Future Vegetation Management "Observatories": The Value of Industry / Academic Partnerships in Understanding Ecological Impacts of Rights-of-Way Vegetation Management and Engaging Students of All Disciplines in Practical Environmental Issues

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ABSTRACT

The longest continuous study of the effects of right-of-way (ROW) vegetation management on local ecosystems began on Pennsylvania State Game Lands (SGL33) in 1953 [e.g., Aurora Consulting, 2013; Bramble and Byrnes, 1983; Holt and Orr]. More recently (since 2015), an industry/university collaboration has begun to establish similar long-term vegetation management "observatories" in substantially different environments in the western United States. In general, the findings from the eastern and western sites seem to support the idea that modifying the habitat can be beneficial (or at least not harmful) for certain wildlife and pollinator species. ROW study funds have also been combined with other sources of funding to begin new studies on the ROW sites, involving "non-traditional" disciplines such as computer science and engineering.

With the increased membership in the UAA, and the establishment of the TREE Fund Research Endowment, the industry has some choices to make about ROW research into the future. This panel (author list above) will spend a few minutes each summarizing their individual thoughts on ROW research and future directions, and then open the floor to audience discussion. We hope explore "next steps" with the help of audience participation, particularly focusing on: improving student outreach, expanding research opportunities, increasing community awareness, and leveraging industry associations to help recruit trained students into industry careers.

INTRODUCTION

The longest continuous study of the effects of right-of-way (ROW) vegetation management on local ecosystems began on Pennsylvania State Game Lands in 1953 [e.g., Aurora Consulting, 2013; Bramble and Byrnes, 1983; Holt and Orr]. Although the initial proposal was to study the efficacy of herbicides in vegetation management, the study has grown over the years to include effects on wildlife, pollinator utilization, and other

variables. The ROW habitat created through large tracts of forest appears to support increased abundance of small mammals, birds, and pollinators [e.g., Bramble, et. al., 1992; Bramble, et. al., 1997; Bramble, et. al., 1999; Forrester, et. al., 2005; Yahner, et. al., 2002; Yahner, et. al., 2003; Yahner, 2004]. Similar studies have been conducted at a companion site, Green Lane Research and Demonstration Area (GLR&D), in southeastern Pennsylvania since 1987. Researchers at Pennsylvania State University continue the studies today, providing invaluable insights for understanding the response of plants and animals to vegetation management on rights-of-way.

Utility companies across the country have used results from these ongoing studies to develop best practices, provide information on impacts, permitting, etc. However, many professionals have questioned whether the results are applicable to other areas of the United States. Especially questionable is the application of results to California ecosystems, with its much drier and more variable Mediterranean climate, more diverse habitats, and high diversity of species. California is recognized globally as a biodiversity hotspot, one of 34 sites on earth that contain 60% of the plant and animal species.

To address this issue, in 2015 Sonoma State and PG&E began exploring the idea of establishing long-term research on the effects of ROW vegetation management in California. Initial studies were undertaken as part of the Nature!Tech Collaborative, which explores how LiDAR and other technologies can be used to enhance academic research into vegetation management practices. Studies included LiDAR-based biomass estimates, microclimate sensor development, wildlife movement, and pollinator use of the ROW at Sonoma State's Fairfield Osborn Preserve [Clark, 2016; Diaz and Halle, 2015; McGuire, 2016a, 2016b; McGuire and Farahmand, 2016; Romero and Clark, 2016; Wininger, 2016; Wininger and Rank, 2015; Zhong and Halle, 2015].

In the rest of this paper, we explore some of the key findings of the eastern and western research sites, and provide recommendations for continuing to expand the research into the future.

METHODS

METHODS: Eastern United States Sites

To test the environmental effects of ROW maintenance methods, six mechanical and herbicidal treatment sites (with replicates) were established. These treatments included: hand-cutting (control), mowing, mowing plus herbicide, stem-foliage spray, foliage spray, and low volume basal spray. In addition, the treatments were managed to include a 50-foot border zone. This approach to vegetation management typically produces a tree-resistant forb-shrub-grass cover type in the wire zone and a tall shrub cover type in the border zone. The treatment effects on vegetation and wildlife communities (via multiple surveys, live trapping, and vegetation inventories) were compared to each other and to the adjacent, mature, mixed deciduous forest.

In 2015, vegetation diversity on all treatments was examined in light of Lepidopteran host plant availability. Plant species documented on all treatments were compared to on-line databases (primarily the Museum of Natural History-London, United Kingdom) of host plants for Lepidopteran larva. All Lepidopteran species were then compared to appropriate range maps to create a master list of species that potentially use plants on the powerline ROWs within our study treatments.

