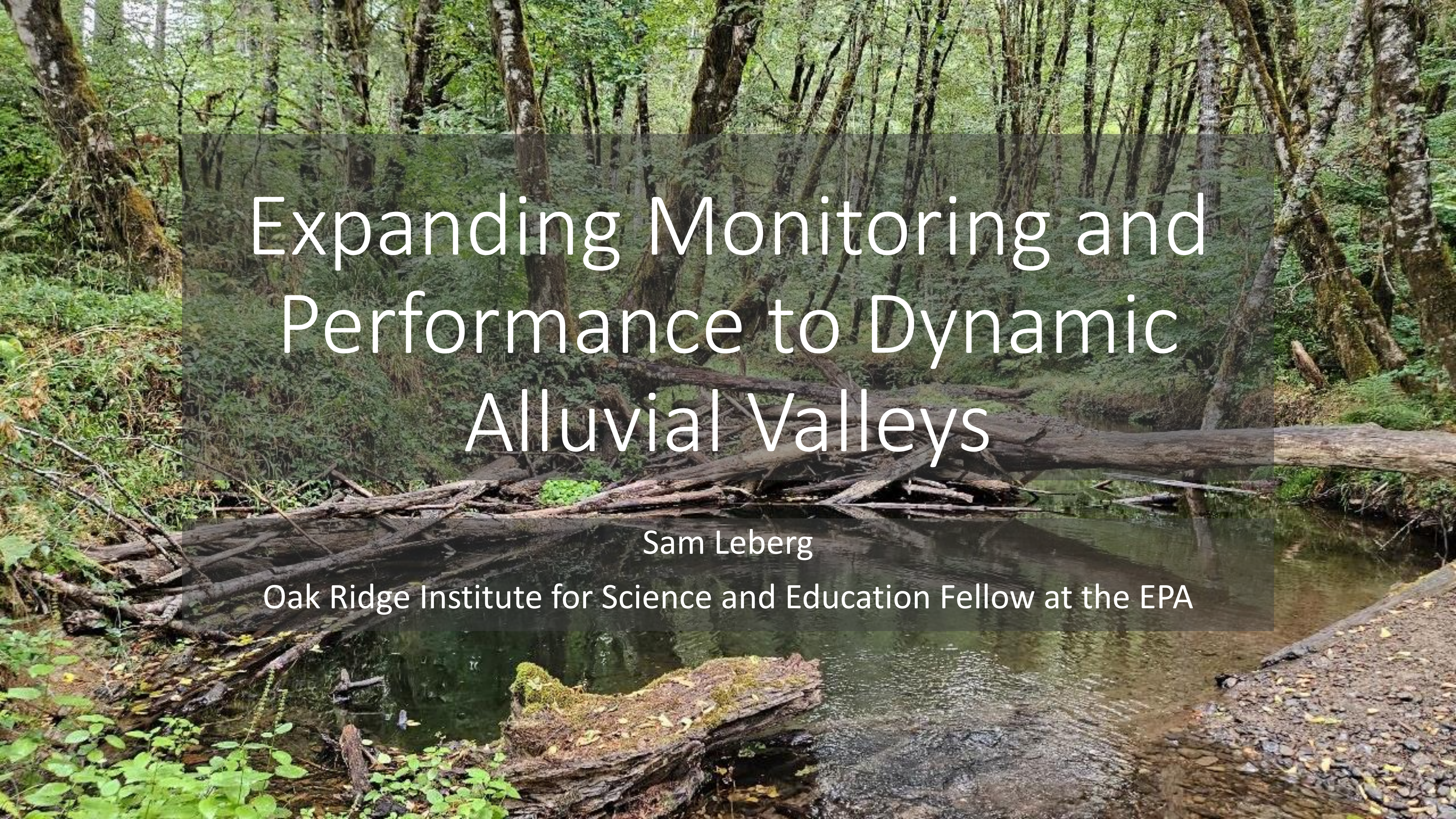

Expanding Monitoring and Performance to Dynamic Alluvial Valleys

