

Fire in the Sonoran Desert

SUMMARY

The expansion of the **grass-fire cycle in the deserts of North America is driving ecosystem level transformation** from patchy desert scrub to invasive grassland. A **novel fire regime in the Sonoran Desert is forcing a new approach to land management**. Unprecedented large-scale fires in recent years, especially in 2005 and 2020, have been driven by the exponential expansion of introduced invasive plants. **An ecological transition from desert scrub to grassland has begun, which creates management and societal challenges as fire becomes a part of the ecology of the Sonoran Desert**. This fact sheet summarizes the full report on the history and trends of fire in the Sonoran Desert and discusses future conservation strategies, with some fire ecology information presented for the Mojave Desert, which is experiencing a similar ecological transformation.

History of Fire in the Sonoran Desert

The Sonoran Desert is characterized by an openness or inherent patchiness in vegetation. **Large areas of bare ground and insufficient continuity of fuel have largely excluded fire from desert habitats during the last century and perhaps longer**. Conventional wisdom holds that fire has been a minor to inconsequential factor in the evolution and origin of the Sonoran Desert, with fire return interval estimates exceeding 100 to over 1,000 years. However, these model-derived estimates have not been directly tested due to the lack of evidence of historical fires.

Grassification and Agents of Change

Several invasive grasses and a few invasive annual forbs are spreading rapidly and contributing to higher fuel loads that carry fires in the Sonoran Desert at an unprecedented scale. These invasive species are creating a self-perpetuating grass-fire cycle that progressively excludes native plants and results in grassification, the physiognomic conversion of shrublands to grassland.

KEY MESSAGES

- The Sonoran Desert evolved largely without fire, but invasive grasses and forbs are rapidly converting the desert scrub ecosystem into a grassland that feeds frequent fires.
- Invasive species fill in the patchy vegetation of the Sonoran Desert, resulting in fires that now spread between forested areas and desert valleys.
- Post-fire recovery of desert scrub species is very slow often resulting in an ecosystem type transformation after repeated burns.
- Mitigation and control of invasive species today is significantly cheaper than future costs of grassification and post-fire recovery.



The eight main species of concern that are carrying fires in the deserts of North America (note, plants not to scale). Illustrations by K. Gibson.

