◦ LIFE17 NAT/IT/000609◦

Deliverable name:

Final version Platform design and App description

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Table of content

1. Summary

Advanced information technology infrastructures support the project with state-of-the-art tools, allowing the collection and exploitation of different data, which has to be integrated in a common spatially explicit and dynamic environment in order to produce relevant information for different categories of users. The action A.3 carries out the design and set up of:

- a central platform (X-platform) for data storage, integration, validation, analysis, and output information; the X-platform is a communication and decision support system embedding spatially explicit information, such as those coming from Geographic Information Systems, Remote Sensing and Citizen Science activities;
- an application (X-app) for mobile devices supporting the *Xylosandrus* monitoring and citizen science activities within the project, that communicates with the central platform, exchanging information with it and sharing the database with the X-platform.

The collected information cover all the project areas so to make accessible a wealth of knowledge on *Xylosandrus* invasions in and around nearly all infested (semi-) natural areas in Europe currently known. The specific objectives of these tools, according with the purposes of the A3 action, are:

- Supporting the collection, validation and quality control of data on beetles and damages presence acquired from traps, observations and citizen science activities (X-app), sharing the output for other project activities
- Integrating data from different sources (field monitoring, remote sensing, citizen science) for advanced analysis about the temporal and spatial dynamics of the infestations
- Processing, updating and sharing the project "performance indicators", defined in the action D2 and E2, providing a synthesis of the project progress about the infestation dynamics, the mitigation activities and the communication/training and awareness actions
- Supporting the improvement of the risk assessment and of the protocols of actions A2 and C
- Supporting the correct recognition of the insects, their infestation and host plants and the collection of *in situ* observations, by dedicated mobile app tools
- Engaging citizens, rising awareness about the Xylosandrus matter by citizen science activities, through gamification
- Targeting different stakeholders (park staff, researchers, orchard farmers, agronomists, scientist, visitors..), profiling users specific needs and goals

This document describes the general infrastructure and the contents of the final version of X-Platform and X-App. This is the result of a design work carried out by Terrasystem, that took into consideration the feedback received at the bilateral meetings whit the partners after the sharing and publication of the "alpha versions".

With this deliverable, the applications in their final version will be shared with the partners.

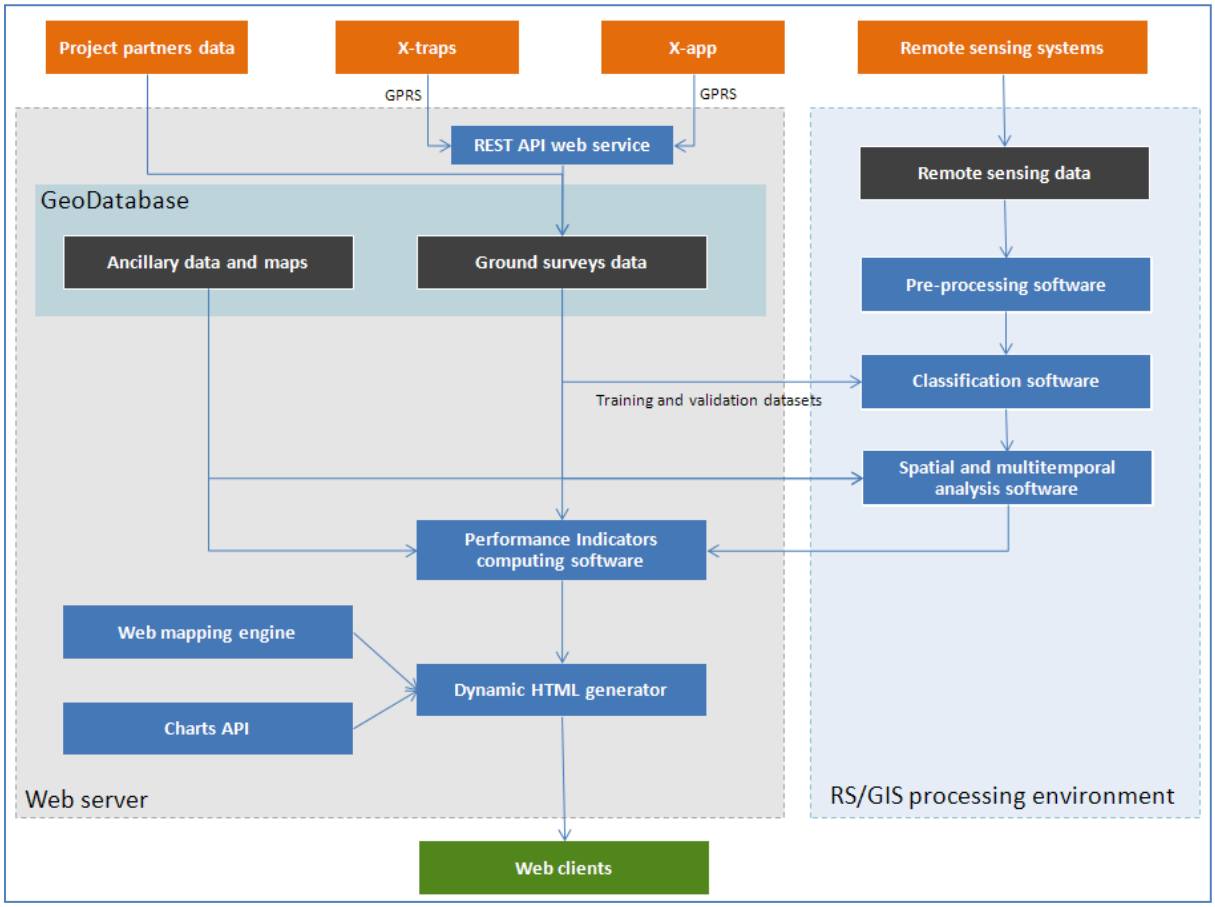
2. X-platform design

2.1 X-Platform stack

Features

- Suite of software modules installed and managed in a dedicated web server **Windows Server 2012**
- **Open source relational geodatabase Postgresql** with Postgis spatial extention storing all alphanumeric and geo-referenced information. It is fed with information from i-X-traps, X-app, remote sensing and ancillary cartographic data.
- **Data repositories** for images, documents files, with related metadata stored in the database
- Web portal with internal and open data sections, in **dynamic HTML**, with user friendly interfaces and **javascript API** components for interactive **charts, maps and widgets**
- **Webgis** section developed by Pmapper, a php/mapscript framework based on Mapserver, featuring interactive maps with GIS tools (navigation, query, layer selection etc.)

Stack schema

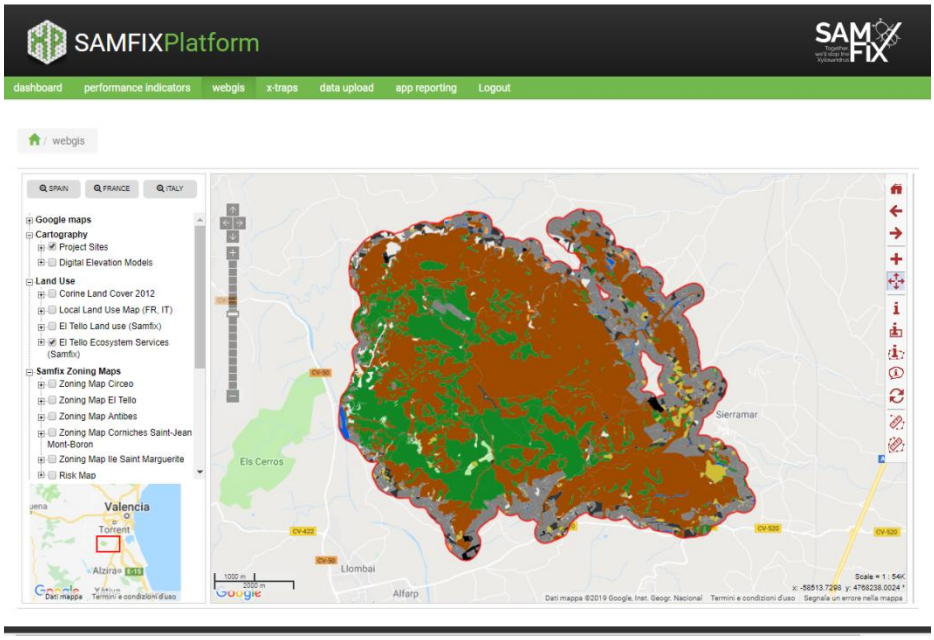


2.2 X-Platform brand

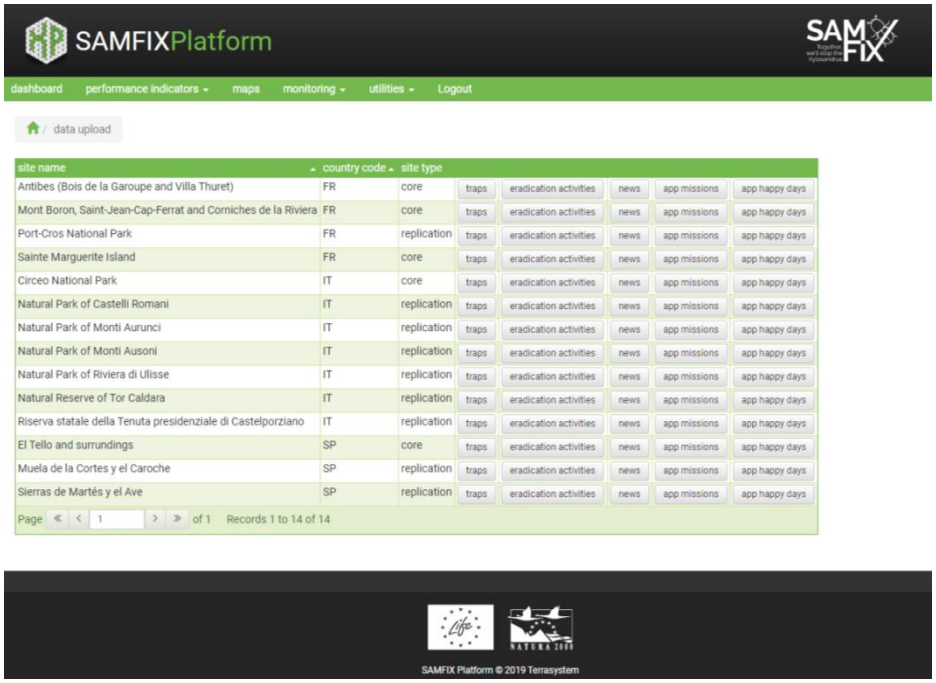
The proposed name of the application is **"SAMFIX Platform"**.

The graphic theme is inspired by the brand of the www.lifesamfix.eu. Dedicated themes and icons were developed.

Front-end page example with site header



Back-end master table example



site name	country code	site type					
Antibes (Bois de la Garoupe and Villa Thuret)	FR	core	traps	eradication activities	news	app missions	app happy days
Mont Boron, Saint-Jean-Cap-Ferrat and Corniches de la Riviera	FR	core	traps	eradication activities	news	app missions	app happy days
Port-Cros National Park	FR	replication	traps	eradication activities	news	app missions	app happy days
Sainte Marguerite Island	FR	core	traps	eradication activities	news	app missions	app happy days
Circeo National Park	IT	core	traps	eradication activities	news	app missions	app happy days
Natural Park of Castelli Romani	IT	replication	traps	eradication activities	news	app missions	app happy days
Natural Park of Monti Aurunci	IT	replication	traps	eradication activities	news	app missions	app happy days
Natural Park of Monti Ausoni	IT	replication	traps	eradication activities	news	app missions	app happy days
Natural Park of Riviera di Ulisse	IT	replication	traps	eradication activities	news	app missions	app happy days
Natural Reserve of Tor Caldara	IT	replication	traps	eradication activities	news	app missions	app happy days
Riserva statale della Tenuta presidenziale di Castelporziano	IT	replication	traps	eradication activities	news	app missions	app happy days
El Tello and surrundings	SP	core	traps	eradication activities	news	app missions	app happy days
Muela de la Cortes y el Caroche	SP	replication	traps	eradication activities	news	app missions	app happy days
Sierras de Martés y el Ave	SP	replication	traps	eradication activities	news	app missions	app happy days

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2.3 X-Platform general contents organization