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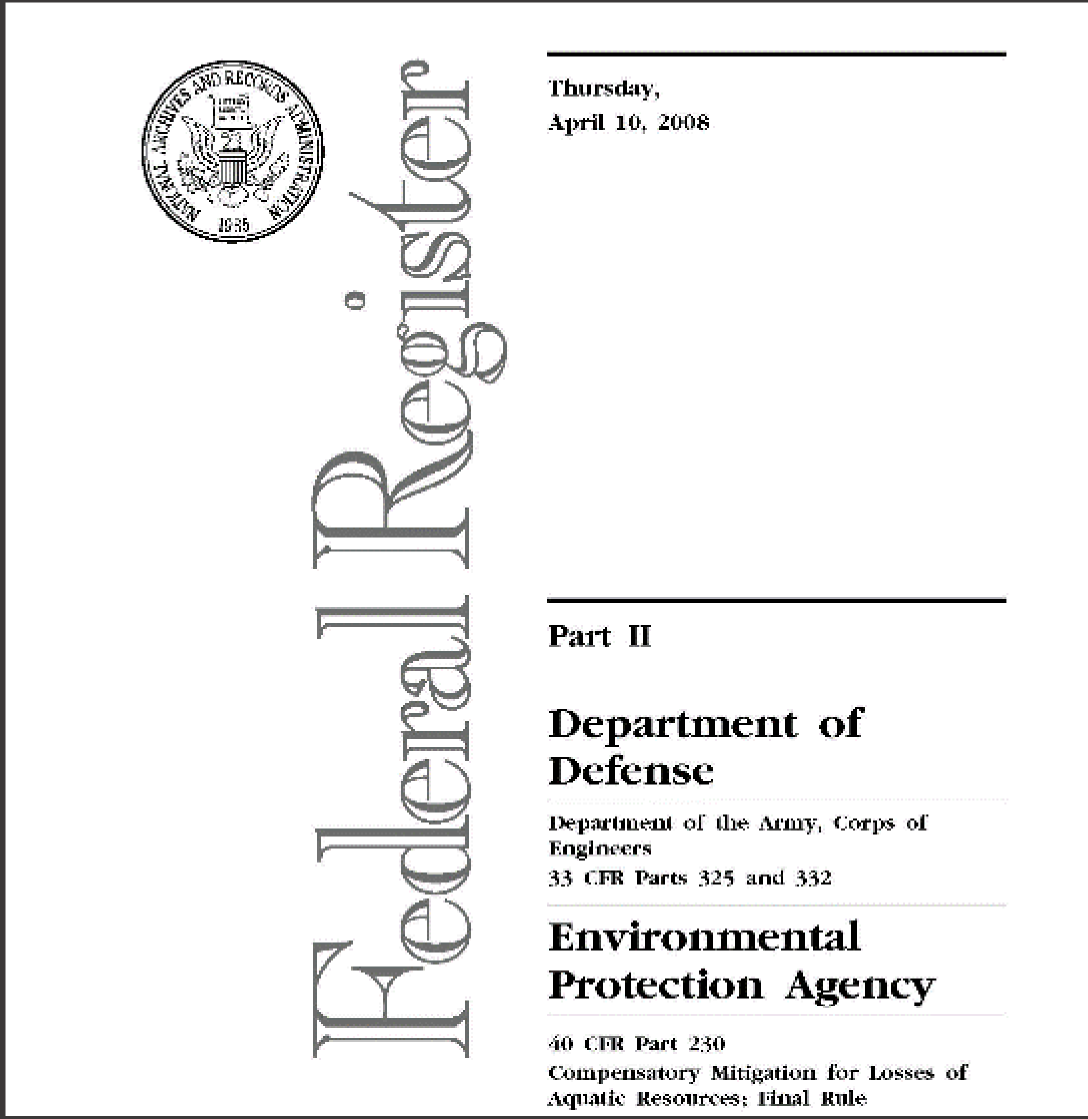
Stream Compensatory Mitigation

