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JOURNAL REPORTS: TECHNOLOGY

How AI Can Help Save Forests

Satellite imagery and artificial intelligence give new hope to those fighting pests, wildfires and deforestation

AI is assisting in preparing for, suppressing and recovering from wildfires.

PHOTO: ELIAS FUNEZ/ASSOCIATED PRESS

By Ted Alcorn

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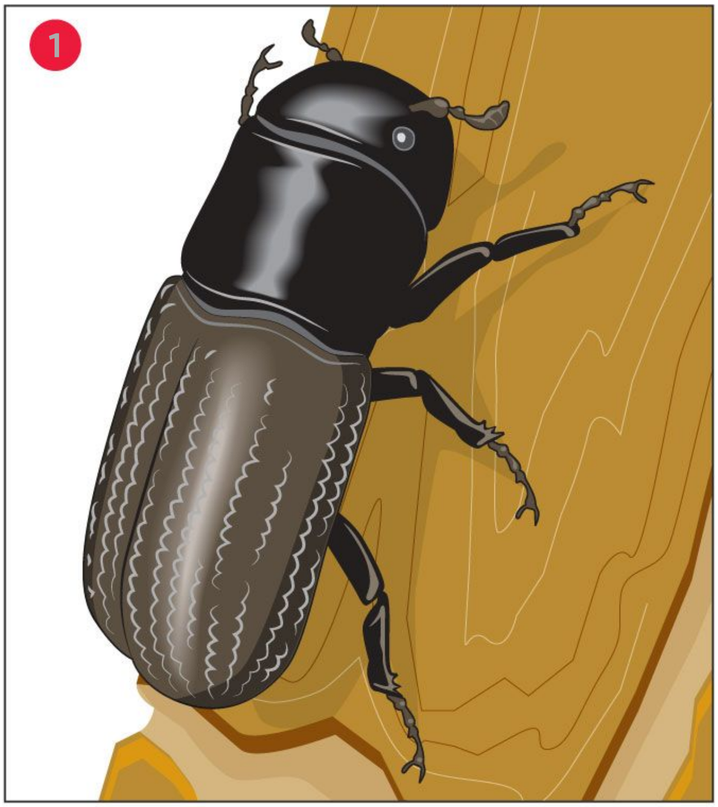
A beetle no larger than a grain of rice is ravaging European forests, infesting and killing trees faster than they can be culled to slow the insects' spread. It turns out the best way to spot the pests, and stop them, may be from space.

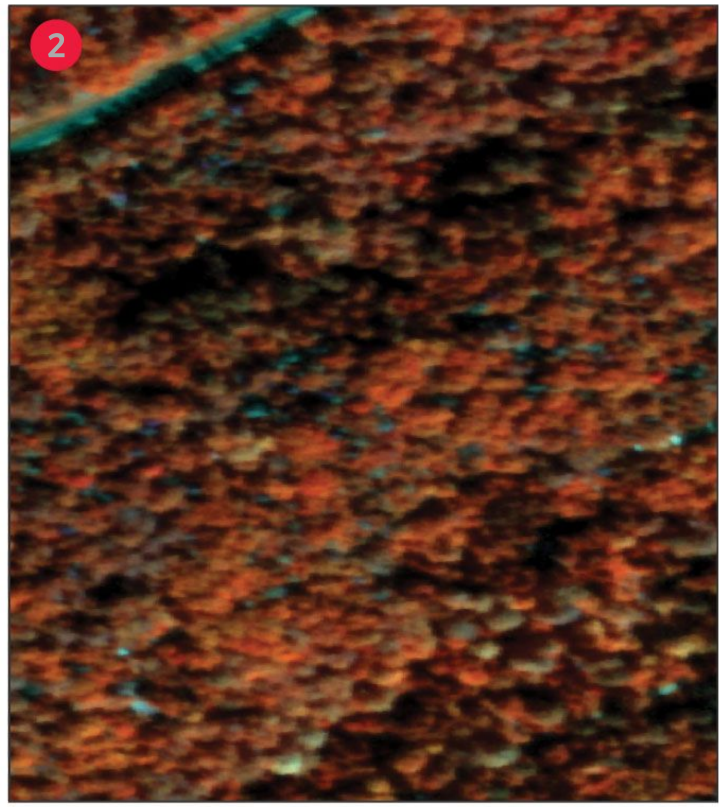
For years, Swedish forestry cooperative Södra has deployed hundreds of foresters to walk the widely spaced spruce on properties it helps manage, monitoring the trees' bark for drilling holes that are a telltale sign of infestation. But it can take days to assess a single 100-acre estate by foot, and Södra oversees more than five million acres. Last year, the beetles damaged five million cubic meters of lumber, about a quarter of the season's potential yield, says Johan Thor, an applied physicist and head of data science at the cooperative.

