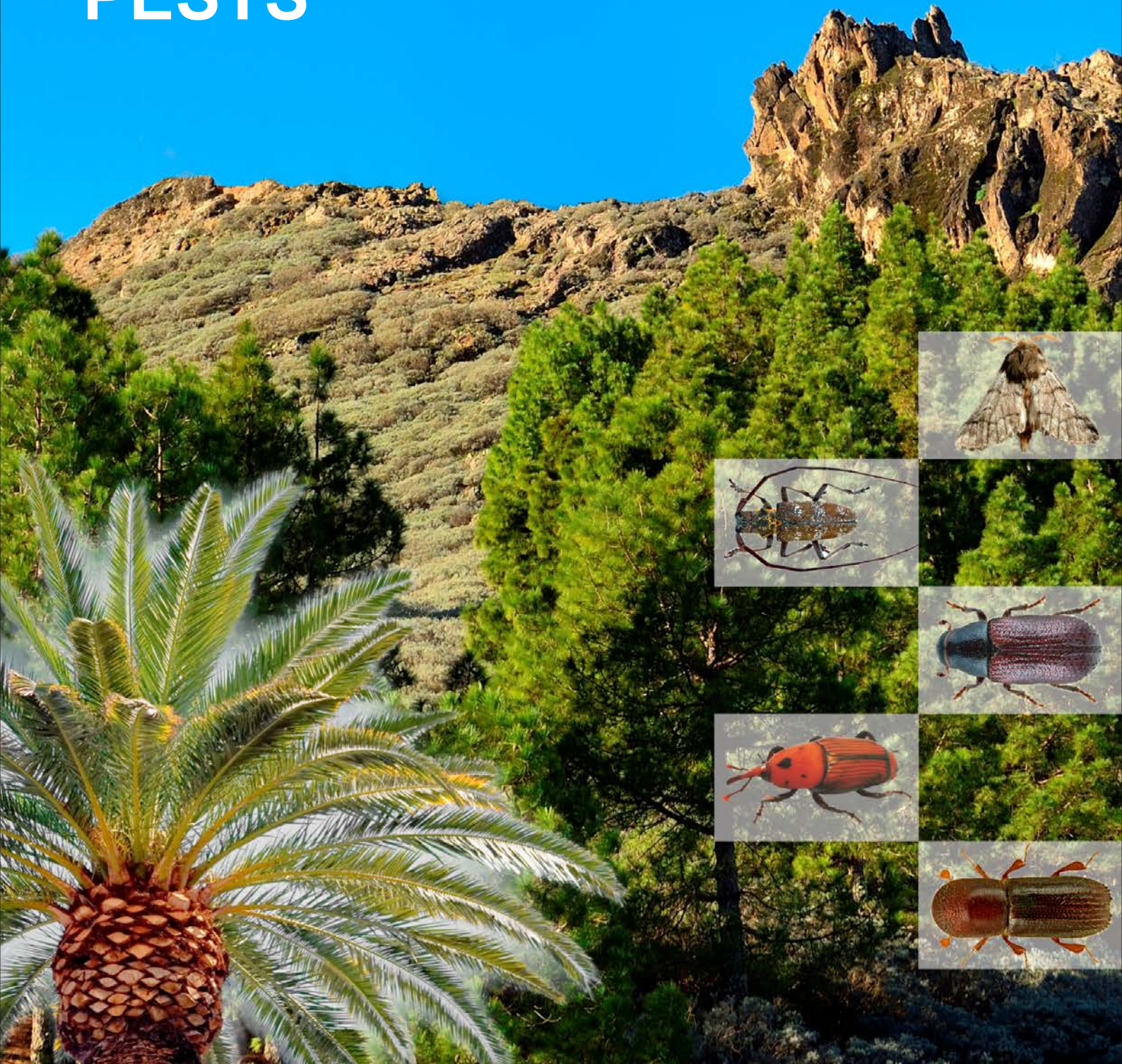
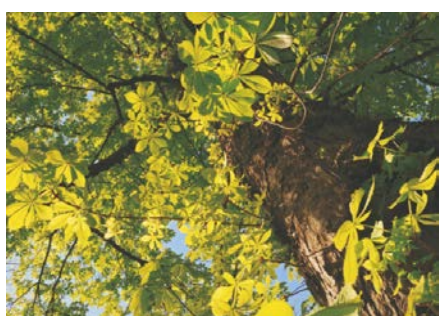
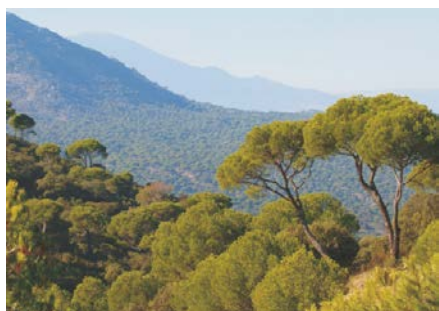


CATALOGUE OF PRODUCTS AND SERVICES FOR FOREST PESTS





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■ PHEROMONE AND TRAP MANAGEMENT FOR FOREST PESTS

Using traps baited with attractants for the study or management of forest insect populations is a tool that has demonstrated more than enough its efficiency in the last few decades.






















This tool permits the attraction and capture of many target species, being able to use highly specific pheromone attractants or general kairomonal attractants, depending on the aim of the captures.

This high plasticity allows for the use of traps directed to estimate the population density of a specific species, such as *Ips sexdentatus* or *Monochamus galloprovincialis*, or the detection of exotic beetles, such as *Xyleborus ferrugineus* for example.



The use of different traps, such as ECONEX TRAMPA G, CROSSTRAP® or CROSSTRAP® MINI, baited with the appropriate attractants are useful tools for the monitoring of many autochthonous species of forest insects such as *Thaumetopoea pityocampa*, *Tomicus destruens*, *Tomicus piniperda*, *Orthotomicus erosus* e *Ips sexdentatus* amongst others. The trap densities vary from one or two traps per hectare, up to one trap every 18 hectares.






















DIFFUSERS FOR FOREST PESTS









CODE	TRADE NAME	Length (days)	TARGET PEST	RECOMMENDED TRAP
VA128	ECONEX ARCHIPS SEMIFERANUS	40	Oak leaf roller	
VA234	ECONEX CAMERARIA OHRIDELLA	40	Horse chestnut miner	
VA129	ECONEX COLEOPHORA (EUISTA) LARICELLA	40	Larch leaf miner	
VA348	ECONEX CYDALIMA PERSPECTALIS 2 MG 60 DAYS	60	Box tree moth	
VA373	ECONEX CYDALIMA PERSPECTALIS 3 MG 200 DAYS	200	Box tree moth	
VA180	ECONEX CYDIA FAGIGLANDANA 2 MG 40 DAYS	40	Beech moth	
VA141	ECONEX CYDIA SPLENDANA 2 MG 40 DAYS	40	Acorn moth	
VA393	ECONEX DENDROLIMUS SIBIRICUS 60 DAYS	60	Siberian silk moth	
VA134	ECONEX DENDROCTONUS RUFIPENNIS	40	Spruce beetle	
VA135	ECONEX DIORYCTRIA ABIETELLA	40	Spruce or fir coneworm	
VA136	ECONEX DIORYCTRIA DISCLUSA	40	Webbing coneworm moth	
VA137	ECONEX EUCOSOMA SONOMANA	40	Western pine shoot borer	
VA138	ECONEX GRAPHOLITA (LASPEYRESIA) JANTHINANA	40	Hawthorn leafroller	
VA187	ECONEX IPS ACUMINATUS	45	Engraver beetle	
VA306	ECONEX IPS MANNSFELDI	60	Bark beetle	
VA294	ECONEX IPS SEXDENTATUS 3C 60 DAYS	60	Six-toothed pine engraver beetle	
VA140	ECONEX IPS TYPOGRAPHUS	45	Eight toothed spruce bark beetle	
VA142	ECONEX LYMANTRIA DISPAR 2 MG 40 DAYS	40	European gipsy moth	
VA266	ECONEX MALACOSOMA NEUSTRIUM	40	Liveried caterpillar	
VA195	ECONEX MONOCHAMUS ATRAYENTE 60 DAYS	60	Pine sawyer beetle	
VA189	ECONEX ORTHOTOMICUS EROSUS 60 DAYS	60	Mediterranean pine engraver beetle	

	WHITE TRIANGULAR		EOSTRAP®		POLILLERO		GREEN POLILLERO		MOSQUERO
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	TRIANGULAR BLANCA DESECHABLE		INVAGINATED EOSTRAP®		G TRAP		CROSSTRAP®
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DIFFUSERS FOR FOREST PESTS






CODE	TRADE NAME	Length (days)	TARGET PEST	RECOMMENDED TRAP
VA336	ECONEX ORYCTES ELEGANS 60 DAYS	60	Date palm fruit stalk borer	
VA213	ECONEX PAMMENE FASCIANA	40	Chesnut leafroller	
VA144	ECONEX PANOLIS FLAMMEA	40	Pine beauty moth	
VA145	ECONEX PARANTHRENE TABANIFORMIS	40	Dusky clearwing	
VA369	ECONEX PITYOPHTHORUS JUGLANDIS 60 DAYS	60	Walnut twig beetle	
VA146	ECONEX RHYACIONIA (EVETRIA) BUOLIANA	40	Pine shoot moth	
VA149	ECONEX RHYACIONIA DUPLANA	40	Pine tip moth	
VA147	ECONEX RHYACIONIA FRUSTRANA	40	Nantucket pine tip moth	
VA148	ECONEX RHYACIONIA ZOZANA	40	Ponderosa pine tip moth	
VA197	RHYNCHONEX® KAIROMONE 90 DAYS	90	Red date palm weevil	
VA179	RHYNCHONEX® PHEROMONE 90 DAYS	90	Red date palm weevil	
VA295	RHYNCHONEX® PHEROMONE 150 DAYS	150	Red date palm weevil	
VA286	ECONEX RHYNCHOPHORUS PALMARUM 90 DAYS	90	Black palm weevil	
VA150	ECONEX SCOLYTUS MULTRISTIATUS 40 DAYS	40	European elm bark beetle	
VA256	ECONEX SESIA APIFORMIS	40	Poplar borer	
VA152	ECONEX SYNANTHEDON VESPIFORMIS	40	Yellow legged clearwing	
VA153	ECONEX THAUMETOPOEA PITYOCAMPA 60 DAYS	60	Pine processionary moth	
VA331	ECONEX THAUMETOPOEA PITYOCAMPA 200 DAYS	200	Pine processionary moth	
VA250	ECONEX TOMICUS DESTRUENS 60 DAYS	60	Pine beetle	
VA188	ECONEX TOMICUS PINIPERDA 60 DAYS	60	Pine shoot beetle	
VA154	ECONEX TORTRIX VIRIDIANA 2 MG 40 DAYS	40	Green oak tortrix	

 WHITE TRIANGULAR	 EOSTRAP®	 POLILLERO	 GREEN POLILLERO
 DISPOSABLE WHITE TRIANGULAR	 RHYNCHONEX®	 G TRAP	 CROSSTRAP®

DIFFUSERS FOR FOREST PESTS

CODE	TRADE NAME	Length (days)	TARGET PEST	RECOMMENDED TRAP
VA155	ECONEX TRYPODENDRON LINEATUM	40	Ambrosia beetle	
VA156	ECONEX ZEIRAPHERA DINIANA	40	Larch tortrix	

SPECIAL ATTRACTANTS DIFFUSERS

CODE	TRADE NAME	Length (days)	TARGET PEST	RECOMMENDED TRAP
VA309	CROSSTRAP® DETECTION KIT	60	Kit composed of 3 kairo-pheromonal attractants for the early detection of autochthonous and invasive species of forest insects.	
VA303	ECONEX CERAMBYX 60 DAYS	60	Kairomonal attractant diffuser for the attraction of both sexes of different species of the genus <i>Cerambyx</i> .	
VA399	ECONEX CERAMBYX 1 L	---	Liquid kairomonal attractant for the attraction of both sexes of different species of the genus <i>Cerambyx</i> .	
VA407	ECONEX CERAMBYX 5 L	---	Liquid kairomonal attractant for the attraction of both sexes of different species of the genus <i>Cerambyx</i> .	
VA263	RHYNCHONEX® ATTRACTANT KIT 90 DAYS ENV. 6 UD. (pheromone+kairomone)	90	Kit composed of a diffuser of pheromone and kairomone attractants for <i>Rhynchophorus ferrugineus</i> . It is sold in boxes of 6 units.	