METHODS: Western United States Sites

To test the various IVM treatment options, three sites were established in different ecosystems. The "low elevation" site is a mixture of grasslands and oaks, the "mid-elevation" site is a mixture of oaks, bay laurel, and grasslands, and the "high elevation" site is a mixed conifer forest. In contrast to the eastern sites, the treatment options have been broadly grouped as "mechanical" and "herbicide" treatments, as some of the sites are different enough that controlling the treatment more rigorously might have been a challenge. Each of the sites contains a "mechanical only" plot as well as a "mechanical plus herbicide" plot. The surrounding areas are also surveyed.

Vegetation in the plots is mapped annually. Pollinator surveys are conducted every two weeks from spring through the fall. In addition, recent funding from the TREEFund is used to provide small amounts of seed money to researchers from fields that do not normally study ROW issues (e.g., computer science professors, engineering professors, etc.).

RESULTS

RESULTS: Eastern United States Sites

Over the past 60+ years of research, our study has found that deer, small mammals, birds, reptiles, and even butterflies – considered a true test of environmental impact – were using the early successional habitat created and maintained by vegetation clearing [Bramble et al. 1997, Yahner et al. 2002, Yahner et al. 2007, Yahner 2004, 2012]. In particular, early successional communities of native birds were thriving in the ROWs [Yahner et al. 2002]. These early successional bird communities are declining throughout the eastern United States and many species that reproduce in the ROW (e.g., eastern towhee, field sparrow) are on the Audubon society's conservation watchlist [Yahner et al. 2004]. In addition, we noted American woodcock persisting and breeding on our treatment plots. American woodcock is a gamebird that is in dramatic decline throughout the eastern United States [NRCS 2007].

The inclusion of a border zone method of managing the ROW at SGL 33 appears to increase the use of powerline rights-of-ways by salamanders. Several studies have indicated the forest fragmenting features like roads, ski-slopes, and rights-of-ways impeded movement of forest salamanders [Lannoo 2005]. In our treatment plots red-backed and spotted salamander were both observed using the border zone habitat—thus minimizing the fragmenting effects of the ROW.

In 2015, we documented 35 species of plants in our late spring inventory of vegetation at SGL 33. These plant species potentially support the larval stage of 245 species of native Lepidopterans (butterflies and moths). Species of plants compatible with ROW management (e.g., non-trees) support over 50% of these potential species. In particular, goldenrod, Virginia creeper, dogbane, witch hazel, bracken fern, and blueberry support a variety of sphinx, tiger, and io moth species. Butterflies such as gray hairstreak, striped hairstreak, field crescent, and spicebush swallowtail all depend on host plant species that are compatible with ROW maintenance.

RESULTS: Western United States Sites

The western sites have only recently been established, so long-term trends are still being observed. The longest observed western site (which is treated as a full IVM site, including both mechanical trimming and herbicide application) has been observed for three years. In general, pollinators utilize the managed ROW more than the surrounding areas. However, native bees have a slight preference for the nearby unmanaged area. This contrasts with a site previously studied by PG&E along the American River, where native bees overwhelmingly preferred the ROW. This difference is really due to the surrounding ecosystem and the differing management goals. Along the American River, the ROW was cleared of invasive plants; the remaining ROW flowering plants appealed more to the native bees than honeybees.

Fire clearly plays a big part in western ecosystems. One of our sites (Eldorado National Forest) was chosen because it burned in October 2014. Another site (Pepperwood) burned in October 2017. Although the fire was not very hot and moved through the area quickly, the brush piles left at Pepperwood to create habitat acted as a kiln, and baked the ground underneath. The site was covered with tall grass by the time vegetation surveys were done again in May 2018, although the species were different from the previous year. Comparing the fire affected sites of Pepperwood and Eldorado as they are managed into the future will continue to be a focus of the study.

Perhaps some of the most exciting aspects of the western studies have been the projects that were funded using small amounts of seed money. The seed money is used to encourage “non-traditional” ROW research by helping to fund equipment and publications costs. Two of the projects that have been started with this seed funding are: (1) low-cost, networked microclimate stations, and (2) the development of a computer algorithm to automatically screen “false alarms” from wildlife camera images. The microclimate stations were originally developed as part of a graduate thesis [McGuire, 2016a, 2016b; McGuire and Farahmand, 2016], and are of interest to local winegrowers. The new computer algorithm began as a simple undergraduate guided class project, and provides an effective way to reduce the manual screening time for wildlife camera images, particularly those images where the camera motion sensors are triggered by moving vegetation and cloud shadows [Halle, et. al., 2018].

