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Webinar Transcript

Climate Change and Federal Land Management: Assessing Priorities Using a Social Network Approach

Speakers:

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Ashley Fortune Isham: Good afternoon from the U.S. Fish and Wildlife Service's National Conservation Training Center in Shepherdstown, West Virginia.

My name is Ashley Fortune Isham and I would like to welcome you to our webinar series, held in partnership with the U.S. Geological Survey's National Climate Change and Wildlife Science Center in Reston, Virginia.

The NCCWSC Climate Change Science and Management webinar series highlights their sponsored science projects related to climate change impacts and adaptation and aims to increase awareness and inform participants, like you, about potential and predicted climate change impacts on fish and wildlife.

I'd like to introduce our speaker today. Dr. Mark Schwartz is a conservation biologist with research interest in climate change impacts on rare and endangered plant species, climate change adaptation through resource management and decision making for research managers under uncertainty.

He's a professor in the Environmental Science and Policy at UC Davis and the director of the John Muer Institute of Environment. Dr. Schwartz is also a UC Davis co-PI for the Southwest Climate Science Center.

Mark, welcome.

Mark Schwartz: Thank you, Ashley. Thanks for inviting me to do this webinar today, with you.



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As I get started, I want to thank a large number of people who've helped out with this project. That we had a lot of help from collaborators at the Fish and Wildlife Service, National Park Service, Bureau of Land Management, Forest Service and others.

We had funding from the USGS and the Southwest Climate Science Center to do this work. This is really a combination of an effort from myself and Mark Lubell, who is also in the Environmental Science and Policy Department, who works on social network analysis. And Casey Peters and Carlos Barahona, who are graduate students, technicians and programmers who do all the heavy lifting on trying to sort out all the numbers that we have.

To start off with I'd like to address the questions that we're trying to answer. This has come out of a series of conversations with the Climate Science Center.

We're trying to understand how natural resource managers and policy-makers decide what they're going to do in order to try and manage for resilience in natural ecosystems, given climate change.

To do this we needed to know what these people are worried about, with whom they're connected in order to get information to make decisions differently than they did in the past, and how do they want to access information? What kinds of information go into natural resource management decisions? How will they use that information in decisions?

We think of this as different than a needs assessment. A needs assessment is asking a bunch of people, what do they want?

We want to know more than just what information they want. We want to try and understand who they get that information from, how they convey what information needs they have to a research community that might be able to develop information for them.

Once they get it, how do they use it, exactly? We found that generally, if you said, "If we made a map of this, or a map of that, would that be helpful?" The answer to that question is always, "Yes." But, the use of that information is subsequently spotty. We're trying to get down a little bit more deep into this question and say, "Well, exactly how are you going to use that information?"

To start off we want to think about how people are connected to one another. Why network analysis? Network analysis and the environmental sciences is coming online quite rapidly. Fundamentally, it's just asking a very simple set of questions.

One is, who's talking to whom? Over in the left, you can see a diagram with arrows and a bunch of names. That some people are more connected, some people are less connected. Some people are central to the network and some people aren't in the network at all.

Over on the right is, which way is information flowing? Are people giving information or receiving information from different people, differentially?

One thing I might note about these pictures here, is that there's also a certain sensitivity in this information in that, for example, we wouldn't want to be calling out Rebecca as being unattached to any information networks here.



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The presentation that I'll be giving is going to be looking at these things at a fairly high level. We don't want to be pointing fingers at anybody about whether they are or aren't connected. That's not our intent. Our intent is to more think about it from a structural way of what kinds of resource managers and what kind of people, in which agencies, are connected to whom and how.

We can start with the conceptual model that looks something like this, where down in the lower right you have an agency field manager. We know that these agency field managers are talking to one another. That's that brown arrow.

We know that they're getting information from their regional and national headquarters, the other brown arrow. We presume that those regional and national agencies are getting information from a variety of research centers.

We also believe that there are agency and field managers who are getting information directly from that research community. That research community could be federal scientists at places like the USGS, university scientists, NGOs or at places like the Weather Services. We're trying to look at how these different people are connected in different ways.

As I mentioned, the social network analysis is our primary tool, there's a broad expansion of this in the literature now. This graph and time across the x-axis, the number of publications on the y-axis, these are a number of publications that use the term "social network" along with natural resources, management, or conservation, or fisheries.

You see that it's a literature that has grown quite rapidly over the last couple of years. This is because there's a couple of really great examples now of how understanding a complex resource management network has allowed resource managers to operate in different ways and solve some problems.

