

Action C3.

Implementation and management of prevention, early warning, eradication and containment protocols in El Tello and surroundings

Deliverable: Management Protocols: prevention, early warning, eradication and containment of *Xylosandrus crassiusculus* in El Tello and surroundings

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Prepared by: Diego Gallego, Noelia Molina, Estefanía Micó, Andreu Bonet, Susana Bautista, Hugo Mas and Eduardo Pérez-Laorga.

With support of:



Revision history

Version nº	Date	By whom	Concerns
Rev.1	08/05/2020	Diego Gallego, Noelia Molina, Estefanía Micó, Andreu Bonet, Susana Bautista, Hugo Mas and Eduardo Pérez- Laorga.	First protocol version after a year of sampling and field prospections. These protocol will revisable after second year of sampling and prospections.

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1. Introduction

Xylosandrus crassiusculus was detected for first time in Iberian Peninsula in the residential estate “El Pla de les Clotxes” (Benifaió, Valencia) in October 2016, affecting 4 carob trees, located in a recreational zone with natural vegetation. *X. crassiusculus* is an invasive species included in the Alert List of EPPO, together with *X. compactus*. *Xylosandrus* genus is composed by about 54 species, widely distributed worldwide, mainly in tropical and temperate zones. *Xylosandrus* is included in the Ambrosia Beetle group, a group of Scolytinae that have established a symbiosis with saprophytic fungi, whose spores are transported in special organs called micangia. Adults females usually bore live woody vegetables, entering into the xylem and digging galleries. Those galleries are upholstered by the fungus, which is consumed by insect's larvae and adults. This behavior is known as xylomycetophagia. These insects are considered a concern due to their ability of transporting and inoculating fungi directly into xylem in many woody and non-woody plant species, with supposes a high risk of entrance of pathogens or oportunist fungus. In adition, *X. crassiusculus* has invaded 55 countries of the tropical and temperate world, favoured by its high polyphagia, capable of attacking 29 agricultural and forest hosts. Fifteen of this 29 hosts are present in El Tello and surroundings, 6 in natural areas an 12 in residential and crops areas. However, currently, *X. crassiusculus* has only been detected attacking carob trees in the region. And its external symptoms may be confussed with damages made by the widely extended black rat (*Rattus rattus*), in this respect *X. craussiusculus* presence only could be clearly identified by a detail observation of the trunks and branches, searching fringed holes, exudate drops or dust strings.

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After the first year of SAMFIX trapping and prospections (1999), it is possible to conclude that *X. crassiusculus* flight period is from the end of April and early May, until the end of November, with two peaks of polulation (early July and end of September), being the second one more important (Figure 1). Most of the captures have been located around the first detection area (east of the study site, in the municipalities of Benifaió and Picassent), althought some specimens have been captured in nord-western area (Monserratmunicipality) at the end of September, during the main fligh peak, so we suspect that this could be the true dispersive flight (Figure 2).

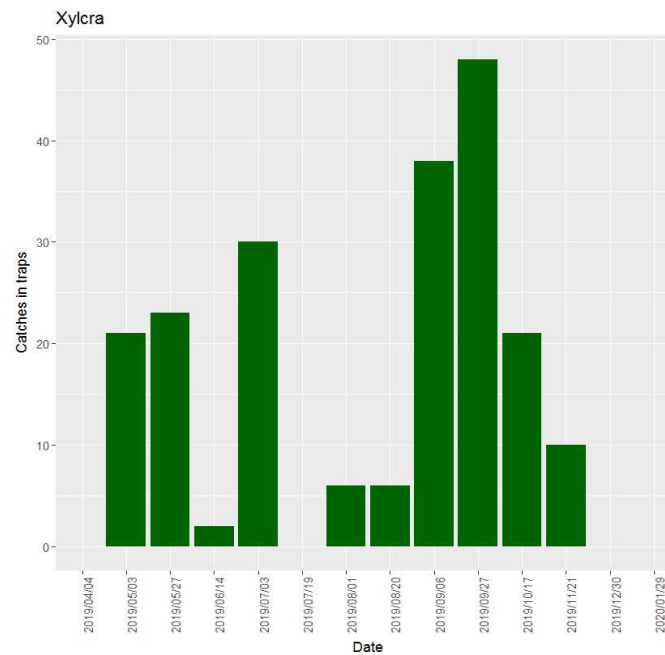


Figure 1: Flight period of *X. crassiusculus* in Valencia in 2019.