AI in the Sky for Protecting Forests

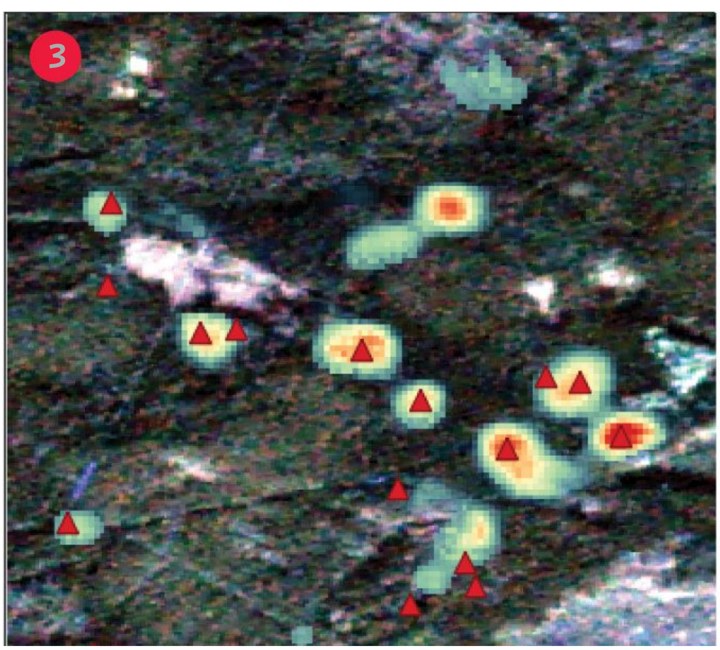
Improved satellite-imagery analysis is giving conservationists and companies new ways to monitor forests in near real time. In Sweden, forestry cooperative Södra is applying this technology to pinpoint infestations of bark beetles.

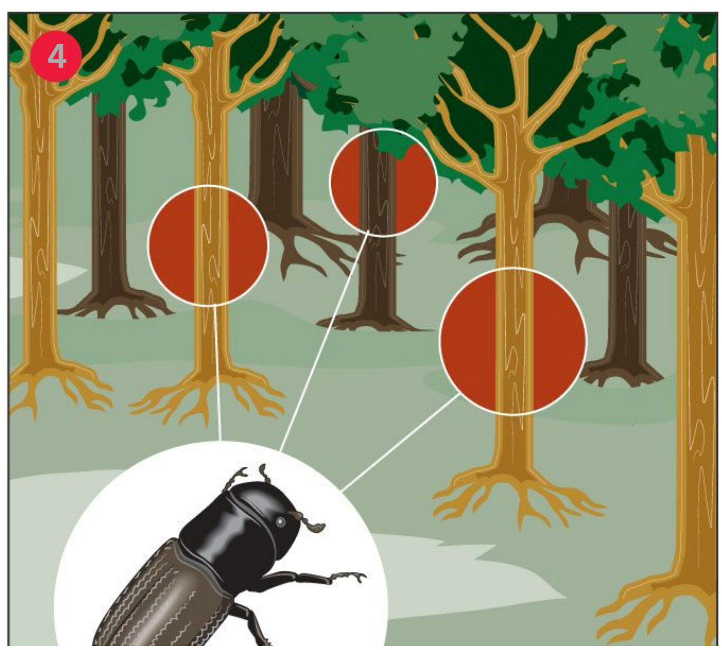


The pests: The European spruce bark beetle is tiny, but its impact on forests is massive: The insect damages or destroys as much as a quarter of the lumber on the five million acres that Södra manages.



Satellite patterns: In the past, Södra's foresters monitored the trees on foot, a time-consuming process. Now satellites offer a flow of contemporaneous images of the forests. Above, healthy trees (red) and infested trees (blue).





