



CCAST Panel Discussion Summary, September 9th, 2021

Existing and Emerging Decision Support Tools for Vegetation Management

Link to Recording on CCAST's YouTube Channel: <https://www.youtube.com/watch?v=vsqHXfK51Yo>

Austin Rutherford (arutherford@email.arizona.edu) - SEEDS and Shrub Encroachment Toolkit

Austin Rutherford and collaborators are developing SEEDS (the Shrub Encroachment Early Detection System) a map-based tool to predict a site's risk of shrub invasion, and expanding the [Brush Management section of the Rangelands Gateway website](#) to offer a comprehensive understanding of the ecology of brush encroachment and potential management options. Usable by a broad audience, these tools will help prioritize areas to monitor and treat for maximum effectiveness of shrub removal projects. SEEDS will initially cover MLRA 41 and 40 but can quickly expand to cover additional areas. Next Steps are to advertise the release of these tools, run live demos, produce user guides, incorporate feedback from users and expand the tool based on user feedback (ex: incorporating chance of ELRE invasion post-treatment).

Amanda Haverland (ahaverland@abcbirds.org) - Tree-age

Tree-age (pronounced like triage) will estimate the effect of various brush management practices on breeding and wintering bird populations. This tool covers 7 western states that include 6 bird conservation areas and overlaps with the footprints of 4 Joint Ventures. Tree-age will be capable of making estimates at both the broad, landscape scale to help inform management decisions and improve funding, as well as by biologists working with landowners at a project scale. Next steps are to complete the statistical analyses, find resources to expand the tool to cover northern Mexico, complete the design of the tool, and advertise tool rollout.

Elise Gornish (egornish@arizona.edu) - EcoRestore

EcoRestore is a one-stop-shop for all things ecological restoration in Arizona with information that is applicable throughout the Southwest. Accessible to anyone interested in native plants, users can find support for everything from site preparation, species selection, sources for plant materials, and post restoration maintenance on EcoRestore based on the goals and characteristics of their restoration project. Next Steps include creating a tiered list for plant species recommendations, increasing community involvement with ecorestore, creating EcoRestore portals in NM, UT, NV, and CO, and setting up real time connections between businesses selling native plants and EcoRestore users looking for plant materials.

Next steps and needs identified during discussion:

- Forest Service looking for more project level grassland decision support tools
- Research the risk of invasion by lehmann's lovegrass (and other invasive grasses) post shrub removal

Potential Collaborations that emerged during discussion:

- Expanding SEEDS model to predict Lovegrass invasion (Steve Sesnie FWS & Austin Rutherford UA)
- TreeAge to include Forest Service Data (Valerie Stein USFS & Tree-age)
- Future workshop about preventing invasion post-restoration (UA Coop Extension)



Appendix: Panelists' responses to additional questions

Dr. Elise Gornish's Responses (Ecorestore):

1. Are you looking for contributions or collaboration to improve or continue developing this tool? What are the next steps? Where could more capacity be effective?

Yes, we want to expand EcoRestore to the entire southwest. If folks are interested in being a part of that they should reach out to me.

2. Who has been using this tool so far and what feedback have you gotten from end users?

Anyone interested in land management. Folks love the tool so far.

3. Is your tool effective? Is it being used and helping people overcome the challenge you intended it to? How do you know/how are you tracking success?

I know that lots of folks use the species candidate tool to create lists. Right now tracking success is tracking online visits to the site – we get about 25-35 people a day on the site.

4. What does success look like for you as a tool developer? What metrics do you use to determine if you built a successful tool?

Google analytics.

5. What is one of the most important things you think land managers should consider in grassland restoration that involves woody shrub removal and how can your tool help with this?

Weed control and restoration go hand in hand.

6. Are you aware of other tools that can help end users with similar challenges? If so how is your tool different? How is it complimentary? How does/will your tool integrate with or link to these tools?

None.

7. Many tools are developed and then do not get used for very long. How do you or do you plan on keeping users engaged with using the tools you are developing/have developed?

Monthly newsletters, updated species list, communication among users on the site.



8. We have heard from managers that it can be difficult to keep track of all the tools that are out there and where to find them when they are needed. How do you/or plan to do outreach for the tool you are developing?

Monthly newsletter

9. At what level of specificity does your tool help users answer questions? Is it restricted to very specific questions (what plant should I seed here?) or does it provide broader guidance (what conditions do I need to keep in mind when planning a vegetation management project?)?

Ecorestore is for general use (general resources)

10. What do you see as the strengths and weaknesses of the tool you developed or are developing?

Strengths – general, applicable to a huge range of goals, locations. Weaknesses: generality means that folks will need to look elsewhere for super details recommendations.

Can you give some examples of some real-world scenarios where this tool would be particularly useful?

Anyone who wants to do restoration and has questions.

11. If the end user of your tool is a non-expert in the field, how are you providing directions for how to use the tool. (ex: if it suggests monitoring, what kind of monitoring?)

We give clear direction on how to use the species selection tool and the entire site was created with non-experts in mind.

Austin Rutherford's Responses (SEEDS and Shrub Encroachment Toolkit):

1. What is the challenge that this tool can help grassland restoration practitioners and land managers overcome?

Access information and existing tools on brush management & planning treatments in one location. Have geospatial data accessible from a single web application for use across multiple platforms (desktop, mobile, tablet) for the specific purpose of evaluating shrub encroachment, identifying key areas to monitor, and planning for future brush management treatments.

2. Who are targeted end-users?

Members of the general public, ranchers/producers, private landowners, and agency land managers.



3. What is the geography/ecosystem that this tool covers/is designed for?

The information developing is for brush management and treatment methods in general, but the new tool will be focused initially in the Southeastern AZ region.

4. What are any limitations/caveats people should consider when using this tool?

The new web app is a prototype designed to be improved and expanded in the future. With all mapping web apps, the goal is to show patterns across the landscape for aid in the expert, landowner, and land manager decision making.

5. Where can people find this tool and who can people contact for more info or for help using the tool?

It'll be linked from the [Brush Management Rangelands Gateway](#) main web page.

6. Are you looking for contributions or collaboration to improve or continue developing this tool? What are the next steps? Where could more capacity be effective?

Yes! Once the web app (and web text) is released, we would love to get feedback on missing information/data, useful additions, problems/issues, etc. The next steps are to get the first draft so to speak out, then begin fine-tuning the tool to improve it for all the potential users.

7. What does success look like for you as a tool developer? What metrics do you use to determine if you built a successful tool?

Evidence of use, getting feedback (formal or informal, positive or negative), survey responses, Google analytics/Server tracked visitations.

8. What is one of the most important things you think land managers should consider in grassland restoration that involves woody shrub removal and how can your tool help with this?

Potential for the land to increase in shrub cover in context of the existing plant community members and abundance (Lehmanns vs native), bare ground cover, and efficacy of treatments. To meet a shrub cover goal, multiple treatment types and re-treatments are almost always needed. Is meeting the shrub cover goal in the short-term worth the cost of returning high shrub cover in the long-term, especially if invasive grasses move into or take over the site.

9. Are you aware of other tools that can help end users with similar challenges? If so how is your tool different? How is it complimentary? How does/will your tool integrate with or link to these tools?

Additional tools will be provided from the Rangelands Gateway web page. Can get similar or the same information if you use multiple tools, DroughtView + RAP, or NRCS Web Soil Survey + DroughtView, but our goal is combining data from various places into one, while also creating a new data product, to try and remove some of the hassle of going back and forth from multiple



tools. Also, with functionality of using it on a phone or tablet. The lack of cell/internet service is a real issue that we're not sure yet the best way forward to handle the issue quite yet, being able to export PDFs/Pics is one option, not sure if you'll be able to load the web page and interact offline quite yet. This will be evaluated in the testing period in the late fall or next spring.

10. Many tools are developed and then do not get used for very long. How do you or do you plan on keeping users engaged with using the tools you are developing/have developed?

Tools often don't get used because of either user frustration with the tools functions (chunky), needing to use multiple tools to get all the information wanted/needed (missing info), or sometimes the website just disappears one day. We're starting small to get feedback and suggestions, while purposefully keeping the focus area small to work with the community to make the improvements, more quickly too. Going too big, too fast can reduce the potential utility for the users, so we're trying to start small and dial things in before expanding. Engagement will be kept through involvement in groups like AVCA, CCAST Grasslands CoP, LCNCA Bioplanning, AZ SRM, etc.

11. We have heard from managers that it can be difficult to keep track of all the tools that are out there and where to find them when they are needed. How do you/or plan to do outreach for the tool you are developing?

So true. We hope that compiling the tools/links on the BM RG main page can take some of the pain out of keeping track of multiple tools. Heard this before I'm sure, but try to make a 'one stop shop' for any tool potentially useful for BM decision making/planning, including our own. Outreach will include ads through email lists/newsletters like AZ SRM, Coop Ext, AVCA, CCAST groups. But also offer live demos (assuming allowed/safe) to local NRCS offices, AVCA, BLM, county managers. We purposefully built in funding and time to do these demos because these guided walkthroughs could be extremely important to solve any issues, difficulties, and provide real scenarios in person and in real time vs reading general written user-guides, which will also be made available.

12. At what level of specificity does your tool help users answer questions? Is it restricted to very specific questions (what plant should I seed here?) or does it provide broader guidance (what conditions do I need to keep in mind when planning a vegetation management project?)?

The new web tool is being designed for broader guidance and landscape scale planning. The model or map that's a product for my dissertation work is at the 30m or 100ft scale because a lot of it hinges on Landsat imagery, which is at 30m. The shrub cover estimates originate from USDA NAIP imagery, which is at the 1m or 3ft scale, but NAIP isn't available everywhere or very consistently in time or data quality. Some years are better than others, Landsat is consistent in time and quality of data. Other imagery products are out there but sometimes it's not freely available or doesn't provide consistent coverage in time. Many of the other data products don't really change like slope, elevation, distance to nearest wash, clay content. Precipitation and



temperature information is tough too with large area coverage, so my work uses 30 yr climate normals from PRISM but can provide monthly or daily modeled products.

