Notes/Summary

Connecticut River Pilot Core Team Meeting

November 21, FWS RO in Hadley, MA

Attendees by phone: Bob Houston, Chad Rittenhouse, Emily Preston, Patric Comins, Bill Labich, Catherine Doyle-Capitman, Jed Wright

Attendees in person: Nancy McGarigal, Maritza Mallek, Jeff Horan, Randy Dettmers, Scott Schwenk, Dave Perkins, John Warner, Andrew Maclachlan, Ethan Plunkett, Bill DeLuca, Andrew Milliken, Andrew French, Colleen Sculley, David Stier, Eric Sorensen, Kevin McGarigal, Marvin Moriarty, Rachel Cliché, Tim Wildman, Tanya Lama.

Webinar times in brackets after headings

Updates (Nancy McGarigal) [0:00]

David Payer, Supervisory Ecologist from Arctic NWR was here on a detail. We've been talking up the Pilot in various forums, including at the fall Steering Committee meeting and the Regional Conservation Partnership meeting hosted by Highstead. We'll do very quick subteam updates today.

Terrestrial Subteam Updates (Randy Dettmers) [5:05]

We didn't have a meeting per se this past month, but we had some lengthy email discussion that led us to investigating developing core areas using ecological systems as well as the macrogroups we've been using since the beginning. That's going to be fairly important for us to look at today.

Wetland Subteam Updates (Andrew Machlachlan, Dave Perkins) [6:15]

Andrew: We also did not meet as a subteam last month. We have tentatively agreed to use the HUC6 scaling for our data. I say tentatively because we want to review the results and make sure no big problems arise. We have a special condition when it comes to identifying lakes and ponds. We're trying to identify the most important 25% of the landscape in that habitat group, but when you include the Quabbin that takes up almost the entire 25%. Our solution is to run the model without the Quabbin, and then add it back at the end. We plan to use rare species data as an overlay afterwards, as the terrestrial team is doing. The other issue we spent time on is brook trout, which is basically our representative species for cold water habitat. We've been working on defining goals and objectives for brook trout. Dave Perkins is with the Brook Trout Joint Venture, and has a few things to say about brook trout.

Dave: We've been operating on the Pilot in a way that mirrors the Joint Venture already, such as conserving "the best of the best" habitat that supports existing wild, healthy brook trout populations. In fact, the Joint Venture has really set the direction we've been pursuing on the aquatic subteam. We're also planning to update our objectives based on the climate change modeling, some of which we should see today. Finally, I want to extend a heartfelt thank you to Andrew for your leadership and support. I didn't get to work with Andrew much while he was with FWS in the past, but it's been great to work

with him on this project. You've contributed so much to the team, helped us move along, and so we extend a heartfelt thank you to Andrew Mac.

Presentation by Kevin McGarigal (UMass) [10:55]

Slide 2: Topic for today

Scaling by HUC6 or full watershed

Slide 3: Terrestrial Core areas – scaling by CTR vs. HUC 6 for ecosystem-based approach; IEI scaling by macrogroup [original approach]. The most important thing to realize here is that the overall differences are not that great. Roughly 90% of the cores are in the same location. Subtle differences on the scale of 5-10%. We're pulling some out of the north and into the south. The northern part of the HUC6 benefits the most from scaling by HUC6 compared to HUC4 (CTRiver).

Slide 4: Terrestrial Core areas – scaling by CTR vs. HUC 6 for species-based approach

Slide 5: Aquatic Core areas – ecosystem-based; mostly you see the lotic cores, because the lentic cores are smaller and more scattered. Once again overall, the cores are not drastically different.

Slide 6: Summary statistics for Ecosystem-based aquatic core areas

Slide 7: Aquatic Core areas – species-based

Slide 8: Summary statistics for Species-based aquatic core areas (difference is less than 1%)

Mitch: On one of the earlier slides you had the lake and ponds at the bottom. That looked like the only significant difference.

Kevin: This refers to what Andrew referred to at the beginning. This reflects our manipulation of pulling out the Quabbin to create cores and adding it back in later.

Nancy: For the guests in the room, we decided to use HUC6 rather than the full watershed in order to have more evenly distributed cores. We backed away from the HUC8 because it was too finely scaled. What do people think about HUC6 vs. the full watershed?

Kevin: And I'll add that part of the motivation for using HUC6 was that it seemed more extensible to the regional scale.

Andy French: Other than streams, lakes, and ponds, where are wetlands?

Kevin: They are accounted for in the terrestrial part – it's actually terrestrial/wetlands.

Dave: Thanks Kevin, this is really helpful and understandable and interesting. I think as we move forward with other discussions today, as we look at ecosystems and species and how to combine them, then the mainstem is kind of a moot point because the mainstem area is in the species group, so we basically "get it back" later. I'll just mention that we thought about doing HUC6 earlier in part because it was a

latitudinal gradient. In other areas, the HUC6 might not be helpful as far as distributing cores in the way you want it to. For instance, Massachusetts has 5 HUC6s in it. Scaling by them might not be as useful. This is just something to keep in mind in the future.

Randy: On the terrestrial side, a couple clarifying question. What you presented up here looked like it was based on macrogroups?

