# Vegetation type conversion in the Southwest: A workshop summary

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SOUTHWEST FIRE SCIENCE CONSORTIUM

*Above: Workshop attendees in Tucson, Arizona, March 2019. Photo by Rachel Gregg.*

## Workshop Purpose and Objectives

Increasingly common large and severe fires in the Southwest are now often followed by vegetation type conversions (VTC) where once-dominant vegetation fails to return to its pre-fire state. Case studies have documented abrupt transitions from forests to shrublands or from shrublands to grasslands. In some cases, these transitions may be persistent, and are associated with potential losses in biodiversity, ecosystem services, and cultural values. Forests in the southwestern United States are in a state of flux as the ecological effects of climate, anthropogenic, and natural disturbance factors play out across multiple scales (Keeley et al. 2019). VTC is the lasting consequence following a disturbance in some areas; for example, forests may be lost, and grass or shrubs become dominant. In some cases, VTC may be initiated by accelerated mortality of overstory trees from severe wildfire exposure combined with climate stress (van Mantgem et al. 2018, 2020). Understanding the mechanisms that contribute to VTC as an ecological response to high-severity fires, as well as those that promote resilience, are critical to better inform on-the-ground management actions.

In cooperation with the Southwest Fire Science Consortium, partners from the U.S. Geological Survey, University of Arizona, and EcoAdapt hosted a two-day workshop in March 2019 to discuss what constitutes a VTC, including its mechanisms and drivers, where it may be happening across the Southwest, and how managers and/or practitioners can respond. The workshop convened land managers, practitioners, and scientists from regional agencies and organizations to discuss observations and insights on VTC mechanisms and management responses in Southwestern forests. Outcomes from the workshop reflect the perspectives of 26 participants (scientists and managers and/or practitioners) from 16 organizations, including federal and state agencies, universities, and nonprofit entities.

This workshop provided an important opportunity to share what is currently known and unknown about fire-caused VTC in the Southwest and to discuss research and management needs. This workshop was held as part of the broader *Understanding Fire-caused Vegetation Type Conversion in Southwestern Conifer Forests under Current and Future Climate Conditions* project[1], funded by the Southwest Climate Adaptation Science Center. The goal of this project is to identify and fill knowledge gaps on fire-caused VTC to better inform research and management. The purpose of this summary is to synthesize the workshop discussions and outcomes, including defining type conversion, documenting observations of VTC, and identifying management options and research needs.

## Observations and Mechanisms of VTC

Evidence from firsthand accounts, observations, and modeling indicate that wildfire plays an important role in type conversions in the Southwest. During a mapping exercise, participants identified specific locations where VTC has occurred and may be occurring across the landscape, along with details about transitions to new ecological community types that may be indicative of VTC (see map figure). These observations include high-severity fires driving shifts from mixed-conifer to shrub in Coronado National Forest and Madrean pine oak to Encinal woodlands in the Chiricahua Mountains, invasions of buffelgrass in non-fire adapted areas such as Saguaro National Park, and drought-associated loss of pinyon-juniper in Gila National Forest.