One of the classic cases that I think about has been relatively unregulated fishing in international waters. Particularly, around Antarctica, where there are NGOs, and governments and fishermen, who all have an interest in seeing better compliance to rules that are out there. Yet there are fishermen who weren't complying.

Using the agencies and the NGOs at loggerheads with the fishermen wasn't working very well. Once you understood how people were connected and talking to one another, and bringing the fishermen who were interested in seeing compliance into the picture, it started to work a lot better. It was through a social network analysis that they were able to do that.

What did we do? We were looking at five major questions. What are resource managers worried about? We want to understand the attitudes towards climate change, and how they connect those to the resources that they're managing. We want to know with whom they're connected in order to get information. We want to understand how they want to access that information. What information is valuable to them?

Then, how they'll use that information in decisions. That's in a little bit of these arrows here, because we haven't fully answered that question yet. We're really addressing that question through a different process. I'll be talking a bit about that right at the very end.



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We also want to develop a baseline for understanding the role of the Climate Science Centers and the Landscape Conservation Cooperatives in climate information. I'll talk about that a bit as well.

We started out with a survey. We had 25 questions in the survey focused on six areas -- professional background, opinions on climate change issues in public lands, personal views on climate change, involvement in adaptation planning, scientific understanding of climate change, and then the network connections, who they're giving information to, who they're receiving information from.

The study area for our project was the Southwestern Climate Science Center and the North Central Climate Science Center Footprints. Although, once you started asking people who they talked to, it diffuses out from those footprints proper.

We focused our survey on workers in four agencies -- the Forest Service, Fish and Wildlife Service, National Park Service and the Bureau of Land Management.

This worked with an initial survey, where we asked regional leads from each of those four agencies to distribute the survey to their staff, who have resource management responsibilities that would have a climate change impact.

Then, we asked those people who filled out the survey to identify other people that they've talked to, that we might follow-up and do a snowball survey. We gained additional participants through that snowball.

We ended up getting 590 management and research units, 313 of them were federal. We had named connections from more than 20 agencies. That map of the things that we had sampled looked something like this, where you have lots of little stippling up in the Dakotas. Up in the upper right there on that map, these are mostly refuges, Fish and Wildlife Service Refuges. Then, of course, there's lots and lots of public lands in the Southwest in the north central regions.

So that you get National Park Service in the blue, the Forest Service is in green. That, I guess it looks more peachy to me than orange, is the BLM. The tiny dots are mostly Fish and Wildlife Refuges. There's places in the West where the Bureau of Land Management owns land in a big checkerboard. It just turns black on this map, so that's mostly what this black is.

If you look down in the lower left, you see this is the number of people we had in each of those agencies that filled out the survey -- 763 total survey participants.

We had really great participation from the Bureau of Land Management. The Fish and Wildlife Service is a smaller agency. The National Park Service, we felt we had pretty good participation from people in that agency.

The Forest Service is a big agency. We didn't do quite as well in sampling that group, but we still had 115 people filling out the survey. We had 34 people from universities. I'll talk a bit about that as we go through.



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We can also identify things as nodes. A node is a combination of a physical location, an address where somebody works, and a job title. Often, a node is a person, but if a particular regional office of the BLM has two range plant managers, that would still be just one node.

You can have more than one participant as a node, and nodes can include contacts that are not survey participants. We have a total of 1,452 nodes, so this is a reflection of how many people were pointed to that they themselves didn't take the survey. It was quite a large number.

I forgot to fill in the number of contacts on this map here, but this just describes where those people are geographically. You see that there's heavy representation in the states that are in the Southwest Climate Science Center, which are California, Nevada, Utah, Arizona, parts of Colorado and New Mexico.

The North Central Climate Science Center, which includes Idaho, Montana, Colorado, Wyoming and the Dakotas and parts of Nebraska.

The first thing that we wanted to look at is what are resource managers worried about, and then to understand the attitudes toward climate change among resource managers.

The first thing we asked is, how well informed do you think you are, with respect to climate change? Here, of course, we get a completely non-surprising answer that university people always feel like they're completely well-informed about everything.

That's this purple bar. Jokes on webinars don't go very well, since you can't hear any of the audience participation in that humor.

What we find is the BLM feels a little bit less informed than the Fish and Wildlife Service. Then, the National Park Service, et cetera. From the left to the right on that graph.

We also asked about views on climate change. Here we have a series of graphs, and the labels on the bottom are very small. The labels on the vertical graphs are also very small, but they just sum to 100 percent of the responses.

What I did for the upper left here, is to identify these groups by their bars. Again, I'll just define what the question was and what the answer was.