13. What do you see as the strengths and weaknesses of the tool you developed or are developing?

Strengths will be the amount of information and existing/new tools available from one central website with the BM update, and the new web app's strength will be only those data that are focused on woody plants and brush management planning. Ideally, you wouldn't have to go to a bunch of other places to get the cover, precip, ecosite, slope, etc. with the ability to use it on your phone or tablet with cell signal. The weaknesses are that the internet/cell signal will be needed, the scope/area of this project with it being a prototype for SE AZ, and the risk map being developed at the SRER initially. Hope to overcome all of these in the future.

14. Can you give some examples of some real-world scenarios where this tool would be particularly useful?

Have a pasture that you've noticed increasing in mesquite cover and density over time and a loss of the herbaceous grasses and forbs. The cover increases aren't consistent and there are a couple washes that go through it. Can use this tool to see what ecological sites are in the pasture, compare the current state to the reference state, receive some characteristics of the soils, climate, and topography, ground cover to understand where the cover is increasing and select areas for monitoring or potential treatment.

15. If the end user of your tool is a non-expert in the field, how are you providing directions for how to use the tool. (ex: if it suggests monitoring, what kind of monitoring?)

User-directions, best practices, and interpretations will be provided in written user guides. With any new tool, or web app, these are very important and more important that they are clear. The risk map is designed for proactive management (what sites are most likely to see large increases in shrub cover from its current condition), these areas should be considered for monitoring or potential future brush management. Types of monitoring would be native vs invasive grass cover (is it dominated by Lehmann's?, does it have intact populations of native grass species?, where are the native species [under the shrub canopies, then may want to do very selective treatment to preserve the natives and their refugia]?).

Hope to help with some of the BM treatment selection through some simple decision trees. For example, if the area that you want to treat has slopes >30%, then herbicide (individual plant or aerial/broadcast), prescribed burning might be best options given difficulty to use machines on steep slopes.

If the target shrub is a resprouting species, then herbicide with retreatment, prescribed burn with retreatment, or mechanical grubbing below the root crown might be the best options forward.



Does the potential treatment area have areas of sensitivity like arch sites? Then herbicide, prescribed burning if no threatened historical structures, or rubber-tired low impact mechanical equipment. If ground disturbance, structures, or fire disturbance are a concern, then herbicide might be the only treatment option moving forward.

Responses from Amanda Haverland (Tree-Age):

1. What does success look like for you as a tool developer? What metrics do you use to determine if you built a successful tool?

Actually creating what we set out to build. Success means people are using it and find it helpful. To facilitate success, we want to work with partners in each of the participating JVs encourage them to link to this tool on their website. We have started discussing links between the RAP platform and the Tree-age tool with folks from Working Lands for Wildlife.

2. What is one of the most important things you think land managers should consider in grassland restoration that involves woody shrub removal and how can your tool help with this?

Shrub removal will benefit some species and have negative effects on others. In many parts of the project area, shrubs are a component of the ecosystem; it's not as simple as removing all woody stems.

This tool can show which species will benefit and which will not and allow planners to take into account the relative 'pros' and 'cons'.

3. Are you aware of other tools that can help end users with similar challenges? If so, how is your tool different? How is it complimentary? How does/will your tool integrate with or link to these tools?

There are other tools out there that provide information about habitat types and different threats, the JVs involved in this project have developed some. This tool is building on the work the four JVs have already completed. Tree-age will be more spatially explicit than current tools available in the region and will consider breeding and non-breeding seasons in the same tool.

4. Many tools are developed and then do not get used for very long. How do you or do you plan on keeping users engaged with using the tools you are developing/have developed?

Good question. We will build a communications plan that all the JVs can use. As mentioned, we are also talking with partners about linking somehow to their own websites. [And, I think we probably need to think more about this.]



5. We have heard from managers that it can be difficult to keep track of all the tools that are out there and where to find them when they are needed. How do you/or plan to do outreach for the tool you are developing?

We mentioned the communications plan already. The thing we're most excited about is the Advisory Committee we have organized to help us with tool development. We invited a few biologists and land managers from a variety of agencies in the project area to provide guidance about what the Tree-age will do and how data will be presented. We're not only consulting with them on tool design but asking what sorts of questions they need answers to and how could the Tree-age help them with that. The idea is to build this group little by little, ask them to test functions, and include others in their agency who might be interested. The hope is that we build a user group as we build the tool. And this user group can help us with communications and outreach in an organic, 'hey, check this out' way. We feel that the continued engagement with the advisory committee is probably more important than any formal communications and outreach we could do.

6. At what level of specificity does your tool help users answer questions? Is it restricted to very specific questions (what plant should I seed here?) or does it provide broader guidance (what conditions do I need to keep in mind when planning a vegetation management project?)?

Broader guidance. At least in the first phase, it will answer 'what if' questions. For instance: what if shrub encroachment continues at the current pace? Or: What if we are able to fully implement this five-year shrub management plan in these priority areas in Kansas? Etc. The intent is to help tie biological objectives (in this case bird population size) to management actions or land cover change.

7. What do you see as the strengths and weaknesses of the tool you developed or are developing?

Weaknesses: models are not perfect. We have lots of data but it's spotty throughout the region. Strengths: Information about breeding and non-breeding season together in one tool. Ability to ask questions at the landscape scale and at a project scale

8. Can you give some examples of some real-world scenarios where this tool would be particularly useful?

Small scale / bottom-up: Conservation delivery specialist working with a landowner trying to either manage for specific species of birds or would like to see the outcomes of different management actions on the bird populations.



Large scale / top-down: Members of the advisory committee have talked (in addition to the small scale uses above) about identifying core areas to work in (what is present in the core area, what will we lose if we lose the core area? What will we gain if we can expand this core area), providing data to funders or upper level management about the potential benefits of continued investment, linking conservation plans for habitat management to outcomes for birds.

9. If the end user of your tool is a non-expert in the field, how are you providing directions for how to use the tool. (ex: if it suggests monitoring, what kind of monitoring?)

Our primary audience for this is biologists and land managers that communicate with landowners about enrolling in conservation programs. We expect that biologists will be present with landowners to walk them through the information. However, there has been discussion among the advisory committee members to be conscious of the messages that are provided by Tree-age. For example, we can't promise X number of birds but we can say that these are the species that are likely to benefit from action on your property. All of this is forefront in our minds and will be worked out over time with the advisory committee.



CCAST Panel Discussion Summary, September 28th, 2021

Tools for Drought and an Online Rangeland Library Toolbox

Link to Recording on CCAST's YouTube Channel: <https://www.youtube.com/watch?v=nIGerxDY4ms>

Tonya Haigh (thaigh2@unl.edu) [Managing Drought Risk on the Ranch](#)

The National Drought Mitigation Center produced a 39 page report and accompanying [online resources](#) for ranchers [Managing Drought Risk on the Ranch](#). This report and online toolbox helps ranchers in the Great Plains and southwestern United States [understand](#) drought, [monitor](#) drought conditions, [prepare](#) and [plan](#) for future drought events, identify when to take action [during drought](#) based on drought thresholds, and [recover](#) from drought impacts. Next steps are to [gather feedback](#) about report and the online toolkit from Ranchers using these resources and expand the reach of these tools to the southwest with the same degree of detail as is currently provided for the Great Plains.

John Bradford (jbradford@usgs.gov) [Land Treatment Exploration Tool](#), [Drought Forecast](#)

John gave an explanation and demonstration of the new [Drought Forecast](#) tab of the USGS' [Land Treatment Exploration Tool](#). This tool can help anyone in the continental United States who is planning seeding or revegetation treatments, or seeking to understand results of past treatment results. The Drought Forecast tool predicts precipitation and soil moisture 12 months into the future (with margins of error) and can help predict optimal seeding times and likelihood of plant establishment based on climate data and scientific publications. The tool currently has the ability to predict the potential of sagebrush establishment through seeding and natural means and there are plans to expand into other vegetation types and roll out monthly maps at 4x4 km resolution.

Anne Gondor (gondora@arizona.edu) [Rangelands Gateway](#), NEPA for Ranchers

The Rangelands Gateway is a comprehensive resource for ranchers, scientists, educators, and anyone who wants to learn about Rangelands. It includes information about rangelands globally and the western United States most specifically. This online library can improve understanding of rangelands, planning, management, and restoration efforts. Anne highlighted the searchable database that includes 25,000 documents; [RangeDocs](#), an annotation tool improves precision and usefulness of searches; and the resources to [help ranchers navigate NEPA](#) processes and requirements. In the near future, Rangelands Gateway will be expanding several sections including the monitoring and vegetation management sections and other relevant environmental laws.

Liz Delcamp (liz.delcamp@pima.gov) [Pima County's Experience with Drought Tools](#)

In response to the recent drought, Pima County combined ongoing field surveys of the ranching operations on county lands with online tools to assess current range conditions to determine if current grazing rates and plans are appropriate to range conditions. They found that, in most cases, the online tools supported the results from field monitoring data and allowed them to understand conditions on much larger areas that would have been possible without these online remote sensing tools. **The [DroughtView](#) and [SPI explorer](#) tools were especially helpful.** Other tools included [VGS](#) for data input, [GrassCast](#), [FuelCast](#), [MyRaingeLog](#), and others. Helpful tools located on [UA Drought Dashboard](#), [Rocky Mountain Field Station](#), NRCS, [SWCH](#) websites.

