we've been able to remove from the territories over the past few years. And that's led to the number of horses we have above our capacity. For example in 2013 estimate we'll remove about 300 horses from our territories and those 300 horses are mainly horses that through a court settlement in Oregon damage and resource impacts on endangered fish, we had a court settlement that we were to remove some horses and also horses in New Mexico where horses ventured on to private lands and the private landowner has requested we remove those horses. So those are where those 300 mainly come from.

But probably what concerns us most, if you really look at where we've been over the past few years, we think that those 6800 horses that we have on national forest system lands today in the next 10 years will be about 30,000 horses. And we're very concerned about that in terms of the impacts to the resources. Probably one thing we're focusing on most in terms of program is getting our territory plans and NEPA documents up to date. Especially on those territories that are way above what the capacity of the land is. So the next two or three years we're going to be working on four or five of those territories and getting our territory plans updated. The AML or appropriate management level revised. In summary as an agency that is really responsible for native ecosystems, we're trying to find that balance between protecting the native ecosystem and managing horses. And that's quite a challenge in today's world. We've been reviewing the NAS report and we look forward to working with you all week on and thank you for working with us on federal land agencies and wild horses.

>> Any questions for Charlie before you runoff. If not, thank you very much.

>> We'll be here.

>> DR. BOYD SPRATLING: Next, a representative from the Navajo nation.

>> We were advised that she was going to be a little late. And so she hasn't arrived yet. So why don't we, you may have something you'd like to do and if not, we'll catch her after the break or --

>> Mike Coughenour are you prepared to go ahead and start? That would be great. We'd like to thank very much, this is maybe kind of a -- not a rare but probably not a normal instance where the members of -- and the authors of the NAS report are willing to come and visit with us. And just clarification and delve into other issues that are involved with their study and their report. So we really do appreciate your traveling to Washington, D.C., to help with this.

>> MIKE COUGHENOUR: My pleasure, it is my pleasure to be here, ladies and

gentlemen of the advisory board.

I'm a research scientist from Colorado State University. Mainly an ecosystem scientist. But I also have some expertise in population ecology.

Okay. I'll just begin. I guess as the first speaker, I should sort of explain what we did as a committee. The BLM gave us a set of questions, charged us with a set of questions basically, to address during our deliberations. So that's what we did. We stuck very closely to the charge presented to us in those questions.

So these are the questions that were presented to us that pertain to population processes.

And the first one is would free-ranging horse and burro populations self-limit if they were not controlled? And if so, what indicators would be present at that point of self-limitation?

And the second question that pertains to population processes was: Is there compensatory reproduction as a result of population size control? Where compensatory reproduction means some increase in reproduction as a result of the management reductions? In order to understand these questions we need to understand concepts involved in population ecology. First of all, what is self-limitation and how does it occur? It's necessary for population processes somehow to respond to population density. Population growth rates or under like processes like birth and death rates have to respond to density. And that's why it's called density dependence. In this diagram, we show some of the linkages between climatic variation, resource or forage abundance. And population processes like population growth rate. And then the ultimate outcome of population size. Arrow at the bottom feeding back from population size and population growth rate is what we're talking about when we talk about density dependence. A little bit later in the talk I'm going to talk about density independence, which is the linkage between climatic variation and population processes.

This is a graph that I don't spend a lot of time on but I think it's important to understand sort of the basics of what was going on here. The top graph is a graph of the number or annual increments in the population. So it's basically the population growth rate. Versus time. This black line is a graph of the trajectory according to the classic logistic population growth curve which includes the carrying capacity term at which point the population self-limits and comes to some kind of theoretical equilibrium. What you want to also see is over time, the gray curve changes. And that is the annual increments and at some point in time, the annual increment is maximized and that takes place about half way up the population trajectory. Above that the annual increment or population growth rate starts to decline and eventually goes to zero in order for the population to stop growing essentially. So that's the underlying theory of density independence, it's long been part of this. The bottom graph is another way to look at it. Annual increment versus population size. So there's some points or some population size at which the annual increment is also maximized. If you get above that, the annual increment begins to decline because of self-limitation and if you get below that, it's lower because the population hasn't reached its inflection point where self-limitation starts to kick in.

All right, it's important to understand there's different concepts of carrying capacity: And first of all, there's what we call food limited or ecological carrying

capacity. That's what I've just been talking about and that's when a population comes into a quasi equilibrium with the food supply and/or predators. You might also talk about management level as being some kind of density capacity. That's different than this one. AML is more addressed to a stocking rates that preserves ecological balance of some sort. It doesn't really involve self-limitation. It's a different concept of carrying capacity. But some people think of it that way. There's also something called economic carrying capacity which is the level that maximizes animal productivity which is what a ranger might be interested in for example.

We looked into the literature of population ecology of course in for large herbivores as well as equids, horses and other species of wild Equids.

There's a lot of literature that says that large herbivores display density dependence in large places like South Africa. In North America too there's a lot of literature that shows that density dependence can happen. Populations can self-limit. There can be a feedback population density and population growth rate. In some cases that's the way the populations are controlled even though there's predators present. Literature shows that works by reduction in pregnancies, fecundity, twinning rates. Number of offspring per female and other population parameters. So there's a lot of evidence for it.

The basic nutritional and physiological mechanisms involve food limitation and the effects of food limitation on the condition of the animal, the energy balance of the animal and the subsequent effects of the nutritional status of the animal on population processes like reproductive and survival rates. Poor nutritional status can also impair animal feeding and predator avoidance and increased susceptible to adverse weather. And of course climatic conditions and spatial accessibility determine the available forage. There are also some behavioral mechanisms. There's two fundamental mechanisms that are involved in density dependence. One is increased dispersal. Two dispersal Sphinx as they're known. Migratory movements to go to areas where there's more forage. So eventually the animal distributions should come in to a proportion with the board's distribution on the landscape. Second way is through social interactions being affected. For example as you get more animals, there's more stress which might cause more rapid turnover in the tenure of males or increased competition among females which leads to female movement among groups. Density dependence can be included in models, mathematical models in different ways. One example is Argentina where they fit the logistification. And in order for it to work they had to have a carrying capacity term so there was some statistical evidence that the horses were starting to reach self-limitation at carrying capacity. Food limited carrying capacity.

Another example is a model of Kenyan zebra where density dependence was included as the ratio of rainfall which is a surrogate of food availability to density. And then a third and more much more elaborate approach is through the use of ecosystem population modeling where the energy balance of the animal is actually modeled as an outcome of the balance between forage intake and energy expenditure. And then the energy balance or condition affects the survival and the fecundity rates in the model. And the ecosystem part of the model is simulating the forage productivity and its responses to climate as well as herbivory. Foremost among those is climatic variation. Of course you have variable precipitation and

winter weather conditions affecting population growth. Precipitation can affect forage production and also affect forage availability in the winter when forage becomes covered with snow.

Periodic large mortality events in severe winters have been well documented. And these effects can be included into the models that I just mentioned. That's just a simple diagram showing the linkages between climate, forage, the amount of forage per animal, the body condition of the animal and the population processes. An important implication of density independence is that in climatically variable environments, herbivore populations should not be expected to reach a steady state in which population density is in some sort of stable equilibrium with forage production. So even though we like to think of a balance of nature or a balance between herbivores and forage or predators and prey, these density independent climatic fluctuations can prevent that from happening to some degree. Depending upon how variable it is.

And this is a diagram from a classic paper about educations of density dependence in a livestock population. But in large herbivore populations in general, what it's showing is that there is a large number of animals that can theoretically be supported if you figure out how much forage is out on the landscape in total. However, density independent factors like climatic variations keep the population knocked down below that level. So like a multiple year drought it will just knock it down and then it will take time for it to recover, and then at some point in time, it will get knocked down again.

It can get knocked down to a lesser degree with a single-year drought or to a greater degree with a multiple year drought. But those climatic events keep the population knocked down to something below what you might think would be supported with all of the forage on the landscape. That would be ideal. All right. We also looked at predation as a population process.

And there's a lot of concern about the lack of predators or potential effects of predators on horses. The literature shows that zebras and other ungulates are limited by predators in many cases and these are just a couple examples. In Namibia it was clear that zebras are regulated by predation more than food. In Kruger National Park in South Africa predation was considered of being a major population control in a collection of populations. In the Serengeti in Tanzania, study found predation rates on zebra were high and subjected predators were holding the population in something termed a predator pit. However, the evidence for that was somewhat inconclusive. We have two predators in North America that could potentially have an impact on horses or horses and burros. One of them is wolves and there are a few studies of interactions between wolves and horses. Some are very recent. In southern Europe there's some good evidence that equids are important in wolf diets. A recent study being conducted in northwestern Spain shows wolves are preying successfully on population free ranking ponies. In Alberta Canada, wolves have been reported to prey on horses. But they have not been shown to regulate the population. The bottom line is wolves can and will prey on horses when they had an opportunity to do that. The other predator is mountain lions. Mountain lion predation on free-ranking equids does occur but it's considered to be uncommon in North America. One population is the free ranging horse

population on the central California Nevada border and mountain lions are responsible for the deaths of 45% of the foals that were born, which is huge. Horses were considered prey in mountain lions in 8 mountain ranges throughout western Nevada. We heard about that during our committee meetings.

However, the potential for mountain lions to affect the size of the populations of horses in North America is limited by the fact that most HMAs are in areas that have few mountain lions. And it's probably in large part due to the fact that mountain lions are ambush predators and they require habitats that provide opportunities for stalking them and finding prey without being seen. And a lot of horse habitats don't have that kind of habitat for the lions.

Also among free ranging horse populations, foals are usual prey. Population size is not affected as much by foal survival as it is by adult survival.

All right. We're also asked about what happens when a population is allowed to reach self-limitation. Well, there's some theory about interactions between large herbivores and vegetation communities that goes back a ways.

That proposed that if you introduce a large herbivore -- and this comes out of some studies in New Zealand where large herbivores were introduced to a place they had never been before. And they theorized that when you introduce a large herbivore into a habitat like that and maybe an analogy would be North America without wild horses for hundreds of years -- but the first thing that would happen is the population would erupt into a larger size. And then that population would start to lead to a decline on vegetation conditions. Which would in turn feedback and lead to a decline in the large herbivore population and they would come into some sort of equilibrium. At the equilibrium, this new equilibrium with the large herbivores, you would expect the vegetation -- or you could expect the vegetation to be less productive, to have less biomass, to have a different plant species composition than it would with large herbivores. But nevertheless, it could be functional sustainable. So it could be different than without large herbivores but nevertheless, it could go on as a thriving system. It's a bit complicated. This is just a graph of the trajectory of the population that would erupt to some maximum level. Then it would start to have negative impacts on vegetation and decline and come into some lower equilibrium.