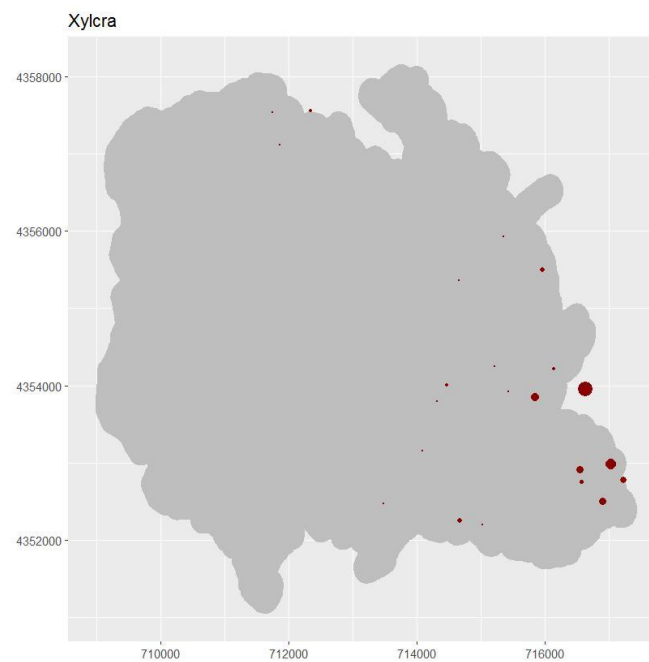


Figure 2: Distribution of *X. crassiusculus* in the SAMFIX core area "El Tello and Surroundings" in 2019.

At the moment, the unique host affected by *X. crassiusculus* in Spain is *Ceratonia siliqua*, carob tree. Only 17 carob trees have been detected in the study area (Figure 3), and none of them has died after the beetle attack. In fact, no recurrent attacks have been observed on the same tree across the years, with the unique exception of a very big carob tree that presents old attack evidences in a big branche and an active attack in another branch at the opposite side of its canopy. All damaged trees occurs at the extended or buffer area, and all of them are whether in abandoned old crops of carob trees, whether in young carob trees born in road ditches or abandoned crops.

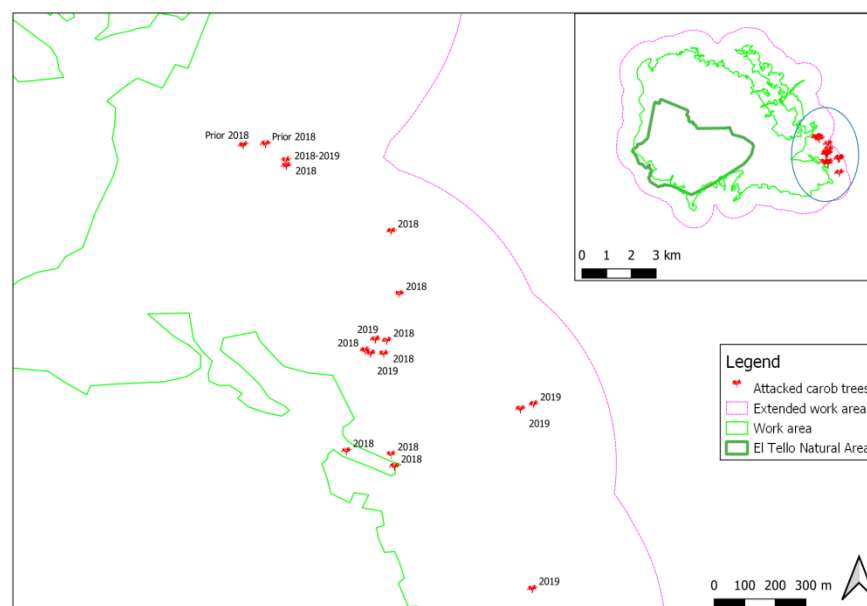


Figure 3: Affected carob trees by *Xylosandrus crassiusculus* in El Tello and Surroundings after 2019 prospections. Date correspond to the year of report of active symptoms. Prior 2008 indicates attack evidences without active symptoms in the first prospection (2018).

No unmistakable external symptoms of *X. crassiusculus* attacks was defined. It can be confused with a widespread carob damage: branche dessecation caused by bark gnawings of black rat (*Rattus rattus*) (Figure 4). *X. crassiusculus* attacks only could be identified unambiguously by a detailed observation of the trunks and branches, searching for fringed holes, exudate drops or dust strings (Figure 5).



