Fig. 1. James Hansen and Chad Hanson in Stanislaus Forest just west of Yosemite in June 2021, in an area "rescued" by the United States Forest Service following the 2013 Sierra Nevada Rim fire.

Silent Forests

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James Hansen

If only forests could speak. It's not hard to imagine that they might cry: "leave us alone, please, for your sake, for all the forest life, and for all other life on Earth!"

Climate and ecosystem sciences are understandable. The public can appreciate what needs to be done – after we correct disinformation peddled by people with economic interest in obfuscating the truth. Nature has tremendous potential to help us. If we work with nature, instead of against it, natural processes will be a big part of the climate solution.

Let's start with two side-by-side areas that had high intensity fire in the 2013 Rim fire, which burned 257,000 acres in central Sierra Nevada including part of Yosemite National Park. Fig. 1 is an area where the Forest Service let loggers cut down 'snags' (burned or scorched tree trunks). Logs containing useful lumber were hauled off; less desirable logs, branches and saplings were ground up for biofuel. Trees were planted, but few are growing. Planters replanted a few times, as there are a few trees of varying ages trying to get started. It's hard for trees to get started in an area compacted by heavy machinery and missing the nutrients that were hauled off for biofuels.

Fig. 2 is a photo of an area a few hundred meters away in which the snag forest (so far) is still standing. Natural tree regrowth, reaching 5-10 feet (2-3 meters) in height, thrives spectacularly. The snag forest is alive with owls (whose favorite nesting place is the top of a snag), woodpeckers, and bluebirds (who nest in cavities that woodpeckers abandon). There are also flowering shrubs and scores of butterflies. Snags topple within a few decades, providing habitat for small scale forest life, as well as water holding capacity and nutrients for the soil.

Fig. 2. Hansen and Dan Galpern in an area that – so far – has been allowed to regrow on its own.

The area in the second photo is scheduled to be clear-cut, the same as in Fig. 1, destroying the natural forest regrowth and robbing the wildlife of the snag forest benefits. Funds for this logging operation are being stolen from $28 million of federal Housing and Urban Development funds appropriated by Congress for the purpose of community disaster recovery and rebuilding after the Rim fire. Chad Hanson and the John Muir Project filed suit to try to stop this forest destruction, and with my attorney Dan Galpern's help I filed a brief in 2019 in support of Hanson's case.

We will see whether the courts will intervene to stop the state of California from brutalizing the forest. Governor Gavin Newsom is responsible for this tragedy, as Hanson and I explained in an op-ed published in the Los Angeles Times in 2019, and Newsom could (and should) reverse course. If not, then citizens of California should hold Newsom accountable. Hanson provides a persuasive evidence-based case for a new approach in forest management in his just-published book Smokescreen: Debunking Wildfire Myths to Save Our Forests and Our Climate.

My role in the legal case is to explain why forest protection is so important for global climate. Already in 2008 several of the world's top relevant scientists joined me in writing Target Atmospheric CO_2: Where Should Humanity Aim? We showed that the United Nations Framework Convention on Climate Change guardrail target of 2°C global warming – which corresponds to about 450 parts per million (ppm) CO_2 – was too high. Instead, we must aim for CO_2 less than 350 ppm. The target will become more specific by the time we are able to slow emissions to a degree that the concentration of atmospheric CO_2 begins to decline.

The task of getting atmospheric CO_2 to decline imposes two big requirements. First, we must phase down fossil fuel emissions as rapidly as practical. Second, we must adopt forestry and agricultural policies that store more carbon in the soil and biosphere. This natural storage of carbon is a large and essential part of the story, as described in my 2008 Trip Report (see Fig. 1 in that report).

