

“Ecological Restoration: Where it has been and where it is going”

Biohabitats/SER Panel Discussion - Additional Questions

What different types of professionals generally collaborate on restoration projects?

Keith: A variety, and it continues to grow. Certainly, there is much collaboration between the environmental sciences (ecology, biology, geomorphology, soil science, forestry, hydrology, horticulture, chemists, etc.) and the design and engineering disciplines (civil and water resource engineering, landscape architecture, land planning, etc.). Other professionals may include permaculturalists, agro-foresters, biomimicrists, economists, geotechnical engineers, cultural resource specialists, community engagement specialists, cost estimators, and researchers to name a few.

Can we hear more about the kind of training that is useful for new people entering this profession? The panelists have such diverse backgrounds. Can any combination of these work to provide the skills needed?

Bethanie: Looking at SER's membership, we have people entering this field straight from college and we have people entering as a second career after working in completely unrelated, non-environmental/ecological fields. And for long-time practitioners the situation is similar, many people “stumbled” upon restoration through their other work. While entering with expertise from one space (e.g. ecological or engineering) works, I would recommend a broad interdisciplinary approach, as outlined in the knowledge requirements for Certified Ecological Restoration Practitioner, that includes biological, physical, and quantitative sciences as well as resource conservation and management (including human dimensions/social sciences). Nature is complex, restoration is complex. The broader your background, the more creative and responsive you can be to restoration's challenges.

Keith: A multi-disciplinary approach is required for ecological restoration. The mix of skill sets depends on the type of restoration needed. At Biohabitats we find that people with skills/background in both science and design are ideal. For example, someone who has an undergraduate degree in landscape architecture or civil engineering combined with a graduate degree in ecology, conservation biology or geomorphology (to name a few)—or the reverse— provides great value. In addition, someone with experience in the field, working for a restoration contractor, landscape contractor, or native plant nursery that can bring that knowledge to the design table is valuable as well. All-in collaboration is the key.

Carolina: Anyone can contribute to Ecological restoration from basically any field. One of the biggest needs in restoring our natural infrastructure is changing people's perspectives with regards to nature and the limits of our planet (how much abuse it can take). So, people with education background could assist in educating children and citizens on what is ER, and how the average person can contribute by applying the 7

Rs. Reduce, reuse, recycle, re-purpose, repair, etc. A person with a background in political science or law can assist policy-makers and government staff in making changes in the way natural resources and nature in general are managed by governments. People need not re-train themselves in ER and become full-fledged ER experts to participate.

What role can environmental consulting companies play in ecological restoration?

Keith: Environmental consulting companies play many roles in ecological restoration. There are many environmental consulting companies that lead ecological restoration projects starting with project planning to developing final design and construction packages, regulatory permitting, community engagement, to administering or performing the restoration construction and performing post implementation monitoring and management. Environmental consulting firms typically work with governmental agencies, private institutions and non-government organizations on a variety of projects at a variety of scales.

What are your thoughts about ecological restoration on mines? Any thoughts how to get started in that facet of ecological restoration?

Bethanie: SER has been working with practitioners, researchers and people in the mining industry to develop a set of Standards for mine site restoration. After undergoing extensive friendly review, we submitted the Standards for publication, and they are now in the peer review process. It is our hope that they will be finalized and released in the next few months. The new mining Standards are modeled after the SER International Principles and Standards for the Practice of Ecological Restoration, but they are specifically modified for ecological restoration at mined sites, moving beyond typical closure and reclamation/rehab to actual ecological restoration, regardless of whether the regulatory structure requires this level of action. They include a series of case studies illustrating different projects that have effectively addressed unique challenges in ecological restoration of mined areas. We will be announcing the new standards broadly once they are published.

Fungi and plants have been in close relationship for a long time. The USA doesn't have a program that I'm aware of and I'm wondering if Arbuscular mycorrhizae or other root associated fungi are being developed for restoration and rehab?

Bethanie: I have seen a lot of news/stories/research cross my email box talking about the use of fungi for restoration. That said, I did a quick search in our Restoration Resource Center, and only found 5 resources. A search for fungi pulled up 25 resources. I know there is more on this topic out there, so I would encourage you to look more broadly into this, including in the video space, as I have also seen some excellent short videos on the use of fungi and mycorrhizae in restoration.

Carolina: Soil fungi, and in particular VAM and AM are critical for the establishment of many tropical species. Research on soil science and the ecological interactions between fungi and plants is growing exponentially. What is lacking is the application of

that knowledge in restoration field experiments, especially in areas where the soil has been greatly damaged.

I'm interested in nature-as-infrastructure in enhancing coastal resilience. Any new projects or approaches you can discuss?

Bethanie: Living shorelines, oyster restoration, and reef restoration are increasingly being implemented and being done so successfully. I believe that Restore America's Estuaries would have a lot of resources on this topic as well.