Figure 4: External symptoms of *X. crassiusculus* attacks and black rat gnawings. Picture at bottom left shows a gnawing detail.



Figure 5: Unmistakable symptoms of *X. crassiusculus* attack in carob trees. Top: White dust strings and exudate drops. Bottom: multiple holes and fringed holes (red arrows)

The work area of “El Tello and Surroundings” includes 3100 ha, with 2 public mountains (Monte V036 Monte Aledua and Monte V3044 Monte de Picassent), the vegetation microreseve “Lloma del Tramussar”, the SIC ES5234005 “Sima del Àguila”, and the Municipal Nature Area “El Tello”. In 2020 works will extended to two replication sites, SIC ES5333011 “Sierras del Martés y el Ave”, and SIC ES2533040 “Muela de Cortes y el Caroché”. At least 1080 ha of natural habitats have occurrences of carob tree specimens, mainly originated by abandoned crops in 1970's decade. Its distribution covers a great part of the core area of “El Tello and Surroundings” (Figure 6), as more or less dispersed trees mainly into mediterranean scrubs or Aleppo pine forests. At the present, no attacks have been detected in natural areas.

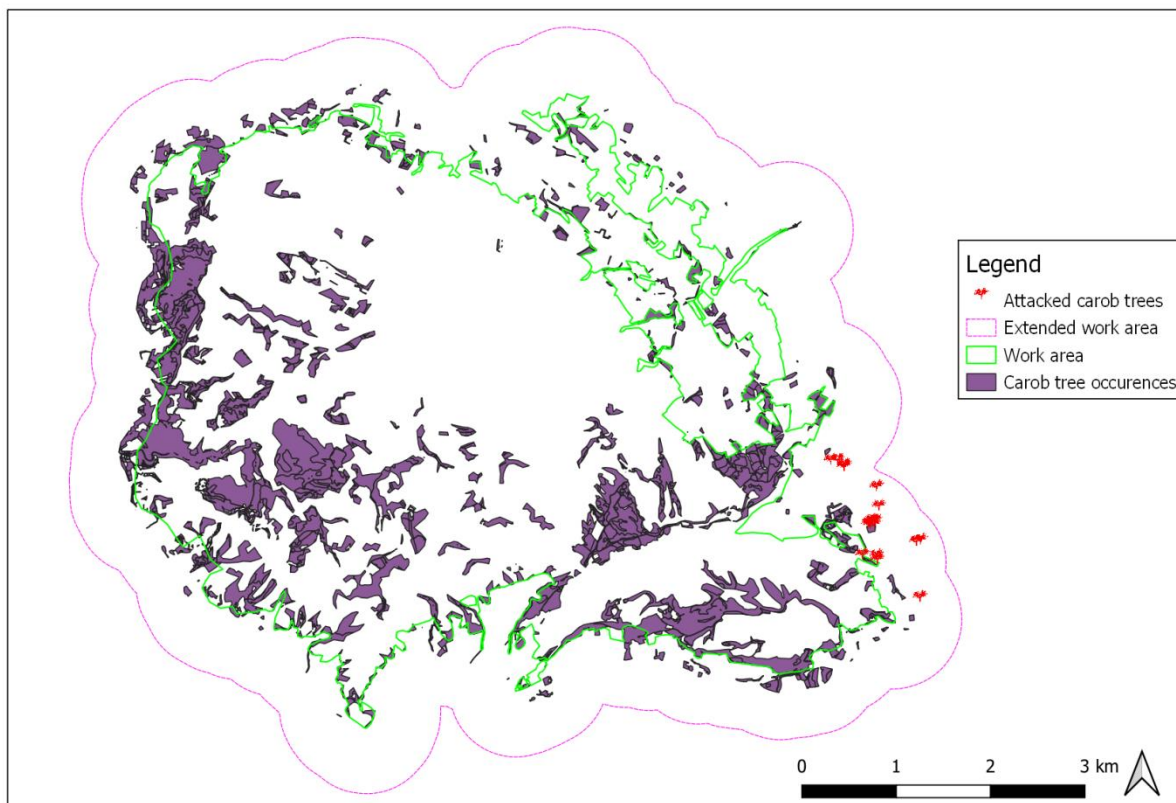


Figure 6: Distribution of *Ceratonia siliqua*, the carob tree in the core SAMFIX area “El Tello and Surroundings”.