**DEPICTION OF THE GRASS-FIRE CYCLE:
HOW FIRE AND INVASIVE SPECIES ARE CAUSING CHANGE**

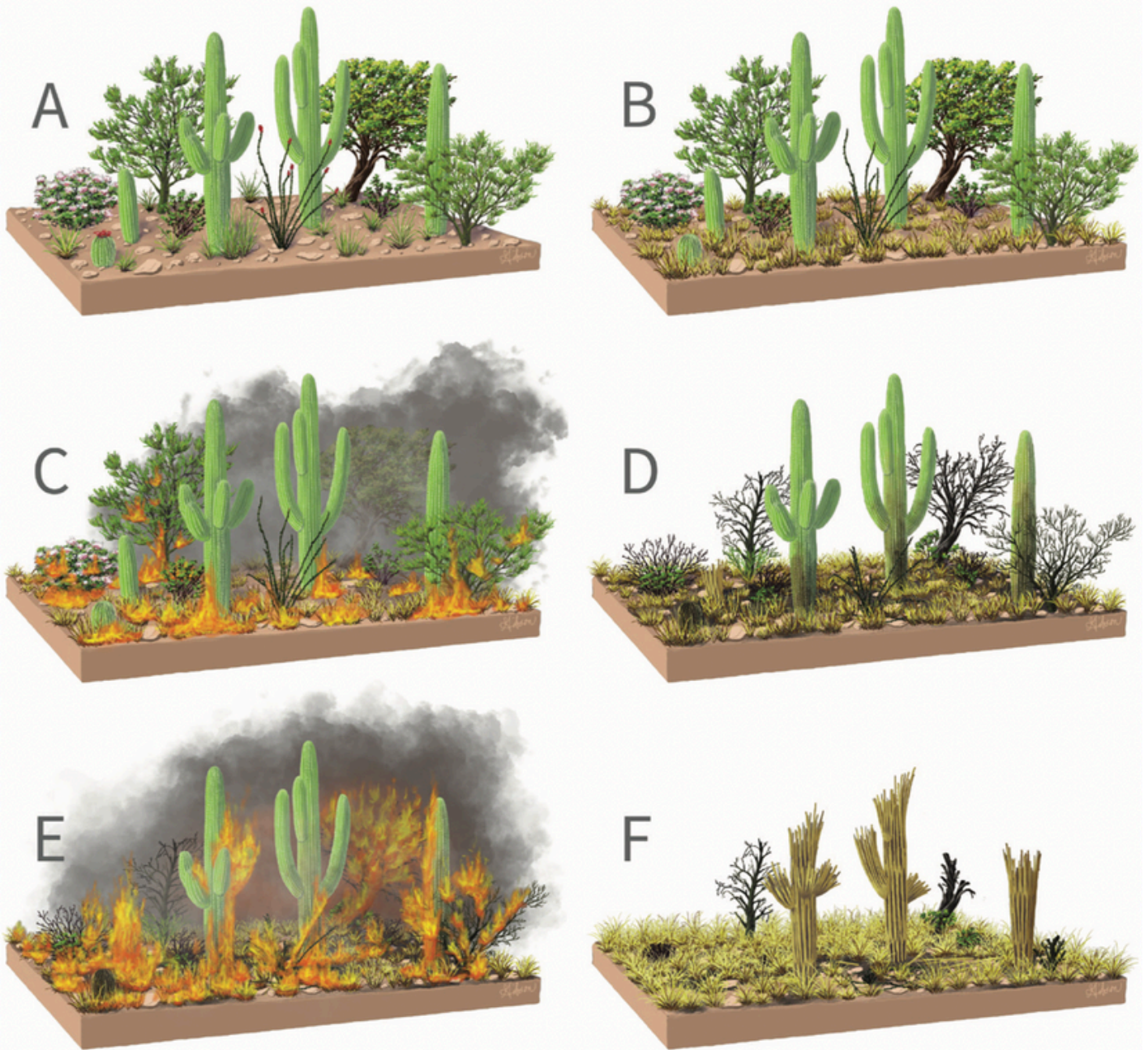
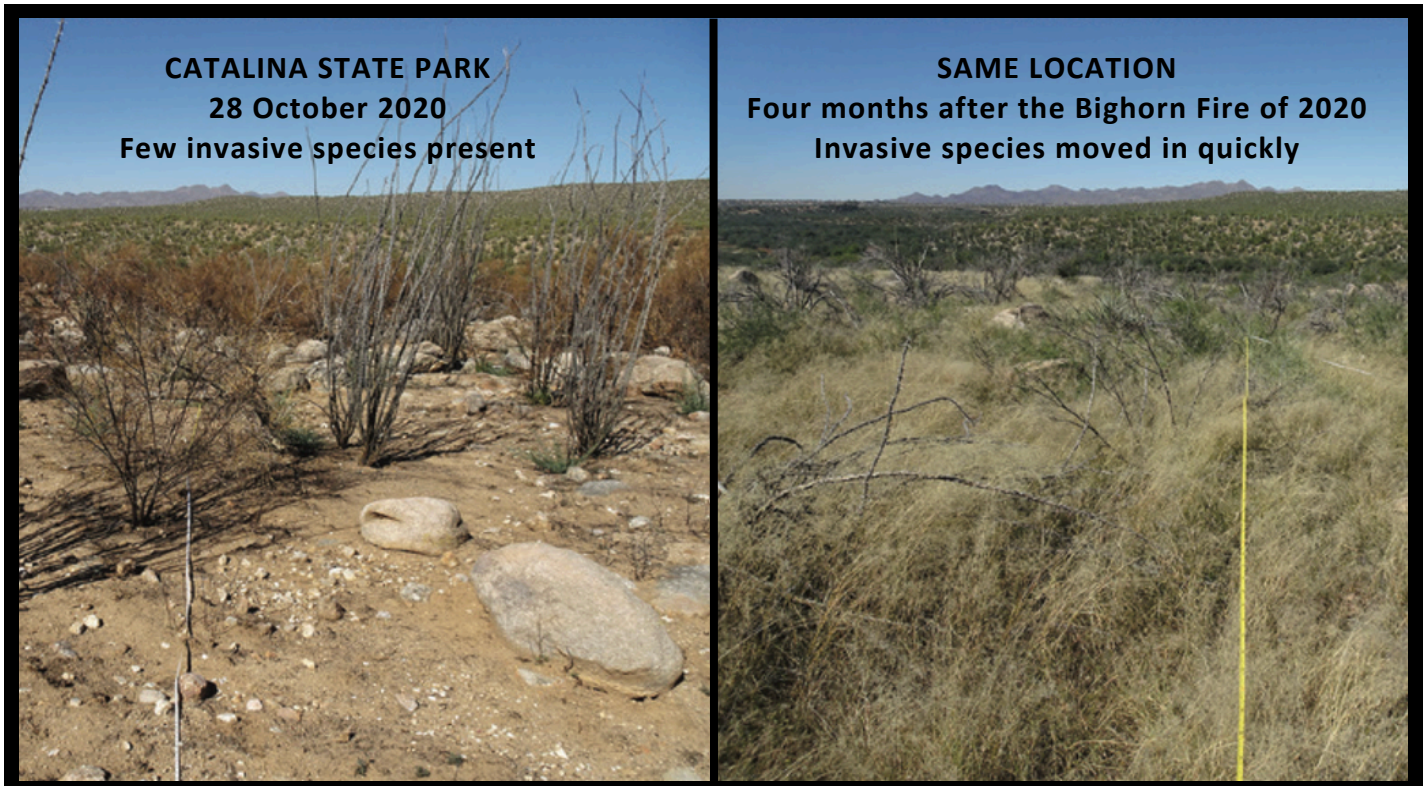