Kevin: Yes, because we didn't have a CT-scaled subgroup approach. But the differences should be consistent.

Randy: You didn't include tables for the terrestrial side, but I'm wondering if you could speak to the general differences.

Kevin: We didn't have results we could use that are directly comparable.

Randy: The HUC6 scaling does seem like it's doing what we wanted to do. The main drawback is that while we get more cores in the southern half of the watershed, we don't add much to the far south, like Connecticut. Does anyone have any comments? No objections, so we'll call it HUC6. Thanks everyone.

Decision: Use HUC6 scaling for selection index, for both aquatic and terrestrial/wetlands indices.

Macrogroup vs. Groups/Systems [35:17]

Slide 9: Macrogroup vs Group – using this sprang out of an email discussion initiated by Eric Sorenson. There's been several back-and-forth emails that had to do with the tradeoffs between using the macrogroup scaled IEI that goes into the selection index upon which cores are built for the ecosystem-based approach and using the ecosystem scaling. We had laid out pros and cons between using ecosystems vs. macrogroups. Eric pointed out that the classes we presented in maps were more highly resolved than the classes used for weightings. So he suggested that we use what's called in the database some group name, which are based on the original habitat classification before they were modified and mapped. So we discussed the idea extensively and all agreed that we liked the fact that systems would do a better job of capturing unique environments that we want included in core areas, but at the same time we were concerned about having so many systems that the landscape would become heterogeneous and the landscape would be fragmented. So we spent a lot of time in the last few weeks preparing input layers. We implemented that during the past week, and right now the terminology is "group." If we implement this, we'll call them systems, but "systems" is already used in the database, so we needed an alternate name for now. The "systems" in the database as they currently exist are too finely resolved – there are 62. We're talking about a difference between 16 macrogroups and 39 "groups". I'm going to go through a couple of different examples, the first selected arbitrarily, and the second selected because it was brought up during the discussion – the Nulhegan.

Slide 10: We see here that these 3 forest types are quite different, but these boundaries are not sharp lines. What actually occurs is a general gradient, so where these types are interspersed, they're slightly different flavors of the same thing. When viewed coarsely, they are definitely different. However, when you are the local level, standing on the ground, it would be very difficult to see the edges that show up

on the map. We want to recognize these differences, but we don't want artificial boundaries to drive the results in a significant way.

Slide 11: Shows the core areas over the IEI scaled by macrogroup.

Slide 12: Shows the core areas over the IEI scaled by macrogroup. The cores end up in different places between the two. We also want to emphasize that on the ground, it would be hard to detect an obvious difference between a very high selection index spot and an adjacent high selection index spot.

Slide 13 (macro) and 14 (group): By adding in the TNC Resiliency layer, we smooth out some of the difference between the two IEI approaches. However, core areas are still in different areas.

Eric: The area you're showing now is highlighting the groups that are the most similar out of the 39 groups we're thinking of using. If you look at Northeastern Coastal and Interior Pine Oak, they get lumped in with the systems you are showing. I'll also note that these systems are all modeled. But the latter two forest types I just mentioned are very different from the forest you're showing.

Kevin: You're right, I picked a fairly extreme example in order to show this.

Slide 15 (macro) and 16 (group): Nulhegan area; the boreal upland forests are an example of how the macrogroups combine very different ecotypes into one group.

Slide 17 (macro) and 18 (group): The consequence of this is that one subgroup can dominate the high IEI values for one group.

Slide 19 (macro) and 20 (group): The selection index for the same area.

Slide 21: Comparison between macrogroup vs. group/system cores. At the system level the landscape is more heterogeneous, so to grab the best of more classes, we get more cores. On the order of 100, and there is 84% overlap.

Slide 22: Probability of core areas of a given size across the two scenarios under study.

Slide 23: Summary stats for ecosystem-based terrestrial core areas by macrogroup; comparison between two scenarios; only the major differences extracted (full table available in Excel)

Slide 24: Summary stats for ecosystem-based terrestrial core areas by group; comparison between two scenarios; only the major differences extracted (full table available in Excel)

Eric: The cool thing about this is that it's pulling out a lot of the southern types, which truly are very different from one another, in contrast to the north where things are more similar. To me this looks really good.

Kevin: What surprised me is that the upper elevation boreal forest didn't jump up also; it had basically no difference.

Emily: Do these figures include the additive of natural communities? [Answer is Yes]

Jeff: I want to point out that in the beginning there were certain system types like calcareous slopes, and we did treat them as indiivduals.

Kevin: No, we upweighted those systems, but we were still scaling by macrogroups. So within the macrogroup that system was upweighted, but the selection was done at the macrogroup scale.

Slide 25: Summary stats for ecosystem-based terrestrial core areas by group; looking at how well the ecosystem approach meets the species target. Blackpoll warbler loses ground because of the dropping out of the montane boreal forest. It's neat that the difference between terrestrial and species is not that large. I think these results are interesting and there's no reason not to use the groups. The main tradeoff is that there are more cores, which I don't see as an issue.

