

QUESTIONS & ANSWERS

* Transcribed

Ecosystem Services Through Salmon Nutrient Cycling

John Reynolds

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Question: (22:21) Every time I see an ecosystem discussion, there's always a circular effect, and I was wondering if you have got any of your students working on a circular effect of the impacts of increase of both terrestrial and aquatic predators on the increase in salmon biomass returning to streams. For example, even if a stream were totally unfished, the salmon run would increase and decrease naturally and so in your [inaudible] on this, on predator abundance, what would be the impacts? And is there a negative impact to increasing the number and wellbeing of salmonid predators? Have you done it?

Answer: (23:20, Reynolds) We haven't done that. It's a tricky one. It's very hard to study the salmon predators themselves, at least in our area, Bella Bella, because the bears are largely nocturnal. And I don't really feel like I should send a lot of graduate students out at night studying grizzly bears and black bears. But I can tell you, from the work that I quoted from Tom Clinton's group, they did show that basically they can max out the predation. The salmon can simply overwhelm the bear numbers in high years. So to that extent, I can certainly see that it's not a problem in terms of the bears whacking down salmon, because there is simply enough salmon to go around. I have trouble with the logic. I cannot see how having lots of fish in the stream can in some way be bad for the fish. Because I think that's the implication. You said in years where there were few fish, well, that's bad for everybody, including fishers and everyone else. If you have a large number of fish in the stream, this will give you some resilience and ability to buffer whatever the predators are going to be throwing at them. So it just seems to me that, I guess I tend to aim for wanting more fish on the streams both to ensure that recruitment as well as maintaining whatever people decide they want to maintain around the streams and ecosystems.

Question: (25:09) That's not the question. One of the things we have discussions about is whether there's a large number of predators as a restricting factor on productivity in the lake. So, for example, if there are high predator numbers in the lake, aquatic predators, in the lake that is having poor returns, are you creating an exponential reduction in the number of juvenile salmon in the lake because you have a large body of predators? Obviously, if that continues, the large body of predators will be reduced according to the decrease in the number of salmon that are returning to that system as a result of the high number of predators. That's what I have been asking. That's what we have had some discussions on when we're looking at Fox, Rogers and whoever else, I can't remember, maybe you were involved, in the lake — the amount of feed a lake can, the photosynthesis discussion of how can you estimate the number of fish a lake can support by the amount of feed that is in the lake. This is on the sockeyes, right? You do that and then you track from your maximum productivity in the lake according to food

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and then you have to look at restrictions that would reduce that from the maximum such as unavailabilities, hunting grounds, and one of the things that is in that is the number of predators. And so that's what I was asking, is that there must be a predator-prey relationship and because salmon are increasing and decreasing, even in a run that is not touched, there will be increases and decreases and have you looked at the implications of that and climate change, where you're going to see huge increases that you may not have seen.

Answer: (27:17, Reynolds) I think, if I were to answer every component of that question, I think it would probably blow into the next talk. I can't answer some of it because I'm not actually a lake person. We don't work on sockeye streams in the Bella Bella area, although we are in Takla and Thompson. But I don't actually know where to begin, Joy. Definitely predators can have a big impact on fish populations, whether it's on the stream or in the lake. There's no question about that. But as to the rest of it, the links to nutrients and so on — sorry, I guess I'm not sure where to begin.

Question: (28:06) Have you looked at the relationship between the levels of N15 and the carbon pool potential of those riparian habitats? Has anybody done that work at all?

Answer: (28:20, Reynolds) The carbon quality in soil or in...?

Question: (28:22) Yes, soil or vegetation.

Answer: (28:24, Reynolds) The short answer is, no, we have not done that yet. We have the samples, we've analysed, whenever we send the sample out, the N15, we also get the carbon signature. So, we actually have that information, but we haven't even begun to analyse it yet.

Question: (28:46) Your study areas are quite diverse. You've got coastal study areas, most of the studies come from coastal places, but I see that your Takla and Thompson ones would be decidedly interior in nature. Would you expect to see any differences or have you seen anything from these cases?

Answer: (29:04, Reynolds) That's a good point. It's really important, obviously from a policy perspective, because this is an issue, and you really extrapolate from one area to another. The short answer is we don't know yet. I've got two graduate students, Doug Braun and Jan Verspoor, who have been doing the Fraser Salmon and Watershed Program study in Takla and we just haven't thrown the effort at that one, just two people compared to our Bella Bella team which is further ahead in putting all this together. So, I'm trying to think if I can even speculate on how exactly these are going to be different. Here's one thing that is different. Most of our relationships are tighter in the Takla area between, say, physical characteristics of salmon or between salmon and their ecosystem impacts. Most of those relationships look a lot better, or tighter, in the Takla area than they are down in the Thompson area. Thompson is much more heavily impacted by humans and nitrogen levels and the background levels in the water are much, much higher. And so, I think I can say that maybe in the heavily impacted areas that have got

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a lot of human activity, I would not be surprised if the salmon are going to be getting less of a nutrient contribution in terms of supporting, say, periphyton in the streams and at that level, I think, we're going to see their proportional contribution will probably be considerably less. Takla is much simpler, the streams we work on are in pretty good shape and there's simply no human impact whatsoever in terms of the nitrogen or phosphorous in the system.