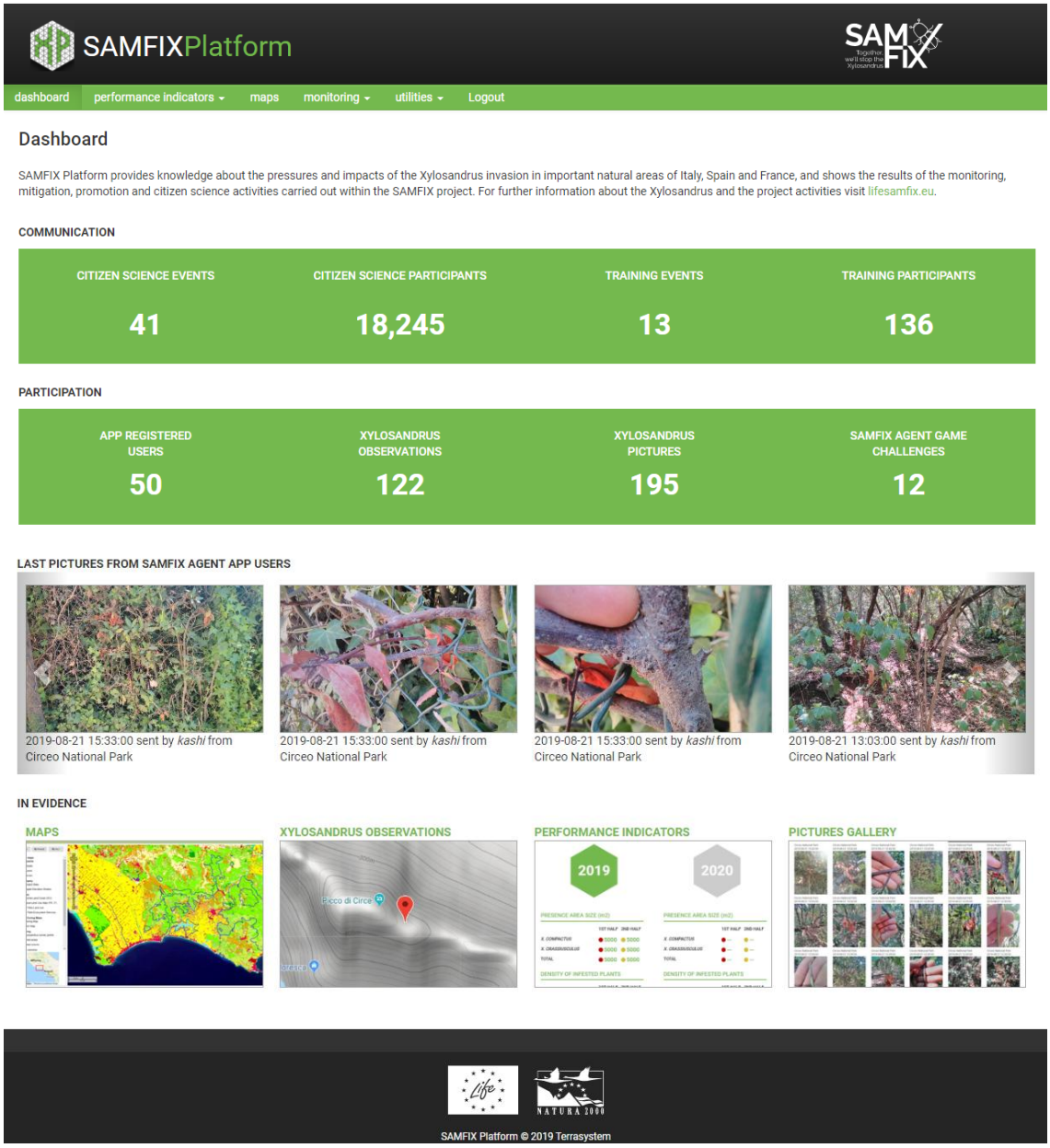
area	sections / main manu link	sub-sections	summary description
Front-end	**Dashboard**		This section contains summary information about the more relevant performance indicator values, the last pictures taken in citizen science activity (X-app) and shortcuts to the most relevant public sections of the portal.
	Performance indicators	Views by indicator category	This section contains the performance indicators in detail, organized by indicator category
	Maps		Web-GIS interface: Interactive map with GIS tools
	Monitoring data/X-traps	Xylosandrus reporting map	Xylosandrus observations reporting, from citizen science X-app activity, with a general map and links to observation monographs
		Pictures gallery	Pictures gallery, from citizen science X-app activity
Back-end	**App reporting**		Section for the viewing and checking of the data sent by the X-app users, with advanced search tool
	Utilities	Data upload	Upload utility for traps data, observation data, eradication activities, back end information and settings of the X-app (news from the parks, app missions,app happy days), with advanced search tool
		Missions report	Back end report of the X-app citizen science functions
	Help		Back end user guide

The links "app reporting" and utilities become active when accredited user is logged in.

2.4 Front-end

2.4.1 Dashboard

The dashboard is the home page and it contains summary information about the more relevant performance indicator values, the last pictures taken in citizen science activity (X-app) and shortcuts to the most relevant public sections of the portal.



2.4.2 Performance indicators

In the table below a summary description of the *performance indicators* visualized in the platform is reported, according with the D2 action specifications. The *Performance Indicators* are organized in different views by theme/category of indicator. Each value is the annual sum of the values processed in the single project sites.

Table1. Performance Indicators definition

Category/ Page name	**Category/Page description**	**Indicator**	**Indicator sub-categories**
Presence / infestation	The indicators of Xylosandrus presence/infestation are obtained by means of integration of remote sensing and ground information.	INSECTS IN MONITORING TRAPS (number)	
		PRESENCE AREA SIZE (m2)	NO PRESENCE LOW PRESENCE HIGH PRESENCE TOTAL PRESENCE
		HIGHLY STRESSED AREA SIZE (ha)	
Traps	Xylosandrus monitoring by trap. Number of captured insects.	NUMBER OF INSECTS	TOTAL X. GENUS (sp. not detected) X. COMPACTUS X. CRASSIUSCULUS X. GERMANUS
Participation	Most relevant yearly and total statistics about citizen science and stakeholders activities. Data are also collected by means of the SAMFIX Agent app.	CITIZEN SCIENCE PARTICIPATION	APP REGISTERED USERS X. OBSERVATIONS X. PICTURES SAMFIX GAME CHALLENGES
		STAKEHOLDERS PARTICIPATION	X. OBSERVATIONS

Communication	Most relevant yearly and total statistics about communication and promotion activities.	CITIZEN SCIENCE / AWARENESS EVENTS	NUMBER OF EVENTS NUMBER OF PARTICIPANTS
		TRAINING/INFORMATION EVENTS FOR STAKEHOLDERS	NUMBER OF EVENTS NUMBER OF PARTICIPANTS
		WORKSHOPS/CONFERENCES	NUMBER OF EVENTS NUMBER OF PARTICIPANTS
		COMMUNICATION MATERIAL	DISTRIBUTED LEAFLETS

2.4.3 Webgis

The Webgis interactive framework contains the project thematic cartography; it can be populated during the project with thematic maps summarizing the monitoring activity developed periodically, also summarized as performance indicators.

Basic cartography and themes:

- Public base layers: Google *satellite, streets, hybrid, terrain*
- Protected areas involved in the project
- Digital elevation models
- Land use: Corine Land Cover 2012 and local land use maps

Remote sensing data:

- Satellite real color map
- Vegetation index maps

Samfix zoning and monitoring maps :

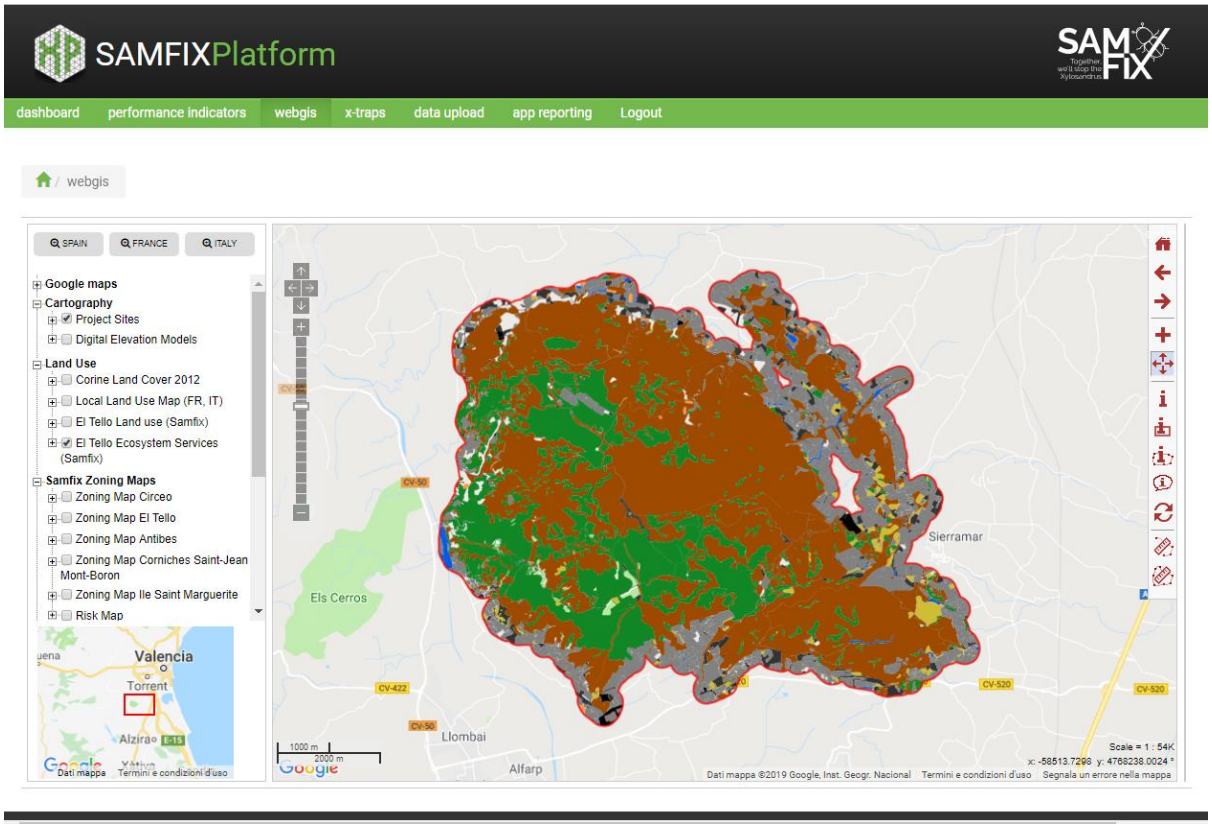
- Zoning maps of the core parks related to the risk assessment
- Risk maps of the core parks

Georeferenced project monitoring activities

- Xylosandrus survey points
- Dried vegetation/crowns

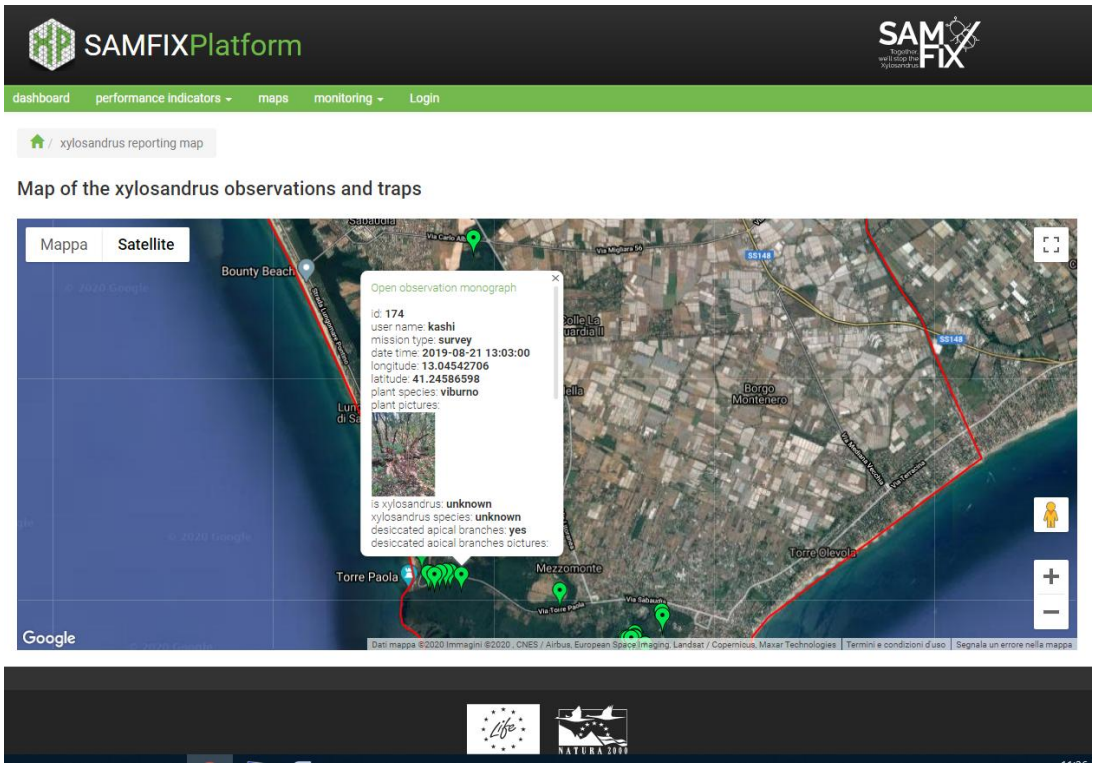
Feature of the Webgis user interface:

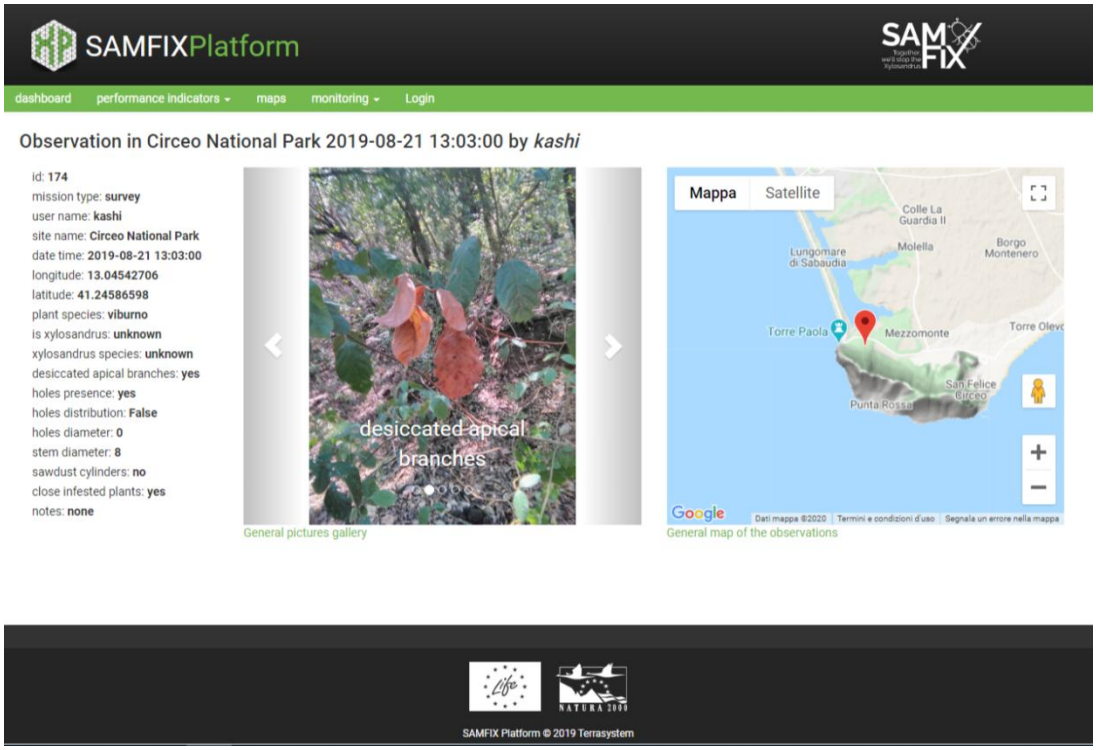
- Interactive map (zoom and pan tools)
- Interactive overview map
- Table of Contents panel with legends, by theme categories
- Indentify tools: spatial features query by point or polygon selection
- Shortcuts to specific project areas
- Measure tools (length, area)



2.4.4 Xylosandrus reporting map

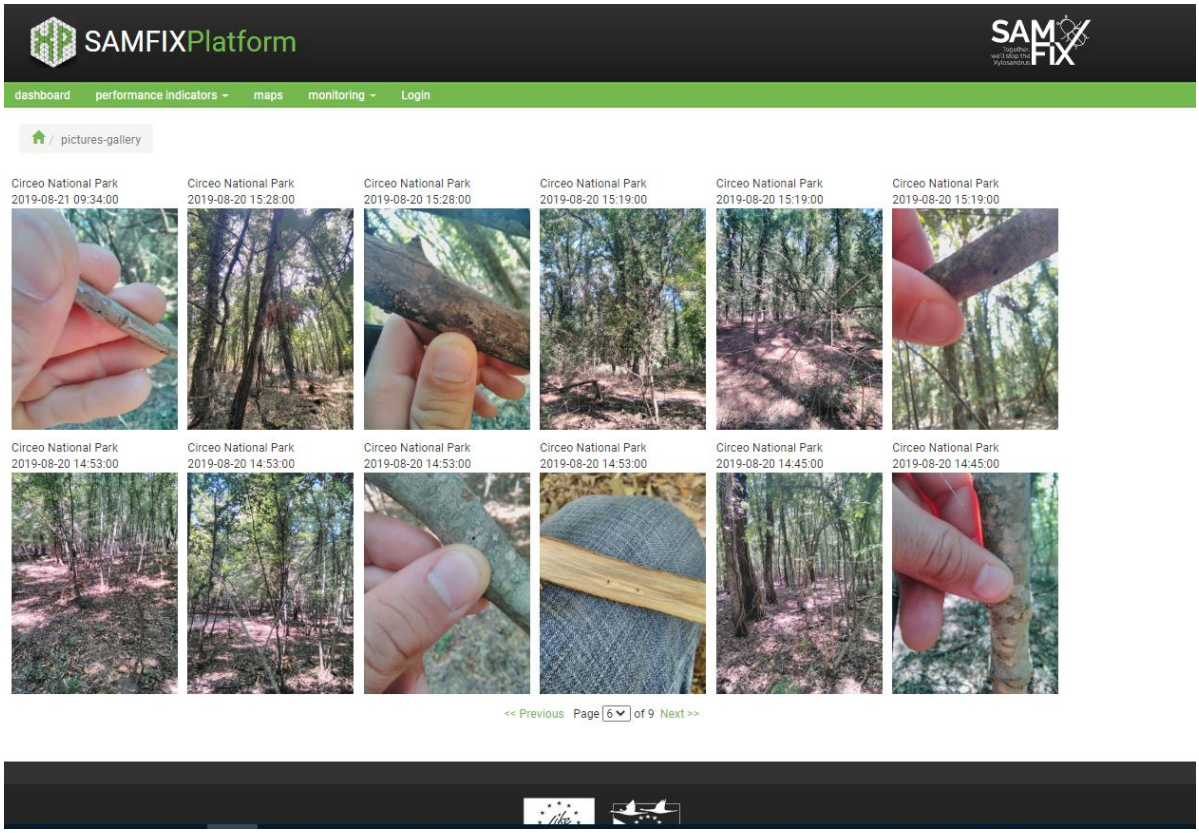
In this section a map with the Xylosandrus observation from citizen science activity (X-app) is shown. Each marker has a ballon with the observation details and pictures and a link to "monograph" page, containing the same information. The monograph has a dedicated pictures galley and a map of the single observation point. The pictures can be viewed at their original size.


SAMFIXPlatform
dashboard
performance indicators
maps
monitoring
Login
xylosandrus reporting map
Map of the xylosandrus observations and traps
Mappa
Satellite
Open observation monograph
id: 174
user name: kashi
mission type: survey
date time: 2019-08-21 13:03:00
longitude: 13.04542706
latitude: 41.24586598
plant species: viburno
plant pictures:
is xylosandrus: unknown
xylosandrus species: unknown
desiccated apical branches: yes
desiccated apical branches pictures:
Bounty Beach
Torre Paola
Mezzomonte
Borgo Montenero
Torre Olevola
Google


SAMFIXPlatform
dashboard
performance indicators
maps
monitoring
Login
Observation in Circeo National Park 2019-08-21 13:03:00 by kashi
id: 174
mission type: survey
user name: kashi
site name: Circeo National Park
date time: 2019-08-21 13:03:00
longitude: 13.04542706
latitude: 41.24586598
plant species: viburno
is xylosandrus: unknown
xylosandrus species: unknown
desiccated apical branches: yes
holes presence: yes
holes distribution: False
holes diameter: 0
stem diameter: 8
sawdust cylinders: no
close infested plants: yes
notes: none
desiccated apical branches
General pictures gallery
Mappa
Satellite
Colle La Guardia II
Molella
Borgo Montenero
Lungomare di Sabaudia
Torre Paola
Mezzomonte
San Felice Circeo
Punta Rossa
Google
General map of the observations
SAMFIX Platform © 2019 Terrasystem

2.4.5 Pictures gallery

In this section a gallery with the Xylosandrus observation from citizen science activity (X-app) is shown. Each thumbnail has the link to the monograph of the observation (see the previous chapter).



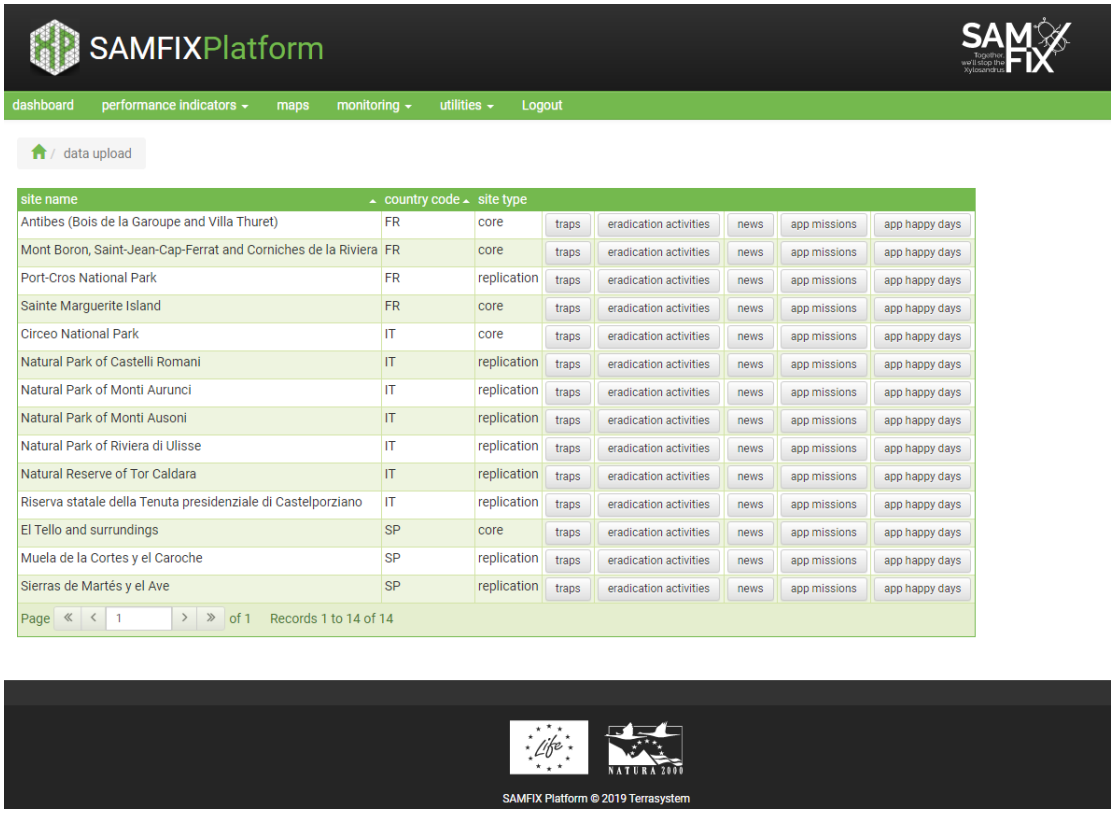
2.5 Back end

It is the restricted access area of the platform, dedicated to the project data upload-download and management, reserved to the project and parks staff; it is accessed by 'collective' accounts (parks and scientific staff). In the back-end sections:

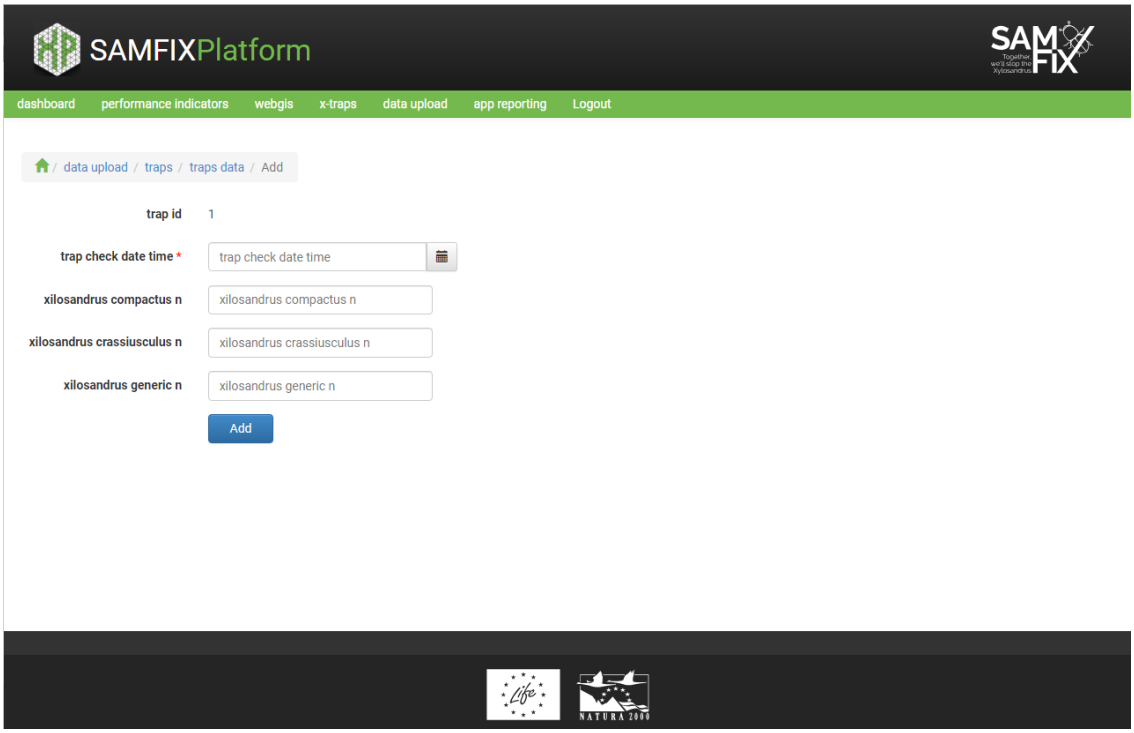
- Data from other project activities will be uploaded, stored, visualized and managed in order to feed the computing algorithm of the performance indicators
- Data from the various project action and activities can be uploaded, stored, visualized and managed in order to share the data among the partners/stakeholder in a restricted access network for the monitoring and analysis purposes

- Data of the observation collected by the X-App can be viewed and validated by qualified users
- Qualified users will upload text for news/events related to their park that will be notified to the X-App
- Qualified users can manage settings of the SAMFIX Game of the X-app

The data upload sections are introduced by a "master" page reporting the parks list, in which the operator can easily access the forms to upload their site-related data.



Back-end input form example (traps data)



2.5.1 Traps data upload function

Users responsible for the traps data collection can upload their data using the adding/editing tool and they can search in the data archive.

Metadata of the forms/tables relating to the traps:

Data table/upload form

attribute	**format**
Trap_check_date_time timestamp	timestamp
Insert_date_time	timestamp
Trap ID	char
User_id	integer
Xylosandrus compactus number	integer
Xylosandrus crassiusculus number	integer
Xylosandrus (generic) number	integer

Accessory table: traps

attribute	format
Trap ID	char
Area ID	char
Coordinate x	numeric
Coordinate y	numeric

2.5.2 Eradication activities upload function

Users responsible for the eradication data collection can upload their data using the adding/editing tool and they can search in the data archive. Each record of the *eradication_activities table* is linked to many records of the table *eradications_plants.*

Metadata of the forms/tables relating to the eradications:

Table: radication_activities

attribute	format
ID	integer
User_id	integer
Site_id	integer
date_time_activity	timestamp
date_time_insert	timestamp
notes	text

Table: eradications_plants

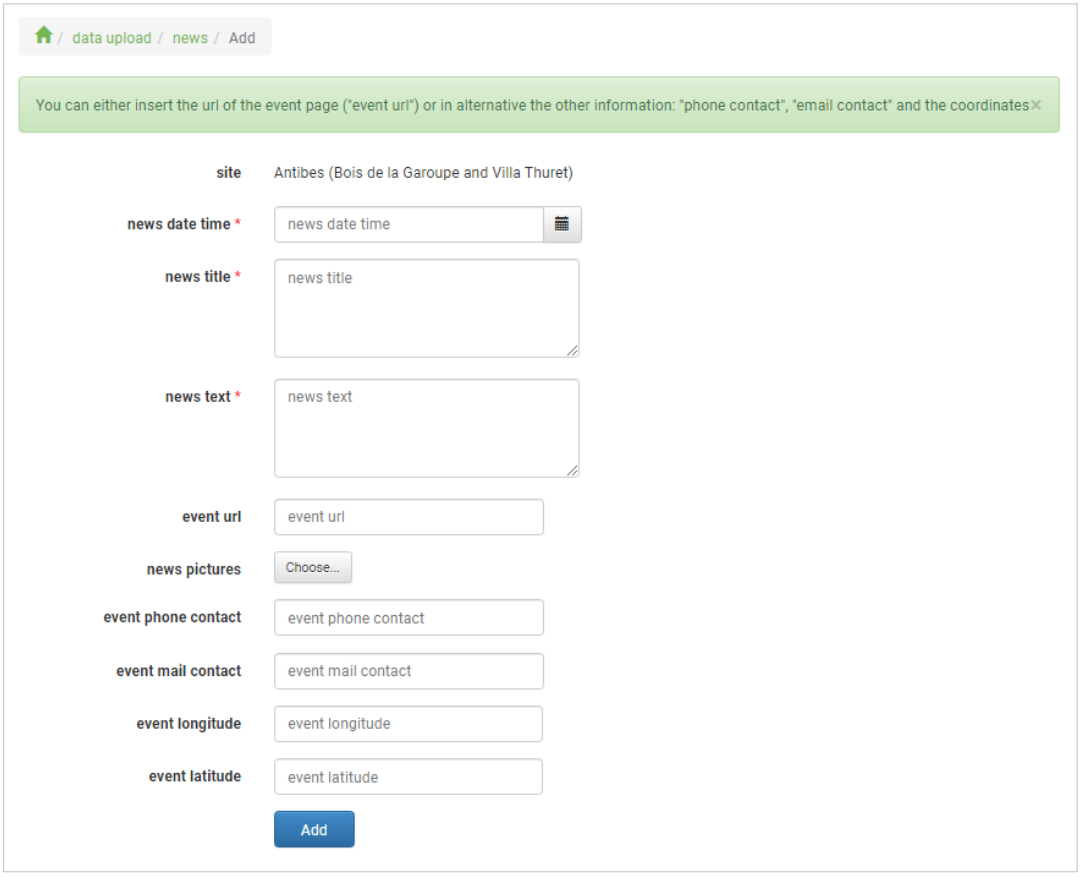
attribute	format
Activity ID	integer
User_id	integer
Coordinate x	numeric
Coordinate y	numeric
plant_species_1	text
n_plant_species_1	Integer
plant_species_2	text
n_plant_species_2	Integer
plant_species_3	text
n_plant_species_3	Integer
plant_species_4	text
n_plant_species_4	Integer
notes	text

2.5.3 X-app settings utilities: news, app "missions", app "happy days"

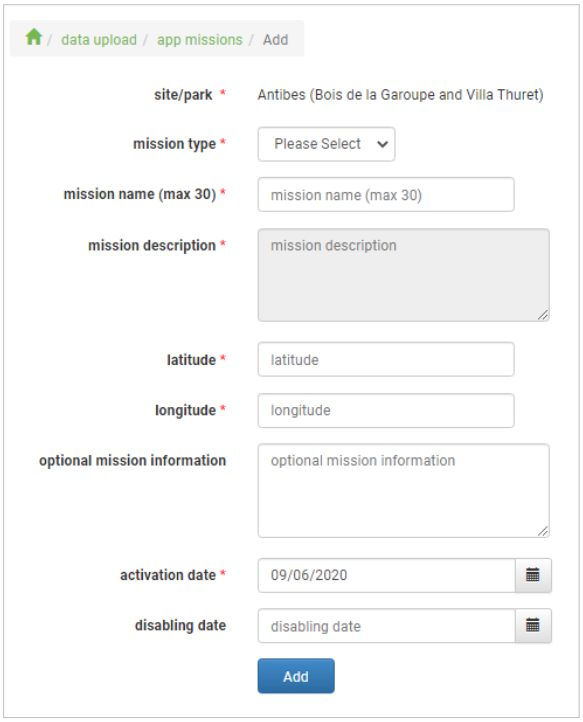
Operators responsible for the update of the news from the park can upload them by this dedicated form, which dynamically feed the X-app. Old news are archived and they can be searched.

Operators responsible for the app settings of the SAMFIX Game can manage them in the forms "app missions" and "app happy days". These settings will dynamically feed the X-app installed on the user's device.

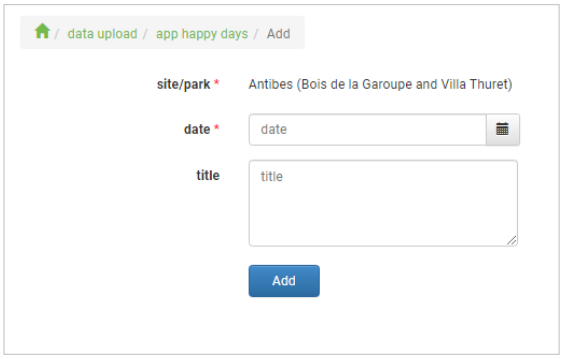
"News" upload form



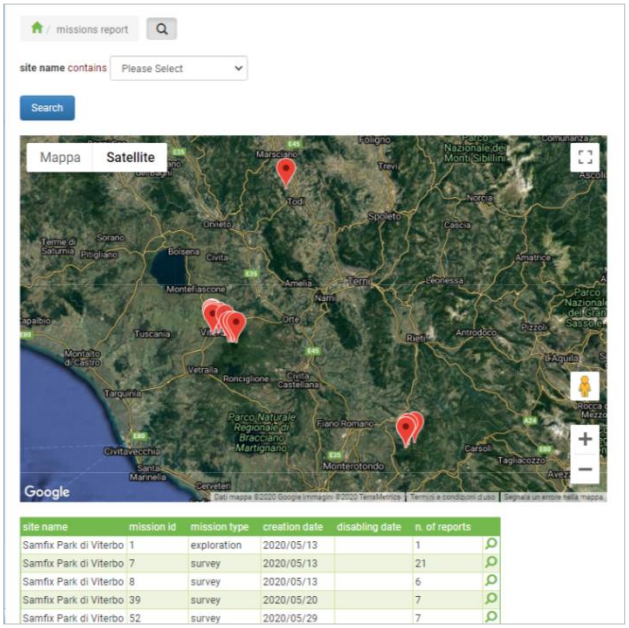
"App missions" upload form



"App happy days " upload form



"App missions report" utility

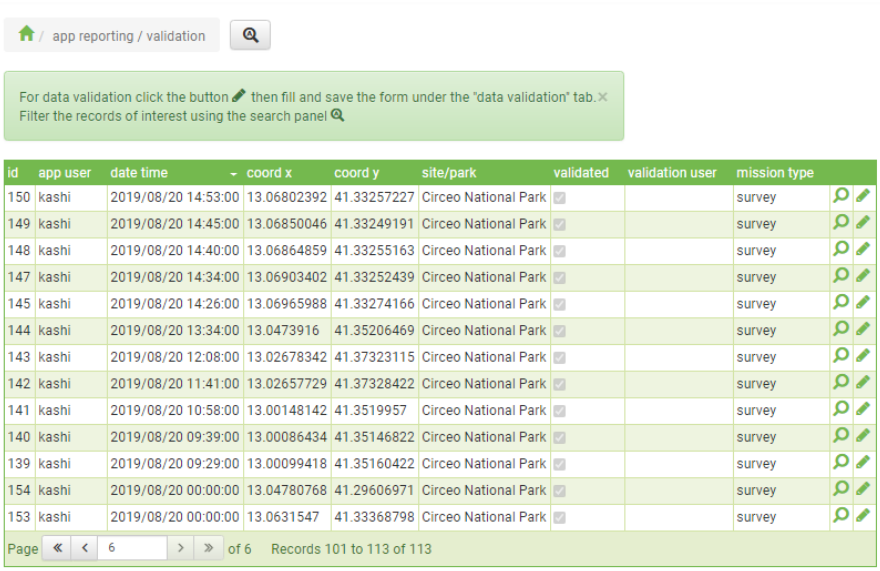


2.5.4 X-App observations data management

The X-app contains tools through which the park visitors and citizens can report evidences of the Xylosandrus attacks. The tool consists of a form with text and select boxes and camera function; some predefined attributes of the attack can be recorded. Some features of the insects attack can be documented by mean of the camera (for further detail about the app tool, see the app description). The whole collection of the data and files coming from the app users can be searched, viewed and analyzed inside the X-Platform back-end section.