The upper left graph shows what was the perception of the scientific understanding of climate change, and whether people think that most scientists agree that climate change is happening. Again, we see that the Bureau of Land Management is a little less certain about whether climate change is actually happening. By and large, there's a fairly strong belief that climate change is happening and it's shown in that upper left graph.

The upper right graph is showing whether it's happening now. Again, most respondents feel that it is happening now, with a little bit lower response rate from that on the Bureau of Land Management.



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In the bottom graph is, what do you view is causing climate change? Where the red bars represent the answer that climate change is being caused by human activities. The green being that it's caused by natural changes in the environment, and not so much by human causes. Then, the blue is people who think that there's no climate change and so it's a nonsensical question to answer.

Again, we see a little bit lower belief in human driver of climate change in the Bureau of Land Management than the other agencies.

I should note that there's no responses from Forest Service in here. The Forest Service didn't want us to be asking these questions of their staff, so we excised those questions from the Forest Service respondents.

Then, we asked a series of questions that are basically going to rank the people's views on climate change. This is an example question, down the lower right part of the slide. "Given your current knowledge about the following potential climate change impacts, to what extent do you expect climate change will make it easier or harder to meet your management goals?"

This going to be something on physical responses. They can click anything from significantly easier to significantly harder, or that they don't know. We're going to get a series of answers that are distributed across that spectrum.

We asked these questions over physical impacts of climate change on management -- things like water, temperature, pollution, fire -- and biological impacts of climate change on management -- things like shifting distribution of species or invasion. Then, vulnerability of cultural resources and also the vulnerability of those physical and biological resources.

I'm going to show you a series of slides and they have a similar format. I'm just going to run through that format, right here.

The upper left panel will always be the Bureau of Land Management. Upper right, Fish and Wildlife Service. Lower left, National Park Service and lower right, Forest Service. You can see those in little letters in the gray bars there.

Red is always going to be that it's significantly harder. With the orange peachy color being somewhat harder, and the blue color as being significantly easier. White being a neutral color.

The different bars represent the different specific sub-questions in each of those areas. Here's that graph again, without those symbols over them. We see here, that this is looking at physical impacts of climate change.

We ordered the questions from top to bottom, from being the most red to the least red. What you find is that everybody is generally worried about things like change in drought risk and fire risk, change in rainfall amounts, and that across the agencies we see significantly less concern about change in sea level rise.



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That's probably not so much a measure of the low importance of sea level rise, but the small fraction of people who have management responsibilities along the coastline and, therefore, have to deal with it. Lower risk associated with air pollution and water pollution, as well.

In thinking about biological impacts of climate change, I just colored all of these red. Because all four agencies, across all of these different attributes of biological impact seemed pretty darn concerned about it. There's not a lot of variation across that spectrum. Everything from changes in risk of invasive and noxious species, down to changes in resource productivity, people are worried and think that it's going to be significantly harder to manage their resources as a consequence of climate change.

We then asked them about the biological resource vulnerability at a high scale from marine biodiversity, aquatic biodiversity, plant population, terrestrial biodiversity and animal population. Again, fairly high and fairly consistent feeling that there's a large amount of vulnerability in the resources that people are out there managing.

People are very concerned about this. This is an issue that is on their mind.

Considerably less so, with respect of these cultural resources. Here, we see a lot more blue and white in the bars. These questions are things like everything from recreation, visitor services and modern infrastructure down in the blues, to being things like the applicability of traditional ecological knowledge and management techniques.

That's makes a perfect set. I would classify under the applicability of traditional ecological knowledge of this idea that we want to use historical range of variation as a target of which we try to manage our ecosystems toward. Then, if we have a changing climate that maybe doesn't make so much sense anymore, so people should be more concerned about that than other things.

They are looking at resource values. Then, many people are also concerned about resource values uniformly across the board. Water resources, forage resources for grazing, forest and timber resources -- these are all things that are on the minds of the various agencies.

There's a little bit of variation across these questions and across agencies, but it seems more that the large take-away message from this is that people are very concerned about most all of their resources.

We can then take and slice those attitudes in a variety of different ways, and one of the ways that we did this is just looking at these things geographically.

If you look from the West Coast in the cherry-red California ecosystem, the blue is the Sierras and that looks at and is the Northwestern forests and the montane regions; the purplely colors and the reddish colors are the deserts and the Southern montane regions over to the deserts.

We've summarized the attitudes of people across those four regions that capture the large fraction of our study region.



