The Future of Dams: Collaborations with Small Unmanned Aerial System Imagery to Improve Dam Decision-making

Alexandra D. Evans and Dr. Kevin Gardner, Department of Civil and Environmental Engineering, University of New Hampshire

The Future of Dams Project

The Future of Dams (FoD) Project is an interdisciplinary project that aims to improve the scientific basis for decision-making regarding dams. This work highlights how unmanned aerial system (UAS) research on dam removal informs and ties into other aspects of the project.

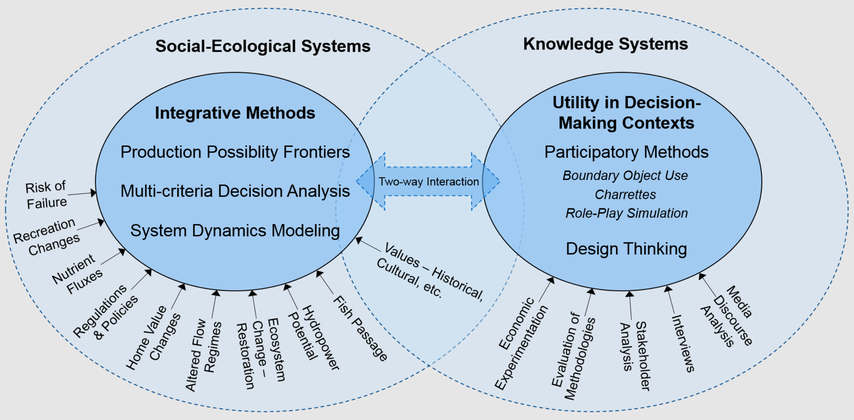


Diagram Credit: Rita Belair & Kevin Gardner, UNH

Ecological Stream Assessment

Aspects from two approaches to ecological stream assessment are being adapted to UAS methods:

- The Stream Visual Assessment Protocol Version 2 (SVAP2) is a rapid visual assessment to determine the ecological condition of streams. The United States Army Corps of Engineers (USACE) is interested in this method to allocate compensatory mitigation credits for restoration projects.
- The Gulf of Maine Stream Barrier Removal Monitoring Guide is widely-used in New England. FoD collaborators in Rhode Island are using this method to study construction of a natural fish ladder and a past dam removal site.
- Tables 1 and 2 depict the different monitoring elements included in each assessment approach.

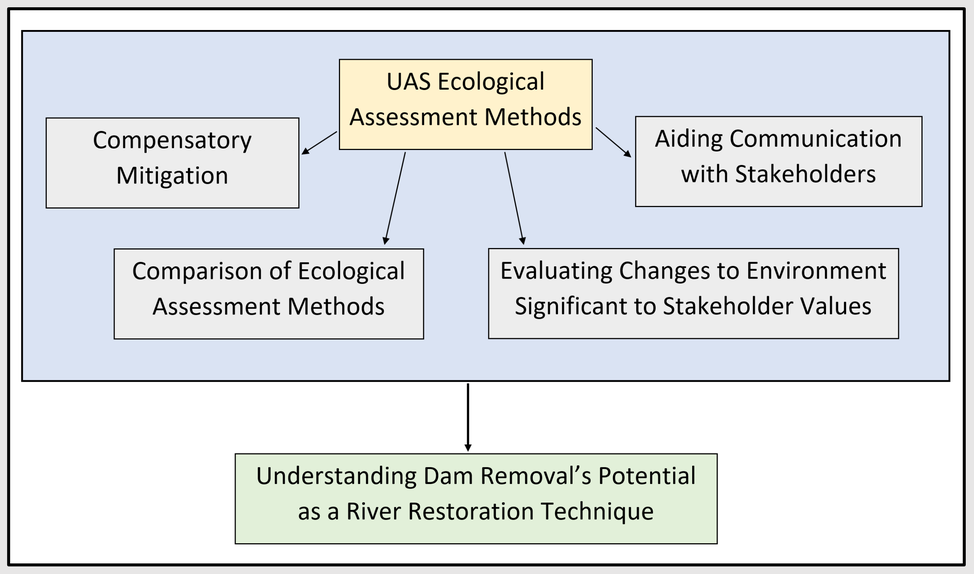
1. Stream Visual Assessment Protocol Version 2 Scoring Elements

Channel Condition	Riparian Area Quality	Manure or Human Waste	Aquatic Invertebrate Habitat
Hydrologic Alteration	Canopy Cover	Pools	Aquatic Invertebrate Community
Bank Condition	Water Appearance	Barriers to Movement	Riffle Embeddedness
Riparian Area Quantity	Nutrient Enrichment	Fish Habitat Complexity	Salinity

2. Stream Barrier Removal Monitoring Guide Elements

Monumented Cross-sections	Grain Size Distribution	Photo Stations	Macroinvertebrates
Longitudinal Profile	Water Quality	Riparian Plant Community Structure	Fish Passage Assessment

UAS Collaborations Across the FoD Team



Past dam removal site in RI. Collaborations will compare UAS vs. boots-on-ground assessments and evaluate the benefits and tradeoffs with each approach. UAS imagery may effectively illustrate expected removal outcomes to stakeholders.

Stitched aerial imagery of the Sawyer Mill upper dam in Dover, NH to be removed in summer 2018. Collaborations with measurements of ecological changes will help assess resulting impacts to ecosystem services.

Summary

- UAS methods will enable the measurement of ecological changes to aquatic ecosystems, which is critical to understanding dam removal as a river restoration technique.
- Collaborations across disciplines enable the FoD project to produce integrative knowledge to better understand the social-ecological systems surrounding dam management decisions.

