Transcript 4

Participants:
Simon West (SW), interviewer
Logan (LOG), a field ecologist in the ecology department at the University, and a participant in Wildlands adaptive management (AM) project

Location:
Logan's office at the University, soon after the field trip

Transcript:
SW: So what was the process leading up the trip and how did you get involved in the project?

LOG: So I finished my PhD – I submitted in December last year. And then I didn't have a position, I didn't have anything after that necessarily until Stevie said that they would offer me a one-year research fellow role at the University. Which essentially was constructed around me – it wasn't an existing vacant position – to be able to finish off all the things that I had started. Because over the course of my PhD I had been doing my research work but also a number of other side projects. So I'd started a lot of these but haven't published any of them. And so it's in everyone's interests for me to hang around for a while to finish those things off. And so in this – in building that position for me they looked at everything I could be of value for the lab group as well as those projects. And one of them is probably my greatest skill-set is in fieldwork, because I've done a lot of it, and I enjoy it, and so they said, "there is this project that is on kangaroos that needs people with field expertise to help out, and so Logan would slot into that perfectly because Logan needs things of value to do in this year" – on top of the things I was supposed to write up. And so that was it. My role is purely a field expert to try to help out with their project. So that was good, I was happy with that.

SW: And so how did it go with the meetings leading up to the Wildlands trip? At what point did you come into the group?

LOG: I came … So the project itself existed before me, and so there were things that had happened before that. But I came in relatively early in this field idea. So all I knew really was that they wanted to do a pilot study to write a report to say how they propose to do adaptive management on this site. And so they knew there was going to be a field component of that, and that the pilot study is going to have to happen to achieve that, and I was in the early stages of that design. But the project itself was up and running quite a long time before that.

So yeah, we had meetings to discuss what could possibly be done, what are the options available – so really trying to look at what their aims are, and how surveys

could be targeted to achieve those, and then how … what are the best ways to do that, are they the simplest ways, the cheapest ways, the most detailed ways – all the different options – and then trying to pull that all together and then saying, "considering what they want to get out of it and how much money they have, and all that, these are all the options." And also how effective these methods are. And that required the pilot study. So there were about three of four meetings before the pilot study actually took place, and then some behind the scenes work, filing transfers, and "have a read of this," and a little bit of that sort of stuff in between … And so it was pretty straightforward … Yeah, I guess you've got a group who knows kind of what they want to achieve, and also have a reasonable idea about the field options (or the sensible ones) available, and so it wasn't too painful, even though it was fiddly to try and nut out something that was likely to be really good without knowing the system beforehand.

SW: Yeah, I was gonna ask whether you'd experienced the Wildlands vegetation before?

LOG: I hadn't actually, I had driven through once. And that made it a lot harder to be honest. But specifically because this question of, "we're looking at regen [regeneration] of the tree seedlings," the idea about "are we likely to see few or very many?" was – no-one actually could answer that. And so – which is surprising … But that was a really important factor, so that was in the survey design; dealing with very few individuals or heaps and heaps of individuals is really important for the time that it takes you to do your surveys. Like you said, when it becomes very few you need to do intensive sampling, but if you have an intensive sampling approach and you end up having lots then it takes you forever to achieve. So without – having to hedge your bets and saying, "well we could have lots or we could have a few, so let's have a flexible approach that we can adjust as we go out there." So it was quite tricky – it was really quite tricky. And then you are also trying to balance out the detail with a simple survey. So at the very least they want to know: tree seedlings occurring, in what densities, and on the other hand they want to get a full idea of structural complexity, species richness, and look at how those things change as a result of kangaroo management. So that would be nice, but I think primary focus is the tree recruitment: are there trees recruiting in the landscape? And so if that is the primary focus then you can have a very simple survey to achieve that. So it depends on their resources and what they want to try to achieve, so we have to give them both options: if you want to do it this way, this is the way you might do it, if you want to do this simple way, this is your option …

SW: So the two detailed surveys and the rapid survey were to try and keep those options open, in a sense?

LOG: Yeah, so I guess we thought, "there is a spectrum of survey design that they can do – something very simple and quick, and something that's very detailed and slow

and requires more botanical expertise to do." And for that one they would probably want to get people in to do because it needs specific skills to do that. And – but the simple ones that they could just get Authority site staff to do that relatively quickly and so between those options is quite a big difference in terms of cost to them … So we tried to say, "OK, let's do sampling to do both ends of that spectrum to see the time it would take and the cost it would be," and then provide those options and say, "these are the two ends, you could also have something that is a compromise between the two." And so I think that will be part of the report that they make – is give that spectrum of options and say, "what do you want to do?"

SW: Yeah, and how did you construct the methods? Is it something that you'd used before or are they new?

LOG: Yes and no. Some of the methods I had used before, so the pointing I had used a lot before, so I knew that well. And the really good thing about that is that it is objective. So any visual estimates of cover and those sorts of things, I guess and you guess and we guess very different values, and that's really subjective and not a good thing to do if you want to look at change over time or repeated surveys or something. Because there's so many studies that are saying we're really bad at guessing. And so pointing is really good because it's fairly repeatable. I do it and you do it, and we get a very similar answer. And it's a number that's actually measured, rather than a guess … But it is a bit fiddly to set up, and that's why people do visual estimates, because you can stand there and look as opposed to having to set up transects and then point them, and record them and then data – and so it's more time consuming for sure … So I had done that a bit.