Potential Collaborations that emerged during discussion:

- Pima County using USGS Drought Forecast and other predictive tools to look at future conditions
- Presentation about USGS Drought Forecast tool to folks working on Burned Area Emergency Response



Appendix A - Links from Presenters

Tonya Haigh

1. <https://drought.unl.edu/ranchplan/Overview.aspx>

John Bradford

1. <https://chsapps.usgs.gov/apps/land-treatment-exploration-tool/map>

Anne Gondor gondora@email.arizona.edu

1. <https://rangelandsgateway.org/project/rangedocs-national-grazingland-information-system>
2. <https://www.unep.org/resources/publication/rangelands-atlas>
3. <https://iyrp.info/>
4. <https://rangelandsgateway.org/>
<https://extension.arizona.edu/sites/extension.arizona.edu/files/attachment/2019NEPA-for-ranchers.pdf>

Liz Delcamp Liz.Delcamp@pima.gov; Vanessa.Prileson@pima.gov

1. https://webcms.pima.gov/government/sustainability_and_conservation/conservation_science/the_sonoran_desert_conservation_plan/
2. <https://cals.arizona.edu/droughtandgrazing/tools>
3. <https://vgs.arizona.edu/>
4. <https://droughtview.arizona.edu/>
5. <https://grasscast.unl.edu/>
6. <https://www.fuelcast.net/>
7. <https://rangelands.app/>
8. <https://myraingelog.arizona.edu/>
9. <https://myraingelog.arizona.edu/>
10. <https://uaclimateextension.shinyapps.io/SPItoolV1/>



Appendix B - Presenter Responses to Questions

To Tonya Haigh, NDMC

Q: How do you think Great Plains ranchers might benefit from expanding your work into areas that experience even more extremes, like southern Arizona ecosystems do?

A: NDMC wants tools to be relevant across the southwest, not just in the Great Plains and works closely with the Southwest Climate hub. Ranchers in southern Great Plains have a lot to learn from folks in the Southwest who might have more experience with drought. Northern Great Plains have much to learn about flash drought and how to adapt to rapid onset of drought. Great benefit in learning from each other about how to make timely decisions about drought and what information is available.

To Liz Delcamp and Vanessa Prileson, Pima County

Q: Why isn't the huge difference due to grazing at least as much as drought? When had grazing been started or stopped for each of the monitoring points?

A: In this particular location (the photo comparison) the ranch had been grazed lightly in a rest-rotation system since 2016, but most of the effect you see was from the drought in 2020.

To John Bradford, USGS

Q: The USGS soil moisture forecast tool seems like it could be helpful in determining seed application efficacy in tandem with BAER and other Rx efforts following landscape scale fire. Just curious if any plans to roll it out for fire Rx use.

A: While we have thought about that potential application, we haven't actually pursued it yet. I'm hoping that generating gridded products every month (which we're working on now) will be a useful step toward informing post-fire activities

Q: Has there been an evaluation of seeding as compared to relying on the seedbank?

A: Seedbanks are definitely a potentially useful source of seed for recovering from disturbance. It seems that, in many locations especially the interior west, the seedbank isn't providing enough seed fast enough to avoid conversion to invasive annuals. My impression is that this challenge is much different (e.g. less) in other areas like the Great Plains that have more reliable summer precipitation.



Summary of CCAST Panel Discussion, November 9th, 2021

Fire as a Tool for Grassland Restoration and Management

Link to Recording on CCAST's YouTube Channel: <https://youtu.be/vhHXsfX-X3s>

Steve Sesnie (steven_sesnie@fws.gov) CCAST Case Study: <https://arcg.is/1C5PeO>

Buenos Aires NWR protects habitat for AZ's rarest bird, the masked bobwhite quail, in sonoran desert grasslands. Using geospatial, field plot, and fire frequency data, Steve et al. found that increasing frequency of summer fires negatively impacts quail habitat by homogenizing the heterogeneous mixture of shrubs, sub-shrubs, grasses, and forbs that make for good quail habitat. Recommendations are to implement cool season burns at BANWR, assess species-specific habitat needs, implement long-term monitoring, and use data for adaptive management.

Scott Collins (scollins@unm.edu) CCAST Case Study: <https://arcg.is/1r1qKL>

Although frequent fire helps maintain grassland vegetation structure in wetter-cooler grasslands, this is less clear in arid grasslands like the Chihuahuan grasslands of New Mexico. In a replicate controlled experiment, researchers burned in spring, fall, and summer of 2008 and again in 2017, and compared effects on vegetation structure over 10+ years. Burning did not increase cover of grasses or reduce cover of shrubs compared to unburned controls but it did increase cover of forbs. Cooler season burns resulted in the largest increase in grasses and reduction in shrub cover.

Jeff Adams (jeffrey_adams@fws.gov)

Prescribed burns are an important management tool to maintain ecological function in grasslands and prevent catastrophic fires. However, work remains to craft Best Management Practices (BMPs) that are locally appropriate, informed by science, and aware of barriers (logistical, political, funding related, etc) that can prevent implementation of prescribed burns. There is an ongoing need for dialogue that can bring together scientists, managers, and policy makers to align the science, funding cycles, and on-the-ground practicality needed to implement prescribed burns.

Discussion

- Sacaton grasslands respond well to fire (spring pre-greenup) when shallow groundwater is available (Leslie Canyon NWR and Babocomari Ranch in SE-AZ).
- High tumbleweed biomass failed to increase mortality of shrubs.
- Find timing of fire that promotes native species in areas where invasives are present:
 - Cool season burns in L. Lovegrass dominated areas allowed re-growth of native, warm-season bunchgrasses. Warm season burns increase L.lovegrass and decrease shrubs important for Masked Bobwhite Quail (SE-AZ).
 - Blue gramma is resistant to fire. Black gramma which does better with no fire
- Cool season burns have been used to effectively meet management goals in NM and SE-AZ when burning is more logistically feasible.

Needs identified by participants

- Research to find optimal seasonality and frequency of burns to benefit desired species.
- Tools that can help to prioritize when and where to burn during increasingly short burn windows (fall and winter) to optimize wildlife connectivity and linkages.



Appendix A. Chat Comments

- Steve--I am very interested in seeing the final pub on the LiDAR and fire recurrence. THX.
- This is consistent with what we were seeing in late 1980s when I did my Habitat studies of reintroduced masked bobwhite. Prescribed fires were increasing Lehmann's lovegrass and decreasing native grasses in bottomland areas preferred by the masked bobwhite. The diversity of native grasses was an important habitat component
- Nicely done Scott, very interested in the prospects of conducting cooler season burns and still achieving objectives
- BANWR burns during cool season over the past 5 years to help break up continuous L. lovegrass fuels. This is important because the natives are still there, underneath the dense lovegrass, and the natives can take advantage of temporary lovegrass setback by fire. We don't really know what frequency is necessary to maintain native grass seed production. Burning in cool season doesn't hurt most natives that use a monsoon season for their growth spurt.
- Sevilleta hasn't done a summer prescribed burn in over a decade and has gone to cool season burns.
- Would like to hear what people know about burning sacaton and impacts on birds.
- Our burn windows have shrunk quite a bit with changing weather patterns. We are doing most of our burning now and early winter. Tools that can help to prioritize within those short windows to help optimize wildlife connectivity and linkages could be really helpful if anyone is working on those.
- I have seen the 99-Bar Ranch upstream from Leslie Canyon NWR burn giant sacaton almost annually during April before green-up, and it sustained well. There is a shallow groundwater level at that location.
- I know Babocomari Ranch in se AZ also burns sacaton regularly, almost annually and it does seem to sustain well. Also has shallower groundwater there
- I think the tumbleweed might cause the shrubs to burn better too as the old weeds build up at the bases of shrubs
- prior to 2003 management burn we piled tumbleweeds around some creosote. No effect.



Appendix B. Additional Question Responses from Panelists

- How to overcome the hurdle of private insurance and liability? Any resources to point towards?
- How to overcome the barriers of cost and availability when professional teams need to be involved to use Rx fire?
- What are the benefits for ranchers to using fire as a management tool on working lands and how do you communicate and demonstrate those benefits?
- How do you overcome the barrier of working on land managed by agencies that may have policies in place that are difficult to meet practically (i.e. time & money needing to monitor or survey the entire burn area before a Rx fire)
- Any lessons learned to share about conducting outreach with stakeholders when planning a fire? How do you keep stakeholders engaged?
 - Steven Sesnie - A few lessons learned from fire and other stakeholder driven work :
 1. Respectful communication is paramount
 2. Make frequent/punctual updates and reach out to stakeholders with interim information
 3. Ask for input and show where it has been assimilated
 4. Follow-up when asked for something
 5. Meet deadlines
- What is one of the most important things that folks should consider when planning to use fire as a grassland management and restoration tool?
 - Scott Collins - One of the biggest challenges is to know the plant community and the consequences of burning on species of interest. Some plants do not have a long evolutionary history with fire and they don't respond well to burning. Others do. In many mesic grasslands, though, fire is an important tool and widely used.
 - Steven Sesnie - I give three with equal weight:
 1. Must have an idea of desired outcomes both short and longer-term (under what conditions can these met?)
 2. Safety assurances for people and valued assets
 3. Pros/cons of treatment alternatives (Is fire the right tool?, Should fire be used in combination with other treatments? etc.)