It's well known and many, many studies have shown that large herbivores have numerous effects on their environments resulting not only from eating but also from trampling and behavioral interactions with other species. If the feedback between equid population growth are ineffective, are if they've been disrupted by human activities, range land ecosystems can be pushed across a threshold into a degraded state. I'll talk more about that tomorrow with respect to chapter 7. So it's not necessarily a perfectly equilibrial world out there. There is a danger of disrupting the feedback mechanisms to vegetation and that can lead to degraded conditions. But it's not a universal phenomena. It has to be studied or predicted. Another thing you can expect is that grazing structure can be expected to be spatial heterogenous. Some areas perhaps heavily grazed and others would be little used because it's too far from water maybe or some sort of topographic barrier. You can't think of the landscape as being universally grazed or respond uniformly to herbivory. You can expect horses to be in poorer body condition than on average. Mortality will be greater in times of food shortage resulting from drought or severe winter weather. If

you let the population self-limit, the animals will probably be in lower body condition and there will be significant mortality events resulting from starvation.

During periods of food limitation. It's difficult to generalize about the role of food limitation. Indeed many herbivore populations are regulated through food limitation, that's a natural process. Predation is a factor in many large herbivore populations and some equid populations. However, in North America, predators are absent or present at low densities. The ranges of wolves in the course hardly overlap at all in the North America and the ranges of mountain lions and horses land to a small degree and they're limited to certain habitats. Another factor that makes it difficult situation is that the degree of naturalness has been affected by other activity that are like land use and barriers to movement and so on and so forth. Previous grazing histories by livestock. So the extent to which the system can be natural regulated has to be considered in light of that studies where courses have been allowed to self-regulate. One is in central Australia. 2 is 6,000 animals the numbers increased and decreased in response to a drought which does suggest there was food limitation. High densities were associated with degradation but it was difficult to definitively prove that it was due to horses because of other impacts on -- of other factors on vegetation.

Argentina a population was allowed to increase. And naturally, and it increased according to a logistic curve. It was starting to show signs of density dependence before they decided to carry out some reductions. It was all consistent with the theory that fecundity would be reduced to higher densities through reduced pregnancy. With the vegetation there was reduced plant cover, reduced plant diversity and species evenness and there was an effect on the wildlife.

Another example is in Shackleford Banks on the east coast. Population was allowed to reach its own self-limitation. It was clear through studies carried out and just the condition of the animals that population was being food limited. When they removed competing domestic livestock from the islands, that resulted in increase in horse body condition in numbers which is another bit of evidence that food limitation is going on. There was some important behavioral responses like decreased hearing stability. Then the vegetation was clearly affected. There was decreased plant cover. Increased bird diversity and increased fish diversity. For example. So the habitat was affected by the animals and that's -- that was the outcome. Another interesting example is the Netherlands in a reserve called the Oostvaardersplasen. There were a couple international committees to oversee and examine the way it was being managed because it became very controversial. ICMO. I was on the first one in 2006. So that's how I knew about this. It's a reserve where the idea was to try to make it as natural as possible without human interference. So they introduced three species of human herbivores that resembled the Pleistocene species. And one of them was an equid horse, Conic horses. And they let them go to food limitation. As a result, they saw food limitation and periodic large winter die offs with a lot of dying animals. And then the public wasn't very happy with seeing those animals dying. It's very small reserve and people can easily see the animals. It's not like a huge expanses we have in the west here. And what they decided to do was to call the dying animals unethical grounds. Maybe limiting what a predator would do. But it still allows food limitation to take place. They also considered the animal welfare.

And of course they had impacts on vegetation. The vegetation is clearly affected by the herbivory. And a lot of the changes are actually considered to be beneficial. The final case study is the Pryor mountains in southern Montana, northern Wyoming. I have the opportunity to work on the system itself and became quite familiar with it. And these horses were there since at least 1901 when there was photographic evidence. They were probably there long before that. Possibly as early as the 1700s. They were wild and they must have self-regulated somehow for hundreds of years. But then the BLM started to manage them in 1971. And they have been intensively managed ever since then and intensively studied, interestingly, all they've been reduced in number since 1971, range condition is still considered to be unhealthy. This is interesting because one of the outcomes is supposed to be improvement of range condition but it hasn't been documented that's what's happened. An ecosystem population modeling exercise predicted what would happen at food limited carrying capacity and it was able to represent the underlying processes and it predicted a number of animals at self-limitation that was about equal to what was found there originally in 1970. Compensatory growth issue, first of all, horse and burro populations are seldom limited by density because they're carried below food capacity. I think Bob Garrott will talk more about that today. So the population is likely to be kept down below a level that involves maximum population growth rate. And it might be kept at a level that maximizes population growth rate. And I want to go back to this that I showed earlier and there were some misconceptions or oversimplifications in the press reports that came out after our report came out. Where they were interpreting what we said to mean that management reductions lead to increased numbers of animals. That does occur under certain set of conditions, but it's an oversimplification. What happens is if you have a population here that's fairly high up here and you reduce animals down to this level here, look what's happening to the population growth curve. It is going to be going up. You're going to be taking it to its maximum level. Then you can go further and reduce the population down here, then you'll start to reduce population growth rate. You have to really knock the population down below that hump and that curve to be able to get a handle on it to the point where you're actually reducing the annual increments. So it can go both ways, management renewals can either stimulator they can reduce a population increments. There was an example of compensatory growth at Chicoteague versus Assateague, a study chairing those populations. One population was heavily managed and the other one was not. Higher foaling rates was observed in the population that was managed with foal removals which you might consider to be compensatory growth. They talked about this being due to a says session of lactational anestrus, but they didn't present any evidence of that. However, it was possible that the pregnancy and foaling rates were reduced in lactating mares because of low body condition produced by the lactation. That could be an underlying mechanism of the higher foaling rate or conversely lower foaling rates in unmanaged populations.

But the BLM doesn't manage horses this way anyway. So it's kind of irrelevant. The BLM doesn't manage through foal removals. So that mechanism is kind of irrelevant. The other question about compensatory growth is it has been alleged that PZP can cause compensatory population growth. This was studied on a population

over on Assateague. Body condition in mares could have increased because of reduced competition for forage. In the treated mares, contraception reduces the energetic costs of reproduction. This also results from increased body condition and longer life span that's just a result of, of not being pregnant. This could be the term compensatory population growth. A stimulation population growth to a small degree. But it's very unlikely that this degree of compensation would be sufficient to overcome the degree to which contraception reduces reproduction population growth so that the negative effects of the contraception are going to be far greater than the positive effects. And that's all I have to say and I'd be happy to take any questions.

>> DR. BOYD SPRATLING: Do we have any questions?

>> Thank you very much more the clarification. I was just wondering were you -- I don't remember if you said you were able to be with the Pryor?

>> MIKE COUGHENOUR: Yes.

>> CALLIE HENDRICKSON: Could you describe what kind of shape in '71 the range was. You say poor condition, but how far that's one of my concerns in our west. In the dry country we don't recover. If we think we're going to recover in just a few years we're afraid we're going to get moisture, that doesn't happen. I wonder how severe it was or not.

>> MIKE COUGHENOUR: The reports in the range assessments were carried out at that time by the BLM. And it clearly showed the range was in poor to fair condition. There was no doubt about that. There were probably parts of the landscape that weren't as in poor condition as others, probably areas that were further from water because water hadn't been fully back then. There had also been a history of livestock grazing, heavy livestock grazing by sheep and cattle for a number of years. So that had to have an impact. It shouldn't necessarily all going to be attributed to the horses.

>> Right.

>> MIKE COUGHENOUR: So .

>> Callie: If I could do a follow-up to that so in areas not as heavily impacted further from water, do you know if that was recovered better than that had been so impacted. That's a pretty detailed question, I understand. The most recent assessment I had seen by the BLM actually by the NRCS and it was a very thorough assessment. And it also showed the range was still in fair condition, poor to fair condition. But anecdotal comments have been out there about it being in better shape than it was in '71. The people who were there in the early days in '71. Saw it then. Came back later, felt it was in better shape recently than it was back then. But I wouldn't call that a scientific assessment.

>> I have a couple questions. Before I do, I want to introduce you for introducing you properly.

>> DR. BOYD SPRATLING: He has a Ph.D. from Colorado State University. My concern -- the trouble I had in deal with density dependence population dynamics here, all the discussion involves no record for -- it's as if we're in a vacuum. You're in a void where horses are the only impact to that situation. And we're talking about forage levels, body conditions improving. Mares will breed, foals will survive. Population will increase. What happens from your perspective, I know you fully understand. What happens when an animal goes above the carrying capacity for

that land? Does the land actually collapse first or the horse population?

>> MIKE COUGHENOUR: That's a complicated question. I wouldn't want to make a generalization about that. But I would say if you introduced a large herbivore population where it had not been present before, the first thing that would happen would be some sort of a decline vegetation conditions. That would happen before the quasi equilibrium would be reached between vegetation and herbivores. But in the case where there's been previous herbivory either by horses or by love stock or wildlife and the vegetation has already experienced some level of herbivory, I would expect that response to be less pronounced because of the previous herbivory.

So it's a gray area. But you know, it's something that can be assessed, I think.

>> DR. BOYD SPRATLING: You did talk about range lands or forest -- or just composition on those range lands -- could decrease through a threshold to where that range would be essentially altered in the future.

>> MIKE COUGHENOUR: Absolutely.

>> DR. BOYD SPRATLING: I just wanted to emphasize that point. That could happen as we're going through this cycling up and down in this population.

>> MIKE COUGHENOUR: Yeah. It's an important point. It's not necessarily an equilibrium world out there. And I will talk about that more tomorrow. In the ALM section. We now know there are thresholds between alternate stable states and you can push a system beyond a threshold where it becomes something entirely different and then it's stuck there. And it's very difficult or impossible to get out of that. And you have to know what to look for if you're -- whether or not you're approaching such a threshold. And we're just starting to understand those sorts of things in range lands. But that's the state of the times actually.

And recognizing that those thresholds exist and the new approach to assessing range land condition that accounts for that and mandates and assessments of how close you are to a threshold and whether or not you're in an alternate stable state and so forth.

>> DR. BOYD SPRATLING: When we're talking about those thresholds and descending through one possibly in a certain given range, is it more likely to send through a threshold in a low precipitation, high elevation brittle environment as opposed to an area that perhaps has better precipitation and more abundant grasses? (off mic) I would say that would be accurate, yes.

The higher precipitation or the more productive system should have a higher degree of resistant to those perturbations. What can push the system across the threshold is the combined action or the combined outcome of a climatic event like a drought or something and a high stocking rates. You know, and then combined stress can push it across one of those thresholds.

>> DR. BOYD SPRATLING: And one final question if I could. Knowing what you know about herbivores and I -- from what I've observed, horses are quite intimidating, highly mobile species, what would you say as we get to that population where we're talking about there has to be a reduction, forage production to get for the horse numbers to come up here and start to level off and start to decline. If you're looking at that as horses as opposed to prong horn or mule deer, elk. To a lesser extent, which species would essentially last the longest and still be seen in that area before they start to -- population tipped?