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We can summarize their attitudes as well, with the desert being up in the upper left-hand corner, the Great Plains in the upper right-hand corner, the Mediterranean California down in the lower left and the Northwestern forest and mountains down in the lower right. This is again across different resources, and we get perfectly sensible answers coming out of this.

If you look at the right-most bar in each of those graphs, people in the desert, Great Plains, forest and mountains are not so worried about changes in sea-level rise. People in Mediterranean California, considerably more so. That's the only part of the coast that's in our sample area, so it makes sense that they are the ones that are worried about that.

Again, if you look at the rank order of these measures of physical vulnerability, that changes to drought risk, fire risk and annual rainfall amounts, that water in the West is a very, very large concern for a lot of people in the resource management area. That's true across all of these different groups of people.

Again, here's looking at biological impacts. Not a lot of variation in this by agencies. Not a lot of variation in this with respect to where you are in the region. People are generally concerned about biological impacts of climate change and the ability to meet management objectives as a consequence.

There's a couple of other ones that I'm not going to go into in too terribly much detail. If you want to come back and go to this webinar not live and pause and squint at these bars, you're welcome to. I encourage you all to do that and give us some questions about them as they occur to you.

We can re-parcel these attitudes in a variety of different ways to look at how people are concerned about resource management issues, and we have done so both by agency and by region for the purpose of this webinar.

OK, so we then asked, "Well, what kind of information is useful to people?" One of the ways we can ask that is the format of useful data. Green here represents very useful, yellow somewhat useful, red not very useful. Down at the bottom, data in raw format, not very useful to respondents. More than half the people in the survey said that's not useful for them.

Only slightly better than that, orally summarized data. Then, on number eight, through fourth from the left, video and slide show, so I guess that means this webinar not very useful but there you go. No, again another joke on webinars - don't do that.

Starting on the left, the things like visually summarized data, maps and geospatial illustrations, written summarized data, these are all useful sorts of things. Peer-reviewed research literature, of course, because it's making them meet the documentation, having a peer-reviewed source to point to is a very helpful thing indeed.

We can examine the way that information is useful for people. We can also look at this with respect to what is actually being used, types of models or data being used.

Here I think this is a very interesting response in that what you get is, across the board, top to bottom, from vulnerability assessments down to global climate models, that you find people using



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them and where the green here is that they currently are using them. The light green is that people are planning to use them, and yellow is that they may use this information.

You're seeing across all agencies people who are currently using a wide variety of different kinds of tools to help them make management decisions. That's I think a very encouraging kind of response that we get out of this survey, even down to the point of using global climate models.

I've always thought that really, for a resource manager to make use of that information in the decision, that it's helpful to have that global climate model interpreted with respect to some resource, but here you see people already using these pieces of information in their decision processes.

OK, so the next thing we want to do is to talk about with whom are people connected in order to get information? This is where we get to that network analysis that I promised and that there is the network that we have. This is a very, very difficult thing to look at. What you see is a lot of things in the center that are well-connected to a variety of different agencies or different groups.

Then, of course, there are people out there that are connected to one or two other people, or are not connected to this network at all, as sampled by the questionnaire. There are a lot of different entities that are captured here. The color scales all bleed together. It's not a very helpful picture to look at in some ways.

We can summarize this by agency or entity group. We see that this comes out a little bit differently in this regard and that not surprisingly the Forest Service, BLM and Park Service are very central to the connectivity among groups here, but we also targeted our survey at them.

The Fish and Wildlife Service is a little bit further out. Well, that's also sensible in that it's a smaller agency, and we had fewer connections from those people. What we want to do then is to think about some metrics that we would look at, in terms of social network.

There's something called in-degree. How many people are pointing in towards you as a source or a recipient of information? Out-degree is, what people are you pointing at, in terms of the source or a recipient of information? Centrality is how many different connections that you have.

This is a table from Prell et al. in 2009 that looks at these ideas of concepts that are relevant for natural resource management, that strong ties are good for communicating about and working with complex information and to hold and maintain trust between actors.

These actors are more likely to influence one another's thoughts and views when we have these strong ties, but weak ties can be useful as well. They tend to bridge across diverse actors and groups and bring in new ideas and things like this, so we can look at this in a variety of different ways.

I'm going to go into this relatively lightly here today, as I said, just keeping it on a very high level. This is a very simple summary of directionality of people's connections.



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This is, the columns here, the betweenness is basically the average number or metric that reflects the connectedness of people who responded to the survey from these different agencies. I've colored the four focal agencies in green and then also colored the university participants that are at universities, that are in the climate science centers.

