

Action C1

Remote sensing data provision and

X-platform management

Deliverable: Report on Remote Sensing data  
collection, analysis and integration procedures

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**OVERVIEW:** the report illustrates what has been carried out for C1 Deliverable named 'Report on Remote Sensing data collection, analysis and integration procedures', that originally was planned for April 2020 and then was postponed to due COVID-19 emergency. This report details the collection of remote sensing data of different types and from different dates, the processing and the analysis that have been conducted to obtain useful information, and the integration of the original datasets as well as the derived information in to the Life Samfix portal. It has to be remarked that this deliverable has been produced under very difficult conditions, as the partner offices were closed for several months in 2020 and smart working is still the preferred job mode. This pose challenges for the processing of huge datasets –such as those from remote sensing- because certain tasks require high computing performances. The same tasks, when performed with common IT facilities available from home, can be executed only with a considerable amount of extra time.

**OBJECTIVE:** the report illustrated the progresses made with the deliverable related to the collection of remote sensing data, their analysis, and their integration into the Samfix IT facilities.

## **METHODOLOGY:**

1. Collection, review and storage of remote sensing datasets, from Sentinel 2 archives and from data providers for purchased very high resolution imagery (Spain and Italy)
2. Preliminary computation and analysis of vegetation indices for data time series, useful to detect signs of vegetation stress at multiple sites in the core study areas
3. Integration into the Samfix portal of the original datasets and the derived analysis results

## 1. Methodology: Collection, review and storage of remote sensing datasets:

As planned, the main remote sensing data type acquired over the project areas is represented by multispectral Sentinel 2 data, available free of charge from the Copernicus facility. Sentinel 2 are often affected by cloud cover issues, that hamper data use, and thus the first step requires screening the imagery, detecting clouds and haze, and select those that have a better radiometric signal and are less affected by atmospheric effects.

The imagery cover from the end of spring to the beginning of fall and thus the most adequate period to detect vegetation stresses potentially attributable to *Xylosandrus* invasion

Below, the list of selected S2 imagery per study area is provided:

Circeo National Park (Italy)			
Date	Satellite	Orbit	Tile
25-05-20	2A	R122	33TUF
24-06-20	2A	R122	33TUF
09-07-20	2B	R122	33TUF
13-08-20	2A	R122	33TUF
17-09-20	2B	R122	33TUF
22-10-20	2A	R122	33TUF

El Tello (Spain)			
Date	Satellite	Orbit	Tile
20-05-20	2A	R51	30SYJ
14-06-20	2B	R51	30SYJ
19-07-20	2A	R51	30SYJ
13-08-20	2B	R51	30SYJ
12-09-20	2B	R51	30SYJ

12-10-20	2B	R51	30SYJ
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<b>Mont Boron, Saint-Jean-Cap-Ferrat and Corniches de la Riviere, Antibes, St Marguerite (France)</b>			
<i>Date</i>	<i>Satellite</i>	<i>Orbit</i>	<i>Tile</i>
04-05-20	2A	R108	32TLP
23-06-20	2A	R108	32TLP
25-07-20	2B	R65	32TLP
12-08-20	2A	R108	32TLP
13-09-20	2B	R65	32TLP
08-10-20	2A	R65	32TLP

In addition to Sentinel 2 images, two very high-resolution satellite images were purchased and stored, with the aim of conducting fine scale detection of stress symptoms at selected sites, as previously planned.

a) A GeoEye 1 dated 3/10/2020 was acquired over Spain El Tello area. GeoEye1 is a 4-bands (VIS-NIR) plus panchromatic orthoimage, with spatial resolution included in the 0.3-0.6 m range. A small western portion of the study area has no data, but this is not going to affect the tests for Xylosandrus detection that can be performed in the larger remaining part.

Below the GeoEye 1 acquired over El Tello area:

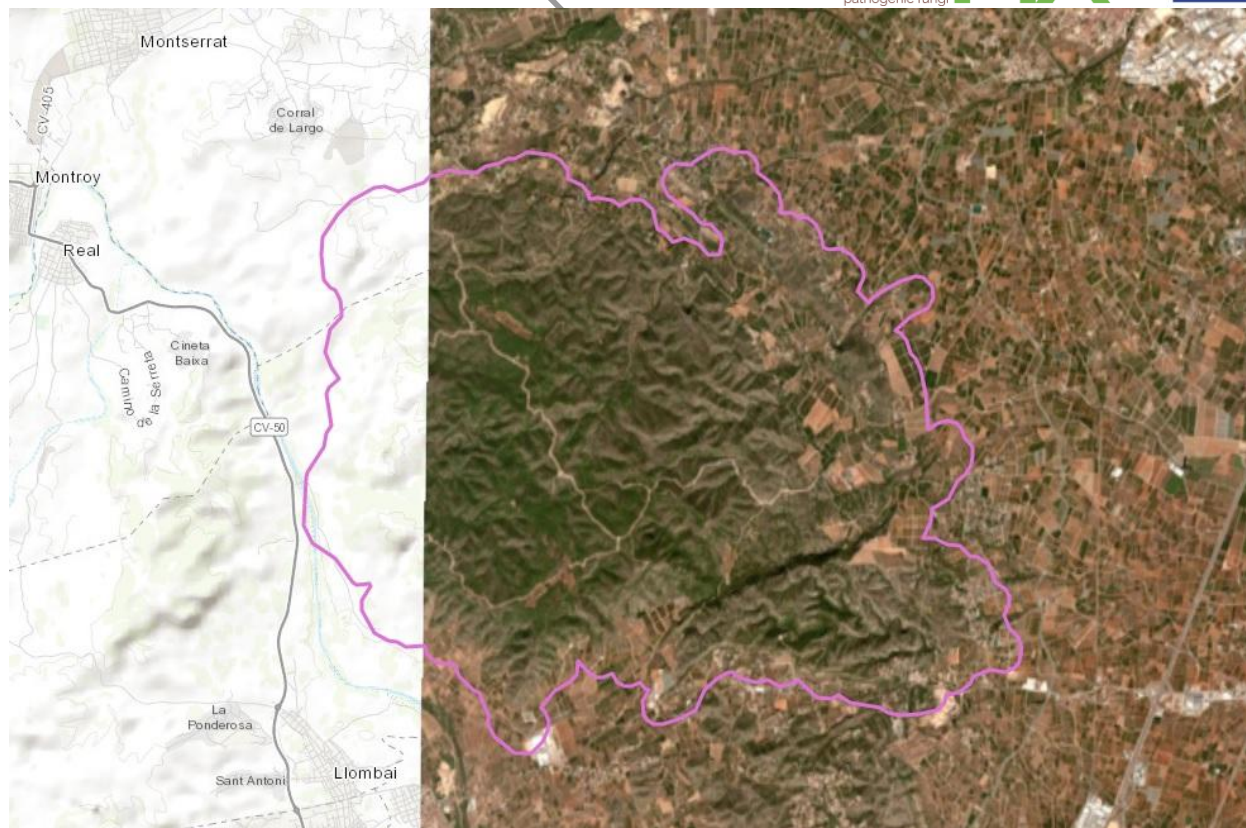


Fig. 1: GeoEye1 very high-resolution image acquired in 2020 over El Tello area (Spain).

b) A SPOT 7 satellite image was acquired on 17/09/2020 over Circeo Nation Park area (Italy). SPOT7 has 4-bands (VIS-NIR) plus panchromatic spectral range, and a spatial resolution equal to 1.5 m.



Fig. 2: SPOT7 very high-resolution image acquired in 2020 over Circeo National Park area (Italy).

Both very high-resolution images were acquired at the very end of 2020 summer, when the chance to detect signs of *Xylosandrus* attacks are higher. The different spatial resolution of these images was selected according to invasion characteristics, that in El Tello area is mainly at single tree level, while in Circeo was associated to large vegetation zones.

## 2. Methodology: Preliminary computation and analysis of vegetation indices for data time series

As the previous season, to test the opportunity to detect advanced signs of stress from data recorded by Sentinel 2 sensor, the spectral data from the different archived images were used to compute three vegetation indices, namely NDVI, RENDVI, and SR.

The indices were extracted at known locations, evaluating in the same vegetation type the indices response in infected as well healthy vegetation.