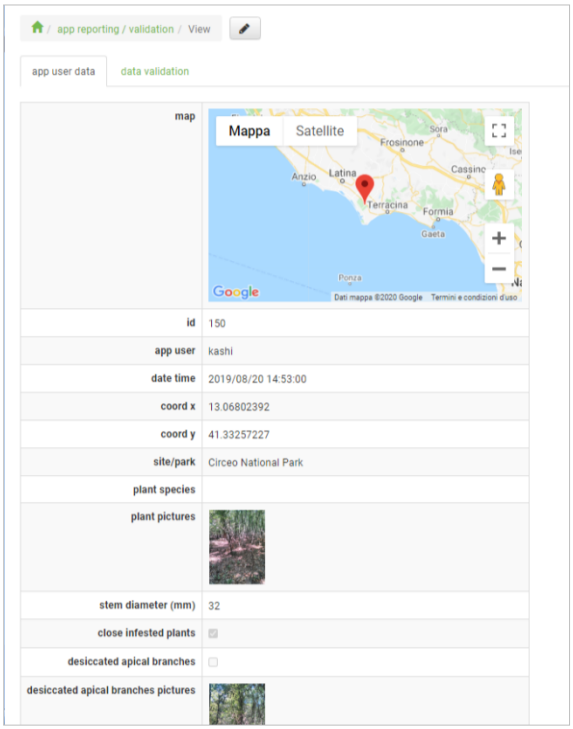
This section include an editing tool by which accredited and qualified operators for this task can validate the data coming from the app users for their publication in the front end sections (map, monograph, pictures gallery).

Observations main table:

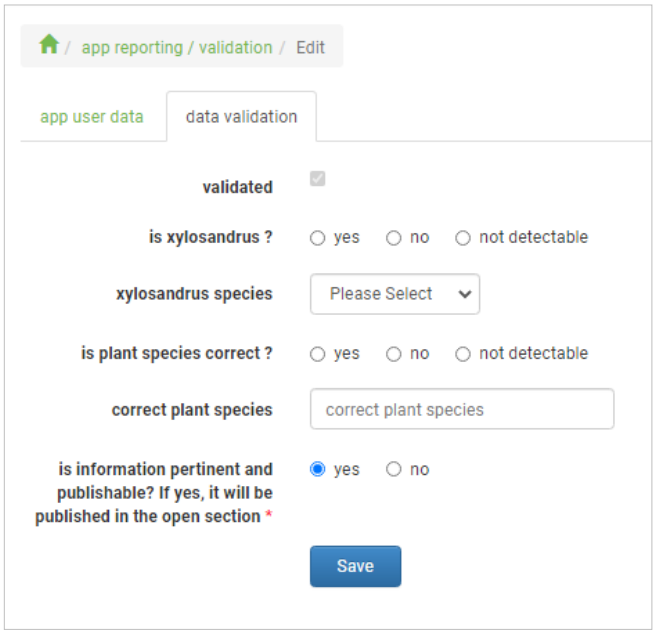


id	app user	date time	coord x	coord y	site/park	validated	validation user	mission type
150	kashi	2019/08/20 14:53:00	13.06802392	41.33257227	Circeo National Park	✓		survey
149	kashi	2019/08/20 14:45:00	13.06850046	41.33249191	Circeo National Park	✓		survey
148	kashi	2019/08/20 14:40:00	13.06864859	41.33255163	Circeo National Park	✓		survey
147	kashi	2019/08/20 14:34:00	13.06903402	41.33252439	Circeo National Park	✓		survey
145	kashi	2019/08/20 14:26:00	13.06965988	41.33274166	Circeo National Park	✓		survey
144	kashi	2019/08/20 13:34:00	13.0473916	41.35206469	Circeo National Park	✓		survey
143	kashi	2019/08/20 12:08:00	13.02678342	41.37323115	Circeo National Park	✓		survey
142	kashi	2019/08/20 11:41:00	13.02657729	41.37328422	Circeo National Park	✓		survey
141	kashi	2019/08/20 10:58:00	13.00148142	41.3519957	Circeo National Park	✓		survey
140	kashi	2019/08/20 09:39:00	13.00086434	41.35146822	Circeo National Park	✓		survey
139	kashi	2019/08/20 09:29:00	13.00099418	41.35160422	Circeo National Park	✓		survey
154	kashi	2019/08/20 00:00:00	13.04780768	41.29606971	Circeo National Park	✓		survey
153	kashi	2019/08/20 00:00:00	13.0631547	41.33368798	Circeo National Park	✓		survey

Observations detail page



Observations validation form



2.5.5 Back-end users

The back-end users belong to the categories:

- "Scientific staff" (partners of the project), they can view all the back-end data
- "Project site staff", they can view and upload data relating with their monitoring and communication activity
- "Platform administrator", has access to users management and settings

Users' accounts

Name	X-Platform user name	Category
Terrasystem	terrasystem	Platform administrator/ Scientific staff
Ente Parco Nazionale del Circeo	circeo	Scientific staff
Ville d'Antibes Juan-les-Pins	antibes	Scientific staff
Institut National de la Recherche Agronomique	inra	Scientific staff
Regione Lazio - Direzione Ambiente e Sistemi Naturali	regionelazio	Scientific staff
Universidad de Alicante	ua	Scientific staff
Università degli Studi della Tuscia (Dipartimento per la Innovazione nei sistemi biologici, agroalimentari e forestali)	unitus	Scientific staff
Circeo National Park	circeo-tec	Project site staff
Natural Park of Castelli Romani	castelli-tec	Project site staff
Natural Park of Monti Aurunci	aurunci-tec	Project site staff
Natural Park of Monti Ausoni	ausoni-tec	Project site staff
Natural Park of Riviera di Ulisse	ulisse-tec	Project site staff
Natural Reserve of Tor Caldara	torcaldara-tec	Project site staff
Antibes (Bois de la Garoupe and Villa Thuret)	antibes-tec	Project site staff
Mont Boron, Saint-Jean-Cap-Ferrat and Corniches de la Riviera	montboron-tec	Project site staff
Sainte Marguerite Island	marguerite-tec	Project site staff
Port-Cros National Park	portcros-tec	Project site staff
El Tello and surrundings	eltello-tec	Project site staff
Muela de la Cortes y el Caroche	muela-tec	Project site staff
Sierras de Martés y el Ave	martes-tec	Project site staff

2.6 SAMFIX Platform link

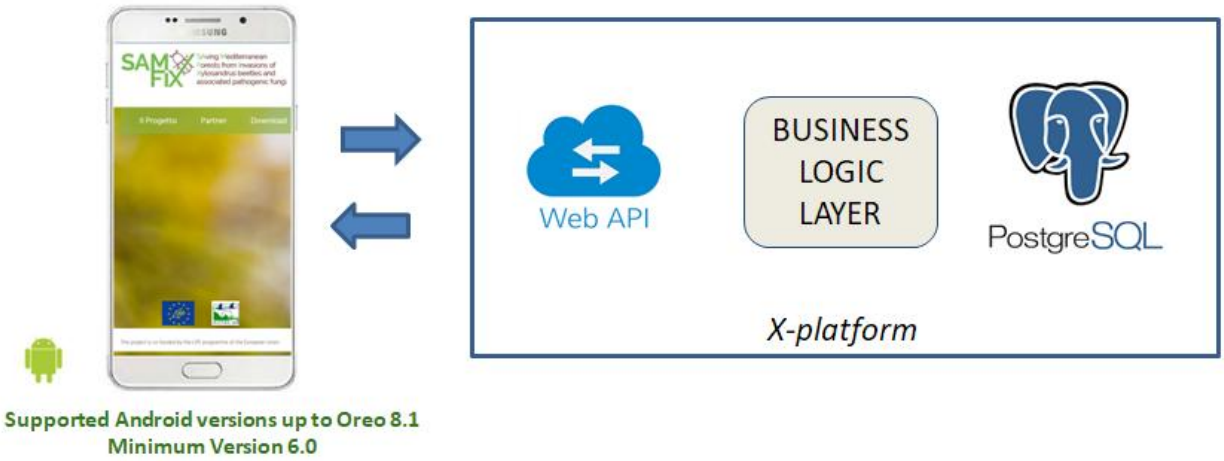
http://x-platform.lifesamfix.eu/samfix/cms/dashboard.php

3. X-App design

3.1 X-App main features

- Native app for Android: supported Android versions up to Oreo 8.1. Minimum Version: 6.0
- Selectable language: English, France, Spain, Italian
- language setting both from user profile and selectable from the settings panel
- Permission request for camera and GPS data in app
- Local storage database: SQLite
- Server database: Postgresql (shared with X-platform)
- Data exchange with server: immediate and synchronous when internet connection is available, synchronization process on app start or whenever internet connection becomes available otherwise with timed attempts.

X-App architecture



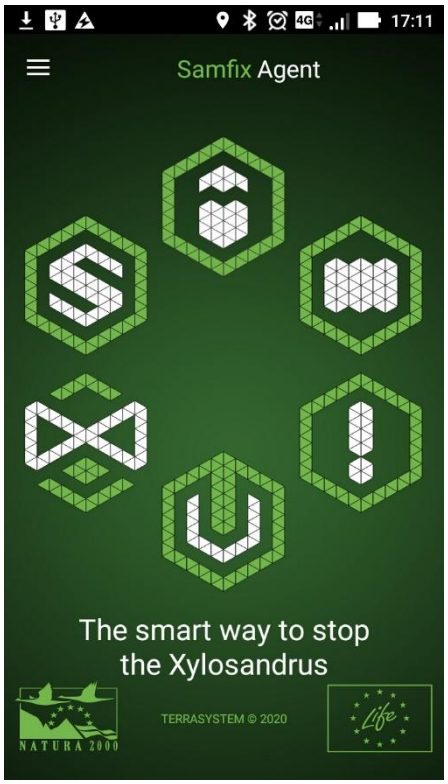
3.2 X-App brand

The proposed name of the application is **"SAMFIX Agent"**.

The graphic theme is inspired by the brand of the www.lifesamfix.eu and extended with dedicated themes and icons. For the complete theme elements see the descriptions of the sections.

Samfix agent brand - examples

Start – Splash screen



Dashboard - Main menu

3.3 X-App organization and contents

Sections in green will be accessible through icon buttons in the "dashboard".

section	sub-section	page(s)	description
Dashboard		Dashboard	App start page with link icons to the other sections
SAMFIX Project Info | Parks	**Project Info**	The project	Contents from the site https://www.lifesamfix.eu/.
	Samfix sites	Circeo National Park (IT, core)	sites description and map
		Natural Park of Castelli Romani (IT, replication)	
		Natural Park of Monti Aurunci (IT, replication)	
		Natural Park of Monti Ausoni (IT, replication)	
		Natural Park of Riviera di Ulisse (IT, replication)	
		Natural Reserve of Tor Caldara (IT, replication)	
		Antibes (Bois de la Garoupe and Villa Thuret) (FR, core)	
		Mont Boron, Saint-Jean-Cap-Ferrat and Corniches de la Riviera (FR, core)	
		Sainte Marguerite Island (FR, core)	
		Port-Cros National Park (FR, replication)	
		El Tello and surrundings (SP, core)	
		Muela de la Cortes y el Caroche (SP, replication)	
		Sierras de Martés y el Ave (SP, replication)	
Registration			Form for user registration
Xylosandrus identification guide		Biology	Text and pictures
		Infestation (Demage and symptoms)	Text and pictures
		Monitoring	Text and pictures
SAMFIX Game	**Missions**		Main game interface
	Map		Game map viewer
	Status		Game score and ranking section

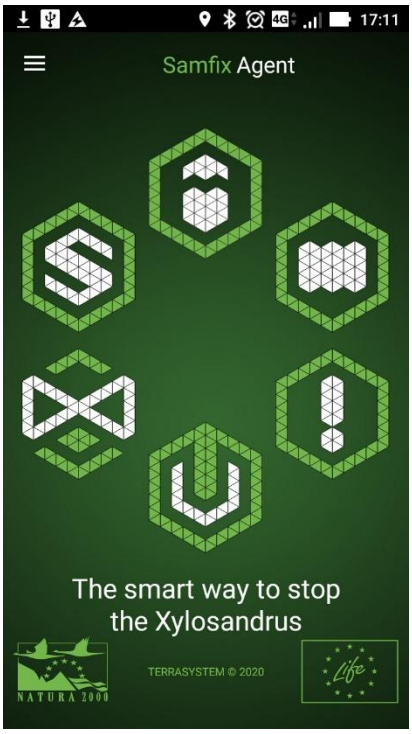
Report infestation		Reporting form	Form to allow any user to report about Xylosandrus infestation, with use of the camera.
		My reports	view of the records previously inserted by the registered user
News		Project news	News dinamically acquired from the site https://www.lifesamfix.eu/ through RSS feeds or Web APIs
		Park news	News from the SAMFIX sites uploaded by qualified users
User settings			Change password, set language
Credits			Project partners logos
Help			Link to help page

"Dashboard", "Samfix project" and "Identification guide" are public sections. The other sections require the user registration and login.