Andrew: I want to recognize the people who have been part of this conversation – this is exactly what we need to do. I want to recognize everyone for thoughtfully evaluating this and moving towards a resolution. Secondly, I support this change. I went back to the fundamental objectives (reads it) and I feel like this change helps us meet that fundamental objective a little bit better.

Scott: I want to echo Andrew's comments of appreciation. A couple of other points: one is related to the landcover mapping. We have a tremendous TNC product based on ground points, satellite imagery, and lots of other data. But we do recognize that it's not 100% accurate. It's the most accurate at the coarser scales. As we get down to systems, the mapping becomes less accurate. I think the two maps Kevin showed illustrate that. I do have some concerns about the accuracy of the system classifications. On the other hand, I suspect that the boreal differences – high elevation vs. the flat, are probably real. So I caution against relying on it as a perfect map. So I think we really have this tradeoff between the diversity objective, where it's better to scale by ecological system, versus the large intact blocks objective, which is impacted by adding more core areas.

Emily: I think it's fascinating that these are so similar. I was just on a call with Mark Anderson, who said he just realized a more accurate update to the terrestrial map. Maybe for the next iteration that will help us. I think this is real challenge because we're all biased by whatever habitat we know best. One question I have is if we took out the rare natural communities, and did it the original way, would the differences between these two strategies pop out more clearly.

Kevin: I don't think there would be a big difference. It's mostly an additive effect. Where the landscape context is great, the land would be in a core anyway. But where the landscape context is really poor, not very many cores are going to be put down, and it takes a very small % of the landscape to include those extra cores. So I feel pretty confident that there wouldn't be a big change.

Emily: I thought that this issue was what brought up the idea of changing in the first place. When we did the cores without natural communities, that Nulhegan spruce-fir flat did not end up in a core. So I'm suspicious that adding the rare communities in will smooth out the differences between the macrogroup and group solution.

Kevin: I understand the point you are making, but I'm still confident that there would not be large differences – big deltas – between the two strategies described, even if we didn't bring in the rare communities.

Emily: I'm thinking about this as a Pilot project, and if this is done in other geographies that lack as much natural community data, then the difference might be significant.

Andy French: It seems like wetlands are not popping up as important, and they should. I'm looking at known areas, and the Nulhegan was one. Another one that pops up for me is the Pondicherry. To me wetlands are really important, yet they don't seem to drive the outcome as much as I think they should.

Kevin: This goes back to earlier steps in this process, where we decided that IEI and TNC Resiliency would be the basis for the selection index. Because of the quantile scaling, we represent each system proportional to its extent on the landscape. Some wetlands were given increased weight, and they do show up as more represented. But we didn't impose a really strong wetland weighting, to get all or nearly all of the wetlands in the watershed, and then fill in the rest with uplands.

Andy: I understood that. But like you said, just looking at the presence of wetlands in the landscape, even upping it doesn't change things. I'm just speaking from my perspective and what we're looking at programmatically.

Kevin: In general, wetlands tend to be in lower lying areas that are more developed, so they tend to have a lower IEI value, a lower landscape context. There is clearly a natural bias to the less developed areas on the landscape due to the way we developed this approach. It's also necessary to keep in mind that there are going to be some places on the landscape that don't match your prior expectation. With any GIS modeling product, there are just some places that aren't captured because the data and algorithm don't allow them to emerge. But wetlands are generally upweighted and are technically over-represented in the cores relative to the actual extent of wetlands. However, they'll always be dwarfed by the other terrestrial habitat types.

Rachel: I just wanted to point out that using groups/systems does increase wetland representation, which is why I support using the system.

Randy: I don't hear any real objections to going with the groups/systems. Scott pointed out some potential drawbacks. I would like to hear Eric's perspective on the systems.

Eric: I do think that macrogroups and systems are very different. As Kevin showed, in the northern part of the watershed, they may not be that different. But in the central and southern part, the differences are really important. I also talked to Mark Anderson, Charles Feree, and Lesley Sneddon, and they all said that the systems were designed for this type of procedure, and macrogroups were not. I think we'll really see the differences when we go to the regional scale. I think these changes are a big deal. The things that change are important types that had been lumped into a much coarser scale. I think everyone knows that I think this is a really good change.

Randy: Pending any other discussions or opinions otherwise, I think we've decided to use the groups/systems.

Eric: Not for now, but I think we should tone down some of the roads, especially skinny little dirt roads that aren't open in the winter.

Kevin: We would love to have better data, but we just don't. We have similar problems in the Prescott peninsula, where there are many unused roads. But to fix this right now, we'd have to do it manually.

Decision: Use new systems/groups approach for scaling IEI.

Combining Ecosystem and Species-Based Approaches [1:26:00]

Slide 26: Terrestrial Core areas combination – shows reduction in ecosystem-based core areas

Slide 27: Terrestrial Core areas combination – shows ecosystem and species cores

Slide 28: Terrestrial Core areas combination – shows ecosystem and species cores colored the same

In looking at combining the cores, we realized that we could theoretically create the ecosystem cores using the same method as for species. This would take considerable time to come up with the algorithm and implement it. We don't know yet, but I expect that such an approach would use even more cores.

Mitch: I didn't realize we were hoping to combine these; I think of them as two different approaches.