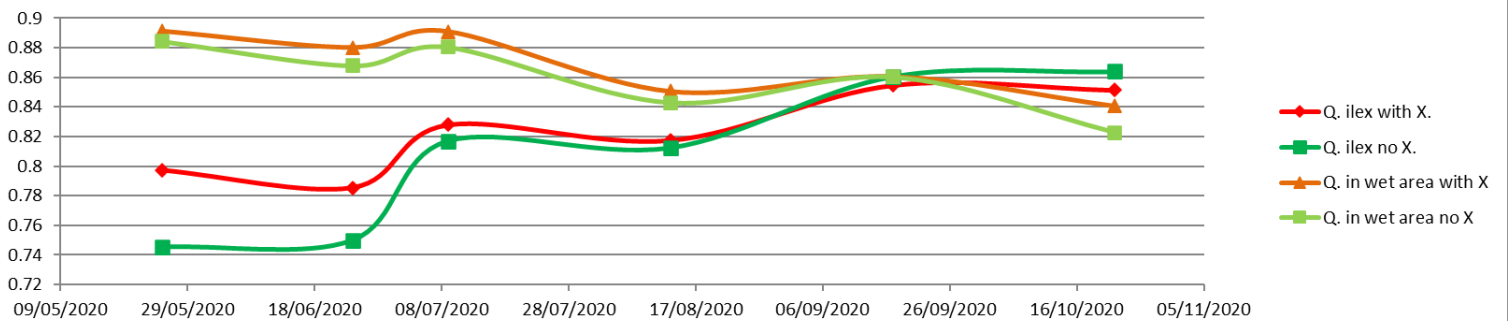
The results, also included in the geoportal, are shown below for each study site:

## Circeo National Park (Italy)

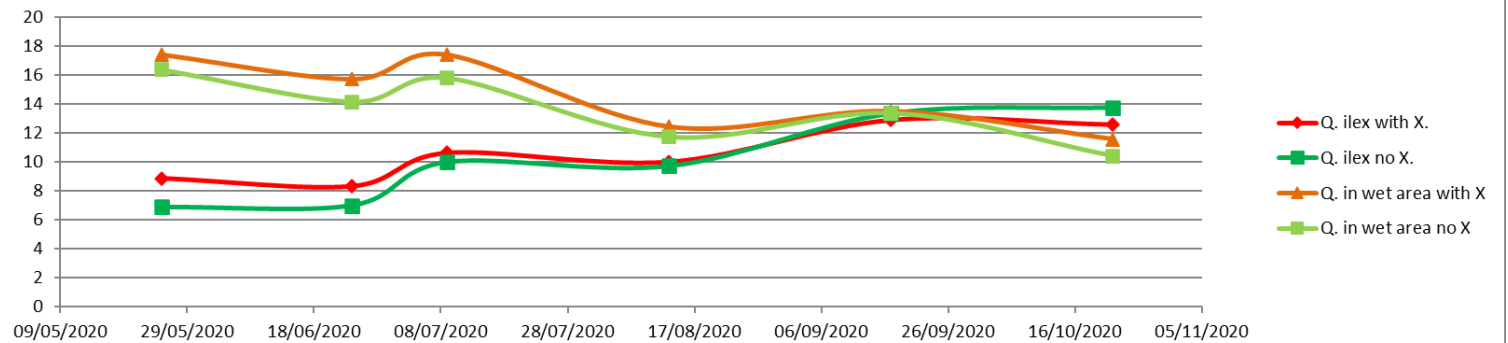
Data from 2020 from this study area, indicates -as previously noted- that only very large invasions can be detected using the Sentinel2 spatial resolution, possibly due to the multilayered forest structure, that allows Xylosandrus to attach lower layers with limited damages visible on the top of the crowns, which is the layer sensed by satellite data.

Here the NDVI, SR and RENDVI provided very similar results, with no discrimination capability between healthy and stressed vegetation as indicated by the convergence of red and green lines in the figure 3 below. Tests based on the recently acquired very high-resolution SPOT imagery are on-going to assess the role of spatial resolution on detection potential.

**Preliminary trend of NDVI vegetation index for healthy and attacked forest samples in Circeo NP (based on Sentinel 2 data)**