>> MIKE: Horses are capable of surviving in very marginal conditions, as you know. Conditions might be marginal because of climate or they might be marginal because of the high level of herbivory that they've imposed. It's amazing when you go to the Pryors and you look at vegetation that they're able to survive on. That's in large part due to herbivory. Because they're able to graze down to that level and subsist, very marginal set of conditions with respect to vegetation biomass, I would say the horses would probably be more likely to --

>> DR. BOYD SPRATLING: I think perhaps we're agreeing that horses are very rigorous viable animal out there.

>> MIKE: Definitely.

>> DR. BOYD SPRATLING: Would you agree there would be impacts to other wildlife horses go through that stage and density dependence drop in other population, would other wildlife be affected at that point?

>> MIKE COUGHENOUR: Yes, studies clearly show that horses affect other species in a lot of ways.

>> DR. BOYD SPRATLING: Don't want to dominate this. Any other questions?

>> A little bit of what you were just addressing. R, Boyd, is my understanding -- what I'm listening to is because the horses are a little more adaptable or a lot more adaptable than some of the other wildlife species, in order to get to the self-regulating state. They're going to be almost like the last man standing. Is that what I'm understanding?

>> In other words that can be competitive dominance over --

>> They're going to be competitively dominant by the fact that if they take away enough of the vegetation that the other species that are maybe a little more vegetative specific in what they can feed on have to -- you know, they die off or migrate off whatever they have to do because there's nothing there. So I'm thinking of tiers, Michael, of you know, looking at tier number 5 between the horse and you know, maybe in one and deer at 3 or whatever. And so I'm just -- I'm just -- what I'm trying to get a handle on is if you allow these -- the horses to self-regulate, what's the collateral damage? Is that something that your study that you've looked at -- because we'd have to look at not just the horses but we have to look at the collateral aspects of allowing the horses to go to that stage. And I think that's something that needs to be considered looking at that as an option or not.

>> I agree you do need to look at that. And I also agree that they do have impacts on vegetation and other species of wildlife and they do have the ability to markedly alter the habitats for other wildlife species. But I also don't care to generalize to that he agree where you're going to necessarily extirpate all the wildlife or all the vegetation species. The habitats can be spatially structured in such a way that there's refugia for certain wildlife species. For example, there can be differences in diets between wildlife and horses like between bighorn sheep and horses in the pryors, they were eating different things. So even though the horses were there and grazing the grass down like this, the sheep had shrubs to subsist on and the horses hardly touched that.

>> TIM HARVEY: That's what I'm trying to figure out. That's what I'm asking. It's not just a cut and dried issue.

>> MIKE COUGHENOUR: No, in fact, horses can positively influence the habitat

for some species, there's birds that require short vegetation horses and burros at and horses can create those habitats for them.

So it's -- we can't just generalize. You have to recognize the heterogeneity of the habitats and diversity of responses for different wildlife species.

>> Thanks.

>> DR. BOYD SPRATLING: Dr. Coughenour, we appreciate your time and coming to grips with our questions. Is Roxie June here?

>> We're going to hope that she will arrive prior to -- or just after our break.

>> DR. BOYD SPRATLING: Okay. So you're suggesting we now?

>> That's what I would suggest. Yes. And Dr. Coughenour, thank you so very much. We're miraculously exactly on the schedule. We're using the right amount of time for everything as you always do. So I would like to suggest that we reconvene at 3:00. So we just cut 5 minutes off your break.

>> DR. BOYD SPRATLING: Okay. We'll be back here at 3:00 to start.

(A break was taken.)

>> Okay, hi, everybody. We're going to get started in two minutes. So, if you would take your seats and finish up your conferences. I can't couldn't see because I can't see that side of the room. But Carol Lanne of the National Research Council National Academy of Sciences is here and she was very involved in the coordination of this report. I wonder if she would take a moment to explain in digs to the 11 questions that the BLM asked of the NAS, what the -- what the report did and didn't cover intensely just to help it be more clear why some things may be in and some things may not be in and what you're leaving it to us to kind of do with the report if you wouldn't mind.

>> Sure. Thank you, again for making the report your focus of this meeting. My name is Kara Laney. I'm the study director for this particular project. And I'm a program officer at the National Research Council.

As you'll find had your report on page 2 and 3 in the summary and then again on page 16 and 17, that's a statement of tasks that the BLM and NAS agreed that the committee would look at. Following that there's a section in the report called bounds of the study which goes through what we were asked to look at and what we weren't asked to look at. As you're all aware there are many issues that are not related to science but national research committees are commissioned to look at science-based questions so that lends itself to the nature of the questions that are part of the statement of task which have to do with population estimates, range land estimates. Population growth. Genetic diversity population control. Things outside the bounds of science supp as how many animals should be on the range -- because that's a policy question, not a science question. Forage can tell you how much forage, how animals may use the forage, how different animals may use the forage but how many animals you're going to have out there and what kind of animals they're going to -- for instance livestock and wildlife or some of all. That's a question for policy makers to make. So the purpose of the report in answering the science question is they can inform the policy conditions. That's the role of BLM. Not the committee.

>> And Kara, if you don't mind just for clarification, what BLM asked the NAS to do was look at these 11 questions about the science of the animals on the range.

But not to look at perhaps the multi use nature of the rest of the agency for example. Is that right?

>> KARA LANEY: Yes, things like whether the law could be changed, whether different laws perhaps conflict with the Wild Horse and Burro should be changed, whether the allocations can be changed. Those are policy conditions that the policy was not asked to look for?

>> JOAN GUILFOYLE: And the logistical political educations that were asked for that were science based you're leaving up it up to the receiving agency to determine the feasibility of some of it.

>> KARA: Correct. So the budget associated with recommended actions was not part of the committee's purview. As you'll note in the report, we do find that -- we do go so far as to say an option will be expensive such as continuing to move horses to long-term holding will be expensive and the committee thought that its recommendations would be less expensive in the long run. You about we don't go through and put a financial -- attach a number to those actions or to the actions of gathering animals, implementing fertility control, anything of that nature.

>> JOAN GUILFOYLE: Boyd, just one more thing if I could add. The NAS, if I can say for Kara just for a moment, was concerned just as we were that there were a lot of interpretations about the report immediately after it was filed and to look at how we could correct that or they would correct that. They did do a posting on the Web site and I don't know if you're going to be here, Kara but I'd like that to be part of what we share with everybody.

>> Sure, I plan to be here the whole time.

>> JOAN GUILFOYLE: So we can go over that briefly now or wait until public comment period or Wednesday morning. It doesn't matter. But I want to make sure that you all hear what they felt the media had misunderstood about the report and to be clear about what they said.

>> DR. BOYD SPRATLING: Kara, just so you know, we're going to take latitude as a board to ask questions while we have experts in the room. We fully understand that a lot of the questions we ask were not part of the boundaries of the study and report. While we have people here that understand the dynamics out here, we'd like to ask questions to help us from our recommendations to the BLM.

>> Please make use of our expertise, they're helpful to us and I hope they'll be helpful to you, too.

>> DR. BOYD SPRATLING: Thank you. Next I'd like to introduce Dr. Robert Garrott. He's a faculty member of the Department of Ecology at Montana State University.

>> ROBERT GARROTT: Thanks. I have two back to back talks, one dealing with estimated population size and growth rates. And then I'll give another one on chapter 6 as well.

So, as everybody can imagine, how many horse there are out there and how fast they grow is basic fundamental actions for the BLM might take. So our job in this chapter was to look at those things and the objectives within that chapter was to review the method used to inventory horses by the BLM and provide potential recommendations for improving the methods. And thirdly to review the data available to estimate growth rates. Typical growth rates of course on western range lands.

BLM spends about 1% of the wild horse and burro budget. Inventories horses, make sure the animals are accounted, HMA herd management area periodically and those counts are then used as your foundational knowledge for population management. Key attributes of any scientifically rigorous are good survey method. Scientific standpoint is that the methodologies be rigorous and standardized, that there be a statistical basis for how that's done. That they're consistently applied, they're well documented and that the data that comes from these are complete, organized, and accessible. So that's sort of the gold standard for what we're looking for in a scientific inventory program for wildlife. Our expectations before we actually looked at any of the BLM databased on our understanding of how the numbers will be generated and this partly comes from my experience in the 1980s when I worked on this issue by population dynamics of horses and potential of contraceptive control on horses in the 1980s and I worked with all the BLM offices was that there be a periodic count. So someone from the Bureau of Land Management most likely wind up in a helicopter or airplane and flew through the herd management area and counted all the horses they could see. That count could be reported as a population estimate which you see this column here in this fictitious table that's empty right now or that count could be modified to come up with a population estimate. If you think you counted them all, in other words, you had a perfect census of the heard management area, you just translate the number you counted into that population estimate. But in general what we do know about counting large mammals and many, many places is that we don't count them all. There's a bias, what proportion you counted can be use if you have an estimate of that or even ball park figure, you can take and modify your count for the proportion you think you actually counted or the proportion you missed and come up with a population estimate. For example if we counted 422 animals. And we thought we counted 80% of them, if you divided 422 by .8, you get an estimate of 527 animals on that herd management area you've accounted for approximating what you think you might have missed. But we also know that we don't have the budget or the agency doesn't have the budgets to count these populations every year. So, if you need a population every year. And you're not going to count those years and you have some way of projecting that population from one year when you did do the count to the next years when you don't do a count. And in general the expectation is you're going to multiply your population estimate in one year by what you think is a growth rate of that population over the next year. And in this case, this example, if think that the population is growing at 20% annually, we multiply 527 by 1.2 and we get an estimate the next year. And next year, 2003, there's no count, you do the same thing again. Get a population estimate. 2004, you get a count. You do whatever you're going to do to that count to turn that into a population estimate and that's -- with the expectation of what was being done with the Bureau of Land Management. Then of course for national statistics if you do that for herd management areas every year and you aggregate population estimates for all the herd management area, you get statistic how many horses you think are on the western range land throughout the west. So that was our expectation. And to see if that's what was actually being done, the NRC committee requested the BLM provide us records from 2000 to 2011 for all herd management area. The BLM was --'s response was that there was no -- excuse me. No

centralized database. The data was first among field office thought that request wasn't manageable for what they asked it to do, they thought what would be more manageable would be if we requested records from agencies and suggested a maximum of 40.

And so what we did is the committee selected the 40 HMAs that requested data for and these are the distributions of the sample of HMAs that we received data from BLM versus the number of HMAs based on criteria that were available to be sampled. So we got records from 40 HMAs represented there across those states based on the sample we requested.

And this is an example of what we got back. We provided BLM the national office a standardized table so we could get the data back in the same way. And I'm going to spend a little bit of time with this to point out some attributes of this. So this -- I'd say, is a typical record for one of the herds we saw. And you request see that there's attributes across the columns and there's data filled in and there's places where there aren't any data. So those are the actual population counts. And the first thing you can see is that they're irregular as far as when they were conducted. So sometimes we had two counts. Back to back and other times we had a year in between and sometimes in this case, a couple years in between. So there's some inconsistency on how frequently this herd counted.

