News & views

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Figure 1 | Overnight burning event. A wildfire burns through the night during July 2014 in the community of Old El Portal in California.

Environmental science

Drought-fuelled overnight burning propels large fires

Jennifer K. Balch & Adam L. Mahood

Burning events that occur at night have been revealed as a driver of large wildfires. Prolonged drought conditions are to blame, making it easier for fires to spread at night when they would ordinarily slow or extinguish completely. **See p.321**

Global warming is often associated with visions of hot, sweltering summer days. But nights are also warming rapidly in many areas[1,2], and this change is affecting overnight burning events (OBEs), when wildfires burn through the night and into the next day. Some of North America's deadliest and most damaging fires in the past decade burned through communities at night[3], with little advance warning, highlighting the need to understand these events better. On page 321, Luo *et al.*[4] report that OBEs are a key factor driving large wildfires in the United States and Canada. The finding suggests that drought is priming vegetation to help fires to persist in conditions that usually pose a barrier to fire — lower night-time temperatures and higher humidity[1].

Luo *et al.* characterized OBEs for 23,557 fires between 2017 and 2020 using the Geostationary Operational Environmental Satellite (GOES), which detects active fires in most of North and South America, updating approximately every 15 minutes. They then associated these detections with known fires drawn from US and Canadian governmental records. The authors found that OBEs occurred in 20% of fires that covered more than 1,000 hectares, but were almost never detected in smaller fires. Night-time fire activity has been pinpointed[5,6] as a mechanism through which fires can increase in size during meteorological conditions, such as dips in solar radiation and increases in moisture, that would otherwise slow fires and reduce their intensity. Luo and colleagues' analysis shows that this effect is most pronounced in boreal ecosystems, where OBEs can lead to much larger fires than those that occur in temperate and subtropical systems.

The authors found that OBEs occurred most often when there were long periods of accumulated dry fuel, as is the case during drought conditions. Dry fuel accumulation is an indicator of how primed the vegetation is to burn. By making this connection, Luo *et al.* have made it possible to predict OBEs using information about daytime conditions. This, in turn, could allow fire managers to keep firefighters out of harm's way and to warn local communities more effectively of an impending fire risk. It is not surprising that large fires, which burn over multiple days or weeks, are primed by long-term drought, but the authors' work demonstrates that overnight burning is also implicated in driving these extreme events.

Luo and colleagues' work increases our understanding of how OBEs occur and how they affect the next day's fire activity for temperate and boreal ecosystems. However, there remains a need to understand how night-time burning is affecting flammable areas across the globe (Fig. 1). Burned regions in the United States and Canada represented 1.2% of global burned area from 2003 to 2020 (ref. 7), with most fires occurring in tropical and arid grasslands and savannahs.

The GOES data cover most of the Western Hemisphere, but Luo *et al.* considered only fires that correspond to event perimeters documented in US and Canadian records, which meant that they were restricted to the large events that are delineated in those records. Satellite-derived event perimeters are now available for almost every country in the world[8], providing a fuller distribution of fire sizes than was used in the authors' study. These new perimeters could be used in conjunction with data from other geostationary satellites, such as Himawari over East Asia and Meteosat over Europe and Africa, to expand the scope of OBE research to the countries and ecosystems in which most fires occur. This extension could provide crucial insights into how fire interacts with tropical deforestation and increased agricultural activity. It could also improve our understanding of how night-time temperature increases are affecting intentional burning and Indigenous fire management.

Researchers are only just beginning to investigate the temporal nature of wildfires on timescales of hours to days. The analysis of Luo and colleagues adds to a growing body of research[2,5,6,9] that demonstrates the importance of night-time burning — from its role in creating extreme events[6] to its part in increasing fire intensity[2]. By linking remotely sensed data from multiple sources and associating them with a single event, scientists are able to understand better how different aspects of fire activity are changing. But Luo and colleagues' study highlights the urgent need for satellite sensors that match the resolution of the minute and metre scales on which fire operates — a conclusion that has been drawn elsewhere[10].

There is a clear need to improve understanding of the coupling between long-term climate changes and weather conditions that vary on a daily basis, and how this coupling can turn small fires into big ones or increase their intensity. Nights are a key factor in this equation. As nights continue to warm, firefighters should expect to fight fires around the clock. Moreover, it is not just fire that is changing as night-time temperatures increase. A lack of night-time cooling has been linked to human health consequences[11] and to shifts in crop production. Luo and colleagues' study is yet another reminder that the impact of climate change on nights has knock-on effects for ecosystems and people.

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Evolution

Intricately patterned scales of ancient skin

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The discovery of 285-million-year-old fossils of intricately patterned animal scales indicates that evolutionary tinkering of armoured skin started at the dawn of life on dry land as aquatic vertebrates adapted for terrestrial survival.

What type of skin did early land-dwelling vertebrates have? Writing in *Current Biology*, Mooney *et al.*[1] present fossil evidence that sheds light on this. Their findings have implications for scientists' understanding of the evolution of pattern formation and the emergence of scales on body surfaces.

Much of what we know about extinct animals — how big they were, whether they swam, walked or flew, and even whether they were prey or predators — comes from their fossilized remains. For invertebrate animals, such as the once-abundant, ocean-dwelling trilobites, the exquisitely preserved exoskeletons that formed their outer layer provide us with a detailed picture of their oval segmented shape, similar to that of a woodlouse. In the case of vertebrates, such as dinosaurs, which mainly leave behind fossilized bones, a fair amount of imagination is needed to envision what they might have looked like when they were alive.

Admittedly, palaeontologists often get things wrong when interpreting fossils. For example, people who watched the 1993 blockbuster film *Jurassic Park* might remember the velociraptor dinosaurs as particularly intelligent and cold-hearted predators, covered by fittingly chilling-looking scaly skin. Yet, thanks to subsequently discovered fossilized imprints of skin, it has emerged that velociraptors had feathers[2], just like some of their dinosaur relatives, including the earliest known bird-like relative called *Archaeopteryx*[3] and the startling four-winged creature described as 'microraptorine' (*Changyuraptor yangi*)[4]. This fluffy and much less terrifying image of predatory dinosaurs might have sat poorly with Hollywood producers. However, even they eventually caved under the mounting scientific evidence and introduced a feathered *Pyroraptor* in *Jurassic World Dominion* (2022), although it was depicted as being several times larger than it probably was. It took more than 20 years after the emergence of evidence of feathered dinosaurs[5] in 1998 for the movie franchise to correct its 'scaly' mistake.

Fossil skin finds have a profound effect on our understanding of what extinct animals really looked like and how they adapted to their natural surroundings. Yet, we have very little skin to go by for one of the most consequential evolutionary periods in vertebrate history — the time between 350 million years