2. Aim of the document

This document is aimed to establish the basis of management protocols regarding prevention, early warning, eradication and containment of *Xylosandrus crassiusculus* in El Tello and surroundings for 2020.

This document also includes incidences on C3 Actions due to the COVID19 restrictions.

3. Monitoring and experimental mass trapping actions in 2020

.- Monitoring trap network.

In 2020, 40 trap installed in 2019 (Figure 7) will be maintained baited with generalist lure alpha-pinene and ethanol, with aim of monitoring dispersion of *X. crassiusculus* in the core area. Traps was activated and revised monthly since January to end February. Biweekly revisions was programmed for starting half March to end November, but this was interrupted since 15/03/2020 for the restrictions imposed by the Spanish COVID19 quarantine.

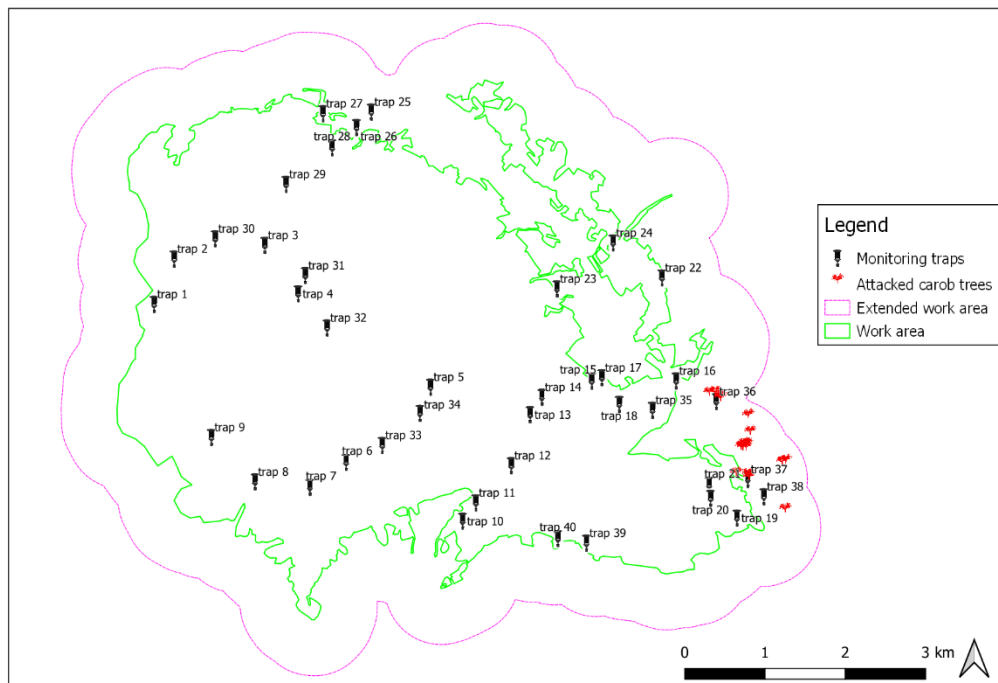


Figure 7: Monitoring trap network of El Tello and surroundings.

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.- Experimental mass trapping.

An experimental mass trapping action was programmed for 2020. A network of 10 trap aimed to massive catching of *X. crassiusculus* will placed in ubications showed in Figure 8. Traps will be baited with a multilure composed by alpha-pinene, ethanol, quercivorol and alpha-copaene. Traps will installed end of March and revised biweekly to end November. This action was also interrupted since 15/03/2020 for the restrictions imposed by the Spanish COVID19 quarantine.

