

# Landsat—The watchman that never sleeps

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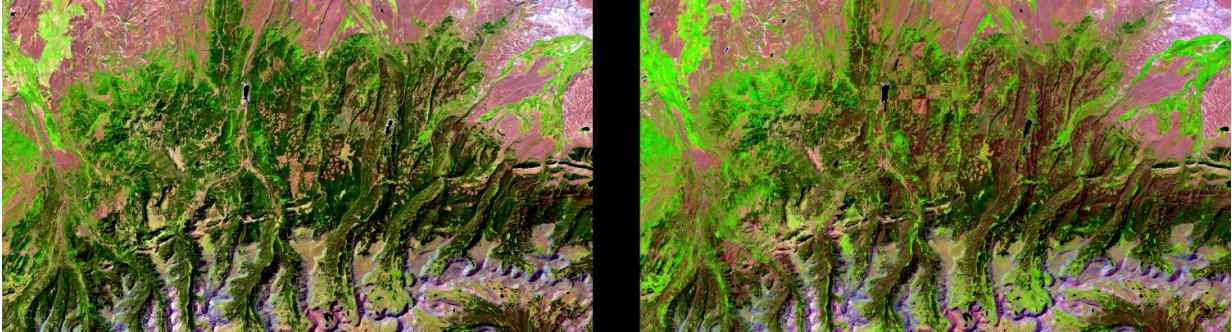


Image pair reveals pine beetle assault on Utah forest. Dark green healthy forest in 1992 (left) is dark red in 2010 (right). Credit: USGS

In western North America, mountain pine beetles infest and ravage thousands of acres of forest lands. Landsat satellites bear witness to the onslaught in a way that neither humans nor most other satellites can.

## Life and Death in Forests

Since 1972, the U.S. Geological Survey's Landsat satellites have been the watchman that never sleeps with spectral bands capturing the subtle turning of green mountainsides into dying forests. From the ground, the extent of [forest](#) land damage is simply too large for field observers to quantify. But 438 miles above the Earth, Landsat satellites pass over every forest in the country dozens of times a year—every year—creating a historical archive of clear, composite images that tells the hidden

stories of life and death in our nation's forests.

Such was the vision of Secretary of the Interior Stewart Udall 50 years ago when he boldly called for Earth observations from space. What the U.S. Geological Survey has accumulated now are vast and continuous long-term records from Landsat that have become critical tools for agencies such as the U.S. Forest Service (Forest Service), which reports the status and health of our nation's forest resources.

## Seeing the Forest for the Trees

Although Forest Service field crews can sample plots to characterize forest types, the species and age of trees, even soil types, the lands are so vast that in the West, field crews visit only a small fraction of the nation's forests each year. Landsat data increase the ability and frequency of the Forest Service to make these characterizations.



Mountain pine beetles have killed pine trees across vast areas of western North America since the late 1990s. Image of the northern Williams Range, Colorado, where beetles have killed more than 80 percent of mature lodgepole pine over many square kilometers. Credit: USGS

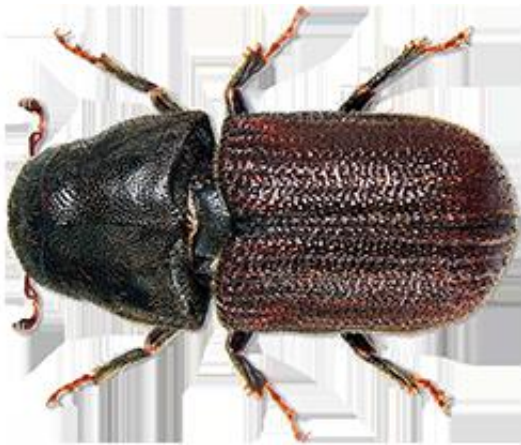
Through continuous monitoring, Landsat satellites can produce a series of images over time that reveal subtle changes in near real time. Such monitoring is not as crucial in cases of timber harvesting or wildfire as the impact on forests is easily identified in those situations. Pine forests under siege by beetles, however, can die a slow death. Forest Service personnel indicate that noticing such trends can be difficult, depending on whether the trees under assault are just a few or number in the thousands. Although aerial photography and field observations might find some of the tree damage, the large-scale revelations really happen only because of Landsat's ability to monitor forests year after year.

## **The Big Picture for Forest Management**

In addition to longevity and consistency, Landsat data are particularly valuable since the 2008 USGS decision allowing users free access to archived satellite data. Free access has emboldened the evolution of time-series images, giving forest managers a key economical asset in discerning where outbreaks are happening as they occur. Pine beetle outbreak knowledge in real time enables forest managers to make more informed decisions on when to go in and break up stands of trees affected by beetles, thus minimizing the potential fire threat pine beetle damage could pose.

In the larger picture, knowing when and where forests are changing, and what is causing that change, are important in understanding how forests interact with the atmosphere given climate change. The pine beetle is a

good example of understanding forest and atmosphere interaction. Researchers can use forest inventory data to study how longer growing seasons and less harsh winters affect [pine beetles](#). As warmer weather boosts pine beetle populations and broadens their range, scientists are trying to discern whether the killing cold of winter still acts as a strong deterrent against the forest pests, or if rising temperatures and drought stress trees to the point of becoming defenseless against pine beetles.



The mountain pine beetle is much smaller than this image -- about 5 millimeters or the size of a grain of rice. Credit: Courtesy S.D. Department of Agriculture.

Although questions about the impact of pine beetle infestation still remain, with Landsat data, answers are becoming clearer every day. When it comes to the future of forest health in the United States, USGS scientists understand the invaluable contribution Landsat can make, now and for years to come.

**More information:** [dx.doi.org/10.3133/fs20163045](https://dx.doi.org/10.3133/fs20163045)

Provided by United States Geological Survey

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