

Landsat—The Watchman that Never Sleeps

“A vision to observe Earth for the benefit of all...”

Interior Secretary
Stewart Udall, 1966



▲ The mountain pine beetle is much smaller than it appears in this image. The pine beetle measures approximately 5 millimeters, or about the size of a grain of rice.

In western North America, where infestations of mountain pine beetles continue to 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 see.

For 47 years, the fleet of Landsat satellites has 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 important stories of life and death in our Nation’s forests.

Beetle-damaged tree. ►

Photographs courtesy of South Dakota Department of Agriculture.

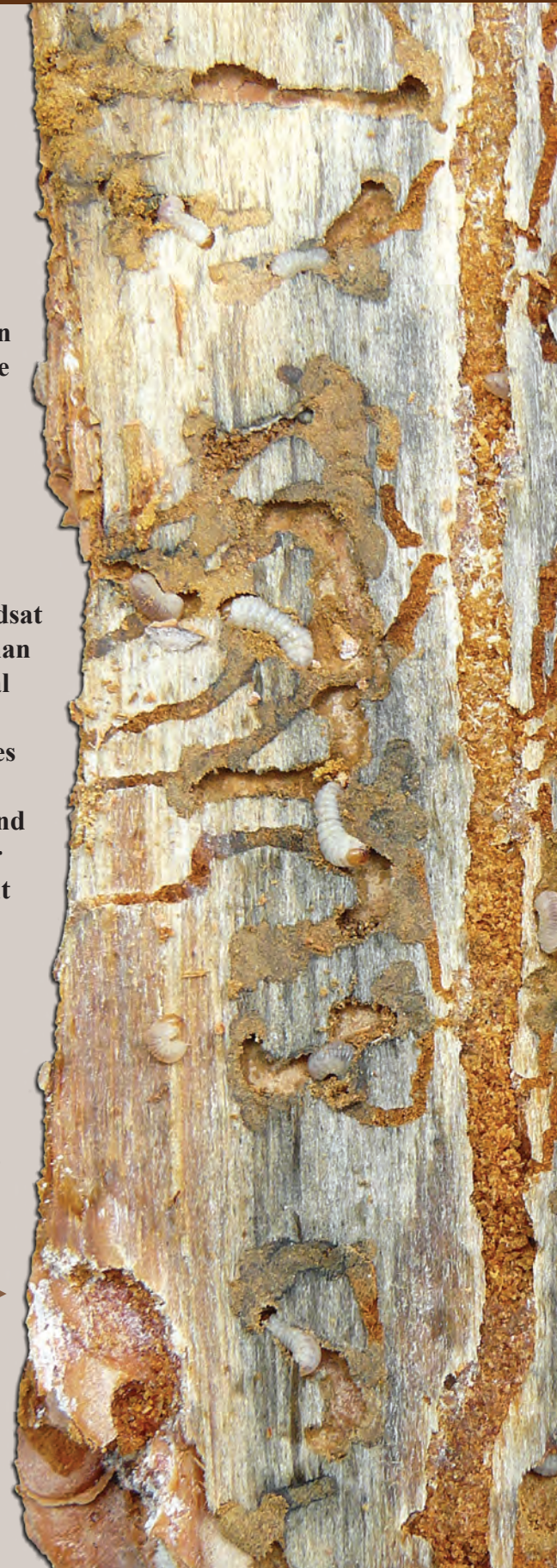




Figure 1. Landsat time-series satellite imagery captured this dramatic assault of mountain pine beetles on forest land in the Uinta Mountains east of Salt Lake City, Utah. In the August 1992 image at left, the shades of dark green indicate areas of healthy, undisturbed forest. At right in 2010, the dark red stains reveal widespread pine beetle destruction.

Such was the vision of former Interior Secretary Stewart Udall more than 50 years ago when he boldly called for Earth observations from space. What the U.S. Geological Survey has accumulated now (2019) 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 on the status and health of forest resources in the Nation.

Although Forest Service field crews can sample plots to characterize forest types, the species and age of trees, and even soil types, the magnitude of the work is so immense that field crews actually visit only a small fraction of forests across the Nation each year. Data from Landsat satellites show immense value in increasing the ability and frequency for characterizing forests, species, and soils for the Forest Service.

Through continuous monitoring, Landsat satellites can produce a series of images of a forest over time that reveal subtle changes in near real time. Pine forests under siege by mountain beetles 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 the ability of Landsat to monitor forests year after year.

In addition to longevity and consistency, Landsat data are particularly valuable today (2019) following the 2008 U.S. Geological Survey decision to make archived satellite data free for distribution. Free access to Landsat data has emboldened the evolution of time-series images, giving forest managers an important and 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 in terms of 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 range expansion, 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.

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, scientists at the U.S. Geological Survey studying these patterns understand the invaluable contribution Landsat can make, now (2019) and for years to come.

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