Both the Southwest and the North Central are blue, and the USGS is the other line in blue. We lumped everybody else -- the university people, NOAA, NGOs -- all those other 20 or so organizations into this other category.

What we see from this is that, in terms of betweenness, the Climate Science Center folks and the USGS folks are far, far ahead of this other suite of people, both in terms of receiving information and providing information. That's a good thing. That means that we think that, even though this survey took place really early on in the Climate Science Centers, they're well-connected.

I guess I would probably interpret that as being more that the USGS did a good job of picking universities to host the Climate Science Centers. Rather than that the Climate Science Centers have positioned themselves well, because it's really too early for them to have produced very much that would be of value as a Climate Science Center during that survey.

The other things that we see is that the National Park Service, which is I think taking on this job of climate change adaptation very seriously and really trying to think about how to change their management as a consequence of climate change, are both big recipients of information and providers of information and have a lot of connectivity.

BLM came out looking very good as well. Forest Service a little bit less so, and it's not clear to us now in looking at these numbers the degree to which that is an attribute of the Forest Service or whether that's an attribute of the fact that we did not saturate as well as we did the other organizations, in terms of the Forest Service.

We really had a different process for getting the surveys out to people in the Forest Service, and that became a bit of a challenge. We'll talk about that right at the very end here.

Another thing that we have is that connectedness is not really related to a risk or vulnerability perception. This is a model analysis of those things that link connectedness to people's perception, a couple of the questions in the survey. They're just summarized down here in this anova table, the group called A, the four bottom-lines.

If you look inside the box, those are all P values that are well above 0.5. They're above 0.3, and that just really suggests that there's no relationship between a person's connectedness and their perception of overall risk.

However, there are some things that do predict connectedness, and that is participation in planning exercises, information demand and being informed.

There was another set of questions on what people's information demand was, how much they had participated in activities. The more people participated in activities, the more connected they are to a community that deals with climate change.



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This is one of the questions that we asked early on about attitudes. How important is climate change adaptation planning? You can see the blue is extremely important to somewhat important, the red being not important.

You can see variation across these agencies where the Park Service feels it's more important to be engaged in this planning process than, say, the BLM does.

OK, so the other thing that we could do is look at this idea of mapping risk perception. We can map connectivity by geography, and we can map attitudes by geography. We've done a little bit of both those things. This is kind of a complicated graph, but I'll draw your attention just to the lower right-hand corner.

This is a variable called "climate velocity" that was defined by Scott Loarie about five years ago. It really reflects how far or how fast a species might have to change or move its distribution or evolve in order to maintain its position in the landscape.

In other words, where climate may be changing but there's a montane environment, such that staying in the same climatic envelope only means moving up slope a little bit, that velocity is relatively low. Hence, the Sierras turn into blue in this graph.

If you have to go a long way across relatively homogeneous environments to get to a new environment and change climates, then that would be a high climate velocity. That's why the Central Valley of California looks red there.

We asked whether climate velocity -- because we have a map of climate velocity for all of North America -- is related to climate risk as measured by the average score of how much harder a manager thinks management will be.

This is a graph that just simply shows there's no relationship there. People are worried about their resources, no matter what those sorts of attributes are of potential for climate change. I guess that suggests that the vulnerability of resources may be tuned to those environments and that they're still of concern to people.

OK, so what are the lessons that we learned from this exercise? Well, we had the regional offices pushing our survey out and there are a lot of things that were really good about that. The response rates are pretty good among places where regional officers asked for people to participate. I don't think we would have gotten quite as a high response if we didn't have those regional officers suggesting that it was a good thing to do.

There are also some constraints that slowed us down considerably. It took a long time to get some of these surveys out to people as a consequence of that filter. The Forest Service, for example, put some filters on questions that were not put on by other agencies, so we don't have exactly the same questions asked for everybody.

It constrained the number of people who actually, in the end, saw the survey. There were some drawbacks to having this survey sent out through regional offices as well.



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What did we learn from the data themselves? We learned that federal resource managers are generally informed and genuinely concerned. The managers are able to distinguish among resources at risk, but they don't tend to scale them relative to the geographical variation of that risk.

It's easier to assess from the ground up, who do field people talk to, rather than from the top down, who do the researchers produce information and who do they engage with. That's the process that we took.

The network is massive. There's a lot of people out there making resource management decisions and that makes assessing those attitudes very difficult because it turns into a very big data stream.

One of the things that we learned in our survey was that it's important to define a time frame when asking people about their perceptions of climate change. Some people felt that they have a very different attitude about thinking about climate change impacts over 20 years versus 100 years. We didn't specify that in our questionnaire, and we should have.