## SR



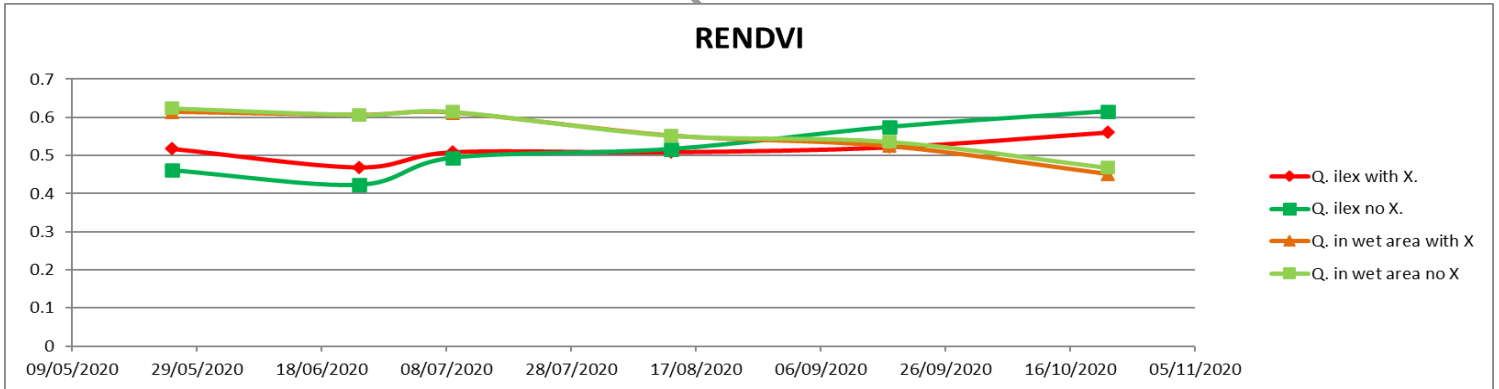


Fig. 3. Circeo NP: trends in vegetation indices extracted from Sentinel2 images from different dates. Tests were conducted in two forest types.

Below, the locations where the tests were conducted, one in 'lowland wet forest' and another in 'quarto freddo' forest area is shown:



Fig. 4 Circeo NP: forests location selected to compute trends in vegetation indices.

## El Tello (Spain)

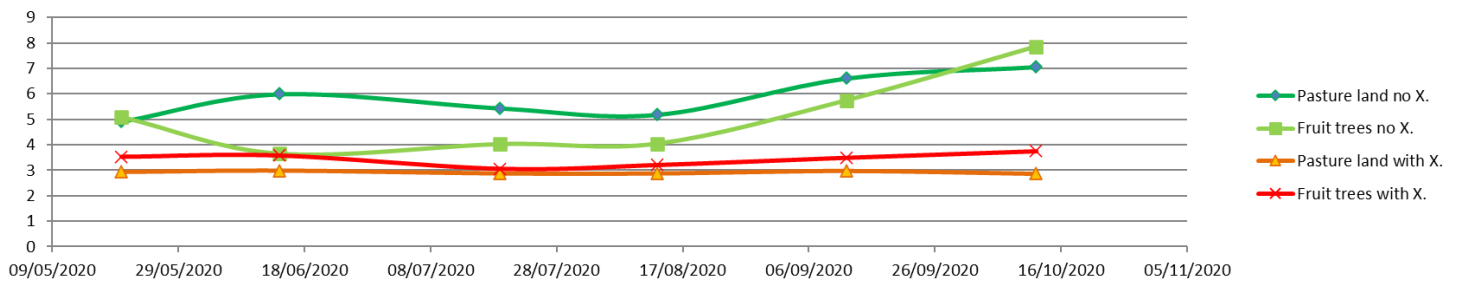
Information for El Tello extracted from satellite data in 2020 indicates that stressed vegetation where *Xylosandrus* presence was confirmed can be distinguished from healthy one, being this a promising approach for fast identification of areas under risk of attack. In fact, the red and green lines presented in figure 5 are clearly distinguishable especially using the Simple Ratio index, that provided good results also in tests from previous years.

The period in which the difference in response between healthy and stressed vegetation is larger corresponds to late summer, thus at the end of the invasion period when most damages occurred and no regrowth takes place.

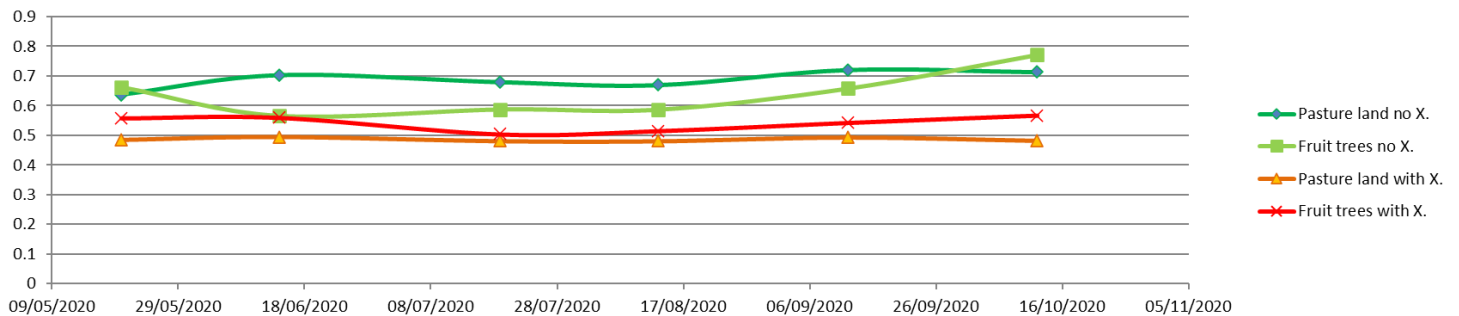
The difference between this result and the one obtained in Circeo NP is possibly due to the very different characteristics of the vegetation, here represented by trees or shrubs in pastureland or Carob trees, in a drier environment characterized by shrubland with sparse trees.