Appendix C. Recent publications from Steve Sesnie relevant to his presentation:

1. Tellman, B., K. McSweeney, L. Manak, J.A. Devine, S. Sesnie, E. Neilsen and A. Dávila. 2021. Narcotrafficking and land control in Guatemala and Honduras. *Journal of Illicit Economies and Development* 3:132-159. DOI: <https://doi.org/10.31389/jied.83>
2. Lehnen, S., M.A. Sternberg, H.M. Swarts and S.E. Sesnie. 2021. Evaluating population connectivity and targeting conservation for an endangered cat. *Ecosphere* 2:e03367. DOI: <https://doi.org/10.1002/ecs2.3367>
3. Tellman, B., S.E. Sesnie, N.R. Magliocca, E.A. Nielsen, J.A. Devine. K. McSweeney, M. Jain, D.J. Wrathall, A. Dávila, K. Benessaiah, and B. Aguilar-Gonzalez. 2020. Illicit drivers of land use change: narcotrafficking and forest loss in Central America. *Global Environmental Change* 63:102092 DOI: <https://doi.org/10.1016/j.gloenvcha.2020.102092>
4. Sesnie, S.E., H. Eagleston, L. Johnson, and Y. Yurcich. 2018. In-situ and remote sensing platforms for mapping fine-fuels and fuel-types in Sonoran semi-desert grasslands. *Remote Sensing* 10:1358. DOI: <https://www.mdpi.com/2072-4292/10/9/1358>
5. Butler, M.J., S.E. Sesnie, J.M. Timmer, and G. Harris. 2017. Integrating land surface phenology with cluster density and size improves spatially explicit models of animal density. *Remote Sensing of Environment* 199:51-62. DOI: <http://dx.doi.org/10.1016/j.rse.2017.06.046>
6. S.E. Sesnie, B. Tellman, D. Wrathall, K. McSweeney, E. Nielsen, K. Benessaiah, O. Wang, and L. Rey. 2017. A spatio-temporal analysis of forest loss related to cocaine trafficking in Central America. *Environmental Research Letters* 12:05401. DOI: <https://doi.org/10.1088/1748-9326/aa6fff>
7. S.E. Sesnie, J.M. Mueller, S.E. Lehnen, S.M. Rowin, J.L. Reidy, and F.R. Thompson III. 2016. Airborne laser altimetry and multispectral imagery for modeling Golden-cheeked warbler density. *Ecosphere* 7:e01220. DOI: <https://doi.org/10.1002/ecs2.1220>



CCAST Webinar Summary, March 1st, 2022

Grassland Effectiveness Monitoring (GEM) Protocol: A Rapid Approach to Evaluate Grassland Management Activities & Monitor Grassland Condition

Link to Recording on CCAST's YouTube Channel: <https://youtu.be/L2VKKI1736w>

Presenters: Daniel Bunting and Don Wilhelm

The GEM protocol is a rapid assessment tool in its second year of field trials designed to quantify effectiveness of restoration, monitor grassland trajectories, and validate value of incentive programs. GEM is based on BLM's AIM protocol and offers three tiers of complexity allowing managers to rapidly assess grasslands based on their objectives. The main survey method used is the Line-point Intercept to document vegetation cover and to characterize ground cover and substrate type. By leveraging ESRI's Survey 123 platform, GEM integrates plant lists and relational databases to automate data analyses. ArcGIS Online is used to centralize data collected in the field and minimizes front- and back-end data processing.

Appendix A: Notes from Discussion & Chat

- One of the goals behind the GEM effort is to be able to use a common protocol across multiple agencies and partners to collect standardized data that can be used to analyze the health and condition of our grasslands.
- GEM uses a tablet based app, Survey 123, and can record survey data even when outside cellular service or wifi range. Participants have successfully used Survey 123 on both tablets & phones (iOS devices and other operating systems).
- The app developer also has more control on data consistency, leading to less data QA/QC. Data entry directly on tablets with data synching allows data to be directly uploaded to a cloud server, in this case AGOL. This eliminates data entry and potential errors related to human error or bad handwriting.
- Potential challenges with tablet based data collection could be related to impacts of weather on screen functionality (e.g., tablets could overheat or rain could preclude the use of a touch screen) or the process of transitioning a program or agency from paper based datasheets to digital tablets. A participant said that Ice packs can prevent overheating of personnel and electronic equipment in warm field conditions. Write-in-the-rain paper can still be used as a back-up to collect data in rainy conditions. Using old cell phones with Survey 123 can help reduce cost when transferring to tablet based data collection. Once moved over to tablet-based systems like Survey 123, staff tended to prefer it because of ease of post-collection data processing and how much quicker you can go from data collection to data use.
- Forest Service Region 3's range program is working on Survey123 data to hopefully feed into a cooperative database, but uses [VGS](#) Vegetation GIS Data System for long-term vegetation sampling protocol. VGS was unknown to presenters and several webinar participants.
- Since GEM is based on AIM and NRI protocols, it has potential to be used to integrate into large datasets with existing data taken using these methods. There is also potential for it to be used to help validate remote sensing products like the Rangeland Analysis Platform (RAP) that use this data. The



data gathered using GEM can be easily shared amongst partners or restricted if there are issues with data privacy.

- GEM protocol can be used across wide geography and grassland sub-biomes. Plant lists have already been generated TX and preliminary lists are available for AZ and NM but some work needs to be done for it to be used in OK.
- When thinking about using GEM and what level of rigor to use, consider protocols already in use and what data they capture. Is it redundant with GEM or complimentary? The GEM team is interested in knowing what survey requirements or success criteria managers or end-users consider when measuring species specific habitat characteristics. The GEM program is in year 2 of a 2-yr pilot study and still has time to make final adjustments. For example, adding relevant or excluding unnecessary components to the survey apps (e.g., GEM does not survey litter depth but has recently heard that that is an important component for certain foraging birds; GEM could easily add litter depth to LPI measurements).
- Oaks and Prairies JV will be doing bird surveys in GEM plots to try and correlate bird data with GEM data. The GEM team is interested in what other species, guilds, or resources are being managed within grassland communities, (e.g., pronghorn, pollinators, grassland birds, ground-nesting birds, etc.) and what is considered important in the context of habitat requirements.
- GEM envisions success criteria being different within different grassland sub-biomes. Reference sites may or may not be present in your geography. In the future, however, GEM data points can be correlated to or integrated with other resource surveys to provide insights on which landscapes support healthy, sustainable populations. Success criteria can then be based on reference conditions of the best survey sites within each grassland sub-biome.
- Some thoughts participants shared about success criteria for grassland management and restoration include:
 - Success criteria vary by the scale of the question. Site scale measures are likely different than regional scale assessments.
 - Having a suite of different metrics could help balance needs between species like big game vs obligate bird species.
 - Litter depth for bird species that forage in litter or bare ground
 - Success is having resilient grasslands that still produce forage during droughts
 - Success means increased native forage, species abundance, and increased diversity for resilience.
 - Need to monitor % bare ground and % perennial herbaceous cover (for a Rangeland program)
 - Success is % bare ground decreasing and indicator species increasing
 - We focus on % bare ground and perennial cover, but I would like to see an emphasis on species richness as well.
 - species richness, height heterogeneity, native plant diversity, amount of open ground (sand), range production
 - Need to know about shrub diversity & structure
 - Measure results of Juniper encroachment treatments, including any distinctions between mastication v. agroaxe v. pushing.
 - Percent canopy cover especially in pinyon-juniper woodland savanna's

Appendix B: Follow-up conversations:

GEM developers want to hear:

- What data folks monitoring grasslands for species-specific habitat characteristics need to ensure GEM is capturing relevant data. Especially for birds. Oaks and Prairies JV is actively working on this.
- What level of the GEM would meet manager needs (Cadillac, Impala, Geo)



- In the context of integrating GEM with remote sensing: can GEM data be used to train & validate remote sensing products (e.g., Rangeland Analysis Platform). Rocky Mountain Research Station folks (USFS) would be helpful here. Also, how can long-term remote sensing monitoring be implemented to track grassland health (e.g., vegetation indices [EVI/NDVI] to track health and productivity, supervised/unsupervised classification to track woody vs herbaceous cover)

Appendix C: Upcoming Opportunities Shared:

- 1) Quivira coalition's monitoring workshops - [Collaborative Monitoring Success](#)
- 2) Decision Support Tools - looking for case studies using Grassland Decision Support tools & Contact Ariel if you would like to join a Working Group building a searchable database of Grassland Decision Support Tools - Arielleger@arizona.edu
- 3) [CCAST Bullfrog workshops](#) - March 30th
- 4) [Sonoran Seed Summit](#) - Tuesday April 5th 2022



CCAST Panel discussion Summary, May 19th, 2022

Rock Erosion Control Structures to Improve Perennial and Ephemeral Riparian Habitat

Link to Recording on CCAST's YouTube Channel: <https://youtu.be/1zWjKkRYOcw>

Laura Norman - Presentation Slides (Coming soon)

Dr. Norman's presentation gives an overview of previous and current research about Natural Infrastructure in Dryland Streams (NIDS) that include many different types of erosion control structures from small scale one-rock dams, to medium sized check dams or beaver dams, and larger gabions. The presentation includes quantification of ecosystem services such as carbon storage, sediment retention, erosion reduction, and groundwater recharge that these structures can provide.

Tess Wagner - [Presentation Slides](#)

Tess discusses Borderland Restoration Network's (BRN) approach to watershed restoration and how Erosion Control Structures are a foundational part of restoring ecosystem processes, and habitat for native species. BRN combines multiple types of low-tech loose rock structures including Zuni bowls, one-rock-dams, and hybrid rock-wood structures, with pelletized native seed, to slow water, reduce erosion, and re-establish native plants.

Discussion Summary

Questions revolved around how to implement, maintain, measure impact, and navigate regulations. Tess and Laura go over details of factors to consider when using different types of structures, provide helpful materials to guide implementation and reduce chances of failure and consequences when structures breach, how and when to maintain structures, costs of implementation, benefits to ecosystem services and for specific species. Discussion is included in the webinar recording.