The lay-out of the plots – so having a circle around the trees, or having the quadrat position around the trees – that's not really a standard thing, and that was tailored for the question. And so it makes sense that if you're looking at seedling recruitment you have a tree because you are most likely to get seedlings near an adult tree. And so it's sort of – you can waste your time to do it outside. So you start with an adult tree in a place where you think these things can occur, and then build a sampling design around that. So there was a bit of discussion about how big a plot should be. Obviously a smaller plot is faster but a larger one is slower but you are more likely to get more information out of it, so … Yeah, so the discussions in our meetings were a lot about that. What sort of shape, how big, how many, that sort of thing. And then within those sampling units, what do we measure? What do we estimate? So the pointing was an option, the rising plate-meter was good because that's another way of looking at biomass separate to cover, which I hadn't done before but one of the other guys had. And that's simple, and so easy to do. Just a number of measurements, so again it's objective, mostly, or more than an estimate … Yeah, and so the layout was a discussion, but the tools – the survey methods used within them were all things that one of us had used before. So yeah, just discuss, discuss, discuss, and try to nut it out and pros and cons of each method, and then come up with a best guess. And it was

tricky, but that's what we came up with – the best guess of something that would balance out a detailed and a rapid survey that would provide the best information that they want.

So the pilot study was – we were really hoping that the study would in itself help answer a lot of those questions. So we didn't need to have it figured out by then, and doing field surveys – if you think you can do it off the top of your head in a place you've never been and start without never having – "OK, we've got it right, let's go!" – then you are kidding yourself. So we knew it was going to change, and we hoped that being there would help inform how good those methods were and try to – is this the right size, are these the right number of points, are we doing too many, or is this to slow – all of those things come out in the wash in the pilot study. So the pilot study is really important for that, and we learned heaps. So even though we didn't get to do that many actual surveys, we learned a lot about the method and probably, more importantly, where sites might be – where we might locate sites, and how many we might want to do of the surveys … So that's giving a much better indication of that. So …

SW: And what happened when you actually arrived there? What was the biggest surprise for you there? Or was it how you expected?

LOG: Uhh … No it wasn't how I expected, I thought it was going to be more shrubby. And in some parts it was like that, but it's not your – if you say to someone, "it's the Wildlands region," they think [the vegetation will be] multi-stemmed eucalypts, shrubs, that sort of thing, at a fairly short height. This [pine-ironwood vegetation community] is a particular veg within the Wildlands region that has got a fairly separate structure, and so it was different – it was very low understory and trees, fairly sparse trees. And that made it simpler to survey but it wasn't really what I expected. But that's OK, it didn't really matter for our survey method necessarily, because we tried to make it flexible enough to allow for different types. The main thing that was a surprise was how few seedlings we saw. So going there thinking, "are we going to see hundreds and hundreds of seedlings or are we going to see zero?" and we saw essentially zero …

SW: So you hadn't had any indication from Authority staff about what you might expect to see?

LOG: Not with the seedlings, no. So we'd seen some photos of the landscape and that sort of thing, and you can get an idea but it's never the same as when you actually go and drive around and that sort of thing. But we didn't have a clear idea of – obviously with the seedlings the recruitment level was low, because that's the whole reason why they are doing the cull in the first place, and that's why they're concerned, because they're not seeing as many as they would like. But having said that there's been relatively good rainfall over the last few years and we thought there was a reasonable

likelihood that you would go to patches where you would have large numbers of seedlings. And the fact that we saw that once – well I guess twice with that burnt, low-density ironwood area, and then – but evidence of historical examples of that in the pines, the two, three, four-meter ones that were really dense, where that had obviously happened before, shows that it can happen and it does happen, but it hasn't been happening much lately. But it was just – "what are we going to see?" not sure – "probably this" but not sure – and then, answered, right there. So that was good to know.

SW: Yeah, and what is the scientific understanding of ironwood and pine recruitment? Because I haven't quite been able to pin it down, but I've heard that ironwood recruitment is not that well understood in terms of …

LOG: Ironwood recruitment is tricky because it seeds, but [it] also re-sprouts vegetatively from the roots. So that's a big thing. It tends to do that more following soil disturbance. So say you drive a tractor or something over the roots, anywhere where there is a nick or exposed roots to air, the shoot goes up. That doesn't have to be like that necessarily, and it can do it otherwise. But it's common to see in areas where there are healthy ironwood trees, that you see really dense patches of ironwood thickets, I guess, and a lot of them are – so a lot of them are seeds but some of them are these vegetative re-sprouts. And so that's – the thing is, is that it's really tricky to know which one is which, and there's some papers which have … they dig around the tree and find the roots, and identify which ones are seedlings – but I think it really depends on the area and the tree, and the land-use of the area, and that type of thing. In some places it's going to be more seed recruitment and in other places it's going to be lots of vegetative recruitment, so that's tricky, but the thing is … I guess in that situation we know that they can reproduce on mass. And the same with the pines and a lot of these things, it can reproduce on mass. But having said that they are living in a harsh environment. Wildlands is harsh. They are opportunistic species and they will recruit when the conditions are right. And sometimes that's just rain, and other times it's a particular type of rain – so it could be rain at a certain time of year, or it could be multiple years and at a particular time of the year as well, or it could be a flooding sort of thing … And this vegetation type is in a flooding sort of area, but they like to be on the sandy ridges which obviously are less likely to be flooded. So it's a weird – it's quite an unusual ecology to the vegetation type, I suppose.

