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Wildfire science is at a loss for comprehensive data

An international monitoring initiative is crucial for understanding wildfires and reducing their damage, says **David Bowman**.

In 2013, a ferocious fire destroyed a small seaside village east of Hobart, Australia, the city where I live and work as a pyrogeographer. A newspaper photograph captured the terror of the firestorm: in it, a family shelters under a jetty in surreal, smoky orange twilight. Last week, spookily similar images from Greece, where people fled to the sea to escape an inferno, hit me with a jolt.

Fires have ignited elsewhere, including in Sweden and California, in recent weeks. But we can say little for certain about trends in wildfires worldwide. Data are too scant to say conclusively whether fires are becoming more destructive. If humans are to live sustainably on flammable landscapes, we need a global system for collecting data on fires to gain a coherent picture and assess strategies.

My colleagues and I analysed records from 1979 to 2013 (W. M. Jolly *et al. Nature Commun.* **6**, 7537; 2015). We found that fire seasons worldwide are lengthening, and that 'fire weather' — the combination of humidity, temperature, wind and other factors that help blazes to spread — is becoming more extreme. Yet the strong links between humans and flammable landscapes make fire a natural hazard like no other. We can both amplify and dampen the cycle by setting fires and fighting them. So a longer fire season does not necessarily mean more fires.

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Satellite imaging has revolutionized our understanding of fire activity: it has provided global data on areas burnt and on variations from season to season regarding when fires occur and how large they grow. But satellite imagery is imperfect. Time courses of high-resolution images are separated by days, weeks or even months, if clouds cover the fires or patches of burnt ground. Geostationary satellites, which have higher orbits than other types, can provide real-time information, but only at coarse resolution.

In addition, satellite images became widely available only in the 1980s, so scientists know little about areas that burn infrequently. Instead, we rely on historical proxies, such as dating fire scars on tree trunks and examining charcoal layers in lake sediments.

Satellite analysis suggests that the total area burnt by wildfires over the past 18 years has declined (N. Andela *et al. Science* **356**, 1356–1362; 2017). This seems to be, in part, because much of the world's tropical savanna has been converted to ranches and cropland that fragments landscapes and makes them less flammable. For disasters, however, area burnt is usually less important than fire intensity, as determined by estimates of the energy that fires release. We've found that disastrous fires typically occur in regions with medium population densities, and at times of anomalously high heat, wind or dryness (D. M. J. S. Bowman *et al. Nature Ecol. Evol.* **1**, 0058; 2017).

Even a low-intensity fire can have a severe biological impact, especially in areas, such as rainforest, that are poorly adapted to handle it. And reliably assessing severity requires field work to collect data that might otherwise be missed. For example, fires under forest canopies are generally invisible to satellites.

To gain a comprehensive view, we need an initiative similar to the confederation of national meteorological networks that monitors daily weather conditions. This global network, established over the nineteenth and twentieth centuries, is an underappreciated scientific triumph. Its data are the backbone of weather forecasting and calibrating climate-change models. Imagine how unreliable weather projections would be if based only on satellite data, spotty field measurements and historical reconstructions — as is the case for landscape fires.

Comparative analysis of fire activity became possible in Europe only in 2004, with the advent of the European Union's fire database, which contains data from 22 nations. Few countries maintain records of fires stretching further back in time.

A global clearing house that monitors landscape fires could record the types of vegetation burnt, how severely, over what area and with what loss of life and property. We need these data to facilitate analyses of causes and effects, evaluate fire-management approaches and guide re-insurance rates. They would let us predict how well burning or not burning vegetation might modulate levels of carbon dioxide and other greenhouse gases, and to assess how climate change, land management and socio-economic policies influence fire vulnerability and activity.

Creating a global database will pose a huge policy and technical challenge. But so was building meteorological stations. Some of the elements for such a database already exist in EU and national databases. As well as remote sensing, on-the-ground observations are essential for calibrating and validating these data streams. We could enlist citizen science: smartphones with Global Positioning System access could document biological impacts, and platforms such as Google Earth could help to merge and manage data.

Achieving a global understanding of fire activity will require a major international initiative, and will probably need to be led by an authority such as the World Bank or the United Nations. Although difficult and complicated, the rewards would be invaluable; other projects of this scale reveal the potential: witness the impact of the World Health Organization, and its assessment of the global burden of diseases.

Without improved mapping and monitoring, we will remain unable to answer the most basic questions about trends in wildfires. Acting in ignorance is a poor way to honour — let alone decrease — the lives lost to fires each year. ■

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