REPELLENTS

VA308	ECONEX TOMICUS REPELLENT 120 DAYS	120	Repellent diffuser of <i>Tomicus destruens</i> with 120 days duration.	---
VA219	ECONEX VERBENONE 7,5 G 40 DAYS	40	-----	---

AUXILIARY PRODUCTS

TA180	RHYNCHONEX® DECOY	---	Plastic <i>Rhynchophorus ferrugineus</i>	
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 WHITE TRIANGULAR	 EOSTRAP®	 POLILLERO	 GREEN POLILLERO	 CROSSTRAP® XYLOFAGOS
 DISPOSABLE WHITE TRIANGULAR	 RHYNCHONEX®	 CERAMBYX TRAP	 CROSSTRAP®	



Tomicus destruens

www.tomicusdestruens.eu



Tomicus piniperda

www.tomicuspinnerda.eu

TOMICUS DESTRUENS and TOMICUS PINIPERDA · Pine borers / Pine shoot beetles



The *Tomicus* genus is composed of seven species of Coleoptera from the subfamily Scolytinae (Curculionidae) that cause damage in species of the *Pinus*, *Abies*, *Larix* and *Picea* genus. They are mainly distributed in the Palearctic region, having been introduced into North America in the 1990s.

The *T. destruens* and *T. piniperda* species are widely distributed in pine forests. *T. destruens* attacks *P. halepensis*, *P. pinaster*, *P. pinea* and especially *P. nigra*. *T. piniperda* reproduces on *P. pinaster*, *P. sylvestris* and has been found on *P. nigra*.



Pinus halepensis attacked by *Tomicus destruens*

The *T. destruens* and *T. piniperda* adults are considered aggressive species and are almost morphologically indistinguishable. They are approximately 4mm to 4,5mm long, with a black head and thorax. *T. destruens* generally has red-brown elytrons and legs, while *T. piniperda* usually have them black. In any case, they are not constant characteristics and the only certain way of knowing is an analysis via a PCR (Polymerase Chain Reaction) or SEM (Scanning Electron Microscope). Sexual dimorphism is not very noticeable, it is only present in the last abdominal tergite.

Tomicus destruens

MORPHOLOGY AND BIOLOGY

T. destruens can measure between 3,5 and 4,5 mm long, they have a black head and thorax, the elytrons are chestnut brown, the same as the legs. Oviposition takes place in the maternal galleries, in some incisions made by the female on both sides of the gallery. The eggs are white and approximately 0,5 mm in diameter.



Physical appearance of *Tomicus destruens*

The number of eggs that the females lay can vary between 60 and more than 200. The larvae are apodal, curved, and white in colour with a brown head. When they are born they barely surpass 1mm in length, reaching in the 4th and final larval stage the same length or slightly more than the imagoes.

The pupae live at the end of the larval galleries, inside the pupa chamber, situated in the bark or between the bark and the wood. These pupae are whitish and you can see the appendages of the imagoes.

T. destruens has two clearly different stages in its life: one below the bark in **debilitated trees**, where copulation takes place, then egg laying and the complete development of a new generation. The other stage develops in the branches on the tops of **healthy pine trees**, where the imagoes feed.

T. destruens starts to fly in the middle of September until the maximum temperature is less than 20°C, something that can also happen in short periods of time from December to February in which they can fly. Between October and December the first generation eggs are laid and hatch during March.

When the maximum temperatures in February and March begin to exceed 20°C again, reproduction starts a reproductive flight once more, laying the second generation eggs that will emerge in May or at most the beginning of June. Both generations are sisters, as they come from the same parental generation.

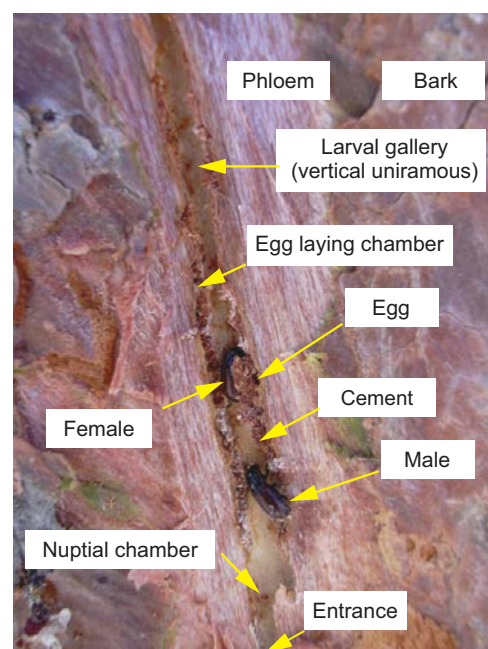
Reproduction starts after finding through the sense of smell (at long distance) and sight (at short distance) the host tree. Once located, the females begin to bore a hole in the bark of tree trunks and thick branches. The male enters in after her and after copulation, it stays behind the female clearing away the sawdust, while the female excavates the vertical and uniramous gallery. The female places each egg individually, in small incisions on either side of the gallery, cementing the cavity afterwards to stop the egg predators from gaining access.

Shortly after, the larvae are born and begin perforating the galleries perpendicular to the maternal galleries. They fill them with sawdust and excrement behind them to stop predators from entering. The larva goes through four stages, later transforming into a pupa inside a small chamber in the interior of the bark of the tree, which can mark the wood. The pre-imago, without pigment, remains some time in this chamber to later come outside through one of the holes bored in the bark.

After this, they fly to the tree tops and insert themselves into the xylem of dying branches, to feed themselves and mature sexually. The imagoes remain in the tops of the trees throughout the summer, moving from one branch to another. The ends of the branches are very often broken, falling to the floor. The parental generation also needs to spend time feeding itself on the branches between the egg laying in autumn and again in spring.



Larvae of *T. destruens*. Left: larva in 2nd stage. Right: Larva in 4th stage.



Pair of *T. destruens* in the gallery under the bark of the tree



Pupa of *T. destruens* in pupal chamber



Volcanoes of resin

Tomicus piniperda

MORPHOLOGY AND BIOLOGY

T. piniperda can measure between 4 mm and 5 mm long, the elytrons are dark chestnut brown with a black head and thorax. Egg laying takes place in the maternal galleries, below the bark in some fissures on both sides. The eggs are white and round, the number of eggs laid by each female oscillates between 20 and 50. The larvae are apodous, whitish, curved and with a brown cephalic capsule. The pupae always live at the end of the larval galleries.



Physical appearance of *Tomicus piniperda*

It is a monogamous species in which the female creates the first colonisation by making a hole that will lead to a subcortical chamber, which is a little bit wider. It is known as the nuptial chamber.

The gallery is made by the female while the male is in charge of throwing out the sawdust, as well as, preventing the resin that the pine tree secretes from blocking the gallery. The female places the eggs in tiered cells in the maternal gallery.

Generally, *T. piniperda* lays its eggs in the first weeks of March up to August. Therefore, the *T. piniperda* period of attack on tree trunks is much shorter than *T. destruens*. After the juveniles emerge, from July to December, they fly to the crown of the trees to feed themselves the same as *T. destruens*.

With the arrival of the cold weather, the adults take refuge in the bends of the thick bark, to get through the winter until the beginning of their flight period in March.



T. piniperda galleries marked in the bark



Pre-pupa of *T. piniperda* in the pupal chamber

SYMPTOMS AND DAMAGES

The *Tomicus* genus produces two types of damage: subcortical galleries in trunks and thick branches and galleries in the small branches on the crowns of the trees. The attack on the crowns of the trees is irrelevant given that the trees that they attack have enough strength to regenerate the losses. However, attacks on the tree trunk are always mortal, given that through the maternal galleries and especially the larval chambers the fungi gets in and produces the degradation of the phloem around the gallery. Also, during larval feeding, a mechanical destruction of the phloematic canals is produced.

They select trees or sections of tree trunk with bark that is not too thin nor too thick. They do not tend to attack the reforested trees. The attacked trees are easy to identify because of the volcanoes of yellow resin that surround the entrance holes. Sometimes, trees with rejected attacks can be found alive, but with volcanoes of resin.

They prefer to reproduce in trees with initial stages of deterioration, mainly due to lack of water, competition with other trees, damage by fire or mechanically damaged. They behave like a primary species, capable of killing very weakened trees and they do not tend to damage previously attacked trees by other bark beetles (except in very rare cases in *Pinus pinaster* is attacked by *Ips sexdentatus*).

In the absence of episodic damages, such as fires or droughts, the trees at most risk of attack are the ones situated in poor, not very deep soil, little rain and too many trees per hectare. Also, frequent attacks on very old trees have been detected (> 80 years), which is possibly linked to ageing. Another risk factor is forest work, such as thinning out the forest and extraction, given that in certain conditions, attacks have been registered in healthy trees.

Special attention must be paid to the periods of intense and prolonged drought, given that they are predisposed to attacks by *Tomicus* not only to individual trees, but also to large masses of forest. Between 1994 and 1996 almost 40.000 ha of pine forest in the Region of Murcia were affected, after a prolonged drought.

Wood abandoned in the forests from forestry work is the perfect material for reproduction and once its populations reach the highest levels, they can become a real threat for other trees and forests.

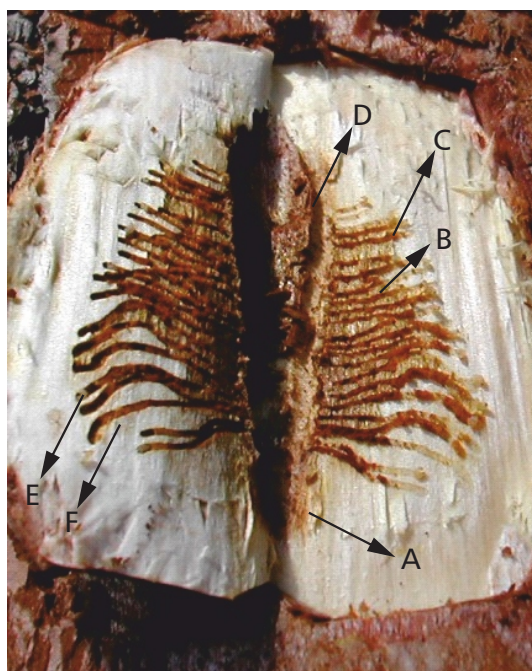
When infested, at the beginning the dead trees appear isolated or in small stands. The insect population increases rapidly and the focus changes into continuous stains, becoming more extensive every time.

The visual diagnosis is based on the presence of volcanoes of yellow resin on the trunks and thick branches. Normally this symptom is detected after the crowns of the trees suddenly turn yellow. After debarking the tree the presence of the specie is confirmed. This discolouration is produced in the advanced stages of infestation, when the parents and part of the offspring generation have already abandoned the host.



