Welcome to the COCO-CRA CSRN Riparian Book Club

Coalitions & Collaboratives (COCO) & Colorado Riparian Association (CRA) are teaming up in 2023 as your co-hosts for

RIPARIAN BOOK CLUB

Helping bridge the gap between academic research on stream and wetland systems and applied restoration design in Colorado

Welcome

Riparian Book Club Hosts

Julie Ash, PE | Colorado Riparian Association (CRA) | Education & Outreach Committee Lead
Maria Brandt | Coalitions & Collaboratives (COCO) | Outreach & Development Director

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Discussions, Polling, Q&A,

- Polling is anonymous. Please be respectful and professional.
- Please reserve GoToWebinar to raise your hand.
- If called upon, you will be unmuted by host.

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We ask that you please...

- take care of yourself
- practice confident humility – the self-awareness that we all have wisdom and we will always have more to learn
- consider listening if you talk often (if you often listen quietly, consider speaking up)
- listen actively and with an ear to understanding others' views
- speak your truth using "I" statements
- avoid assumptions
- commit to learning, not debating
- embrace paradox

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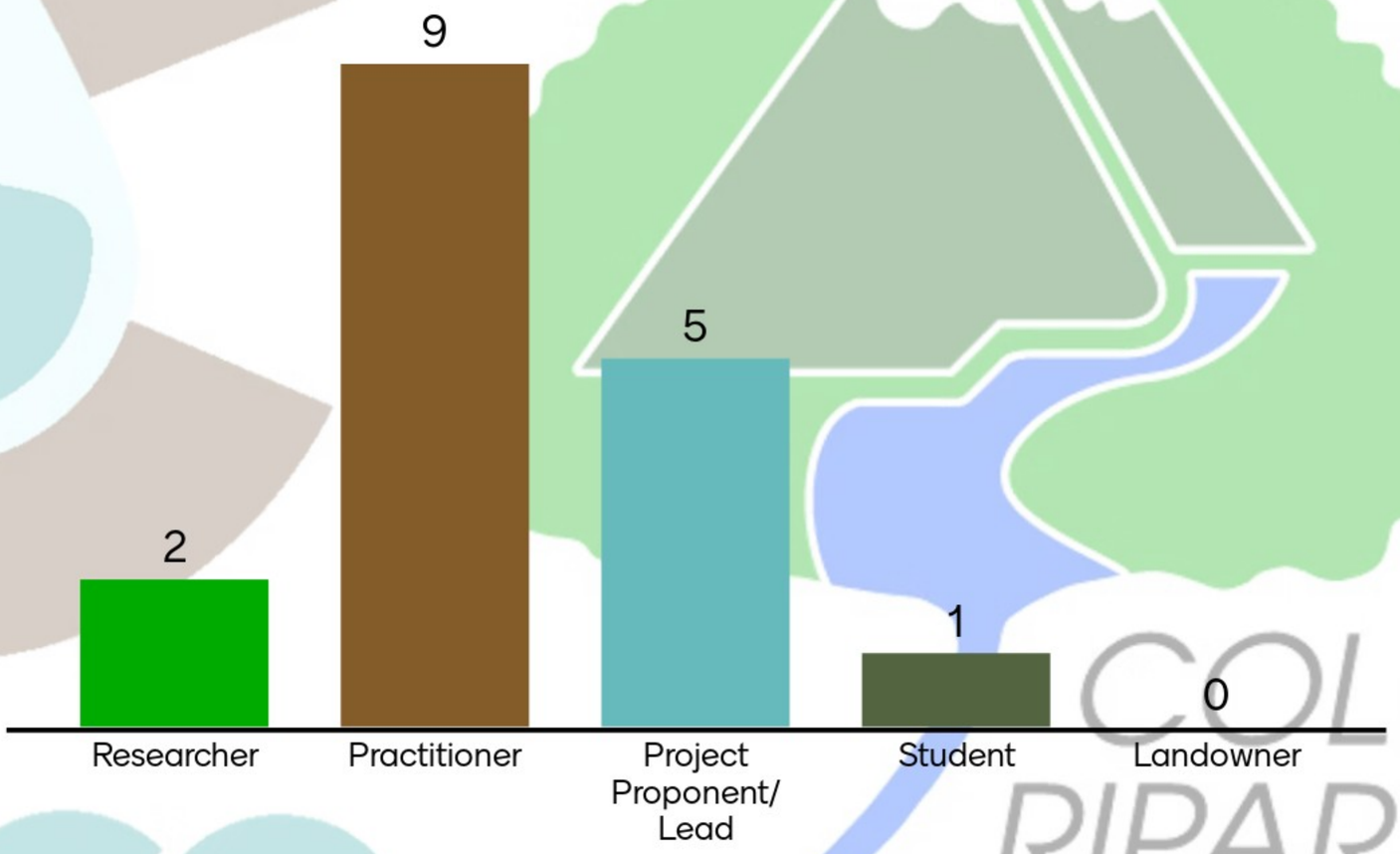
I'm a