FIGURE: The grassification (grass-fire cycle) in the Sonoran Desert. (A) Sonoran desert scrub with native grasses and common patchiness in vegetation with bare ground between plants. (B) Sonoran desert scrub now infilled with invasive grasses, here buffelgrass. (C) Buffelgrass was able to carry a fire through the desert habitat. (D) Post-fire desert scrub with charred, but still alive, mature saguaros, dead young saguaros, resprouting desert trees (mesquite and palo verde) and shrubs (fairy duster and limber bush), and rapidly regenerated and now denser buffelgrass. (E) Recurring fires carried by dense buffelgrass. (F) Desert scrub now converted to a grassland dominated by buffelgrass. All saguaros have died and native plants—aside from a lone mesquite—are no longer resprouting. Illustrations by K.S. Gibson are available by request.

Where Are We Now?

We are at an inflection point of fires in the desert. Beginning around 2000, fires in the Sonoran and Mojave deserts have dramatically increased in number and size, showing a distinct departure from historical norms. In the United States, desert fires thus far have been concentrated at the western and northern boundaries of the Mojave Desert and the northern boundary of the Sonoran Desert. **The likelihood for successful control of invasive species is highest, and the costs of control are lowest, when populations are small and localized on the landscape. As populations spread and the grassification process begins, the likelihood for control decreases, fires become more prevalent, and burned desert habitat is eventually converted to grassland.** There is a clear correlation between winter precipitation and fire number and size the following dry season. Since 2000, fire size and number were amplified with the subsequent rainy winters of 2005 and 2020, which were associated with El Niño events.



Repeat photography by B.T. Wilder, showing rapid change to the desert after wildfire.

Where Are We Going?

One of the clearest signals to emerge as invasive species spread and desert fires increase in frequency and extent is the accelerated rate of conversion of desert to grassland-like habitats. In the Sonoran Desert, fires are most likely during the hot and dry months of May and June prior to the arrival of the summer monsoon. However, **as invasive plants add to the abundance and continuity of fine fuels, and human-caused ignitions continue to increase, fires may occur nearly year-round.** In addition to fires in desert valleys and flats, a new fire mosaic is being established in the region whereby wildfires driven by invasive grasses can spread from the forested mountains to the desert valleys, and vice versa. **The economic impact of the grassification of these view-sheds and recreation areas is orders of magnitude greater than the costs of mitigation and control efforts available today. Post-fire recovery of most desert species is slow, requiring decades to centuries, and desert scrub communities will almost certainly never achieve the previous community composition after repeated burning.**

What Can Land Managers Do?

A set of management actions, or a toolbox, which will be iteratively developed, refined, and added to is starting to be identified. Key components are:

- Fuel breaks
- The use of a strategic response system for addressing wildland fire in the Sonoran Desert, such as Potential Operational Delineations (PODs)
- Identifying and protecting refugia
- Fuels control
- Restoration

Areas of Focus

The fast rate of change of fire in the desert leaves many standing questions and areas in need of further work, including:

- A better understanding of new fire regimes and novel Sonoran Desert vegetation associations
- Adaptive management to Sonoran Desert conservation in a fire prone landscape
- Research to fill in many existing data and management gaps
- Concerted efforts that develop shared governance for a fire-prone future

ADDITIONAL RESOURCES

VIDEO // Changing Fire Regimes in the Sonoran Desert



THE FULL REPORT // Fire in the Sonoran Desert



Appendices contain lists of repeat photo stations and long-term desert fire plots

GROWING EDGE // Designing Fuel Breaks for Desert Ecosystems



FACTSHEET BASED OFF THE FULL REPORT: Wilder, B.T., J. Shelly, K.S. Gibson, J. Malusa. 2024. Fire in the Sonoran Desert: An overview of a changing landscape. Southwest Fire Science Consortium.

Cover Photo: Sean Parker, June 2020

The Southwest Fire Science Consortium (SWFSC) is a regional organization that facilitates knowledge exchange and disseminates wildland fire research and information across agency, administrative, and state boundaries in the Southwest. The SWFSC is one of 15 Fire Science Exchange Networks funded by the Joint Fire Science Program.



The Arizona Wildfire Initiative (AZWI) at the Northern Arizona University's School of Forestry supports Arizona's wildland fire needs by enhancing workforce development and education, communicating science, and increasing resilience to Arizona's communities. AZWI is funded by the state of Arizona.

