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SATELLITE MONITORING OF FOREST DAMAGE CAUSED BY THE BARK BEETLE

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Bark beetle infestation in Val di Gares, Province of Belluno | Photo by Daniele Savio

The work presented is a continuation of a monitoring activity initiated in 2020, utilizing Sentinel-2 L2A satellite images to delineate infested areas up to September 2022. In subsequent years, commercial satellite images with better geometric resolution were integrated.

THE CHALLENGE

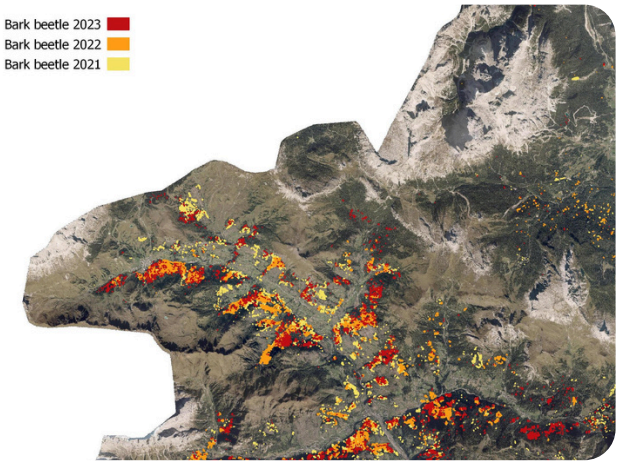
Since 2020, when the Ips typographus L. infestation began to become widespread, the Veneto Region has initiated an annual monitoring program for forest areas affected by this beetle. The resulting maps, obtained from the interpretation of satellite imagery, enable the identification of areas where the beetle is most widespread, the correlation of its proliferation with specific predisposing factors, the prioritization and planning of restoration interventions for damaged woodlands, and the identification of the most suitable species to use. In this context, monitoring is part of the "Regional Strategy for the Control of the Norway Spruce Bark Beetle," adopted by the Veneto Region with Regional Government Decision of July 12, 2022, Annex A, which also provides for support for forestry interventions by forest managers, direct management interventions, and the planning of restoration interventions in affected areas.

THE SPACE SOLUTIONS

The satellite monitoring activity for the bark beetle infestation began in 2020 and is updated annually, allowing for assessments of the infestation trend. The trend peaked in 2022, with almost 1,500 ha monitored, followed by 982 ha in 2021 and 1,088 ha in 2023.

The workflow uses Sentinel-2 L2A images in late summer and involves the development of two indices, MCARI2 and NDWI. From the aggregation of the annual differences of these two indices, processed to a limited extent to the surfaces covered by the Copernicus Forest type 2018 layer (10 m raster), the thresholds for vectorizing the potential surfaces affected by the bark beetle were determined. The classification accuracy was improved through subsequent supervised classification, validated by systematic checks on orthophotos from 2021 (0.2 m raster) and Triplesat images (1.5 m raster) from 2022 and 2023, which were also used in the selection of training polygons.

To increase the geometric precision of the survey, Planet SuperDove images were recently used. The temporal resolution of this satellite constellation is almost daily, and, therefore, it is more likely to acquire cloud-free images, but compared to Sentinel-2, it has a lower spectral resolution capacity, as it lacks bands between 945 nm and 2190 nm.
The results are published in a dedicated webGIS of the Veneto Region (https://idt2.regione.veneto.it/idt/webgis/viewer?webgisId=204).



Forest areas affected by bark beetles in the Agordina Mountain Union | Own Work

THEMATIC AREA

Biodiversity and Environmental Protection

REGION OF APPLICATION

Veneto Region

SENTINEL MISSION USED

S2

COPERNICUS SERVICE USED

CLMS

THE BENEFITS AND THE BENEFICIARIES

TMonitoring plant diseases through remote sensing data enables the obtaining of results that would be impossible to achieve in sustainable times and at costs using traditional methods. This methodology, however, is subject to an important criticality represented by cloud cover, which was always present on the mountainous territories of Veneto during the late summer period of 2021-2022-2023, albeit with varying percentages, as indicated in the available Sentinel-2 images.

This limitation necessitated the integration with satellite sources characterized by a daily review time, such as PlanetScope images. In this way, it was possible to achieve good coverage of the forest territory and provide users with an estimate of the phenomenon not too far from the real entity.

This reliable and annually updated geographic information is available to any user through a dedicated WebGIS integrated into the Geoportal of the Veneto Region.

Benefits and beneficiaries can be identified at various levels: public administration and policy makers, who can rely on the geographic information provided to define suitable and targeted actions for monitoring, contrasting and restoring the affected forests, forest owners and professionals, who can use it as a support to apply for grants for contrasting and restoring interventions, research institutions for studies on the progress of the infestation, citizens interested in the phenomenon which has a substantial visual impact.

	TIER 1 SERVICE PROVIDER	TIER 2 PRIMARY USER	TIER 3 SECONDARY USER	TIER 4 END USER BENEFICIARIES
SERVICES AND BENEFITS	Open satellite data (Sentinel-2), high resolution data: PlanetScope, Triplesat (used as ground-based reference data)	Annual update of the vector layer that identifies the forest surfaces damaged by the bark beetle. Implementation in WebGIS dedicated	Reference data for planning restoration interventions for forests destroyed by bark beetles (MASAF Ordinance No. 8 of 12/06/2024)	Positive impact on environmental and landscape quality and local economic chains linked forestry through the adoption targeted action strategies
BENEFICIARIES	Veneto Region, Forestry and Silviculture Organizational Unit, responsible for updating the vector layers relating to satellite monitoring	Veneto Region (other Directorates), regional agencies	Municipalities, Provinces and professionals involved in forestry planning and silviculture, companies involved in the forest-wood supply chain	Citizens, society (ecological resilience), environment

EU POLICY / DIRECTIVE

Other

TYPE OF SERVICE PROVIDER

Public Service

TYPE OF FUNDING SOURCE

National or regional non space Programme

USAGE MATURITY LEVEL

4



A FUTURE WITH COPERNICUS

Satellite data processing will increasingly be the preferred solution for implementing large-area monitoring due to its low costs and relatively short execution times. The implementation of models based on artificial intelligence has already proven to bring additional advantages in terms of speed of application to an already competitive analysis methodology. The future with Copernicus will be conditioned by the possibility of having higher resolution images and characterized by reduced review times.



DID YOU KNOW?

Few people know that when a Norway spruce shows visible signs of bark beetle infestation—such as yellowing needles or bark loss—the beetle has already completed its life cycle and moved on to another tree. The symptoms, therefore, indicate irreversible damage, making prevention and early monitoring essential.

Acknowledgements

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