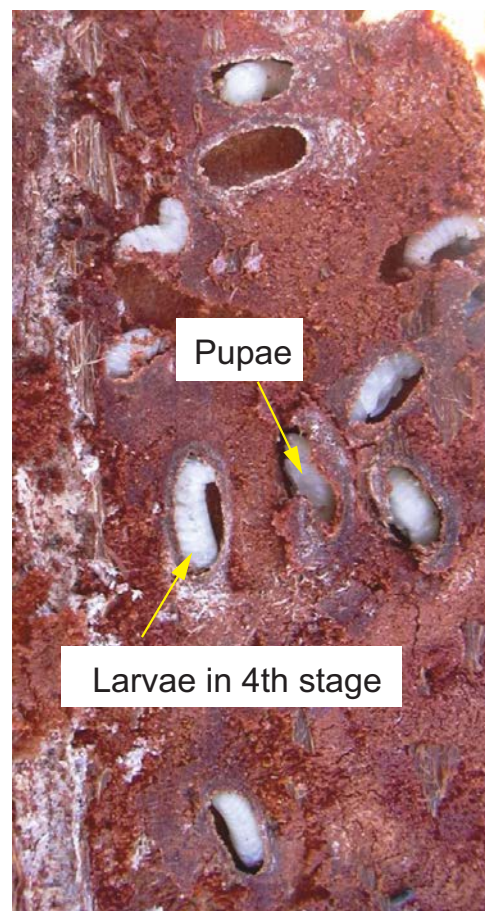
Branches perforated by *T. destruens* and thrown down by the wind

This contributes to making it more difficult to control, given that treatments such as tree felling and debarking the tree are only partly effective, by acting solely on part of the offspring population and practically nothing on the parent generation. In very weak or felled trees the volcanoes of resin are not formed, so diagnosis will only be carried out by debarking and gallery identification.



T. destruens galleries after the removal of bark to access the phloem.

- A. Entrance
- B. Filling of larval galleries
- C. Larval gallery
- D. Maternal gallery
- E. Larva excavating
- F. Phloem



Larvae in 4th stage, pre-pupae and pupae of *T. destruens*

LEVELS OF DAMAGE

Two types of damage should be distinguished, with different management approaches.

EXTENSIVE DAMAGE, in forest areas. The following grades of damage have been suggested:

Grade 0: Stand with some dead trees, possibility of rejected attacks.

Grade 1: Stand with dispersed dead trees.

Grade 2: Stand with dead trees and some small dispersed stands.

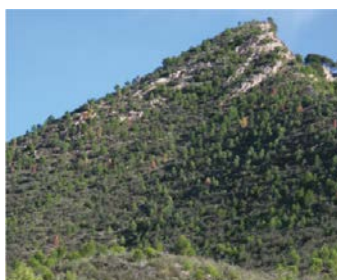
Grade 3: Stand with clear evidence of large sites or lots of small sites with a tendency for mass death.

Grade 4: Mass death.

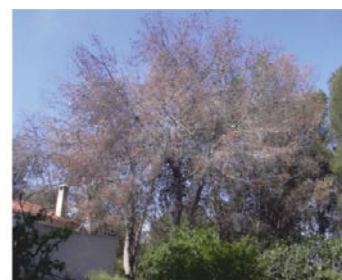
LOCALISED DAMAGES, in areas of public use, parks and gardens.

Grade 0: Death of some roots and rejected attacks in others.

Grade 1: Death of less than half of the trees.



Extensive damage, grade 1



Localised damages of *T. destruens*, grade 2

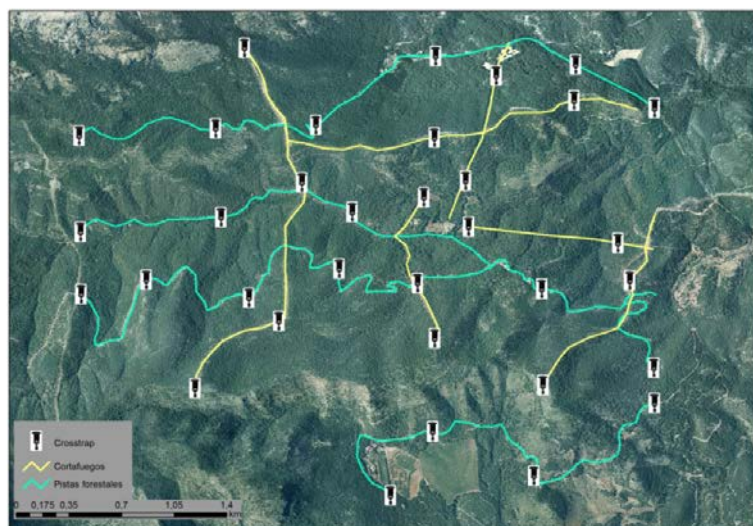


Extensive damage, grade 2



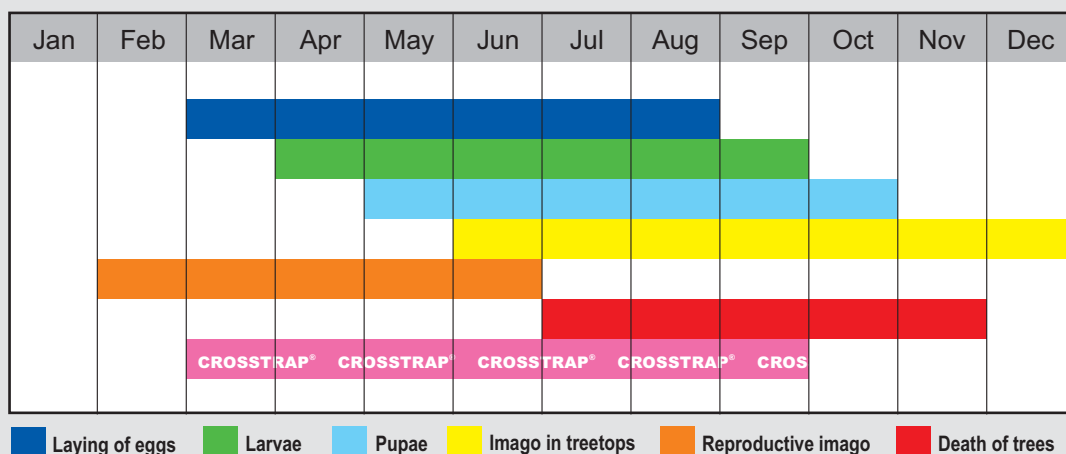
Extensive damage, grade 2

As a minimum, it is recommended that captured insects be collected fortnightly.



Example of the installation of traps for the DETECTION AND MONITORING of *T. destruens*, in a forest area of 1500 ha, with 35 traps installed following forest trails and fire-breaks with a distance of 1000 m between traps.

Phenology of *Tomicus piniperda*



Installation of CROSSTRAP® MINI traps



EXHAUSTIVE MONITORING

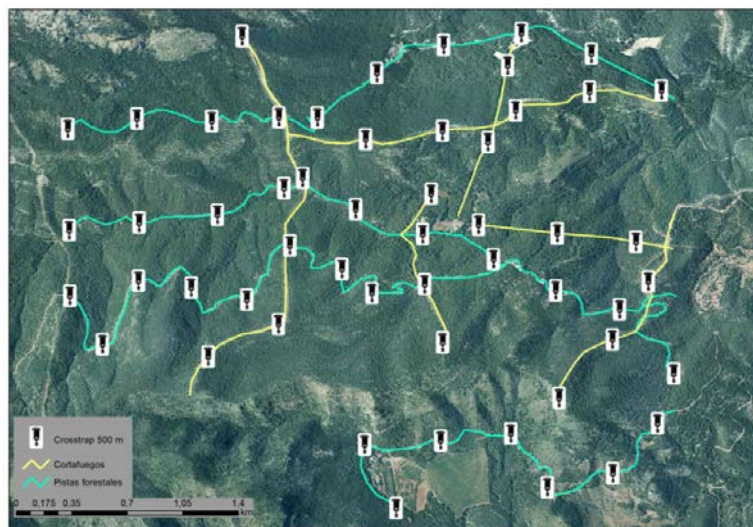
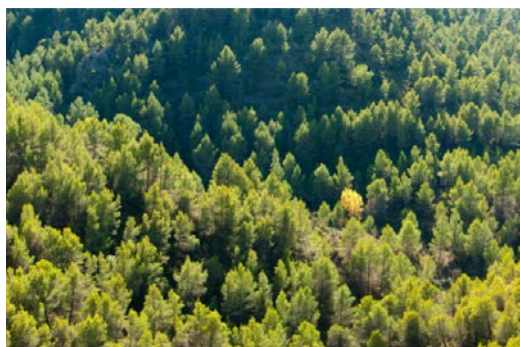
In forests

To intensify monitoring, the traps should be placed at a distance of 100 and 500 metres apart, following forest trails, fire-breaks or the edges of the forest.

The amount of traps can rotate between 0, 3 and 3 **CROSSTRAP® MINI traps per ha**. They can also be installed inside the forest, provided that the forest is not too dense. **For exhaustive monitoring dry (live) captures are recommended**, using the collection cup with a stainless steel mesh and a slippery film.

This collection cup prevents the beetles from escaping, as they cannot climb up due to the slippery film. But, it allows the entrance and exit of the predator *Thanasimus formicarius*, which eats the captured insects.

In this way, it minimizes the impact of trapping non-target species.



Example of the installation of traps for the EXHAUSTIVE MONITORING of *T. destruens*, in a forest area of 1500 ha. 55 traps have been installed following forest trails and fire-breaks with a distance of 500 metres between traps.

In parks, gardens and residential areas

The management of *Tomicus* in parks and gardens presents some peculiarities that differentiate it from management in forests. The biggest risk of attack on ornamental trees is the one induced by mechanical damages. Work involving excavation around the trees destroy the roots, often causing a weakening that facilitates the attack by *Tomicus*. In general, the ornamental trees are not very susceptible to attacks by *Tomicus*, provided that they maintain the conditions in which they grew up in. Sometimes putting or taking away irrigation in garden areas can provoke attacks by these insects.

Controlling *Tomicus* in these circumstances should be very effective, given that it is about reducing the mortality rate of trees to zero. Therefore, efforts should be made to intensify trapping to the maximum, so that **a density of 3 CROSSTRAP® MINI traps per hectare can be used**. They should be controlled weekly.



Example of the installation of traps to control *T. destruens* in an urban area with public parks with pine trees present (0,8 ha), with 4 traps installed in selected areas.

NECESSARY MATERIAL

CROSSTRAP® MINI TRAPS

The **CROSSTRAP® MINI** trap is the latest generation in forest traps. This trap is product of an R & D project (University of Murcia – Econex) aimed at developing traps and attractants for forest pests.

The trap consists of a polypropylene lid, 33 cm in diameter with a central carabiner attached to a steel spring. Two reinforced PVC sheets are held in place by four steel springs in the lid's upper section, serving as shock absorbers against strong winds. This helps to avoid damage to the trap. In the lower section, the reinforced PVC sheets are held in place by a polypropylene funnel, 30 cm in diameter and four steel springs. The collection cup for the captured insects is in the lower section of the funnel and is attached by metal screws.

The PVC sheets, funnel and collection cup are treated with a slippery film to significantly increase captures and prevent the pests from escaping.

The unfolded trap measures 33 cm in diameter and 100 cm in height. Once folded the trap measures 33 cm in diameter and 40 cm in height, making it easier to transport.