There's a real inconsistency on when they were counted. And this is important because there's a birth pulse where the population increases because of foaling and then throughout the rest of the year, there's attrition, animals are being lost. If you count the animals at different times, you're counting for a different amount of the seasonal mortality that occurs. And it makes the data less comparable from year-to-year. So there's inconsistency in these records in timing of surveys. And here you can see that there's inconsistencies when the survey platform. Usually a helicopter was used. And then one year a fixed wing airplane was used probably because of logistics or perhaps budget. Fixed wings are much cheaper than helicopters. But the proportion of animals you can detect different survey platforms to be very different. So by changing your survey platforms from year-to-year, you're probably adding additional variability to the count data that has nothing to do with what the population is doing. It's due to your changes in the methodology you're using to count them. You can also see here that there's also incomplete counts. Here's that year that the fixed wing was used, only 70% of the area was surveyed. So that that adds a little bit of problem to interpreting those data as well. Now, if you look at the relationship between the population count and the reported population estimate. You see there's a difference in this. There's a first record. 190 were counted but population estimate was 164. You look over there at the last column on the right, the adjustment to the count was filled in as none.

But it -- but the numbers are reported as being different. We're not quite sure why those numbers were different there could be many reasons but we don't know why. If we go down this column and look at how that number changed between counts and the population estimate each year, you see this year, the population estimate was a little lower than the count. Next time that incomplete count was 60, for some reason it was a really low count. But the population estimate -- next year the population estimate was exactly the same. The next year it was counted, a little

bit higher than the count. Population estimate was a bit lower. Next year is much lower. Next year little bit lower. Next year could be accounted for if there's removal between population count and population estimate and that was accounted for. We also had data on all the removals so we had the ability to cross reference these data to see if some of the discrepancies especially if they're lower, sometimes that was the case. And then you had the years that there were no counts and the population was projected for those years as well. And we could find real consistencies if we adjusted the math just to see if there was a multiplier effect for population growth rate. If there was, it was very inconsistent from one projection to the next on the years that there weren't counts. Here's a different record that recommends another HMA that represents the best record we had at the 40. You can see that everything is consistent. Consistent use of both vehicles and horses. So these are ground counts, consistent time of the year, area was completely covered. Population counts were believed to be a census and they were always reported as population estimate. Herd happens to be one that the USGS was conducting research project on supported by the BLM and so this might be a reflection of a research activity this herd is very much like the prior herd where the horses are all known individually by color patterns, there's a lot of people to keep track of every horse. So this is an example of a small isolated herd. This would be represented of the horse record we received where there's very little data filled in. There's wide gaps, inconsistency where they're counted and no population estimates filled in at all. We can just assume that the count was projected as population estimates since nothing else was provided in this table. This gives you a representation of the types of data we received from the Bureau of Land Management from their inventory program. The other type of data you get is aggregated data which is reported on the BLM Web site that gives you an idea of the -- excuse me, trajectory of the population range wide population throughout the west. Each of the data that have been reported on the Web site. This is important because it's interpreted by public administrators. Gauge success of the program. It's used in formal government review programs from the government accounting office reviews. And foundational data for planning and budgetary decisions that go to the Congress as well. Given some of the data we saw in the field offices we weren't quite sure of the national number. We started a conversation with Bureau of Land Management national office asking for an explanation how those national statistics came about. We were provided no documentation linking the national statistic to the field office. We compared the field office data from the sample of 40 HMAs and looked at what was reported on the Web site for those HMAs that were aggregate for national statistic. So Web site reports the sum but it also reports the number of population estimate for each HMA. I'm sorry, I had surgery just a little while ago on my throat.

And so when we did that, we found quite a few discrepancies between the field office data provided to us in given years and what was reported on the Web site. And we received no explanation of those discrepancies. So we just link -- we can't adequately link the field data to the national statistics.

So the committee conclusion regarding quite a few methodological flaws, inconsistent methods. It was also noted very often and with the public gave us testimony about movement of horses among HMAs. Which can confound at the

HMA level that horses are freely moving back and forth and adds variability to interpreting data. These are just straight counts. Go up in a plane or helicopter and count all the animals you can see. So there's no statistical method so there's no proportion of animals detected which can be very substantial. The proportion that are missed. That's giving a statistical range in what's a plausible value given the data you collected and certainly inadequate recordkeeping and database management.

So we concluded that BLMs current herd inventory procedures don't meet the modern standards management applied for most other systems where we're required to inventory populations that we manage. Given how the data were collected and reported, we concluded that the population estimates that are provided are likely substantial underestimates simply because we know we don't count them all when we go up there and there wasn't in most population estimates counts weren't reported directly and if you didn't count them all, it would suggest that the population estimates that are reported are underestimates of the number of animals actually on the range.

We also noted that this is the exact same conclusions that were made 30 years ago by the NRC committee that was in place when I was doing my Ph.D. in the 1980s and so this has been and this seems to not have changed since the program began. We also noticed there are attempts to improve the inventory program.

2010 wild horse and burro management handbook is published a rigorous set of guidelines for survey techniques and these are an excellent set of guidelines that mimics what I dictated as what would be ideal attributes there at the beginning of my presentation. They've also been working hard to aggregate HMAs where there's a believe that horses are freely moving among HMAs and to essentially come up with more reasonable biological units to conduct surveys over which are called HMA complexes. So, if there's no fences or fences are permeable between herd management areas, aggregate them together. Census and manage that as one population so it's more interpretable data. That's an improvement or could be an improvement if it's implemented.

And finally, BLM has had a partnership with USGS for about a decade to develop and test statistic rigorous survey methods. There's a lot to be had from that 10 years as far as developing methodologies and horses can be counted well and scientifically rigorous. You can estimate detection probabilities and do a better job in that decade of collaboration certainly gives us some good science. So our recommendations for improving population monitoring is that those two things that have been initiated, those guidelines from the 2010 handbook and the HMA complex initiative that those things actually be implemented well and consistently across west and evaluated on a routine basis. We also suggest that BLM should consider more intensive monitoring for what we call sentinel herds. So I'll relate a little bit more to sentinel herds and why this is important, why we think this might be important in the presentation on the next chapter. But this is the idea that on some of your heards, a sample of your heards throughout the west that represent a diversity of ecological settings where BLM manages horses, that survey and inventory work should be done almost an annual basis in order to better understand population of horses. We recognize there's a budge teary constraint that's firing that most HMAs only be inventories every two, three, four years, but in order to get the foundational knowledge like population

dynamics, at least a sample should be monitored relatively routinely. Probably annually, to provide good data that can then feed into population management decisions and models that I'll talk about. We also recommend improved recordkeeping and development of a standardized and comprehensive database. And that all of this, inventory procedures. And data be made readily available to the public. We heard from a lot of public constituents that they don't trust the numbers, don't know where they come from and we think that that causes a lot of mistrust between many public groups that are concerned horse and burro management and the agency that's responsible for the management. Dealing with the second subject, population growth rates, our work primarily was limited to looking into literature review because there hasn't been a lot of data available to estimate growth rates. So we looked at the papers that were published in the literature to estimate growth rates. We did conduct one novel analysis that provides additional insight and we looked at the age structure of about 168,000 horses that had been removed from public lands in the west. To try to get additional insight. Essentially what we did is for each year, those horses are all age removed, that's a lot of horses each year. So what we could develop is a young of the year to adult ratio is. And this is what those data look like. So this is sort of a moving window average of the young of the year versus an adult ratio for the horses removed from the range each year.

And you can see that generally between 20 and 25 young of the year say per hundred adult horses so this is an index of population growth rate using those age data. We know that would be biased to growth rates because horses are moved to the range in order for it to be indicative of the actual growth rate, all the horses would have to be removed before the birth pulse. You had all the an halls that were going to die for the rest of the year up to the next birth pulse and ideally that's when you'd use these ratios since they're throughout many more months, it's providing a bit of an overestimate of population growth rate. But you can see where those numbers lie. So our conclusion is while growth rates certainly vary from one herd to the next and within a herd to the next both the population and age structure data from the horses removed is consistent with the idea that typical growth rates are probably in order of 15-20% annually. What's that mean? This is a graphic, a table, BLM estimates that there are 3,000 horses on public range lands in the west this year. If we want to project the number, say horses aren't managed based on the growth rate you multiply that 33,000 by 1.2. And these are the numbers you get from that. So 20% growth rate would lead to a population doubling every four years if they weren't actively managed and contribute willing in six years. If you look at the same data for 15% population growth rate, if left unmanaged, horses would double every five years. And triple every 8 years until they became food and water limited like we heard about from Mike in a previous presentation. But that growth would probably go for quite a while when we start seeing that food and water limitation throughout the west. So what's that mean, these sort of numbers mean as far as BLM's real dilemma and that is trying to manage the annual increment of horses so the population gets stabilized. So, if you multiply, this would be the annual increments for that 33,000 horses on the range that would accrue over one year, this current population if the populations were growing at 15 and 20% annually. You can see 6600 horses would be added to the population I'll point out that for 10 years BLM has been removing an average of 8700

horses a year from the western range lands. Considerably higher than that annual increment at 20%. And the national statistics would suggest that the population over that 10 years is approximately about the same. If the population is growing at 30% the BLM could remove an average of 8600 horses, I think that's additional evidence that there's more horses out there than the reported number. And it also provides evidence that these growth rates are realistic given that the off take of horses and the removal program. So what would that mean if we looked at that annual increment at the different population levels. This would be the number of horses that those different population leveled. You'd have to remove from the range land just to keep the population in any one of those years stable. We know we can only adopt anywhere between 2 to 4,000 maximum. That's the problem. And so you can see that there's two things that are going to affect the annual increment that has to be removed. The annual population growth rate and the number of horses you have on the range.

So, if the ultimate goal would be horse management in the west is to only have to remove the horses that you can readily adopt 0 so you can get rid of long-term and even short-term folding facilities, you have to get the annual increment down to between 2 and 4,000 horses and there's only two mechanisms to do that. And that would be to reduce the population growth rate which we have the NRC committee recommended at least three or four different fertility intervention technologies that could be used and/or you'd have to limit the number of horses on the range so that base population that that growth rate is acting on can meet those management objectives of 2-4,000 horses to be adopted.

So, in summary, we think the horse inventory procedures are not scientifically rigorous. That improvements to those inventory procedures have been initiated but we don't know the extent to which actually been manipulated. Our implemented, excuse me. And whether or not that's range wide throughout the west or not.

We definitely think that recordkeeping and database management has to be substantially improved. There's no clear linkage between the national statistics and field offices or at least it wasn't demonstrated to the committee. I'm sure there is a linkage but we don't know what that is or we couldn't cover that and horse populations are growing at 15-20% annually. And with that, entertain questions if we have time.

>> Thank you very much for that presentation. Do we have any questions from the board. (off mic).

>> Have you done -- in looking at nonlethal methods of slowing the growth rate, have -- with what -- what you've learned so far, do you feel that there is an opportunity to zero the growth rate based on the current population sizes?