Yeah, so it's quite hard to know off the top of your head what you are likely to see. Harsh conditions, a place where it's been grazed, you think "OK, it's very likely to be zero," but you know both these species can reproduce opportunistically and in large numbers, so it may have been the case in the last few years it was good, and we're going to see heaps. It looks like it had happened previously, and had happened in one patch, but not across the landscape …

SW: Yeah, it's tricky to think of how you capture that unpredictability in the methods, I guess…

LOG: Yeah, it really is. It is – it's tricky through time and it's tricky through the space of the site as well because there's places within the study area that are more likely to get recruitment, but also there's years that are more likely to have recruitment. And so trying to balance your survey area across that – and that's something we considered as well, that maybe culling or management can be applied to certain years where conditions are favourable, and maybe the years that are dry where you're unlikely to get recruitment then don't worry about it because the culling is unlikely to do much good for tree recruitment. But in the years where it's good, and there's actually recruitment, that's where it's really important to make sure there's not too much grazing pressure. But that's tricky as well because it's hard to – you've got to pre-empt that with, "we don't know exactly what the conditions are that are going to produce that" – and so without knowing exactly how the system works, it's hard to really be predictive and reactive like that. In the absence of that you have to do repeated sampling to gather that information, whether that be every year or every few years, and just see what is happening through time, yeah.

SW: And yeah, I guess it really affects establishing experiments and things like that …

LOG: Yeah it does. But the good thing is that there's a lot that could be learned from exclosure experiments. Because if you put an exclosure in and you get no recruitment, then that's a really – or a number of exclosures so you've got replication through the landscape, and you get no recruitment in those places where you've excluded grazing – then that means that grazing is not always the key bottleneck for recruitment of these tree species. So instead there's something else – maybe the seeds aren't dropping, or they're not very good seeds, or they're germinating but they're dying after that because of rainfall conditions of something else, or there's some other break that is preventing them … But on the other hand – so in that case the kangaroo culling is not gonna be very effective, if there's some other thing that is more important … However, if you put the fences up, and in a number of them you get recruitment, even if it's relatively low densities – but more than we saw when we went out there – you can say, "OK, clearly grazing is a key factor." It might not be the only thing but it is an important thing. And in that case, the culling program, or something related to the control of numbers or grazing pressure, is likely to be important.

So the good thing about the study is that it's really selling the idea of the exclosure as a good thing. Or many exclosures to try to understand that, and you could learn a lot. If you weren't getting recruitment you could even plant things into the ground, plant them into exclosures and then next to exclosures, and then see if the ones inside get eaten and the ones outside… Which would tell you if they're there they *do* get eaten,

but for some reason they're not there at all, which can help you to answer both of those questions. When they're in the landscape and they're short, they're likely to get eaten. But when they're not recruiting and they're excluded, it's some other reason. There's lots of things you can answer with future study, which is interesting.

SW: Yeah, and do you think it would be possible to do adaptive management without the use of exclosures? Are there other ways to do that in the landscape?

LOG: Yeah – so that's a good point – in that situation, the adaptive part of it and you're changing … your design might be particularly important in certain combinations of sites. So say you are, you only have enough money for ten exclosures, and you are seeing recruitment in two or three of them and not the others, and so in that situation it might be really interesting to figure out what is happening within them – the ones that are recruiting and the ones that aren't. And maybe in that situation you could decommission some of the ones that clearly aren't going to be very good, and replace those exclosures in other locations. It could be the case that you have different types of fencing on different plots, and only the ones that have rabbits and kangaroos excluded are seeing recruitment, and the ones that are, say, only kangaroos and not rabbits, they are not seeing recruitment, and so you might want to adjust that and add or change the fencing type. And so in those ways you can try to answer those questions, and with plantings, for example, so that's a good example, you put exclosures up [and] you're not seeing anything, so then you say, "OK, we want to know if they are there, are they getting eaten?" And we can't answer that at the moment because they're not coming up in the first place, so let's plant some.

So these are all options available to you that are hard to – so it's good to know what options are available, and what is possible and how you might anticipate where you would apply those options if this and this and this happened, but in that situation a lot of it is being reactive to: "this happened, so how do we tweak it?" Rather than letting it go and letting it fade out. "What's the next thing that we can learn by making a slight adjustment or whatever to any of those things?" So they might not be the same list of things that Sam and Val have in their ideas for adaptive management but they're some of the ones that come to my mind when I think about this particular situation. So – and I think if we had a discussion as a group and talked about adaptive management options, we would come up with a big list of all different things, and things that I haven't said there. But yeah, I think there's lots of potential in that sort of approach – to be able to adjust where required to get as much information out of it. Because you're spending lots of money and you need it to happen in a certain amount of time. Just waiting, and letting it go, and not taking the opportunities to learn more, is not very cost effective, and that's important 'cos there's not enough cash going around.

SW: Yeah, exactly, I was going to ask – I think I remember at some point in the trip you mentioning that you had to think all the time about the questions – whether the ones you are interested in as a scientist are always the same as the ones you are interested in as a manager. I wondered if you could explain that in relation to the trip?

