Hi all!

Looking at Serenas nice model results there are some comments to be made, some already said - but here they are all summarized. I'll start with the predictors.

Avg air temp (Latitude) - it is well known that abundance of trout increases with temperature (well the most southern part of the country may have too high temperatures certain years). Trout has an optimum growth at circa 14 oC, and at temperatures above 20 growth is often impaired.   The positive effect of temperature is not so pronounced for salmon, and northern rivers may have equal abundance as southern. So the results looks fine.

Obviously less LWD is produced in warmer climates. This could be due to the fact that conifer forest (barrskog) is replaced with deciduous/hardwood forest (lövskog) at warmer latitudes. The life-time of LWD from the former is much longer due. This could lead to an accumulation of LWD in such areas.

Distance to sea: I suppose that this variable is correlated to altitude? The red arrow means that LWD decreases with distance to sea, which is surprising to me. My expectation was that at higher altitudes there would be more forest (as opposed to more arable land close to the sea), resulting in more LWD. But of course LWD is not just a product of supply from the surroundings, but also affected by a lot of confounding factors. But as you have compensated for most of them there must be something else behind this pattern. However, the significance is weak (indicated by the thin arrow).

One way of finding out a probable cause would be to add data on forest cover and type around each site. That wouldn't have to go into the model, but could be tested separately?? We'll discuss this tomorrow.

Wetted width:  Is probably correlated to Catchment area. It is well established that trout decreases with increased width as young trout are littoral and are found at the shores of streams. However wide stream, the trout stays close to shore at shallow depths. In salmon rivers the opposite was true, an effect of salmon occupying the central part of the stream - thriving at higher water velocities.

Wetted width also affected LWD strongly in the smaller trout streams. In samller stream the logs, branches and twigs got stuck between shores and wasn't transported downstream. In larger river most LWD was swept away.

Avg depth: The young trout (and salmon) stay in shallow water to avoid predation from larger fish. As they grow they can use deeper habitats. There is always more of the young than the old ones (naturally!) so the abundances will be highest at shallow water.

Also LWD decreases with depth. I suggest that this is caused by larger friction against boulders, shores, hard bottom areas at shallow depths. With increasing depth a log may be buoyant and float downstream.

Slope: Gradient is important for water velocity. With increasing slope >0,2% the proportion of  a stream section that is lotic will increase, while the lenthic proportion will decrease. This will result in fewer competitors and predators for young salmonids.

This is not evident for salmon rivers as they are lotic even at small slopes (0,1%) due to reduced friction against shores and bottom substrate in a larger water body. Our quantification of differences in slope is to crude to detect the effect of slope in salmon rivers.

Slope also affects LWD since the higher slope the coarser the bottom material. The coarser material the more LWD is likely to be trapped.

But, maybe the effect of coarser substrate and width on LWD was accounted for when studying slope? If so there must be other explanations.

Substrate: The coarser material the more LWD is likely to be trapped, but this effect is probably already accounted for by width and slope? Hence, no correlation with substrate?

That salmon and trout prefer coarser substrate is well known and your results are expected.

Julian date: As we discussed before I don't like this correlation and believes it to be a sampling error/effect. Surely it could be that LWD is successively added to streams during storms during autumn-spring, and then is successively transported downstream when water levels rises after the summer. If so, I would expect the effect to be more pronounced in wider/deeper river where LWD may not be firmly stuck.

Year: Certainly the supply of LWD has increased over time as a result of more storms (Per, Gudrun, Leonard).

And yes, the abundance of salmon has increased in the Baltic rivers since approx. 2004 due to fishing regulations.

Type of migration: This is a predictor with values 0 (not migrating to lakes/the sea) or 1=migrating. Salmon should only be present at the latter, but maybe there were some spurious data? For trout there is a distinct effect of migration as the young are left alone in the streams while the parents are gone. Leaving the kids are dangerous and the house (read the site) will be full of kids in parental absence. To be serious this is due to lessened competition for energy (one adult has the biomass of hundred young, so even if the P/B-ratio is lower the food competition is evident).

The predators pike and burbot: We have shown that they affect trout, but never salmon. This is in accordance with your results. The theory is that salmon utilizes the central part of the stream with too high water velocities for these predators.

Summing up: The results are nice and most of them understandable (except perhaps Julian date and LWD).

We started our quest with the aim to quantify/verify the effect of LWD on salmonids. Could artificially adding LWD at dry river beds be an evidence-based mitigation strategy. I think Serena has answered yes for trout, but no for salmon - much in agreement with our expectations.

So when we add water to an old river bed (torrfåra) with trout LWD might be a good supplementary action. The next question may then be where to prioritize LWD? Looking at data there should be more LWD with higher slope, smaller and shallower streams. This also indicates that LWD is not so frequent in larger rivers and that salmon does not need it.

What amount of LWD to add is another question that cannot be answered with the data present - I suppose. Cristina Trigal and I looked for thresholds of LWD in streams for occurrence of different species and found none (at least not distinct). But in an earlier paper we found distinct values, but then we worked with a specific subset of streams (stream-resident trout, small streams in forested catchments etc).

So what's more? The models are fine does not need to be adjusted/altered. I think that it is time to wrap up and start writing, unless....we want to test more species. Stensimpa (Cottus gobio) is listed in the Habitat directive. The occurence of Lampetra (nejonögon) increases with LWD and so on...

Cheers Erik

Hej Serena,

Don’t ever hesitate to ask. The only problem is that I try to be off work on Fridays. Therefore this late answer. On top of that I am off to a meeting at 09:30 about a new hydropower plant & fishway that SLU wants to build (might be a project in the future).

As for your first question the occurrence and abundance of trout usually increases with slope up to 5-10% slope. This is because few competing species and predators can live in such rapids, giving trout an opportunity to expand. As for LWD it is more about where it gets stuck. In low slope rivers the bottom is often with finer substrate, sand, gravel, which is not so god at retaining LWD. In areas with higher slopes the bottom is coarser (stones, boulders) and LWD easily get stuck between boulders.

Question 2. There is a nice negative correlation with trout and the number of other fish species. It is a poor competitor and predator, and often suffers from predation. The main predators are pike and burbot (Lota lota). We have good evidence on this.

As for other important species/taxa you might include:

Cottus spp – one of the few species complex that brown trout holds down by predation on their young. If trout is absent, Cottus expands its niche.

Brook trout and brown trout are competitors, but there are quite few cases with both species in your data I guess? Anyway, I enclose a paper on the competition of the two species.

Young trout and grayling also compete the first summer. Then they use different habitats. Paper enclosed.

Salmo salar and trout certainly compete in fast flowing waters. I’ve only written some PM:s about that as I recall. We have a paper: Milner, N.J., Karlsson, L., Degerman, E., Johlander, A., MacClean, L.P., Hansen, L-P. 2007. Sea Trout (*Salmo trutta* L.) in European Salmon (*Salmo salar* L.) Rivers. In: Sea Trout: Biology, Conservation & Management. pp. 139-156. Blackwell Publishing Ltd, Oxford.

But I don’t seem to have it myself (). I’ll ask Nigel Milner to send it.

As for roach, stickleback, minnow, Arctic char and Lampetra there are no direct interactions.

Otherwise I’d recommend to not include too many species, but rather use guilds, i.e. species that for instance prefers lotic or limnophilic environments. The latter, limnophils, usually increase when there is a disturbance of habitat diversity or water flow alterations.

Cheers Erik