**Exploring Heterogeneity in the Ecology, Restoration & Management of Longleaf Groundcover**

**Executive Summary from the workshop held on October 21, 2014**

April 1, 2015

To Whom it May Concern:

Our workshop brought together 37 participants to discuss the current state of science and management of high-diversity groundcover plant communities in the longleaf pine ecosystem. Participants represented a broad range of backgrounds and interests related to longleaf ecosystems and the groundcover in particular, including land-managers, restoration professionals and academic ecologists.

The workshop helped clarify and expose principles on which these stakeholders found broad agreement. For example, frequent fire is a key ecological and evolutionary process in longleaf ecosystems and is critical as a restoration and management tool. There was also broad agreement that management / restoration, basic science, and policy pertaining to this ecosystem should be further integrated.

In that spirit, the workshop helped identify additional scope for improvement. We need to better and more fully develop the concept and practice of restoration. Much restoration is being done in a "data vacuum" (owing to case-specific deficits in funding, time, expertise, and the lack of a unifying conceptual framework to guide efforts). Useful improvements would be to implement better assessment, monitoring, and information sharing. These advances would require development of both better tools (*e.g.*, assessment criteria, critically evaluated case studies, *etc*.) and infrastructure (*e.g.*, a monitoring network, web-based resources, *etc*.).

Finally, the group broadly recognized the need for landowners and managers at all scales to focus more attention on the groundcover. An end goal of having continuous fuels to carry surface fires is insufficient; true restoration must consider species composition, species diversity, critical component species (including threatened or endangered species, keystone species, *etc*.), and physical aspects such as dominant bunchgrass patterning related to population, community, and ecosystem viability. This broadened focus could be promoted and incentivized by means similar to those currently employed to increase acreage of well-managed longleaf pine populations.

Sincerely,

Kyle E. Harms, Professor, Louisiana State University
Paul R. Gagnon, Assistant Professor, Murray State University
Jonathan A. Myers, Assistant Professor, Washington University
Carol Denhof, The Longleaf Alliance

# Exploring Heterogeneity in the Ecology, Restoration & Management of Longleaf Groundcover

**A workshop convened by Paul Gagnon, Kyle Harms & Jonathan Myers**
**Discussion facilitated by Chris Adams**

**October 21, 2014**
(first day of the 10th biennial Longleaf Alliance Conference)

**Mobile, AL**

## Introduction to the Workshop

"*Broader implementation of prescribed burning and strategic management of wildfires in fire-dependent ecosystems will require improved integration of science, policy, and management, and greater societal acceptance through education and public involvement in land-management issues.*"
K. C. Ryan, E. E. Knapp & J. M. Varner (2013)
*Frontiers in Ecology & the Environment* – doi:10.1890/120329

The goal of our workshop was to bring together a diverse mix of ecologists, restoration professionals, and managers to discuss and identify the existing knowledge, key assumptions, and unanswered questions related to the high biodiversity and heterogeneity of longleaf pine plant communities. Our workshop was meant to be broad in scope – including ecology, restoration, and management, as well as the links among them – while remaining focused where the majority of the diversity occurs in these unique ecosystems, *i.e.*, the groundcover.

The workshop comprised small-group and large-group discussions to organize our collective thoughts and questions. Participants had opportunities to better develop communication across the network of longleaf groundcover practitioners (researchers, decision-makers, *etc*.).

Discussion topics included questions and concerns proposed via e-mail by participants prior to the workshop (see Appendix 1), as well as questions and concerns that arose during the workshop itself. In addition, we collectively identified key unanswered questions concerning longleaf groundcover and began charting courses towards bridging gaps between research and management, and towards future, more targeted actions to promote the appreciation and management of these extraordinary ecosystems.

Assessments of the efficacy of the workshop are provided in Appendices 2 and 3.

## Acknowledgements

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## Workshop notes

Compiled by: Chris Adams; Amanda Briant; Paul Gagnon; Cory Groover; Kyle Harms; Katherine Hovanes; Christina Mahmood; Jonathan Myers; Whitney Wallett

Disclaimer: The notes below accurately reflect thoughts and opinions that were shared by individual participants, either in small-group or large-group discussions. Accordingly, each individual thought or opinion may reflect the perspective of one single individual, whereas in other cases the thought or opinion reflects the general perspective of many of the participants. It was beyond our capability to gauge and record the collective degree of agreement or disagreement on each shared thought or opinion. Even so, we provide an Executive Summary at the beginning of this document as a synthesis of the overall discussion and recommendations.

### *Introduction – 8:00 a.m.*

- Kyle Harms gave an introduction and overview of the day's plan.

- The introduction to the workshop included reference to a new publication by Reed Noss *et al*. (2014, "How global biodiversity hotspots may go unrecognized: lessons from the North American Coastal Plain", *Diversity & Distributions* – doi:10.1111/ddi.12278). Noss and colleagues highlight the special character of longleaf groundcover. Native remnant, well-managed, or restored longleaf groundcover plant communities harbor among the highest levels of diversity and endemism in all of North America.

- It was noted that even though the individual reasons differed that motivated participation by the various participants assembled for the workshop, we were united by an intense interest in and passion for these high-diversity, longleaf pine communities.

- Facilitator Chris Adams noted that an important outcome for him as facilitator would be improved communication among the participants, which included understanding one-another's perspectives and was meant to extend far beyond and long after the workshop itself.

- Facilitator Chris Adams led the group through a "Who's in the Room?" exercise. Each participant introduced her/himself and gave a very brief reason for being a stakeholder in longleaf groundcover research, management, or restoration. Participants were then asked to assemble into a series of sub-groups in which each participant self-identified her/himself into one of two categories:

    - Working in longleaf ecosystems > 10 yr vs. < 10 yr
    - Live > 10 min drive from longleaf ecosystem vs. < 10 min drive
    - Can identify > 50/75/100 species by sight vs. fewer
    - Growing longleaf groundcover / understory species at home vs. not
    - Carried a drip torch/set fire to longleaf habitat vs. not

… and also along a continuum:

- Place yourself/work/effort on the spectrum of:
  management/restoration ←→ basic science/research

***Whole-Group Discussion of Expectations – 8:30 a.m.***

- Early during the workshop some anxiety was expressed about what would be accomplished during the workshop and what new ground would be covered. Even so, it was recognized that covering bases that have been covered in past meetings can provide "continuity" – especially for new participants. In addition, it was agreed upon fairly early in the session that products beyond the workshop itself should be goals to which we should aspire, especially as sub-groups in follow-up workshops, meetings, informal gatherings, and activities to develop and influence practices and policies.

- Some participants were involved in a similar meeting in ~2008 (*i.e.*, "America's Longleaf Charrette") and were "frustrated that we're still in the same place with these conversations." One participant saw two possible ways to move forward: 1) by bringing in new faces to this conversation; and 2) by addressing new/modern challenges like climate change.

- Rigorous monitoring is needed to inform how much longleaf habitat we are losing and so as to inform adaptive management for conservation/restoration of longleaf pine groundcover. Are agency folks satisfied with current management? There are "no data" to inform this question.

- We need to define "restoration," but can it be done with blanket terminology and common language?

- We need a restoration infrastructure, and we need to define "infrastructure."

- As Bob Mitchell used to say, "better is better" with respect to restoration; there are many levels of restoration.

- How can we translate "David Printiss' TNC" model of quick, effective restoration to the broad scale?

- Perhaps the biggest challenge on the research side is how to do the basic research given the extreme difficulty of the current funding environment.

- Major goals from now on should be in finding answers, not just in compiling the questions; perhaps best accomplished in smaller, more focused groups, *e.g.*, specific topic working groups.

***Session One – 9:00 a.m. – Small-Group followed by Whole-Group Discussion***

***How do we bridge the gap between Management / Restoration and Basic Science?***

- There is a degree of mismatch between research and the needs of managers – we need better communication.

- Sometimes an issue of mistrust exists between scientists and managers.

- Different stakeholders often have very different views and may not want to share or compromise.

- Sometimes there is frustration in the communication between scientists and managers; sometimes the science goes unheeded by managers; sometimes the needs of managers remain hidden from, misunderstood by, or actively ignored by scientists.

- We need two-way communication, requiring input from managers to guide science questions and a way to translate science to managers (*i.e.*, synthesis), in terms of both language and relevance.

- How can we improve communication across the network of engaged scientists and practitioners?

- Systemic problem of distrust between managers, agencies, *etc*. & scientists; scientists don't know how things "actually" work, whereas people on the ground don't listen to the suggestions or advice from researchers; how do we facilitate understanding or communication between these two groups?

- A disconnect exists between scientific theory and its application (*e.g.*, the research that identifies questions or answers in pristine longleaf doesn't set realistic goals or provide applicable answers for managers working in degraded, current conditions).

- Science identifies broad patterns, whereas management requires specific answers.

- Where to obtain the funding to dispense the information gained from research at a relevant time and spatial scale?

- Need exists for efforts to consolidate scientific information and to place this information into a modeling framework for management use.

- Agency elimination of positions and consolidation of position responsibilities means that the connection or translation of information from science to management is lost.

- Need to connect research conducted to the current conditions or management objectives that people on the ground are encountering – connect management to science by using research to give people on the ground the information they need to meet their objectives.

- Scientist–Management communications have to provide measurable, achievable goals, milestones, *etc*. to encourage and inform involvement.

- A framework for communication could list: (1) the key questions; (2) answers to each; (3) the degree of confidence in each of those answers; and (4) the degree of predictability generated by those answers (*e.g.*, when translating science into policy or management prescription, how much confidence does one have in the predictability?). [For a model that illustrates how to communicate consensus statements, emerging trends, and the uncertainty ("balance of evidence") for each see: B. J. Cardinale *et al*. (2012, "Biodiversity loss and its impact on humanity," Nature 486:59-67 – doi:10.1038/nature11148).]

- A good start to bridging the gap would be a region-wide website.

- Public land management goals do not always equal or result in groundcover diversity; but it could be possible to maintain groundcover under these current goals, perhaps through better communication of groundcover needs, restoration/maintenance methods, *etc*.

- Advertise grad research in order to get larger picture studies/data.

- The transition from academia to applied work is tough for students with degrees – could be made more integrated in degree programs.

- Gaps of science/knowledge makes predictability and conveying info difficult.

- Social, political, economic hurdles exist in science-management communication.

- Dwindling habitat makes collaboration especially important.

- It is important to merge science, management experience, and available data into guidelines for Best Management Practices.

- Iterative and integrated relationship / communication between scientists and managers is a key to success.

- Bridge gaps via tech transfer.

- Researchers often deem sites as good if there is good flexibility for them to work there.

- A bias towards research in areas with more flexible management may bias results of research.

- What is restoration? How do we define it? It is heterogeneous! The restoration package should include how to define reference conditions and how to get there.

- Bob Mitchell used to say, “better is better” with respect to restoration, but how do we define “minimum”, “moderate”, and “maximum” restoration?

- What does “minimally restored” mean?

- Restoration has degrees; does any improvement qualify as restoration?