- Compensatory Mitigation required for dredge and fill impacts under Section 404 of the Clean Water Act
- 2008 Mitigation Rule
  - Standardized review and approval
- Monitoring requirements and performance standards central to the evaluation of compensatory mitigation projects


Federal Register

Thursday,
April 10, 2008

Part II

Department of Defense

Department of the Army, Corps of Engineers
33 CFR Parts 325 and 332

Environmental Protection Agency

40 CFR Part 230
Compensatory Mitigation for Losses of Aquatic Resources; Final Rule

Stream Compensatory Mitigation

- Stream mitigation practices have focused on stability and form, particularly perennial single-thread transport channels
  - Determining compliance is relatively straightforward
- Existing mitigation protocols increase time and effort required for reviewing other stream types and restoration approaches
  - Limited best practices for process-based frameworks
  - No standard methodology for addressing healthy dynamism including beaver
  - Metrics lacking for retentive and multi-thread systems

What is needed?

- Regulators and mitigation providers need tools to monitor and evaluate retentive systems
  - Identify healthy versus degrading sites
- Healthy dynamic systems will naturally experience shifting habitats across their site
  - Requires an approach addressing a range of potential outcomes
- Design considerations are important for successful implementation
- Informed a performance and monitoring document

Monitoring Report

- "Expanding Monitoring and Performance to Dynamic Alluvial Valleys"
- This report provides a national resource for the stream compensatory mitigation community to consider when proposing or evaluating dynamic alluvial valleys
- Sections
  - Design Considerations
  - **Monitoring Considerations**
  - **Performance Metrics**
  - Adaptive Management
- Published as Proceedings Document on the National Stream Restoration Conference Website

Report downloadable under "Workshop Proceedings" heading

Methodology

- Created a series of questions to examine performance standards & monitoring requirements
  - Identify other areas where changes are needed
- Conducted semi-structured interviews with 60 participants concurrently with literature review
- Regulators (18)
  - EPA
  - Corps
  - States
- Practitioners (27) & academics (15)

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Dynamic Alluvial Valleys (DAVs)

- Stream System, not a design practice
- Depositional/retentive systems within the stream network whose form is dominated by biological drivers (vegetation, beaver, etc)
- May be multithreaded, and the location and relative coverage of specific habitats may change between monitoring periods
- Defined by four key processes

- **Extensive lateral and vertical connectivity**-Biologically active surface and subsurface connectivity is maintained even during baseflow conditions
- **Creation and maintenance of diverse habitats**-The channel and the floodplain are a part of a united mosaic of streams and wetlands
- **Retention of materials**-The valley retains sediment and organic matter.
- **Abundant biological communities**-The valley supports an abundant (often diverse) biological community that contributes to the form of the valley

Monitoring Procedures

- Valley-wide transects

- Large site-scale assessments
  - GIS, LiDAR, and drone-based photography
  - Hydraulics and geomorphological, some vegetation metrics

- Random grid-based sampling (Hinshaw et al. 2022)
  - Encompassing in-channel and floodplain
  - Geomorphology and biological metrics

- eDNA monitoring
  - Amphibians and fish, some macroinvertebrate metrics.