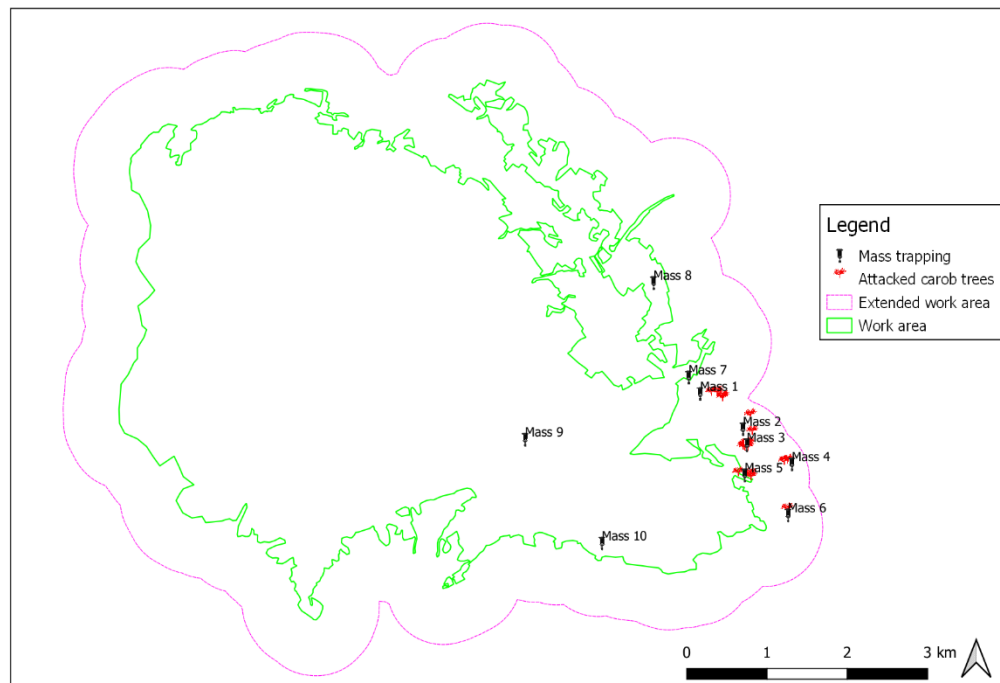


Figure 8: Mass trapping network programmed for 2020.

4. Stage of invasion of *Xylosandrus crassiusculus* in Spain. New event or unsuccessfully event?

The first step of this plan is to define the stage of invasion of *X. crassiusculus* in Spain. This includes a date estimation of start date of the invasion and the putative pathway of entrance.

At the present we know:

- 1.- *X. crassiusculus* has not been detected in Iberian Peninsula out of the SAMFIX core work area "El Tello and Surroundings", covering around 1300 ha, including attacked trees and trap collections in 2018-2019. So, although the widespread (Figure 6) of invasion is reduced,
- 2.- Dispersion ability of *X. crassiusculus* in Spain is still unknown, but some insects have been captured with traps more than 5000 m far away from the core of the populations, at the north of working area, in coinciding with the peak of the flight (end of September). And no colonized trees have been detected in this area.

3.- The number of detections of new attacked trees between 2018 and 2019 is very low, only 4 of 17 (five if the recurrent attack on a same tree is considered), and all the trees in a small area of around 80 ha. So, the infestation ability is low in the working area.

Regarding these three points, we could hypothesize that the outbreak occurred in 2016 (or 2015), in a point near the residential areas "El Pla de les Clotxes" and "Sierramar". At this time, the spread of the invasion was very slow, so called "silent invasion", possibly because of the possibility that carob tree is the unique suitable host in the area, since we have evidences of a possible dispersive flight of 5 km far away from the core area (assuming that of all attacked trees of the area have been detected). Under this hypothesis, eradication actions could be still considered.

5. Aggressivity of *Xylosandrus crassiusculus* in Spain.

X. crassiusculus doesn't seem an aggressive species. Attacked trees do not die, only dead branches have been observed. The unique record of dead trees was observed in 2016, the first four trees detected. After this date, no dead of any tree have occurred. These trees were cutted and chipped, and currently, a strong resprouting can be observed from the stumps (Figure 9).



Figure 9: Resprouting from two stumps of *X. crassiusculus* attacked and killed carob trees in "El Pla de les Clotxes"

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With our observations we can explain the attacking process of *X. crassiusculus* on carob trees in Spain as showed in Figure 10. Females select and attack trees along spring and summer, during the first peak of the flight. The breeding generation emerges at end of September (second and main flight peak) and find other trees to spend the winter and breed a new generation that will emerge next spring. So, species behaves as bivoltine in the working area.