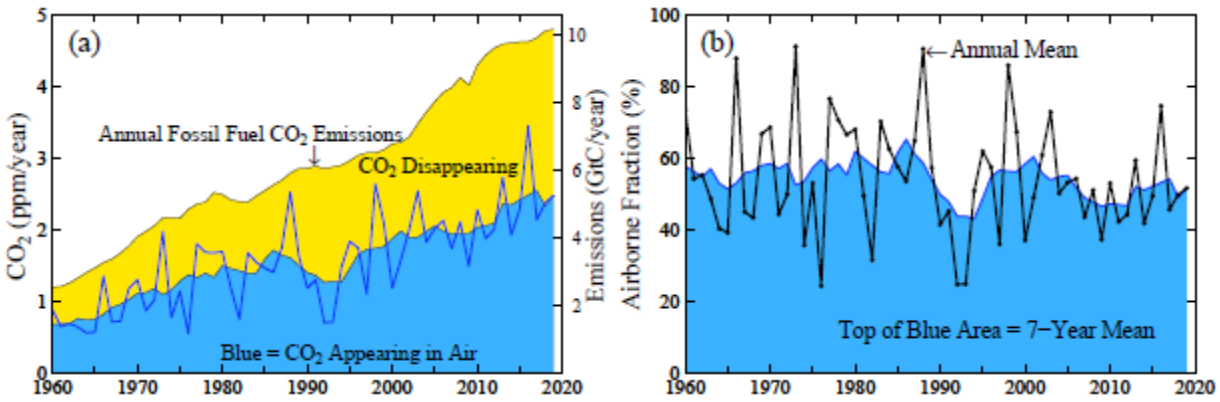

Fig. 3. Annual fossil fuel emissions are now about 10 GtC (gigatons of carbon) per year [right scale of part (a)], which corresponds to about 37 $GtCO_2$ per year; the left scale is CO_2 emissions in atmospheric parts per million in the air and the observed increase in atmospheric CO_2 amount. Part (b) is the observed atmospheric CO_2 increase as a fraction of fossil fuel emissions.

Fig. 3 helps reveal the potential for natural drawdown of atmospheric carbon. The line at the top of the yellow area is the annual fossil fuel CO_2 emissions. Growth of atmospheric CO_2, shown by the blue line, is only about half of the fossil fuel emissions. The other half of the emissions – the yellow area – is disappearing, taken up by a combination of the ocean, soil and biosphere. The uptake fluctuates from year to year; blue and yellow areas are 7-year running means.

Fig. 3 is based on only two quantities, both known accurately: atmospheric CO_2 amount and fossil fuel CO_2 emissions. Carbon cycle literature usually includes an estimated source of CO_2 emissions from logging/deforestation and other perturbations of the biosphere. That biospheric source is very uncertain in amount, but its existence implies that the CO_2 'sink' – the CO_2 taken up by the ocean, soil and biosphere – is even larger than indicated by the yellow area in Fig. 3.

In other words, despite all the things we are doing that increase the flux of CO_2 to the air and decrease the natural CO_2 sinks, nature takes up a large fraction of our CO_2 emissions. "All the things we are doing" includes deforestation and ploughing of grasslands, which release carbon in soils and biomass. Increased forest protection and improved forestry and agricultural practices can help draw down atmospheric CO_2.

We estimated at that time (2008) that sequestering more carbon in forests by working to end deforestation and maximizing reforestation of marginal lands (i.e., land not needed for food production) could draw down atmospheric CO_2 by about 100 GtC. Together with a steadily rising global carbon price (sufficient to reduce fossil fuel emissions by about 2%/year), it would have been possible to get atmospheric CO_2 back below 350 ppm this century.

No carbon price was achieved, however. Instead, fossil fuel subsidies continued. So now we face a tougher challenge. And now it is more urgent. I argue that it is still feasible to meet the climate challenge, as I outline in the Foreword of a book (*Conservation Science and Advocacy for a Planet in Peril: Speaking Truth to Power*, edited by Dominick DellaSala) to be published next month and more fully described in my book *Sophie's Planet* to be published next year.

Chief obstacles to achieving greater uptake of carbon by the Earth system are analogous to obstacles in phasing down fossil fuel emissions. The agriculture, lumber and forest biomass industries, like the fossil fuel industry, have major political clout, and these industries provide

jobs. Solution will not come instantly. A rising carbon price is needed to achieve a sustainable approach that increases carbon uptake by the Earth system as well as phasedown of fossil fuel emissions, while allowing transition to clean energies and new employment opportunities. This is the approach that economic science indicates will be most rapid and effective.

Note that the problem is not Forest Service employees. The Forest Service is filled with people who want to do best for the forests, the wildlife in the forests, and the public. This observation is consistent with anecdotes in Hanson's book and in an excellent 2017 article (Let Forest Fires Burn? What the Black-Backed Woodpecker Knows) by Justin Gillis in the New York Times.

The fundamental underlying problem involves the role of money in our government, which prevents adoption of effective policies to address climate change and has many other adverse consequences. Indeed, the power of special interests and political corruption have infested our government to an extent that national and global governance are presently threatened.

Special interests and political corruption are nothing new, and it is feasible to overcome them. I argue in Chapter 49 (The American Dream) of *Sophie's Planet* that science has an important role to play in addressing the threats posed by growing climate change and failing governance.

Some solace is provided by realization that there have been periods of extreme corruption in the past that were overcome. The difference now is that climate change and its amplifying feedbacks are a ticking time bomb that demands prompt attention and actions.