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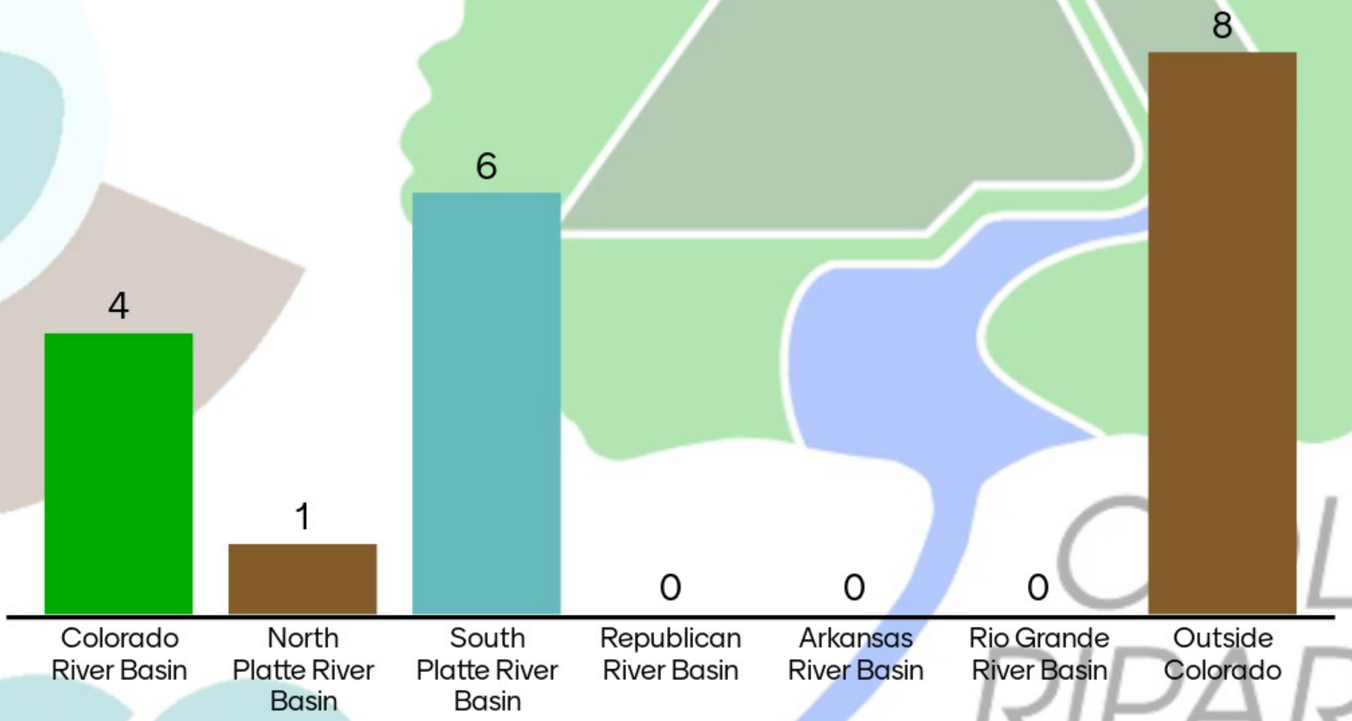
What geographic location are you joining us from?