LOG: Yeah, so it's a really common issue in relation to science, especially applied science, and I guess particularly in ecological applied science … The idea is that you are doing research that can help do something in the environment. To make things better, protect something, make better decisions about management, whatever it might be. But actually to try to do something, rather than … So part of it is to learn about how the system works, but then the applied projects are trying to actually - using that information to make decisions and make things [happen]. But the issue is that very often the decision-context in the research institute, the Uni, is very different to the decision-context of the manager. So the manager has – might have some cash that they've got to spend before June, they've got three guys to do it, and the easiest thing is just to plant a bunch of trees in the ground, or get a bunch of ten-eighty baits and bait a bunch of foxes or something, and so there's just not the resources and the time to do an analysis of the most efficient, cost-effective method, there's not a lot of time to spend on doing analysis or reading about people that have done these things and try to apply them, or these people have worked in the area a long time – we know with this much money we can put up this much fence, and we've only got a few people to do stuff …

So it's hard to translate … It's important but very difficult to make sure that the applied nature of your research actually is relevant to the management that is possible. In this case it's quite good because the manager and the researchers are working together, and so the Authority has a problem and they've requested an answer or a solution to this problem or a way of evaluating it, the researchers are working with the manager to achieve something that is going to work for them. [The researchers] give them options and then the managers can say, "OK, we want to do this one and this one, or this one." And that works really well, I think. I haven't done a lot of it, but it seems to be an effective way of doing it as opposed to the science that occurs in the institution and only rarely breaks out into influencing management. And so, I don't know, you like to think that your work is doing something, but rarely is it affecting day-to-day decisions of management. In this way it will actually do that, which is good.

SW: Yeah, I was going to ask this later on, but it's probably a good point now. When you're in the field talking to the site staff out there, how that interaction and that conversation helps you to think about what's happening in the landscape?

LOG: I think it's really good because the interesting thing is – when you are talking to manager – is that they know a lot. They know an awful lot because they've spent an awful lot of time in the area. They know all the roads, where things are roughly,

they've got lots of good information about all kinds of things that they might not even know that they have. They just see and they take it in, and it's – until they get asked the questions they might not even think about it. Having said that, there were a number of occasions where it was pretty clear that the manager was – because they weren't looking for something, then they didn't really notice something. So it – as valuable as a manager's experience is, I don't think that it, in itself, is enough in all situations. So it can be really good information in lots of ways. But in some cases, maybe a particularly targeted question or something that you would really have to looking for, observing and watching for change, that is not on their radar for some reason, they – you might get misleading guesses from them. I think that – which makes it quite clear to me, then, that you really need both. So trying to do it without any manager help would be silly, because there's just way too much that they know. But trying to use only what they *think* is happening to make decisions, is probably also not a good idea either. Because it's really easy to think that something has happened, and then you get optimistic and see a few seedlings, and you start seeing seedlings everywhere. Or you start seeing kangaroos in a few places and you start thinking, "they're going up!" when in fact they're just moving into different places, or … It's important to have both I think. Both are valuable.

SW: Yeah, did you – so when we were driving back down through the park on the last day, and you were talking to the member of the site staff – did you hear these hypotheses?

LOG: Yeah I did actually, but it was really good. So questions about why the northern parts of the Park were looking different to the southern end, and theories that there was more rainfall in the southern part and more grazing in the northern part. And it seems to align quite well, but it's hard to know exactly how that balances out. So maybe … In reality it could be just one or the other. Like, the rainfall's quite similar, but there's slightly different veg types because of historical land-use which means that kangaroos can be more visible in those top parts, or also because it's more open then you get more of them there, and so I think they're really good places to start for getting ideas – yep that's probably a good thing and we can test that to get these hypotheses – and they'd be much better, they'd be great at guessing as opposed to what I could guess (probably) because I don't know the area very well. But having said that I would want to check – to test them out with some data as well. I thought it was really good – really interesting conversations and so many things to observe and they know a lot. But, it's a big area and they're not – they don't have … What you find, what I did notice was that a lot of their management is the same sort of things again – they have the resources to do fencing, they have the resources to do spraying, they've got to clean up the campsites where people visit because that's really important, so I think it ends up being a very simple management strategy. Spray the really bad weeds because that's something we know we can do, we know how much it costs, we have all the gear for it, and that's part of our job. And there's a collection of things that they will always do because that's their default, their bread and butter,

and then there's special things on top of that which require other thought. And if you're not thinking about those, and anticipating that you might be doing a lot of learning or something in those other things, then I guess you don't pay as much attention. So there's a limit to how much information you're going to be able to provide on specifics, rather than just, "what do you know about this?"

SW: And it was interesting to see the way that you would form hypotheses as well during the trip. Looking at the system and trying to figure out what was going on. And I was wondering how that process of forming hypotheses helps you to think about the complex dynamics that were happening? Especially with regard to temporal cycles and things like that.

LOG: Yeah I think it's really important, and I was specifically trying to do that because I didn't want to – when you only have a few days there, and this is a pilot study where you're trying to learn as much as you can, it was important to try to get as much of an understanding of that area as possible. So by looking and trying to take it in, you learn a lot, but by asking yourself those questions: "OK, where are we seeing these things? We're only seeing them there, we're not seeing them there … What sort of – the places where we are seeing the things, what age might they have been? How does that relate to what the historic flood levels might have been, or the historic grazing?" Because they're all the things that are driving the system. "And how does what *has* happened – how is that driving what we're seeing now? And then, how does that help inform what we're likely to see in the future? Based on the other events that are likely to happen. So if they got rid of lots of grazing, what might we see? If there were more floods, what might we see?" And so trying to – I was really trying to make sure that I could have the best guesses of those things as possible, so it was important to try to visualize those mental models of all sorts of things – "how is the system working? Where are these things occurring? The recruitment that we're seeing is this height, how old might this be? What are the sorts of things that happened in that sort of time that might have influenced that? Why are we seeing them in some places and not others? How is this site different to the other site we were at?" All that sort of stuff I think makes that report about future predictions, and where we're likely to see things, and how the system is working, a lot easier to try to understand. That was the idea.