Appendix A: Presenter Responses to Unanswered Questions

- What kind of permitting was necessary (if any) for installing in stream structures?
 - **TW**—It depends on where the work is being done. If we do work on federal lands, we have to get NEPA clearance to do any sort of work. We work with federal land managers to make this happen. On private lands, we don't need to worry about permitting. The structures we build are water retention structures, so we aren't detaining or diverting water in hugely significant ways that affect downstream water availability and would require permits.
 - **LN**- 'RDS are established to detain water (not retain it) in more remote areas; allowing water to slowly pass through, infiltrate the soils and regenerate landscapes'
- Was success/failure [of erosion control structures] linked to stream gradient or stream order?
 - **TW**—Those definitely have an impact on the success of ECS (erosion control structures). Bigger flow volumes (i.e. increasing stream order) do result in more failures generally. And, since an increased gradient increases flow velocity, that also contributes to more failures in structures (flow velocity and volume are the most important factors to consider). That's why this type of work is much better suited for smaller, ephemeral, and often upland work, and why we start at the top of the watershed and work our way down.
- How effective are these types of structures in times of drought? It's my understanding that they require precipitation to provide any functionality, or does it matter?
 - **TW**—If water isn't flowing through the landscape, these structures don't do much. ECS performance is very much reliant on the context they occupy, and they are meant to modify flows. So, if there is no water flow, there is nothing to modify. But that's ok - because in drought you don't typically have massive erosion issues because rapid, human-caused erosion occurs with the flow of water.
- Have you installed any structures in areas with extensive salt cedar? If so, can you explain challenges and responses?
 - **TW**—We have not done this. I am curious to know more about this question because tamarisk is actually extremely effective at erosion control, so we haven't seen these issues occur together at any of our sites. I think this is a very context-specific question that I would need to know a bit more about to answer properly (and also quite possibly I don't have the appropriate experience to provide any good answers here).
- Alternative materials for construction of Erosion Control Structures: are tires a good alternative to rocks in erosion control structures? What about repurposed chunks of cement?
 - **TW**—We have used repurposed concrete before, and it works great! It has nice flat surfaces and angular sides, which are the ideal shape for building these structures. One thing to consider is that concrete can leach contaminants into the ground. This is especially true for fresh concrete - though presumably if you are using repurposed concrete, it is not fresh and has likely already leached what it is going to into the ground. Concrete will continue to contribute lime to the soil as water flows over it, so that's something to consider. We've never used tires, and I'm not quite sure how this would work. I'm thinking you would have to dig a trench and then put the tires upright (like how they sit on a car) and bury them about halfway. But then you would need to stack rocks behind the tires to fill in the hole in the middle, and then the tires wouldn't be serving much of a purpose (why not just do the rocks? Then you don't have to dig a big trench and you don't have to use tires). Regardless of construction technique, my bigger



concern would be leaching from tires. They have a number of toxic chemicals in them, and introducing that into any area where water is flowing is likely not going to be very beneficial for downstream systems.

- **LN** - CONAFOR advocates using tires, with great success (see <http://www.conafor.gob.mx:8080/documentos/docs/20/1310Manual%20de%20Conservacion%20de%20Suelos%20.pdf>).
- What about the utility and application of Rock Detention Structures in perennial streams?
 - **TW**—We haven't done this because in these arid, flashy systems, anything that's perennial will typically receive too much water moving at too high a velocity in monsoon season for the ECS to hold. These systems would be more appropriate for larger structures like gabions - though ongoing maintenance is necessary for these to function, and if they aren't built correctly they can fail pretty catastrophically so these are some considerations. If there's a perennial stream with issues, I would look at what's happening in the tributaries upstream. Can you mitigate some of that flow volume and velocity by building structures in ephemeral tributaries upstream so that surface water entering the perennial area isn't causing severe erosion as it enters the system? You likely won't be able to treat all the tributaries because of scale and access and capacity, but even working on one can have real impacts, especially if more of us are doing this work across the region.

Appendix B: Resources and Links

- CCAST Case Studies featuring Erosion Control Structures:
 - [Post-Fire Watershed Restoration and Monitoring in the Chiricahua Mountains of Arizona](#)
 - [Cuenca los Ojos: Three Decades of Restoring Water Flows on Private Land in the U.S. and Mexico](#)
 - [Assessing the Hydrologic Effects of Erosion Control Structures on the Babacomari Ranch](#)
 - [Collaborating to Enhance Habitat for the Montezuma Quail](#)
 - [Cienega Watershed Erosion Management and Restoration Plan](#)
- Erosion Control Guides
 - [Quivira Coalition Guide](#)
 - [Watershed Artisans Guide](#)
 - [Food and Agriculture Organization \(FAO\) guide](#)
 - [Protección, restauración y conservación de suelos forestales: Manual de obras y prácticas \(5.ª edición\)](#). Comisión Nacional Forestal (CONAFOR).
 - [SER Newsletter with article about cost of implementation](#)
- USGS Research on Rock Detention Structures:
 - [Aridland Water Harvesting Study | U.S. Geological Survey \(usgs.gov\)](#)
 - [Ciénega San Bernardino - Wetland Restoration | U.S. Geological Survey \(usgs.gov\)](#)
 - [Patagonia - Gully Restoration | U.S. Geological Survey \(usgs.gov\)](#)
 - [Nogales, Sonora - Flood Control | U.S. Geological Survey \(usgs.gov\)](#)
 - [Chiricahua Mountains - Reduction of Channel Gradients | U.S. Geological Survey \(usgs.gov\)](#)
 - [Babocomari - Managed Aquifer Recharge | U.S. Geological Survey \(usgs.gov\)](#)
 - Select publications:
 - [Ecosystem Services of Riparian Restoration: A Review of Rock Detention Structures in the Madrean Archipelago Ecoregion](#)
 - [Commentary: Dryland Watershed Restoration With Rock Detention Structures: A Nature-Based Solution to Mitigate Drought, Erosion, Flooding, and Atmospheric Carbon](#)
 - [Editorial: Combining the Science and Practice of Restoration Ecology—Case studies of a Grassroots Binational Restoration Collaborative in the Madrean Archipelago Ecoregion \(2014-2019\)](#)
 - Norman, L. M., Lal, R., Wohl, E., Fairfax, E., Gellis, A. C., & Pollock, M. M. (2022 *In Press*). Natural infrastructure in dryland streams (NIDS) can establish regenerative wetland sinks that reverse desertification and strengthen climate resilience. *Science of the Total Environment*.



CCAST Webinar Summary, July 19th, 2022

Grassland Restoration to Support Pronghorn in Southeastern Arizona

Link to Recording on CCAST's YouTube Channel: https://youtu.be/L_KvkUgGyzw

John Millican - Field Manager [Arizona Antelope Foundation](#) AAF ([Slides](#))

The Arizona Antelope Foundation and partners deployed over \$1.7M in grant funding to support Pronghorn in six herd zones to increase connectivity and habitat condition. These herd zones include the Altar Valley, San Rafael Valley, Sonoita plains, Allen Flats, Bonita, and San Bernadino Valley. Activities included grassland restoration (burning, grubbing, and herbicides), water installations, and fencing modifications. John presents these activities, monitoring and follow-up restoration treatments, and impacts on Pronghorn and other wildlife, as well as land owners.

Gerald "Gerry" Bethellette - [Landowner Relations Program](#) (LRP) Arizona Game and Fish Department (AZGFD) & Pheasants and Quail Forever ([Slides](#))

Gerry explains the AZGFD Landowner Relations Program, and his role implementing habitat conservation projects in Southeastern Arizona. The AGFD LRP looks for win-win projects that benefit wildlife and cattle. The LRP helps develop plans, overcome compliance needs, and provide matching funds for implementation by leveraging partnerships with multiple organizations and agencies. Gerry presents funding opportunities, his work with the Southern Arizona Grassland Initiative, and discusses the use of multiple grassland restoration methods to improve habitat and connectivity for wildlife.

Resources

-[Arizona Antelope Foundation Website](#)

-Resources for funding opportunities:<https://www.tenstrategies.net/newfederalfunding>

-[CCAST Case Studies about Woody Plants](#)

-CCAST Case Studies about Pronghorn;

Habitat projects:

-[Pronghorn-Friendly Fence Modifications in West Texas Grassland](#)

-[Increasing Habitat Connectivity and Permeability for Pronghorn in Southeastern Arizona](#)

Post fire:

-[Rangeland Restoration Following Fire in Reno, Nevada](#)

Landscape level planning:

-[Green River Basin Landscape Conservation Design Project](#)

-[CCAST YouTube Channel](#):

-[CCAST webinar featuring a presentation about TreeAge, an emerging tool to predict the effects of woody plant removal on grassland and migratory birds](#)



[-Andersen & Steidl 2019 "Woody plant encroachment restructures bird communities in semiarid grasslands" Biological Conservation](#)

-Upcoming AAF Events: [Sign up through AAF website](#)

-Williams—US 89 Fence Removal August 06, 2022 8:00 AM Williams—US 89 Fence Removal

-Seligman Fence Removal: September 24, 2022 7:00 AM approximately 2.3 miles south of Highway 66, 17.3 miles west of Seligman, AZ

Discussion & Chat

-SEAZ Grassland map data is still relevant and valuable. Some of the data is from early 2000's and could benefit from being updated.

[-https://azconservation.org/project/grasslands/](https://azconservation.org/project/grasslands/)

[-https://azconservation.org/publication/grassland_assessment_report/](https://azconservation.org/publication/grassland_assessment_report/)

-When discussing mesquite removal, it is important to note both the increases and habitat changes while also being careful about labeling mesquite and Juniper as "invasive" trees since they are native species that have evolved in this landscape

Q: What herbicide did you use for stump treatment?

A: Valpar ground application. AAF utilizes the expertise of the local NRCS office to identify which herbicide to utilize depending on the density, size of mesquite, and other site characteristics.

-Q: What was your success rate for preventing re-growth with herbicide?

-AAF relies on NRCS to recommend type and application method of herbicide, as well as do monitoring for effectiveness. Herbicides can reduce costs and some of the more onerous compliance requirements needed for grubbing projects. Herbicides are usually used for maintenance after initial grubbing. Found that fires tend not to kill mature mesquite, only set it back, and can be difficult to integrate into ranch management plans if cattle need to stay out of burned pasture for several years to allow pastures to recover. AAF have plots in areas treated with herbicides. Full effectiveness of herbicides can take several years to take effect. AAF have yet to assess effectiveness from these surveys.

-Q: What is the monitoring plan for areas that have been cleared of mesquite? How frequently are you doing revisits to document changes?

-A: AAF relies on NRCS, forest service, blm does monitoring.

-A: AGFD is in the process of completing a [study about the long-term effectiveness of various woody plant removal techniques](#). The second year of monitoring and data collection will end this fall.

-Q: Did you see an increase in invasive herbs/forbs coming into the area after the removal of the woodies?