The CROSSTRAP® can last up to 7 years due to its highly resistant components

The trap can be used with two types of collection cup: **collection cup for wet captures** (CROSSTRAP® WET COLLECTION CUP) and **collection cup for dry or live captures** (CROSSTRAP® DRY COLLECTION CUP).

The **CROSSTRAP® DRY COLLECTION CUP (Code: TA157)** has approximately a 2 litre capacity (12,5 cm diameter x 19 cm height) and is supplied with a stainless steel mesh that drains away rainwater 100% and provides excellent air circulation for dry (live) captures.

The **CROSSTRAP® WET COLLECTION CUP (Code: TA156)** has the same capacity and measurements as the CROSSTRAP® DRY COLLECTION CUP and a drain in the upper section to prevent it from filling with rainwater.



CROSSTRAP® MINI
trap



Collection cup for dry (live) captures



Collection cup for
wet captures

POSITIONING AND USE: The trap should be suspended horizontally with a rope in-between two trees or from one of the branches, taking care that the trap does not come into contact with the tree trunk. In this way, the trap does not knock against the tree and break, therefore ensuring that the insects are able to distinguish the trap from the tree trunk and go to the trap.

The trap is activated by placing the attractant diffusers hung in the holes of one of the PVC sheets with the clips provided.

The height of the installed trap is not of importance, as long as the collection cup does not touch the ground or any other object. A metal support designed specifically for this purpose is also available: **ECONEX CROSSTRAP® SUPPORT** (Code: TA147).



ECONEX CROSSTRAP® SUPPORT.
Special iron support sold in 2 pieces, which are assembled before placing in the forest.

TYPES OF CROSSTRAP®



**CROSSTRAP®
WITH DRY
COLLECTION CUP**
(Code: TA132)

**CROSSTRAP®
WITH WET
COLLECTION CUP**
(Code: TA227)

The **CROSSTRAP®** trap has the same characteristics as the **CROSSTRAP® MINI** trap, varying only in the height of the trap.

The unfolded trap measures 33 cm in diameter and 146 cm in height. Once folded the trap measures 33 cm in diameter and 40 cm in height.



**CROSSTRAP® MINI
WITH DRY
COLLECTION CUP**
(Code: TA204)



**CROSSTRAP® MINI
WITH WET
COLLECTION CUP**
(Code: TA226)

ATTRACTANTS

ECONEX TOMICUS DESTRUENS (Code: VA250)

The product contains two kairomonal attractant diffusers with 60 days duration.

Diffuser A, contains 25 ml of α -pinene with 98% purity. The release rate is 0,3 g per day at 20° C.

Diffuser B, contains 100 ml of ethanol with 96% purity. The release rate is 2 g per day at 20° C.



Packaging and diffuser A

ECONEX TOMICUS PINIPERDA (Code: VA188)

The product contains two kairomonal attractant diffusers with 60 days duration.

Diffuser A, contains 25 ml of α -pinene with 98% purity. The release rate is 0,3 g per day at 20° C.

Diffuser B, contains 100 ml of ethanol with 96% purity. The release rate is 2 g per day at 20° C.

Once extracted from the package (metal envelope) **the diffusers do not need to be activated**, simply placed correctly in the trap using the lateral holes on one of the vanes.



Packaging and diffuser B

REPELLENTS

ECONEX TOMICUS REPELLENT (Code: VA308)

Tomicus repellent diffuser with 120 days duration.

Diffuser with benzyl alcohol, containing 100 ml of product. This product acts as a repellent for *T. destruens*, having shown a reduction in captures of between 70% and 80% in traps baited with the *T. destruens* attractants and these diffusers, compared to the same traps without this repellent.

Its recommended use is for the protection of individual trees at high risk in parks, public or private gardens, as well as unique and protected trees.

To optimise its efficiency, it is recommended to install a **CROSSTRAP® MINI** trap baited with the kairomonal attractant **ECONEX TOMICUS DESTRUENS** close to the trees that need to be protected. A minimum distance of 20 m must be maintained between the trees and the trap, to ensure the insects go to the trap and not to the protected trees.

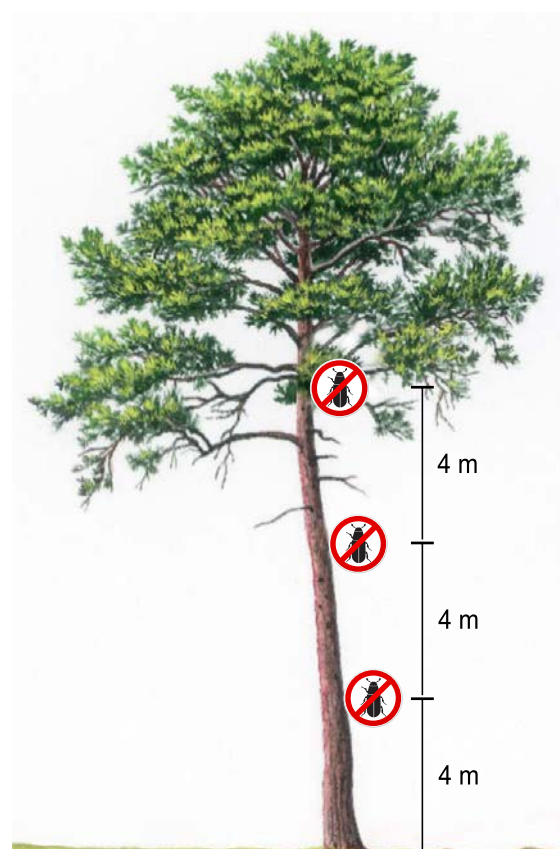


Diagram showing the installation of the ECONEX TOMICUS REPELLENT diffusers protecting a tree that is about 20 m high.

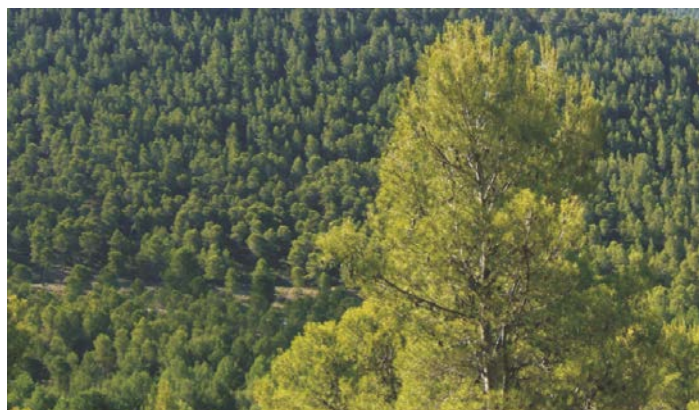
A diffuser should be installed every 4 linear meters of the tree trunk, until the bark becomes thinner. The diffusers will be installed by nailing them to knots or other areas of dead wood in the tree.

Example of the installation of repellents and traps for the protection of individual trees against *T. destruens* in an outdoor garden.
The distance between the trap and the tree with repellents is 50 m.



FACTORS THAT INFLUENCE IN THE NUMBER OF TRAPS REQUIRED

In forests, the number of traps are determined by the area that needs to be covered and the network of paths, fire-breaks and accessible edges. For intensive monitoring a density of between **0, 1 and 0, 3 CROSSTRAP® MINI traps per hectare** are recommended, separated between 100 and 500 lineal metres. The use of a GPS is recommended during the installation.



In parks, private gardens, recreational areas, public gardens or smaller forest areas (<5 ha), the density of traps can be greatly increased, using **3 CROSSTRAP® MINI traps per hectare**.

In these places, the death of one tree alone is shocking enough to intensify trapping, so that it can capture the maximum amount of insects possible.



CROSSTRAP[®] DETECTION

AN EARLY DETECTION SYSTEM OF FOREST INVASIVE SPECIES

Tomicus destruens
Orthotomicus erosus
Hylurgus ligniperda
Dendroctonus micans
Monochamus galloprovincialis
Xyleborinus saxesenii
Etc...



AUTHOCHTONOUS AND INVASIVE SPECIES OF FOREST INSECTS



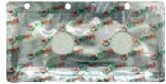



The exotic invasive species represent one of the greatest threats to biodiversity. Infested Roundwood, packaging and storage timber have been the vehicle that has allowed the invasion of many species of bark beetle, or pathogens vectorised by them. The NIMF15 normative has tried to put a stop to these invasions, although a constant vigilance to detect invasive species is necessary.

Amongst these species the perforating coleopterons are highlighted, which are frequently intercepted in ports all over the world. In accordance with Rassati et al (2014), the development of early detection methods is a crucial step when rapid response programmes are implemented, so that these exotic species can be rapidly detected/identified and the plans of action can be applied in time.

For this purpose, it is essential to have a tool with enough plasticity to attract and capture the largest number of species possible. The **CROSSTRAP® DETECTION** system is made up of a **CROSSTRAP® MINI** baited with kairo-pheromonal attractants *a-pinene*, *Ethanol*, *Ipsdienol* and *Ipsenol*. This system is capable of attracting a large number of species (Gallego and Campo, 2010). Its versatility also allows live captures (with dry collection cup) or wet captures (collection cup for wet captures).

COMPONENTS AND FUNCTIONALITY OF THE CROSSTRAP® DETECTION SYSTEM

Device	Imitation	Attraction
 CROSSTRAP® MINI TRAP	Shape and colour of the trunk of a tree.	Community of Scolytidae and saproxylic beetles.
DIFFUSER A a-pinene lure 	Anaerobic metabolism in vegetable tissues. Microbial fermentation of vegetable tissues.	Aggressive species of Scolytidae. Types of ambrosia beetle.
DIFFUSER B Ethanol lure 	Activation of the induced defenses in trees, via external aggression, with monoterpene, insecticides and fungicides synthesis. It can work synergised with ethanol.	Less aggressive species of Scolytidae. Community of phloem-xylophagous insects.
DIFFUSER C Ipsenol-Ipsdienol lure 	Aggregation pheromones from some Scolytidae, produced in the process of attack and colonisation.	Scolytidae from the Ipinae tribe, community of predators, parasitoids and intra-guild predators.

EARLY DETECTION OF FORESTS PESTS

For the early detection of invasive species, at least 1 baited **CROSSTRAP® MINI** trap should be installed in areas of high risk from exotic species of sapro-xylophagous and beetles entering, such as, Border Inspection Points, Customs warehouses, ports or airports with transport of goods.

For early detection, **it is recommended to opt for wet captures**, given that it allows for the precise identification of the specimens. For this, the collection cup must be filled with 10 ml of propylene glycol diluted to 10 or 20%. As an alternative, car antifreeze can also be used. This liquid is used to kill the captured insects and preserve them, as long as the antifreeze does not get too diluted by the rain. If it does get diluted it must be replaced. It is recommended, as a minimum, that the captures be collected fortnightly.

The traps can be installed in open areas inside the facilities, hanging from artificial or natural supports. It is also recommended to install **between 1 and 10 traps** in forests closest to the areas studied, in order to increase the efficiency in detection. Once they get diluted it must be replaced. It is recommended, as a minimum, that the captures be collected fortnightly.

MONITORING FOREST INSECT COMMUNITIES

The **CROSSTRAP® DETECTION** system can also be used for monitoring species and communities of sapro-xylophagous forest insects (in a general sense) in forests.

This system is currently being used in the quality monitoring and forest health networks set up in three Spanish Autonomous Communities; the ESFP network (Autonomous Community of the Region of Murcia), the MUFFET network (Government of Autonomous Community of Valencia) and the Balearic Network of evaluation and monitoring of forest damages (Government of the Balearic Islands).

This type of monitoring is based on the set-up of networks of low density trapping: one point in each type of ecosystem, in order to cover the biggest part of environmental variability of the area of study.