SW: Yeah, it seemed interesting to think about the historical factors, like the flood regime, that has not been flooded for about 30 years I think …

LOG: Yeah, certain parts had been – it's an interesting flooding history because there's larger floods and smaller floods, and so only the larger ones would get right down into the bottom. So there'd be – the time since flooding events will be dependent on the part of the park that you're looking at. But it was very clear to see in some parts that there was a topographic line that would coincide perfectly with a water level. And so the water comes up to here, and bang, you've got trees up to

there. Or – and then something else after that. So it was a bunch of cases where it was really clear … And so obviously that was having a huge effect, and this particular veg type is a floodplain vegetation type within a very dry landscape, and that's why it's different, because it does get flooded semi occasionally.

SW: And how often do the big fires go through? Because there was one just before we arrived, right?

LOG: Yeah, that's right. Fires are common in Wildlands, but not as common as what people had thought. There was a really good study, I think it was Adrian who was doing that, they did a talk at the University saying how because its dry and because its easily burnt, that means it probably burns really regularly or really frequently. But in actual fact they looked at a lot of fire histories across the site and there were plenty of places that hadn't been burned in many years, and places that had been burned relatively frequently as well, so there was a real scattering. And some of the long fire intervals were quite a long time – more than sixty- or seventy-years sort of thing. So we have a range of fire histories in there, and a tough part of management at the moment though, is with the state government's plan now where they have to burn a certain percentage of the state every year as part of that response to those big bushfires a few years back. So they said, "right, we're going to burn a certain percentage of the state every year to reduce the fire risk," and that sort of thing. The only thing is, is places like the Wildlands region, which is a very large area and very easy to burn, and very low risk to people, it's *really* easy to burn large areas and to get their quota up. So places like that get burned often as part of this new plan, even – this is sort of a separate question – defeating the purpose of trying to protect houses, when you're burning up in a place that no-one lives.

But anyway, regardless of that, it means that fire is probably going to be a more common thing in the landscape there, and that'll be an interesting thing to see how that influences things. But, yes, it is a place that is ripe and ready for fires a lot because it is so dry and the right sort of vegetation for that.

SW: Is there much understanding of how these events like fire and flooding impact pine and ironwood communities?

LOG: Yes, well I'm not sure about it actually, I haven't read much of the literature. The only thing is that a lot of the trees that we saw would have been fire killed, and they were quite large trees, so that suggests that this place doesn't burn that often. So when you're getting very large trees that are killed by fire, then you – it's a good indicator that there haven't been many fires occurring. Having said that we – in some of the places that had a low intensity burn through them, trees don't die, and they re-sprout again, and so it may be very likely that there have been fires through that area but they've just been low intensity fires, and not killed the trees. So it's hard – fire, flooding and grazing are having a very – and rainfall – they're really important, each

of those, and I don't have … I personally don't have a very good understanding of how each of those is working in this system, and each of those is influencing tree recruitment, and I'm not sure if it is well understood by anyone. There is some work done that has ideas about some parts of these, but I'm sure to what extent that understanding is reached, so yeah … I would have thought that maybe Sam and Val would have a better idea about that because they've read more widely on this area. So, it's a really good question – they're hugely important, and future management is going to need to accommodate or to understand those things because if its – if grazing is less important that fire, flooding, rainfall factors, then spending lots of money on culling is not a valuable thing. But at the moment that doesn't seem clear. And hopefully some of this study will help tease out a lot of that.

SW: Yeah, and I was interested in this idea of the reference state, or what you are trying to achieve in the Wildlands. I was wondering whether you were aware of pine-ironwood communities that are in a 'healthy' state that you're thinking of when you're looking at this woodland?

LOG: I don't know of many, I wasn't visualizing a reference state, but I've done a lot of work with reference states and benchmarking and that sort of thing, and that's a big thing in [this state], and a big part of my research. My research has been in vegetation condition, and when you're looking at condition you've got to compare it. The only way you can really assess condition is by comparing it against something. So how do you say something is 'good' if you don't know what's 'bad,' or you don't know what it should be? So vegetation – or creating benchmarks and things is an increasingly common thing in ecology all over the world, and benchmarks exist for every veg type in this state and have done for a number of years. That is the basis for condition assessment across the state. And that is closely intertwined with offset policy and those sorts of things. And so there is a reference benchmark for this vegetation type and so that can be used.

SW: Is that on the Authority website?

LOG: It's on the [state government's environmental department] website, yeah … And the assistant EVC benchmark – the Ecological Vegetation Class … And that can be used. The only thing is that the benchmark is a snapshot in time. It has this percent of each life-form type, so twenty percent shrubs, forty percent grasses – they're just examples, but whatever they are – but in reality you have a much more diverse and heterogeneous landscape. But they're just the – the idea is that that is the central position of somewhere not touched by humans, kind of thing. But in a place that gets burned, and that has succession type of things, then it doesn't really apply directly to any particular place, it's just, "on average we would want these sorts of things in the landscape." And so they're hard to use in a place that is fire-prone and flood-prone, because there's huge events in the landscape and there's very different vegetation before and after the event, so … But, yeah that can be used to influence management

to say, "this is what we're seeing at the moment, this is what we probably should see, and the biggest gaps between the two are in this and this and this. So understory is quite good, tree cover is OK, but we've got no medium shrubs, and we've got no younger trees, and those are important." So you can identify what parts of the vegetation are lacking and how much that might be. But it is complicated when you're looking at a system that is event driven …

SW: … and is changing through time …

LOG: Yeah, so … But that's another issue.

SW: Yeah, and moving onto the methods. How did you find that practice in the field? What were the main things that you changed?