-A: Lehmann lovegrass comes back a lot after spraying with herbicides or other disturbances from removal of mesquite. Have not heard from landowners that any other invasive species have returned or had adverse effects on wildlife or cattle.

-Q: Have you developed a map of priority areas across AZ where you believe these grassland restoration treatments should be expanded? If so would you be willing to share the GIS data?

-A: The Nature Conservancy have used the following resource extensively with partners to target grassland restoration work:

https://azconservation.org/publication/sustaining_the_grassland_sea/

-A: It would be great if we could revisit the assessments this paper is based on and determine how our grasslands have changed over the past two decades (that paper is largely based on grassland data that was completed/compiled in the early 2000s)

-Q: How were locations for Pronghornwaters selected? Is use by pronghorn monitored? Have there been any issues of pronghorn being excluded from using waters due to the presence of livestock?

-A: Where are year-round, perennial waters and trying to have one every mile or two on the landscape which is important during fawning season. Many of the waters were already there but not working or not year-round. Sought out existing installations and helping improve and form agreements to keep them around year-round. Have not seen many negative interactions between livestock and cattle but when they have, have installed fences to keep livestock out.

-Q: have areas where woody plants were placed as windrow more beneficial for native birds than brush piles? How do other wildlife spp. respond to mesquite removal treatments? Need understanding of full ecological response and getting presentations about effects on multiple species, birds and others.

-A: AZGFD does an assessment for mitigative methods needed when implementing projects to benefit multiple species

-A: As AAF is doing more work in the uplands, many more species use the landscape. AAF is working with AZGFD, NRCS, landowners, and applicators to develop prescriptions that will benefit pronghorn, grassland birds, quail, and big game, and tweak prescriptions to benefit multiple species.

-A: [Andersen & Steidl 2019 "Woody plant encroachment restructures bird communities in semiarid grasslands" Biological Conservation](#)

-Q: What is the style of water developments you are using? Are most float valves and troughs from wells? Any in more remote areas without wells?

-A: Most from existing wells. Some have water lines that are over a mile long where wells are not available. Others have dirt tanks where wells are not proximate. Mesquite removal and grass response reduces silt in water that fills dirt tanks and helps keep them usable for longer.



-Q: How are you monitoring pronghorn use of waters and evaluating success and effectiveness?

-A: AZGFD wildlife managers and landowners are doing monitoring on a yearly basis during the driest part of the year to ensure use by pronghorn. AZGFD did not have to haul any water for pronghorn in project areas in SEAS: a testament to the success of these projects.

-A: Some folks are using remote monitoring system to be able to monitor water levels at a distance. Using weather station data loggers at wells.



CCAST Webinar Summary, August 30th, 2022

Recovering the Endangered Sonoran Pronghorn

Link to Recording on CCAST's YouTube Channel: <https://youtu.be/UegKZGUiXrY>

Stephanie Doerries - Sonoran Pronghorn Recovery Coordinator Wildlife Biologist FWS

Stephanie talks about the historical and current range, biology, and ecology of Sonoran pronghorn including preferred habitats and population estimates. Recovery of this endangered species has relied on captive breeding, habitat modifications, a robust monitoring program, and effective partnerships. Over the years, the FWS has released nearly 400 pronghorn back into the wild with close to 70% survival. Stephanie introduces methods used to track pronghorn via radio collars. The FWS estimates pronghorn populations via aerial surveys and non-invasive genetic monitoring. Methods and lessons learned about the captive breeding program as it grew, and details about habitat modifications, forage enhancement plots, and supplemental feeding and watering stations are also discussed.

Resources

[Grassland Community of Practice Public Folder](#)

[Previous CCAST Grassland Webinars](#)

CCAST Case Studies about Pronghorn:

[Increasing Habitat Permeability and Connectivity for Pronghorn in SE-AZ](#)

[Pronghorn Friendly Fence Modifications in West Texas](#)

Upcoming Events:

-Volunteer Opportunity in September in Ajo AZ to help set up corrals to prepare for releases. Volunteer through the [Arizona Antelope Foundation](#), or by contacting Stephanie stephanie_doerries@fws.gov.

-Cabeza Prieta Wildlife Refuge has regular volunteer opportunities, contact Stephanie stephanie_doerries@fws.gov

Discussion & Chat

Q: At a landscape level of restoration (thousands of acres or more), what are the most important and/or cost effective ecological modifications that can be strategically implemented to support Sonoran Pronghorn?

A: The best tool, and in some ways the most cost effective, is to **reduce further impacts like habitat fragmentation and degradation**. For example, in some of the areas where FWS is supporting nonessential populations, solar developments are being installed on areas of flat desert pavement. These are important areas for Sonoran Pronghorn because they have high forb production after rainfall. Reducing fragmentation and



habitat loss requires partnerships with other agencies and can depend on broader policies, especially when they occur outside of protected areas. **Providing supplemental water** is another cost effective way to support pronghorn at the landscape scale, especially with a large, permanent system requiring minimal management over time. In 2M acres where the endangered population of Sonoran pronghorn roams, there is only one permanent source of water, Quitobaquito, and Sonoran pronghorn don't typically use this area because of the dense vegetation, proximity to the border, and high human disturbance on MX HWY 2. Thus, additional waters are important. **Pronghorn survived where they were left alone, not necessarily in the best habitat.** Many of the historical water sources in their habitat range are no longer available.

Q: Is there coordination with Mexico to maintain genetic diversity?

A: FWS is currently trying to **translocate 6 pronghorn from US to MX**. Permitting has been a difficult barrier to overcome. Hoping to do the translocation this December. Genetic structure in the US and MX are different. FWS is **wanting to undertake a more regular genetic monitoring program, including sampling in MX** to understand the genetic makeup of Sonoran pronghorn populations. Melanie Culver said that **as long as an animal reproduces, moving one individual every decade or two can be sufficient** to maintain genetic diversity. We are **partnering with geneticists at UCLA and California Department of Fish and Wildlife to map the pronghorn genome** so that we can understand pronghorn genetics and heritage in the US and MX.

Q: Has there been a noticeable impact on pronghorn movement or use of areas close to the US/Mexico border from the building of the border wall?

A: It has been difficult to monitor pronghorn movement near the border because we don't have radio collars in that area. In recent years we have collared only released animals. It's logistically challenging to release pronghorn near the border and pronghorn released in other locations have not moved to the vicinity of the border so we don't have much data about movement in this area and impacts of construction on pronghorn. Mexico HWY 2, which runs parallel to or near the border, prevented movement of pronghorn between populations even before border wall construction began. We did have several pronghorn from the US cross into MX prior to construction that are now trapped between the wall and HWY 2; we are trying to leverage partnerships to move them to the Pinacate or back to the US. In 2007-2008 there was a buck released from the captive breeding pen that crossed HWY 2 several times and was later found with the Pinacate population.



Q: How important is it to the Pinacate population to be able to move in and out of the area between the HWY 2 and the border wall?

A: The largest issue there is HWY 2. The border wall does stop movement. Prior to construction, pronghorn used the area between HWY 2 and the border, but they were predominantly from the US. The border wall will not jeopardize pronghorn recovery. Even before the construction of the wall, HWY 2 effectively prevented movement of pronghorn between US and MX and so was not important to the Pinacate population.

Q: Are we trying to sustain AZ and Mexico populations before reintroducing them to CA and Baja CA?

A: There are currently **no plans to reintroduce pronghorn to Baja California** because that is where Peninsular pronghorn (*A. a. peninsularis*) likely were, not Sonoran pronghorn (*A. a. sonorensis*). Sustaining MX populations from captive breeding pens in the USA is not possible because of the difficulty of moving animals across the border. **We are considering a captive breeding program in MX, but the current focus of the program is on AZ populations, especially the experimental ones.**

Q: How often/many are captive pronghorn released into the wild and how are those areas for releasing them determined?

A: **Can only release pronghorn where habitat quality is sufficiently good.** The number of yearlings (almost 2-year-old pronghorn) in the captive breeding pens determines the number we can release into the wild each year. Where pronghorn are released is determined by habitat conditions in potential release areas and where we need more radio collared pronghorn for monitoring purposes. We try to keep 10% of each population collared.

Q: I noticed the map showed potential habitat east of the Baboquivari Mountains. Thoughts of establishing Sonoran rather than Mexicana at Buenos Aires NWR?

A: This is a good question and something that has been discussed within the recovery team. Unsure if Buenos Aires NWR is historic Sonoran pronghorn habitat or not and if Sonoran pronghorn might have some genetic adaptations to desert habitats that make them better suited to the area despite vegetation in Buenos Aires NWR being more grassland than desert. We are currently focused on the California, Kofa, and Sauceda populations, and other places in Mexico, including if it would be possible to do captive breeding there. These areas have higher priority than Buenos Aires NWR.

There's been some really great bird diversity at pronghorn drinkers: golden eagles, prairie falcons, and more!



CCAST Webinar Summary, October 17th, 2022

Supporting Pollinators in Grasslands

Link to Recording on CCAST's YouTube Channel: <https://youtu.be/D0Gcp4CHCF0>

Dr Lauren DiCarlo - Westfield State University - Presentation Slides - [CCAST Case Study](#)

Altered fire regimes, woody encroachment, and invasive annual grasses are leading to the decline of semi-arid grasslands of the Pacific Northwest. As managers restore these grasslands, little is known about the impact of restoration on native bees. Dr. DiCarlo and her colleagues studied vegetation composition and bee species at three grasslands in northwestern Oregon. They found that current grassland restoration projects could increase their positive impact on native bees by providing more nesting habitat and increasing floral forage throughout the season.

Dr. Diane Larson - USGS - Presentation Slides - [CCAST Case Study](#)

Grassland managers must balance the needs of multiple resources and objectives, including native plants, pollinators, and removal of invasive species. Dr. Larson's research investigates how the removal of invasive flowering plants, sweetclover (*Melilotus officianalis*) and russian thistle (*Salsoa spp*) might impact native pollinators and reproduction of rare plants. Invasive plants may be beneficial to pollinators and the other plants they support, and their removal may have potential negative impacts to consider for native pollinators and the plants they pollinate.