Question: (30:56) Is there a way to see if nitrogen is in streams longer [inaudible] such as trees? So, what I'm interested in, is to see if there's a way to even get a guesstimate of the salmon populations in the past... [inaudible]

Answer: (31:26, Reynolds) Yes, Tom Reimchen has been working on this for a number of years and a couple of other researchers have actually done some work in Alaska as well and it is possible to detect this elevated nitrogen signature in trees. But there are some real caveats and people have been really struggling with this, because it's possible to get a false signal for reasons that aren't fully understood. This high nitrogen N15 isotope that we detect, that can be affected by other things, it doesn't have to just come from salmon. It can also come from other chemical processes. While we've got a good handle on that, through looking at control streams where there are no salmon so we know what to expect, people have had more of a technical struggle trying to interpret these tree rings, so Tom Reimchen's hope, plan, is to at least to look at the width of the tree rings, perhaps, to see if they actually grow and get a growth signal and also to look at the strength, as you suggested, of the salmon nitrogen isotope and rings and reconstructing the runs. The last time I talked to him, he was making some progress, but he was still having a bit of a struggle getting a clear answer on it. There is another study that has shown that white spruce and a couple other species, I've forgotten what, do grow faster beside the streams that have higher inputs of salmon. And the only time that's not the case is if there are a lot of alders and alders fix their own nitrogen, so the alders can create an alternative nitrogen source to those trees.

Comment: (33:06) I just wanted to make a comment on the last question. The other way to look at this is in the lake sediment and there's quite a number of sockeye lakes where we can reconstruct populations for hundreds and thousands and ten thousands of years. But it doesn't work for all lakes. [inaudible] My question for you is, you talked a lot about how salmon affect other species and the one case you talked about how salmon and, I'm guessing most of the carcasses we're talking about were not total carcasses, and I'm guessing they were just chums, but the Holy Grail question here that often comes up is, do salmon have a positive feedback loop on more salmon for future generations? For example, if you have a big chum run one year, do you have another big chum run years down the road or higher productivity, because you got a more productive watershed? It's been a really difficult question to answer. Is any of your work starting to get to an answer there and do you think we will get to know, do salmon beget more salmon just through nutrients?

Answer: (34:19, Reynolds) It is a question a lot of people would like to know. In our

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study systems, the Bella Bella system, the answer is going to be no, because the main fish that arrive there, that we've studied, are chum and pink and the juvenile chum and pink leave as soon as they hatch in the spring. So, they cannot benefit the next generation of chum and pink. That cannot happen. That's why we go on to Coho, because that's our other resident fish that spends a year or more in-stream. So, I think we are heading for a finding and we're still working on it. I have a PhD student specifically asking this question about Coho. I think we may well have a crossover effect between species of pink, chum, Coho and that, one could extrapolate, may also occur with other salmon and steelhead which spend significant time in fresh water. So, the other place then that I am most familiar with would be the one you're probably also familiar with, which is attempts by the Bristol Bay gang to find sockeye. My understanding is that they are not finding evidence that the lakes are being better fertilized by high runs and that if you do add all the math together, they are not getting this circular effect. So, to my knowledge, I don't know of any study that has shown that within the species, the nutrients from one generation are benefiting the ones that follow. The closest I think that I can come is that one of those Coho studies was done in a natural stream that only had Coho. So there was, and I can't remember whether that was, which I may not have presented to you, it's a [inaudible] or Riddell or one of the [inaudible] papers. They did do the study and they did have some evidence for it, but it was a small sample size and I think we have to be cautious about that. We'd all love it to be true, but...

Question: (36:06) Would you expect it to be more likely in a big system like the Skeena where a lot of populations are upstream, as opposed to smaller [inaudible] just because you got [inaudible].

Answer: (36:22, Reynolds) It depends on how much those carcasses get blown out. Surely, even if the carcasses get blown out, if the carcasses get blown out at the top of the Skeena, they're still not going to make it all the way out to the sea. On that level, it does give them more time. But we know that large woody debris is critically important. When I see the photos of Bristol Bay of those systems, they look like spawning channels compared to what we've got. For example, down in the central coast, where we have trees over all the streams, lots of pools, tons of structure, tons of wood in the streams and so on, I know that these have got to be retaining the carcasses as well. The short answer is, yes, it could be that in the Skeena, they'd have a longer time to do some good — we'll call it that — and have some impact on resident fish, but from seeing that slideshow last night, I saw a lot of systems that looked like those carcasses surely aren't making it very often into the riparian zone.