- What is required to establish baseline conditions (to know where we are and what we are aiming at in restoration)?

- It is an exciting time for conservation, in part since we are “no longer doing conservation on a gardening scale.” Even so, what mechanisms are needed to take what works to broader scales?

- A management hierarchy could begin with: What do we have to have? Then, what additional activities could take the site further towards the restoration/recovery target or move it further along the trajectory towards conditions in a reference site.

- Managers don’t always know why a restoration project is not working (*e.g.*, planting seeds, but they won’t germinate or establish).

- Basic science is a potential starting point, but we don’t yet understand all the basic science for longleaf ecosystems!

- Do we understand the evolutionary role of fire? Just burning may not be enough.

- How do the region’s endemic species respond to management prescriptions?

- We may need an evolutionary model first with basic science understanding - focusing on what we can save vs. trying to restore the un-restorable.

- Keep evolutionary context to preserve biodiversity - need to know something about evolutionary relationships, perhaps by looking at genetics/genomics.

- Need for more information on basic population genetics for many many species.

- Challenges of restoring with taxa that grow robustly in certain regions and what other desirable/undesirable species that are capable of moving in.

- Every restoration project should be part of a research project.

- Is every process or framework of restoration trial and error?

- Choose some key restoration successes (and possibly some failures) for intensive study to figure out the mechanistic details of what worked and didn’t. These could be

written up as a set of Case Studies to serve as guides to restoration professionals and land managers. For example, at Apalachicola Bluffs & Ravines, some science was done early on, but now they are in the operating phase to implement restoration. Limited resources mean that monitoring and research are limited. Even so, there are opportunities for relatively rapid research results, since the operating procedures now allow a 40-month time frame to turn sand pine stand to wiregrass ecosystem that carries fire.

- Transferring understanding of one site to many requires recognizing that uncertainty circumscribes both true uncertainty ("known unknowns" & "unknown unknowns") and a component that is contingency (*i.e.*, site-specific processes); avoid over-extension.

- Need more consideration of landscape-scale questions (connectivity, fragmentation, *etc*.) What data are needed? How do we convey the need for data, questions, or answers to managers?

- Identify reasons for lack of consensus; in some cases we don't know the answer, but in other cases variability exists across the broad range of systems and conditions, so the answer is context-dependent.

- Communicating contingencies is regionally subjective, *e.g.*, starting groundcover restoration with wiregrass or little bluestem, depending on which is more dominant.

- Define/quantify hierarchy of management needs, activities, priorities.

- What are the important groundcover questions to answer?

- There is a need to identify key questions in this field and where consensus already lies.

- Spread research effort across different sites and environments.

- How to identify quality spots to restore?

- How to avoid "eco-mythology" (*i.e.*, the adoption of rules of thumb, best guesses, or recommendations on current best-available data) when understanding is dynamic and as we learn more might overturn pre-existing or pre-conceived notions?

- Does competitive exclusion occur in the understory? The extent to which seed addition makes a difference in restoration depends on the extent to which competitive exclusion occurs.

- Does groundcover require disturbance? Quail managers assume that it does, which motivates mechanical groundcover disturbance practices by quail managers.

- There is a need to increase public awareness about the longleaf ecosystem to facilitate funding and success; getting managers and landowners interested in ground cover is a priority.

- How do we translate science and management reports into documents or other resources that are easily accessible to the general public? (Increased scope for Longleaf Alliance? Websites? Blogs? Extension and outreach to schools?)

- Often not enough time or funding within grants, research projects, *etc*. to include the outreach activities or efforts necessary to communicate the findings or importance.

- Consider the rest of biome beyond plants, as well.

- There is a need for seed resources for research and for restoration.

- How to develop market for seeds? Funding? Matching funds in the form of seed donations? Look to possibilities from Monarch Butterfly project and its funding.

- What are the best strategies for identifying and dealing with ecotypic variation, especially for restoration?

- How can researchers have access to seed stocks and information on good species for restoration?

- There is more research on wiregrass vs bluestems and this could possibly be due to ease of research/accessibility.

- There is a need for more research on bluestem-dominated sites.

- Asking managers what their questions are before designing basic research. Stay in touch with land managers throughout the process.

- Useful would be answers to questions about particular species that have important implications for management success. Problems getting particular species to germinate for unknown reasons. Defining restoration in terms of minimal/moderate/maximal restoration. What are the functional groups necessary for success?

- How to disseminate basic research to managers who need it? *E.g.*, Southern Fire Exchange (SFE) fact sheets. Deciding who will do the work of synthesizing basic findings so managers/practitioners can digest and understand?

- There is a genuine need for extension agents focused on longleaf pine groundcover. Current extension agents are focused on trees or other components.

- We need intermediaries to work between science and management – folks who understand the findings of science and needs of managers.

- We should be working with horticulturalists for groundcover restoration.

- What is “minimally restore?” Which animals? What group of animals must go in with the plants to effectively restore?

- To restore, first priority is the structural vegetation and fire regime.

- We need workshops for land managers, luncheons and the like.

***Morning Break – 9:45 a.m.***

Participants voted during the break on the “most important questions regarding diverse groundcover.” Questions were e-mailed to the organizers prior to the workshop (see Appendix 1). These were listed on large sheets of paper. Each participant placed stickers next to her/his preferred topics. (See topics in Sessions Three, Four, and Five.)

***Session Two – 10:00 a.m. – Small-Group followed by Whole-Group Discussion***

***What are the most significant barriers to establish & maintain diverse understory, from a management focus?***

- Issue #1 is funding!

- There is no “one size fits all” for restoration; take, for example, sandhills vs. flatwoods.

- There is a strong need for evaluation of restoration progress – community structure and ecosystem function (*e.g.*, fire) are important targets, but species composition and diversity also need to be more of a priority than they are currently.

- It is important to recognize what components of groundcover you already have on site (education).

- Defining timeframe for restoration, reasonable time for dispersal.

- Prolonging efforts is a barrier in itself.

- Policies and modeling. Models to follow? Example policies?

- Seed sources, growing and harvesting seeds.

- Paying attention to genetics and seed varieties from outside areas.

- Compatibility between species from various geographic areas (in mixed plantings).

- Sourcing locally and related challenges genetically.

- Uncertain importance or knowledge of genetic differences within a species.

- Can we do passive restoration and leave out expensive seeding process?

- Impacts of climate change.

- For uplands (*e.g.*, xeric sandhills) we "have it down."

- For controlling shrub layer it is more difficult, *e.g.*, in mesic flatwoods.

- For some types of sites we have no idea how to restore them (this is a "known unknown"). This provides a key role and opportunity for controlled experiments.

- One of the many million-dollar questions: How to get off-site pines (*e.g.*, pine plantation pines) out?

- How do we translate what a site is to a series of prescriptive steps to get to where the site needs to go?

- We are always operating within constraints: social, policy, infrastructure, time (*e.g.*, sometimes a manager or land owner needs an answer now, not when the research results would come in at some later time), lack of knowledge, resources, *etc*.

- Funding is an ever-present constraint for conservation, management, and research. For example, long-term monitoring is difficult (impossible?) to fund under strict research culture. Perhaps fortunately, the pools from which some of these activities draw are separate (*i.e.*, federal science budget separate from federal management budget).

- To economize on a tight restoration budget might mean piggybacking with various/different restoration efforts.

- Direct relation between cost and level of diversity on a specific scale.

- Dynamism complicates restoration, *e.g.*, "dynamic reference"; climate change; *etc*.

- Simpler is often better for management "Rules of Thumb."

- "Passive management" can bring back a lot, *e.g.*, adding fire back to a fire-suppressed site adds back that key process, even if the effort stops short of adding seeds or other more active-management activities that would advance restoration or recovery even further.

- Lack of local seed sources.

- Lack of knowledge of how far away can a seed source come from and be okay for an area.

- Lack of knowledge of Natural History and usage of an area.

- Basic science communicated to restoration and management individuals - transferred into relevant and useful language for all parties involved.

- Is it possible to maintain groundcover and manage it with regards to other restoration and management overlap? Distress between scientists and managers re the transfer of ideas between the two.

- Identifying key questions in the field and moving beyond to how to address those questions - are they broad, specific, useful to managers and/or scientists?

- Need to formulate bullet list of basic practices – *e.g.*, fire, then overstory and light saturation, *etc*. for varying ecosystems.

- A lot of science we don't know! Lack of predictability creates the challenges between science and management.

- Private vs. public land ownership.

- Communicating and teaching landowners what they have.

- Public education - people do not know what longleaf pine is.

- Maintaining groundcover after everything is in place – long-term plan for maintenance.

- What is fire's role - are we burning at the right times? Is there ever a "right" time? Can't imagine this ecosystem was built on planned burning!

- Incomplete knowledge of how the system works.

- People who can communicate with landowners and scientists.

- Speak everyone's language.

- Be able to be appealing to all groups in order to have the best outcome.

- Need to spread the word on the benefits of fire.

- Structure funding to include long-term monitoring.

- Make clear to layman why long-term monitoring is important.

- Is conservation (vs. restoration) occurring? Are we identifying what we already have or what remains at sites prior to management activities, or are we automatically assuming that restoration has to start from scratch? It's important to identify the areas that can be conserved and improved versus restored. Long-term monitoring might help with this.

- Reference site models are currently incomplete; need exists for a bigger set of reference sites.

- Issue exists with where the bulk of research has been conducted. Much is understood in pristine longleaf habitats and in the most degraded habitats, but less is understood about habitats and management of sites somewhere in the middle.

- Need for improved state and transition models.

- Huge lack of high diversity identified as a management priority – might be mitigated with increased education and a way to assign a value (monetary or otherwise) to high diversity in the ground cover.

- Lack of advocacy for maintaining high-diversity ground cover.

- Need for increased public education to increase interest in ground cover as a management priority.

- Need to identify ways to make ground cover important to land owners, agencies, land managers, *etc*. – economic value, ecological importance, *etc*.

- Latimore Smith mentioned recent restoration in Louisiana where TNC has spent ~$1500/acre to restore 20-30 species/acre. Source was Pollinator & Monarch money from a mitigation program. He (or Mark Fiely?) also suggested Virginia Working Landscapes with the Smithsonian Institute as a model using fund-raising from wealthy donors. He says there is a degree of clique-mentality, so if one person in a clique donates, oftentimes others will too. The challenge is in figuring out which levers to push so as to connect with them.

- Given the funding environment, it is necessary to successfully evaluate cost effectiveness of management techniques. Is sweeping seeds with a Flail-Vac the way to go? We need to be looking for less intensive ways to restore groundcover.

- We lack local ecotypes of seeds. We don't know how close must seed be sourced to be "local."

- What criteria can be developed for determining when is seed "local enough?"

- Where can that local seed be collected?

- There simply must be a market for the seed or restoration is impossible. If there is a market, then the seed can and will be found.

- It is critical to know site history and whether site history can even be overcome; if not, restoration efforts are futile or goals should be heavily modified. For example, in some areas of the Red Hills, folks want to restore longleaf pine, but if a given site was used for agriculture, oftentimes the sand cap is completely gone, rendering the whole restoration program effectively futile if longleaf pine is the goal.

