CT River Pilot Connectivity Presentation

Attendees (In Person): Kevin McGarigal, Nancy McGarigal, Randy Dettmers, Dave Perkins, Tanya Lama, Maritza Mallek, Scott Schwenk, Andrew Milliken, Jeff Horan

Attendees (on the phone): Andrew Fisk, Bill Labich, Bob Houston, Catherine Doyle-Capitman, Dave Stier, Emily Preston, Eric Sorenson, Jed Wright, Marvin Moriarty, Chadwick Rittenhouse, Pete Murdoch, Kim Lutz, Patrick Comins

Annotations for presentation slides:

Slide 4 – focus on the schematics on the right to understand each of these terms. Having a lot of flow outward from a source, or a lot of flow inward to a target, are not necessarily the same. But both tell you a lot about the ecological integrity of a cell. Having high traversability and connectedness implies high ecological integrity. The index of ecological integrity that the team created incorporates these metrics. However, a cell could have relatively lower ecological integrity and high conductance, if it's the best connector between areas of high ecological integrity. Conductance is the best for assessing connectivity, since we only get at it in this metric.

Slide 5 – Local connectivity will vary by organism (e.g. marbled salamanders and black bears experience different connectivity at the local scale). We use the lens of conductance to assess connectivity at both scales.

Slide 6 – Caveats: some organisms are not well modeled by this approach. For example, insects operate at scales much smaller than the smallest grain of our analysis, and we can't make real predictions for them. On the other end of the scale, really wide-ranging organisms such as coyotes are using so much of the landscape that our model doesn't really help there either. So we choose an intermediate scale and identify those species for which we can make strong inferences. For the record, in the past we have tried to look at a few different scales, and we found that our results did not differ significantly from using the average.

Any questions at this point?

Jeff: Does this mean that the cell-based assessment is not as relevant to the cores?
Kevin: The CBA can be used to look at connectivity within the cores. It doesn't depend on nodes, so if we want to look at areas of high conductance within the nodes, we use our node-based assessment.

Bill: In trying to think about how to communicate how regional connectivity is done, how is gene flow determined, measured, what species?

Kevin: It's not. That was just an example of a process that is multi-generation and requires a larger perspective to think about. But it's not something we're modeling. It's just an example of the kind of processes that need to adopt a broader scale as their perspective.

Continuing on…

Slide 8 – Local conductance is the generic probability of flow through a cell from nearby cells. Refers to its ability to promote or impede flow. It's modeling this conductance at the scale of a few kilometers, which we've defined as local. That produces a grid that you see at right. This is node independent and has nothing to do with core areas. How much flow do we model through a given cell? This map can be used independently of the landscape design.

Andrew: Does this apply to terrestrial and aquatic systems?
Kevin: Yes

Andrew: I don't understand why the river would lack conductance.

Kevin: Like everything else we've talked about, systems that are rare or thin (like aquatics) tend to get dwarfed by the surrounding landscape. So the conductance of the aquatic systems is less than the conductance of the terrestrial systems adjacent to them. But you make a good point – maybe we want to rescale this by macrogroup.

Jeff: Could you also call the brown areas barriers?

Kevin: Nothing here is deemed a barrier per se. The brown areas have little flow going through it. But it could be for two reasons. One is a lack of undeveloped stuff that functions as the source or target. Second is if a given cell itself is developed. So in a highly developed area you're going to have low conductance, even if an individual cell is undeveloped.

Emily: Are you going to do this differently for aquatic systems? It looks like they have low conductance. But they have a lot of conductance for the aquatic species.

Kevin: I think the solution to this would be to scale this map by macrogroup, which would make the aquatics jump out more.

Emily: I think doing it by macrogroup isn't good, because there are too many. Also, sometimes water itself is a barrier. Maybe we just need to talk about surface waters in a different way.

Kevin: Water is highly resistant and a partial barrier to the terrestrial systems. But within the aquatic environment, the terrestrial system is a barrier. That's happening here, but you don't see it because much of the landscape is terrestrial. I think you do want to scale it by ecological systems, which would bring out aquatic groups and what matters to them.

Emily: I'm worried that if we do it by macrogroups – they don't really matter to a lot of terrestrial species. A grassland may or may not be a barrier, but it's rarely a strong barrier. I don't want to split habitats apart when so many species use multiple macrogroups.

Kevin: I don't have time to go into full detail on this, but resistance here is based on ecological settings. Remembering that we're not modeling this from a single species perspective – it's just a generic assessment of how different one system is from another system.

Dave: Maybe we can keep this as is for terrestrial, and implement something different for aquatics.

Emily: That's what I was trying to suggest; I guess I didn't articulate it that well.