>> ROBERT GARROTT: So the question -- I don't think the mic was working the question is do we think there's a possibility to stabilize the populations using only --

>> Correct with the current based population?

>> ROBERT GARROTT: That wasn't part of the charge of the NRC committee. I can tell you that there are a fair number of papers that were population models using horse data have been built and then what might be considered realistic fertility interventions with the tools available today and what might be viewed as realistic treatment levels have been applied. And, in general, those modeling experiments

would suggest that fertility control can help reduce the growth rate but it will probably be difficult to stabilize the population utility control alone. The fertility control is dependent on the number of the horses, the population of the population that can be treated. You can't tread them all or if they do, it can be very expensive or difficult. And so it can help the problem but fertility control at least in the current forms we have probably are not going to -- is not going to be able to essentially stabilize the population at whatever level.

So it can help. It can help substantially.

>> One of the tools that can be used.

>> ROBERT GARROTT: One of the tools, yes.

>> Thank you, again, appreciate that information and well-presented. I've got a couple of questions. So back to the estimating of the population size. And where you weren't, I have my note here, did you question the local offices. So my understanding is you had to go to the local offices to get the data that you did for each one of those 40, is that correct?

>> ROBERT GARROTT: Not quite. The NRC communicated only with the folks at the national office. So the national -- when we requested the data from the national office, the larger data request, the national office asked us if we would make a more modest request. We made a request to the national office. And I think they made a request to the field offices and then the data came through back to us through the national office. We didn't have communications with the field offices directly.

>> All right. Thank you for that clarification. So you've not had the opportunity to have the conversations with the local staff at all in any of the BLM offices?

>> ROBERT GARROTT: Not as part of the NRC committee.

>> Okay.

>> On the new ways of counting that have been put in the policy book, there's two, I can't remember what they're called. The handbook, yes. My question is are you familiar or have you seen them be what I guess I would refer to as ground troops or are they just models? I guess what I mean by that is for instance in the little book cliff because we do know how many horse there by name and picture. Have we flown that and done this process to verify that we are accurate?

>> That was one of the areas that USGS worked in. That they did do one of those survey methods which is called more creek capture where essentially that -- every animal's ID'd by his particular colors and patterns. They're all individually marked. They're intensively surveyed and known you actually very seldom do actually know the truth. So they use this herd because they did know the truth and then they applied a March creek capture technique where they didn't use the known identities of those horses but you fly once and you photograph bands of horses and you essentially mark those bands you saw by the coat colors of that aggregation of horses. Then you go out and do a second flight and now you're considering those groups being marked groups, you know them. You saw them in the first light. And you go out a second time and you fly and you see unique groups that you saw the second time that you didn't see the first time. You see the proportion of the marked groups that you saw in the first slide. And that can -- stat thickly adjusted -- statistically adjusted to allow you to estimate for the proportion

missed. So essentially you have your first flight identifies animals you know are out there. Groups you know are out there. Second time you don't see them all and you see new ones so that provides you a way of estimating the proportion missed where you don't have to know all the horses from the ground so you can do this on a -- on a herd where you don't have those individual IDs for all the animals. It does require, though, it's hard to believe that this technique would be used for population these horses. It's a methodology used for relatively small eyes isolated population where it's realistic to do that and it take quite a bit of manpower to go through those photographs and identify them all. So what USGS did is identified a suite of techniques and they evaluate several more that didn't work out very well.

And it would be that you're not going to use -- you probably wouldn't be using this same methodology for every herd management unit. You have a suite of scientifically rigorous methods that were matched to the ecological conditions and the survey conditions on the various ranges.

>> Thank you.

>> DR. BOYD SPRATLING: Dr. Bray.

>> Dr. Bray: Dr. Garrott? Robert Bray. Clearly you and your colleagues on the committee have provided a comprehensive review of the literature so thank you very much for that. You reference that the field data was -- could not be linked to the national statistics that were imported. Was there any pattern in those differences, less, more, highly variable. Any numbers to say they were consistently X percentage? Differences.

>> The only thing we'd have there is the population estimates reported for the 40 -- the sample 400 HMAs that we were given and compare that against what was on the Web site for those herd management units. And for those where we had the field population -- field office population estimates and we could compare with what was on the national Web site there was no consistency. Less or more?

>> I would also offer that of those 40 HMAs, I think something -- I have to look back at the report. I can't quite remember the figure but I think we only had about 50-60% of those population estimates filled in. From the field offices. But there were population estimates filled in in all the national statistic.

>> Was there a subsequent requests when you did not receive one the first time? Did you have a delivery request?

>> ROBERT GARROTT: There was about six months of communications back and forth to try to understand.

>> Dr. Bray: Is there any reason they were ignored or not responded to.

>> ROBERT GARROTT: They were always responded to. We always got responses and I think that the records of the committee would have all the email responses went back and forth about that except for a couple conference telephone calls that weren't recorded.

>> And finally with the 40 HMAs that you requested numbers from were they randomly selected or were they identified by the national law office as to what was going to be provided.

>> ROBERT GARROTT: No, the national office didn't select that. The committee selected that.

>> Was that random or how did you go about making those 40?

>> It was a systematic example and let me explain that a minute. We took the most recent population estimate for each HMA, we ordered based on population size, since we could only get 40, we decided we didn't want to burn up our sample of 40 by getting records for an HMA where there's only 12 horses or 30 horses, we wanted to have something that represented both a range of horse sizes but to get the best information we could from those 40. The present population had to be at least 40 or 50 animals. It couldn't be a mix of burros and horses because we wouldn't know how to split up that number between those two. So it was only horse only HMAs and then when we had that listing, then we took every third. So -- when that list -- we got a systematic sample across the range of horse sizes. That took us up to about 336 and then we added 4 in the 80s we he had population data that weren't on that list that would give us more data that could reflect population growth rates to bring it up to 40 and that's how it?

>> ROBERT BRAY: And one finally -- my voice normally carries so I don't worry about a microphone.

One final question, when you look at that pattern of differences between field data versus national numbers, can you give me a sense of high and low and how they varied? They were off by 4% or --

>> ROBERT GARROTT: All I can say is sometimes they were right on the money. It was exact same we got in the field office. Sometimes they might minor differences on the order of horses but it wasn't unfrequent, infrequent to have differences of hundreds of horses. And the proportion would depend on the herd. We looked for patterns. We looked for patterns and could not find consistent patterns. So I think the NRC committee report we said we think that the national estimates are based on probably many hundreds of somewhat subjective independent judgments because there were certainly judgments being made at the field offices when they reported population estimates. And there must have been judgments being made at the national office as well after they got the field data.

>> ROBERT BRAY: I probably know the answer to this. But 15-20% foaling rate, do you think that's a real number?

>> That wouldn't be the foaling rate, it would be population growth rate.

>> ROBERT BRAY: I'm sorry, do you think that's a real number.

>> ROBERT GARROTT: I'm not sure what you mean by that.

>> ROBERT BRAY: Do you think it could be substantially higher?

>> ROBERT GARROTT: Probably not. It's plausible based on the biology of the animals, but probably not much higher. Some of the literature has reported population growth rates up to 28%. And the way that's.

>> DON: I think in all of those records it's where you have a good sequence of population counts. Say, 8, 10 counts in consecutive years and you can look at the trend of those counts and estimated a growth rate from that and that particular methodology has generated some estimates of population growth that exceeds 20%, up to about 28% there's confidence limits on those and that's when those higher estimates would cover 20%.

>> That model wouldn't be based on accurate counts of animals.

>> It's .

>> You how do you define an accurate count if you don't know truth.

>> You could have some variability in what proportion you count every year but, if you had consistent methodology, and you counted those populations over a number of years, you could statistically estimate the growth rate even if you don't know the proportion you counted. And you get a legitimate and scientifically rigorous estimates of growth rate without knowing truth. How many horses are out there or any wildlife in our populations other than those few that are tracked by individual animals and they're all named and you've got 20 people growing up out there that loved him and watch them and keep an eye on them for you?

>> ROBERT BRAY: Thanks again.

>> ROBERT GARROTT: Yep.

>> I've got a couple questions on the growth rate, do you have a percentage of it's interesting, I spent my entire career working, one of the places I work is Yellowstone National Park and there's more science on the demography of one out population in Yellowstone National Park than this entire species on the western range lands and indeed there's been very little science done and most of it was done in the late 70s and 80s on population demography, growth rates, foaling rates, serious signs to understand horse vital rates, survival reproduction age first reproduction pregnancy rates. And so there isn't much science there and that's the idea of sentinel populations could help us get a little bit more of that. But certainly pregnancy rates at least 50-60% based on -- 50-60% pregnancy rates based again on research done way back in the 70s and 80s, where a lot of horses were bred and certainly levels were assayed for horses being removed from the range land and part of a big research project that I was part of there in the 80s. So the foaling rates, the pregnancy rates as much as we can tell in the foaling rates would certainly support the idea that populations could routinely be growing at 20%. (off mic).

>> That would be more valuable than the actual growth rate of the herd I think as far as knowing population growth expression. Am I incorrect in thinking that way?

>> ROBERT GARROTT: So you don't know which animals are pregnant or which animals are fertile most likely when you'd be treating them. So you're going to -- in a practical standpoint, you'd be treating at least mare oriented contraception. You could be -- wouldn't be able to carefully target which animals were probably treated. In order to do any effective management with contraception and I'll touch on that in the next presentation, you certainly have to have -- or I would think you'd want to have some model of population dynamics for the horse herd that includes pregnancy rates. As well as foal survival.

>> TIM HARVEY: That's where I'm going, I'm trying to figure out how many mares you would optimally treat to get that rate you're trying to get earlier to achieve the number of growth rate you were talking about that would be sustainable.

>> It would depend on the demography of the herd. So even though our conclusion is that typically herds in the west are growing on average of 15-20%. There are probably herds that are growing much less than that.

>> TIM HARVEY: I'm grasping for is there a number we need to treat 15% of the mares, 40%. The number that gets treated is quite low. So what I'm trying to get my mind around is mares need to be treated 0 on average. Can you comment or can you throw a number out there how many would have to be gathered and treated in order to affect some of the changes that we're looking to do?

>> ROBERT GARROTT: So effect some -- so -- there have been a number of population modeling studies looking at just that question. If your target is the reduced growth rates, and the mare that you stop from having a foal for a year or two is helping to contribute to that. If you're looking for a proportional decrease, it depends on what your state goal is. If it's to reduce the growth rate by at least half, I think all the studies that have been published thus far with limited demographic data on horses it would suggest that at a minimum for mare oriented couldn't Secretaries only you'd have to be treat -- couldn't sent only you'd have to be treating 20% of the mare. Chemical vasectomy could be used, no one has incorporated any modeling that experiments where both mare and stallion contraceptive tools were used in combination. The bottom line is that to have a noticeable and a measurable effect that you could measure with good population inventory techniques, you'd have to be treating at least 30-50% of the annuals, of the animals and you'd have to repeatedly do that at least for the mare oriented an animals that were available.