LOG: I thought that it was crucial to do. The things that we adjusted were the size of the areas around the tree in the rapid sampling, because it was slow and tedious and didn't seem like we were going to get more information by going further out. So we were able to shorten that into a smaller area and make that rapid thing actually rapid. Also, by breaking it into an inner and an outer circle, and an inter compass direction quadrants, made it spatially explicit, I suppose. So within that rapid survey there was some idea of spatial orientation, which we think may be influential because of some things of aspect and slope and these sorts of things. Prevailing wind direction may be influencing seed range and that sort of thing. And so those sorts of little tweaks were quite – were good to know. I guess also in the detailed survey to try to get an idea of the number of points. It was like, "OK, this looks like plenty" … and the rising plate-meter, number of points, they're really quick so we can actually do quite a few of them. "How do we lay out the lines of the transect either side?" Just the specifics of how you actually efficiently do that with a few people – how many people you need to actually do that. "Is two inefficient? Is three better?" So lots of little questions.

I guess the overall structure of the sampling designs didn't change a lot. It was more of those nuances and the little things – and obviously your data sampling sheets change a lot. It's very hard to make a survey sheet to record your data straight away, without having been there and seen what you think you might be recording, so those would change a lot.

SW: So what kind of things changed for you?

LOG: Well I guess for example in the rapid surveys, a really easy way to record was to have the picture, and the inner circle and the outer circle, and you just divide it up and put those numbers directly in those spots, rather than having lines or grids or something. That was the simplest and most straightforward way to do it. So we ended up drawing those on the page, because they weren't there already. So that's a good example. Other ones were life-forms and things that were missed – so we didn't think

we were going to see much soil crust and things that weren't on the list, and that was actually an important component of some of the sites that we went to, so it probably deserves its own category, um … those sorts of things – how you lay out the information on the page, that sort of thing.

SW: Yeah, and there was that discussion about, say for instance, where you measure the diameter …

LOG: … yeah, exactly, then you go there and find that lots of the trees actually have lots of branches low down and it's just way too hard to do a diameter at breast height. So by lowering it down to the base it makes a huge difference in the consistency in the estimate between people, and it takes away that issue of having to measure multiple stems and things. So it's much better information in the end, I think. All perfect examples of that type of thing.

SW: Yeah, and there was that textbook going around as well. Were you using that much?

LOG: I wasn't using that. That was one that Riley had brought up because she hadn't done many surveys and wanted to try to look up the ones we were doing and how they fitted in to the broader spectrum of field survey options. And I had a quick look through the book and it gives you lots of options, but it had very little detail about – it said how you do it, but just in a very straightforward sense. As you found out, and as we all noticed, when you go out there in reality there are all – very many small questions that you need to think about when you get out into the field. So diameter of breast height is a perfect example. Often a textbook will just say you measure the diameter at this height, you use the DBH tape or calipers or something like that. It'll give you those technical details but it won't say, "if it's on a slope, and you stand at the bottom of the tree it's here, but if you stand at the top of the slope on the other side of the tree it'll be thirty centimeters higher, or if there's multiple branches – which ones you might include …" You have to make those choices and decisions on the fly when you're out there. So, they're good, those resources, they give you an idea of the options open to you, but I don't think by themselves you can read it and know exactly how to do it without having to make further tweaks and decisions while you're out there. It always happens – always happens in fieldwork. And you hope that people write those down and record them. A lot of it's not. That's the interesting thing about data but that's a whole 'nother kettle of fish.

SW: And what happens then if you have a bunch of different people doing data collection through time? How would you negotiate that type of issue?

LOG: Ideally you will have very very good records of the method, written down, and a lot of those small things – say, "OK, in this situation we did this, and in this situation we did that," for each of the different random events that might happen that

might happen, that present you at a different patch of vegetation or something: "This was really hard to survey so we had to make an adjustment and we did this," or whatever. It's like the tree canopy, when you are doing pointing, how high above do you record those ones, really tall shrubs, those sorts of things. So – and often they're not, to be honest. Some of them are, but not all of them. And those little things are likely to make differences in the survey method for sure. That's the thing about sampling and that's happened forever, and that's not ideal but it's just a thing you have to deal with. Apart from the variation between observers as it is, so let alone – even if you have the same training, and the same instruction, at the same time, you still will get differences. And then through time all of those get distorted with different training and different ideas, and it makes more of a difference again, so …

SW: And are you also thinking about who is gonna be doing the surveys in the future when you're thinking about the design? For instance, you're an expert or well-trained at doing the pointing method, or stuff like that …

LOG: Yeah, well in that case it wasn't – and that's the whole thing about the subjective versus the objective estimate. So pointing is a good thing because we're much more likely to get similar – you're much more likely to get similar estimates of cover through time, between observers. Because it's not very subjective – you either hit it, or you didn't hit it, and you've done the same number of points in a very similarly structured design. But when you just do subjective estimates and you stand there and you say, "is it this?" that's really highly influenced by who the person is that's doing it. And that's why we did the two different types of detailed survey – one that was measured with the pointing, and the other that was small areas where we did best guess of the cover, but also an upper and lower bound of where we think the plausible values that it may exist in. So – sort of like the ninety-five percent confidence interval of your estimate. So it's very unlikely to be outside of those things, but it's possible that it could go anywhere from here to here, so my best guess is this. So that can be helpful and studies have shown that that helps. It depends on how you use the data after that. So that – you can work it into the design after to reduce – so the more objective it is, and the more measured it is, the more likely you are to have issues with observer variation through time. But, it also takes longer, and you need to be more skilled to do it, in a way, because you need to know that particular technique. So those are really important considerations for the sampling design. And so that's why a count is quite good in the rapid survey – you're counting seedlings. I count, you count, we're likely to be similar even if we don't get exactly the same. They should be similar, and so – and the cover estimates of that [in the rapid survey], they were gonna be very different but they were just an indicator of general cover. They were just an idea, they weren't – you don't care if there's a difference between five and ten percent cover because there's no way you can tell the difference between observers. Because that's how small they are. But you do care if it goes from zero to fifty percent. And you can probably pick that up.

