

## QUESTIONS & ANSWERS

\* Transcribed

### ***Modeling changes in river flows and temperatures caused by climate warming***

**Jack Stanford**

Director, Flathead Lake Biological Station, University of Montana

**Question:** (24:52) Give us a little bit more, Jack, on, what you would recommend in terms of further downscaling and zoning.

**Answer:** (25:10, Stanford) Good question. I would like to be able to model all of these rivers at least at 1/16<sup>th</sup> scale. It's a little too coarse. Confidence goes off when you are that coarse of resolution. So, I would like to do it at that level of resolution. It will take another year of computer time to do that. So, we're going to go ahead and run it at 1/8<sup>th</sup>, see how the projections for river-by-river stack up. If there are several rivers that are completely different than adjacent rivers, then we're going to have to sort it out and see what happened. But that's what I'd like to do. What do you think? You think about these things all the time.

**Question:** (25:58) I think that we need to downscale further and then we have to look and see about the results. Especially in headwaters... [inaudible]

**Answer:** (26:25, Stanford) I agree with you and the challenge for me is, take these coarse results and say, "Look. Climate is a problem. We've got to include it in everything we're thinking about here and better resolve it locally." And some of the SST and pressure signals that Jeff will talk about in a minute reinforce that.

**Question:** (26:52) Has any thought been put into the effects of the pine bark beetle on the watersheds?

**Answer:** (27:00, Stanford) Yes. So, that's in the feedback arena. One of the things about climate warming that people don't realize is that what's changing most rapidly is the minimum winter temperature. It's getting warmer more rapidly than the maximum summer temperature. So we're not, in many places, especially in the pan arctic, seeing the tremendously cold temperatures that normally come in mid-winter. That had a major influence on things like pine beetles because they were killed by extremely cold winter temperatures that are not occurring anymore. As you change the vegetation and its solar insulation and reflecting capacity, it accelerates the effect. So, your question is, what happens when thousands of square miles of formerly green vegetation is now brown, it changes the trajectory of heating and cooling. So, it actually makes things worse in some respects and not so bad in others. For example, in the tundra regions, when the snow goes off earlier because of warming, our group has shown that it greens up. The green adds more thermal units to the landscape and you get a non-linear response. It gets warmer faster. Just how that's playing out with the beetle kill, I can't answer exactly, but the MODIS satellite is measuring that daily. And that's going into these new simulations that are occurring. So, it will be accounted for, but

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how it actually plays out, I don't know. You would expect that if the trees are dead and not up taking water, transpiration changes and so on, run off would get more flashy.

**Answer:** (29:10, Brian Riddell) Ken asked a good question about what's the next sort of scaling and I'm not sure I agreed with the sort of— If you think about what it takes to run these models, and are you really going to benefit much by having things in an even finer scale. I think I would be more concerned about running other scenarios and what would you have to be wrong on to actually be wrong in your projection. What would it take in terms of an error to really not show this sort of outcome? And that's because I think the reality is it's going to happen. We don't know the rate. But we certainly have the people in the basin to monitor the rates and I don't know that the message is really going to change very much. It might get scarier. But I think we have to accept a certain reality here and start taking these sort of final conclusions to heart.

You're going to ask me a question, Walter? OK, only because of your age.

**Question:** (30:09) You talked about the increase in temperature. What effect will that have on salmon?

**Answer:** (30:16, Riddell) There are numerous ones and it really depends on the rate that it increases and the timing of when the increase is really occurring. Obviously, if you're hitting numbers like we saw on the Fraser this summer, we had flows in the Fraser of 24 to 26 on the surface. In the interior basin, those are near lethal. Now that's not what the animal is going to be at. It's certainly going to put a severe stress on the animal and their migratory ability. That burns up extra energy, makes them susceptible to various pathogens, etc. Many of which they carry naturally. There's really quite a variety of things that could affect them. Ultimately, their reproductive fitness is probably going to go down and their survivorship in fresh water is going to go down. The real concern is how quickly this is going to occur.

**Question:** (31:15) About 15 years ago, at an AGM in Vancouver, Dr. Kees Groot did a presentation on climate change. He said, "You guys live in a garden and there's [inaudible] outside your garden. And I said, what's the response to climate change and everything else and he said, "Well, the rational response to climate change and the uncertainty it presents would be that, you would actually protect every last scrap of habitat that you have in order to preserve as much resilience that you have in order to preserve as much abundance and diversity as possible [inaudible]." Is there anything changed from this interpretation of it 15 years ago? Would you say that's still a rational response to climate change?

**Answer:** (32:12, Riddell) There's been a number of changes and the Wild Salmon Policy, that was certainly one of the hearts of why we continued to push that forward. There's no question that the diversity in salmon is linked to the diversity in habitats and that's led to increasing interest in establishing better water management, including ground water and the need to conserve

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refuges and so on. So I think there is a realization that the effect is coming and you need to do something about managing now. Like Jack has just said, don't wait, you've got to start responding now. At the other end of the scale, I'm not sure that federally that you have a great response to climate change. Provincially, you have a more active response. I think most people would say that neither are really fully adequate at this time and they're not really focused on salmon. So, I mean, I think there are yes and no answers to what you are saying. I think people still are a little hesitant to really think that it's coming that quick. But it's only going to take a few more examples, like losing eight million sockeye in one season, to make people realize that there is a very serious amount of unknown out here and there's going to be a lot of big effects. And the mountain pine beetle's another obvious example.