Scott: We did discuss earlier that we wanted to have all 3 to look at. The advantage to combining them is that then we do have a single design.

M&M Cookie Approach

Slide 29-31: This was presented at the last meeting, and comes from the idea that cores are not reserves; they don't stand alone and aren't sufficient for meeting all objectives. So we could think of the cores as M&Ms in a cookie, which are bound together by the dough matrix. And we live in a super fragmented landscape. What you see in this map are all the major roads and a lot of development. What you're seeing in the background is the ecosystem-based selection index. No matter what you do in this landscape, given how much it's fragmented by roads, you're never going to get big cores. If a core is an area of high integrity, unique habitat, or high biodiversity, you're not going to have big cores. So we may have to get over the idea that we're going to get a big huge core, unless we want to redefine what a core is. The consequence of this is that the less developed areas have a lot of cores, and the cores are fragmented by the roads. That's just the nature of this landscape. The species cores are showing up in the developed areas because they do offer something to certain species, such as agricultural lands that are good habitat for birds, or streams that function well for wood turtle.

Slide 32: So perhaps we need a different perspective. We propose to embed the core areas and connectors in a buffering matrix. We still don't allow spread across roads and development. We buffered cores by 1 km and connectors by 250 m.

Slide 33: Zoom in of the cookie scenario. So the buffers fit with our conventional idea of buffers, around our cores, which are themselves buffers around the best of the best of each system.

Slide 34: Zoom in of an area with floodplains. Where the floodplains exist in a landscape context with other decent stuff, but where you have other rare communities that are in a poorer landscape context, using the cookie approach buffers them a bit nicer. Otherwise about half of the rare communities end up being isolated cores/cookies.

Jeff: This is really cool, because it's been hard to visualize all this stuff. My question is how much of the landscape to the cores with the matrix take up?

Kevin: That's coming in the next section.

BJ: It seems like you're using different terms for concepts common to conservation biology. Corridors have become connectors, and the cookies are buffers.

Kevin: Yes, they're the same core-buffer-connector concept.

Marvin: In the area that's not core – I think of the connectivity as more critical. This way treats them the same. I wonder if you lose that subtlety by showing it this way.

Kevin: The display options are all on the table and can be adjusted. We can definitely highlight the connectivity part.

Andy: When you mention buffer, it brings me back to a conversation I had with Bob Miller (Realty) about 30 years ago. Buffer in CT and MA implies "extra." When we look at conservation tools – land is really expensive. The way I look at it is that buffer is an important part of the core. It seems like it should be core and connector. As soon as you get out of the buffer, you might have other things driving land values. The buffer is important if the core is going to remain structurally sound and resilient.

Kevin: It's both a matter of perspective and terminology. We're thinking of the buffer as functionally different from the core. The buffer may be somewhat developed. It's going to be lower quality land. It's not going to itself provide the functions that cores do. But preserving/protecting/managing those areas will help preserve the functions of the cores. Having them distinct highlights the fact that they do represent different things.

Andy: I don't disagree with any of this. I'm just concerned about how these products will be viewed by people who are looking more at the pictures. It's about how this information is going to be used by people who make decisions that weren't part of the thoughtful conversations that have occurred here.

Mitch: To me, when we move away from a small realistic goal (say 5%) to something larger, those constraints on this are really important. If a design is going to be useful, we have to include constraints. This would have to include something about how important a corridor is relative to the core, or how important a buffer is. Otherwise we're moving into fantasy land. It will tell us if we wanted to protect 60

or 80% of the landscape, here's how to do it. I think the overall amount of land in all of those is constrained.

Jeff: This may be an oversimplication, but when you look at the cores and buffers and matrix, a lot of that may be where you have opportunities to do restoration and management, even if it's not a place where you can protect them fee simple. I actually really like the way this looks, where you have priority areas.

Emily: We've been looking a lot at connectivity, and this approach adds an enormous amount of area without a lot of focus. I was kind of hoping I'd see more of a connectivity-based approach.

Kevin: The connectivity –based approach is in establishing the connectors between the cores.

Emily: I think it's just too much land. From an on-the-ground management side, I think people will not know where the focus is.

Kevin: Yes, and that gets to the point Mitch made, which is where and how do we impose constraints. Here we've constrained the cores and built off that, but we could also impose a constraint on the total area in the matrix. We have to decide what the design is really about. Is the target for conservation the cores and connectors, or is it the full matrix. One way to look at this is a way to provide additional context for decisions about where to protect, manage, and restore areas in the cores or corridors.

Marvin: The purpose of corridors and buffers is the maintenance of ecological integrity. With regard to species, it's the maintenance of connections between habitats for maintaining populations. We haven't established population-based objectives for the species.

Andrew Maclachlan: I can sympathize with Mitch and Emily. I want to address their concerns. Kevin is trying to solve a problem for us. The core areas are nice spots right now, but they're not enough by themselves. We won't retain this 25% of top land as cores if we don't do anything to address what's going on in the buffer. The problem is that cores don't stand alone, and we have to remind ourselves and the public that they don't stand alone.