SW: Did you find the pointing method more useful than the quadrats, or?

LOG: The good thing was that it wasn't slower, and that was part of the thing was to see if it was slower to do. The thing about pointing is that it's not very good at picking up rare things in the landscape. So if you're doing two hundred points in a transect, through an area, you're quite unlikely to hit something if it's small and uncommon within that patch. So if there's only one or two little plants of this, then you're very likely to miss it. But the visual estimates in the quadrats in the detailed sampling one, you find everything in the one meter by one-meter quadrat. So you intensively sample that patch. And so for rare things that actually works better. So it really depends what your focus is. We're not really looking for rare things from the pointing though, we just want to get an idea of the vegetation cover. So in that respect the pointing worked quite well.

SW: And when you're thinking about using these methods through time to pick up these unpredictable changes in the landscape, how do you think about that kind of research design? Like – whether you would keep transects in one place and go back to them repeatedly, or whether you would move them around the landscape?

LOG: Yeah, I think it really depends. So if you're trying to do vegetation surveys through the landscape, because of the variation in the landscape it's probably really important in that situation to try to go back to the same place, and measure it again in a detailed – if you actually really care about, say, a change of a small amount of change in a vegetation type, and it goes from five percent cover to ten percent cover, or – and that sort of thing – then if you care about that level of detail, it's really important that you measure it, that you try to go back to the same place, or do heaps of surveys if you can't go back to the same place and you're trying to make up for that, and to measure it in a way that is relatively high resolution, so that you get the detail in there.

But, so that's the thing, in this situation they don't necessarily want that. So, that's part of the idea, is to provide them with an option that if they want to do something intensive, then they could do this, and they could do that. So the reason why we had that sort of design was that it could be applied within exclosures, and so if you had an exclosure around a tree you could do the sampling within that exclosure. So that was a key part of that design. But it could also be done outside of an exclosure as well. So you're trying to factor in heaps of different things. So they might actually not care at all about – they might care but it might not be the key for their study, or worth their money to know if there's an increase in shrubs of ten percent for these particular shrubs, or the perennial grasses are increasing by five percent. It might be really interesting and might be valuable, but they don't have the time and money to deal with the information. It might purely be key to just, "we have this many – we have very few tree seedlings now, and then we do this, and we have more." That might be purely what they want to know. With the idea that if they take care of the dominant –

the apex strata, the trees, the tallest thing in the landscape – then the rest of it is probably OK, sort of, is the idea. Because the other thing is also that the understory plants have shorter timeframes, they can recruit more easily; but trees – because they are so long-lived and it takes a long time to get them back – it's more important for those to … Once they're lost they're hard to get back, I suppose. And it might just take one or two events of getting recruits to then say, "OK, no we're covered for another thirty years." If you can break that suppression cycle and get some in, then it's, "OK, we're good for a while." But if you don't get any for fifty years then you're in trouble, because you don't have any big trees in the landscape and things need the trees, so … It takes a long time to replace them, whereas shrubs and things you can try to put in, and five years later there's mature shrubs there ready to go. If you plant trees it takes thirty or forty years to get big trees, so …

SW: So you are kind of going back and forth between the objectives, I guess?

LOG: Yeah, it really depends. So our aims in this study are highly dependent on their objectives, on what they can do and what they want to do, because it is a response to their needs for the most part. We can provide all the options and different examples of what you might do in this situation, what you might do in this situation, and this is probably the best guess in this, given what we know and the resources that you might want to put into it. But it all comes down to what they want to do, what their focus is and how much they want to invest.

SW: And how was it – well, first of all, you mentioned that collaboration takes place quite a lot in the University department, in the sense that you have this unwritten agreement that you will help each other out on field trips and stuff like that …

LOG: Yeah, most people, I guess – if you're interested in fieldwork – will … Most people doing a PhD will expect to volunteer and help out another person's fieldwork at some stage. Because it's interesting but also because you want to pay your dues to the group, because it's likely that you're gonna need people to help you as well. It sort of works out like that. And another way of looking at it is that everyone in the lab has a very different skill-set, and it's important for you to try to learn how to do lots of different things, but you can also get very large benefits from using people who know a lot about something. For example, I can use someone who has got very good statistical skills to accelerate my data analysis by weeks, and so it can be really helpful to work together in that sort of thing. And that's what's happened in this case, where the people in charge of the project have got less field experience, and so it's sensible to try to get the help of people that have other experience, especially because they have the funding to be able to pay for that. And that's part of my role and I guess it pays part of my salary, that project budget, so … And so, I think it's really good, but it was really interesting in that situation because going away with people who have done lots of field ecology and then also people who are primarily statistical ecologists, you might say, or do a lot of that – even though they do understand the real

world very well as well, but they spend most of their research time doing statistical stuff, dealing with data that's been sourced from somewhere else. You've got really quite a good balance and discussions about what is important, and it's really good to make that link between wanting to go out and collect these data, and you need to find ways to bring it back and say, "well, how are we gonna analyze the data and how are we going to learn from this?" It was quite an informative thing for me to think very very hard about what are the data trying to say, and how are we going to use the data to answer the questions that we've got. So that was really good, because they had a focus on that, and a real – a vested interest in that because that's what it all comes down to. It's not that you don't normally, but it's enhanced in this situation because of that combination of people that we had.