Tein: important too are mangrove and saltmarsh restoration projects, of which there are many examples that can be searched on the web. These two ecosystems are capable of migrating into new habitats as sea levels rise – but there is often a problem of suitable land and substrates available on the coast due to competition from human settlements and roads.

How has accounting for climate adaptation needs changed your approach to restoration over time?

Bethanie: In the International Principles and Standards for the Practice of Ecological Restoration we include an appendix on seed sourcing and provenance in the context of climate change that I recommend as a helpful resource. The Standards also very specifically talk about choosing reference ecosystems in the context of climate change, and doing so in a manner that considers historical context but then looks forward to incorporate projected change. Separately, there is an ongoing debate about the merits and drawbacks of assisted migration for plants and wildlife in the context of climate change as well, but this is increasingly being considered and assessed. It is a controversial approach.

Stephen: There is no one approach. For some preserves we limit seeds to very local, in hopes of conserving whatever local adaptations. For some preserves, we introduce seeds (and someday animals?) from farther south and west. In all cases, we hope that both “genetic reshufflings” and evolution will do their work, though imperfectly, as much as possible.

Tein: I agree with Bethanie's response. Regarding provenance in a changing climate. it might also be useful to consider the Florabank guidelines. Although published for Australian conditions the principles are likely transferable globally.

I live in the Mediterranean area of central Chile and i am witnessing the death of native sclerophyllous forest due to mega droughts lasting in the last 10 years due to global climate change. So, I wonder how restoration projects being performed in this territory will fit the short term and rapid changes. The paradox of maintaining watering where water is turning scarce... how restoration adapt at an appropriate speed for incorporating these changes in the environmental changes.

Bethanie: SER now partners with the Kuwait Institute for Scientific Research to host publication of Restoration Ecology – Arid Lands as a thematic series of our journal,

Restoration Ecology. (All SER members receive a subscription to *Restoration Ecology* (and therefore also RE-Arid Lands) as part of their membership benefits.) Arid lands restoration research and restoration techniques are expanding rapidly and we expect to see more and more information available about how to improve arid land restoration outcomes. SER is also finalizing a virtual training course that is focused on arid lands restoration, it should be available later this year. There are also some simple things to consider – for example, (I am not a restoration practitioner, so this is one anecdote): I visited a savanna restoration site a few years ago. They had started their restoration effort by planting seedlings, but they had limited success due to water issues. When they switched to seeds instead of seedlings, they saw much greater success with their revegetation efforts.

Stephen: There are certainly better experts on challenges in Chile than someone from Chicago, but a few principles may help: 1) Consult with the most knowledgeable, creative, and courageous local experts (and native plant gardeners?). 2) If some watering can help pockets of ecosystem survive a drought while whole species are lost elsewhere, it's worth trying; we do it; and then restore those species "up hill" or "on north-facing slopes" or in other situations where they'll have a chance to re-establish in an evolving community. 3) some species and communities are adapted to stresses of various kinds and will come back when flood, fire, drought, disease or other stress abates. Some only survive in such a context. 4) Much more research is needed. But in many cases, definitive research will not be completed in time. Thus, as with medical doctors, we ecosystem medics need to try various approaches (as well-informed as possible) to see what may work. Hand-wringing and nothing-doing are not answers.

Tein: If you are talking about an already mature natural ecosystem that is in decline due to severe drought, this could be an instance of climate change rendering a habitat unsuitable for a past ecosystem. But it is important not to jump to conclusions too early. Watch what happens when the drought breaks; might there be recovery of all or some species? If so, consider introducing some individuals of the same species from already hotter/drier-adapted examples of that same ecosystem elsewhere to bolster adaptability of the local populations (if any such sites exist). If no recovery or substantial mortality, this may be a case of a full or partial shift in the ecosystem towards another expression or form of the same ecosystem. If it is really clear that the new conditions better suit another locally occurring ecosystem you might consider facilitating natural colonization of species from other adjacent, more drought-adapted ecosystems or placing some 'starter' species from these close to or into the site to see if they might expand and colonize over time. Bear in mind that because you are wanting a self-perpetuating natural ecosystem, it is good to rely on these cues for natural shifts rather than design a replacement ecosystem that turns out incapable of reproduction under the new conditions.

Carolina: There are studies being conducted in the Coquimbo (In Northern Chile) area by CONAF to assess the effectiveness of different strategies, including methods for assisting water infiltration. You may want to contact Liliana Yañez. This is one of those

extreme situations, where a lot of innovation is required to try and address the limiting factor (water) and ensure some minimum vegetation cover that will stop the downward degradation spiral before it gets too critical. Areas like Parque Nacional Fray Jorge are another story. Because of their particular location and dependence on horizontal rain, their future is much dire. Nevertheless, some thinking outside the box and serious investment in cloud catching structures may assist in maintaining the forest.

In terms of engaging an "orders-of-magnitude-larger" audience/workforce, how does that interact with economic forces? How do we turn world economies toward restoration? Seems to turn on the conflict between capitalism and communal care.