Finally, we learned that connecting activities, training sessions, planning, et cetera, heightens both the connections of people to one another and awareness of issues that come up.

We need to be working on things that build those connecting activities. We have a long way to go to build an effective bi-directional climate information stream with the researchers. Resource managers talk to each other quite easily. Researchers talk to each other quite readily. Getting those places where researchers and resource managers are in the room, defining problems and working together to solve and get answers, is the much more difficult thing.

I wanted to go on and spend just a few minutes then on a project that we're really doing as a follow on to this climate network project. This one is funded by the Southwest Climate Science Center. It's a collaboration with Matt Williamson, Christine Albano and myself, all working just in the Southwest now.

Our goal here is to assess the landscape of climate-relevant resource management decisions. What are people making decisions on, and how are they making those decisions?

Our objective is to develop decision support tools, knowledge networks and climate science targeted specifically to meet the needs of managers and decision-makers. How are we doing this? We've taken two overarching approaches.

One is a content analysis. We're using the federal records of decisions, things like the Federal Register and looking at words that are used in the Federal Register, and from that, we're trying to classify decision types.

How many different decision types are there? Then, what are the frequencies of these resources that have decisions, and what kinds of decisions do they have?

Then, a second set of activities go about getting information from individuals themselves. We've convened a series of consultative groups in the process of developing a web survey to ask the



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question of, What information streams are being used? How are they being used? What do managers say that they will use? and How will they use that information in those decisions?

This slide here is kind of a complicated one, but it captures the problem, if you bear with me for just a minute. Across the X axis, or the horizontal axis, we have different resource types like managing people, managing aquatic environments, managing terrestrial environments and managing the estate, things like mining permits or purchasing land.

From the bottom of the graph to the top, we have some kind of scope of a decision, so we have decisions that are very broad across all of those different attributes -- people, aquatic, terrestrial, estate -- that are all-encompassing for resource managers. Things like land management plans and forest plans, and things like this.

As you go down on this scale, you find things that are more linked to actions and are more specific to the kinds of resources that they impact. Down on the lower left here, you have a yellow box called "Trail maintenance," where that's really some combination of working with the estate and people.

We could be having "Manage fire" as something to do with the terrestrial management of the ecosystem so that we have decisions at different breadths of scales of these different resources and at different levels, in terms of the time and the area that they impact.

Characterizing these decisions is one of our challenges that we're trying to work on, both with these consultative groups and with the content analysis of federal decisions.

We've had four consultative groups -- Sacramento, Reno, Salt Lake City and Tuscon. In these, we've been looking at what are these people concerned about with respect to resource management. Some of the takeaway messages that we've heard from these groups, that the administration's current emphasis on mitigation is often driving resource information needs as opposed to adaptation. This is, sometimes, to the frustration of individuals who would like to be working on adaptation and they're tasked to focus on mitigation of climate change.

Uncertainty in climate models and uncertainty in outcomes is a key road block to using climate information in NEPA documentation, there has to be...these documents are setting the bounds, the fence line, as it were, for an action that could be taken.

When we have uncertainty, that makes it harder to accept those boundaries. Uncertainty has always been a problem with respect to NEPA documentation, but it's becoming more of an issue with these climate change.

Major decisions up on the top of the last graph I showed, like Forest Plans, deal with multiple resources simultaneously. As a consequence, they may have limited bandwidth for taking on single resource climate models, things that deal with individual species.

Now, of course, there's exceptions to that. Things like the sage grouse, which are hugely controversial now in the Western United States, are certainly getting that sort of species-level



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attention even under these major decision documents. Just generally hard to look at single resource models for integrative decisions.

Matching the scale of the assessment and the decision is difficult and is often presumed to be a barrier. Although, when we stop and quiz people very carefully on this it's hard to get them to say exactly how they would make a different decision if they had a downscaled model to two centimeters, two kilometers, or 20 kilometers.

Everybody would like more finely-tuned, downscaled models, but it sometimes doesn't drive decisions that much differently. I think that our climate science friends would say, oftentimes, there's a point at which that further downscaling isn't actually adding additional information. It's just sort of smoothing over maps in the way that we understand those landscapes to be present, and assuming that that same differential will exist in the future.

Then the last point, and I think this is a very important one, maybe the most important one, is that knowledge co-production has a strong preference for information generation.

When the resource managers can sit in the same room with the research resources, they can define a problem and then generate information and support for a decision that really works for that decision.