>> Can I follow up on that, you're saying you'd need to treat them. Is that accounting for the fact that only a certain percentage are going to be effective in contraception. Are you saying that 30-50% have to be contracepted or treated?

>> ROBERT GARROTT: We're getting way beyond the NRC report. The NRC didn't do any modeling of that. So I'm speaking partly from the modeling that's been done in the past of which I was part of when I was involved in the wild horse research in the past. I think that the NRC committee did strongly recommend that fertility control, there's been 30 years of research on fertility control specifically targeted horses. That the problem of excess horses as defined by appropriate management levels that BLM has now is a real issue I think you can see by the end of that presentation that reducing growth rates can contribute to helping BLM solve the problem. How it can contribute, how much it can provide, this would be a management experiment because nobody knows. But we do know there are multiple pools that can inhibit reproduction effective with side effects in the context of behavior in ways that were viewed to be acceptable. That could be applied. You about it's not something that we'd recommend that BLM be able to say that for the next 10 years, we're going to increment the number of horses treated with TZP or something by a thousand. It needs to be done if it was going to be credible, it needs to be done as science and as an experiment because it's very uncertain how much of an effect it can have. But we're very comfortable with the fact that it could have an effect. It could have a measurable effect.

>> Did you have a follow-up question?

>> TIM HARVEY: I'm just thinking numbers. I'm a numbers guy and I'm just listening to within 5-20% growth rate wondering what we have to do to get that growth rate down to something that can be handled by the adoption program. So looking at the growth rate and how does that shake out from foals in the ground and natural mortality westbound the herd? And you know, because that's going to knock that number down a little bit. I think that again we're outside the committee. Committee's work. But there was -- some work done outside of the committee. And it's a pretty easy math exercise if you look at that last table. If you applied if you enough horses on the range for horses, I think the upper level for appropriate management is something like 23 or 24,000 horses on the range land. If you had

that many horses on the range land and you reduce the growth rate by 50%, so dropping it down to 710%, you'd have annual -- 7-10%, you'd have annual increase 3,000 horses that could be adopted equivalent to adoption demand. So there is the potential that in the long run, effective application of contraception with a base population of what is your appropriate management level now, beyond appropriate management level could eliminate the need for removals beyond what the adoption demand can take. I'm saying that's not going to happen in a year. We're looking at -- you'd be looking at a fair amount of time to ratchet up to a nationwide program like that. And a fair amount of science to understand how to do that. But it's certainly within reason that that could happen.

>> TIM HARVEY: I think there needs to be activity going on that's what we're looking at as advisory board. We have to address this issue from a couple perspectives. One is crisis management situation that is looming over us, the elephant in the room. And then you've got the long-term. So in trying to come up with a process and a plan that allows you to basically address the problem from more than one perspective or angle, it seems to be the way to do it. The questions are geared at long-term management. One is not exclusive of the other.

>> ROBERT GARROTT: The crises you have now with the budget, BLM isn't going to remove as many horses this year from the range and they typically removed for the last 10 years which means that next year the annual increment will be bigger than it was this year because you didn't remove as many horses as you did last year and the year before. And so the longer the budget crisis that BLM faces now that's going to curtail the amount of money that can be applied to active management of horses on the range applied to horses that need to be maintained in long-term holding facilities that is a real problem that you have right now. Because the more money that has to go into that, the long-term holding facilities, less money you have to manage, if the budget stays the same. You have to maintain the horses in captivity. The only place it seems you have left to go is not to actively manage as many horses on the range, which means that there will be more out there and larger increments.

>> Page 22.

>> Yes, it?

>> TIM HARVEY: One of the things I find -- I don't know the right word for it. I'm looking at perceptions BLM is saying there's more horses out there. There's certain citizens groups that main there are nowhere near as many, many out there and have you guys come along with your study and this really is fond that there are a lot more horses out there and appear to be more horses out there than a lot of citizens think. And I think from an outside agency coming in with that information, I'm hoping will give some credibility to where the BLM stance has been on how to manage these horses in this crisis situation. I firmly believe the facts that you guys have presented. And I'm hoping that maybe the reason I'm kind of asking you to reiterate some of this reaffirm the validity of the percentages in the growth rates and stuff is so that maybe some of the citizens groups that have been fighting the BLM on some of these actions can maybe participate in the process to help instead of fight with them so much over it. And that there's -- the fact that an outside agency has come in and verified that these populations are growing at this exponential rate is really going to

create a really, really poor situation in a short period of time.

>> ROBERT GARROTT: The NRC committee certainly does not support the idea that removal program that BLM has had ongoing for the last 30 years is managing the population to extinction. And indeed, 195,000 horses have been removed from the range lands thus far, at least according to the records that the committee receives. And one can do the math on those removal rates and there has to be a substantial base population on the range in order to sustain 195,000 horses removed over that period of time. And the last 10 years on average 8700 horses have been removed from the range consistently over the last 10 years. And you saw when I added 33,000 multiplied by 1.2 at 20% annual growth rate, that only comes up with the 6600 animals. The disjunct there is we're not sure how the national statistics go with that.

>> When our facilitator starts to dance around over here, I know our time is limited.

>> That's extremely important.

>> It is important.

>> I really wanted to understand --

>> Unfortunately Dr. Garrott is going to give us the next presentation so we can carry over questions in the next segment. Joan?

>> JOAN GUILFOYLE: Thanks for saying you agree we're not managing these animals to extinction. I hope that is a myth that will now die. I appreciate that. I had a couple questions about what you said Bob we've been frustrated. Now that I see the best example and the worst example, I think I understand now why it's been difficult to get a grasp of this. So that was very illustrative. 179 HMAs, different methods, different timing, I can see it. I appreciate that you recognize that we have made improvements. A handbook, you're looking at complex as USGS methods that we've done training on twice with field people. When we read this chapter, we said absolutely yes and we have been able to put some money aside. I want the board to know, I'll update you on some of these things as we go along. We're able to get money into the USGS agreement to help us and be in charge of the design for our field folks on using these as a side or simultaneous double couldn't methods if those are the most appropriate and depending on the HMA, we absolutely agree. We have to know the number that we're talking about so we can do the rest of the management so thank you for that. And I'm -- I always say this when we get input from external folks that it really does help us -- helps me manage and improve the program and so this was -- this was -- this is an obvious one to us. We met with Dave Powell on the committee that Kara set up last Thursday and he did a presentation for us on all the chapters and to the chapter you're referring to, the population survey estimation one, one your recommendations is that we have' centralized database and we agree with that and would love to be able to do that. The interesting point he also made that in a lot of the public testimony that the committee got was really that the public, the people don't understand that data that we're putting out there. It isn't so much that we're trying to confuse anybody or hide anything. But they do not understand it. Which is our job to do a better job with that. I think not understanding and not believing, I appreciate that this report and U.S. GS's methods will enable us to convey what the actual facts are and that they won't

be disputed and they will be out there and clear for everyone to understand. So I wanted to say thank you. And Boyd, I don't know if -- the BLM as you know, we've been looking at this report quite heavily too and we do have a person in charge of looking at this chapter and I just wanted to invite that person, who I think is Dean, if you had any questions and comments and he's saying no. So that's all that I wanted to just do, Boyd, thank you.

>> DR. BOYD SPRATLING: Dr., I'd like you to go ahead and proceed on the next presentation of population models and evaluation of models.

>> As he gets a glass of water and rests his throat. I want to let you know, in order for everybody to hear you well, these microphones require that you do have them reasonably close. But also directionally, they almost have to be facing your mouth. (off mic).

>> Like that when you moved your microphone away.

>> ROBERT GARROTT: Chapter 6. NRC dealt with population models, statement and tasks to evaluate. Population models are models in general. And the first thing I'd like to say are some people think models are esoteric but they're actually extremely useful tools for any manager because you can understand they can understand and help explain and predict a dynamics of populations and we're all in the business of managing populations putting treatments on populations and some expectations of where they're going to go afterwards. Population models are very useful to any wildlife manager. In particular on this case where we're doing active management and maybe thinking about even some new and more aggressive management with new tools is allowing population models allow you to manage various treatment options that you might have and predict the consequences from alternative management action. It's useful in any agency. So objectives for the chapter was to provide a brief description for models that had been developed for wild horses over the years, in particular we were asked to evaluate the WinEquus model which is a model the BLM contracted to be used for management of wild horses in the west and also comment about alternative models that may also be useful. So that's what we'll cover here in this. WinEquus. Very briefly, the first population models for wild horses in the west were probably developed in the late '80s and early 1990s. I was part of the group of scientists doing that throughout the west when the same issue was really hot in the 80s when there was really aggressive removals going and excess of animals with no place to put them. Soon after basic models were developed and that was trying to put together enough survival and fecundity data to understand how these -- how these populations operated. Then once we had that, then we could start manipulating either survival or fecundity in models to look at various -- how those interventions would affect population size and growth rate so that really got started by the mid 1990s. And that's when the WinEquus model was developed as well. And then going down a little further. 2,000. Mike alluded to ecosystem models where you're modeling everything from the climate, its effects on the forage and plant base and all the herbivores, not just horses that might be off taking that forage and trying to understand essentially how horses fit into all these ecosystem processes and Mike was involved in that and 2000. So that's a brief history of types of models and when they were developed for horses. We believe we spent a lot of time looking at the WinEquus model because

this is the model that was built to inform routine BLM management of wild horses. It's individual based model which means the model is keeping track of every individual animal in the population whether it's male or female. Whether it's 2-year-old or 5-year-old or 25-year-old. So it's age and sex structured individually-based model. It provides output for up to 20-year prediction on the population given whatever you put in to the model. And it's used by all that -- am all the HMA planning that involves management interventions. So you see this model in all the intervention documents. The EAs and the gather plans.

The real strength of the model is it's easier to use with minimal train. It's flexible and you can change lots of input parameters and basic mechanisms influencing population like density dependence and how variable the climate is affecting vegetation. It effectively simulates management scenarios which at that time was female fertility control and removal or a combination of those two things. It provides informative output and it's very well documented. All models require data. What has to go into the model are some sort of initial age and sex distributions to the population being monitored. Age specific foaling rates and if desired, the user of that model can turn on parameter values that will implement density dependence which Mike talked about earlier as well as environmental casuistry, that's variation of the amount of forage that might be available based on climate. And of course interventions like removal and female contraception. The council reviewed HMA gather plans and what we saw was that in general the WinEquus model was used to assimilate alternative management actions for no removals to removals only. Maybe it's several different levels. And perhaps contraceptive treatments as well. The plans would provide basic model output in those plans, those gather plans, management plans. Often they were account and pasted from the computer output as an appendix and very often with no interpretation at all. So the output of the models is an appendix at the back of the report but no interpretation of the model. Based on both the reports and interactions with BLM, representatives, the committee really couldn't determine if the use of the WinEquus model actually informed the management decisions. Whether it was used to justify management decisions independent of the model results. Or whether it was simply a boilerplate requirement of management plans. In other words, planning management plan was written, it was required that everyone put some WinEquus model output in the plan and so it was run and put in the appendix. We just tell.