Kevin: I think that's what is in here already. For the aquatic systems, they are very different from terrestrial systems but similar to aquatic systems. You just can't see it in this map. If we scaled it by aquatic vs. terrestrial you might see that.
Andrew: I think that's what people are saying. [others agree]

Kevin: We can do that, and let's move on to the next slide.

Slide 9 – Across future scenarios. This is only for places with high conductance. So high conductance and high probability of future development is in red. The grey areas are places with no probability of development (either in permanent protection or already developed). So this map can be used as a map of risk.

Dave – I'm trying to interpret this from the aquatics perspective.

Kevin: All water is grey – it can't be developed.

Eric: I'm still confused about the grey areas. [we reviewed each type that's grey again]

Kevin: The conductance and vulnerability are meant to be taken separately. I can make the grey areas 0 if it would help with interpretation.

Slide 10 – Note, this is now node-based. Everything from here on out depends on the core areas being set.

Slide 11

Slide 12 If we don't scale this product and leave it in a raw form, then regional connectivity will have a disproportionate role. That is one way to prioritize the cores.

Slide 13 – The links you see here *are not real*. This is an abstraction to create a link between every node.

Slide 14 – We can test the relative importance of each link by dropping them out one at a time. A link is now the connection between two nodes (not the spatial route it takes).

Jeff – Will you only use the random low-cost path in the design, or will you use the link.

Kevin: The link is not real. We'll get to your question in just a minute here. These are two options, so far.

Slide 15 – How do we look at those linkages in more detail? How does it connect to conservation on the ground? The first option is to use the regional conductance that I presented. This metric is node-based but applied at the cell level. So every cell gets a value. That value is the sum across all the random low-cost paths. If you're near big nodes, you have more conductance. If you're near a big node and there's not much resistance between that node and you, you have high conductance. If there's an intervening landscape between you and a node, and you're not very resistant, then you will have high conductance to that node. How much stuff can get to a place?

Slide 16 – The next concept is irreplaceability. If you sum the random low-cost paths (which decay with distance and with the size of the node you're coming from, plus resistance) you get a nice metric. But you can also say how many of the paths between the nodes go through a given cell? If there's a lot of nonresistant landscape, then many paths are available, so no one cell is likely to be irreplaceable. But if there is a pinch point, where a small set of cells are needed for links to be made, then that set of cells will have high replaceability. This metric doesn't take into account any decay or resistant kernel effects. This is another perspective: if you can get to a cell, how important is the route?

Slide 17 – Next we bring in this idea of vulnerability. If a cell has high conductance, and is irreplaceable, and has high probability of development, then it has high vulnerability. This is another perspective on thinking about connectivity.

Jeff – How mutually exclusive are these?

Kevin: One is a refinement of the other. They get more and more refined.

Scott: Have you explored any kind of regional connectivity that doesn't require nodes? If our nodes are in a matrix, then node-based connectivity might make less sense. So what are your thoughts on regional connectivity that doesn't require nodes.

Kevin: We could do local connectivity at the regional level, but it's computationally extremely intensive. We also tried a graph theoretical approach initially, but it turned out to be insufficiently sensitive to development.

Slide 19 – Highlights higher conductance among closer nodes. Recall that conductance is flow that honors the kind of ecological systems from one node to another.

Slide 20-21 – Irreplaceability – again, how important is a given path between nodes. We clipped the most irreplaceability cells and overlaid it on the regular land use map in slide 21.

Slide 23 – Combining conductance, irreplaceability, and development probability, gives us regional vulnerability. Areas in red are areas with the highest vulnerability for maintaining the connections among the nodes, which supports regional connectivity.

Slide 25 – Conductance is light blue/purple. Everything in red is highly vulnerable. Conductance shows potential corridors (not empirically based) and they are not delineated as corridors or not. They appear as a gradient. The darker areas are more likely to be used as corridors and have a greater role in promoting connectivity between the cores. The red areas are vulnerable and would interfere with connectivity.

We are interested in your ideas for the best ways to use these products in conservation design.

Pat: We need something that can be explained in laymen's terms. We need something tractable and understandable.

Pete Murdoch: I think it came together in the end when he explained how everything was combined. I think focusing in on these last few slides, it won't be too confusing.

Dave: I'm concerned about how water is acting as a barrier. I don't want to miss out on vulnerable areas that might be along riparian corridors but aren't showing up because they aren't very conductant.

Kevin: I'd have to think carefully about whether that is happening or not.

Pete: Are you particularly interested in the scenario where the river is on the left side of the screen? That river itself might be a connectivity corridor someplace else.

Kevin: There are a couple things to remember here. First is local conductance, which might get at that. We're not looking at aquatic nodes here, so the aquatic connectedness is being downplayed. Identifying dams and road crossing that could be improved to fix connectivity.

Dave: I feel like water is not a barrier to a lot of connectivity.

Pete: The river itself should be a corridor for birds.