Now, that's a very expensive way for Climate Science Centers and LCCs to provide information to resource managers. That's why we want to know something about the frequency of different kinds of decisions, because we ought to be cautious about when we're going to invest a lot into this knowledge co-production and when we're not going to invest in that knowledge co-production, in terms of helping resource managers. We want to be doing the more important decisions.

That is the end of my presentation, and so I'm going to open it up and take questions. I think Ashley will probably take it off mute or else she'll field the questions.

Looking over in the chat box, I see Joy Marburger said, "NASA is another federal agency doing a lot of outreach on climate change," and she's absolutely right about that. It's a group that we did not survey well in our network analysis.

Ashley: All right. The next question is from Beth and it said, "Can you comment on why NOAA figures are such an outlier in a network diagram? Is it a function of methods geared towards DOI and Forest Service, or are there other possibilities?" There's another part of that question, but I'll wait.

Mark: Yeah, so I'm going to scroll back up for that there. The question looks at the outer galaxy of NOAA way over to the left-hand side. Drilling down into this a little bit more carefully, we could be looking at this and figuring out why this is so.

One hypothesis is that the network is exactly how it looks. NOAA is providing information to people at the research institutions, like at universities, who translate that information to resource managers.



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Alternatively, an explanation is that we didn't send a survey to anybody at NOAA. What we got was people who pointed at NOAA and said, "That's where we get some information."

When we're looking at who people are pointing at, those are by default going to have lower sample sizes. Things like the privates, the locals, the state governments, they're also outliers. They also had relatively small sample sizes.

Were we to focus on something that was a little bit more...were we to have designed the survey to capture the NOAA people, we would have a better idea of who NOAA is directly communicating with.

If we had sent the survey to NOAA people, for example, we would presume that they are, in fact, connected and we would learn who they're connected to.

Instead, the only way we really sampled NOAA here is by asking the people in our main focal areas who they'd been in touch with. OK, I hope I answered that reasonably.

I see that one up now and then I have one up from Amber, thanks for listening to the talk.

"I noticed at the beginning of the survey results, you showed that a significant fraction of respondents didn't believe that climate change was happening and/or didn't believe that it was caused by humans. Were they exempted from the rest of the survey?"

No, they were not exempted from the rest of the survey. They were in the rest of the survey. Actually, I found this to be an interesting result in a different way.

I think it was probably two years ago, I was listening to public radio and there was a story where people had surveyed people who were working at national parks and state parks and things and found that, in terms of climate change, that those people who work at parks are no different than the average American, where something like 25 percent of individuals don't believe that climate change is happening and don't believe that it's human-caused.

Actually, the fractions that we had were a fair bit lower than that, so it suggests that these resource managers aren't like the rest of America. There's more confidence that, in fact, climate change is happening and that it's largely human-induced.

Ashley: Then, we have Shannon with a question over the phone. Shannon?

Shannon: Great. Hi Mark. This is Shannon McNeely from the North Central Climate Science Center. Thanks for your presentation, a lot of interesting information in there.

I just had a comment about a necessary caveat about viewing this as a baseline for the North Central region. I know you know this but I didn't hear you make this comment, so I just wanted to make sure this got out there.

It's really only a partial baseline for the North Central region because of coverage, first, geographic coverage. There's a significant portion of our North Central region that wasn't in your survey data.



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The, basically, four states out of our seven state region, there's little to no data. Coverage in the Northern Plains and the Missouri Basin region is limited compared to our western portion of our North Central region and compared to the Southwest region, so that's just an important thing to note.

Another thing is that we increasingly have been focusing a lot on tribes, tribal engagement through both the BIA and through tribal nations and tribal lands themselves. I don't believe you had any tribal respondents in your survey.

That's just another thing to think about, in terms of the stakeholder or manager coverage. That's all I had to say. Thank you.

Mark: Yeah, OK. Shannon, thank you for both of those comments. Those are good.

What Shannon points out are true on both accounts, and I think that that points to another one of these struggles or challenges that we have with doing any of these kinds of surveys that are based through regional offices.

These four agencies all have different regional boundaries. As a consequence, finding a regional person and having them push it out to their different regional staff, we found that there was a boundary overlap issue that comes up again and again.

We have respondents from Texas and that's because one of the agencies...Texas is within the Southwest region and the rest of them are not. We sampled some people from Texas as well.

Yeah, we don't have equally strong coverage from all of those different areas. There's two reasons why we have a reduced number of people surveyed from those other states from the North Central region, as Shannon pointed out.

One is that we didn't do a good job of sampling it, but the other is that there's considerably less federal land in those states as well, and so there's a smaller footprint out there.

There was a question that came up that's related to this on the...I should also point out that we struggled with the tribes question here in the Southwest as well.