-- we just couldn't tell. It's probably or it could be a little bit of that each depending on which herd management plan you're looking at. Just couldn't tell. Not a weakness but something to consider with the WinEquus model is there are many decisions and assumptions in setting up that model. So somebody has to sit in front of a computer and actually make all those decisions and put those into the -- before they can run the model. Those decisions actually dictate the performance and output of the model. But WinEquus also has the ability for the user not to set any of those things. It just uses default data sets, default parameters. And so, if you choose not to do anything, you can open up the model and run it and not set anything because our default parameters that allow it to be run. The management plans typically didn't provide any of the information about how the model was set up for the run. So you get a simulation that was put in the management plan but all the information on how

the model was set up, whether or not density dependent was added to it, environmental stochasticity, what age specific survival and fecundity rates were being used as demographic of herd being modeled. So almost universally, not quite, like we looked at one management plan that did a very good job of telling us exactly how the model was set up before the run. But there was no information about how the model was set up for those particular runs. So without that information, a critical user can't really evaluate how well that model was mimicking that population and critically evaluate the output. Alternative models, we were asked to look at alternative models. The WinEquus model is a model built to emulate a population of horses and you're managing primarily on the population or HMA level. So looking into the future, so planning what kind of a population management BLM might use. In the future a little bit beyond WinEquus, in other words, things that could be done to improve a population model for the future would be to have survival and fecundity and age structure data that better matches the target population. WinEquus has three default data sets for these things that all come from three different herds that were researched in the '80s and whether or not any of those default parameter sets are even legitimate for those herds that they were generated from 20 or 30 years later. Might be a little bit questionable. There's a future to better match the populations you're going to be modeling and one thing that can be done is use herd specific age and data from gathers and removals. Often times those are substantial removals and they aren't selective. There's information on the age and sex structure from previous removals of the population that you're actually model for. They could be used rather than the default data set. This brings back the idea again of using demographic data from closely matched sentinel populations. So, if you improve inventory techniques and then you also identify a suite of populations that you apply those inventory techniques to routinely in extremely arid environments, mountainous snow environment, across a sample of populations that represent the difference with ecological settings that horses are found in throughout the west, then you could at least say that the herd I'm going to manage comes from a very arid desert environment and we have sentinel population that's provide fecundity and survival data that are similar to that, parameterize and model with that, it doesn't come from your herd but it's ecologically similar. So you have a suite of default data sets so you match the default data set that you're going to use with the ecological conditions of the population that you're modeling. It also might be important have the capability to model both male and female contraceptive techniques which the WinEquus couldn't do. If you can't get the population growth rate to meet your management objectives with just male or female contraceptive techniques, it may be a combination of the two can do a better job. Right now we have no models that can apply both removals, mare oriented contraception and male oriented contraception and it may be that that could be a useful addition in the future. If those sorts of interventions are going to be considered. The other thing we learned since WinEquus has been built there's been good studies where horses have been manage the pretty heavily with fertility control. These are primarily the Shackleford Banks and Assateague island situations and from those studies, as Mike alluded to, when you shut down reproduction in horses and don't have that additional energetic costs, they're healthier, they live longer. So there's a feedback there that we know enough about or start to know enough about

to be incorporated in population models future. Also in those studies, there's an indication that repeatedly for the PZP vaccines that if you readily treat mares with PZP, when you withdraw that treatment, more times animal has been treated with PZP, the longer it is for her to return fertility to the point with enough treatments they may indeed be sterile. These sorts of demographic feedback provide a means of trying to develop models that are more realistic for what we've learned in the science thus far. Another type of model that might be useful is a comprehensive model of the wild horse and burro program. So right now we're talking about models just for a specific herd unit. We know there's 172 of those out there. So that would all relate to the free ranging herd populations. BLM manages more horses in captivity than they do on the range. So entire program includes the demography of horses in short-term fast its and long-term facilities and movement of horses between those. That's your model. Having a more comprehensive program might provide insights for future, especially long range planning budgetary planning and things like that that could be helpful as well. Finally, a different type of model adaptive resource management models, short-term for it. ARMS. I think could be very useful moving forward. This is the idea that BLM managers need to make important decisions about what tools or combinations of tools they want to use to manage horse populations that's made with incomplete and imperfect information about how the horses will respond to management actions. Adaptive resource management models is a structured way to make decisions scientifically incredible manner where you continue to learn so you reduce the level of uncertainty as you continue on in the management program. The premise here is there's a lot of uncertainty and the more we could reduce the uncertainty, the better we could find management. Decisions have to be made in the face of that uncertainty we've got to manage even though we don't know perfectly how many animals are out there, how good the contraceptive treatments are going to be, what sort of feedback might be there and we have to keep making decisions over and over again. So, if we have monitoring in place or it could be implemented, then we can actually learn every time we make one of these management decisions. Here's the process. If we do X, Y, and Z, here's the objective. We want to reduce population growth rate from 20% to 10%. So we have an explicitly stated objective. We say okay, how can we get that done? With are our management alternatives. We could have PZP vaccine at a certain level. We could have chemical vasectomy at a certain level. Combination of those. Combination of removals and both fertility interventions, all the options available. And you make predictions about those options, which those options will best meet your management objectives or predicting will meet them. That's your population model. So you manipulate the population model based on interventions and make a prediction. That model was your best knowledge. That's your best guess, you implement it and follow up and monitor and see if you got what your model told you, whether or not did meet your objective? Were the predictions met? If they aren't, then you either chose the wrong management alternative or your model is not quite right yet. So you get chance then to go back and say well, I should have chosen another objective you need to change your model because there's other feedbacks we don't know. Next time you go back and make decision you've reduced uncertainty and you've improved your ability to manage over time. This ARMS model is being used to learn as you go because

managers are experimenters. They're researchers that learn how to do things better if you do it in a structured way and we think this could benefit BLM in the and the wild horse and burro program and models themselves if a model like this was implemented. So in summary, we think models are essential tools for management, that the WinEquus model is scientifically sound but its application for informing management has been poor or at least as much as we can understand from how it's being used with the documents. We think its implementation to help inform management has not been what it could be. We think substantial improvements could be made for planning future population management or improving on models existing. And we think models of free ranging and BLM could be useful especially in the context of the budgetary constraints you have. It costs a lot of money to manage the captive program, understanding the dynamics of that -- those captive horses and your options there and how that influences how much money you have for free-ranging horse management could be useful.

And we think implementing adaptive resource management models could strengthen the scientific credibility of the program going forward. With that if I have questions, I'll take them.

>> DR. BOYD SPRATLING: Questions. John.

>> I'd like to follow up on the adaptive management plan you've presented there because as you know, we're hogtied on a lot of avenues to control these horses. My question is of all the practices that you presented which of these do you think would be most likely to be able to be presented and get on the ground so they could actually control the number of foals being produced.

>> That's completely based on what's likely depends on the political actions taken by all the people that care about horses. I think that any combination of those three fundamental management actions you have, removals, female oriented fertility control or male oriented fertility control, all of them can help. They all have costs: They all have proponents and opponents. So the policy on what could be used effectively in the political arena I can't -- I can't tell you. But I can tell you that no matter what you do as -- no matter what the agency does, if there's no assessment of how well that is done then it's difficult to sell it to the public over time. So going out and saying well, next year we're going to treat 500 horses with some contraception, if there's no explicit objective, and no follow-up to tell how well you did, you simply will have a eroded public support for continuing along any track that you don't follow up with reasonable monitoring and something like this adaptive resource management model. Which tools you use, that say political decision and is right now an economic decision as well. None of them are cheap. If you believe that horses have to be active managed, that the public will not accept self-limitation as we heard about the consequences, that they have to be actively managed, all the active management tools you have are expensive. They're all invasive. They're all going to require capturing and handling a lot of horses which a lot of people don't like. And so there's going to be political obstacles to any of those tools or combination of those tools and I don't know how you get there.

>> From your perspective, do you think you got any choice?

>> ROBERT GARROTT: Well, you could just simply stop managing horses and they would self-limit. And I think you can look and see what's going on in Australia

right now with 400,000 horses and catastrophic mortality happening because of the drought and there's no reason to think that that wouldn't happen here. I think -- well, it would violate every mandate for responsible management of public uses. So I think you have to manage horses, yes. Most of us agree that self-limit is not an option. Then we have to go back under today's parameters we're operating under. To get a handle on foal crops. So, if that's what we're looking at, then we have to go back to what your suggesting, I think you're on the right track, getting it implemented is my biggest concern.

>> ROBERT GARROTT: There's only two ways to reduce the annual increment. You reduce the population growth rate and/or base population that's growing at that rate. So you have reproductive intervention of a suite of tools that can be used to reduce population growth rate and reducing the number of animals, base population, you only have one tool there right now and that's removal and captivity. That's expensive and prohibitive because you have no place to put them.

>> John: Alternative is expensive also. Thank you.

>> I have a quick question. I'm looking at the enormity of trying to implement these changes. I'm realizing this is outside injure study area. But it seems to me it would make sense to implement them and decide on a couple different passes. There is no one answer. We're looking at a quiver of arrows, not one silver bullet. Does it make sense for you -- for the BLM to perhaps select several HMAs that we would focus on and implement -- using several different tools and permutations of some of the things that you folks have come up with? And go head and implement some of these changes and see what the results are over a year or two. Rather than trying to broadcast every single horse on a ranch in 179 HMAs, as a scientist I would think it would make more sense to approach it individually so you can also see what's going on. You can then judge the results of what you're doing. A little bit easier?

>> ROBERT GARROTT: This is again where the agency is in a really hard spot. So, if you there's been 30 years of contraceptive research on wild horses and you could pick a couple HMAs in the west and do a several different types of treatments. You could have replicates. And you'll get good science out of that. You'll learn from that especially if will follow up well from treatment and modeling. So that's a dilemma. That's good science and you can do that at the small scale and be really cautious but you still have the issue you've got to do something with your annual increment right now. And so they aren't going to help you with the national level. They'll help you get good science and understand what the effects are of these controls. You know, that will be a 5, 10 year process to try to fine tune the technique. Reproductive inhibition techniques before you go a little more aggressively with the national population and mean while you're still going to have to take care of the annual increment. So whether or not BLM moved forward with any sort of management level applications of contraceptive treatments are keep it very small scale couple HMAs. That's a policy decision that needs to be made. Using sentinel populations to get more frequent and additional data. If you were -- wouldn't you also agree that those would be the places fairly quickly if you decided to start working on some of these sentinel population as that's that where we would do adoptive management experiments. More about demographically would be better places for to start and herds that are intractable or like a herd that only gets surveyed

every 6 or 8 years. Simply because you don't know the form answer of that herd to begin with. So the more you know about a herd, the better able you are to tailor your first experiment, your first treatments. It tends to be that the herds you know most about are small herds and the problem isn't as much the small herds as it is the really big wide ranging herds in remote areas that are most subjected to drought. But in the ideal world, you know, a lot about the herd before you started so you really would be able to parameterize your models well and have a lot of confidence in them. Go small herds because it would be easier to know what you're doing. And ideal world when all your worried about is science and not managing what -- not managing the national population. Thanks.