The sampling areas are carried out with continuous registers of temperature and rainfall and band dendrometers. These networks carry out periodic controls, generally monthly to collect the captured insects and download the information.



Location of the sampling areas in the ESFP network in Murcia

NECESSARY MATERIAL

CROSSTRAP® MINI WITH WET COLLECTION CUP trap (Code: TA226)

(Description of the CROSSTRAP® traps on pages 14-15)

CROSSTRAP® DETECTION KIT (Code: VA309)

The product consists of 3 kairo-pheromonal attractant diffusers, **A**, **B** and **C**, with 60 days duration. They are individually packaged in poly laminated aluminium bags.

DIFFUSER A, contains 25 ml of α -pinene with 98 % purity. The rate of release is 0.3 g a day at 20 °C.

DIFFUSER B, contains 100 ml of ethanol with 96 % purity. The rate of release is 2 g a day at 20 °C.

DIFFUSER C, contains 0.2 ml of Ipsenol/Ipsdienol (1:1) with 96 % purity. The rate of release is 2 mg a day at 20 °C.



Packaging and dispenser A



Packaging and dispenser B



Packaging and dispenser C





Orthotomicus erosus

www.orthotomicuserosus.eu

ORTHOTOMICUS EROSUS · Mediterranean pine engraver beetle

The *Orthotomicus erosus* (Wollaston, 1857) belongs to a genus made up of 24 species of Palearctic and Paleotropical distribution that attack many species of trees. *Orthotomicus erosus* is a bark beetle that mainly attacks the *Pinus* species, although it has also been sighted on *Cupressus*, *Picea*, *Cedrus libani*, *Abies pinsapo* and *Pseudotsuga menziesii*. It is distributed in a natural manner through circummediterranean Europe, central Europe, the British Isles, North Africa, central Asia and China. *O. erosus* is considered an invasive exotic species that has introduced itself into South Africa, Chile, Uruguay, Fiji Islands, USA and other islands of the Pacific.

In general, it is considered a secondary species that attacks very weak trees, but it can also attack live trees in states more or less at the beginning of deterioration or extremely stressed out. The causes of this stress tend to be the extreme lack of water due to drought or fires. Also, blue stain fungi can vectorise, like *Ophiostoma* or *Leptographium* (Kirisitis, 2004) or other pathogens, such as, *Fusarium calmorum* (Romón et al, 2007) or *Sphaeropsis sapinea* (Zwolinski, 1995).

BIOLOGY

This species can produce more than three generations a year depending on the temperature. It is a polygamous species, meaning that its biological potential is enormous in the Mediterranean areas where the temperature is high in summer.

The male excavates the entry point and the nuptial chamber, emitting aggregative pheromones which attract many females, normally three. The pregnant females excavate the maternal gallery leaving the nuptial chamber and following the longitudinal axis of the tree. The males remove the sawdust from the maternal galleries.



Male



Female

When the larvae are born, they begin to feed on the phloem creating sinuous galleries very close to each other at the beginning. As the larvae continue to grow the galleries increase their diameter and separate from one another.

The larval galleries are full of compacted sawdust and excrement, product of the food supply, while the maternal galleries remain clean. When the larva reaches its maturity, it excavates a pupa chamber where it transforms into an imago. It emerges on the outside through a hole that it has perforated in the bark after a period of maturity on the inside of the pupal chamber.

The duration of the larval period is variable. Normally, a week passes from the eggs laying to the eggs hatching if the temperature is between 15 and 25°C. The larval period lasts about 20 days and the pupa one week. So normally, the cycle is completed in about 35 days. Exceptionally, it can be completed in 15 days if the conditions are favourable.

The new imagoes come out ready to start the cycle again. When the temperatures start to lower, between the months of September and November, the adults group together in the winter galleries, where they get through the coldest months.



© François Maugard, Département de la Santé des Forêts, Bugwood.org

These winter galleries have a different shape that are more irregular. Grouping can cause the bark to lift up and detach itself. Its activity begins again when the temperature rises, beginning a biological cycle again.

DETECTION AND MONITORING

In forests **1 CROSSTRAP® MINI trap per 20 ha should be installed**, the traps should be separated at least 1000m from each other. **In surfaces less than 20 ha at least 1 trap should be installed per forest stand.**

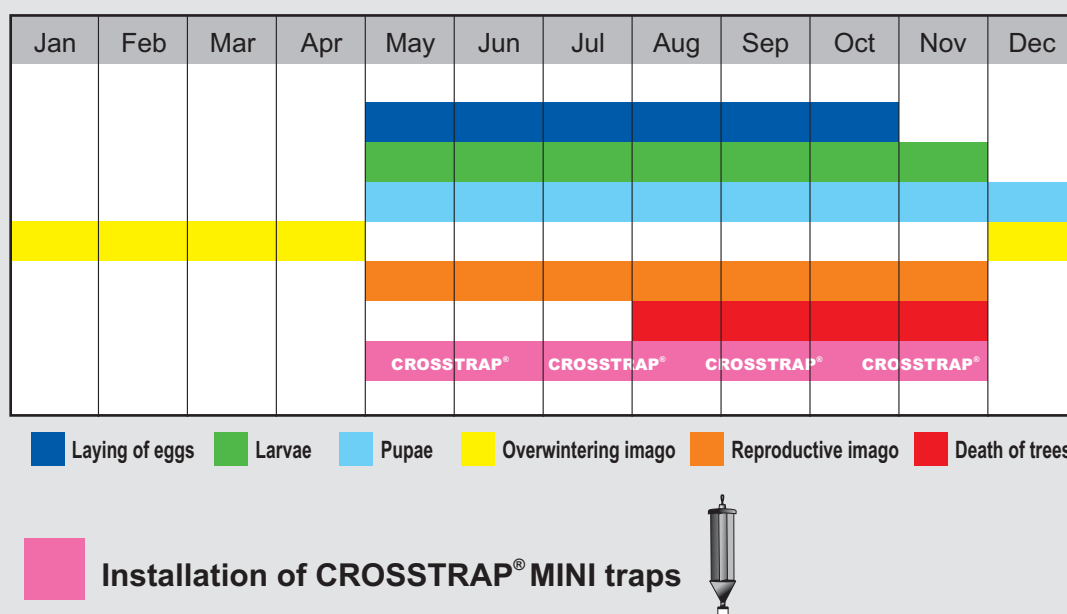
The traps should be installed in areas with good visibility, such as edges of the forest, forest paths or fire-breaks. Especially windy areas should be avoided, as it makes it difficult for the insects to fly and could damage the traps.

A detection trap should cover the environmental changes of the target forest area. In general, the traps should be installed and operative between May and October.

For monitoring it is recommended to choose wet captures, given that it will allow the precise identification of the captures. For this purpose, the collection cups can be filled with 10 ml of diluted propylene glycol at 10% or 20%, or anti-freeze for the car could be used.

This liquid is used for killing the captured insects as well as preserving them, as long as, it does not get too diluted by the rain, in which case it should be replaced. As a minimum, it is recommended that captured insects be collected fortnightly.

Phenology of *Orthotomicus erosus*



EXHAUSTIVE MONITORING

To intensify monitoring, the traps should be placed at a distance of between 100 and 500 metres apart, following forest trails, fire-breaks or the edges of the forest.

The amount of traps can rotate between **0,3 and 3 CROSSTRAP® MINI traps per ha**. They can also be installed inside the forest, provided that the forest is not too dense. **For exhaustive monitoring dry (live) captures are recommended**, using the collection cup with a stainless steel mesh and a slippery film.

NECESSARY MATERIAL

One **CROSSTRAP® MINI** trap and an **ECONEX ORTHOTOMICUS EROSUS 60 DAYS** pheromone diffuser (**Code: VA189**) which will be hung on the trap using one of the holes made for this purpose in one of the PVC sheets.

(Description of the **CROSSTRAP®** traps on pages 14-15)



Pheromone diffuser **ECONEX ORTHOTOMICUS EROSUS 60 DAYS** and package presentation of the product.

ECONEX ORTHOTOMICUS EROSUS 60 DAYS is a blister-shaped diffuser, with a duration of 60 days in field conditions and it is individually wrapped in an aluminium sachet with labelled specifications.

DAMAGES AND ELEMENTS OF DIAGNOSIS

The larval galleries made by the larvae when they feed cut the circulation of water and nutrients in the tree. As a general rule, *Orthotomicus erosus* attacks very weak, but still living stems.

On occasions, and in areas where the forest is much debilitated, primary insect behaviour has been detected. That is to say, that they are capable of colonising apparently healthy trees.

The affected pines initially turn yellow on the upper part of the crown, until finally reaching the lower branches of the tree. The dark sawdust is very obvious having been evacuated from the galleries in mass attacks.

Orthotomicus erosus is a transmitter of blue stain fungus, apart from the direct damage to the tree, it causes losses to the wood.



Ips sexdentatus

www.ipssexdentatus.eu

IPS SEXDENTATUS · Ips engraver beetle

The *Ips* genus is comprised of 36 species distributed throughout North America, Europe and Asia, having been introduced into Australia and Africa (Faccoli, 2004 & Sun, 2007), of which 14 species are distributed throughout the Palearctic region (Knizek, 2011).

Amongst the *Ips* species are some of the most aggressive of bark beetles. On the Iberian Peninsula 4 species are distributed, amongst which *Ips sexdentatus* is found, the biggest bark beetle of all European fauna.

This species has on occasion been considered primary or aggressive, capable of killing trees in the initial stages of deterioration, of the species *Pinus sylvestris*, *P. radiata*, *P. nigra* and *P. pinaster*. It has also been sighted on *Pseudotsuga menziesii* and some species of *Abies*, *Picea*, *Cedrus* and *Larix*.

BIOLOGY

It has three generations annually. In each generation the females can lay eggs during two or three consecutive periods, leading to various sister generations.

It is a polygamous species in which the male is the pioneer in colonisation, making an entrance hole in the tree trunk that leads towards the chamber beneath the cortex, where mating takes place (nuptial chamber).

The average amount of females that enter in each mating chamber are four. After mating, all of the females start excavating a gallery in which the egg-laying will take place staggered and on both sides, depositing between 10 and 60 eggs.

At the beginning of May, the first nymphs and immature adults can be observed. Once they have reached their sexual maturity, they begin to look for new places to lay eggs. In this way, a second and third generation begin and they develop throughout the summer.

The first flight period can last up to two months, producing up to three sets of laid eggs that will produce three sister generations, so it is possible to find larvae and imagoes of this insect all year-round.

The initial period of flight and the number of generations can vary annually depending on the temperature, so that in favourable years a fourth sister generation can exist, although with few individuals.

The minimum period that an egg needs to reach adulthood is four weeks. This occurs between the middle of July and middle of August.



Developed larvae



Pupae

DETECTION AND MONITORING

In forests **1 CROSSTRAP® MINI trap per 20 ha should be installed**, the traps should be separated at least 1000m from each other. **In surfaces less than 20 ha at least 1 trap should be installed per forest stand.**

In order to protect little stands or wood stockpiles use from 3 to 10 traps surrounding the area. The traps should be installed in areas with good visibility, such as edges of the forest, forest paths or fire-breaks. Especially windy areas should be avoided, as it makes it difficult for the insects to fly and could damage the traps.