The Lower Dam at Sawyer Mill Apartments in Dover, NH. Dam to be removed in summer 2018.

Acknowledgements

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References

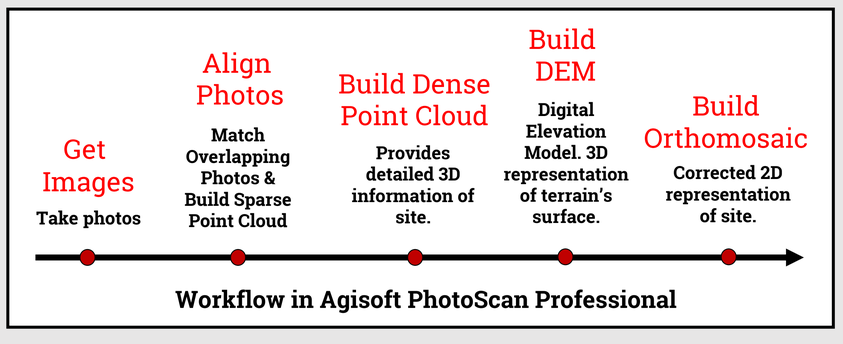
- United States Department of Agriculture. (2009). Part 614: Stream Visual Assessment Protocol Version 2. National Biology Handbook Subpart B – Conservation Planning.
- Collins, M., Lucey, K., Lambert, B., Kachmar, J., Turek, J., Hutchins, E., Purinton, T., & Neils, D. (2007). Stream Barrier Removal Monitoring Guide. Gulf of Maine Council on the Marine Environment.

General UAS Workflow

- A DJI Phantom 3 Professional is used to collect imagery.

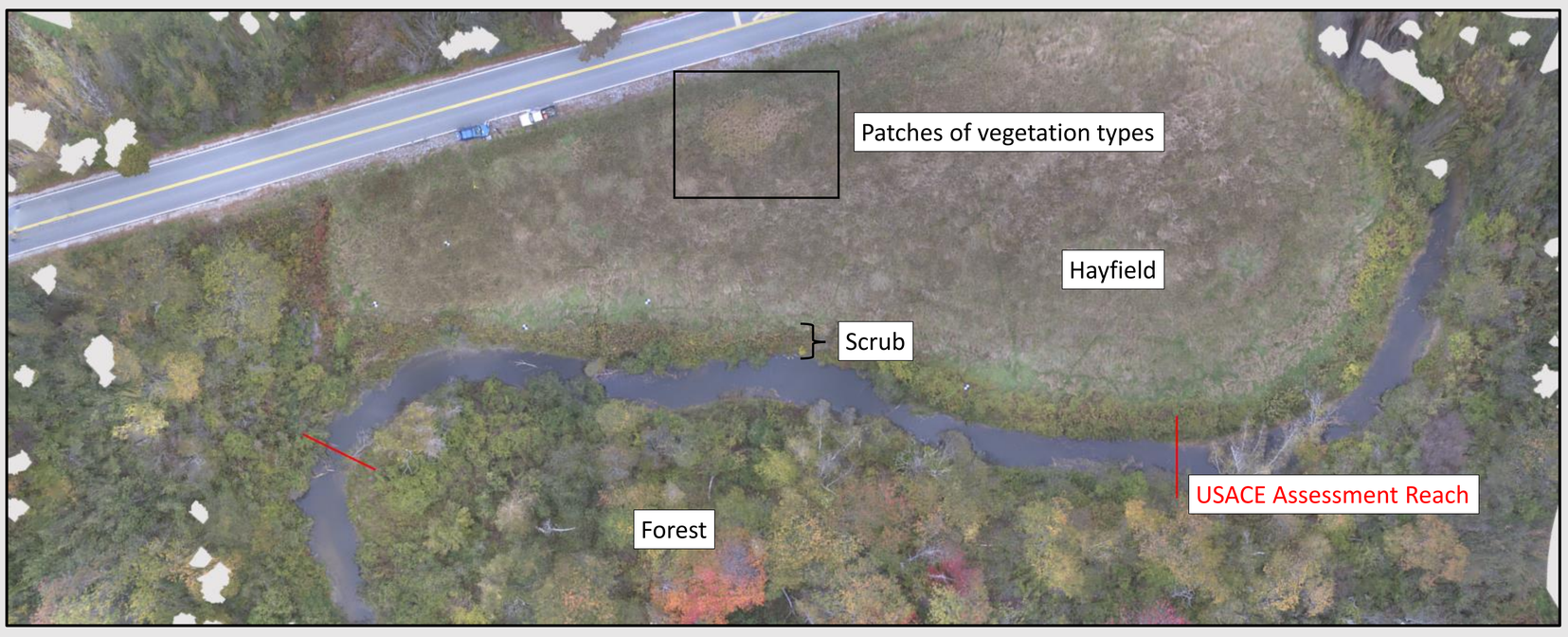
Photo Credit: Scott Greenwood, UNH

- Images are processed in Agisoft PhotoScan Professional to produce dense point clouds, DEMs, and orthomosaics.



- These products can be evaluated in GIS to quantify ecologically-significant parameters, such as river channel topography and riparian vegetation diversity.

Example UAS Orthomosaic: USACE Site in Falmouth, ME



- Orthomosaic created of a USACE site in Falmouth, ME on the East Branch Piscataqua River. UAS methods will provide a detailed and objective technique for scoring ecological elements. This will provide quantifiable metrics for ecological assessment and help to accurately allocate credits for restoration projects.
- Created from 131 photos taken at 120 feet above ground level on October 16, 2017. Orthomosaic pixel size is 1.51 cm. Ground control points (black and white squares) provide sense of scale and points to survey for georeferencing imagery in post-processing steps.