- We need better information for all the different scenarios.

- Must make science applicable to managers – encourage out-of-the-box application of fire, identify common priorities across the ecosystem and achieve these priorities through strategies tailored to local conditions.

- Some landowners don't know how to get info they need, *e.g.*, help for burning their land.

- Suggested (for afternoon or for the next workshop) a time for sharing what all the different researchers are doing. This would be useful information for the managers, who often simply cannot know what the researchers are doing.

***Lunch – 11:30 a.m.***

***Session Three – 1:00 p.m. – Small-Group followed by Whole-Group Discussion***

***Top 3 questions (based on votes cast during morning break) for Basic Science / Research***

***- What are the effects of habitat loss / fragmentation on understory communities and how can these be mitigated with connectivity?***

- Fragmentation has influences on dispersal, fire characteristics, and hydrology.

- No matter our effort our land is fragmented as heck.

- Big bluestem and *Arundinaria* don't have much genetic diversity.
    Could this be because of highly fragmented land?
    Does clonality persist just due to habit?

- We need stepping stones to encourage connectivity.

- Landscape connectivity and fire should be the basis for modeling.

- Roadsides can act as corridor between habitats far apart - changing a lot in how managed. Harder to burn, less migration leads to negative effects in habitat fragmentation.

- How do we involve connectivity in management? We know that connectivity is important for migration, dispersal, gene flow, *etc*., but at what extent, by what methods, *etc*.?

- In terms of ground cover, the exchange of individuals, species, genes, *etc*. through connectivity may occur on such an extended time scale that adding connectivity to the current landscape is rendered ineffective or pointless.

- Fragmentation is all a matter of spatial and temporal scale; necessary to identify what scale is being discussed or managed.

- Longleaf communities are already naturally highly fragmented at a landscape scale (*e.g.*, fragmentation by creeks, streams, wetlands, *etc*.). In contrast, fire is often thought of as a historically homogeneous process in these systems, or at least active across a more or less homogenous historical landscape.

- Hydrology of a site may be an important way to achieve or increase connectivity in these systems. Changes in hydrology and hydroperiods may be one of the ways that climate change influences these systems in the future.

- Source-sink dynamics in longleaf; to what extent do we see small, insular communities vs. sink populations?

- Is it worth it or even possible to restore connectivity in fragmented areas where fire management can't be implemented (*e.g.*, areas where smoke management or proximity to human development prohibits fire)?

- Importance of corridors in fragmented sites. Roadsides have been important refugia and corridors in the past; now see mowing and herbiciding of roadsides that threaten these areas.

- Known effects of fragmentation – no emigration / immigration of species, difficulty in conducting burns, Allee effects, inbreeding depression, *etc*.

- Corridors are critical. For groundcover and small critters these include roadsides and powerlines; herbicides are a major risk here for loss of biodiversity. Do we need intensive mitigation of immigration / emigration in any given site? Private lawns and gardens, patch gardens are potential ways to help mitigate loss.

***- Which evolutionary mechanisms generate and maintain high diversity groundcover?***

- Need to figure out *how* plants evolved, *i.e.*, under what environmental conditions they evolved.

- We are using the wrong fire model (*i.e.*, the outdated idea that "fire resets succession"). We need to manage for vegetation-fire feedbacks that will help maintain groundcover.

- Need to shift the focus of fire from killing shrubs, controlling woody growth, or preventing succession to creating the conditions necessary to provide for future positive fire feedbacks (*i.e.*, use fire to generate the fuels necessary to achieve burning and management objectives in the future).

- Fire is the key to keep high diversity, but how does fire do it? Do not necessarily need to know, depending on management or restoration goals.

- Fire may be the key for allowing other relationships and mechanisms in these systems to be expressed.

- How much is diversity co-existing over the long term vs. co-occurring by chance? Are the communities present at equilibrium?

- A continuum exists from no dispersal of species to complete dispersal of all species; reality of what occurs in nature is somewhere in the middle. This middle is probably closer to isolation of communities vs. connection between due to small-scale changes in conditions (*e.g.*, water gradients, ridges, *etc*.).

- What is the combined effect of fire and competition on diversity? Need more studies on this.

- How does fire change flowering success & does this matter? What does this effect?

- All agree that fire is what maintains high diversity, but how? What mechanisms underlie that? Is it necessary to identify these mechanisms, or is it enough (for management) to know that fire is critical?

- How is fire functioning? Why is its role so different in somewhat similar systems (*e.g.*, tall grass prairies)? What processes underlie fire?

***- What threats do climate change, particularly from drought, pose to groundcover and how do we mitigate negative effects?***

- We do not know what's going to happen under climate change (it is unpredictable), so we should manage for uncertainty.

- It would be useful to identify and use "climate reliable" species mixes or genotypes.

- Focus on "climate-reliable species" – may improve predictability.

- Local seeds don't always work; sometimes perhaps because land use altered soils, so sometimes regional mix of seeds works best.

- Managing for uncertainty.

- Human / management limitation.

- Altered response to fire.

- Species and community changes due to drought.

- Species and community changes due to $CO_2$ increases.

- Examples of species and community changes: C3 and C4 grass shift; species of small stature do not thrive/fade out; competitor relationships change.

- Adjusting protected boundaries can provide more "success."

- Take small-scale study - input drought at start, 2 year, 5 year, 10 year, *etc*. of implemented recovery space.

- Focus energy where change occurs more rapidly and area is more diverse.

- Avian species might show change more rapidly in drought situation; reproductive activity might help gauge progression of local climate change.

- High productivity sites should be the early focus of studies to gauge large-scale changes.

- How can you manage for temperature change? Can we identify areas more resilient and more affected by drought and use them as touchstones?

- Since Southeast is historically used to fire and thunderstorms will our climate change that much? Maybe not… but $CO_2$ increase is of major concern.

- Create habitats with reliable species that will survive in all environmental systems and changes in climate. Is that possible?

- In preparing for climate change frequent fire can maintain a normal system, possibly even in the event of a climate shift.

- Habitat fragmentation along with climate change will make it more difficult for some species to advance inland with sea-level rise.

- Phenotypic plasticity may allow some native species to cope with environmental changes.

- Longleaf pines cover so much ground that they might be fairly resistant in the face of change, perhaps especially owing to range-wide gene flow (but what are those gene flow patterns?).

- Climate change likely will make fires get hotter, mess up burn regimes, and reduce the number of burnable days; if you can't burn you can't manage longleaf ecosystems!

- Effects of habitat loss are dependent on landscape and what you start with.

- Unknown effects of drought, but everyone wants to know!

- These communities have been here for a long time.

- As long as fire is contained they should work themselves out.

- Plants may be able to survive but could affect prescribed fire – *e.g.*, how things burn.

- What are the drought thresholds (when it becomes too negative)?

- Sea level rise is another big unknown.

- Should we transplant plants - if so, where?

- What people are doing (*e.g.*, moving more inland and taking over forests) will probably affect forests more than climate change.

- We should always evaluate current weather to decide when to implement burns, so we need to be flexible.

- Use gardens to test how droughts affect plants. How long before plants die from drought stress? Will they eventually come back?

- Can fire reduce competition during drought or just add insurmountable stress to a stressful situation?

- How to manage for uncertainty?

- High diversity should be focus because those sites change quickly due to productivity. Even so, some high diversity sites are quite unproductive.

- Triage - should we focus on certain areas if they're already doomed?

- Climate change affects practicality and how you do things; *e.g.*, prescribed fire - when and how burned.

- Can we manage for increase of temperature? Manage for unpredictability but look for possible long-term "rules of thumb" management plans.

- Is climate change really our most important question?

- No matter the change, all might stay the same.

- Social changes could also affect habitat.

- Monitoring efforts to keep up with the effects of drought.

- Synergistic effects: Climate change and habitat fragmentation are both hurting habitat worse as a combination.

- Important to create strategic new habitat.

- Frequently burned areas are healthier and can survive better, so just manage with fire as best you can instead of worrying of what might happen.

- No single model gives consensus as to what climate change will bring or mean for the future – turns efforts into managing for the *uncertainty* of climate change versus any of its direct consequences. Managing for uncertainty might be the most effective conceptual framework for addressing climate change.

- Efforts should focus on high productivity sites given the rapid change these sites are capable of exhibiting.

- Groundcover monitoring efforts might need to shift to a population dynamics approach. Given current monitoring focus, it is hard to identify the "walking dead," or long-lived perennial species that may already be doomed over the long term.

- The unpredictability of climate change impacts fire tremendously – changes in regime, intensity, feedbacks created, *etc*.

- An increase in temperature is one relative constant across climate change models; can we manage for that? Can we identify those factors of climate change that are more certain than others and target management towards them?

- Hotspots of diversity occur in areas of climate refugia; is there any reason to assume that climate change now will cause the SE (a climate refugium in the past) to be much different? Will biodiversity become concentrated in the same areas it did in the past?

- Sea level rise and carbon dioxide concentrations may have effects, but condition of interior, inland areas might not be massively different.

- Important to consider human dimensions of climate change as well; as sea level rise occurs, human populations will push inland and increase complications with fragmentation, fire management, *etc*.

- Predicting the system's response to climate change requires data and patterns recognized from long-term monitoring.

- The rate of climate change and modern habitat fragmentation means that we can't see the shrinking / shifts / responses of communities seen in the past.

- Smaller populations lower the ability of species to respond to climate change genetically.

- Potentially use seed mixes that are more resistant to changing environmental conditions.

- Mix seed regionally versus local - only because climate change may alter local conditions.

- Have to put climate change concern in context; can't let the "sexiness" of the topic outweigh the importance of soils, fire, and local site management.

- Soils are an imperative factor – have experienced much change over time.

- Systems adapted to frequent fire or disturbance are already more resilient than other systems – the best way to prepare for climate change may be just to maintain or promote good fire management.

- Strive to keep genetic diversity as high as possible to allow for adaptation given future change.

- Need more studies on climate patterns across longleaf range to identify variability in drought and burn seasons across the range (*e.g.*, dendrochronology to identify when fires occurred and what environmental conditions were experienced at the time).

- Prescribed fire often can't be implemented at natural times due to high risk nature.

- Need to compare the effects of wrong vs. correct or functional regimes; wrong regimes must be documented to make this possible.

- Much more complex to piece together more modern vs. historic regimes due to complexities associated with land use changes, climate change, and human disturbance (vs. climate as a solo primary driver of regimes in the past).

- We need drought/climate projection models to target highly sensitive areas. From there, how to mitigate?

***Session Four – 2:00 p.m. – Small-Group followed by Whole-Group Discussion***

***Top 3 questions (based on votes cast during morning break) for Management / Restoration***

***- What limits the passive re-establishment from relict understory into disturbed sites? What management practices facilitate this re-establishment?***

- Once the natural system is spoiled by humans, it's very difficult to get it back.

- Some species come back on their own if an area is taken care of (fire).

- Some species are difficult to reestablish-microbes/fungus in soils are lost?