Resources

[Grassland Community of Practice Public Folder](#)

[Previous CCAST Grassland Webinars](#)

[CCAST Case Studies about Pollinators](#)

Publications from Lauren DiCarlo:

Smith DiCarlo, L. et al. (2020) [Arid grassland bee communities: associated environmental variables and responses to restoration](#). *Restoration Ecology* 28 (S1): A54-A64.

Smith DiCarlo, L. et al. (2019) [Short-term response of two beneficial invertebrate groups to wildfire in an arid grassland system, USA](#). *Rangeland Ecology and Management* 72(3): 551-560.

Smith DiCarlo, L. & DeBano, J. (2021) [Spider community variability and response to restoration in arid grasslands of the Pacific Northwest, USA](#). *Insects* 12: 249.

Smith DiCarlo, L., & DeBano, J. (2018) [Spider community responses to grassland restoration: balancing tradeoffs between abundance and diversity](#). *Restoration Ecology* 27(1): 210-219..



Discussion & Chat

After the presentation, there was a lively Q&A where presenters and participants discussed the questions below and others. You can listen in to this discussion by viewing the [recording in the YouTube video](#).

Did you happen to note any SGCN throughout the study?

Are grassland bees using stems/vegetation for nesting habitat at all? Or primarily soil?

What, if any, large herbivores were in your study area? Ungulates etc.?

In your conclusion, you stated bees are a good species for this type of monitoring. Just curious, are pollinators usually used for grasslands restoration monitoring? If not, what other species are traditionally used? Thanks!

Do you see thresholds of bare ground that seem to be enough for native bees? In arid Arizona, grassland management often aims to reduce bare ground to avoid erosion. Interesting to hear about a negative side of having too little bare ground!

Are there any specific management practices you would recommend regarding next steps at Badlands National Park based on your studies?



CCAST Webinar Summary, January 31st, 2023

Recent Updates to the Land Treatment Exploration Tool (LTET)

Link to Recording on CCAST's YouTube Channel: <https://youtu.be/AP6lzU5eUbl>

Michelle Jefferies, United States Geological Survey (mjeffries@usgs.gov)

The LTET contains data from >62k land treatments across the western USA as well as ecological and climate data to help land managers plan land treatments. In this webinar, Michelle gives us a live demo of the Land Treatment Exploration Tool (LTET) used for a hypothetical grassland restoration treatment in the Curlew National Grassland UT. Michelle also introduces important updates to the LTET that include improvements to accessibility making the data more usable by all, a tab to see BLM AIM monitoring data, and an interactive time-series vegetation cover figure that displays data from the USGS Rangeland Condition Monitoring Assessment and Projection dataset that includes time-series plots of precipitation, wildfire, and land treatments. Michelle is looking for feedback on how the LTET can be improved and expanded upon to be of most use to practitioners in the Southwest. If you are working with publicly available data that is not currently in the LTET, please consider getting in touch with Michelle to integrate it into the LTET and improve functionality and power of the tool.

Resources

[Grassland Community of Practice Public Folder](#)

[Previous CCAST Grassland Webinars](#)

[Land Treatment Exploration Tool](#)

[CCAST Case Study about the Land Treatment Exploration Tool](#)

Discussion & Chat

During the discussion, Michelle answers questions about data availability in Arizona, and potential integration of other publicly available datasets into the LTET. If you are working with publicly available data and models or know of publicly available data and models, please get in touch with Michelle to discuss integration into the LTET, especially if the data you are working with is at an ecosystem scale. Michelle also walks through the plant cover data that shows changes in vegetation over time and the complementarity of other publicly available remote sensing data like the Rangeland Analysis Platform and others that use different modeling platforms.

Michelle is looking for feedback!

What mapping and data products could the LTET could serve up to help fill information gaps at this scale? What data do you wish you had for planning that LTET could serve up to help you in planning and adaptive management? What public data sets could be incorporated into the LTET to fill gaps in Arizona?



CCAST Webinar Summary, February 8th, 2023

Using Mulch for Grassland Restoration in TX and UT

Link to Recording on CCAST's YouTube Channel: https://youtu.be/S253ss7_WDQ

Jeffery Bennett, American Bird Conservancy & Rio Grande Joint Venture - [Presentation slides](#)

The Grasslands not Badlands project at Big Bend National Park started using branch mulch for restoration in 2004. Almost 20 years later, Jeff Bennett discusses how the project effectively restored the soil and plant community on the fine textured erosion prone soils at Big Bend National Park. The Grasslands not Badlands project leveraged a keen understanding of erosional processes and hydrological function to develop successful strategies to restore soil and plant communities at the park.

Rebecca Mann, United States Geological Survey (USGS) - [Presentation slides](#)

The USGS' Southwest biological Science Center in Moab Utah has done a lot of research reclaiming oil and gas sites, degraded rangelands, and mining sites using soil amendments including mulch. Rebecca presents the results of a comprehensive literature review about the effects of various types of mulching for reclamation as well as the results of collaborative research reclaiming oil and gas wells in the Uintah basin. The preliminary results of the collaborative research revealed that mulch was more effective than no mulch, pitting, or connectivity modifiers. At scale, mulch was not as long lasting as surface roughening and broadcast seeding. And a cost effective method of mulching is needed.

Resources

[Grassland Community of Practice Public Folder](#)

[Previous CCAST Grassland Webinars](#)

[CCAST Case Study about Restore Net](#)

[CCAST Case Study about Jeff's work](#)

Discussion & Chat

After each presentation, there was a shorter Q&A as well as a longer discussion at the end of the webinar. You can listen to this discussion by viewing the recording [here](#). Summary of discussion during Q&A below:

Questions for Jeff Bennett

- Arranging treatments linearly to mimic banded vegetation worked well on flat ground but needed to use V's, chevrons, or squares in deeper rills.
- Used multiple kinds of brush. Thinner brush like bee brush and white brush did not work as well as more robust pine or juniper.
- Needed to go through archeological compliance to implement treatments.



- Used salt cedar, no trouble with any salt cedar establishing at dry sites. Chipping finely enough can avoid establishment in wetter sites.
- Branch mulch worked better than chipped mulch. Also the case in the Altar Valley Arizona. Chipped or composted mulch smothers seeds and is difficult to apply in correct quantities/thicknesses to avoid smothering.
- Hydromulcher worked well (also works well across the west) prefer agitator to jet models as the agitator models use less water. Also used a lot of tackifier to protect seeds.
- Saw considerable establishment upslope from treatments where water ponded.

Questions for Rebecca Mann

- Turning literature review into a searchable online tool that will be available soon
- Used commercially available cedar mulch of the type that can be purchased at a hardware store, \$2000/acre.
- Would be terrific to use locally sourced mulch. Talked with local foresters to get wood from slash piles but could not find a good way to transport to restoration sites. Need to put more effort into solving transportation challenge.
- Having vertical structure can be very beneficial to improve microclimate and trap sediment.
- Currently working on analysis of results using integrated mulch and compost and inoculant.



CART Webinar Summary, May 4th, 2023

Understanding Piñon-Juniper Encroachment and Pinyon Jays for Grassland Management

Link to Recording on CART's YouTube Channel: <https://youtu.be/QIGGd6klofk>

Tara Bishop (USGS) tbishop@usgs.gov - Presentation slides

Tara's research group is developing a decision-support tool to assist in landscape-scale management of fire-prone PJ ecosystems on the colorado plateau. This multi-year collaborative project seeks to map current ecosystem conditions, desired future conditions, and how current conditions have departed from desired ones. Tara's research group has condensed 800+ ecological sites into 25 ecological site groups (ESGS) and developed a preliminary state and transition models for the most fire prone ESGs that will be informed by robust and usable fire and fuels data. Ecological conditions are informed by robust data and monitoring and transition models are developed using a collaborative process that leverages the experience and knowledge of a board partnership.

Scott Somershoe (FWS) scott_somershoe@fws.gov - Presentation slides

Populations of Pinyon Jays are declining and the species was petitioned for listing under the endangered species act in 2022. Pinyon Jays are a challenging species to study because of their large home-ranges and the multiple habitat types they depend on, resulting in a lack of data that can help inform conservation of the species. Scott presents about the growth of the Pinyon Jay working group, the Pinyon Jay Conservation Strategy that they published in 2020, survey protocols and species occurrence models the PJWG has developed. The PJWG is helping coordinate range-wide monitoring, developing smaller-scale monitoring protocols for Pinyon Jays that are usable for project-scale monitoring, and assessments of Jay habitat use and movement that can improve understanding of how land management treatments impact this at-risk species and move towards a more holistic approach to management.



Resources

- [Grassland Community of Practice Public Folder](#)
- [Previous CART Grassland Webinars](#)
- [EDIT State and Transition Models](#)
- [Pinyon Jay Working Group](#)
- [Pinyon Jay Conservation Strategy](#)
- Intermountain West Joint Venture report on [Improving Climate Resilience of Persistent Pinyon-Juniper Woodlands](#) that advances a holistic approach to PJ management, addresses threats to persistent pinyon-juniper woodlands, identifies the role of changing climate, and highlights innovative management efforts.
- [Threat-based Ecostate Map](#) for Oregon developed with sage-grouse in mind
- [Soil geomorphic unit and ecological site group maps for the rangelands of the Upper Colorado River Basin region](#)
- [Fire dataset that is a tiered combination of >40 fire data layers through 2022](#)

Discussion & Chat

After the presentations, there was a panel discussion where the two speakers were joined by Valerie Foster (USFS Kaibab NF), Steve Cassady (AZGFD Flagstaff), Edwin Juarez (AZGFD), and John Boone (Great Basin Bird Observatory). You can listen to this panel-discussion by viewing the recording [here](#). Summary of discussion during Q&A below:

Tara answered questions about the data sources her team used to develop the ESG STMs, future data collection to improve understanding of how fire is driving change in PJ ecosystems, and how the drivers are linked to actions land managers can take to help PJ ecosystems move between different ecological states.