3.4 Dashboard

The dashboard contains the links to the main app section:

1. SAMFIX (Project Info | Parks)
2. Xylosandrus identification guide
3. SAMFIX Game
4. Report infestation
5. News
6. User settings

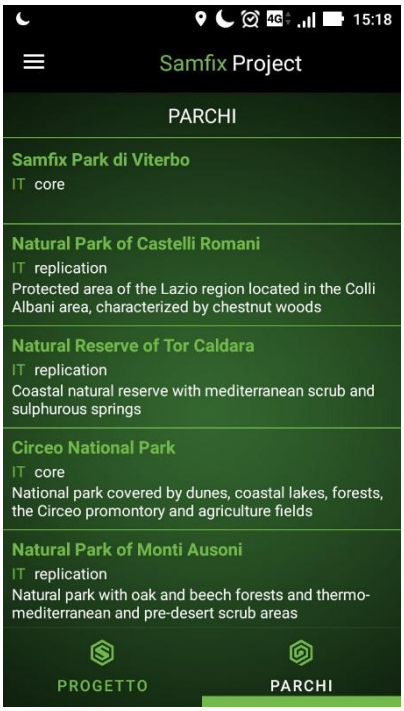


3.5 Samfix project

The general section with the description of the Samfix project and related activities is organized in the two sub-sections:

- Samfix project info
- Samfix sites

The contents are organized similarly to the site https://www.lifesamfix.eu/. The Texts about the project are taken from the same site.



3.6 Registration

The user registration is needed to access the sections *Report infestation, Park news, Identification guide, Game, User setting*. In the registration form the user will be asked to submit these information, just for statistic purposes:

- email
- username
- password
- age
- profession
- if user is a project's partner or stackeholder

A link to the privacy policy is present, together with the accept button.

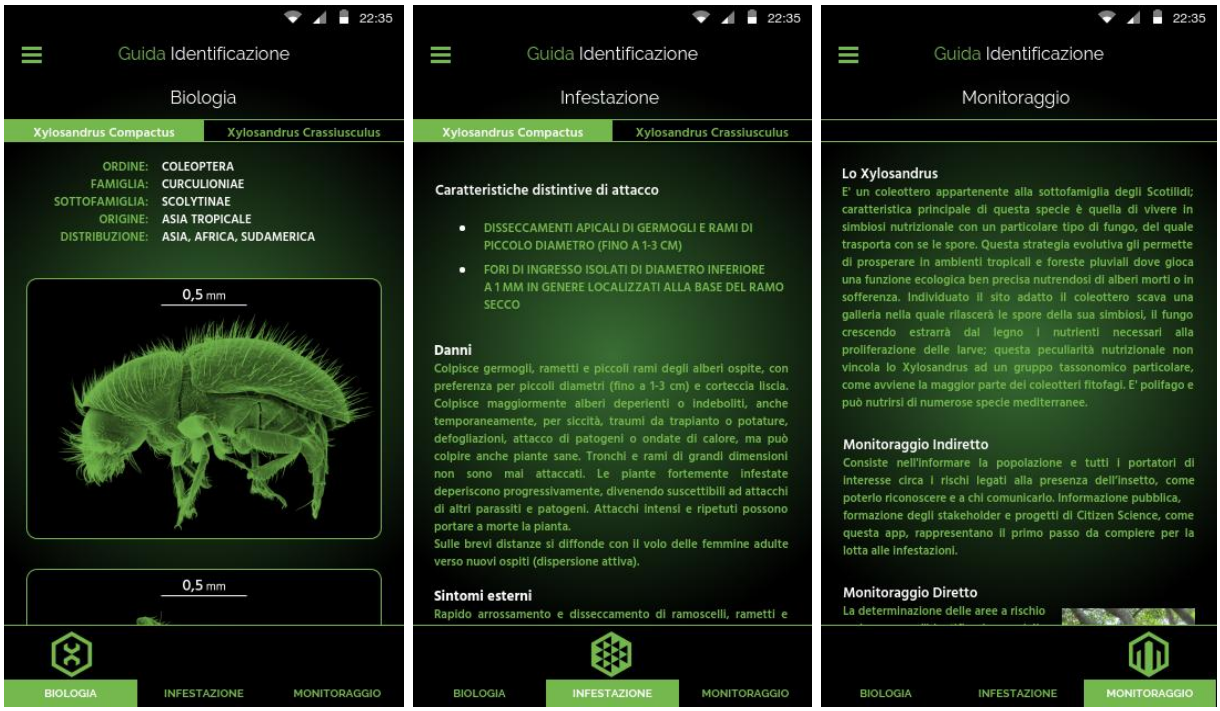
3.7 Identification guide

The identification guide about the Xylosandrus insects and related symtoms of attack will be articulated in the sub-sections:

- Xylosandrus biology
- Infestation (damages and symptoms)
- Monitoring

Text and some pictures come from an adaptation of training material of University of Tuscia (M. Faccoli, S. Speranza, A. Vannini). Other pictures are taken from www.insectimages.org.

The texts of the guide are in the appendix of this document.

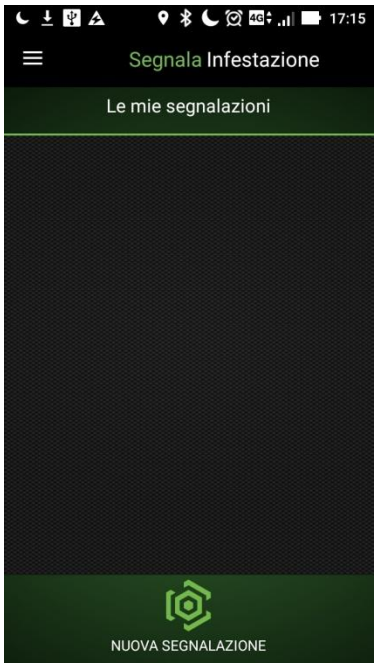


3.8 Reporting infestation

The X-app contains a tool through which park visitors and citizens can report evidences of the Xylosandrus attacks. The tool consists of a form with text and select boxes and camera function; some predefined attributes of the attack can be recorded. The GPS function supports the localization of the observation. Some features of the insects attack can be documented by mean of the camera. See the detailed attributes of the form below.

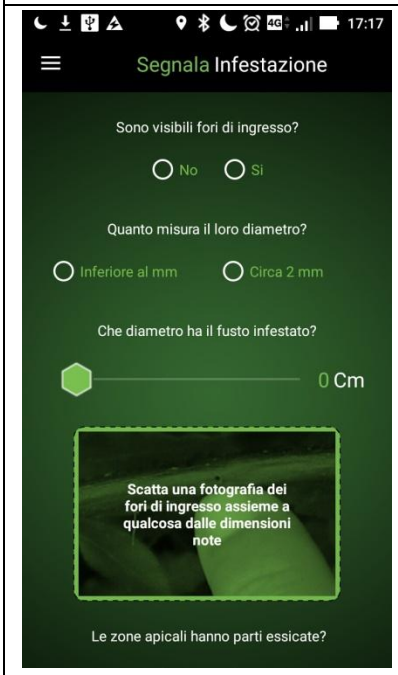
attribute	**format**	**entering mode**
User id	integer	Automatically registered
Date and time of the observation	timestamp	Automatically registered
Coordinate x of the observation	numeric	Geographic position of the user, automatically registered by the app (GPS)
Coordinate y of the observation	numeric	
Observed plant species (if recognizable)	text	Text box

Picture of the plant	file	By mobile device camera
Presence of desiccated apical branches	boolean	Check button
Picture of desiccated apical branches	file	By mobile device camera
Presence of holes	boolean	Check button
Holes distribution	integer (possible values: 1=grouped, 2=isolated, 3=both)	Text box
Holes diameter	Integer (possible values: 1 or 2)	Text box
Stem diameter	numeric	Text box or widget
Picture of the holes	file	By mobile device camera
Presence of small sawdust cylinders on the stem/branches	boolean	Check button
Pictures of the sawdust	file	By mobile device camera
Presence of galleries inside the branches	boolean	Check button
Picture of galleries inside the branches	file	By mobile device camera
Presence of similar syntoms in the neighboring plants	boolean	Check button
Other observations and notes	text	Text area

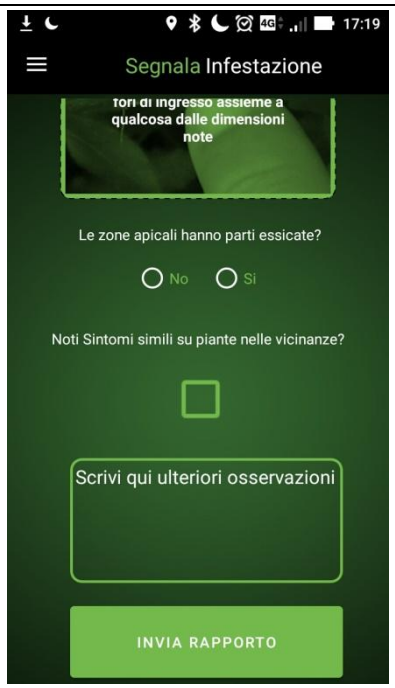


1.Start report / user report log

2. Identify plant / take picture



3. Identify the syntoms / take picture



4. Save and transmit the report

3.9 News

The news section ha two sub-sections:

News from the project: they are dynamically acquired from the site https://www.lifesamfix.eu/ through Web APIs.

News from the parks: these news notified by the individual parks will be published. The news are entered by the park staff through the X-Platform. The news will include the information:

- News timestamp
- Publishing user (park name)
- News title
- News text
- News pictures (optional)
- Related event url (optional)
- Related event phone contact (optional)
- Related event mail contact (optional)
- Related event geographic coordinates (optional)

3.10 SAMFIX Game

Description of the game

The player is a detective who is responsible for collecting evidence, information, images about the presence of Xylosandrus. Depending on the type and profile of the player, the app will propose a series of "missions" characterized by a certain level of priority, in which the player is called, through the use of a map, to reach points distributed in the park (hotspots) in which he/she will have to perform actions and report them in a preset survey form, for example: to take pictures, to answer questions, to observe, count, or recognize plants, insects and monitoring traps. There are three types of missions in the game:

1. "sampling" – it is a mission to be carried out in an area where the presence of Xylosandrus is already known and it will be useful to gather further information on the trend of presence, spread and damage;
2. "survey" – it is a mission to be carried out in a place where the presence of Xylosandrus is not known. The survey form in this case is the same as the function "Reporting infestation" of the app;
3. "recon" - it is a mission to be carried out at a monitoring trap installation point and is used to check if the trap has been damaged or if the funnel was obstructed.

Each completed mission earns the player "experience points", which are added to his/her final score depending to which the player can increase his/her rank in the scale: *cadet, scout, ranger, pioneer*. This way, park gadgets can be won and collected at the visitor centre.

The missions and their features are set by the game managers in the back-end interface of the game, located in the SAMFIX Platform. They can also set "happy days", i.e. special days, notified in the app, in order to intensify observation and monitoring actions or to promote communication and engagement campaigns/events. The missions completed on these days result in an extra score.

The missions

When accessing the SAMFIX Game, the user is in a screen containing the list of predefined and selectable missions. A slider allows him/her to choose his/her operating space: the available missions will be displayed within the selected distance. By selecting a mission from the list the player has access to the mission details and can "accept" it.

Missions can have three different levels of priority; a high priority indicates a greater urgency to obtain data from one position rather than another. The allocation of experience points is higher as the priority increases.

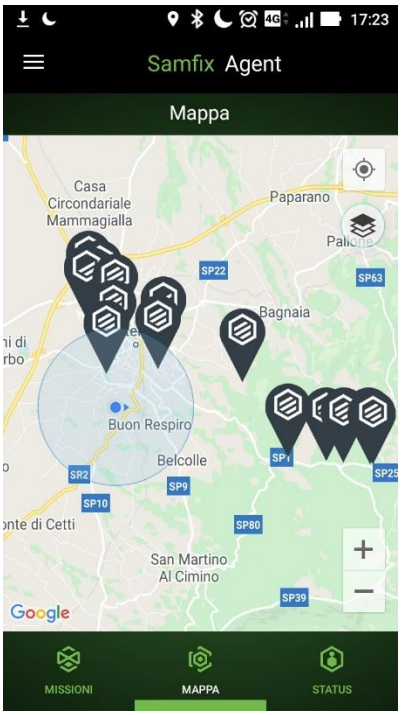
Once a mission has been accepted, as soon as the player arrives near the hotspot coordinates, he/she will receive an alert and a warning icon will appear on the map: now he can perform the activities required by the mission filling in the report.

