NICE TO KNOW

Rapid Prototyping: Deschutes National Forest - Part 1

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In this section, I'm going to tell you a story about a week that I spent with a small, interdisciplinary group of biologists advising them on a model that they might usefully develop. I'm telling you this story for two reasons. The one is that I think the interaction between a modeler and a small group of biologists is an interesting story in itself, and the second is because I learned a lot about modeling from that particular experience. And some of the materials you've had in this class so far grew out of that particular experience.

So, once upon a time--and once upon a time was probably in the early to middle 1990s--there was an interdisciplinary group and an interagency group of people working in Bend, Oregon, on a problem in the Deschutes National Forest. And the problem was a concern about large fires. Basically, the story is that in the region of the forest that we're talking about, up in the top region, you had pine forest. I think it was lodgepole pine and ponderosa pine. And then in the lower slopes, you had about 40,000 acres of predominantly bitterbrush. And then the mountains leveled off, and you had high desert with sagebrush and some juniper.

And the concern was that the bitterbrush was a fuel load that was just waiting to burst into flame. And the 1990s was the beginning of concern in the forest service about the possibility of large fires. And this group had a little bit of money to spend on trying to reduce the fuel load. And they had been meeting and talking, I think very effectively, on a regular basis about how to spend the money. And, at some point, they felt that they were probably talking around in circles. And somebody said, "We don't seem to be converging here. Maybe we need a model."

And so a couple of months later, I arrived in Bend, Oregon. And the idea was that I was going to spend a week with them, helping them to develop a modeling approach to their problem. And I'm going to give you a sort of day-by-day story on how that interaction worked.

So it turned out that there were four main groups of specialists working on this problem. The first group was the tree experts. They were the people who knew about the pine trees growing up at the top of the mountain. And it turned out that, within the bitterbrush, there were clumps of ponderosa pine, and they knew all about them.

Then there were the experts on bitterbrush. Then there were fire experts. And then, finally, there were mule deer experts. Now why mule deer? It turned out that the bitterbrush was prime winter forage habitat for herds of mule deer in the region.

And if you push them as to what they were trying to achieve, in the first instance they were trying to minimize the chance of a large fire, but in the second instance they were trying to maintain that winter forage for the deer.

So on my first day, these four groups gave presentations, and they'd done a very careful job of figuring out what I needed to know. And each group spent about two hours telling me what they thought I needed to know. And by the end of the day, I was totally frazzled. I'd been given all this information, and the onus was on me to come back next day and say, "Okay, after hearing everything yesterday, this is what I think you need to do, from a modeling point of view."

So that evening, sitting in my hotel room, I was trying to think through what we could possibly do. And as I was going through my notes that I'd taken during the day, it suddenly struck me that I really wished I'd had one diagram that I could've had up on a wall while these four groups were presenting their information.

And that diagram would have had two very simple axes. On the horizontal axis, I would've had **spatial scale**. And on the vertical axis, I would have had some kind of **time scale**. And so every time somebody told me something, I would want to represent where, on that spatial-time continuum, whatever they were talking about could be represented by a little cross.

So, for example, at some stage, people were talking to me about fires, huge fires, that maybe burnt thousands or even ten thousands of acres. And these fires maybe occurred once every 50 or 100 years. So we'd have a little cross way up with large time scale. And then they'd suddenly switch, and they'd be talking about small fires that maybe burnt just tens of acres or even less, and maybe these occurred every year or every few years. So we'd suddenly have a point down at the bottom of the diagram.

And then, suddenly, a bitterbrush person would start telling me about chipmunks. Why chipmunks? Because apparently chipmunks play an important role in burying bitterbrush seed that is going to germinate after the next disturbance. And suddenly now we're talking about

chipmunks and bitterbrush seed, and we're right in the bottom corner at the origin of that diagram where you can hardly tell what the time and spatial scale is.

And I realized that while the people were talking to me during the Monday, they had been jumping all over that particular space-and-time continuum.

So kind of the first question I had to face is at what scale does one really want to think about this problem? And the heuristic I used here was, "What is the problem?" And the problem is that they are scared about large fires. And if they are scared about large fires, maybe the most useful model one can build is a model that produces large fires.