A detection trap should cover the environmental changes of the target forest area. In general, the traps should be installed and operative between the middle of March and middle of November.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Laying of eggs	Laying of eggs	Laying of eggs	Laying of eggs	Laying of eggs	Laying of eggs	Laying of eggs	Laying of eggs	Laying of eggs	
		Larvae	Larvae	Larvae	Larvae	Larvae	Larvae	Larvae	Larvae	Larvae	
				Pupae	Pupae	Pupae	Pupae	Pupae	Pupae	Pupae	Pupae
Overwintering imago	Overwintering imago										Overwintering imago
		Reproductive imago	Reproductive imago	Reproductive imago	Reproductive imago	Reproductive imago	Reproductive imago	Reproductive imago	Reproductive imago	Reproductive imago	
				Death of trees	Death of trees	Death of trees	Death of trees	Death of trees	Death of trees	Death of trees	Death of trees
		CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	

■ Laying of eggs
 ■ Larvae
 ■ Pupae
 ■ Overwintering imago
 ■ Reproductive imago
 ■ Death of trees

Installation of CROSSTRAP[®] MINI traps

To intensify monitoring, the traps should be placed at a distance of between 100 and 500 metres apart, following forest trails, fire-breaks or the edges of the forest.

Ips sexdentatus usually behaves like a secondary species, attacking recently dead trees, such as newly felled, or much damaged trees made by fires. On occasions it can also behave like a primary or aggressive species, attacking supposedly healthy trees, but having some sort of decay.

The attacked trees are not very recognisable, only because of the piles of sawdust evacuated from the galleries and, on occasions, the volcanoes of resin in relatively healthy trees. When the destruction of the phloem is well advanced the crown begins to turn yellow, so they are easily distinguished from those that weren't attacked.

This species is also important because it vectorises blue-stain fungi, such as, *Ophiostoma* or *Leptographium* (Kirisits, 2004), also it includes pathogens like *Ophiostoma minus* and *O. ips* (Romón et al, 2007).



© Eudaldo González

Volcanoes of resin



Entrance hole



Typical subcortical galleries



Monochamus galloprovincialis

www.monochamusgalloprovincialis.eu

MONOCHAMUS GALLOPROVINCIALIS · Pine sawyer beetle

The Cerambycid or Longhorns are a family of beetles with strictly phytophagous habits, which highlight in importance the species that feed on woody vegetable tissue.

The *Monochamus* genus (Coleoptera, Cerambycidae) is part of the Monochamini tribe, made up of more than 600 species grouped into nearly 100 types. It is about a family with phytophagous habits, being of forest interest many species that feed on woody vegetable tissue, the large majority of them are in the group of saproxylics. These species play very important roles in the forest ecosystem and are key parts in the material and energy cycles in the forests.

The *Monochamus* genus is composed of some 150 species distributed all over the world, mainly living in Equatorial Africa, where numerous species attack the coffee and cocoa. In the temperate forests of the Holarctic region, the *Monochamus* species live on top of conifers.

With regards to the Iberian Peninsula, two species of the genus can be found: *Monochamus sutor* (Linneo, 1758) and *M. galloprovincialis* (Olivier, 1795). *M. sutor* is a Palearctic species that reaches as far as Japan, but rare in Spain considering that it only distributes in the Pyrenees. The second species, *M. galloprovincialis*, is much more common and is found in the Mediterranean basin, central Europe, Caucasus, Siberia, Mongolia and China. On the Iberian Peninsula it lives on practically all of the *Pinus* species, including *Abies* and *Picea*. Some evidence indicates that on the Iberian Peninsula they show a low preference for *Pinus pinea*.

BIOLOGY

The adults gnaw at the bark and the phloem of the growing twigs and the larvae feed on phloem-xylem tissue. None of the species from the *Monochamus* genus reproduce in healthy trees.

They only feel attracted to very stressed-out, dying or recently dead trees and also newly chopped down trees, favoured by previous attacks from Ips beetles (*Orthotomicus* and *Ips*).

In fact, the kairomonal bait used to attract them is composed of kairomones produced by the host tree and kairomones produced by the bark beetles that attack the tree, mainly Ipsenol.



When *Monochamus* colonise these trees with a previous population of bark beetle established, it then acts as an *intraguild predator*.

This means that the *Monochamus* larvae feed on the phloem and beetle larvae that they find in it, without distinction. This extra protein contribution is very likely to give the larvae a certain advantage over those that do not eat them, (Mas, 2016).

The female lays eggs in openings or bite marks, excavated in the bark of dying trees.

The larvae, apodous, are more or less cylindrical and have a thickening on the cephalic segments that partially hide the head. They initially feed on phloem and cambium to later enter into the xylem and build a U-shaped gallery that becomes a pupa chamber, where they emerge through a circular hole. Once the young adult has surfaced, it goes through a period of sexual maturity, in which it feeds on brachyblasts, phloem, and tender bark from small branches and pine shoots.

Monochamus galloprovincialis is a non-aggressive insect that contributes important benefits to the function of the forest ecosystem and it would not be of much interest were it not for the fact that *Monochamus galloprovincialis* was identified as the vector for the Pine Wilt Nematode (PWN). The disease was produced by the *Bursaphelenchus xylophilus* (Sousa et al. 2001) and is currently the main vector of the disease on the Iberian Peninsula. Interaction between the two organisms is a relationship of mutual interest, obligatory for the nematode and facultative for the beetle. It is like that because the nematode needs the beetle for its transport and dispersal. The beetle benefits from the death of the forest caused by the nematode because it means an increase in host material where they can lay their eggs.



Bursaphelenchus xylophilus is a pest introduced into European territory in 1999 when it was detected in the Setubal Peninsula, in Portugal. Since then, it has spread out so much so, that it has currently been declared a demarcated area in practically all of continental Portugal.

Since 2008, four recordings of PWN have been detected in Spain. All of them near the Portuguese border, three of them distributed in the Cáceres province and one in Pontevedra. Three of them are considered to be under control and one completely eradicated.

Worldwide, only seven species of the *Monochamus* genus have shown to be effective in transmitting *B. xylophilus*: *M. carolinensis*, *M. mutator*, *M. scutellatus* and *M. titillator* in North America; *M. alternatus* and *M. saltuarius* in Northeast Asia and *M. galloprovincialis* in Europe.

Therefore, one of the fundamental tools for the control of the disease is the control of its vector, seeing as it is the only method of transmitting the nematode from one tree to another.

DETECTION AND MONITORING

Work carried out in the framework of the REPHRAME European Project have revealed that the most effective trap in capturing *Monochamus galloprovincialis* is the CROSSTRAP® (Álvarez et al, 2014), including the live capture of this insect. Capturing live insects is the best way to evaluate if they carry nematodes, given that when the insect dies, the nematodes abandon the insect.

For the detection and monitoring of *Monochamus galloprovincialis* in areas free of the nematode, **1 CROSSTRAP® trap will be installed every 20 ha** in forests. They should be separated at least 1000 m from each other. **In surfaces less than 20 ha at least 1 trap should be installed per forest stand.**

In order to protect wood stockpiles, use 3 to 10 traps surrounding the area. The traps should be installed in areas with good visibility, such as forest edges, forest paths or fire-breaks. Especially windy areas should be avoided, as it makes it difficult for the insects to fly and could damage the traps.

In general, the traps should be installed and operative between April and December.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®	CROSSTRAP®

■ Laying of eggs
 ■ Larvae
 ■ Pupae
 ■ Adults in flight

■ Installation of CROSSTRAP® traps



One **CROSSTRAP® TRAP** and the kairomone diffusers **ECONEX MONOCHAMUS ATTRACTANT (Code: VA195)** which will be hung on the trap using one of the holes made for this purpose in one of the PVC sheets.

The diffusers have a blister-pack shape, with a duration of 60 days in field conditions. They are packaged in aluminium sachets with labelled specifications.



Kairomone diffusers **ECONEX**
MONOCHAMUS ATTRACTANT and
package presentation of the product



Cerambyx spp.

www.cerambyx.eu

CERAMBYX SPP. · Great capricorn beetle

Cerambyx is a genus of coleopterons belonging to the Cerambycidae family. It comprises of around 35 species distributed in the Western Palearctic zone. In Europe there are seven species: *C. carinatus* (Küster, 1846); *C. cerdo* (Linnaeus, 1758); *C. dux* (Faldermann, 1837); *C. miles* (Bonelli, 1823); *C. nodulosus* (Germar, 1817); *C. scopoli* (Füsslin, 1775) y *C. welensii* (Küster, 1846). On the Iberian Peninsula only three species can be found; *C. welensii*, *C. cerdo* and *C. miles*.

It is about large sized coleopterons, able to surpass 5cm in length, without counting the antennae. The morphology of the three Iberian species is very similar and a detailed examination of certain structures to be able to differentiate them is needed, which has led to confusion in numerous references. In accordance with Vives (2001) *C. cerdo* is the most common species on the Iberian Peninsula, being present in all the Holm-Oaks and Oaks, including the ones in Majorca. *C. welensii* has a more restricted distribution, being present in the Baetic mountain range, the Sierra Morena mountain range, the Central System, Alentejo and Algarve, the Galaico-Leoneses mountain range, the Cantabrian mountain range, the Pyrenees, the Ebro Valley and the Iberian System.

BIOLOGY

The biology of both species is very similar. The adults are active during twilight, although in accordance with (González et al, 2015), in Majorca, *C. cerdo* seems to be more active during daylight. After copulation, the females place the eggs under the bark of the trunk and the thickest branches of various species of leafy trees, such as, *Fagus*, *Castanea* and *Ulmus*, although they are more often found on any species of *Quercus*. They have also occasionally been cited on *Corylus* and *Ceratonia*.

After hatching, the larvae begin to feed on the bark, entering later on in the wood to stay there for two or three years, until reaching a very large size, up to 7cm. Meanwhile, each larva would have excavated a good number of elliptical section galleries of great size.



Female of *C. cerdo* laying eggs



Galleries excavated by *C. cerdo*

When the larva goes to change its stage to pupa, it excavates an exit hole in the tree. Afterwards, it returns to the gallery on the inside of the wood to pupate in safety with sufficient protection. The pupa hatches in autumn, but the imago remains in the gallery throughout winter until it emerges at the beginning of summer.

DAMAGES AND ELEMENTS OF DIAGNOSIS

The adults can be observed licking the exudation from the tree canker in trees, generally affected by wounds through bad pruning. The adults place the eggs close to these open and exuding wounds, as a way of accessing its main food resource, the xylem.

The infested trees with initial attacks do not show any symptoms whatsoever. As the population and size of the larvae increases, so does the build-up of sawdust. After the first emergence of the adults, the exit holes and a large abundance of sawdust are clearly observed. These insects can carry on reproducing or years on the same trees, given that the larvae feed on the xylem, not delivering a direct and immediate death to the tree.



Tree heavily affected by *C. cerdo*



Emergency hole for the adult

The crown of the affected tree, or a part of it only affects a thick branch, it starts losing its vigour and defoliation becomes more obvious as the years go by. With the destruction of the xylematic veins the amount of water going to the crown of the tree decreases and it reacts by reducing its number of leaves.



But a tree in these conditions can last for many years. The trees affected by *Cerambyx* tend to die for another reason, induced by the loss of biomechanical resistance of the wood perforated by the larvae. This silent loss of resistance accumulates until it produces a tear from the main system of foliage.

In fact, the branches that break are the larger ones, given that they weigh more. Sometimes the trees split lengthways through the middle, literally. Therefore, it's about a slow process, hidden and silent, that takes many years to manifest itself, given that it is a build-up and that, in an instant it can end the life of a one hundred year old tree.



These attacks are of great importance in the open woodlands and Cork Oak stands of occidental Andalusia, Extremadura and the Holm Oak forests of the Balearic Islands.

One detail to take into account is that the *Cerambyx cerdo* species is protected in the European Union by being included in the Berne Convention, annex 2: "Strictly protected species" by the Habitats Directive in the annexes 2: "Species of community interest" and 4: "Species subject to strict protection" and classified as Vulnerable by the IUCN - International Union for Conservation of Nature.