Steve Cassady spoke to management that can benefit both Pronghorn and Pinyon Jays simultaneously, and how to ensure that management actions are focused on restoring grasslands and not on converting stable woodlands to grasslands by using soil surveys, ecological site descriptions, and on-the-ground surveys to find locations that are good places for PJ removal to restore grasslands. Steve also described pronghorn use of the ecotone and what the edges of treatment areas look like.

Valerie Foster discussed how the USFS is balancing the needs of multiple species in PJ ecosystems on the Kaibab NF using pronghorn and other big-game collar data & Pinyon-Jay surveys to identify overlap between species habitats to be able to incorporate needs of multiple species in restoration work. They used soil data to identify grassland soils (mollisols) to inform



areas of historical grassland cover to restore by reducing PJ canopy cover. Funding - Joint chiefs project fuels reduction and wildlife habitat enhancement.

Several presenters & participants spoke about the importance of working with partners from Tribal Nations and organizations. Working with federal Tribal liaisons, the strengths and limitations of different engagement methods, and training to help improve tribal engagement. Working with students from Navajo Technical University and Hopi Nation in surveying protocols and grassland restoration work and opportunities for co-stewardship on the Kaibab.

Research Questions & Science Needs

- What can managers do to help enhance habitat for Pinyon Jays in the face of changes like large-scale Pinyon dieoff driven by drought?
- What does restoration in Pinyon-Juniper woodland itself look like to help meet habitat needs of multiple species?
- What are the available funds to make the changes we are seeking to make in Pinyon-Juniper ecosystems (including grasslands and woodlands), and what are the priorities those funds linked to, e.g. fuel reduction, pronghorn habitat improvement, etc.?
- What is the role of the mycorrhizal community in the transitions of Pinyon-Juniper ecosystems between various ecological states?
- Need - More field visits!
- Need - Continue developing relationships with Tribal nations and organizations, and increase training and support for Federal employees to improve these relationships.



CART Webinar Summary, July 6th, 2023

Collaborative Adaptive Management and the Co-Production of Knowledge: The Results Oriented Grazing for Ecological Resilience (ROGER) Collaborative Group

Link to Recording on CART's YouTube Channel: <https://youtu.be/L9quoxVvC0k>

Laura van Riper (BLM) & John Tull (FWS) - [Presentation slides](#)

ROGER is a rancher-led collaborative in Nevada that began in 2019 that emerged from efforts to address highly contentious relationships between permittees and land management agencies in NV. ROGER functions as an interest-based collaborative with sub-groups that carry out specific place-based projects and bring that information back to share with the collaborative as a whole. Primary focus areas include: outcome-based grazing, adaptive management planning, assessment and monitoring, and wildfire & invasive species management. Laura and John present key products and outcomes of the ROGER collaborative, focusing in on the assessment and monitoring work of the science team, and how ROGER is addressing issues of fire and invasive species management. The presentation concludes with lessons learned from sustaining the ROGER collaborative over the past 5 years, the impacts of the COVID-19 pandemic on the collaborative, and quantification of ROGER's impacts using the partnership impact model.



Resources

- [Grassland Community of Practice Public Folder](#)
- [Previous CART Grassland Webinars](#)
- [Case Study about post-fire seeding and recovery in NV after the Martin Fire](#)
- Principal Investigators on the ROGER Science Team are Tamzen Stringham from the University of Nevada, Reno; Peter Coates from USGS; and Matthew Rigge from USGS
- Publication about the [Partnership Impact Model](#)

Discussion & Chat

See recording at [39:19](#) for answers and discussion

- Q: What long-term monitoring are you doing to measure success of fire rehab (Martin Fire)?
- Q: Was there a focus on soil restoration?
- Q: Did the partnership impact model create any changes in the research or future plans?
- Q: Am I understanding correctly that kochia was purposely seeded? Isn't this considered a toxic invasive weed?
- Q: Did you find there was a desire/hunger for this collaboration and how did this manifest itself?

CART Webinar Summary, June 8th 2023

Management Implications of Climate Impacts on Southwestern Grasslands

Link to Recording on CART's YouTube Channel: <https://youtu.be/Ww2znQCFxxc>

Joel Biedermann - joel.biederman@usda.gov

Joel and colleagues at the USDA ARS and UArizona run “RainMan SR”, a rainfall manipulation experiment at the Santa Rita Experimental Range that researches how plants and soils respond to different rainfall scenarios that range from many/small rain events to few/large rain events. This allows researchers to understand how these systems may respond to climate trends that indicate fewer, larger storms with longer dry intervals between them, and less winter precipitation. Plots with few/large rain events wet the soil more deeply sustaining deeper rooted perennials but not shallow rooted annuals. There was more root production in deeper soil layers, and fewer but larger perennial grasses in the few/large plots. There was no detectable change in total biomass in any of the rainfall regimes but peak productivity occurred one month earlier in the many/small rainfall regime (July) than in the few/large rainfall regime (mid-September).

Martha Sample - martha.sample@nau.edu

Martha presented on the creation of the Arid Grasslands Climate Adaptation Menu. This project began in 2018 as a collaborative effort between the USGS and NPS staff from several parks in southeastern Utah. Through a series of collaborative works using the NIACS climate adaptation planning process and workbook, the team developed a menu of climate adaptation strategies for Arid Grasslands that will soon be public. This menu was developed by discussing model results of predicted climate impacts on grasslands in southeastern Utah to generate a suite of potential adaptation strategies, each with multiple possible approaches that managers can consider based on their unique context.

Resources

- [Journal article about the response of plants to grazing animal saliva](#)
- [Journal article about changes in c3 vs c4 grasses with climate change trends](#)
- [Swantson et al. 2016 forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers 2nd edition](#)

Discussion and Q&A

Joel

- Q: Are you clearing any invasives and are you following any invasives as part of an experimental group. Buffle grass and cheat grass of particular interest.
 - A: Neither buffelgrass, cheatgrass, nor Lehmann's lovegrass in these plots. This research is mostly interested in responses of AZ cottontop. Lehmann's lovegrass is functionally similar to cottontop and the response should be similar as well.
- Q: I wondered about deeper-rooted plants being more drought resistant. Do you have plans to study that?
 - A: Yes it seems like they are. In the few/large rainfall scenarios, perennial grasses continue to thrive even in winters with a 5th percentile of winter rainfall (very dry).
- Q: Is there any indication the large/infrequent rain or small/frequent rain model might increase or decrease fire severity across the region especially as plants experience periods of drought?
 - A: Few large by end of a few years, all shallow rooted annuals die and seedbank deplete. Seem less likely to carry fire. VS few small seems like it might be more likely to burn with lots of dead annuals high cover.

Martha

- Q: Curious.. if there is a holistic approach to these areas where it includes livestock grazing.. that evolution between grasses and salvia..??
 - A: Arid Grassland Menu does not include grazing because the team that developed this iteration was focused on NPS lands where there are no grazing animals.
- Q: Do you have an ETA on when some of those upcoming menus will be published?
 - A: Not sure. Contact Courtney Peterson CSU: courtney.peterson@colostate.edu
- Q: How were various dimensions of inclusion (gender age race) incorporated into this planning (for the Arid Grasslands Climate Adaptation Menu)?
 - A: Earlier menus tend to not have human dimensions included. Focus of this menu is on ecological aspects. Includes tribal perspectives explicitly but not as much of a focus on including perspectives of other groups at this moment but would love to move in that direction.

Questions presenters have for CoP participants. Feel free to email with responses:

- Joel (joel.biederman@usda.gov) wants to know: what remote sensing and decision support tools folks in the grassland CoP are using? Joel wants to work with tool developers to leverage the data from RainMan SR to improve predictive capacity of remote sensing tools.
- Martha (martha.sample@nau.edu) wants to know: If grassland CoP participants have any initial thoughts and feedback on the Arid Grasslands Menu?

Arid Grasslands Menu

1. Sustain fundamental ecological functions of arid grasslands

- 1.1 Maintain or restore native perennial vegetation
- 1.2 Maintain or enhance soil stability
- 1.3 Maintain or restore hydrologic function

2. Limit or reduce the impacts of stressors and disturbances

- 2.1 Prevent the introduction, establishment, and spread of nonnative invasive plants
- 2.2 Limit and selectively apply land use activities that can increase stress to the ecosystem
- 2.3 Reduce impacts and risk of climate-driven disturbances

3. Conserve and protect priority plant communities and sites from the local to landscape scale

- 3.1 Identify and protect refugia and other unique sites
- 3.2 Identify and maintain low-vulnerability sites
- 3.3 Conserve and promote grassland communities across diverse sites and conditions
- 3.4 Increase habitat connectivity across the landscape

4. Promote plant communities, species, and genotypes adapted to future conditions

- 4.1 Allow incremental plant community conversion to occur
- 4.2 Promote species and genotypes currently performing well in response to change
- 4.3 Expand seed sources to incorporate new genotypes adapted to future conditions

5. Guide ecosystem transition in accordance with expected future conditions

- 5.1 Facilitate plant community transitions after disturbance
- 5.2 Assist migration of species expected to be adapted to future conditions
- 5.3 Consider nature-based environmental engineering solutions where conventional restoration is insufficient

6. Promote adaptable organizations and human communities

- 6.1 Maintain a co-developed research agenda to inform adaptation management
- 6.2 Explicitly consider current and future effects of climate change during planning and adaptive management
- 6.3 Promote social awareness and increase education about anticipated effects of climate change in arid grasslands

Next Steps and Research Needs:

- Adding some adaptation strategies or approaches to the Arid Grasslands Menu that include grazing animals as this version was designed for the NPS lands where there is no livestock grazing.
- Linking results from RainManSR to existing remote sensing and decision support tools to improve their effectiveness in the Southwest.