- Native species aren't sufficiently vigorous.

- Well-managed sites near "bad sites" help tremendously in naturally restoring habitat.

- Passive management probably will not work on its own, definitely not quickly.

- Soil disturbance reduction is important!

- Skidder trails *etc*. can be selectively beneficial in ways such as helping some rare species.

- What is this human disturbance mimicking?

- Passive establishment limited because: (1) habitats are no longer flammable or exhibit different fire characteristics; and (2) the limited dispersal capabilities of wiregrass, bunchgrasses, *etc*.

- Many groundcover species never evolved for long-distance dispersal.

- Selection favored keeping seeds near parent individuals because very locally adapted to fire over time.

- Root competition for nutrients, water, *etc*. a very important factor; can't consider competition for sunlight alone.

- Fire eliminates competition for light and "levels the playing field" in terms of root mass competition (as influenced by size).

- May need to reduce aboveground vegetation and shrubs that prohibit dispersal.

- Girdling and herbicide application to eliminate root competition?

***- Best Management Practices that will avoid or repair management related impacts on groundcover (e.g., plow lines, skidder trails, logging decks, etc.), especially regarding how and when to apply herbicide.***

- Restoration should be more of a process instead of a goal.

- Stoddard-Neel approach.

- Minimize disturbance.

- Herbicide is sometimes necessary.

- Some species turn "savage" after herbicide application and rebound much quicker than others; possibly due to high tolerance to the herbicide and a release from surrounding competition due to the herbicide.

- Herbicides have particular effects on certain species depending on application. The timeliness of herbicide application is very important – are there papers to clarify?

- What about food plots of native plants rather than corn?

- Windrows as refugia – think twice about what sorts of legacies might be acting as refugia on a given piece of land. Seedbanks can be decades-old and still germinate under the right conditions. It is possible to wipe out these refugia in well-meaning "restoration" projects.

- What are you trying to control with herbicide?

- Herbicide is not always the answer- you need to have specific problem to deal with (*e.g.*, cogon grass, shrubs that are extremely dense).

- Just like fire you do not want to treat all areas the same when using herbicide.

- Don't herbicide everything (patchy application might be best).

- Herbicides have species-specific effects, and the timing of use and type used can effect phenology, interactions, *etc*. differently; need more information on these effects and the exclusions, releases, *etc*. that result despite what we often anticipate.

- The timing of herbicide application may be the most important factor; different effects given different times of the year and throughout different life stages.

- Should attempt to manage with herbicide in a highly variable way – vary timing, products used, and the patterns of their application.

- We see a recent trend or shift from mowing to herbicide application due to cost efficiency, labor requirements, *etc*. Long-lasting effects of this shift are unknown, and this shift to herbicide often eliminates roadsides as important refugia or corridors.

- Some suggest that herbicides should be used only in the case of particularly invasive species or in situations where no alternative method of removal or reduction is available; only use in areas where fire alone seems unlikely to control brush, encroachment, *etc*.

- Overzealous restoration can hurt natural refugia.

- Stop creating management-related disturbances.

- Reduce the use of ATVs and ATV access to restoration or conservation areas.

- Minimize human disturbance on a site-specific basis; must consider multiple-use policies.

- Need for infrastructure in longleaf restoration field – long-term monitoring program + best management practices for land managers + advocacy / outlets for education, outreach, *etc*.

- Best management practices are known, just need to be repackaged – brochures, fact sheets, *etc*. are a good approach; synthesize known information to make it useful and to identify any of the areas we aren't as sure about.

- Focus on minimizing soil disturbance – Stoddard-Neel approach to distribute disturbance across landscape vs. having much disturbance concentrated in a single area.

- Reduce the use of heavy equipment in forestry to prevent compaction and disturbance (see Wade Tract soils vs. other sites).

- Timing of equipment use – can be more damaging at certain times of the year than others.

- Use firebreaks, logging decks, and other areas of management disturbance as areas to establish forbs, fire-adapted legumes, native warm season grasses, and/or food plots to benefit wildlife.

- Under certain circumstances, these areas of management disturbance can be small areas harboring high species diversity or serving as refugia.

- What natural disturbance is this management disturbance mimicking or most similar to?

- Areas of disturbance might benefit annuals and biennials most (*i.e.*, species with short life history strategies) before we see gradual reinvasion of perennials over time.

- To be beneficial, these areas have to be monitored for weedy invasion that results in competitive exclusion.

- Need to be cognizant of legacy effects acting as refugia on sites; census prior to any restoration or management work to know what already exists on a site to be sure that restoration efforts don't accidentally damage refugia present.

- New species and highest diversity identified in windrow areas throughout longleaf restoration; windrows typically eliminated for aesthetics, but may be beneficial and might be better retained.

***- How do we get at evaluating and understanding the effects of variation in fire intensity and behavior?***

- Treat management as an experiment.

- We are getting better at measuring fire intensity

- We are getting a better understanding among / between fires as far as heterogeneity.

- Yet lots of research opportunities in fire heterogeneity remain.

- Monitoring to see how different fire intensity affects plants.

- Does seasonality really affect fire intensity?

- Fuels affect fire intensity and behavior.

- Do we burn too conservatively?

- Need long-term monitoring and experiments to better understand variation in fire effects.

- Need to identify when your region burned historically/naturally (drought, lightning, *etc*.); mimicking natural regime should give you maximum diversity and success for that area.

- Natural regimes can vary widely across regions.

- How does the target of management (wiregrass vs. diversity vs. quail, *etc*.) shift the intensity, frequency, *etc*. of fire desired? What if diversity isn't the primary goal? Does a different goal mean a different best combination of fire characteristics?

- Every fire is different, and it's difficult to say that a particular fire, regime, combination of fuels, *etc*. will meet a given goal.

- Can only target for broad conditions or goals due to variability in fire.

- Can manage for particular conditions with artificial or altered regimes, but won't be restoring the original longleaf system when you do.

***Afternoon Break – 2:45 p.m.***

***Session Five – 3:00 p.m. – Small-Group followed by Whole-Group Discussion***

***Top 3 questions (based on votes cast during morning break) for Restoration***

***- Where are the longleaf pine savannas? Mapping!***

- Mapping is a bit subjective to what individuals think is pristine, functional, *etc*.

- Is there a reference condition, what is the definition of restored?

- What do you do with them once you find them?

- Ecological modeling needed.

- Bob Peet shared Jen Costanza's (N. C. State) map in progress; developing map of potential longleaf restoration areas based on current areas of longleaf, soil units, vegetation associations, and habitat classifications/ecoregions.

- NRCS efforts.

- Florida Natural Areas (FNA) efforts.

- FNA has made attempts to assign quality rankings to polygons of longleaf areas across the state of Florida, and this attempt might include more private lands than actually reported due to privacy protection.

- Some substantial mapping is available via Florida Natural Areas Inventory (FNAI) Cooperative Landcover Maps.

- NatureServ efforts.

- See Longleaf Partnership webpage.

- Natural Heritage at state levels often have this information if you know where to look and who to ask.

- Need to encourage states to beef up Heritage Program data and the tracking of reference sites.

- These various mapping efforts almost always over-emphasize structure over composition. In other words, some sites may only have longleaf, or longleaf plus wiregrass, but they are "wiregrass deserts."

- Generate computer models from existing data sets for guiding/prescribing restoration actions, choices, methods.

- This group, or someone, could become a nexus for compiling and disseminating known information.

- What gets counted? What is the quality of extant stands? Effective mapping will require a combination of remote sensing and ground-truthing. Most of the information is likely already out there but not compiled. Sounds like a master's project?

- For passive restoration, we need to know regional specific indicator species of site integrity, or at least site potential. Choice of indicators will inevitably be arbitrary, which we should admit upfront.

- We need ways of evaluating state-level transition (restoration progress) criteria, including models. We need computer models based on site information to guide landowners as to direction for restoration efforts. We need Best Management Practices (BMPs) delineated.

- On a regional scale where are the tracts of good Longleaf that should be prioritized?

- There's a lot of private land that is unknown.

- Using soil info and physical censusing can narrow down.

- More info. on where habitat is would facilitate reaching out to landowners.

- Need for information about habitat loss. What are the genetic risks to small populations? Allee effects/inbreeding depression/loss of pollinators/loss of networks.

- Needed regional database of geographical extent and local abundances.

- Might identify success by assessing % similarity to most similar sites.

- Why map? To identify what we already have; some efforts have been made in some areas to separate things out to the species level at a minimum.

- In small areas, local experts know where frequently burned, undisturbed areas of high quality longleaf are located, but do we have any idea of the grand total of these longleaf areas? This is further complicated by the fact that many pristine areas lie on private lands or property. Concerning current restoration efforts, are we even aware of what all we have? Public lands usually mapped, but others not.

- Mapping necessary to help with site prioritization.

- Issues exist in defining what a high-quality longleaf ecosystem is; define in terms of endemism, dominant species, size, or another metric? How do we define high quality across such wide variability in longleaf conditions across its range?

- Can we reach consensus on a defined degradation spectrum to allow prioritization of conservation/restoration efforts? Use this spectrum to identify which areas are most worth our efforts to restore.

- For restoration's sake, the presence of wiregrass identifies as a site as having higher restoration potential than others. Wiregrass presence typically indicates the presence of a seed bank and a lack of disturbance from land use that makes restoration possible with much less effort expended. These areas typically only require release from encroachment via reintroduction of fire versus other management methods.

- Ecological Condition Modeling work being done – needs to be expanded beyond local and regional scales, and needs to incorporate species composition versus structure alone.

- Need to expand local or regional efforts to rank habitat quality – increase extent, consider factors beyond vegetative structure alone.

- Use weighted mean habitat fidelity scores or the composition of what's already there to determine restoration potential, value, or goals.

***- Define "Restored." What would be a threshold of minimum success? How do we know (is there a reference site condition)?***

- This is very site specific.

- Will vary a lot throughout the range of longleaf pine.

- Also landowner specific; different folks have different ideas of what constitutes "restored."

- Basic structure and basal area are critical to get to the final biodiverse goal.

- Once it's been disturbed it can't ever go completely back (general agreement, or opinion of a few?).

- "Resilience" or "recovery"?

- Are we "restoring" or are we "recovering" ecosystems given that we're unable to go back to prior conditions? Consider restoration as a process versus the goal of management activities. Are we performing recovery of the future vs. restoration of the past?

***- How do we know we have successfully restored function, structure and disturbance regimes? Or species composition?***

- If you have longleaf pine and a fire regime you're a lot better off than having slash pine plantation.

- There is no single definition of reference condition.

- Could a set of plants and conditions be established as indicators of successful restoration?

- When and where are we managing for matrix instead of an overall view?

- Need to figure out indicators for different areas that show management practices will be beneficial and likely to work.

- Data need to be put in a usable format!

- Develop a model so you can come up with a target that can be reached.

- We need a way to evaluate the cost effectiveness of restoration – triage! We need ways of determining what areas/species are lost causes so that scarce funds can be used most effectively.

- Need for more indicators of where you'll get the most restoration bang for your buck.