Riparian Book Club | June 26, 2023

Articles

Process-based Principles for Restoring River Ecosystems

TIMOTHY J. BEECHIE, DAVID A. SEAR, JULIAN D. OLDEN, GEORGE R. PESS, JOHN M. BUFFINGTON, HAMISH MOIR, PHILIP RONI, AND MICHAEL M. POLLOCK

Process-based restoration aims to reestablish normative rates and magnitudes of physical, chemical, and biological processes that sustain river and floodplain ecosystems. Ecosystem conditions at any site are governed by hierarchical regional, watershed, and reach-scale processes controlling hydrologic and sediment regimes; floodplain and aquatic habitat dynamics; and riparian and aquatic biota. We outline and illustrate four process-based principles that ensure river restoration will be guided toward sustainable actions: (1) restoration actions should address the root causes of degradation, (2) actions must be consistent with the physical and biological potential of the site, (3) actions should be at a scale commensurate with environmental problems, and (4) actions should have clearly articulated expected outcomes for ecosystem dynamics. Applying these principles will help avoid common pitfalls in river restoration, such as creating habitat types that are outside of a site's natural potential, attempting to build static habitats in dynamic environments, or constructing habitat features that are ultimately overwhelmed by unconsidered system drivers.

Keywords: river restoration, ecosystem dynamics, ecosystem processes

In the last century, the world's rivers have been severely altered by river- and land-management actions that have interrupted fluxes of water, sediment, and nutrients (Dynesius and Nilsson 1994, Ward et al. 1999, Syvitski et al. 2005); simplified the physical structure of habitats and floodplains (Beechie et al. 1994, Hohensinner et al. 2005); and degraded habitat and water quality in river systems by the loading of nutrients and pollutants (Tilman et al. 2001). These changes to watersheds and rivers have altered riverine ecosystems dramatically (Poff et al. 2007), and investments in river restoration over the last few decades have failed to halt declines in habitat quality and ecosystem function (Bernhardt et al. 2005). Moreover, stresses on riverine ecosystems will be exacerbated by steadily rising human demands for water and land, as well as by climate change and shifts in availability of water during seasons when irrigation and ecological demands are high (Postel et al. 1996, Barnett et al. 2005).

Recent calls for national and international river restoration efforts have pressed for more holistic approaches to river management (Palmer and Allan 2006), and for restoration actions that better address primary causes of ecosystem degradation (Kondolf et al. 2006, Roni et al. 2008). However, this recent literature remains fragmented, and the proposed management concepts are still not widely implemented (Palmer et al. 2005, Wohl et al. 2005). Hence, there remains a need to synthesize recently developed concepts in restoration science and practice into a usable set of guiding principles for sustainable river restoration. In this article we define process-based restoration as a means of addressing root causes of degradation, and we characterize the primary processes driving habitat conditions and ecosystem dynamics. We then synthesize recent literature into a set of four fundamental process-based principles for restoring river ecosystems, and explain key analyses needed to implement process-based restoration. Finally, we present several examples to illustrate how process-based restoration actions create more resilient ecosystems than do actions that attempt to create static channel or habitat features.

What is process-based restoration?

Process-based restoration aims to reestablish normative rates and magnitudes of physical, chemical, and biological processes that create and sustain river and floodplain ecosystems. Processes are typically measured as rates, and they involve the movement of or changes to ecosystem parts and features (Beechie and Bolton 1999). Examples of the processes we discuss include erosion and sediment transport, storage and routing of water, plant growth and successional processes, input of nutrients and thermal energy, and nutrient cycling in the aquatic food web. Process-based restoration, then, focuses on correcting anthropogenic disruptions to these processes, such that the river-floodplain ecosystem progresses along a recovery trajectory with minimal corrective intervention (Sear 1994, Wohl et al. 2005). Restoration of critical processes also allows the system to respond to future perturbations through natural