In case of missions carried out where there is no mobile network coverage, the collected data will remain in the queue and they will be sent as soon as there is coverage. An icon indicates if the transmission was successful or if the data is still waiting to be transferred.

The mission list keeps track of those already completed by the player.

The map

The player also has a map that provides an overview of the mission locations. Even from this section he/she can access the details of a specific mission and decide whether to carry it out.



The "status"

The "status" section shows the player's progress during his career as a SAMFIX Agent. The completion of missions allows level advancements based on the earned experience score.

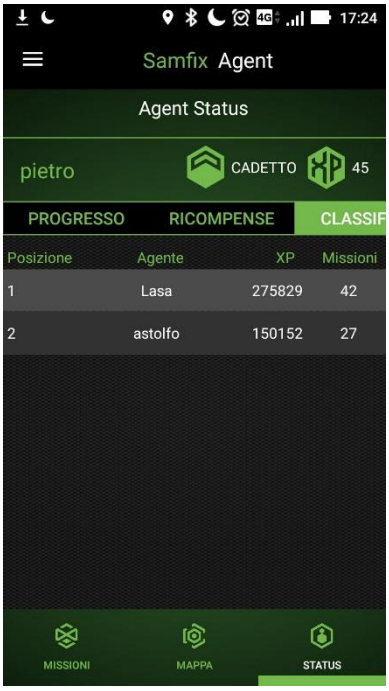
The PROGRESSION tab keeps track of the career progress (level), how many experience points are needed for the next promotion and any redeemable rewards. a badge alerts the player to the level progress: by showing the badge on the application at the visitor center of a core park, the player can collect the prize.

The REWARDS tab keeps track of special one-off prizes. When special objectives are achieved, the prize is notified by a badge and experience points (XP).

Finally, the LEADERBOARD tab shows the ranking of all players.

Progression tab

Reward tab



Leaderboard tab

3.11 Settings page

User settings are:

- Change password
- Exit
- Notice of proximity (for SAMFIX Game)
- Warning distance (for SAMFIX Game)

3.12 Credits page

Page with the logos of the project partners and creative commons license.

Appendix A – Text contents of the Xylosandrus recognition guide (English)

Biology - *Xylosandrus compactus*

ORDER:	COLEOPTERA
FAMILY:	CURCULIONIAE
SUBFAMILY:	SCOLYTINAE
ORIGIN:	TROPICAL ASIA
DISTRIBUTION:	EUROPE, ASIA, AFRICA, SOUTH AMERICA

FEMALE

2-3 mm, reddish-brown, winged.

MALE

1.5 mm, rare, no wings.

LARVAE

C-shaped, white, legless, glabrous, with evident cephalic capsule.

Xylosandrus compactus is a highly polyphagous species. It is present on arboreal and shrubby plants, mainly on broad-leaved trees but also on conifers, in particular pines and cupressaceae.

The main host plants in the Mediterranean maquis are: Laurel (Laurus nobilis), Lentisque (Pistacia lentiscus), Holm-oak (Quercus ilex), Butcher's-broom (Ruscus aculeatus), Carob (Ceratonia siliqua), Laurotino (Viburnum tinus), Strawberry tree (Arbutus unedo), Phillyrea (Phillyrea spp.), Lime tree (Tilia cordata).

Adults are active from the end of March to October with variations related to climate and latitude; females are able to fly and attack new plants, penetrating into branches of 1-2 years of age. Entry is through a small circular hole with a diameter of 0.7-0.8 mm, dug into the underside of the twig. Once entered, the female proceeds until it reaches the marrow of twigs, twigs and small branches. In the chamber, the female lays her eggs and releases the spores of the

symbiotic fungi transported on her body through a structure called micangium. The larvae never dig into the wood and do not eat the tissues of the plant, but feed on symbiotic fungi that grow on the inner walls of the development chamber. The larvae develop in a gregarious way in the chamber, feeding on the fungi for about 20 days. The metamorphosis of the mature larvae gives rise to the pupae, from which the new adults develop. After the mating between siblings, the few males die in the tunnel while the females leave the tunnel through the entry hole, becoming again covered by spores of the symbiotic fungus, ready to colonize a new host. Once out of the twigs, the adults do not disperse, but tend to remain on the same plant or on the neighboring ones. At temperatures of 25°C the cycle is completed in about a month. Under favorable conditions, there are many generations per year.

Biologia - *Xylosandrus crassiusculus*

ORDER:	COLEOPTERA
FAMILY:	CURCULIONIAE
SUBFAMILY:	SCOLYTINAE
ORIGIN:	SOUTH ASIA
DISTRIBUTION:	EUROPE, AUSTRALIA, NEW ZELAND, UNITED STATES, CANADA

FEMALE

1.6-1.8 mm, dark black, shiny, winged.

MALE

0.9-1.3 mm, reddish, rare, without wings.

LARVAE

C-shaped, white, legless, glabrous, with evident cephalic capsule.

Xylosandrus crassiusculus is a highly polyphagous species and attacks numerous species of broadleaf trees.

The main host plants are: Maple (Acer), Alder (Alnus), Birch (Betula), Chestnut (Castanea sativa), Carnelian (Cornus), Persimmon (Dispyros Kaki), Fig (Ficus Carica), Ash (Fraxinus), Apple (Malus), Plane (Platanus), Poplar (Populus), Prunus (Prunus), Oak (Quercus), Willow (Salix), Elm (Ulmus), Grapevine (Vitis), Carob (Ceratonia siliqua), Judas tree (Cercis siliquastrum)

Adults are active between the end of March and September, with variations related to climate and latitude. Females are able to fly and attack new plants. The female digs only one small circular entry hole (2 mm) that penetrates deep into the wood for about 6-8 cm. The entrance tunnel widens to form an elongated chamber where about 50 eggs are laid. The female also releases the spores of the symbiotic fungi transported on her body through a structure called micangium. The larvae develop in a gregarious way in the chamber, feeding on the fungi for about 40 days. The metamorphosis of the mature larvae gives rise to the pupae, from which the new adults develop. When they reach sexual maturity, they mate between brothers in the developmental chamber and only the females flicker through the entry hole dug by the mother, becoming again covered with spores of the symbiotic fungus. The entire development cycle (egg-adult) lasts about 55-60 days, with significant variations in relation to climate and latitude.

Damage and symptoms of attack – *Xylosandrus compactus*

Distinctive attack characteristics

- APICAL DESICCATION OF SPROUTS AND SMALL DIAMETER BRANCHES (UP TO 1-3 CM)

- ISOLATED ENTRY HOLES WITH A DIAMETER OF LESS THAN 1 MM GENERALLY LOCATED AT THE BASE OF THE DRY BRANCH

Damage

It affects shoots, twigs and small branches of the host trees, with preference for small diameters (up to 1-3 cm) and smooth bark. It mainly affects perishable or weakened trees, even temporarily, due to drought, transplanting or pruning traumas, defoliation, pathogen attack or heat waves, but it can also affect healthy plants. Large trunks and branches are never attached. Strongly infested plants progressively deteriorate, becoming susceptible to attacks by other pests and pathogens. Intense and repeated attacks can kill the plant.

Over short distances it spreads with the flight of adult females to new hosts (active dispersion).

External symptoms

Rapid redness and dessication of twigs, twigs and peripheral parts of the canopy. Small circular holes (<1 mm) on the underside of shoots and twigs, often surrounded by browning.

Internal symptoms

Presence in the wood of long tunnels that develop in the marrow often full of white or adult larvae. On very small branches, the development chambers can run even under the bark. Wood chromatic alteration with darkening or blueing due to the symbiontic fungi that develop in the wood starting from the chambers.

Damage and symptoms of attack - *Xylosandrus crassiusculus*

Distinctive attack characteristics

- LOCATED ON MAIN STEMS AND BRANCHES WITH A DIAMETER OF MORE THAN 6-7 CM. ENTRY HOLES OF ABOUT 2 MM, WHICH MAY OR MAY NOT BE ISOLATED,

- TYPICAL SMALL CYLINDERS OF SAWDUST OF 3-4 CM CAN COME OUT OF THE HOLES AND THEN FALL OFF.

Damage

It affects the stem and the main branches of the host trees, with preference for small diameters (2,5-8 cm), but also diameters up to 30 cm, better if with smooth bark. It infects recently dead trees (with still bark and fresh wood), perishable or weakened (even temporarily) due to drought, traumas from transplanting or pruning, defoliation, attack of pathogens, damage from fire. Debarked trunks/branches are never attached, even if they are still fresh.

Over short distances it spreads with the flight of adult females to new hosts (active dispersion).

External symptoms

Rapid and generic decline of trees with reddening and drying of the canopy or parts thereof, and subsequent death in a few weeks. In the case of early spring attacks: drying of the shoots and non-emission of leaves. Presence of numerous small circular holes (2 mm) on the stem and the main branches, which penetrate deeply into the wood, often associated with emissions of liquids, lymph or gummy (in the Prunoidee) The holes are surrounded by a dark halo determined by the growth of the symbiont fungi. Emission of fine white sawdust, dry, floury, compacted in typical small cylinders protruding from the entrance holes for about 3-4 cm.

Internal symptoms

Presence in the wood of tunnels and breeding chambers often full of white larvae.

Monitoring of infestation

Indirect monitoring

It consists of informing the population and all stakeholders about the risks associated with the presence of the insect, how to recognize it and who to communicate it to. Public information,

stakeholder training and Citizen Science projects, such as this app, are the first step in the fight against infestation.

Direct monitoring

The determination of risk areas as well as the identification of host plants and the recognition of infestation symptoms is a key element for direct monitoring. The monitoring of the spread and extent of the attack is carried out by means of traps with appropriate attractants, such as ethanol, which are placed in places at risk. Traps are checked periodically between April and September.

Appendix B – Text contents of the Xylosandrus recognition guide (Italian)

Biologia - *Xylosandrus compactus*

ORDINE:	COLEOPTERA
FAMIGLIA:	CURCULIONIAE
SOTTOFAMIGLIA:	SCOLYTINAE
ORIGINE:	ASIA TROPICALE
DISTRIBUZIONE:	EUROPA, ASIA, AFRICA, SUDAMERICA

FEMMINA
2-3 mm, color bruno-rossiccio, alata.

MASCHIO
1,5 mm, raro, privo di ali.

LARVE
a forma di «C», bianche, prive di zampe, glabre, con capsula cefalica evidente.

Xylosandrus compactus è una specie altamente polifaga. E' presente su piante arboree e arbustive, principalmente su latifoglie ma anche su conifere, in particolare pini e cupressacee.

Le principali piante ospite nella macchia mediterranea sono: Alloro *(Laurus nobilis),* Lentisco *(Pistacia lentiscus),* Leccio *(Quercus ilex),* Pungitopo *(Ruscus aculeatus),* Carrubo *(Ceratonia siliqua),* Laurotino *(Viburnum tinus),* Corbezzolo (*Arbutus unedo*), Fillirea (*Phillyrea spp.)*, Tiglio (*Tilia cordata*).

Gli adulti sono attivi da fine Marzo a Ottobre con variazioni legate a clima e latitudine; le femmine sono in grado di volare e attaccare nuove piante, penetrando in rametti di 1-2 anni di età. L'ingresso avviene attraverso un piccolo foro circolare del diametro di 0.7-0.8 mm, scavato sul lato inferiore del rametto. Una volta entrata, la femmina procede fino a raggiungere il midollo di ramoscelli, rametti e piccoli rami. Nella camera la femmina depone le uova e rilascia le spore dei funghi simbionti trasportati sul suo corpo tramite una struttura detta micangio. Le larve non scavano mai nel legno e non si cibano dei tessuti della pianta, ma si nutrono brucando funghi simbionti che crescono sulle pareti interne della camera di sviluppo. Le larve si sviluppano in modo gregario nella camera nutrendosi dei funghi per circa 20 giorni. La metamorfosi delle larve mature dà origine alle pupe, dalle quali si sviluppano successivamente i

nuovi adulti. Dopo l'accoppiamento tra fratelli, i pochi maschi muoiono nella galleria mentre le femmine lasciano il tunnel attraverso il foro di ingresso imbrattandosi nuovamente di spore del fungo simbionte, pronte a colonizzare un nuovo ospite. Usciti dai rametti, gli adulti non si disperdono ma tendono a rimanere sulla stessa pianta o su quelle limitrofe. A temperature di 25°C il ciclo si completa in circa un mese. In condizioni favorevoli si hanno numerose generazioni all'anno.