If you think about it, this kind of thinking goes right back to, for example, the elephant exercise we did where we were interested in the possibility of elephant contraception, because, again, we said, "What is the core of this problem?" And the core of the problem was trying to control an elephant population. And our argument was, "Good. Well, let's develop a model of how an elephant population grows."

So I came up with the idea that what we really needed to do was build a model that would be spatial, that represented 40,000 acres of bitterbrush, and it would be a sort of cellular model with maybe a scale for each cell of just one or two acres. So we were going to have tens of thousands of these cells. And what we wanted to do was to create fires and then, ultimately, to change the fuel load in some of the cells to see how that affected the possibility of future large fires.

One of the considerations that came into choosing the size of each cell was thinking about the second objective because the second objective, remember, was the question of winter forage for the mule deer. And what had come through on the Monday was that the food available to the deer depended on how close the bitterbrush was to little clumps of trees that would enable the deer to go there, to take shelter if the weather was bad or to hide there if they thought there was some kind of danger. So the actual ability to use food depended on proximity to trees. And we're talking there about a radius of maybe a kilometer or less, okay? So that was my thinking.

And on the second day, I went in, and I said to them, "You know, I think we need to develop a prototype here. And I think the issue that you guys haven't got your mind around yet is the question of how do big fires happen, and how does management of the fuel reduce the risk of a big fire?" And I think they were a little bit surprised because they, I think, expected me to spend

the week coming up with a fairly complicated conceptual model. And what I was suggesting was that I wanted to develop an actual working model during the week that I was there. And they bought into the idea.

So I said, “Okay, well, if this is what we’re going to do, these are our objectives. Now, could you please go in your separate disciplinary groups and think about everything you told me yesterday, and reduce what you had told me to the key essentials that I need in order to develop a first prototype.”

So, again, to tie this back to other things that we’ve talked about, what we’re doing here is saying, “How do we design the simplest possible model world for a first prototype?” And they said, “Yes,” they understood what they were going to do. And I should stress that this was really a super group of people to work with.

And off they went, and they came back an hour or so later, and each group had a list, and each group had a list of about 20 or 30 items. And what they had written down was everything they had told me the day before, everything from large fires to chipmunks. And I said, “Uh-uh, we’ve got to make assumptions. We’ve got to reduce this list. So it’s no good telling me everything. What I want is a prioritized list. And just to make your life a little bit more easy, I don’t want you to prioritize all the items on your list because we’re never going to use all the items. I want you to pick the three most important items and prioritize them. And the reason you’re prioritizing the three most important items is because maybe we’re only going to use two of them.”

And I sort of sensed that maybe I was going to get a revolt, but off they went. And they did a fantastic job of pulling out the key issues that one needed to look at, from the point of view of the fire, the deer, the trees, and the bitterbrush.

And on that basis, I started designing a first prototype of the model. And the plan was that when we kicked off on day three, I would kick off with my design of the model. And I was feeling pretty good about it.

But when I met with the group on the morning of day three, they had been thinking and thinking and thinking overnight, and they were all extremely unhappy about the items that I’d made them cross off the list. So there was a kind of anxiety attack amongst the team of saying, “We’re over-simplifying. We’re leaving out this, and I think it’s important. And we’re leaving out that, and I think it’s important.” And I didn’t quite know how to handle this.

And, eventually, what I came up with was this idea. “You’ve got two options. Option one, I’m going to try and get a running first prototype for you to look at by the end of this week, and if you want to run with that option, you can’t add any more detail. Option two, we can spend the week designing a complex conceptual model, and then I’m out of here, and it’s your job to, somehow or other, build a model.” And after a little bit of discussion, everybody calmed down, and we agreed we were going to go ahead with the prototype.

One of the things that also came out that morning was that what I really needed for the model was to say, “Okay, here’s a map. The map is going to tell you at each cell how old the bitterbrush is, in other words, how long it’s been growing there since the last fire.” And it turned out that it was important to divide the age of the bitterbrush into three seral stages. And one of the reasons for this was that the different seral stages would have a different flammability, and also, only one of those seral stages was really suitable for the mule deer to eat. So we’re going to tell you how old the bitterbrush is in the cell, we’re going to tell you which seral stage it’s in, and we’re going to tell you something about whether or not there’s a clump of trees in that cell, and something about how large or how old that clump of trees might be.