Kevin: Rivers are not a barrier here. There aren't true barriers. The areas with highest resistance are roads and developed areas. Rivers are much less resistant than any of the developed. The resistance depends on how ecologically dissimilar two systems are like. So water is intermediate in resistance. The reason we see that there isn't conductance between some nodes is related to the scaling we chose – if we had allowed longer distances than 10km, then conductance will connect some nodes across the river.

Dave: I think we need to understand better how much resistance there is.

Kevin: It's tricky in our approach. Normally people create a static resistance map, often from the perspective of a single species. But this is a multivariate and dynamic resistance. We're comparing the 20 settings variables dynamically from cell-to-cell.

Jeff: Since regional conductivity is based on the cores being set…if we build the aquatic cores into the selection process, won't we see more connectivity among the aquatics? So it's very important to consider whether to use the aquatic cores separately or incorporate them into the whole.

Kevin: I don't know how much we can talk about this, but we may not want to try and apply this approach for the aquatic cores, because it's a fundamentally a different situation. For aquatics, dams and critical linkages may be more important to think about.

Pete: Would there be higher connectivity if the route were longer.

Andrew: I wanted to respond to the question about how to use this information. I can think of a couple of partnerships who would be interested. Staying Connected works across all of New England, at maybe even a larger scale than this project. There is also a Quabbin-Cardigan corridor project. The third scale is a local conservation partnership of some kind. I can see all three of those partnerships using this combination of conductance and vulnerability to help target where they might work both in core areas and in corridors. I think the translation could start with a statement saying these are area of high value and high vulnerability. But this might allow some of these partnerships to zoom in more than they have in the past and focus on the small scale about where to focus their efforts. The first two partnerships I mentioned – I don't know how this sits within that framework.

Kevin: this is all high resolution, fine scale stuff. So it was designed for.

Andrew: I'm saying that it might actually be useful at a broader scale. There was a recent EO Wilson op-ed that focused specifically on the CT River watershed.

Kevin: I don't think we need the LCAD tools to do that.

Andrew: Sure, but for communication, putting this into that broader context may be useful.

Bill: The conservation plan for QtoC was built using gravity models. I see this as being really useful. I think this is totally applicable to the scales that Andrew just mentioned. Staying Connected really focuses on the linkages, which is at a smaller scale (less than 500,000 acres). QtoC is much larger, but the focal areas are smaller and we could use this info to tweak the conservation plan. A lot of us on Friends of the Conte are working on a proposal under the Farm Bill program "Long Island Sound Watershed: RCP" and we're thinking about how to use this program to implement aspects of the LCD, even though we don't know what it is yet. I'm seeing a lot of possibilities to use this at different scales not only for conservation, but also stewardship. Which brings me to a question – on slide 24 – from a conservation perspective, there is usually a greater interest in conserving land than there is resources to do it. So vulnerability is really interesting because it highlights exposure to risk if you have important linkages between cores and vulnerabilities within cores, is there an ability to understand which linkage or core is the best bet – highest conservation value with the lowest risk of losing value because of development. If development reduces importance of core or linkage, we might want to take this into account.

Kevin: Those are really interesting points. I have two comments. One is that now that we have implemented this algorithm, we can apply it to any core area network. If you had a different set of cores that you wanted to use this connectivity assessment on, I think that's doable. Second, you're right that our node and link importance do not take into account vulnerability – just their role today. And that's a really interesting point. We'll have to think about how to bring in risk to the node and link importance.

Pete: Connectivity sounds like it's defined using existing development pressures. What is the application of this in on the coast where we're thinking about things like managed retreat?

Kevin: It's definitely possible. I would think of that as restoration. What we haven't done is think about restoring developed land to a natural state, although we have talked about doing that in the future. We're hoping to model restoration of agricultural lands to wetlands/forests/etc. That will be hard because predicting what a site can be restored to is not easy. But you could assess connectivity by assigning a potential restoration area; we could run this analysis and see what connectedness we gain.

Jeff: I'm still stuck on the aquatic pieces. In work with the Chesapeake, I really expected the riparian corridors to be picked up as part of connectivity. But I think because the Connecticut has so much agricultural and urban development next to the river, we're losing it. Migratory bird surveys in the past found a lot of use in the riverine system, which decreased as you went into riparian. I don't want to lose those macro components. I don't know exactly how to do it. When I look at the implications of this, I am worried about losing important functional components of the riverine system, even if it's within a disturbed environment overall. Maybe we can get at it with aquatics; I don't know.

Kevin: It may be that in this scenario they don't show up. This is the cores without rare. If we ran this with the floodplain system as cores, we might get a pretty different result. I do think that aquatics and riparian are not the same.

Nancy: Thanks everyone for joining us. Those on the terrestrial team, we'll see you again at 1pm.