ECONEX CERAMBYX 60 DAYS

Detection and monitoring

In forests **1 or 2 CROSSTRAP® XYLOPHAGOS traps per hectare** should be installed. The baited traps should be present in the forest between June and August, depending on the target species.

Monitoring efforts can be intensified by placing up to 3 traps per hectare, with distances between traps from 100 to 500 m. The traps will be installed on trees with signs of attack, for which the presence of exit holes and sawdust at the base of the trees have to be looked at especially.

Dry captures are recommended and a weekly or fortnightly assessment of the traps to avoid interfering with the wildlife.

Necessary material

A trap **CROSSTRAP® XYLOFAGOS (Code: TA196)** and a kairomone diffuser **ECONEX CERAMBYX 60 DAYS (Code: VA303)** to be hung in the trap using the holes made for this purpose in one of the PVC sheets.

The CROSSTRAP® XYLOFAGOS trap is a trap designed especially for the capture of insects that walk on the barks of trees, capable of adapting to the perimeter of the tree trunk due to its flexible funnel.

The trap consists of a soft funnel that is 30cm in diameter, connected to the collection cup. On the side of the trap, in contact with the tree, a cellular polypropylene sheet is placed and folded in the shape of a vertical cover. The trap is fixed to the tree with two nylon cords. The lower cord holds the trap and joins together the cellular polypropylene sheet and the funnel through a series of perforated holes and grooves in the cellular polypropylene sheet. The upper cord is used to maintain the sheet attached to the tree.

The cellular polypropylene sheet also has drilled lateral holes to hang the attractants, such as ECONEX CERAMBYX 60 DAYS.

The sheets, funnel and collection cup are treated with a slippery film to significantly increase captures and prevent the pests from escaping.

The trap can be used with two types of collection cup: collection cup for wet captures (CROSSTRAP® WET COLLECTION CUP) and a collection cup for dry (live) captures (CROSSTRAP® DRY COLLECTION CUP).

(Description of the CROSSTRAP® COLLECTION CUPS on page 14).

POSITIONING AND USE: Choose a part of the tree that is straight enough with no branches or large knots. Allow maximum contact of the funnel and the cellular polypropylene sheet with the surface of the tree. Hang at a height of 120 cm.

Fit the grooves of the sheet to the side of the funnel. Allow enough cord length to go around the outside of the tree and tie in a very tight knot. Before making the final knot, make sure there are no gaps in the area of contact between the funnel and the bark of the tree. Take this moment to adjust the sheet into the shape of a vertical cover, as indicated in the photograph.

Once the lower cord has been tied properly, push the upper cord through the upper holes of the sheet, adjusting it well to stop it from separating from the tree.



ECONEX CERAMBYX 60 DAYS
kairomone diffuser placed in a
CROSSTRAP® XYLOFAGOS trap



ECONEX CERAMBYX 60 DAYS
kairomone diffuser and presentation
packaging of the product.



The trap is activated once the **ECONEX CERAMBYX 60 DAYS** attractant diffuser is hung in a hole on one of the sheets, with the clips provided.

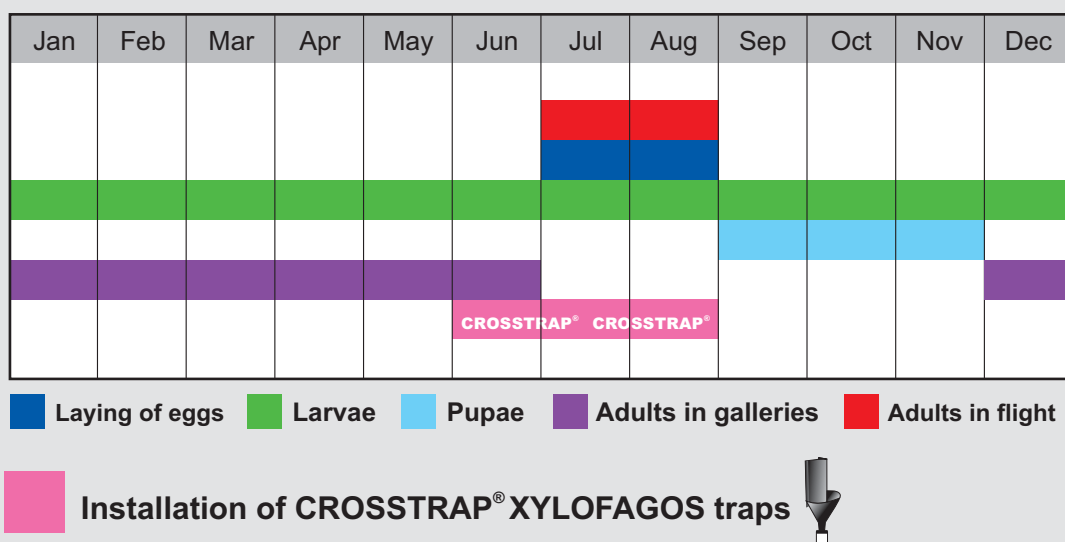
Remove the trap once the capture period has finished to avoid any incidences with the auxiliary fauna.

TRAP MEASUREMENTS: The unfolded trap measures 33 cm diameter and 88 cm high. To make transporting the trap easier, the trap is packed away with the sheets separated and the funnel folded.

Storage of the diffusers

The diffusers should not be stored for a long time. They must be kept in their original container and in a refrigerator at 4°C, or in the freezer at -18°C, in which case they will remain valid for 90 and 150 days respectively.

Phenology of *Cerambyx welensii*



[illegible]

ECONEX CERAMBYX TRAP

Place **1 or 2 traps ECONEX CERAMBYX TRAP** per ha. Baited traps must be present in the forest between June and August, depending on the target species.



Thaumetopoea pityocampa

www.thaumetopoeapityocampa.eu

THAUMETOPOEA PITYOCAMPA · Pine processionary moth

The Processionary moth is a defoliating insect that feeds on all species of pine trees and cedars.

This species is distributed throughout the Mediterranean, being present on all of the Iberian Peninsula. Its distribution is limited due to the climate, so that areas with wintry temperatures below -12° C impede its development.

It has been demonstrated that when the feeding activity is very intense it can diminish the growth of some species of pine trees, this being more important in young pine trees with a lower outward appearance than in older trees. In addition, the forests defoliated by the Processionary moth present a distressing aspect and can become impassable and impede or complicate forestry work because of the urticaria produced by the caterpillars.



MORPHOLOGY AND BIOLOGY

When the pine Processionary is in the moth/butterfly stage, the wingspan in females can reach between 36-49 mm. The forewings are an ash-grey colour with darker veins and margins and three transverse bands. The hindwings are white with grey fringes and a characteristic grey-brown spot in the anal region. They have greyish hairs covering the thorax. The abdomen is cylindrical, stout and its last segments are covered with a tuft of large scales.



Adult male



Adult female

The adult males have a wingspan between 31-39 mm and have lots of hairs on the thorax. The abdomen is also very hairy, conical and slightly thinner than the females.

The hindwings are the same as the females, whereas the forewings are a grey colour varying in intensity and in this case, the three transverse bands are much darker and more visible than the females.

Depending on the weather between June and September, the Processionary moth lays the eggs on the pine needles. The number of eggs laid varies between 120 and 300. They are protected by the scales of the abdomen, making it look like a cigarette that covers the needles.



The caterpillars take 30 to 40 days to be born and immediately after hatching they start to feed on the same place they emerged from, establishing a permanent contact with their sisters, something that will endure throughout their larval life.

The caterpillars go through 5 larval stages, with social and gregarious behaviour. With each change the larva increases in size, also increasing the size and density of its nests. A recently hatched caterpillar measures around 2.5 mm, growing up to 3 or 4 cm before pupating. The caterpillars develop urticarial hairs as a defence mechanism as of stage 3, which happens around the beginning of winter.

The temperature greatly influences the biological cycle of this insect. When the temperature on the inside of the nest is between 20°C and 25°C the caterpillars develop normally. With temperatures higher than 30°C, the egg laying should happen approximately one month before the temperatures begin to drop below 30°C. In the cold areas the egg laying is brought forward compared to the warmer areas.



Thaumetopoea pityocampa caterpillar

They also have a lethal inferior threshold; with temperatures lower than 10°C on the inside of the nest the colony activity stops, so that when the nights are very cold, the caterpillars come out to feed during the day. Below -12°C entire colonies can die. Between 10°C and 20°C, the caterpillars carry on feeding and sewing the nest, but do not progress in their development.

After the fifth larval stage the caterpillars carry out the burial processions, a behaviour which gives it the common name Processionary. The caterpillars travel in a line, coming down from the nests via the tree trunks, travelling around ten metres on the ground until finding an appropriate place to bury themselves. In this phase of burial, with the caterpillars in the ground, is when the greatest risk of contact with people and pets occurs, at times causing serious symptoms. It is very important to avoid contact with the caterpillars while they travel.

When they find the right place the whole group buries itself. Once they are buried, each caterpillar spins its own silk cocoon. They then pass on to the pre-pupa phase, whose duration varies between 21 and 30 days depending on the temperature. In this case it can occur that for reasons not very well known the pre-pupa enter into diapause, in which they can spend between one and seven years. During the pre-pupa phase, great changes are made in the internal conformation, after moulting, to make way for the chrysalis. The latter are a chestnut-red colour and egg-shaped. Females reach a length of about 20 mm and males a little less than that.

DETECTION AND MONITORING

A minimum of **1 ECONEX G TRAP** should be placed **per plot** and up to 1 trap per 9 hectares. The traps should be hung from the pine trees or on a support for this purpose.

EXHAUSTIVE MONITORING

For extensive monitoring the number of traps per surface is increased to **3 traps per hectare**, according to the location and uniformity of the plots. On small plots the number of traps should be greatly increased.

NECESSARY MATERIAL

We need the **ECONEX G TRAP (Code: TA028)** and a **ECONEX THAUMETOPOEA PITYOCAMPA 200 DAYS (Code: VA331)** pheromone diffuser. On the inside of the trap the pheromone diffuser is hung from the stopper cap using a paper clip, which is located in the upper part of the trap. The pheromone diffuser has a duration of 200 days in field conditions.

The ECONEX G TRAP has a large capacity and is used for capturing the males of the pine processionary moth (*Thaumetopoea pityocampa*) through the activation of the trap by placing the ECONEX THAUMETOPOEA PITYOCAMPA 200 DAYS pheromone diffuser inside.

The body of the trap is dark brown plastic, slightly rough on the outside and smooth on the inside. The entrance funnels are extended with flaps that limit the field of vision on the inside of the main body of the trap. Attracted by the pheromone diffuser, the male enters the trap and falls into the bag from which it cannot escape.

The lower part of the bag is a dark brown colour, to stop the birds from seeing the captured insects and breaking it to feed themselves.



The **ECONEX G TRAP** is composed of a body with hanger, a special bag, a plastic support band and a stopper cap to hang the pheromone diffuser.



ECONEX G TRAP



ECONEX THAUMETOPOEA PITYOCAMPA 200 DAYS
pheromone diffuser and package presentation of the product.



Detail of the placement of the pheromone diffuser in the stopper cap with a paper clip.

SYMPTOMS AND DAMAGES

The pine processionary moth produces two types of damage: the first, affecting the plants and causing the loss of pine needles. This is because the caterpillars feed on the pine and cedar needles in winter.

The most significant damage is created from the end of winter to the middle of spring, when the caterpillars are bigger and more voracious.

The larvae from the 3rd to the 5th stage are strongly allergenic. They can even produce severe allergic reactions in people and animals.