Andy: The core-buffer-connect is something I like as far as you prioritize them. I think buffer and connect are equally important. But I hear what Emily is saying – is this prioritizing? At the same time, we don't want to create too many losers by ranking all the cores and connectors. Right now I'm leaning more towards focusing on the core area and differentiating from the buffer-connect. You focus your dialogue on core areas.

Kevin: Keep in mind there are many ways to prioritize, which can be reviewed in previous presentations.

Emily: I have to go, so I'll have to see what you guys come up with. I just want to ask that you keep in mind the practical, on-the-ground implications of the team's decisions.

Marvin: I think it's important to have both, simply from the standpoint from rolling it out. Local land trusts and regional conservation partnerships are going to be able to understand the core concept really

well, but when you go talk to town councils, they're going to need the whole picture to talk to that audience. That helps explain issues related to development near core areas, for example, building a big box store very close to a core.

Bill Labich: I want to express my opinion that I believe the focus area approach [cookie approach] will work well. The land trusts I work with understand that the differences between core areas and supporting landscapes. The buffer areas at this scale can include light residential and rural roads and farmland, as Kevin said. From an RCP perspective, the whole CFA approach allows many organizations and agencies to play key roles over time. Decades. The bolder the vision for the future, the better chance we'll get to implementation. Be realistic and join the plans on the shelf. The point is, the feds and the states have their tools, and towns have theirs. Private capital and good stewardship all have key roles.

Scenario Comparison: Ecosystem, Species, Combined Approaches [2:11:15]

Slide 36: Ecosystem vs Species in terms of secured lands for cores

Slide 37: Overlap between Ecosystem and Species based approaches for cores

Slide 38: Ecosystem, Species, Combo – relation to secured lands

Slide 39: Overlap between Ecosystem and Species based approaches for cores +matrix, plus the combined map, with % overlapping

Slide 40: Map of species meeting 100% of their LC targets, plus with matrix added.

Slide 41: Comparing core area size distribution across potential designs

Slide 42: Tabular summary of the amount of each macrogroup included in the cores for the ecosystem-based and species-based approaches, and their combination. In general the ecosystem-based approach does the best job of meeting ecosystem-based goals.

Slide 43: Tabular summary of the amount of LC met for each species based on the ecosystem-based and species-based approaches, and their combination. In general the species-based approach does a good job of meeting species-based goals, but the ecosystem approach is better for 5/14 species.

Slide 44: On the left is the number of cores and size range of cores for the ecosystem-based solution. On the right is the species-based solution, which is a combination of the brook trout and anadromous fish. You don't get the same large cores, intact, as in the ecosystem approach, which you can see based on the number of cores and core size.

Slide 45: Ecosystem-based approach for the aquascape, with and without the matrix/CFAs added in.

Slide 46: Comparing Eco, species, combo approaches and the degree of overlap. The ecosystems were grown out using a different bandwidth. We stopped at about 13% of the headwaters, and grew species

by slicing the brook trout probability of occupancy until you hit about 25% of the landscape. Then the anadromous fish data was added in.

Slide 47-49: For the non-aquatics team people, our perspective for aquatics was to build networks, and allow for the fact that not everything in a network is full of good stuff. A few examples of what these look like on the landscape.

Slide 50: Comparison of the % of the amount of each macrogroup type in cores for the eco, species, and combo.

Marvin: Why do you think we don't see much conformance between the terrestrial ecosystems and species?

Kevin: Some of it is scaling considerations. Sometimes species are integrating multiple systems, or ease of accessing habitat. Some of the species models account for juxtaposition of different habitats.

Ethan: Eastern Meadowlark has a lot of habitat in grasslands, around airports. So that's an example of a species with a specific need that isn't captured by the ecosystem model. The way we created the combination was to start with 13% from ecosystem, and then start the species algorithm. Eastern meadowlark got the first 100 cores under that system, because it was not captured by the ecosystem approach.

Slide 51: Comparing terrestrial and aquatic core area network. Focus on ecosystem cores.

Slide 52: Comparing terrestrial and aquatic core area network. Focus on species cores.

Slide 53: Comparing terrestrial and aquatic core area network. Focus on combo cores.

Slide 54-56: Same as 51-53, but for northern half of watershed instead of southern half.

Andy: When we look at the combo and struggle to refine this further, for the CCP and the Conservation Focus Areas, we're using a tool called a Conservation Partnership Area. That may be a term or tool that is useful for us.

Scott: It seems like some of the stream networks that are on more main stem or larger order streams perhaps aren't in an intact landscape context, so that's what is missing from the terrestrial focus. But it may be that those streams have decent aquatic integrity because the headwaters are more protected, so in a certain sense maybe there is more overlap than it seems. I was surprised that there is a dropoff in the overlap when we do the combo than the species-species or ecosystem-ecosystem.

Kevin: My knee-jerk reaction is that the combo terrestrial cores are so disjunct and fragmented that it leads to the difference, but I'm not sure and I'd have to think about it more.

Andrew Milliken: Roads tend to be barriers between core areas. How much do streams tend to be barriers between core areas and how much does that influence these results?

Kevin: It probably very much depends on the specific location, but in general, yes, it would be some degree of barrier.