>> The LLC out of Florida that owns the rights to the ARM model. Who are the individuals behind that?

>> ROBERT GARROTT: The adaptive resource --

>> Yeah who are the individuals who have that LLC?

>> ROBERT GARROTT: Well, I would say that the -- the primary people behind adaptive harvest management are the scientists out of Pawtuxet, the USGS scientists. We heard a presentation from one of them with Jim Nichols. The committee.

They've gone all over the nation and have workshops on adaptive resource management. They've built technical models, there's several books published on that. They're sort of the experts although it goes back before the Pawtuxet people got involved. I think -- oh, my, I should know this. I think it was actually generated for fisheries. Ocean fisheries in particular. Can't remember the name of the guy who wrote.

>> CALLIE HENDRICKSON: Just go back real quick. Discrepancy of numbers were you able to get the dates for the reason you got the numbers, for the Web site for the total number is as of usually, like, February 28 of whatever year. I just was wondering if there was any reason that sort of date might have been part of the reason why you had such different numbers, I don't know.

>> ROBERT GARROTT: We just had no information. I think that's plausible that the range manager that did a count in December knows that the population estimates supposed to be for the end of February. And estimates that maybe it was a bad winter and he had a 5% mortality rate between that 3-month period and in good faith adjusted that count by what he thought might have been the population mortality between the count and when the population numbers to be reported. We just simply don't have it. And to -- and to be fair, there wasn't -- when we asked for the numbers, to the national office, and the national office went to the field offices, I assume they didn't ask for a big long diatribe on the numbers they fill in the table and send it back and we have limited ability for individual field area people to provide all the rationale. It would have been nice to have that.

>> If I could, Boyd, folks in the audience who work for BLM can explain how this data transferred. I would invite them to do that. It seems to be a little unclear. Is that Zach or Dean or somebody?

>> Dean is who reacted with a lot.

>> Can you gentlemen explain how it worked.

>> I'm Zach Ryan hold, the senior wild horse and burro program specialist. The

way received the information was exactly that. We received a request to the committee either through Kara. She then relayed that it request to myself. I then relayed that request to the state lead who then spoke directly to the field. The field provided that information. It was in a table. We did speak to the committee and with Bob and explained to him that there has been a number of adjustments at the date and time of reporting for various different reasons over the last 30 years.

And those were primarily due to program decisions. Either it was based on when the budget was falling -- the budget cycle ended or began. Whether or not we were trying to adjust it to capture the whole -- the whole crop after the full crop trying to get it to be in sync with the public lands records and when those are actually reported. So it has varied over the years when that is reported to the national office. And you know, none of it -- it was all in order to try to get it in sync with some sort of program that was occurring at that time. Or for budget reasons. There weren't any hidden underlying acts to try to deceive the public or anything like that. It was merely we were trying to bet it in sync with one reporting system or another.

>> Dean, did you want to add anything to that or no.

>> Dean: Just a couple clarifications. The national office did not manipulate the data any year since I've been involved since 2013. But we get HMA is what they reported to us (off mic) and there's a lack of information about how they've been manipulated the data, increased the estimates since the last survey. But two things it contribute to the inconsistency. There's not information about removal which creates oh, my gosh, how did this number go from this to that and had that information been available, it might have been more easy to interpret but the main message is here. There's good findings. We need to do a better job of recordkeeping and reporting to the public explain what methods we've used the findings are sound and good and that's the direction we desire to go and that we're headed. So --

>> As I said, we want to -- we want to analyze each HMA to see which method is best for that HMA including the two that the USGS recommended. We have to do a better job of that and we are going to. Thank you, Zach and Dean for clarifying some of that.

>> Doctor, I have a couple questions then because modeling tends to have my eyes glaze over and I have a tough time getting around it as a clinician. But I'm going to go back and ask a question about actual counts and methods. And I think we've -- you mentioned that Mark recited or recaptured dash would not be practical in the west where we have a few thousand horses as opposed to a couple hundred. Account -- what model or what attempt at counting would account for human error because I think we have to sympathize with people sitting in that aircraft on any hot bumpy day or whenever they happen to have their flight time be up in the air. How do we standardize the differences in people sit the sitting there doing the count because that I can see would be tremendous differences to human oriented ear and differences being able to spot and see the horses in different locations. PGA or whatever is covering the ground. How do you feel about that? What would your recommendation be in that sense? Since wide life became a science in the late 1930s, one of the primary activities in research is figuring out better ways to inventory animals and statisticians have developed a lot of innovative tools to do that. So we do know that from other studies that there are many places that horses are counted

very effectively especially the wide open sagebrush plains. You see dust trails of those when you start flying, you can find them well and couldn't them well. There's no trees. There's been a good science that suggests that you might only miss 10 to 15% of the animals under those conditions. Basin rank country or book list aerial survey you may only count 50%. So fundamentally without having estimates of detection probability for each of your senses, you could provide your herd management areas based on cover topography, those things that make it more difficult to count animals. In the ballpark when we're counting the desert, we're probably not missing more than 20%. When we're counting some mountainous area that has juniper all over it, we're more likely to count maybe 60 to 70% at the most and just make an adjustment and it's just an approximatization based on what we know about how cover and topography affects it in a more rigorous way one of the methods at USGS suggests is double observer survey. If you're going to use a plane, you have people independently recording which animal groups they see and when and then you have the observer one independent observer in the plane that's seen so many groups of animals on the survey. A second observer that independently saw so many groups of animals on that survey. They identify which animals. The first oftener saw and the observer saw. Which animals the first observer saw and the second didn't. Which the second observer saw and the first didn't and from that you also know statistically the probability that both observers missed some animals. And so USGS used one of those methodologies of double triple or even quadruple observers on the plane that recorded data independently and statistically you can get some of those things. There are other mechanisms too.

>> But logistically, you're sitting in an aircraft, looking out the right window or left depending where you're sitting in the craft. If you're going to have that true double or simultaneous double count, you'd have to have people sitting on the same side of the aircraft, I would think. I mean, I can see so many variables sitting there. I can fully understand the difficulty in coming up with legitimate numbers.

>> I would say 1930s, the tools are interest to make adjustments and appropriate Constance limits on those. Right now we have population estimates with no ability to say how precise those are. When you use those tools even though they're imprecise, you can get scientifically rigorous population estimates that adjust for animals not detected but that also give you confidence intervals that provide -- so instead of saying we have 33,000 animals or let's say 1200 animals in a herd, based on the rigor of our scientific data, that's our best plan estimate. But the -- but given the data, it could be anywhere between 800 to 1600.

>> I understand there are actually tables or data out there that okay, given a certain type of cover, certain type of habitat that you would use a certain percentage of accuracy. Are those tables --

>> Yes, you could just do the ballpark approximation, it would be better than nothing based on some of those attributes. But there are no tables that -- to tell you that the ideal thing is to be able to collect data about detection probability at the time we do the survey. You can use the same aircraft, the same observers, different day or in the morning versus the afternoon. Long shadows versus bright sunlight and the proportion missed will be different. So ideally you'd like to get that information for that particular survey U USGS evaluated some of those techniques, they flip flopped

that several of them were practical. Could even reduce the cost of inventorying it because it might be better done with fixed wing and helicopter and if they were scientifically valid and rigorous.

So there's lots of different ways that one can go and that would be up to BLM to decide if they want to change their inventory techniques or identify them how they'd want to go about that.

>> Hello. Boyd, I think you -- I just want to be clear the USGS. Excuse me at Fort Collins simultaneous double count and mark recite and there are several people in the audience who have been trained on that and have done them, I'm sure, someone back there is going to give us a little clarification who has actually done them on horses. Is that someone out of am I eyesight.

>> It was said not in these words. Simultaneous double count part of what gives you confident limits excludes excitability of animals and also things like the experience of the observers and the position in the air craft. So a lot of those variables are factored into what gives you confidence limit and that's why you have a limit of low confidence to high confidence that includes variables like snow cover, sightbility, bias, based on environmental positions, but position in the aircraft and experience that of the observer can be factored in.

>> So there parameters that are set.

>> That's how you arrived at your statistical estimate of your 90% --

>> Thank you.

>> I'm sorry, this is Dr. Al cane. AFIS veterinarian assigned to work with the wild horse and burro program.

>> Hi, in the NAS report there was some space dedicated to infrared technology. I'm curious in the areas where environmental issues, tree cover and stuff like that, I know in the am ill Terry applications they use it in the cooler part of night to get body counts and who's out in areas. It seems to me that might be a very effective cost effective way. I know that there's restrictions on the drone flying because of air time allowances. But it seems to me with the unmanned aircraft using infrared technology flying at night so that the images quality is way better at night than it is during the day especially at hot regions, is that something that would give you more accurate counting or is there problems with the horse thing that I would be unaware of using it for horses?

>> Well, the USGS team looked at that. And they didn't think at least at this time that it was practical. Partly because that had to be done on contract and cost of forward-looking infrared system mounted on the plane that they had to contact would be considerably higher than what's being paid right now. The other thing about infrared that was an issue is whether or not you can get an image of a higher resolution that you can tell different species of large body mammals. Obviously the lower you fly and the finer the spatial resolution you can get outline to define species but that means more intensive flying more time in the air. This time you'd have to look at the report I think they said they didn't think it was practical primarily because it cost so much to contract all those remote techniques had the potential down the road to be used that they still had the same issues of detection. So you still have the issue of having to do the research to figure out what the detection probabilities are and how they vary over the different types of situations that you might encounter and that very

different terrains that you have. So those are all possibilities but USGS scientists, I think did not think that they were effective at least now. That surprises me.

>> DR. BOYD SPRATLING: We've gone over our agendized time.

>> No way.

>> No way!

>> Is there time for the person would led this chapter review to just see if he has any questions before we --

>> DR. BOYD SPRATLING: Okay. Yes.

>> Roger, okay I'm getting a no. Anybody else from BLM.

>> Okay, never mind.

>> DR. BOYD SPRATLING: So tomorrow we invite you to be back. Does the public have access to the agenda? You'll see what we have coming up tomorrow at 8:00 a.m. he vine it you to return.

>> Did I hear correctly that we might ask Kara to say a few words to start off tomorrow morning.

>> Okay. Okay. And just a final reminder we will close tomorrow 3:00 to 5:00 for two hours of public comment. Sign up and we'll allocate the time based on the number of people, mike, Bob, thank you so much. Mike is back with us tomorrow. We very much appreciate it.

>> Thank you, Dr. Garrott we appreciate your time and Dr. Coughenour.

(Applause.)

With that we'll adjourn until tomorrow morning.