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Overview Articles

Design Criteria for Process-Based Restoration of Fluvial Systems

DAMION C. CIOTTI®, JARED MCKEE, KAREN L. POPE, G. MATHIAS KONDOLF, AND MICHAEL M. POLLOCK

Process-based restoration of fluvial systems removes human constraints on nature to promote ecological recovery. By freeing natural processes, a resilient ecosystem may be restored with minimal corrective intervention. However, there is a lack of meaningful design criteria to allow designers to evaluate whether a project is likely to achieve process-based restoration objectives. We describe four design criteria to evaluate a project's potential: the expansion of fluvial process space and connectivity lost because of human alterations, the use of intrinsic natural energy to do the work of restoration, the use of native materials that do not overstabilize project elements, and the explicit incorporation of time and adaptive management into project design to place sites on recovery trajectories as opposed to attempts to "restore" sites via a single intervention. Applications include stream and infrastructure design and low-carbon construction. An example is presented in California's Sierra Nevada foothills.

Keywords: floodplain, meadow restoration, stream restoration, multithread channel, carbon emissions

Fluvial ecosystems are some of the most diverse and productive systems on Earth (Naiman et al. 1993). They are the hydrogeomorphic template on which most early civilizations arose and they continue to be heavily used (Solomon 2010). Many of the benefits these systems provide to human society, including biological diversity and productivity, have been degraded, and their recovery is limited within the confines of current infrastructure and land uses (Bernhardt and Palmer 2011). As such, there is tremendous societal interest in recovering degraded fluvial ecosystems, and billions of dollars are spent annually on attempts to restore the services they provide (Bernhardt et al. 2005, Ring 2018).

The science of ecosystem restoration is relatively new, and many initial efforts have been primarily focused on designing projects to achieve a specific outcome, form, or habitat feature (Palmer et al. 2005). As restoration science has evolved, we have come to understand that ecosystems provide greater function over the long term when the dynamic forces that create and maintain them are allowed to operate. We have also learned that designing for static conditions provides limited ecological value and requires ongoing management and energy inputs to maintain specific geomorphic structural conditions (Kondolf 2011). Sustainable restoration outcomes are more likely when placed soundly within a broad ecosystem context that allows natural biophysical interactions to drive recovery and requires relinquishing some control over site-specific outcomes to learn from those interactions (Apfelbaum and Haney 2012, Palmer et al. 2014a).

It has been hypothesized that the idealized habitats sought in conventional restoration design may be better achieved when managers influence natural processes and obtain feedback with which they then revise subsequent restoration interventions (see Ross et al. 2015). This iterative and interactive approach acknowledges a lack of complete system understanding at the outset of implementation. Such an approach has been employed with great success in other fields. For example, the early history of flight control was plagued by a "frustrating search for inherent stability," which was solved when the Wright brothers suggested that pilots be "provided with sufficiently powerful controls with which to balance and steer" (McRuer and Graham 1981). Similarly, many ecosystem restoration designers have sought the inherent stability that early flight engineers attempted to create (Ross et al. 2015). However, this static design approach is arguably as inappropriate for managing complex ecosystems as it is for airplanes. By embracing feedback signals and dynamic controls in the design and management of ecosystems, as did the Wright brothers for airplanes, we argue that restoration scientists and engineers will observe similar gains in ecosystem "performance."

The search for inherent stability during the project design phase often and unknowingly conflicts with objectives aimed at restoring natural processes. Design criteria are specific measurable attributes of a project that help designers identify such conflicts and ensure that appropriate restoration objectives are considered during the design phase (Miller and Skidmore 2003). A challenge for restoration science is how to develop design criteria for fluvial ecosystem restoration projects intended to respond dynamically to stochastic disturbances such that there is a range of acceptable

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Dan Scott | Watershed Science & Engineering (WSE) & Colorado State University (CSU)

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37 Answers

Quantifying normative rates is not easy, nor is it always accurate, which is why adaptive management is critical in restoration practices moving forward.

So clarity is helpful on when we are referencing "historical normative" or not

... anthropocentric POV now yes that is possible in certain areas

What does adaptive management mean in the context of process-based stream restoration?