- Is it possible to set up an indicator system as in stream restorations?

- Issues exist in identifying blanket indicators due to local endemism and variability; indicators may need to be defined at local scales.

- On region-by-region basis, identify those species associated with areas of restoration success.

- Even single sites can possess multiple desired community composition or type.

- Are there hybrid community types that can still help to meet conservation objectives?

- Might want to factor in / consider soil restoration when prioritizing sites.

- State-in-transition modeling – mismatch occurs between reference sites and restored sites. Will a restored site ever truly equal a reference site? Where in restoration do we identify "restoration achieved," and how close can we actually get to restoration of the system (composition, structure, function, *etc*.)?

- When do you pay a landowner for "successful restoration"? How do we define success legally? Should we pay landowners for efforts vs. outcomes?

- Should we define conservation realities / objectives based on not only conditions, but the effort willing to be put into restoration as well?

- Potentially evaluate landowner or restoration success by their progress along a restoration trajectory or spectrum versus the site's end condition (as compared to reference sites)?

- Can we develop or utilize an evaluation process similar to that used in sustainable forestry now?

***4:15 p.m. – Reflect & Wrap-up***

***How do we take this and move forward from here?***
***What are some outcomes or actions that could arise from today's discussions?***

- Restoration is like pornography – you known it when you see it!

- We've been attempting to increase fire across the landscape, but we've struggled; is this discussed less now than it was in the past? Have we somewhat given up or backed off on the push for this?

- Conservation objectives at landscape scale should help guide restoration priorities, *e.g.*, sites around core conservation area should be prioritized over sites in the midst of center-pivot agriculture.

- A restoration assessment could be done based on various categories of structure, function, composition; incentivized for each of the categories or variables.

- In future, address nuances of fire for diverse groundcovers.

- Engage with state and regional Fire Councils.

- Advocacy/Policy Letters
    Importance of groundcover
    Commitment to fire, fire and more fire

- Bring groundcover voices to Longleaf Partnership Council
    State and local implementation teams

- High biodiversity is generally found in "old landscapes" (*i.e.*, the importance of Age and Area in creating a large species pool).

- Aboveground / belowground competition model of Bob Peet may be relevant.

- We all agree that fire is the key to maintain groundcover diversity, but do we truly know the ecological processes by which that happens and do we need to know the ecological mechanisms to nevertheless effectively manage and restore high-diversity groundcover?

- Need to develop a definition of restoration or restoration progress, despite knowing that this is likely to be imperfect or arbitrary; better to provide even a flawed definition as a basis to start versus nothing at all.

- Establish a working group to set restoration standards and define restoration and a "starting point continuum."

- Use the "broader impacts" sections of grant proposals to establish working groups or the infrastructure needed for longleaf research of restoration efforts.

- Is there any similar system that undergoes restoration from which to base infrastructural developments?

- Should make attempts to use all reference site data to generate models that use site characteristics as inputs and deliver restoration target conditions or goals as outputs; landowners or managers can then consider these goals and decide how close they'd like to get to them given willingness, possible effort, *etc*.

- Need exists to establish longleaf research and restoration infrastructure – long-term monitoring, mapping of reference sites, *etc*.

- What group should be responsible for all of these needs? America's Longleaf Group? The Longleaf Alliance?

- May need to have additional discussions or separate workshops concerning fire questions.

- Need to further address the divide between science and management and ways by which to close it.

- Get involved with the Coalition of State Fire Councils as a means by which to bridge science/management gap.

- Composition of a consensus document detailing what do we know/agree on, what don't we know, what do we need to know?

- Development and distribution of an advocacy letter detailing longleaf priorities, importance, needs, *etc*. Could use this to convey the value of ground cover.

- Bottom-line remains that fire just simply isn't occurring enough across the SE landscape – future work needs to stress, encourage, address and advocate for the need of an increase in fire activity.

- How does The Longleaf Alliance or America's Longleaf Partnership Council address, understand, or define restoration success, needs, *etc*.? Funding and policy are controlled or shaped by these organizations, yet scientists / researchers and restoration staff aren't typically included or heard. Goals defined by these organizations need to be expanded beyond acreage or number of trees alone. There is a need to facilitate more communication between science, mgt., and these organizations. Groundcover is currently not considered or prioritized by these organizations.

- Current funding structures and processes make inclusion of groundcover in restoration work difficult; changing this will require the presence of workshop attendees and others at funding meetings to push for groundcover consideration.

- What the government and funding sources measure as restoration success matters – can't be acres of trees planted alone; need bigger picture to be considered.

- When evaluating restoration success, need to keep in mind that new acres of longleaf planted will require time to thin out enough to be eligible for or capable of understory restoration.

- A blog for continued communication.

- Use all reference data to develop computer model and generate reference goals for specific sites.

- Use any and all data to develop an infrastructure to hit restoration targets.

- Catalog of longleaf pine areas.

- Need an organization to collect, curate, and disseminate info.

- Monitoring Network with permanent plots and systematic inventories.

- We are not at the table. Need funding. Need to be heard. Engage Longleaf Partnership Council, *etc*.

- Final product suggestion – a letter stating that we should, "burn, burn, burn." Focus should be on groundcover biodiversity. Letter should work through America's Longleaf Restoration Initiative or go to Longleaf Partnership Council.

- Advocacy letters or consensus documents to various policy-oriented groups, congress people, or simply to advertise for high priority of longleaf groundcover.

- "Where is the fire fight?" We never talked about fire explicitly. Members of the workshop should connect to their local/regional prescribed fire councils.

- Potential workshop deliverable = another group / workshop to better define State-and-Transition models. Use of an arbitrary, leveled, or weighted success scale? Have to acknowledge that how we define the "condition" of a site will be arbitrary. May be possible to rank sites based on known system requirements (*e.g.*, Level 1 – return of fire; Level 2 – return of veg. structure; Level 3 – species composition present, *etc*.). Potentially rank based on best management practices followed by landowners vs. outcomes to incentivize restoration efforts.

- Future workshops or working groups:

Fire frequency, timing, *etc*.
(to be led by Morgan Varner?)
Fire is required for groundcover maintenance and restoration, but how important are season and frequency, and is the answer context-specific?

State-and-Transition modeling framework to help guide restoration efforts
(to be led by Susan Carr?)

Assessment criteria for groundcover management & restoration
(to be led by Latimore Smith?)

"How to Restore Longleaf Pine Groundcover" workshop during The Longleaf Alliance biennial conference; led by mangers and restoration professionals who have had some success (and have learned from some failures) "on the ground."

***5:15 p.m. Conclusion***

***Thank you to everyone for participating!***

# Appendix 1

***Potential discussion questions submitted to the organizers by workshop participants prior to the workshop***

***1. How to Define or Evaluate Restoration Efforts?***

- Interested in the interface of basic community ecology and restoration, recognizing that while little 'pristine' longleaf remains, there is substantial 'degraded' longleaf – *e.g.*, pine plantations (which, of course, lack characteristic ground layer species). Understanding and harnessing this opportunity to expand and restore the ground layer onto these degraded sites is a huge challenge and opportunity.

- Loss of groundcover to climate change and what to do about it (*i.e.* rich groundlayer communities in outer Coastal Plain FL may be underwater in 50 yrs)

- What is groundcover restoration?

- Is there a middle ground/minimum threshold for pursuing projects between no hope/waste and projects attempting pre-Columbian conditions? Why?

- Where are the extant pine savannas and what is their condition? Specifically, has there been, or is there potential to identify and map pine savannas of high conservation value across the southeast?

- Are current prescribed fire programs adequate for maintaining and restoring high conservation value pine savannas, and if not what are the major changes that need to be implemented?

- Plantation forestry covers much of the southeast. Could plantations be better managed as part of landscape and regional scale restorations? And if so what sorts of management would need to be implemented?

- Conceptual: Restoration as a "return to the good old days" versus "tracking climate change'?

- Starting Points: Restoration as manipulation of partially degraded (usually shrub encroachment and/or loss of fire) sites or as trying to start from scratch?

- Composition: Restoration as (re)introducing uncommon or rare endemics or major missing species?

- What constitutes a fully "restored" condition vis-a-vis pyrogenic pineland ground cover? Should there be a quantified "threshold" of similarity to a reference site condition, for restoration to be considered a success? Or, is installation of fine fuels to carry fire enough?

- Should basic research be focused on this question of restoration potential relative to reference site conditions? Is such research ongoing, and if not, should we promote it?

- The need to define the meaning of the term “Restoration” for pure ecological restoration. Perhaps think of in terms of minimally, moderately or highly restored, with the objective of at least minimal restoration at every restoration site?

- Can we start to build or do we already have a consensus about what the most important challenges to restoring longleaf pine groundcover?

- Can data from reference sites be used to inform restoration and evaluate potential conservation sites? Extent to which NVC system can inform these activities?

- What is the current “best” management strategy for converting highly degraded sites (*e.g.*, former ag lands, pine plantations, *etc*.) to restored longleaf system conditions?
    - Best way to restore function, structure, & disturbance regime?
    - Best way to restore species composition?
    - Which comes first, or do these occur simultaneously?

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***2. Basic Ecology Questions***

- By what ecological mechanisms is the high understory diversity, characteristic of longleaf pine ecosystems, generated and maintained?

- Are these mechanisms the same or different in intact (*i.e.*, relatively pristine) longleaf vs. longleaf impacted by various aspects of human land use, including legacies of past land use (*e.g.*, tillage agriculture, silviculture)?

- How do we translate understanding of these first two questions (concerning ecological mechanisms of high diversity in restored vs. intact longleaf) into targeted management/ground layer restoration approaches – *i.e.*, management/restoration tailored to sites with particular conditions (*e.g.*, post-agricultural vs. fire suppressed vs. plantation)?

- What are the effects of habitat loss and fragmentation on (particularly remnant) longleaf pine understory communities and in what ways can these be mitigated by connectivity measures (*e.g.*, corridors, management of intervening matrix areas, such as pine plantations)?

- What limits the passive re-establishment of relict understory populations (*i.e.*, those residing in remnant longleaf) into formerly disturbed longleaf – *e.g.*, post-agricultural longleaf or longleaf plantations? What management approaches facilitate this re-establishment?

- Would a meta-community perspective be appropriate for understanding the maintenance of diversity in heterogeneous/patchy longleaf habitats?

- Are long-leaf forests phylogenetically over-dispersed? Under-dispersed? What does this tell us about the maintenance of diversity?

- What is the role of pine cover for restoration of LL ground cover? Without cover, is there sufficient needle cast to carry fires?

- Interactive effects of shade and fire on groundcover.

- Interactive effects of fire regimes and edaphic factors on groundcover

- Does fire really reduce competition between herbaceous species in pine savannas? What is the evidence pro or con?

- What factors determine rates of woody encroachment or regrowth between fires?

- What good are species richness/diversity measures (*e.g.*, counts, Shannon, Simpson, Species-Area relations, Chao) for determining conservation value of groundcover vegetation? Are other measures better, *e.g.*, Floristic Quality Index, Mean Fidelity to Pine Savannas, Mean Endemism?