Data analysis: Using geolocation readings from mechanical harvesters and other data, Overstory was able to train a model to identify infested trees from satellite imagery. Above, areas the model predicts are infested, overlaid with the location of trees known to be sick.

Improved detection: The data allows Södra's foresters to move more quickly to infested areas. In preliminary trials the company estimates it could increase their efficiency by up to 20%, helping preserve hundreds of thousands of metric tons of lumber each year.

Source: Södra, Overstory, Planet Labs Inc. (satellite imagery), Kevin Hand/WALL STREET JOURNAL

So in early 2019, Södra began working with the Dutch technology company Overstory to find the beetles from above—way above. By matching high-resolution satellite imagery with geographic readings of sick trees as recorded by the company's harvesters, and integrating other satellite-derived data such as land-surface temperature, they were able to train a model to quickly and accurately locate infested areas. The complexity of the data—with a profusion of tree species and canopy heights—was "a sweet spot for machine learning," says Overstory's chief executive officer, Indra den Bakker.

"The preliminary results are really quite astonishing," says Mr. Thor.

Mr. den Bakker estimates use of the technology could improve Södra's efficiency at locating diseased trees by as much as 20%, helping save its members hundreds of thousands of cubic meters of lumber annually.

It is just one example of how high-resolution satellite imagery and artificial-intelligence-driven analysis are changing how we understand and interact with forests. Scientists say these technologies on their own won't be decisive in preserving biodiverse habitats or forestalling climate change—but they make possible a real-time awareness of the world's forests that past conservationists could have only dreamed of.

Fire prevention

As California endures the most destructive fire season in its modern history, state and federal agencies are adopting similar technologies to assist in preparing for, suppressing and recovering from wildfires.

Part of the reason fires in California have grown so large in recent years is that the state has been overzealous in suppressing naturally occurring fires that would clear underbrush before it accumulates to dangerous levels. Forest managers say the only way forward is to accelerate the pace at which areas of the state are “treated”—including through controlled burns and by thinning, mulching or removing underbrush with heavy equipment. In early August, the federal government and the state announced their shared commitment to treat at least one million acres annually.

It is arduous for crews to identify where the forest is dense and needs to be cleared, however, and agencies have typically developed individual treatment projects of smaller than 5,000 acres, says Eli Ilano, forest supervisor for the Tahoe National Forest. The advent of Earth-observation data has changed that by an order of magnitude. In 2018, the U.S. Forest Service and other partners initiated a project covering 275,000 acres of the North Yuba watershed, relying largely on remotely sensed data and machine learning to create the treatment plan—without relying on staff on the ground. “Compare that to years and years of crews and crews of people out trying to characterize the landscape,” says Mr. Ilano. “It’s much faster, it’s much safer, it’s much cheaper.”

Fighting deforestation

Whereas foresters in California are working to prevent future blazes, conservationists seeking to guard the world’s tropical forests are trying to hold businesses accountable for fires in the immediate past.

Much of deforestation in these areas is driven by global agribusinesses that source commodities like palm oil, soy and cacao from hundreds of thousands of farms, some of which raze protected forests to convert them into cropland. Conservationists have long employed satellite imagery to flag incidents of deforestation and name and shame the agribusinesses that profit from the destruction.

Global Forest Watch, set up by the nonprofit World Resources Institute in 2014, issues tens of thousands of deforestation alerts every week.

Palm plantations figure prominently in preservation issues that AI analysis can help clarify.
PHOTO: JOSHUA PAUL/BLOOMBERG NEWS

As the number and type of Earth-observation satellites have increased, Global Forest Watch's gaze has sharpened. The program is currently integrating radar data, making it possible to peer through the clouds that shroud tropical areas many months of the year, and in September, Norway announced it would donate a new stream of high-resolution optical data that will be updated monthly, allowing for the identification of deforestation in closer to real time.

"What you do with that flood of information?" asks Crystal Davis, the director of Global Forest Watch. "How do you figure out which ones matter most and which ones we should prioritize acting on first, given limited capacities?"