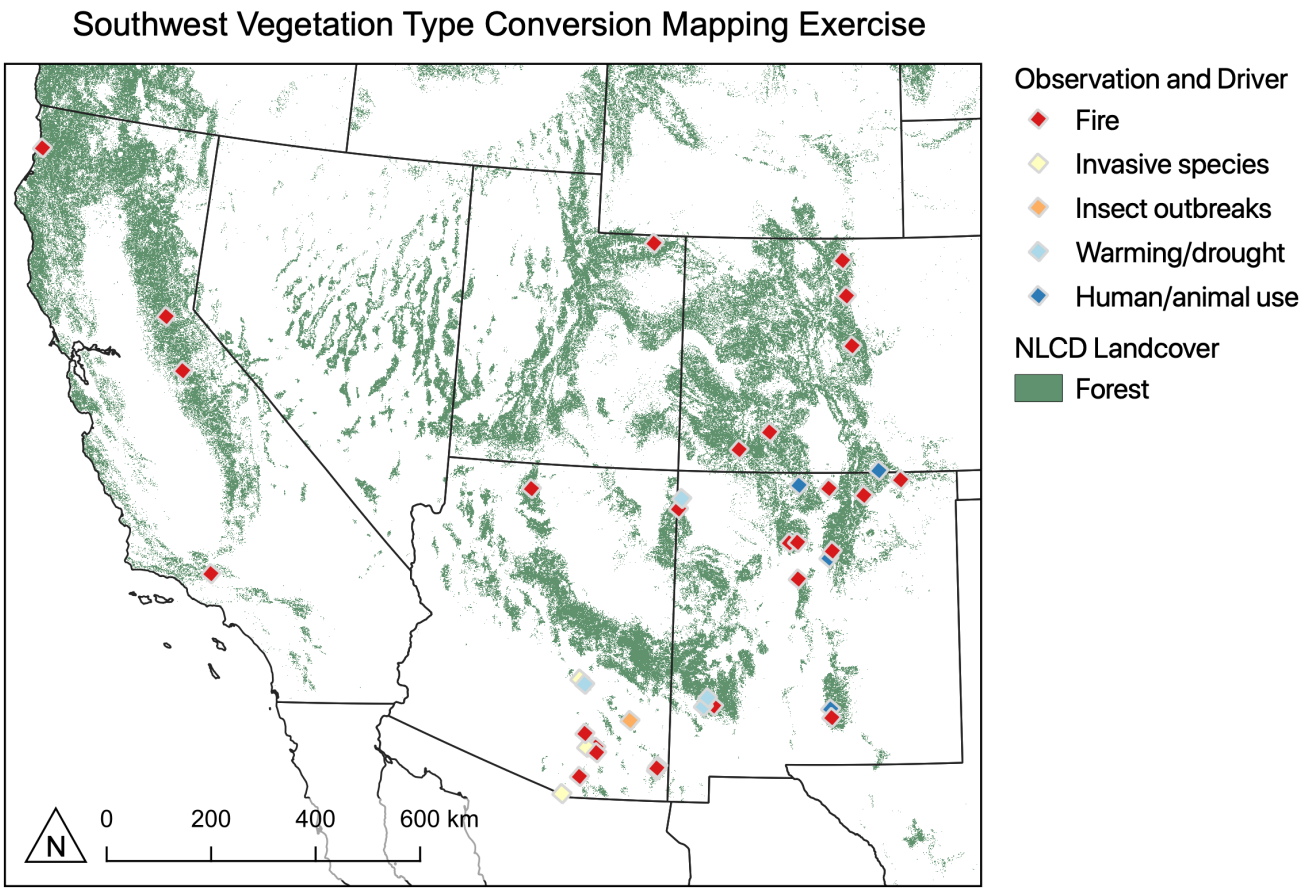
The mapping exercise prompted a discussion about the type of evidence that may be indicative of VTC. Participants agreed that VTC may be characterized by dominance of non-native species not previously found in the system (e.g., buffelgrass, Lehmann's lovegrass), a change in dominance of plant functional type (e.g., arboreal to shrub or grass), or a near-irreversible change from one compositional state to another. VTC may also be characterized by community similarity, fire regime changes, and site potential changes (e.g., soil type). However, if some ecological memory (e.g., propagules or seedlings from previous system) remains post-disturbance, the trajectory toward VTC is more ambiguous and uncertain. For example, if one dominant species remains present after disturbance but another does not, has a full VTC occurred? In addition, the importance of some of these factors differs depending on timescales. For example, mechanisms that push ecosystems past their tipping points may occur over decades to hundreds of years, but decision-makers may need to determine land management priorities on much shorter time scales (Falk et al. 2019).

**The objectives of the workshop included:**

- *Documenting known cases of VTCs in the study region, distinguishing degrees of conversion*
- *Identifying the underlying mechanisms that lead to VTC as an emergent response and conditions that appear to promote its inverse (i.e. resilience)*
- *Articulating current and future consequences and management responses*

[1] cascprojects.org/#/project/4f8c6580e4b0546c0c397b4e/5b58e140e4b0610d7f4bdbec

**Map Figure:**




**Regional VTC observations as indicated during the mapping exercise. Drivers of such VTCs include fire, invasive species, insect outbreaks, drought, and human/animal use (e.g., logging, browsing, grazing).**

## Towards a Working Definition of VTC

Participants generated the following definition through the workshop's discussions:

Vegetation type conversion is a major and persistent change in a community's dominant species, life form, and/or ecological function that is both enduring and spatially extensive.

- Type conversion may be catalyzed by severe, extensive, or frequent disturbances, or combinations of disturbances, that inhibit or protract successional return toward the pre-disturbance vegetation type.
- Type conversion may also result from interruptions or alterations to disturbance regimes, or directly via human development.
- Most researchers and practitioners reserve the use of this terminology for changes that appear essentially permanent, and occur over spatial extents greater than 10s of hectares.
- Type conversion may be associated with environmental changes or feedbacks that constrain return to previous vegetation (as examples, altered climate, new species assemblages and biotic interactions, or reinforcing feedbacks that maintain new types).
- Type conversion may also be used to describe changes where long-term outcomes are uncertain, but where this terminology is still fundamentally useful for the purposes of planning, managing, and communicating persistent ecological change.
- As such, the term "type conversion" is both scientific and pragmatic, intended to reflect current ecological thinking while also providing utility for natural resource management.
- The addition of other descriptors could increase effective communication, for example, "conversion from conifer forest to oak shrubland."