INTO THE FUTURE

As demonstrated above, both the eastern and western research sites are contributing to the understanding of the impact of vegetation management on local ecosystems. In general, the findings support the idea that modifying the habitat can be beneficial for wildlife and pollinators, depending on the species and the environment. The investigators studying the long-established eastern sites and the newer western sites perform public outreach, train student interns, create collaboration among academic departments, and try and leverage other funds to expand the research interest in ROW issues.

Because of time and geographic constraints, however, these study sites seem to exist largely in isolation. The investigators generally only exchange information on research methods and best practices occasionally, at conferences such as ROW 12. In addition, there are multiple sites throughout the United States (and the world) that could benefit from an exchange of ideas on a more regular basis. Finally, with an increase in the number of students being trained on ROW issues, it is worth discussing methods to more effectively recruit the students into industry careers.

To help foster community conversation in these topics, this presentation will be in a panel format. Each panelist will take a few minutes to provide an overview of his/her interest and expertise in ROW issues, and then questions and comments will be actively encouraged from the audience. (For a list of panelists, please refer to the author biographies of this conference proceeding.)

The following general list of topics is provided in the hope of stimulating interesting questions and audience feedback:

- *Industry Internships:* Student interns that pass through these programs have valuable experience and often get offered research positions at other institutions or agencies. Industry partners could also benefit from these programs by making an effort to place recently graduated interns into appropriate positions within their respective companies. Formal internships that combine ROW research with industry needs would also benefit both the interns and the industry.

- *Effective Interaction with Industry Associations:* The UAA is an effective association for providing "two-way" feedback – investigators often receive good advice from UAA members after presentations, and the industry partners are updated on the latest research findings. The TREE Fund also encourages public presentation of research results, and actively funds new studies in IVM. Is there a way to more effectively utilize the fundraising and outreach capabilities of the UAA and the TREE Fund?

- *Academic Outreach:* Increased effort to involve faculty and students of all disciplines would help to expand and strengthen the breadth of research on ROWs. Small seed grants to encourage "non-traditional" research on ROW issues is certainly one effective technique. In addition, encouraging faculty to require their

students to become members of professional organizations such as the UAA would help to highlight the value of real-world experience to the student population.

- *Increased Collaboration:* Regularly planned "working conferences" to allow researchers from different sites to gather, synthesize results, and plan next steps would help to strengthen the ROW results and lead to better understanding across a wide range of ecosystems. One way to achieve this is to set up the network of sites across the United States (and possibly worldwide) as a giant networked "field station". The spatial footprint of such a large collection of sites would open up the networked "field station" to studies of large-scale issues such as climate change, while the individual sites would still be able to pursue investigation into local ecosystem effects of vegetation management. In addition, collecting all of the observations from such a "field station" in a central location would allow researchers from many locations to become involved in ongoing ROW studies.

CONCLUSIONS

As previously mentioned, valuable insights continue to be gained in ROW issues by the established network of sites in the eastern United States, and the newly established sites in the western United States. This discussion panel will be about grappling with next steps. Can the management of the separated research sites be improved? Should the industry and academic community continue with the model of funding separate research sites, or can we improve on that model?

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AUTHOR PROFILES

Chris Halle, PhD has worked with earth observing systems for over 30 years, including managing and leading cross-disciplinary research teams to address complex large-scale projects for industry. His areas of expertise include environmental observation and sampling, data quality control, algorithm development, and data synthesis and presentation. As the Center for Environmental Inquiry Nature!Tech Program Lead, he creates industry/academic research collaborations on environmental and technology projects. He assists faculty in scoping and developing projects suitable for classroom instruction, and supervises students undertaking long-term monitoring projects on CEI lands. He is particularly interested in turning spatially separated stations into true research networks, and has previously performed such feasibility studies for the National Marine Sanctuaries.

Carolyn Mahan, PhD is a professor of biology and environmental studies and co-chair of the Environmental Studies program at Penn State Altoona. Her research interests include the study of biodiversity in threatened ecosystems, the effects of human-modified landscapes on wildlife, and the behavioral ecology of squirrels. Her work has been published in a variety of scientific journals including *Environmental Management*, *Global Change Biology*,*Conservation Biology*, and *Journal of Wildlife Diseases.* Dr. Mahan has served on the board of directors of the Pennsylvania Wildlife Society and The ClearWater Conservancy and she is past-president of the Pennsylvania Biological Survey.

David Krause is a vegetation management specialist for Asplundh. In addition to his B.S. degree in Wildlife Biology, he has been involved with rights-or-way vegetation management for 41 years. His professional affiliations include ISA, Mountain Lake Vegetation Management Council, WV Vegetation Management Association, National Roadside Vegetation Management Association, Responsible Industry for a Sound Environment and is a certified pesticide applicator. He also was recipient of the Utility Arborist Association *Education Award* in 2009 for industry leadership in providing training in stewardship and Best Management Practices.