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# Abrupt Fire Regime Changes Unrelated to Climate

Climatic changes are widely considered to be a major driver for future changes in fire regimes. However, climatic changes alone cannot explain many abrupt fire regime changes observed in environmental records. In a paper published in *Ecosystems*, Juli G. Pausas and Jon Keeley review three major factors independent of climate that can drive abrupt fire regime shifts.

Some major fire regime shifts have been attributed to **fauna**. Insects can abruptly increase fuel loads when large infestations feed and create more dead vegetation with each reproductive pulse. Megaherbivores can suppress growth of grassy fuels in grass-dominated ecosystems through sustained feeding *en masse*. Losses of megaherbivores toward the end of the Pleistocene likely compounded fire regime changes in North America, while modern introductions of livestock herds can suddenly alter fuel structure via intense grazing.

**Nonnative plants** can also drastically impact a local fire regime. Some species of *Laurus* and *Eucalyptus* trees shed litter laden with flammable compounds onto the environment, increasing the fire frequency of less flammable environments. Or, plants better adapted to fire disturbance can sustain new fire regimes by replacing native species. Perennial plants like *Arundo* are highly flammable fuel and sufficiently increase fire intensity when burned, yet survive to replace natives via protected roots. Annual plants, like *Bromus* invading the U.S. West, produce swaths of flashy fuels that increase fire frequency, yet are also adapted to reseed quickly postfire, thus further increasing fire frequency.

**Humans** alter fire regimes as populations shift across landscapes. Massive reductions in indigenous South Americans after European contact registered a decrease in soil-charcoal signatures. In other systems, fuel loads rose when societies industrialized, as rural populations ceased to collect kindling, and fuels were allowed to build up in forests. Finally, humans can increase fire ignition sources as urban development extends into the wildland, introducing invasive plants and new ignition risks. In southern California where Santa Ana winds magnify all fires, increased ignitions have drastically increased local fire frequencies and shifted fire seasons.

## Management Implications

- Distinguishing climate-independent from climate-dependent factors of fire regime change can help resource managers identify and prioritize factors that can be more directly managed.
- Many abrupt fire regime changes in recent centuries may not be a direct effect of climate change, and more driven by human-induced changes in fuels and ignitions.
- Human modifications of nutrients and water levels available to the landscape—and plants—can also alter fuel loads, and these interactions should be further studied.

### THIS BRIEF REFERS TO:

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<http://www.werc.usgs.gov/ProductDetails.aspx?ID=5027>  
<http://www.werc.usgs.gov/keeley>

Initial fuel consumers	Driver of change	Fire driver (fuel/ignitions)	Wildfire activity change
(a) Fauna			
Megaherbivores	Extinction of megafauna (by climate changes and/or human arrival)	+ Woody	+
Megaherbivores	Rinderpest virus eradication; wildebeest population explosion	- Grass	-
Understory fires	Bark beetle outbreaks	Fuel redistribution	- Intensity
(b) Invasive plants			
Rare or no fire	Invasion of flammable perennial plants	+ Grass	+ Frequency + Intensity
Low frequency of intense fires	Anthropogenic ignitions and invasion of flammable annuals	+ Grass - Woody	+ Frequency - Intensity
(c) Socioeconomic changes			
Controlled fires	Demise of Native American cultures (by Europeans); reduced ignitions	- Ignitions	-
Farming	Collapse of a rural lifestyle	+ Woody	+
Understory fires	Change in fire policy: fire exclusion	+ Woody	- Frequency + Intensity
No fires	Arrival of human populations	+ Ignitions	+
Wildfires + controlled fires	Demise of Native American cultures, fragmentation, and fire suppression	- Ignitions	-

Pausas and Keeley 2014

Examples of abrupt climate-independent fire regime changes.