- Spatial heterogeneity: there are lots of unique spaces on the woodland floor (downed logs, shady spots, subtle ridges and valleys) - what is the significance of these patches for plant persistence?

- For each level of restoration:
* Set a minimum number of species within certain key functional groups.
* Set an average desired coefficient of conservatism or similar?
* Set a desired evenness of distribution throughout the restoration area (what I call “interspersion index”).
* Level of species “packing” at small scales, *e.g.*, number of species/sq. meter.

- A more comprehensive understanding of population processes in restorations and existing natural situations.

- How important is drought in shaping plant community structure and how does that impact vary across community types located on a gradient from xeric to hydric?

- What threats do global environmental change, primarily climate change, pose to longleaf pine understory communities and how can we manage to minimize those risks?

- How do modest changes in fire frequency have such dramatic impacts on species diversity?

- Extent to which fragmentation of original longleaf has left us with an extinction debt?

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## ***3. Management Questions***

### ***3A. Fire***

- What is the role of pine cover for restoration of LL ground cover? Without cover, is there sufficient needle cast to carry fires?

- Interactive effects of shade and fire on groundcover.

- Interactive effects of fire regimes and edaphic factors on groundcover.

- Related to above, how do these management-related impacts affect fuels continuity and fire spread over various time/spatial scales?

- What are the groundcover impacts of annual burning and/or burning a site two years in a row? Are there any potential negative long or short-term impacts?

- Does fire really reduce competition between herbaceous species in pine savannas? What is the evidence pro or con?

- What is the effect of variability of fire frequency/return interval on woody and groundcover vegetation?

- How much groundcover restoration it takes to get the all-important ecological process – FIRE – back on the landscape?

- How do prescribed fires (*e.g.*, fires implemented when fuels have relatively high moisture, often using head fires, conducted during the day, and small in extent) differ from wildfires (that often burned when fuels were dry and winds were high, could burn at night, and covered huge areas over many days) in their effects on understory plant communities?

- Are current prescribed fire programs adequate for maintaining and restoring high conservation value pine savannas, and if not what are the major changes that need to be implemented?

- Dynamics: When to reintroduce fire, and how to do it?

- Fire intensity and behavior: we have data on season and some frequency work. Data are needed that evaluate the effects of variation in these and other fire characteristics.

There are a bunch of ways to get at this and many areas/regions where this would be valuable.

- Fire exclusion: A thoughtful evaluation is needed of species that persist over long periods of fire exclusion. How do these plants do this and what is their capacity to capture the growing space once fire is reintroduced?

- What are the effects on the health of longleaf pine groundcover with yearly fire, 2-3 year fire, and 5-10 year fire? What fire prescriptions maintains the overall health of the understory system. (Keystone species, indicator species, *etc*.)

- What is/are the most appropriate scientific concepts for guiding fire management in pine savannas?

- Evolutionary/fire feedback vs. disturbance/selection models for prescribed fire in pine savannas?

- How do modest changes in fire frequency have such dramatic impacts on species diversity?

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***3B. Seeds and Plants***

- Are there any documented cases of northern or western ecotypes of upland groundcover plants crossing with southeastern ecotypes and causing adverse effects?

- Partridge Pea (*Chamaecrista fasciculata*) 'Lark' and switchgrass (*Panicum virgatum*) 'Alamo' have been used fairly extensively for understory plantings in longleaf pine. It is also my understanding that this combination would burn too hot, killing longleaf seedlings.

- Were these genotypes chosen for such plantings due to their ready availability, cost, both or for some other reason?

- If for cost reasons, then what is the seed budget for planting an acre of understory?

- If for availability reasons, then how much is needed for these planting?

- Have other species been trialed?

- Have other seeding rates been trialed?

- What limits the passive re-establishment of relict understory populations (*i.e.*, those residing in remnant longleaf) into formerly disturbed longleaf – *e.g.*, post-agricultural

longleaf or longleaf plantations? What management approaches facilitate this re-establishment?

- What good is fire-stimulated flowering? Does it have any measurable effect on groundcover plant composition in intact or restored pine savannas?

- How much does 'good enough' restoration cost (per acre)?

- Plugs vs. seed mix planting?

- What equipment works for planting?

- What are the advantages and disadvantages in restoring natural herbaceous flora via local ecotype seed?

- What are the best methods and materials one can use to construct large-scale plantings based on species diversity?

- How do larger parcels of land restored with "low (10) species" plantings compare to smaller parcels of land with "high (100) species" plantings?

- Can wild-collected seed be successfully inter-seeded into near-monoculture stands of native grass-dominant vegetation after a controlled burn, to increase species diversity and richness?

- Which Andropogons exhibit allelopathy, and to what degree does this affect germination and long-term success of seeded wiregrass? Is using these grasses to provide intermediate term fine fuels conducive to wiregrass establishment?

- Does *Schizachyrium scoparium* exhibit allelopathy?

- If the area is under a regular fire regime and weed control program does wiregrass recruit from sparsely planted plugs?

- There is a lot of effort towards seed collection and storage, as propagules for reintroducing plant populations on restoration sites. What do we know about these techniques and practices, in terms of what plant assemblages are selected (and more importantly, what is omitted)? Should we focus attention to figuring out what plant species are not represented in the commonly used seed collection and distribution techniques used by restoration practitioners?

- Plant establishment: much is made about fire clearing space/litter so that species can establish in these ecosystems. That statement is included in almost every paper on fire in these ecosystems, but what are the patterns of establishment in LLP ecosystems? A review and synthesis of taxa would be a good platform for future work.

- Specifying desired plant functional groups/guilds to incorporate in the restoration.

- Lack of availability of local ecotype seeds and problems using non-local ecotypes.

- Need to define ecotype zones for individual species to use in restorations in different areas.

- Need to determine best ways to develop sufficient supplies of “acceptable” local ecotype materials.

- Avoiding using non-local ecotypes and very aggressive cultivars that can cause “genetic pollution” and problems such as outbreeding depression and “contamination” of local ecotypes

- More info on seed bank dynamics. Seems many conservative species may not seed bank well.

- Persistence of seed bank and bud bank under different major forest management scenarios.

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***3C. Alternative Forms of Management***

- Effects of silvicultural/forestry systems on groundcover richness and integrity.

- What are the groundcover impacts and recovery timelines from management-related ground disturbance (plowlines, skidder trails, logging decks, roller drum chopping, etc.) across different soil types?

- What best management practices (proactive) and/or rehabilitation methods (reactive) are effective in avoiding, mitigating or repairing management-related impacts to groundcover?

- What are some of the latest, more successful and more environmental-friendly approaches to reduce old field weed competition prior to planting an herbaceous restoration?

- Overall cost to perform restoration.
- Site preparation (can involve repeated herbicide applications and/or mowing in ag fields.
- Hydrology restoration (in the flats).
- Seed collecting/processing/buying/planting.
- Types and longevity of follow up management (burning, mowing, herbicides, *etc*.)

- How best to restore GC of cutover Forest Lands?

- Burn for a couple of years and see what materializes from living veg remnants ("bud bank") or seed bank (?) before putting much effort into ground cover plantings.

- How/when to plant seeds in cutovers with many stumps and other debris?

- How best to restore bedded sites (major challenge)?

- Herbicide questions: most compatible that have least impact on ground cover; how & when to apply?

- Grazing is not commonly used as a management tool to promote species diversity in the longleaf range. Does it have a role in increasing diversity and longevity of LL GC restorations?

- Which brush control herbicides and their methods of application have the least impact on GC communities?

- Best fire surrogates where fire cannot be used (cattle/goat grazing, mowing, herbicides).

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***4. Factors Beyond Groundcover***

- Oaks: there is considerable argument over the place of oaks in these systems. To date, only limited work has evaluated the effects of oaks on groundcover. This is a huge hole in our understanding.

- What could/should be done to assist insects and other invertebrate groups (other than planting suitable plant guilds for some of them)?

- What about the role of soil mycorrhizae? How to know if they're missing and if reintroduction is needed? Is this mainly a problem in ag fields? If reintroduction needed, how best to do it?

- The role of arbuscular mycorrhizae fungi in community composition and structure. When is intro needed and how best to do it?

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***5. Human Dimensions & Outreach***

- How we can improve awareness (and increase knowledge) of the effects of soil disturbance on native groundcover species composition?

- Are we losing groundcover richness from public lands and what to do about it?

- How to motivate groundcover conservation on private lands?

- Can a micro-prairie, a very diverse mix of species planted and managed in the urban context, play an important role in bringing awareness to the plight (and the ecological value) of pine herbaceous understory and the need to conserve and restore it?

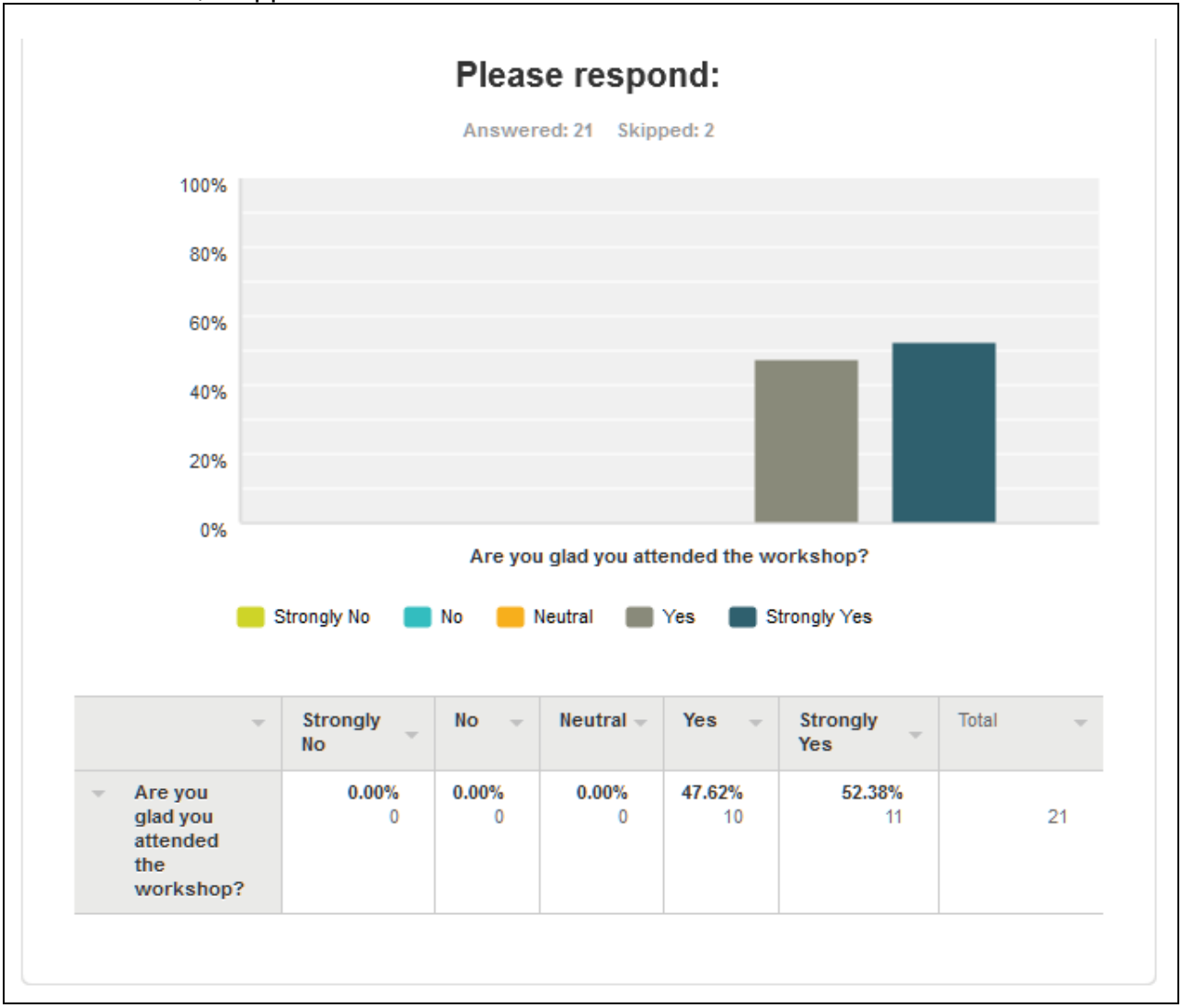
- I frequently hear from landowners that longleaf are not economical for them, then I see models that show that a 20 year plan would compare to slash and loblolly. I recognize that the LLA is on top of this discussion but specifically what is going on with regard to addressing this in terms of outreach? For example, literature with graphs to convince landowners to commit some ground to longleaf.