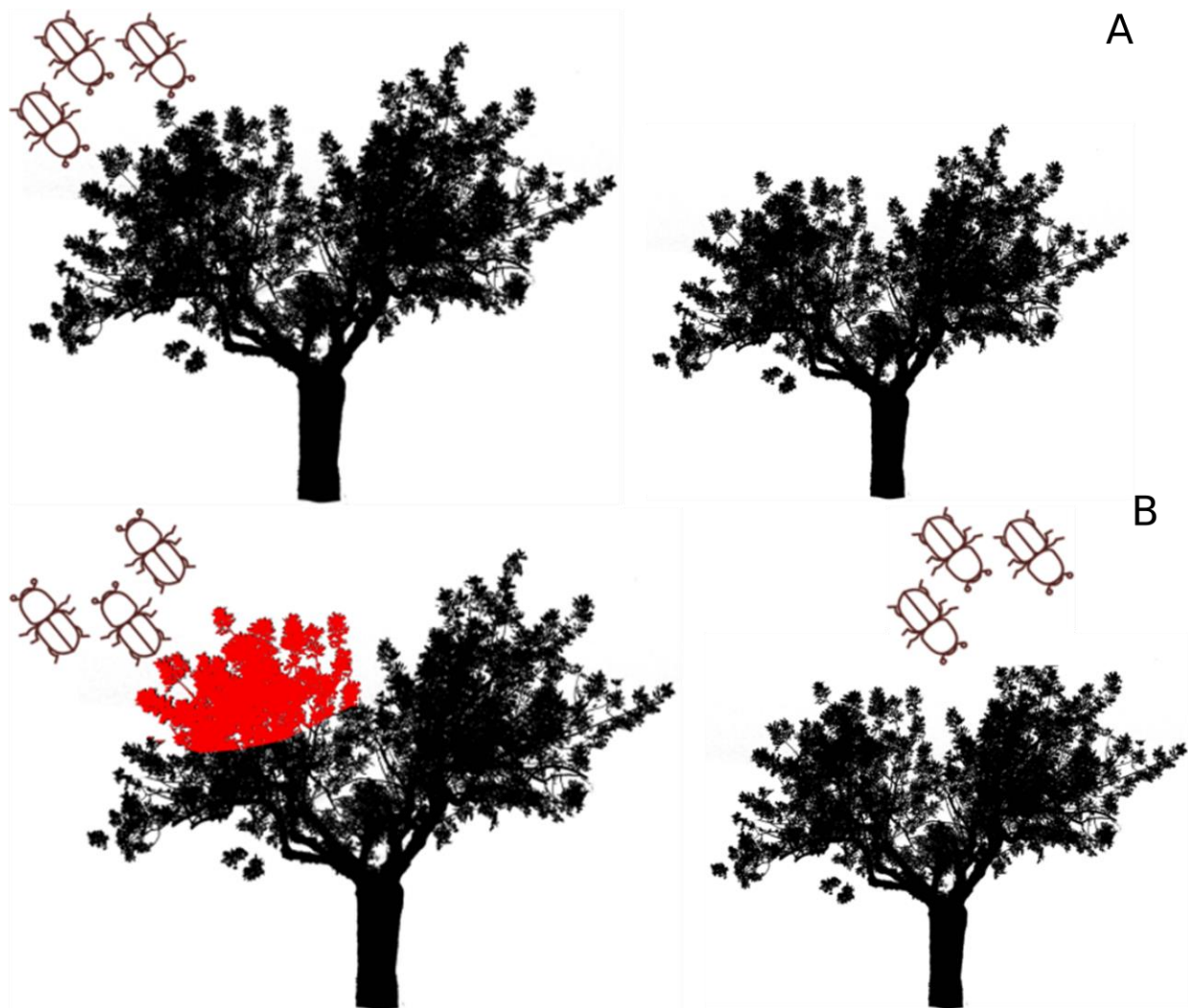


Figure 10: Scheme of possible attack process of *X. crassiusculus* to carob trees in a bivoltine behavior. A: Females select and attack trees along spring and summer. B: Breeding generation emerges at end of September and find another tree to spend the winter and breed a new generation that emerges in the next spring.

6. Action protocols for monitorization and eradication/containment of *X. crassiusculus* in Valencian Community.

a. Monitoring actions

Occurrence and widespreading of *X. crassiusculus* in Spain need to be monitored. Monitoring actions are mainly two: capturing adult females with baited traps, and attacked trees detection by a direct and detailed inspection. These actions will be done in two ways:

1.- **Intensive actions** in the core area and in replication areas (trapping and tree inspection) will be carried out by SAMFIX actions until the beginning of 2022, when Life project will finish.