It's a pipedream - look at the Dolores for example. Anyone that's spent time on wild rivers will appreciate the very, very few that are actually allowed to do what rivers do. Normative according to...

We need to embrace a greater level of uncertainty in project outcomes. Our "restoration " goal may not be what works best in that particular riverine ecosystem given existing constraints.

We know by measuring how many km restored, and normative is not able to be remembered (3000) years of land abuse. Removal of Beaver and Trees (structural complexity) is needed in larger quantity

How have you had those new conversations about something different than a single thread channel?

could it be "normative" as expected from the current and future conditions

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37 Answers

A more realistic aim may be to achieve acceptable or possible rates - rather than a theoretical or historical norm

"Natural" and "normative" are relative. Maybe we should focus more on sustainability and functional, diverse ecosystems.

The difference between 2.5 billion humans 50 years ago is much different than 8+billion now. Let's not say we are "natural", let's use a different word and let's please still help other critters.

a big part of our project planning is finding the middle ground with landowners. What the landowner needs from the landscape to run their operation and what the stream needs to manage it's energy

Restoration approaches need to go hand in hand with policy changes - funding/grants have their reqs that are still "old guard" approaches. Metrics of success/funding requirements need to keep up

The policy and the timescale to see the benefits of that policy. Big ideas take time.

Can you talk about adaptive management? What does it mean to adaptively manage a process-based restoration?

Beechie acknowledges the policy priorities - one of the main issues with metrics from a WQ perspective is that parameters that are the issue aren't the ones being regulated (yet). (1/2)

The 6PPD-quinone/salmon issue in the NW is a great example. You have to think from an umbrella approach and think of what processes help address (2/3)

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37 Answers

a variety of issues versus parameter specific (which again goes back to the policy issue/WQ standards keeping up) - so adaptive mgmt w/ an umbrella approach in project design to address unknowns (3/3

Great distinction of policy requirements as a baseline for restoration goals. Are policy requirements centered around form-based restoration? If so, do you see a shift in policy towards process-based?

Enhanced connectivity, lateral/longitudinal/vertical can hopefully promote sustainability/resiliency

Impacts still happen and that things continually change (2/2)

Sustainable projects have had some success working with processes and thus no need for large-scale human intervention

There will always be O/M, so sustainability would be meeting the goals of that project to address that process being addressed (with the understanding that O/M will still be required) - you still (1/2

intervention versus stewardship

I look forward to using some different terms other than sustainability, but we still need to have that inspirational language. What will it be in the future. And yes "Braiding Sweetgrass" was amazing

sustainability, with respect to biodiversity - native species persist without human intervention

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37 Answers

Would it help for us to change the language around how we "measure" project success?

using process-based restoration to move from intervention to stewardship

One could use the corollary for form vs process-based restoration with this quote - Give a Person a Fish, and You Feed Them for a Day. Teach a Person To Fish, and You Feed Them for a Lifetime

A lot of what has been discussed - policy/science gap & the societal expectations of immediate gratification; Ed/outreach on env processes, connecting to the land, practitioners in DM positions = soln

It is best from the ground up. Communities that have a history of environmental racism need that outreach to come from within that community

I really like Dan's message that we need to change to "selling stewardship" instead of "selling solutions", which ties inherently to needing ongoing actions. We have a perception problem to overcome.

I work in agriculture environments and would say that this discussion around community engagement and environmental racism in the urban setting very much applies to rural ag communities.

Agree with that last comment - having policy coming from the front range impacting the west slope/lower ark is a similar issue

YES!!! Lots to work on with ag producers, but when you can get on their level and build trust you can really make change because they (usually) don't want their livelihoods to die.

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37 Answers

Its respectful relationships that make or break everything, including restoration! Outreach is probably considered mandatory at this point and much in advance.

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Thank You

A recording of this webinar will be available at https://coloradoriparian.org/education-and-outreach-colorado-stream-restoration-network/. You will also receive a follow-up email of the recording with links to any resources shared.

Please stay tuned for future Riparian Book Clubs!

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