## Appendix 2

***Results of online survey to which a link was e-mailed to workshop participants three days after the workshop***

23 participants took the online survey, so for each question below the number who "answered" plus the number who "skipped" should equal 23.

***Q1: Are you glad you attended the workshop?***
Answered: 21; Skipped: 2




| | Strongly No | No | Neutral | Yes | Strongly Yes | Total |
|---|---|---|---|---|---|---|
| Are you glad you attended the workshop? | 0.00%<br>0 | 0.00%<br>0 | 0.00%<br>0 | 47.62%<br>10 | 52.38%<br>11 | 21 |

***Q2: Indicate the elements of the workshop that you found useful.***
Answered: 23; Skipped: 0

| Answer Choices | Responses |
|---|---|
| – Introductions (Name/Affiliation) | 65.22% 15 |
| – Mixer Exercise (i.e. Stand to the right if you have worked more than 10 years in Longleaf Groundcover, stand to the left if less than 10 years) | 52.17% 12 |
| – Whole Group Discussions (~37 people) | 91.30% 21 |
| – Small Group Discussions (~6 people) | 78.26% 18 |
| – Broad-topic Discussion Questions (i.e. How do we bridge the gap between management/restoration and basic science/research?) | 73.91% 17 |
| – Narrow-topic Discussion Questions (i.e. What limits the passive re--establishment of relict understory populations?) | 56.52% 13 |

***Q3: What would you have added and/or excluded from the workshop?***
Answered: 12; Skipped: 11

- I prefer effective facilitated discussions among The Entire Group, rather than small breakouts. Need to have a very competent note taker, and probably best done on a computer in Word projected on a screen to adequately capture all discussed. Mixer exercise was a waste of time.

- I'm not sure if I'd add or exclude anything, but the discussion divulged a bit toward the end and, I didn't think, was very productive for the last hour or so. Perhaps it was simply the end of the day and people were tired. Or, perhaps people were ready to start talking about more specifics at that point (*i.e.*, ready to move onto a future workshop!)?

- I think that the group should have worked toward a well-defined product or goal (*e.g.*, consensus statements).

- More managers ought to have been included.

- I would have limited scope to one or two critical threats that dug deep to discover the causes and solutions. One of them in my opinion would certainly be the need to increase professionally trained prescribed fire capacity in the longleaf range. I also would consider less participants next time.

- I don't think the small group discussions were as effective as they could have been. I think they would have been more effective if each small group consisted of experts on a particular topic and then gave a report of their discussion. One of the problems was that small groups contained some individuals that knew nothing or cared little about some of the topics being discussed.

- The facilitator was not needed and a distraction. One of the main organizers should have led the discussion and focused on the main areas of scientific disagreement or cutting edge science that might benefit managers. Concerning #4 below, the facilitator did a good job but he could not be expected to know the critical issues in the science.

- Perhaps more mixing of the small groups membership, so we would interact with a greater variety of participants in the small group discussions.

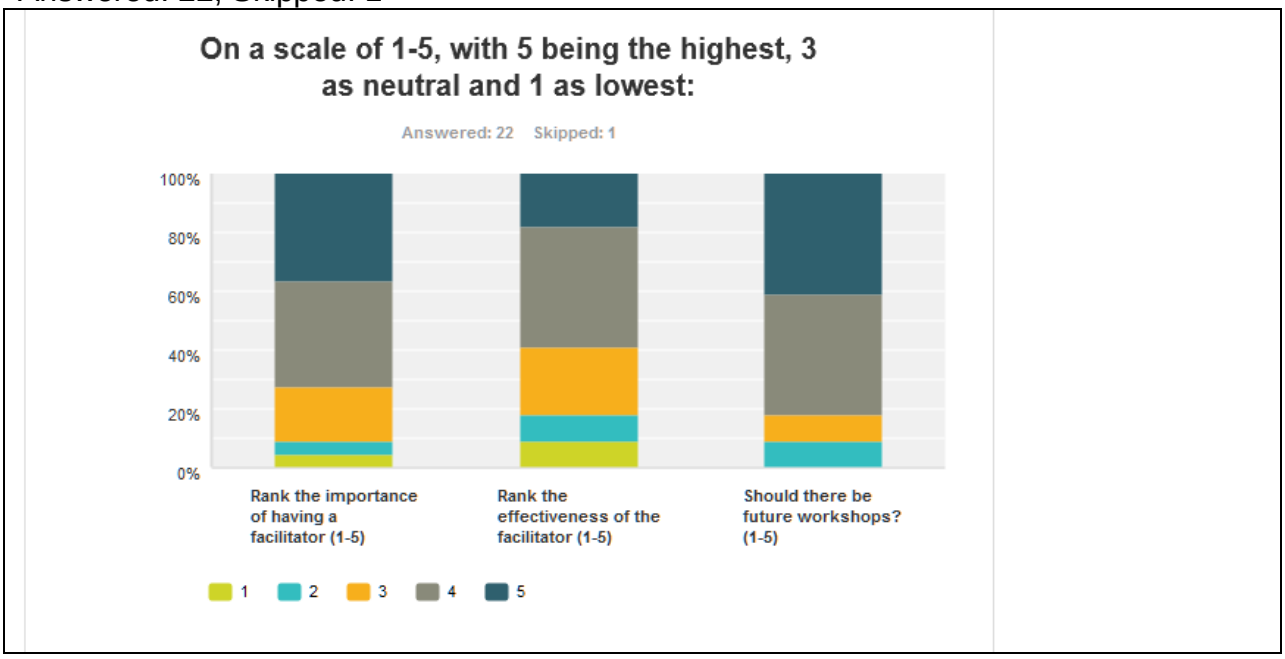
- Highlighted objectives and deliverables.

- Perhaps better defined objectives of the meeting. I felt it was beneficial for mutual information sharing, but it did not seem to have a specific goal or product.

- Perhaps a little less small group time. Also another non-discussion activity to break up the late afternoon. Lastly, some time for being doing basic science to all get in a group together. Also time for the more management/restoration folks to do the same.

- Not sure. I left still not sure what had been accomplished.

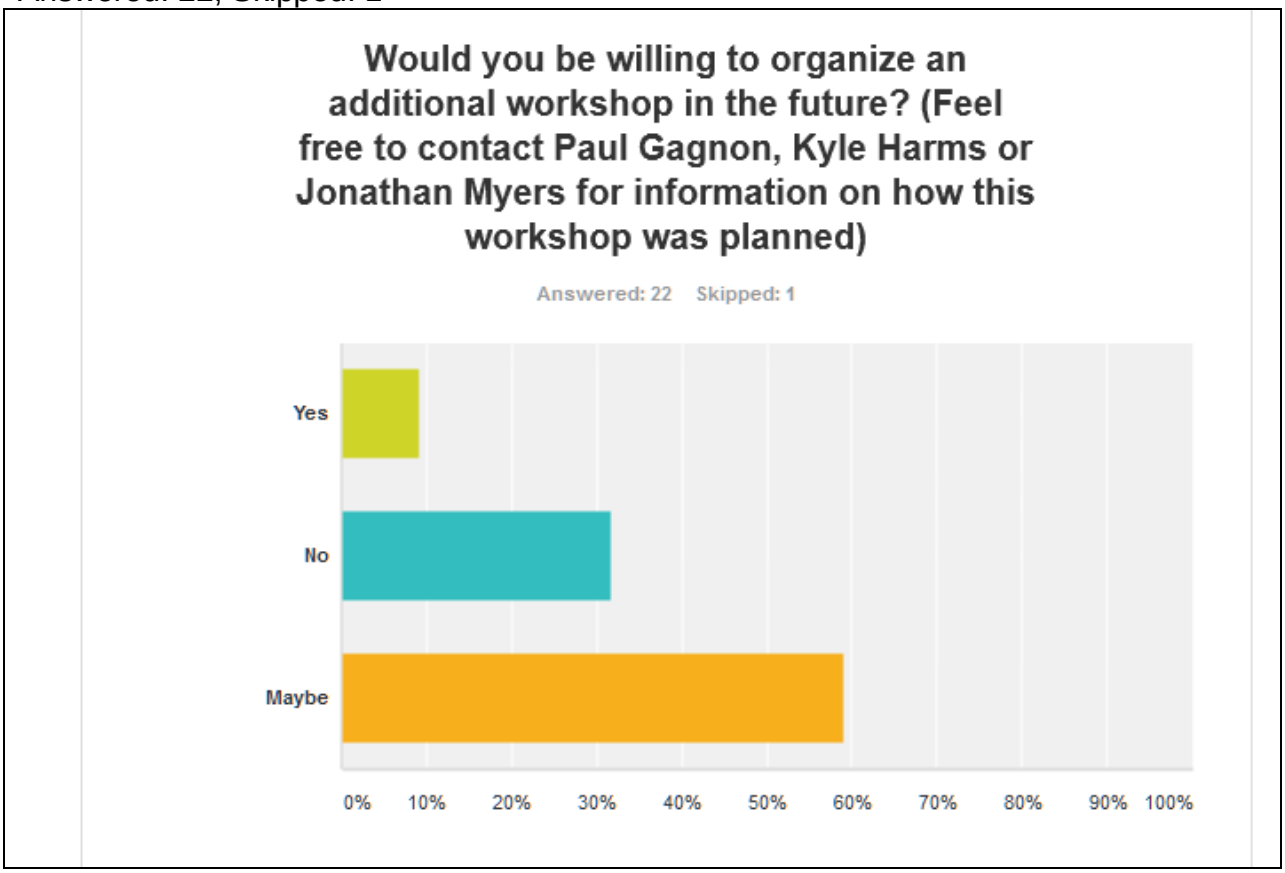
***Q4: On a scale of 1-5, with 5 being highest, 3 as neutral, and 1 as lowest:***
Answered: 22; Skipped: 1



| – | 1 – | 2 – | 3 – | 4 – | 5 – | Total – |
|---|---|---|---|---|---|---|
| Rank the importance of having a facilitator (1-5) | 4.55% 1 | 4.55% 1 | 18.18% 4 | 36.36% 8 | 36.36% 8 | 22 |
| Rank the effectiveness of the facilitator (1-5) | 9.09% 2 | 9.09% 2 | 22.73% 5 | 40.91% 9 | 18.18% 4 | 22 |
| Should there be future workshops? (1-5) | 0.00% 0 | 9.09% 2 | 9.09% 2 | 40.91% 9 | 40.91% 9 | 22 |