## Management Implications

Participants discussed challenges and opportunities for management of VTCs. The range of adaptive options available to fire and forest managers and/or practitioners to respond to VTCs include resistance, resilience, and response (Millar et al. 2007; Falk 2017). These options exist along a continuum wherein decision-makers can opt to manage for ecosystem persistence through aggressive tactics (e.g., prevention of or recovery from VTC) versus managing for future altered state (e.g., active or passive facilitation of VTC). Where a manager's choices land on the continuum are frequently determined by management values, culture, risk tolerance, and regulatory restrictions.

Participants discussed justifications for management as well as specific tactics that may support each option. Efforts to promote resistance and resilience may be undertaken if non-native species begin to dominate a site, if threatened and endangered species are present that may be acutely sensitive to a VTC, to support wildlife habitat and other ecosystem service provisioning (e.g., preserving economic value of timber), and to maintain carbon stocks. Active facilitation of VTC may occur if and where ecological function could be enhanced by converting vegetation type (e.g., removing trees and shrubs from grasslands to improve grassland function), where a priority species is declining, and if there is an opportunity to better understand the dynamics of novel systems (Millar and Stephenson 2015). Passive facilitation of VTC may occur if and when a system is naturally trending towards conversion, there is limited capacity to respond, and there is high uncertainty about unintended consequences (e.g., "sometimes doing something is worse than doing nothing"). In all cases, participants emphasized that triage is critical as all decisions are driven by values and resources at risk, mandates and regulations, shifting agency priorities, and budgetary constraints. In the case of no action or intervention, whether due to uncertainty or limited technical or financial capacity, participants noted that it is still important for land managers and/or practitioners to explicitly acknowledge and document the context within which passive facilitation is occurring (e.g., drivers, ecological community changes) to better inform learning.

| **Resistance**<br>*Prevention of VTC* | **Resilience**<br>*Recovery from VTC* | **Response**<br>*Active or passive facilitation of VTC* |
|---|---|---|
| ***Tactics include:***<br>• Avoiding uncharacteristically severe wildfire<br>• Ignition prevention<br>• Preventing invasive weeds<br>• Prescribed burns<br>• Managing wildfire for resource objectives<br>• Thinning to reduce competition | ***Tactics include:***<br>• Seeding<br>• Replanting<br>• Identifying and protecting refugia<br>• Preventing post-disturbance soil loss | ***Tactics include:***<br>• Facilitate VTC via planting and seeding different species<br>• Allow VTC to happen via no intervention<br>• Monitoring ecosystem progression over time |

## Key Research Needs and Tools to Support Decision-Making

The workshop provided an opportunity for federal and state agencies, universities, and nonprofit entities to discuss current and projected future risk of VTC and to share research needs and approaches to better inform decision-making in the Southwest. Participants emphasized that more effective collaboration and information transfer between scientists and managers and/or practitioners are key to identifying, responding to, and recovering from fire-caused VTC in a changing climate. Barriers to effective science delivery include limited time and capacity for managers and/or practitioners to digest the most relevant scientific research, insufficient resources for continual monitoring, and limited in-person knowledge sharing between scientists and managers and/or practitioners as funding for workshops has declined in recent years. Participants discussed useful information, product types, and delivery methods, including:

- Establishing common terminology related to VTC research and management across agencies, organizations, and communities.
- Risk maps of VTC potential (e.g., likely outcomes/vegetation types expected after conversion).
- Identifying and synthesizing the science behind mechanisms that promote resilience to type conversion.
- Brief summaries of scientific papers with relevant bullet points for communication purposes and peer-reviewed state-of-the-science syntheses to support forest planning and revisions.
- Replicating the FireScape[2] framework to scale scientific understanding, knowledge sharing, and coordinated fire and ecosystem management across multiple agencies and nongovernmental organizations.
- Using field trips to better engage managers, practitioners, scientists, and other local stakeholders in location- and species-specific discussions.
- Co-locating scientists with land managers and/or practitioners to allow for more on-site collaboration.

[2] azfirescape.org/home

## Next steps:

**Based on the input, observations, and outcomes from this meeting and a similar workshop held in December 2019 to gather information relevant to California's forests, the project team is crafting a Tamm Review for Forest Ecology and Management on the mechanisms of ecological resilience that inhibit and drive VTC in Southwestern forests and their relevance to forest conservation and management. The team is also collecting case study examples of VTC and management experiences from across the Southwest. If you have examples to share, please consider reaching out to the project team.**

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Natural Earth borders, roads, NPS units
naturalearthdata.com/

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