2.- **Extensive actions** will be carried out in Valencian Region by Gerenalitat Valenciana resources:

- Systematic trapping network MUFFET, composed by 15 traps covering the forest area of Valencian Community; and RAT, composed by 8 traps located near ports, airports and timber industries in Valencian Community.

- Permanent inspections by the Environmental Agents (annual training sessions will be imparted under SAMFIX Actions until the end of the Project).

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b. Eradication/Containment actions

Control of *X. crassiusculus* consists in massive trapping actions and destruction of infested vegetable material before the breeding generation emergence. But both actions have at the present strong limitations of their efficacy.

1.- Massive trapping need an specific and effective lure that permits the capture of a higher number of specimens of *X. crassiusculus* and no other species. At the moment, the used lure (alpha-pinene and ethanol) is a generic one, attractive for a lot species, including *X. crassiusculus*. Current captures of *X. crassiusculus* are very low using the generalist lure. In fact, less of hundred individuals have been collected in 2019, in 40 traps.

French team of SAMFIX, in Action A1, proposed an high specific lure composed by alpha-pinene, ethanol, quercivorol and alpha-copaene. This lure will be tested in El Tello and Surrounding along 2020 camping. This experiment was programmed for starts in second half of March 2020, but affected for the COVID19 restrictions. This action have a hoped re-starts in early June 2020, if the constraints will soften along May. The results of this trial will be incorporated in following updates of this document.

2.- Destruction of vegetable material infested by *X. crassiusculus* before breeding emergence is the more effective action for reducing insect population levels. Unfortunately, several reasons have made impossible to execute these actions until the present:

a.- The temporal window for acting is narrow, only between August and early September, when unequivocal symptoms of active attacks can be detected. Action requires a forest crew equipped with tools for pruning and chipping *in situ* the vegetable material. Pruning can be carried out by common and or machine tools, but a chipper is so common tool, specially for big branches. Plus, it is a big machine that requires be towed. So, the availability of these staffs of and material endowments of Generalitat Valenciana throughout August and mid-September must be taken into account.

b.- Administrative jurisdiction is the main problem to execute control actions. All infected carob trees occurred mainly in private plots in abandoned crops, and in some cases in private recreative areas or ditches of private roads. In all situations, trees are out of the jurisdiction of Forest Health responsables (Forest Administrations), but within the jurisdiction of Plant Health of Agriculture Administration. On the other hand, carob tree is a very marginal crop in Valencian Community, so, their pests has scarce or null importance versus other pests as the Quarantine species *Xylella fastidiosa* (an important outbreak is being managed currently at the region). Thus, no action on this affected trees has been carried out until the present.

7. Conclusions

This first plan summarises the status of knowledge about *Xylosandrus crassiusculus* in the unique outbreak of this invasive species in Spain: El Tello and Surroundings, Valencia. The plan, written under SAMFIX project framework, by collaboration between Responsibles of Forest Health of Gerenalitat Valenciana and the SAMFIX team the University of Alicante, analyses the uncertainties and knowledge gaps, and proposes actions for monitoring and eradication or control. Plan will be updated annually, accordingly the SAMFIX development, in order to incorporate results and recommendations.

8. ANNEX: Incidence of COVID19 pandemic in C3 actions

15/03/2020 the Spanish Government impose the "Alarm Stage" at entire Spanish territory. Because it, all non-essential movements was forbidden in Spain, together a lot of imposed restriction aimed to limit the contagion in Spanish people. So, this Alarm Stage have consequences on C3 SAMFIX project Actions, as below:

1.- University of Alicante was closed, with only permission for COVID19 related research and other priority activities. Administrative activities was also reduced, including non essential material purchasing.

2.- Since 15/03/2020 to the present, movements between provinces are totally forbidden. It implies that travels from UA (Alicante province) to El Tello (Valencia province) was interrupted.

Possibly, since 18/05/2020, investigation activities will be permitted in entire Valencian Community, implying permission for inter-province travels, so, we hope could start field activities of C3 at second half of May. If the Spanish Government permits these movements, thus:

.- all 40 traps of monitoring network of core area will be revised and refilled with lures. These traps will be revised biweekly until end October 2020. Revisions in November and December 2020 will be monthly.

.- 10 traps for mass trapping will be installed first week of June. We hope completing purchase of specific lures (alpha-copaene and quercivorol) has been possible for this date. These traps will be revised biweekly until end October 2020.