For our region, we have this bi-modal problem that we have in Arizona and New Mexico, some of the largest, most well-organized, powerful tribes in the country...and relatively a small number.

I think we're represented by like 114 tribes in the Southwest region, and 109 of them are in California. They're generally all very small, and considerably less synthetically organized, so they're a very difficult group to get to and try and survey systematically. Feeling that we couldn't do a good job of it, we ended up not doing a job of it at all on this particular project.

Somebody here asked about the Forest Service, and I'll say that..."Do you have a sense of the reluctance of the Forest Service to participate in some of the questions?"

The Forest Service had us go through their Washington office and they were very concerned about the potential sensitivity of Forest Service employees having to reveal their preferences or beliefs



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about climate change to a survey. They felt that people would be less interested in answering the survey and it wasn't information that was appropriate for us to be collecting on their employees, so we didn't.

I can continue reading on these questions that are coming up on the chat box, these are great. One of them is, "Did you think about mapping risk perception on drought or fire risk models, or one of the other higher risks? The climate velocity seems so focused on species distribution, which is just one aspect, right?"

Absolutely correct. We have thought about it. I guess we haven't done it yet. One of the things that we've talked a lot about in the Southwest is that a drought risk map...we're not sure what a drought risk map looks like, and there are likely to be many drought risk maps.

The drought risk with respect to reservoir water and filling of stream flows, and there's other drought risks that might be associated with snow packs, snow melt and fire season. They may be relatively correlated, but they all carry some sort of bias in them. This is something that the Southwest Climate Science Center has spent a lot of time talking about, and we haven't come to a resolution on this.

There are maps that are published on things like fire risk and we could be looking at those attitudes associated with fire risk, and we'll be doing that in the future. Let's see. The questions are coming in pretty quickly, so it's hard to flip down.

"Could you please flip back to one of your map slides that shows where the respondents were located?" Sure, I'll do that. There's a map of the participants and the contacts that were contacted from those participants.

The dot sizes represent the number of people. This map here shows all of the units for which there was federal responsibility that people answered questions from. Also, showing that we sampled some people from the state of Washington and Oregon even though they weren't in our region.

OK. Next question. "Did you investigate trade-offs among natural resource management goals for each agency? For example, did managers indicate a preference or weighting among competing goals, cost versus biological resource state, and how these trade-offs may change with increasing knowledge or climate change effects?" That's a great question. No, we didn't do that.

We are trying to be mindful of the fact that all of our regional resource managers said that what they are worried about is survey fatigue among resource managers and they wanted us to keep the survey questions brief. We tried to keep them brief, so that people would stay engaged with the survey, all the way through to the network component of it. As I mentioned, there was a limited number of questions.

But that would be a really good set of questions to ask. We get at that a little bit in our subsequent survey that we're doing, based on our consultative groups, is thinking about competing goals for management. Not expressing it in exactly that way, but we're trying to get at prioritization of the different resource objectives.



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Mary O'Brien asks, "Do you have a sense of which resource decisions have integrated climate science information?" Again, that's not a question that was asked.

On the survey, we didn't ask people to give examples of where they've used information for good effect. That has been something that we've been doing, with respect to the consultative groups and is done in the content analysis. We have not yet finished the content analysis to be able to answer that question.

Rachel asks, "Did you investigate trade-offs among natural resource management goals for each agency? For example..." Yeah, that's a lot like...Oh, no. That is the same question from above. That just repeated on the thing. I'll leave that one as it is.

With that, I have made it to the bottom of the question list. I think we're coming up on the end of the hour. To be respectful of people's time, I think I will hand it back to Ashley.

Ashley: Thanks, Mark. We did have one more come in, from Amber.

Mark: Sure.

Ashley: Do you see that one?

Mark: I'm sorry. There it is. "You mention that there have been 46 prior studies on social networks and climate change. What did you find out in your literature review about how climate change-related social networks tend to operate? Did your results from this study of Southwest land managers confirm or conflict with these prior studies?" Boy, [laughs] that's going to be a tough one to answer.

How networks tend to operate...Basically, on the literature of social networks and climate change, it's a pretty broad literature across a variety of different things, having to do with human health and all sorts of different things.

My understanding of this literature is that these networks are probably better predicted by the kinds of problems that they're addressing -- things like whether it's human infrastructure, transportation or human health, or natural resources -- than they are by the fact that it's climate change, in particular.

That's not a very good answer. I'm sorry. That's the best I can do at the moment.

Ashley: Thank you very much for the webinar, Mark.