Some big businesses are hiring private companies to help them sift through the data. False positives are a problem because without confidence in the alerts, "you end up not having either the right conversation with the right supplier, or the most meaningful conversation that you could be having," says Giulia Stellari, director of global sustainable sourcing at consumer-goods giant Unilever. UL -0.09% ▼

In March, Unilever hired Descartes Labs to whittle down the deforestation alerts it receives, with a focus on palm-oil production in Indonesia and Malaysia. Descartes used machine-learning techniques to better distinguish between the vegetation of forests that need to be protected and palm plantations where fires and replanting are a natural part of the agricultural process, says Cooper Elsworth, an applied scientist at the Santa Fe, N.M.-

based firm. That, he says, allowed Unilever to narrow down 40,000 alerts in the first half of 2020 to just a few hundred of particular salience and importance.

Of course, a complete picture of deforestation and the parties involved is of little consequence if governments and companies are unwilling to act on it. That is what worries Matthew Hansen, a professor at the University of Maryland whose pioneering research was the foundation of global-scale satellite-based forest monitoring. The world loses some 67,000 acres of forest each day due to inaction, “not because we don’t have shiny enough objects in space or fancy computing,” he says.

The Amazon is a case in point. In the early 2000s, Brazil curbed deforestation there by around 80% using technology that is rudimentary by today’s standards. Tasso Azevedo, one of the principal architects of that effort, says it hinged on commitment by the country’s top leadership and real accountability for violators. “The political will to solve the problem is much more important than all the technology available,” he says.

Based in São Paulo, Mr. Azevedo now leads a private initiative, MapBiomas, that pairs satellite data with records of land tenure to show not only where forests are disappearing but who is responsible. He believes Brazil could halt deforestation entirely if it acted on the information. But in 2019, deforestation in Brazil hit the highest rate in a decade.

New markets?

Perhaps the most ambitious hope inspired by these advancing technologies is that they will allow new markets to emerge that price all of the natural benefits of the world’s forests—such as sequestering carbon from the Earth’s atmosphere and supporting wildlife—and harness resources to protect them.

To date, efforts to establish a sustainable trade in carbon offsets have been hampered by doubts about how effective they are. Investors balk at paying to protect forests they later find weren’t actually imperiled, or out of concern that by shielding some areas, they are merely shifting deforestation to others. Carbon-offset projects with inflexible terms—demanding landowners set aside their forests for decades or even a century—haven’t helped either. Innovators, however, are betting that precise, real-time estimates of forest carbon will change that.

In Pennsylvania, an experiment is under way to test that proposition.

Max Lowrie, who helps his dad and brothers manage a tree farm on 145 acres, says he heard about a new kind of carbon offset last year at a meeting of the Woodland Owners of Clarion-Allegheny Valley. In return for forgoing a timber harvest this year, landowners would be paid for the carbon their forests absorb—but unlike typical offset contracts that are only open to those with huge holdings, landowners with as few as 30 acres could participate, and they would be paid annually and allowed to revise their contract each year. Combined, the participants enrolled 66,000 acres, and were expected to sequester 100,000 metric tons of carbon-dioxide equivalent.

The 53-year-old Mr. Lowrie says that while he is concerned about changing weather patterns, he wanted to participate in the program because of the money. “It makes sense: We’re doing something good for the Earth, we should be rewarded for our work.”

The project hinged on a map of the Pennsylvania forests of unprecedented detail from SilviaTerra, a forestry-data company. Using artificial intelligence to process an enormous amount of satellite imagery of various types and time periods, the company can estimate the size and the species of the trees based on factors like when their leaves begin changing color in the fall.

Zack Parisa, SilviaTerra’s CEO, says landowners are typically paid for the only dimension of their holdings that can be weighed and valued—timber—even if the same acreage creates harder-to-measure benefits like recharging aquifers, supporting wildlife and storing carbon. He believes satellite data and artificial intelligence are changing that. “Our core thesis is that ‘measurements make markets,’ ” he says.

Carbon sequestration is among the most straightforward outputs to measure, but Mr. Parisa imagines landowners ultimately getting paid for benefits as esoteric as providing a habitat for migratory songbirds. “If we are ever to live in a world that reflects our social values better than it does today, we have to find better ways of measuring and paying for more of what we want,” he wrote.

In mid-October, Mr. Lowrie received a check in the mail for $3,649.

Next year, SilviaTerra intends to expand the pilot to commercial scale in 11 states.

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