Eric: What would happen if we took away the species that are well represented by the ecosystem-based approach from the species-based approach, and redid the species-based approach without those species?

Kevin: If the species approach is going to stand alone, it has to have that. So the only thing we can modify is the combo approach.

Ethan: We are doing that actually, because the species-based approach starts from the ecosystem cores.

Bob Houston: On the last slide you showed, of the northern watershed…this shows all of the cores, both terrestrial and aquatic, and all the core and matrix area. I'm not familiar with the northern part of the watershed. What's the reason for that gap on the left side?

Kevin: This has to do with where we've thresholded the cores in order to restrict it to 25% of the landscape.

Bob Houston: Which slide showed 90% of the landscape as being important.

Kevin: That slide is the one that shows the area covered if we meet 100% of the species' LC.

Bob Houston: I think this kind of map can be really important for illustrating that areas that might be far from a core are still important and have value. That's the kind of conversation we'll be having with land trusts and others.

We plan to have products available that show value comprehensively inside and outside the cores.

Dave Perkins: I think some of us were expecting that there was going to be more overlap between the aquatic and terrestrial cores. I feel like we need to step back a bit and question how a unified conservation design that incorporates both can emerge from this. A lot of the aquatic areas aren't surrounded by high value terrestrial areas, unlike what I had imagined.

Kevin: This was an objective process (albeit driven by subjective decisions). This is an emergent outcome of this process. I think all of us expected to see more overlap. One thing that we may have to accept is that it is an emergent property of this landscape (assuming we trust the model inputs and the model itself) that there isn't a ton of overlap between the aquatic and terrestrial designs.

Dave: Some of us have been talking about how to deal with this fact. It would be great to have some sort of integrative synthetic approach that would optimize across terrestrial and aquatic.

Kevin: I think we could work on that problem for 10 years and we still wouldn't please 100% of the group, and we'd still come up with outcomes that are counterintuitive.

Dave: Maybe in our final design where we can look at those areas of overlap and highlight them. If 78% of the landscape is more than we want, then maybe we can highlight those areas of overlap.

Kevin: And that is certainly a way to prioritize within the design.

Andy: One thing we did with our delineation of CFAs – we were looking at subwatersheds. The focus was to try and accrue incidental benefits to water quality by improving habitat within a subwatershed. It seems like the core area approach being used here is pushing terrestrial habitat higher within watersheds, and that's contributing to the differences between the aquatic and terrestrial cores.

Kevin: I think that's certainly part of it.

Incorporating Landscape Change into the Design [3:04:50]

Slide 57: Intro to incorporating landscape change. Model is based on biomass. What we're looking for today is a recommendation. How do we start thinking about incorporating landscape change information? It boils down to thinking about two main things. One way is to think of a low-risk strategy. Take into account the current landscape condition, and basically saying given the anticipated changes, where are the places that are likely to persist being good over time. They're not likely to experience dramatic urban growth, climate change, etc. It's not a pro-active strategy, but it's a safe one. The other strategy is preventative/defensive. What areas are the most threatened? By climate change or urban growth?

Jeff: Can you talk a little about the relative probability of climate change versus urban growth and vegetation disturbance? Or rank them a little bit? I'm assuming that the vegetation change has the most variability among the three.

Kevin: Yes, that's true. The climate change is deterministic. It doesn't mean there's certainty, but it's being implemented as such. Urban growth has a lot of stochasticity, but it has the biggest impact on habitat quality. But it's less stochastic than the veg disturbance – we have a reasonably good way to predict where it's likely to occur at a coarse scale. The urban growth is maybe the most important, since we can directly control it compared to the others. The veg disturbance is highly random at this point.

Slide 58: Looking at the terrestrial core areas from ecosystem approach. Our recommendation is to take the current IEI and use that to identify our cores. These are areas where we could mitigate the impact of urban growth.

Slide 59-60: We can overlay the probability of urban growth, and then this would help us identify the highest priority places for defensive action. This slide allows us to visualize areas that are highly likely to be developed but are in current cores.

Andrew Milliken: I like this idea and want to point out that well-connected core areas are an adaptation to climate change. I assume you'll be discussing species soon.

Eric: I think this is great – can you do the same thing for connectivity?

Marvin: I really like this. One thing I've noticed while watching local conservation is that the association there developed maps of areas of concern to them, and also areas where they would prefer to see development go. Would that be a potential product we could develop?

Kevin: Any place that's not in the core, connector, of buffer, but has a high probability of development – we could argue for development in those areas.

Colleen Sculley: Does the development threat have a time associated with it? Do we know how urgent it is to protect a given area with a high probability of development.

Kevin: This is the cumulative probability of development over 70 years, until 2080. We can take a couple of approaches to this. Right now this is based on our projections, but we are also running our urban growth model many times in order to come up with a probability of development based on the outcome of running our model.

Slide 61: Incorporating climate. Shown is the blackburnian warbler habitat/climate persistence until 2080. This does not include any future urban growth projections. We can take the average of habitat under the current and future climate, which is persistence.

Slide 62: Core area + matrix

Slide 63: We can overlay the development probability as an overlay after the fact to strategize about the conservation approach, as a place where we can overlay the conservation effort.