***Q5: Would you be willing to organize an additional workshop in the future? (Feel free to contact Paul Gagnon, Kyle Harms or Jonathan Myers for information on how this workshop was planned.)***

Answered: 22; Skipped: 1




| Answer Choices – | Responses – |
|---|---|
| Yes | 9.09% 2 |
| No | 31.82% 7 |
| Maybe | 59.09% 13 |
| Total | 22 |

***Q6: What should be the topics or goals of future workshops?***
Answered: 18; Skipped: 5

- One thing: We need to develop metrics for progress in ground cover restoration in a form useful to the Longleaf Partnership Council. Right now, they are not tracking progress in ground cover restoration. Many other worthy topics

- Given the consensus on need for more fire, more focused topics on fire management and unknowns of fire would make for an informative discussion.

- Topics were fine. Future workshops should have an objective, not just meeting in order to cover a range of topics in little detail.

- Outlining and beginning on one or more synthetic papers that the group could write.

- Habitat connectivity, landowner education, propagation methods

- How to actually communicate and collaborate with managers. Determine how to take ideas (like those discussed in the workshop) and transform them into action on the ground (*e.g.*, more fire).

- How to incorporate groundcover restoration goals into longleaf pine restoration in a manner that makes fiscal sense.

- Probably would be good to have separate workshops for more management-oriented and basic ecology-oriented types.

- How-to/ best practices brainstorm type session for different herbaceous approaches, *etc*.

- Discussing fire regimes more explicitly. Discuss management bottlenecks on why fire isn't applied as frequently, seasonally, *etc*. as the science suggests is appropriate.

- Figuring out how to keep the communication going. A workshop every 10 years or so doesn't seem to be sufficient.

- 1. Report progress since last workshop, 2. involve more people, 3. information sharing, 4. influecing policy re: native groundcover restoration on public and private lands

- Although I thoroughly enjoyed the wide breadth of discussion, I feel that future workshops should be focused more narrowly on specific topics (fire, BMPs, outreach/education, management planning, research priorities, *etc*.)

- Making our concerns known to and incorporated into current and emergent initiatives, particularly ones that are well funded by the government and likely to have continued large scale impacts.

- Perhaps to develop a multi-site restoration proposal.

- Building a conceptual framework for the restoration process in longleaf. Synthesis of the information we already have, whether that is plot data or results from published studies to go beyond the site specific approach.

- 1) Discussions on importance/relevance of season of burn. Given that Rxfire already had limitations to implementation (WUI, weather, smoke), should season of burn be a priority or "pushed" on managers as a goal? Is the influence of season of burn (a hot topic, with a wide range of opinions) really that important in the long run for "restoration", given the practical limitations (previous question) and the minor increases in site quality and potentially higher risk of damage to ecosystem structure and function, both also debated. 2) Ways we can quantify the uncertainty of climate change to focus restoration efforts across and among habitats. 3) Debunk the term "restoration".

***Q7: Do you have any other comments, questions, or concerns?***
Answered: 16; Skipped: 7

- Could have used a strong, knowledgeable (about ground cover issues) facilitator to move the group toward productive and efficient discussions. Need to make sure all the major issues identified and any outcomes of this workshop are recorded and distributed: What we know, what we think we know, what we don't know, and what we want to know.

- Narrowing the field of discussion a bit before hand may have helped to dive deeper into issues facing managers. The belief that similar questions were asked 20 years ago and exist today is of great interest given the extensive research investment over that time.

- The discussions were informative but I'm not sure what is going to come from the day. I know there was mention of a document of some sort being produced but I didn't leave feeling like anything significant had been accomplished at the end of the day.

- Overall, I thought the workshop was valuable as means to foster communication. An end product to share outside the participants in the workshop would be nice to see.

- If my current position changes, I may be more able to assist in future workshop planning. Unfortunately, there is simply no extra capacity within my Program. As I have said previously, I am happy to show my Program's results and share our war stories to any and all.

- I think that an important point was made regarding focusing the topics so that by the end of the day we would be at least close to some sort of product/synthesis. I really enjoyed the variety of backgrounds that were present at the workshop. However, I think there could have been more managers present. I learned a lot from speaking with those who were actually implementing the science!

- The best thing about the workshop was seeing people I had not seen in a while and catching up on their work/ideas. This has stimulated a good deal of follow-up discussion and ideas.

- The facilitator did a wonderful job as did the organizational team. I enjoyed meeting those in attendance and the conversations I had with them. My enthusiasm for future workshops is only dimmed by the fact that longleaf pine are not central to my career. I definitely am receptive to being at future workshops.

- I think that the idea of producing an encapsulating document, as intended, is a potentially beneficial outcome of the effort.

- Good mix of participants, from silverbacks to students.

- Despite originally being a skeptic, I have found that I like conferences with facilitators. Some broader goals for the conference other than just communication would be good.

- I liked the workshop and feel like I got something out of it. I hope this momentum will continue vis-a-vis bridging the gap between research and management.

- Well done - although my primary job is wildland fire, I'd like to see momentum going forward in terms of groundcover and will support with as much time I am able to.

- Great to have contact with such a great group of people. It felt like a reunion. I think the most important issues did bubble up to the top, which was useful to me for prioritizing research and future grants. The need to be more involved in large initiatives as described above seems apparent.

- Many participants had little to say, while others spoke often. A number of factors could be related to this outcome: a mismatch of participants with objectives? Confusion among the participants regarding their role? I am not sure, but maybe our facilitator could offer insight.

- The next workshop could maybe broaden the topic or title to not just longleaf pine "understory", but "ecosystem" restoration. This will potentially bring in a broader audience.

# Appendix 3

**Comments on the working group: Exploring Heterogeneity in the Ecology, Restoration, and Management of Longleaf Groundcover**

**T. E. Miller, Florida State University, November 18, 2014**

Thanks again for inviting me to this workshop. I found it personally quite useful and hope other participants did, as well. After your request for comments, I thought about this quite a bit and maybe over-thought it. But, here are comments. I have tried to be as constructive as possible.

A short summary might be that I think the workshop was great for exploring common ground, making personal connections, and providing each of us with a broader knowledge set about long-leaf understory problems. I did feel that the meeting emphasized the restoration of long-leaf structure, over an understanding of long-leaf understory processes, but this may reflect my own stronger interest in processes. I also feel that, for this workshop to have a longer-term effect, you may want to consider further activities.

***Basic Structure: Format, location, and participants***

This was really strong. It was a really interesting group of people from across the spectrum. I knew maybe ¼ of the participants, which was about right. More importantly, you had everyone from Bob Peet and Bill Platt to graduate students. I was way over to one side of the spectrum, in that I am a hard-core academic who does basic research somewhat peripheral to the interest of the conference. But, I felt very comfortable with this group.

The Facilitator was very useful. I am on a NOAA science advisory board for the Restore Act and we use NOAA staff that are trained as facilitators. I thought I would hate it, but it is very productive and I have become a fan. Your needs were very different, but I thought the Facilitator did about the right amount of organizing vs. letting us go. The “games” at the beginning were very useful to let us all see the variety of backgrounds and interests. Breaking us up into smaller groups seemed to work OK, but I think the groups could have been shuffled around more often. I would have liked to have interacted with more people.

***Content: Subjects and continuity of the discussion.***

The questions we ultimately ended up discussing in the smaller groups were not always that interesting to me, but that is the nature of the system. The dynamics in the two groups I was in were surprisingly good. My first group had one person who had very strong opinions that were poorly expressed. However, the group had the patience to figure out that what he was trying to say was actually a good point and to work to figure out how to communicate this point to the larger group. I think this also reflects well on

the structure and the participants, as everyone was really working hard to make this a constructive process.

A negative consideration would be that there were only a limited number of topics discussed and it wasn't clear how these were chosen. This might also be relevant for the productivity question discussed below.

***Short-term Productivity: What do the organizers and participants get out of it?***

I went to this workshop with an open mind and felt like I learned a great deal. I have spent a lot of time in one longleaf forest (the Apalachicola NF), but not that much time talking to others about such forests. I found the diversity of backgrounds and perspectives to be fascinating.

I felt there were two common perspectives in the group that were somewhat at odds: pattern vs. process. Many of the participants do restoration, from managers such as David Prentiss to those in seed companies. They are often just interested in restoring something that looks like "long-leaf" as soon as possible. People in the second group are more interested in the processes that determine diversity and structure in the understory of different long-leaf forests. From my perspective, the discussion was somewhat biased towards the former group. One reason for this is that it is very easy to just say, "We need to burn much more and it will solve most of our problems."

So, what did the participants get out of it? I think everyone gained a broader perspective about both forest dynamics and the people working on forest dynamics. I am sure some important contacts were made and bits of information were passed along; that is, I am sure many of us came away more knowledgeable about long-leaf forests in general. The workshop was also useful for defining broad questions of interest to the longleaf community. Of course, nothing was resolved about those issues, but I didn't expect this to occur! You can't just throw people together for eight hours one day and expect the long-leaf problems to all be solved (despite the "burn, burn!" advocates). Instead, the goal was to increase communication and understanding, which this meeting clearly achieved.

***Long-term Productivity: Where do we go from here?***

Joan Walker and Bob Peet noted in the morning that similar gatherings had already taken place over the last 15+ years and wondered what new could come from this conference. This thought stuck with me the whole day. Can this workshop have a broader and longer-lasting footprint? I had the impression that Joan and Bob felt that the last meeting was interesting, but had little legacy. A legacy would require some written record of this meeting.

This would, of course, require further work from the organizers. Some of this work might be delegated out to some of the participants. Ideas might include:

1. Summarizing the conclusions of the discussion groups.

2. Summarizing the discussion points that received lots of votes on the wall charts.

Either 1 or 2 could include writing (or getting others to write) short summaries of these questions.

3. Sending out summaries of the meetings to the participants.

4. Publishing or otherwise making available to the public summaries of the meeting. This could include something in Frontiers or what remains of the ESA Bulletin.

5. Laying the groundwork for a future meeting.

Feel free to use these comments as you wish...