Bethanie: The restoration sector of the economy is alive and growing, all over the world! Thanks to the UN Decade on Ecosystem Restoration and some of the work they are doing, we are seeing increased interest from governments, industry, and financiers to fund more restoration globally. While there will likely never be enough money for all the restoration that needs to happen, it does seem that more and more money is being invested in this space. With that, we then need to make sure that we have trained workers (at the design level, but also at the workforce level), and that we have high quality restoration implementation. While any existing economic system is likely problematic, I think that we are recognizing, more and more, that we cannot have healthy human societies if we don't have a healthy environment to host those societies. I think local and grassroots investment in restoration, and showing that high quality, well-designed and implement restoration works, is also a really important tool for increasing support for this work, both publicly and financially.

Stephen: One answer is for entrepreneurs to be creative and bold. And for many of us to support them. And by "entrepreneurs" I mean in the fields of science, politics, religion, economics, education, and agriculture (especially where management of ecosystems is economically practical).

Tein: The question is and economic one really and needs an economic answer. If I had my life again I would study economics and work solely on this question. But without that knowledge my best guess is that we need people to increasingly VALUE ecosystem health to a point where there is: a willingness for governments to invest; an increased demand for restoration services by individuals and companies and increased willingness to pay for them; and many, many more individuals to invest their own energy.

Carolina: One of the operational lines of UN's Strategy of the Decade of Ecosystem Restoration is focused on engaging in innovative ways governments and the private sector in ER. Especially, finding innovative ways to support economically the work needed to achieve the restoration goals and voluntary commitments. Bill's point about discovering and supporting what is there, rather than thinking we are creating something speaks to the idea of ecological personhood. I'd like to hear the panelists thoughts on personhood in relation to our work.

Bethanie: There are a variety of legal tools to enshrine environmental protections, including restoration; environmental or ecological personhood is just one of those, but it is tied to the concept of establishing legal rights for nature. Several countries have established rights for nature in their constitutions or other rights of nature laws. There are also declarations about rights for nature. SER for example has endorsed the Universal Declaration for the Rights of Wetlands, including the right to restoration and regeneration. We are working with those promoting that declaration to move from a declaration to actual implementation. As another example, several SER members and other interested parties are now working to advance a proposal to create an Ecological Restoration Principle, which would be similar to the Precautionary Principle. I think it's important to consider all of the different legal tools that might be viable for expanding protection and restoration of nature.

Do you think small scale restoration (native gardens) in private yards and restoring urban canopies is critical to restoration goals or is large scale restoration the only way to meet our goals?

Bethanie: SER is a huge supporter of restoration at every scale, from individual backyards to thousands or tens of thousands of hectares. We need to change how humans interact and engage with nature and make that more restorative. If we only do large scale restoration, then people may think along the lines of "that's something that happens over there, I don't have to have anything to do with it. I can keep destroying over here, because someone else will fix it over there." SER hosts Make a Difference Week precisely to show that everyone, everywhere, can be part of the global effort to heal the planet. MAD-Week encourages people all across the world to host local restoration projects from 4-11 June 2022 to show that local action, collectively, has global impact. You can view the amazing results from the 140+ projects in 34 countries during MAD-Week 2021.

Stephen: All levels can make contributions. "Large scale" and "ultimately, planetary" scales are crucial. But in a yard or park it is possible, for a few examples, to do experiments that help us better understand species, produce seeds of needed and difficult plants, educate and inspire ourselves and neighbors, provide habitat for migratory birds, to list just a few.

Caroline: Absolutely! Every square meter counts! But most importantly, through small individual efforts, we change people's relationship with nature one household, one block at a time! It rings nature to their homes, balconies, green roofs.

We have obsolete run-of-river dam removal projects in Vermont, nationally and globally that restore rivers and streams, wetlands and floodplains, aquatic and terrestrial habitat and improve water quality with the co-benefit of reducing flood risk in communities and reducing related economic flood recovery costs. This is restorative management and amazing how quickly the wetlands are revegetated in our northeast U.S. with just six months of a growing season per year. Are any panelists able to address "where we've been and where we're going" in the ecological restoration of dam

removal projects as the pace of dam removal projects and academic research increases worldwide? For example, recent fluvial morphology research on dam removals at Dartmouth College has shown that dynamic stream equilibrium reaches a balance with 3–4 storms in the first summer post-removal.

Biohabitats: Biohabitats dam removal expert, Laura Wildman agrees that the ecological benefits of dam removal are numerous. Laura says that the Dartmouth data seems to reflect what she often sees at dam removal sites. She cautions, however, that every site is different and will have different response times, depending on the amount of sediment, hydrology of the region, sensitivity of species, etc. One resource Laura highly recommends for post-dam removal monitoring data is the USGS John Wesley Powell Center for Analysis and Synthesis' dam removal monitoring database. According to Jeffrey Duda of the USGS Western Fisheries Research Center, the database is updated annually.