Scott: For the species cores, those are developed by optimizing for lots of individual species. The way that climate will come in is that you will change the species LC and then run the model to select cores.

Ethan: Yes, it will average the future and current conditions.

Scott: So for both ecosystems and species you create your core areas based on the current condition, and then you prioritize the core areas based on the climate conditions. The development comes in as a prioritization after the core area network is developed.

Ethan: For species we're proposing we incorporate future climate because it has a big impact and we think we've modeled it pretty well.

Andrew Milliken: I think I understand that in the sense of a shifting climate niche envelope. I guess my question is that these envelopes are moving north and upslope. How important is it that we have a suite of species that can capture suitable loss and gain? Otherwise we'll just push everything north and upslope.

Bill Deluca: That's a really valid statement and would argue for including some other species that are more southerly located. I think we could very well see what you describe happening.

Andy French: One of the things in the watershed, as you descend in watershed and elevation, the size of the parcel goes down and the cost goes up. When looking at development potential, one thing I've seen

is that ownership fragmentation is the prelude to habitat fragmentation. Are you incorporating parcel size when considering development threat? As the parcel shrinks, more people have access to purchasing it.

Ethan: The short answer is no. The long answer is that we would want to have that data for the whole region. What does go into this model is proximity to roads, proximity to development, etc. If you're interested in how fragmented the landscape is culturally, it's being addressed in other ways. Parcel data is definitely useful for fine-scale distinctions, but we need it for the whole region to incorporate it for the Pilot.

Scott: I think it's fair to say that not all the rep. species will be "losers" under climate change.

Bill DeLuca: I wasn't thinking about it as "winners" and "losers" as much as a spatial shift. Thinking about the persistence, it tends to shift, not disappear. Many of you mentioned where they have high LC values today, where they are supposed to persist in the future, and how we should ensure connectivity between the two locations. I'll be thinking about that more.

Ethan: And some species' "up" may be other species' "down".

Slide 64: Brook trout probability of occupancy and temperature sensitivity. Does anyone have thoughts on how to combine these?

Dave Perkins: It seems like temperature sensitivity should be looked at as a subset of probability of occupancy. None of those areas are getting better in the future – we're interested in what will stay good. The aquatic group is really interested in the temperature sensitivity piece. It can help us prioritize.

Discussion on Matrices; Display of outputs [3:43:10]

Scott: The terrestrial team will want to talk more about how to incorporate climate change, but I think the urban growth/risk of development

Andrew Milliken: My question is around the M&M/amoeba approach. Is it a delineation, or is it a way to display what's behind the core areas? We're not so worried if it's 60% or 70% of the landscape if what we're showing is some kind of relative value. I just don't know what other people are thinking about. Is this a display issue? We don't want to lose the focus on core areas and corridors connecting them. If we do that, how do we represent important areas in the matrix? Is there a way to display gradients or tiers for planning?

Mitch: I think we need to think about this as a specific tool as a specific thing. Andrew Mac said he liked the buffer because it would be helpful to mitigate development. I'm thinking more about a different audience – agency folks, mostly. In my opinion, some of these tools have different uses and might merit a different approach. I think the buffer is important if you're looking at zoning and legislation, but to me the more technical group of users you'd want to look at scenarios with technical constraints.

Ken: My understanding is that for species we can't show a continuous surface underneath except species-by-species. We could do some tiers of including more land under the species approach. I am thinking of people who aren't technocrats – we need to be able to simply show what areas are important. We know the underlying information will be available to those who know how to use it, but we need a simplified map that shows the big picture for audiences like municipalities. There are many purposes beyond those that Mitch highlighted.

Ethan: And in that final tiered map would you like to see more than the tiers and the amoebas?

Ken: Well we had talked about, if you were going to have 25% for speices, that you might show the 5, 10, and 25. Or it's 10, 20, 30. But something that shows some tiers.

Ethan: On the species side, if we look at the core building process by itself, we have that. We have 10 tiers right now, based on deciles on the way to the goal for the target. On the ecosystem side we have IEI

Patrick: My concern is that parts that are important that don't show up. I know some important bird areas in southern Connecticut aren't showing up as important. This has been my concern all along – if a place has been identified at a regional scale as important, but isn't showing up, what happens then?

Ethan: Your concern is valid and it's true that any broad scale spatial data product will miss some things. Any effort has to be coupled with ground truthing and incorporating local knowledge. However, we don't have a lot of latitude to adjust the datasets right now.

Marvin: As hard as this is, I think the real challenge is going to be delivering the information and interpreting it to the folks who can use it. I think the easiest way to do this is with Data Basin. If we could combine all this data into scenarios for people to use, that's ideal. This lets people who want to focus on cores do so, and those who care about the whole amoeba can do that.

Jeff: Under the eco-species combination, can you do a tiered surface showing the rest of the landscape?

Ethan: I suppose we could average the remaining area. I'm not certain how good that would be.

Andrew Milliken: In creating these amoebas, does the approach factor in the value in the selection index.