NDVI and RENDVI also provided good results, and additional tests are on-going with the recently acquired very high resolution GeoEye imagery.

**Preliminary trend of Simple Ratio vegetation index for healthy and attacked forest samples in El Tello (based on Sentinel 2 data)**



**NDVI**



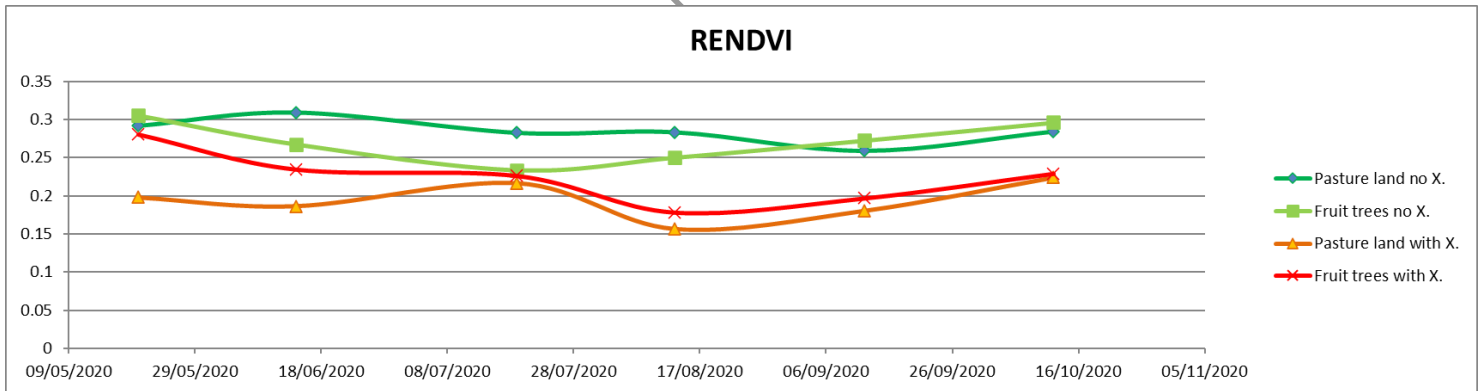


Fig. 6. El Tello: trends in vegetation indices extracted from Sentinel2 images from different dates. Tests were conducted in two vegetation types.

Below, the locations where the tests were conducted, one in 'fruit trees' and another in 'pastureland' land cover classes is shown:

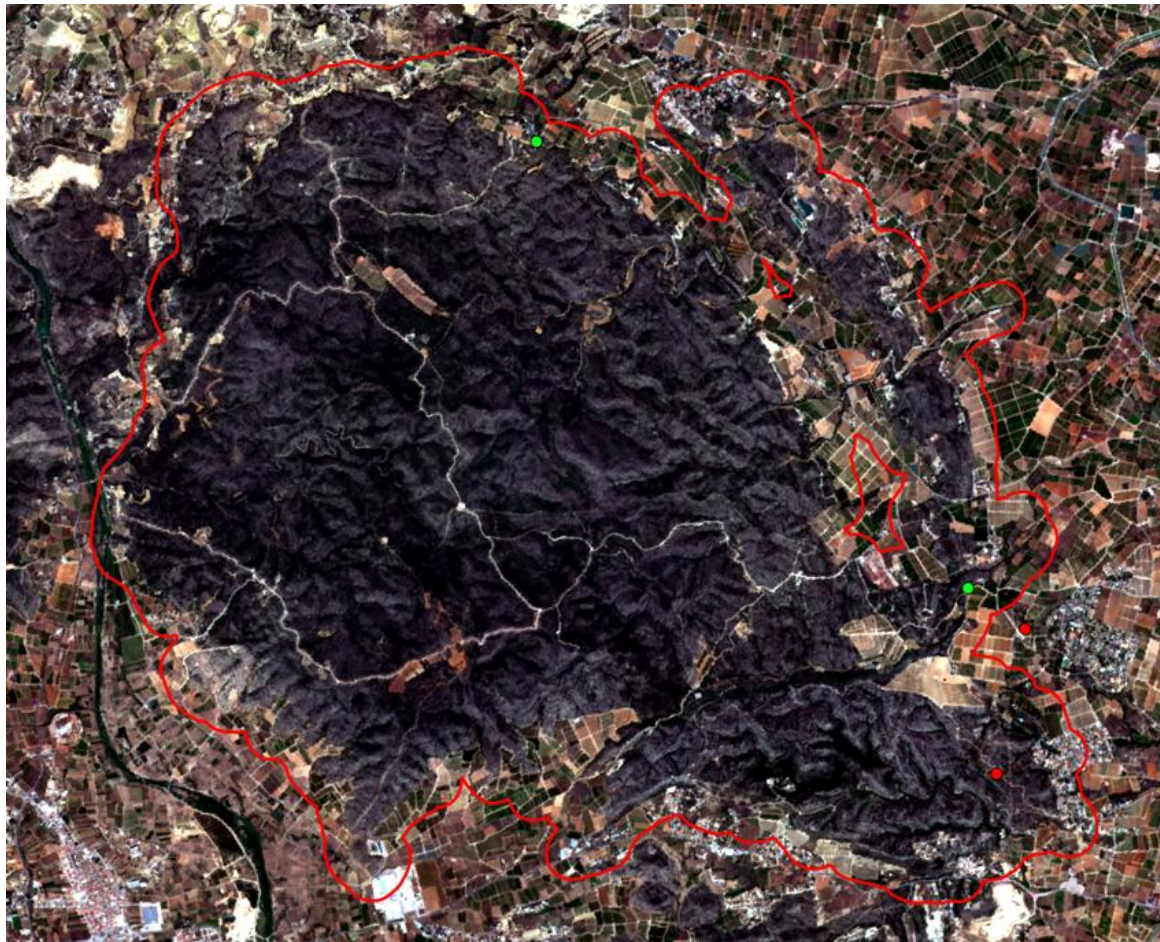


Fig. 6 El Tello: locations selected to compute trends in vegetation indices.

## France

The Sentinel 2 data used to compute the three different vegetation indices for 2020 are not of help for the identification of stressed vegetation, where *Xylosandrus* was detected in the field. In France the samples come from forested areas, an environment very similar to the one found in Circeo NP, where similar results were obtained. Again, this multilayered forest structure often implies *Xylosandrus* presence in lower subcanopy layers and limited damages visible on the top of the crowns, that instead is the layer sensed by satellite data.

All the vegetation indices show no discrimination capability between healthy and stressed vegetation as indicated by the convergence of red and green lines in the figure 7 below.



Fig. 7. France: trends in vegetation indices extracted from Sentinel2 images from different dates. Tests were conducted in forests.

Below, the locations where the tests were conducted, in forested areas :



Fig. 8. France: locations selected to compute trends in vegetation indices.

### 3. Methodology: Integration into the Samfix portal

All satellite and ground collected data have been integrated into the Samfix portal, including those that last year were not included due to COVID-19 issues.

Specifically, the portal now includes, for all the core study areas:

1. Satellite data: Sentinel 2 sample imagery from 2016 to 2019, NDVI vegetation index derived from Sentinel 2, GeoEye1 for Spain and SPOT7 for Italy.

2. Ground data: location of traps and field surveys where *Xylosandrus* was screened for presence/absence.
3. Results: trends of vegetation indices along the spring-fall period, computed at selected sites.

## CONCLUSIONS

This document presented the data collected and the methodology related to remote sensing data collection, analysis, and integration. Due to this complex period of project execution, delays occurred; nevertheless, progresses were obtained, and results demonstrates that in certain areas and for selected vegetation classes the proposed methods are useful to detect damages due to extreme stressful conditions, such as those occurring in pest invasions.

The proposed methods are promising for invasions monitoring, and we expect that the additional results from very-high resolution imagery analysis can bring useful information to refine the remote sensing -based techniques.

The integration of available information into the portal was carried out successfully.