SW: Yeah. And can you think of an example of a problem or a thing that you encountered, where you did come at it from different directions, you were asking different questions?

LOG: Well I think a clear example, which is not necessarily a – probably not a – the clear example is the pilot study and how we allocated our time in the study. So we wanted to collect as much data as we could from the outset, but when we got there and realized that we're not going to see very many places, we really had to think about how we were best going to spend our time to learn the things that we needed to learn, to inform the report to go forward, and so it's not quite exactly the same … But that was a really – so going back to sample these places, we could get more data and so on, more numbers to boost the estimates of density and cover and the things we are likely to see, or we could go out and visit as many places as we could to build a conceptual model of where things are occurring. And it was important then to know that statistically, getting one or two more sites was not going to add very much value at all to their analysis. And so, we were able to prioritize our time based on the value of the information we were gonna get. And I think that also applies to, then, thoughts about how this could go in terms of how many sites we might want, how long does it take to do this, and that needs both a statistical consideration of, how many replicates do you need to get the power that you need to answer this question, as well as, in a field based question, how tedious is it to go to this many places, how expensive is it to build this many exclosures, is it sensible to do the survey where you're not likely to see many things – these sorts of things … A combination of field experience and statistical knowledge is very valuable in that sort of situation to make those sorts of plans.

SW: And what were the main challenges for you?

LOG: For the pilot study or for the future report plans?

SW: Actually, both would be interesting.

LOG: For the pilot study the main challenges were not really understanding the vegetation before we went, and also not having a really direct question to try to answer before we left as well. So we know their focus is tree recruitment but we know their focus is also in the greater flora, and so we tried to accommodate for a lot of things; we tried to accommodate for different sampling methods, and tried, in doing that – with also not having a really good idea of what vegetation we were going to encounter when we got there – made that really tricky. And once we'd got there it was quite challenging to try to maximize the use of our time, our limited time in the pilot study. But I think we did it quite well, but it took a lot of chats to figure out what we were trying to achieve, and because a lot of it was vague, it required those chats to do it. It wasn't: "our real aim is *this*, because we want to do *this*." And so how would you put a survey in a twenty by twenty … If it was a really direct question and very limited options for how we might do it, it's quite easy. But we had everything open to us, so trying to account for everything or allow for everything was difficult.

SW: And how about for the report?

LOG: The report is going to be tricky because of that exact situation, where – it's the same thing where they've got options to provide, but having said that they don't have to provide all of them. They can boil it down into: "simplest case, complex case" – and you can decide. I don't know how they're going to – because I'm not involved in writing the report – I'm not actually sure how they're going to do that. They can simplify it quite a bit knowing all the things that they know now, choose to focus on whatever they think is important, based on what the Authority want but also what they think are the best ways to tackle the problem, based on what we saw and what they know. The report could be very much an "everything's available, there's so many ways in which this could go," sort of thing, and a very open suggestion. Or it could be quite constrained into "here's this option that goes this way and here's this option that goes this way. They have these merits – choose!" sort of thing. And I think it will be similar to that, because it's much more efficient that way.

SW: To have something specific – a relatively small number of choices?

LOG: Exactly, yeah. I think if it was very vague and open, the process of trying to decide on something is going to be drastically lengthened. So, if they want to do something soon, they will want fewer options and that simplifies the process a lot. And I think that's what they will do, but I'm not sure.

SW: We wait and see.

LOG: Yeah, that's right, exactly. It'll be interesting.

SW: Yeah it'll be really cool actually to see the final report.

LOG: Yeah exactly.

SW: Yeah, so if there's anything else that you think we haven't covered or you think is important to understand …

LOG: Umm, I think we've covered quite a lot, that sounds pretty good. Nothing off the top of my head, not for the project or the adaptive management process, or the approach or anything like that. I think that's most of it really. I think a lot of it will apply to the report and the future from here. But based on what we've done so far I think that's a pretty good coverage of that piece of the project.

SW: Yeah, I think it'll be nice … Well I don't know how I'll do it, because I'll be back in Stockholm in September, but maybe doing some phone interviews or something, just to see how this process goes forward through the summer.

LOG: I think it'll be really cool, and I'm sure those guys will be keen to update you, and you might just get a copy of the report of something.

SW: Yeah, I'm actually going up to Wildlands again. I'm going to go and sped three days with the volunteer group …

LOG: Wow is that right? Awesome.

SW: Yeah they go up every year apparently to do works and stuff in Park, and talk about the history of the park.

LOG: Wow, that's a really good idea actually, I think you'd learn a lot. Again, these sorts of people who are going there a lot – it's the same sort of thing with managers, they know heaps, and I think it's a great source of hypotheses, but all of those need to be tested. So …

SW: Yeah it'll be interesting because they also have that snapshot image as well, they go up there once a year …

LOG: … exactly, the same time of year and they see the same sorts of things …

SW: … it's interesting to see the different types of stories that people will weave about what's going on, what's happening up there …

LOG: I bet actually, and that's a great example. Talk to a bunch of people about the same place and they will all have different opinions – and that's a great example of how a person perceives a place differently. And why it is valuable, but why it's not enough I would say.

SW: Right. Have you spoken to Rowan [a member of the site staff at Wildlands] at all?

LOG: No I haven't actually. Because of my position I was never required to. I think Rowan would be really interesting to talk to.

SW: Yeah, I might try to track Rowan down while I'm up there …

LOG: Yeah that'd be a great idea.

SW: Yeah, thanks so much for talking, it's been really appreciated.

[End of interview]