Biologia - *Xylosandrus crassiusculus*

ORDINE:	COLEOPTERA
FAMIGLIA:	CURCULIONIAE
SOTTOFAMIGLIA:	SCOLYTINAE
ORIGINE:	ASIA MERIDIONALE
DISTRIBUZIONE:	EUROPA, AUSTRALIA, NUOVA ZELANDA, STATI UNITI, CANADA

FEMMINA
1,6-1,8 mm, color nero scuro, lucido, alata.

MASCHIO
0,9-1,3 mm, rossiccio, raro, privo di ali.
LARVE
a forma di «C», bianche, prive di zampe, glabre, con capsula cefalica evidente.

Xylosandrus crassiusculus è una specie altamente polifaga e attacca numerose specie di latifoglie.

Le principali piante ospite sono: Acero (Acer), Ontano (Alnus), Betulla (Betula), Castagno (Castanea sativa), Corniolo (Cornus), Cachi (Dispyros Kaki), Fico (Ficus Carica), Frassino (Fraxinus), Melo (Malus), Platano (Platanus), Pioppo (Populus), Pruno (Prunus), Quercia (Quercus), Salice(Salix), Olmo (Ulmus), Vite (Vitis), Carrubo (Ceratonia siliqua), Albero di Giuda (Cercis siliquastrum)

Gli adulti sono attivi fra fine Marzo e Settembre, con variazioni legate a clima e latitudine. Le femmine sono in grado di volare e attaccare nuove piante. La femmina scava un solo piccolo foro circolare d'ingresso (2 mm) che penetra in profondità nel legno per circa 6-8 cm. La galleria di ingresso si allarga a formare una camera allungata dove vengono deposte circa 50 uova. La femmina inoltre rilascia le spore dei funghi simbionti trasportati sul suo corpo tramite

una struttura detta micangio. Le larve si sviluppano in modo gregario nella camera nutrendosi dei funghi per circa 40 giorni. La metamorfosi delle larve mature dà origine alle pupe, dalle quali si sviluppano successivamente i nuovi adulti. Raggiunta la maturità sessuale si accoppiano fra fratelli nella camera di sviluppo e solo le femmine sfarfallano attraverso il foro d'ingresso scavato dalla madre imbrattandosi nuovamente di spore del fungo simbionte. L'intero ciclo di sviluppo (uovo-adulto) dura circa 55-60 giorni, con sensibili variazioni in relazione a clima e latitudine

Danni e sintomi di attacco - *Xylosandrus compactus*

Caratteristiche distintive di attacco

- DISSECCAMENTI APICALI DIGERMOGLI E RAMI DI PICCOLO DIAMETRO (FINO A 1-3 CM)
- FORI DI INGRESSO ISOLATI DI DIAMETRO INFERIORE A 1 MM IN GENERE LOCALIZZATI ALLA BASE DEL RAMO SECCO

Danni
Colpisce germogli, rametti e piccoli rami degli alberi ospite, con preferenza per piccoli diametri (fino a 1-3 cm) e corteccia liscia. Colpisce maggiormente alberi deperienti o indeboliti, anche temporaneamente, per siccità, traumi da trapianto o potature, defogliazioni, attacco di patogeni o ondate di calore, ma può colpire anche piante sane. Tronchi e rami di grandi dimensioni non sono mai attaccati. Le piante fortemente infestate deperiscono progressivamente, divenendo suscettibili ad attacchi di altri parassiti e patogeni. Attacchi intensi e ripetuti possono portare a morte la pianta.
Sulle brevi distanze si diffonde con il volo delle femmine adulte verso nuovi ospiti (dispersione attiva).

Sintomi esterni
Rapido arrossamento e disseccamento di ramoscelli, rametti e porzioni periferiche della chioma. Presenza di piccoli fori circolari (<1 mm) sul lato inferiore di germogli e rametti, spesso circondati da imbrunimenti.

Sintomi interni
Presenza nel legno di lunghe gallerie che si sviluppano nel midollo spesso piene di larve bianche o adulti. Su rametti molto piccoli le camere di sviluppo possono correre anche sotto la corteccia. Alterazione cromatica del legno con imbrunimenti o azzurramenti dovuti ai funghi simbionti che si sviluppano nel legno partendo dalle camere.

Danni e sintomi di attacco - *Xylosandrus crassiusculus*

Caratteristiche distintive di attacco

- LOCALIZZATO SU FUSTO E BRANCHE PRINCIPALI DI DIAMETRO SUPERIORE A 6-7 CM. FORI DI INGRESSO DI CIRCA 2 MM CHE POSSONO O MENO ESSERE ISOLATI,
- DAI FORI POSSONO FUORIUSCIRE TIPICI CANNELLI DI SEGATURA (ROSURA) DI 3-4 CM CHE POI CADONO

Danni

Colpisce il fusto e le branche principali degli alberi ospite, con preferenza per piccoli diametri (2,5-8 cm), ma anche diametri fino a 30 cm, meglio se con corteccia liscia. Infesta alberi recentemente morti (con ancora corteccia e legno fresco), deperienti o indeboliti (anche temporaneamente) per siccità, traumi da trapianto o potature, defogliazioni, attacco di patogeni, danni da fuoco di sottobosco. Non sono mai attaccati tronchi/rami scortecciati, anche se ancora freschi.
Sulle brevi distanze si diffonde con il volo delle femmine adulte verso nuovi ospiti (dispersione attiva).

Sintomi esterni

Declino rapido e generico degli alberi con arrossamento e disseccamento della chioma o di sue parti, e successiva morte in poche settimane. Nel caso di attacchi primaverili precoci: disseccamento dei germogli e mancata emissione di foglie. Presenza di numerosi piccoli fori circolari (2 mm) sul fusto e le branche principali, che penetrano in profondità nel legno, spesso associati a emissioni di liquidi, di linfa o gommose (nelle Prunoidee) I fori sono circondati da un alone scuro determinato dalla crescita dei funghi simbionti. Emissione di fine segatura bianca, asciutta, farinosa, compattata in caratteristici cilindretti che sporgono dai fori d'ingresso per circa 3-4 cm.

Sintomi interni

Presenza nel legno di gallerie e camere di allevamento spesso piene di larve bianche.

Monitoraggio dell'infestazione

Monitoraggio indiretto

Consiste nell'informare la popolazione e tutti i portatori di interesse circa i rischi legati alla presenza dell'insetto, come poterlo riconoscere e a chi comunicarlo. Informazione pubblica, formazione degli stakeholder e progetti di Citizen Science, come questa app, rappresentano il primo passo da compiere per la lotta alle infestazioni.

Monitoraggio diretto

La determinazione delle aree a rischio così come l'identificazione delle piante ospite e il riconoscimento dei sintomi dell'infestazione sono un elemento chiave per il monitoraggio diretto. Il monitoraggio della diffusione e dell'entità dell'attacco è effettuato per mezzo di trappole con appositi attrattivi, come l'etanolo, che vengono collocate nei luoghi a rischio. Le trappole sono controllate periodicamente fra aprile e settembre.

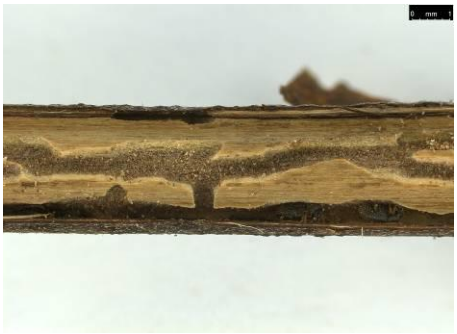
Appendix C - Pictures and didascalies of the Xylosandrus recognition guide (Italian – English)

Biologia / Biology

Xylosandrus compactus

picture	*italian*	*english*
	*Xylosandrus compactus*, esemplare adulto.	*Xylosandrus compactus*, adult specimen.
	*Xylosandrus compactus*, esemplare adulto.	*Xylosandrus compactus*, adult specimen.

	Un caratteristico foro di accesso.	A characteristic access hole.
	Il micelio, coltivato sulle pareti interne delle gallerie di scavo sarà l'alimento delle larve.	The mycelium, cultivated on the inner walls of the excavation tunnels, will be the food of the larvae.
	La galleria scavata dalla femmina adulta si allarga a formare una camera allungata dove vengono deposte le uova	The tunnel dug by the adult female widens to form an elongated chamber where the eggs are laid
	Camera larvale esposta da una dissezione.	Larval chamber exposed by dissection.

	Gallerie scavate nel midollo con presenza di esemplari adulti	Galleries dug into the marrow with the presence of adult specimens
	Galleria di scavo nel midollo di un rametto inferiore al centimetro.	Excavation tunnel in the marrow of a twig smaller than an inch.
	Su rametti di piccole dimensioni gli scavi possono correre anche sotto la corteccia.	On small branches, the excavations can be located even under the bark.

	Femmina neo-sfarfallata	Female neo-crushed

Xylosandrus crassiusculus

picture	***italian***	***english***
	*Xylosandrus crassiusculus*, esemplare adulto.	*Xylosandrus crassiusculus*, adult specimen.
	*Xylosandrus crassiusculus*, esemplare adulto.	*Xylosandrus crassiusculus*, adult specimen.

	La femmina scava un piccolo foro di ingresso (2mm) che penetra in profondità per circa 6-8 cm	The female digs a small entry hole (2mm) that penetrates about 6-8 cm deep
	Il micelio è rilasciato dalla femmina nelle gallerie tramite specifiche strutture tegumentali: i micangi.	The mycelium is released by the female in the tunnels through specific tegumental structures: the micangi.
	Il fungo ricopre le pareti interne delle gallerie. Sarà il nutrimento delle larve.	The fungus covers the inner walls of the galleries. It will be the food of the larvae.
	Larve in una camera di sviluppo	Larvae in a development chamber

	Pupe in una camera di sviluppo	Pupae in a development chamber
	Un adulto immaturo, tenero e chiaro. Continuerà a nutrirsi del micelio fino alla maturità sessuale.	An immature, tender and clear adult. It will continue to feed on the mycelium until the sexual maturity.
	Gallerie con esemplare adulto	Galleries with adult specimen

Infestazione / Infestation

Xylosandrus compactus

picture	*italian*	*english*

	Foro d'ingresso circolare, con diametro inferiore a 1 mm	Circular inlet hole, with a diameter of less than 1 mm
	Rametti apicali disseccati da un attacco	Apical twigs dried by an attack
	Disseccamento di rami di piccolo diametro in vivaio	Desiccation of small diameter branches in nursery

	Piccoli rami disseccati da un attacco	Small branches dried by an attack
	Dissecamenti su rami di piccolo diametro	Desiccation on small diameter branches

	Disseccamenti su pianta di acacia	Desiccation on an acacia plant
	Foro di ingresso evidenziato da una recisione.	Entry hole shown with a cut.
	Rametto disseccato su cipresso	Dried twig on a cypress tree

Xylosandrus crassiusculus

picture	*italian*	*english*
	Disseccamento di alcune porzioni della chioma su una pianta di acacia	Desiccation of parts of the canopy on an acacia plant
	Disseccamento dei germogli a causa degli attacchi primaverili	Desiccation of the shoots due to spring attacks
	I fori, di circa 2 mm sono numerosi e penetrano in profondità.	The holes, about 2 mm long, are numerous and penetrate deeply.

	Le gallerie raggiungono il midollo delle piante anche di grandi dimensioni	The tunnels reach the marrow even in large plants
	Sotto la corteccia, al livello del legno sono evidenti gli aloni determinati dalla crescita dei funghi simbionti.	Under the bark, at the level of the wood are evident the halos determined by the growth of the symbiotic fungi.
	Segni di un'infestazione su un tronco di grandi dimensioni.	Signs of an infestation on a large trunk.

	Caratteristici cilindretti di segatura espulsi dalle gallerie di scavo.	Characteristic sawdust cylinders ejected from the excavation tunnels.
	I cilindretti di segatura sono asciutti e farinosi e sporgono dai fori di ingresso per 3-4 cm.	The sawdust rods are dry and floury and protrude 3-4 cm from the entry holes.
	Cilindretti di segatura su pianta morta recentemente	Cylinders of sawdust on dead plant recently
	Camere esposte con esemplari a diversi stadi evolutivi.	Exposed chambers with specimens at different stages of development.