And what I wanted to do was then take the results. Imagine a map with all that information on it. And I wanted the deer people to come up with an algorithm for looking at that map and saying, “Okay, if this is what we have on the map, then this is how attractive that map is to the mule deer.” And we decided to call this the “Mule Deer Foraging Index,” and come up with an index, on a scale of 0 to 100, where 100 is mule deer heaven, from a winter foraging point of view, and 0 means they’re all starving. And the deer people came up with good reasons, so they thought, as to why they just couldn’t do it.

So I guess at this stage, the heuristic I used was “Press on, regardless. Let’s get everything else working, and we can come back to the question of deer later.” So the rest of day three was developing the model.

And on day four, I came back to the group with an actual running model, something that I could show them on their computers. But before I could do that, we had another anxiety attack. Before they even looked at the model, they were concerned again about the details that had been left out. And it was sort of like the thin edge of the wedge. “Don’t you think we could just put this in,” or, “Don’t you think we could just put that in?” And I had to stick to the rule of “We’re developing a prototype, and we’re developing a first prototype. And all these things you’re mentioning, you can put on a list, and maybe we’ll put them in a second prototype. But if you try to put them in

now, I'm not going to have a working model for you by the end of the week." And so we pressed on, and I showed them the working model that I had.

Now, that turned out to be a turning point because as soon as they saw something running--and, by the way, this model had bugs in it. So the results it was producing weren't really very meaningful. But the mere act of looking at a running model got them animated. It got them animated to the point where they started making suggestions about slight, doable changes in the model. But most important of all, it activated the deer people, and they said, "Ah, okay, we see what's going on." And maybe they also saw that if they didn't contribute, there was not going to be any output to do with deer. And they very quickly came up with a really neat way of calculating this deer-foraging index.

And so on day four, things looked like they were really going to be moving fast. So the rest of the day was, essentially, me programming, changing outputs to meet with their suggestions and so on, finding the bugs, and starting to add management options to the model.

Now, how to represent management options as simply as possible. And the answer was that the effect of any management option was going to be to reduce fuel load in certain cells. And so we put in the ability to do that, okay? And we had a model.

And what came out of the model were two interesting results. The first was a distinction between short-term and long-term outputs.

Again, think back to the elephant model. Remember that one of the concepts that came out of looking at an elephant population model was that one needed to draw a distinction between short-term outlook, where the current age structure of the elephant population was important, and long-term strategies where it was unimportant.

And it just so happens that when one started looking at the results coming out of this model, one discovered that there was a short term, where almost no matter what you did, there was a fairly high risk of large fires. And then there was a longer term where maybe large fires, or if you were lucky, a series of smaller fires had occurred, where you could now look very differently at the way in which you were applying fire policy to the area. So that was the first important distinction that came out.

The second important distinction turned out to be the deer-foraging index. And what emerged was that no matter what you did, the deer-foraging index was going to go down. And it turned out that this had been a key point in the discussions within the group because whenever somebody came up with an idea of some kind of fuel-reduction strategy, the people who were expert on mule deer would say, “Maybe that’s going to reduce the fuel load, but I don’t think it’s going to be good for the deer for their winter foraging.”

What the model did was add an interesting twist to that, because it showed that if you did nothing, the deer-forage index was still going to go down, and that was something that the deer people hadn’t thought about. In other words, the deer-forage index was as good as it was going to get, and no matter what you did, it was going to go down. And that concept kind of broke the logjam in the thinking of the group.

And by this point, we had a working model. We had some results. We were talking about them. The working model got the managers interested in what we were doing. And everybody felt pretty good about the week that we had spent together. They felt good about it, but their parting shot was, “We’ve still left out this. We’ve still left out that. We’ve still left out the other.” And my parting shot was, “Good. So after I’ve gone, you guys can get to work on the second prototype.”

Okay, so that’s basically the story of my interaction. What I’m going to do next is talk just a little bit about what I learnt from that particular exercise.

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