Ethan: It's a fixed buffer of the core and corridors. That is constrained by hard development and large roads. Paths with conductance above a threshold get buffered, and those paths are note based on the value of the underlying land, but rather on the importance of the connection and the resistance of the landscape.

John Warner: As we built the models, we're looking at really precise information to find the most important habitats. Then we took the best. As the seeds were built out, you constrain by a lot of factors. It seems like the CFA approach, with a blanket 1km extension, you're negating a lot of the effort we

went to, to be precise. If you're trying to connect the cores, why not make the cores bigger? Why not get more better stuff?

Scott: I want to highlight some areas of consensus. We want to be sure to highlight the most important areas – the cores. There is also a desire to show the context of the cores. For species, we can use the tiers up to 100% of rep spp LC to show importance of landscape beyond core areas.

Dave: Once you get to a certain core size, how much do you need an extra buffer? Maybe you only need buffers around small cores.

Ethan: A lot of small cores are rare communities. So if you only buffer the small cores, you may not gain that much.

Marvin: I find it hard to visualize what the other options would look like. Would it be possible to put together an example of what that would look like?

Ethan: We could, but we'd have to specify a lot of things. For IEI and the tiers, we'd have to look at those already.

Marvin: I would also like to see a table showing the real effect of a smart buffer versus the amoeba.

Ethan: The idea behind the cookie was to group the cores into larger chunks. And that takes area. So we have to accept that. If we don't want to take more area, we have the cores layer.

Rachel: I wanted to point to a publication by the Nature Conservancy on eastern forest conservation. They talk about cores and species range. Their definition of cores are areas large enough to withstand catastrophic events. They have a core and then a buffer. The core is to restore the ecosystem, and then the buffer is maintain the natural area, and the rest is to enact best management practices. The size of the core is fairly large – they suggest 10,000 to 25,000 acres. This is a publication we could look at.

Eric: I think we should be careful not to change where we've come so far. We put a lot of effort in defining the core parsimoniously. My feeling is the next most important thing after the core is the connectivity among cores.

Nancy: I think Kevin's intent with the cookie was never to lose sight of the core and connections.

Ethan: I echo that 100% and would say when we talk about growing the core more to achieve the buffer, I was thinking algorithmically about how to create the matrix.

Eric: We have a nice, clear definition of what a core is. We can also define what a corridor is. In Vermont, we've run into the issue that "tiers" without clear definitions are harder for people to grasp. So the communication of what these shapes and name are is very important.

Nancy: I agree, and I think we have consensus on that, and I think we are debating now how to represent the larger matrix.

Ethan: The question is, how do we bake the cookies?

Maritza: As the notetaker I feel like I have a strong memory of past discussions, and one thing that has been discussed in the past and sometimes forgotten about, is that there was a really strong desire to not have white space. And to have tiers, or whatever we call them, fill the landscape. When we consider the buffer, we need to make sure we don't create a matrix surrounded by white space. I know there are people on this team that would be unhappy with that outcome. They may not be in the room right now saying so, but I've written it down so I'm confident about this. Additionally, I want to remind folks that one reason we decided to go with the 25% of the landscape in cores was so that we could create a categorical set of tiers that included the next 25%, 3rd 25%, etc. It's an easy number to jump off of. So we could have layers of matrices. We have to figure out some way to represent the entire landscape. We can spend a lot of time discussing how to create that first tier, but then we'll have to solve the next tier. I think it would be easier to make sure our decision works for this larger approach.

Scott: I know from talking to Randy that the terrestrial team wants to talk more about combining the cores and the species cores. We don't need to get into that today. We were hoping that the combined approach would not have so many small cores.

Ken: I apologize because I missed some of the earlier discussion. Is the conundrum because the representative species have constrained habitats? So they naturally lead to small cores?

Bill: A lot of the small cores are coming from marsh and wetland species, yes.

Ken: To me that's not a conundrum – it's what we want. If a core is a core, then it should represent our priorities. If a particular species are zeroed in on a narrow area, we don't want to discard that. It's a depiction of the species we're trying to represent.

Scott: Problem is probably not the right word. There are tradeoffs. The issue is that you lose larger, more resilient cores.

Ken: I expected species like wood thrush and bear to fill in some of those gaps.

Scott: The way that the optimization works, you don't necessarily get large core areas for bears; you get a small core around the very best bear habitat.

Ken: But with the connecting corridors, won't you get a larger area? Maybe I'm not clear on what problem we're trying to solve.

Scott: We want large, well-connected, chunks of habitat. If we end up with small cores for all species, not just certain ones, then are we meeting our goal that's based on our scientific understanding that larger cores are better.

Ken: Why not weight species that use the large blocks heavier?

Ethan: I'd like to point out on this map that there are lots of cores, but some are very large. The small cores occur in more fragmented parts of the landscape. We had several goals: large cores, well-

distributed cores, achieving landscape capability habitat for several different species. So these goals can be and often are in conflict with one another.

Nancy: All right, so there are few things we need to follow up on, soon. Aquatics folks will be meeting on brook trout and stream sensitivity. On the terrestrial side, some discussion of the new products needs to happen. And hey, we're getting there! Good comments from everyone. We'll see you December 19th. Have a happy Thanksgiving everyone! Drive safe.