Metric Identification and Selection

- Interviewee input
- Literature Review
- Selected metrics to indicate
  - Presence of Key functions
  - Site not trending towards failure
    - Without utilizing stability measures
  - Improvement from baseline

Key Processes of DAV lost	Failure Point(s)
Loss of extensive lateral and vertical connectivity	Failure of valley-wide grade control(s)
Loss of habitat diversity	Failure to account for channel drying and loss of water
	Failure to account for excessive deposition
Loss of net retentive valley	Failure to design transitions with upstream and downstream reaches
	Failure to account for excessive erosion
Loss of biological communities	Failure to establish desirable vegetative communities
	Failure to design for poor water quality

Performance Metrics

Key Process	Parameter	Indicator	Target	Timing	Notes & Considerations
Extensive Lateral and Vertical Connectivity	**Floodplain Connectivity**	Flooding/Inundation frequency, duration, and/or aerial extent; stream gage, ground water wells, water presence sensors, other continuous monitoring	Floodplain inundation events or duration in a normal flow year	Monitored in all years	Indicative of a large flood-prone area frequently laterally connected. Specifics will vary by region. As used by practitioners in Pennsylvania, 4 times per year in a normal year, coupled with visual evidence of floodplain inundation in spring season.
Creation and Maintenance of Diverse Habitats	**Depth Diversity**	Coefficient of Variation of Depth	Increase compared to pre-project conditions; Meeting or exceeding reference conditions	Monitored in all years	Depth diversity indicates in-channel habitat and variable zones for temperature and sediment deposition. A matrix of stream depth can be created with aerial and multispectral imagery. Different depths can then be classified, and variation quantified. Restored DAVs should result in a high diversity of depths though specific numerical targets would be regionally-dependent.

Performance Metrics

Key Process	Parameter	Indicator	Target	Timing	Notes & Considerations
Retention of Materials	**Carbon Retention**	Visual, photo station or otherwise	60% of monitoring stations, pieces of LWD retaining CPOM	Monitored in all years	This metric target would demonstrate that a site can retain carbon but would not necessarily demonstrate successive carbon retention. The target will vary by region and site-specific conditions and should only apply to a normal flow year.
Abundant Biological Communities	**Amphibian Communities**	Native abundance	Native quantity increase compared to control reach	Monitored in all years after the first	Retentive systems will result in a larger wetted area that may support more amphibians. Particularly in headwater streams, amphibian metrics may more reliable than fish metrics. For amphibian metrics, sample the perimeter of the reach as well as the underside of logs.

Metric Organization

Key Process	Stream Function Pyramid Level	SFAM Key Functions	Parameter	Indicator	Citation
Extensive Lateral and Vertical Connectivity	Hydraulics	Surface water storage, sub/surface transfer, flow variation, sustain trophic structure, nutrient cycling, chemical regulation, thermal regulation	Groundwater and Surface Water Exchange	Monitoring wells	Robinson Fork Mitigation Bank, Quaker Mitigation Bank
	Geomorphology	Surface water storage, flow variation, sediment continuity, create and maintain habitat	Lateral Migration	Bank Erodibility Hazard Index (BEHI)	Upper Susquehanna River Mitigation Bank-Phase 2, Codorus Creek Stream & Wetland Bank
	Physicochemical	Surface water storage, sub/surface transfer, flow variation, thermal regulation,	Temperature	Surface or mean water temperature through water column- DM, MWAT, monthly average (summer or winter)	Great Pee Dee Mitigation Bank, Upper Susquehanna River Mitigation Bank-Phase 2, Pollock et al. 2003

Adaptive Management-Example

	Expected/designed Endpoint	Alternative Endpoints	
		Acceptable Endpoints	Unacceptable endpoints
Extensive Lateral and Vertical Connectivity– Vegetation	**Wet meadow:** Performance standards include aerial dominance by herbaceous species and presence of hydrophytic vegetation, with limits on invasive species coverage. If floodplain is inundated (i.e., regular overtopping flows) for extended periods during monitoring, percent coverage by herbaceous species may be reduced.	**Riparian forested wetlands:** Performance standards include hydrophytic vegetation and typical tree metrics (e.g., minimum woody stems per acre, species diversity and composition, growth or size and nonnative species limits). Wetland species are represented.	**Upland community:** Community is dominated by upland species. Hydrophytic and wetland species are not present or are minimally represented, indicating that the site is not connected vertically.

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- https://restorestreams.org/2023_workshop_6

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