PERIOD OF USE

In general, the flight of the adult pine processionary moth takes place between the months of June and September.

In spring, observation traps should be placed using 1 or 2 per plot to detect the plague and observe its population levels.

Through tolerance thresholds established in each area, the moment to adopt control measures is later defined.



Thaumetopoea pityocampa nest



TRAP FOR CAPTURING PINE PROCESSIONARY CATERPILLARS

PROCESSIONARYTRAPNEX® L

TO INSTALL ON PINE TREES WITH THE APPEARANCE OF PINE PROCESSIONARY SILKEN NESTS

ADVANTAGES

- Ecological.
- Does not contain pesticides.
- Suitable for biocontrol.
- Large capacity.
- Easy to install.
- Suitable for pine trees with a trunk perimeter of less than 130 cm.
- Join two or more traps for pine trees with a larger perimeter.



PROCESSIONARYTRAPNEX® L trap

The pine processionary caterpillars produce two types of damage:

1. Damage that affects plants and causes **loss of pine needles**, since the caterpillars feed on pine and cedar needles from the end of winter to the middle of spring



2. Damage caused by highly allergenic caterpillars. They can produce **severe allergic reactions** in people and animals in forest areas, parks and gardens.

The **PROCESSIONARYTRAPNEX® L** trap is designed to capture pine processionary caterpillars of *Thaumetopoea pityocampa*, when they descend through the trunk of the pine trees where they have made nests. The aggregative and social behaviour of this species is used to capture the whole group of larvae when they go to the ground to bury and pupate.

The trap consists of a black sheet made of PET which is 150 x 25 cm and 0.3 mm thick; and a rectangular polyurethane foam barrier that measures 150 x 7 x 5 cm. The foam barrier is pierced in the middle by a corrugated tube that joins with a polyethylene bag whose lower part is opaque.

The black sheet is impregnated on its inner side with a pressure-sensitive adhesive (without solvents) to make it easier to install. This also prevents the processionary caterpillars from crawling onto the sheet, forcing them to descend through the tube towards the plastic bag, where they remain trapped.

The trap is installed directly on the trunks of pine trees that contain silken nests of pine processionary caterpillars (*Thaumetopoea Pityocampa*). The gregarious behaviour of the pine processionary is used for capturing the entire group of caterpillars when they descend from the trunk to burrow underground and pupate.

The trap is appropriate for pine trees with a trunk perimeter of less than 130 cm. Join two or more traps for pine trees with a larger perimeter.



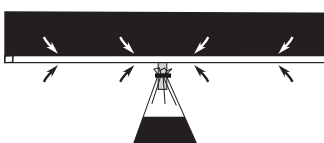
ACTIVATION OF THE TRAP - ASSEMBLY INSTRUCTIONS

Installation on pine trees with a trunk perimeter of less than 130 cm

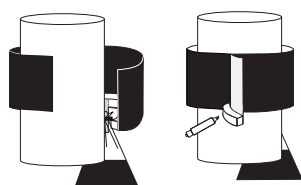
- 1** SPREAD THE SHEET OUT ON THE GROUND AND REMOVE THE PROTECTIVE PAPER.



- 2** STICK THE FOAM BARRIER ON ITS 7 CM SIDE ON THE LOWER PART OF THE SHEET, SO THAT THE PLASTIC BAG IS APPROXIMATELY IN THE CENTRE.



- 3** ADJUST THE TRAP AROUND THE PINE TREE TRUNK AND MARK THE EXCESS FOAM BARRIER ON THE OVERLAPPING PART.

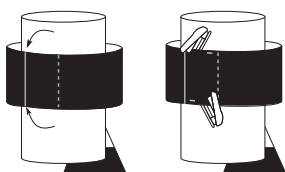


- 4** CUT THE FOAM BARRIER ALONG THE MARKED LINE USING A UTILITY KNIFE. ONLY CUT THE EXCESS FOAM.

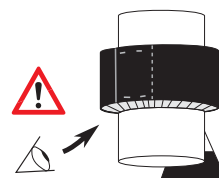
! DO NOT CUT THE SHEET



- 5** FIT THE TRAP AROUND THE PINE TREE TRUNK, ENSURING THAT THE FOAM BARRIER COMPLETELY WRAPS AROUND THE PERIMETER OF THE TREE AND THAT THERE ARE NO GAPS. STICK THE SHEET TOGETHER WITH THE OVERLAPPING PART. SECURE THE OVERLAPPING PART OF THE FOAM BARRIER WITH STAPLES BOTH ON THE TOP AND BOTTOM.



- 6** BY LOOKING FROM BELOW, CHECK THAT THE FOAM BARRIER FITS AROUND THE PINE TREE TRUNK. IF THERE ARE ANY NOTICEABLE GAPS, FILL THEM WITH THE REMAINING FOAM.



7 HOW TO REMOVE THE TRAP

REMOVE THE TRAP WHEN ALL THE CATERpillARS ARE INSIDE THE PLASTIC BAG.

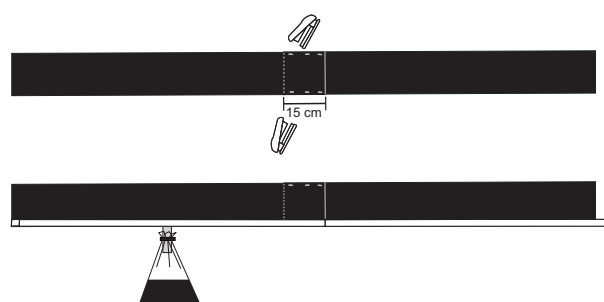
HANDLE THE TRAP WITH PROTECTIVE GLOVES AND USE A RESPIRATORY PROTECTIVE MASK. AVOID CONTACT WITH SKIN. DO NOT HANDLE THE PLASTIC BAG IF IT CONTAINS CATERpillARS.

PUT THE TRAP INTO A RESISTANT BIN BAG AND CLOSE IT TIGHTLY. HAND IT OVER TO AN AUTHORISED PERSON FOR ITS CONTROLLED DISPOSAL.

Installation on pine trees with a trunk perimeter of more than 130 cm

USE TWO OR MORE SHEETS AND FOAM BARRIERS FOR PINE TREES WITH A PERIMETER OF MORE THAN 130 CM.

THE SHEETS MUST OVERLAP BY AT LEAST 15 CM, SECURING THEM TOGETHER WITH STAPLES.



Safety advice: Handle the trap with protective gloves. In case of unprotected handling, wash hands after use. If the caterpillars are inside the trap, handle with extreme care: USE RESPIRATORY PROTECTION MASK. AVOID CONTACT WITH SKIN.



Cydia splendana

CYDIA SPLENDANA · Chestnut tortrix

The *Cydia splendana* larvae (also known as *Laspeyresia splendana*) cause important damages to the chestnut production.

Cydia splendana develops its activity during the fruit ripening phase, between the months of August and October, having several periods of maximum flight that can take place between the end of August and beginning of September. The eggs laid are generally placed on leaves close to the chestnuts, although on occasions the eggs can be found at the base of the chestnut husk.



Cydia splendana adult



The neonate larvae do not feed on the leaf, but immediately penetrate the husk, developing the five stages always on the inside of the same chestnut, where they excavate galleries full of excrements that they do not throw outside. Therefore, apparently the affected nut is healthy (at the most it shows a small dent in its basal part), but falls to the floor prematurely.

The adult moths fly from August to October and generally lay their eggs on top of the leaves. The first stage larvae penetrate the nut close to the joining area, then they bore holes in it destroying its interior. Each caterpillar only attacks one chestnut. The caterpillars' development is completed in approximately 3 weeks.

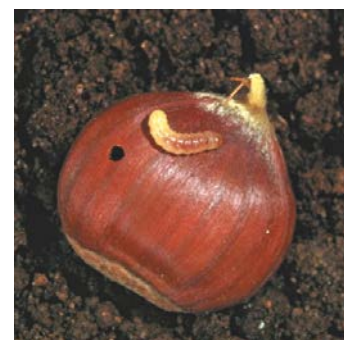
Once the larva is mature it abandons the nut and falls to the floor where, inside a silky cocoon, winter and spring pass by. It pupates in July and reaches adulthood in summer. In this way, it completes its development in a year.

The affected chestnut husks turn brown and fall prematurely, although after the harvest one can also observe caterpillars in the stored chestnuts.

MORPHOLOGY AND BIOLOGY

The caterpillars reach from 12 to 16 mm in length. They have a whitish or pink colour and the first thoracic segment is dark brown.

Cydia splendana has one generation a year.



Cydia splendana caterpillar

It could be confused with another two species that can be present in the chestnuts: *Pammene fasciana* and *Curculio elephas*. The *Pammene fasciana* caterpillar is much smaller (10 – 13 mm) and is a reddish colour. The *Curculio elephas* larva does not have legs and is a creamy white colour with a black head. It measures around 7 – 12 mm, is thick and tends to appear curved in the shape of a C. The sawdust that surrounds it is of a thicker grain than that of *C. splendana*.



DETECTION AND MONITORING

1 trap per hectare should be used, hung at the same height as the crops. The traps can be placed on the trees or on a support for the same purpose.

The traps should be placed in spring.

EXHAUSTIVE MONITORING

The males of this species are captured with the aim of reducing mating, so that the non-copulated females will have unviable eggs. In this way, it reduces the population of the plague.

For extensive monitoring the number of traps per surface area is increased, according to the location and uniformity of the plots.



SYMPTOMS AND DAMAGES

The nuts fall prematurely.

Destruction of the chestnut causing losses to the mature fruit.

The presence of attacked nuts reduces the quality of production and increases the cost of selecting the product for sale.

Risk factors:

Build-up of attacked nuts on the ground.

Generally, the attacks are more important during dry summers.

The damages are greater when the tree grows on shallow, poor and stony ground.



Attack by *Cydia splendana*

NECESSARY MATERIAL

A trap **ECONEX WHITE TRIANGULAR without sheets (Code: TA118)** or **ECONEX DISPOSABLE WHITE TRIANGULAR (Code: TA242)** and an **ECONEX CYDIA SPLENDANA** pheromone diffuser .

The trap **ECONEX WHITE TRIANGULAR without sheets** is activated by placing an **ECONEX SHEET FOR TRIANGULAR (Code: TA248)** at the base of it. The sheet is impregnated with a pressure sensitive adhesive, solvent free, in which insects are trapped. The trap **ECONEX DISPOSABLE WHITE TRIANGULAR** is coated on its inner face with a layer of contact adhesive, solvent free, for the retention of the insects.

Both traps stand out above all for their simplicity of use, and will be operative until pheromone depletion or saturation of the sheet or adhesive surface.

The pheromone diffuser is placed inside the trap on the sheet or adhesive surface.



ECONEX WHITE TRIANGULAR
without sheets



ECONEX DISPOSABLE WHITE
TRIANGULAR

PERIOD OF USE

In spring 1 trap per hectare can be placed to detect the insect and observe the level of its populations.

Through established thresholds of tolerance in each area, the moment to adopt control measures is later defined.



© entomart

Lymantria dispar

LYMANTRIA DISPAR · Gypsy moth

The Gypsy moth *Lymantria dispar* is the larva of a species of nocturnal moth. It feeds on the leaves of *Quercus ilex* (Holm Oak) or *Quercus suber* (Cork Oak) and also, the leaves of fruit trees, *Quercus robur* (Oak) and other trees or shrubs in forests. It can cause serious defoliation.

Their characteristic long hairs come out from protuberances arranged along the body that show two colourings. The blue hairs are at the front of the body and the red hairs on the rest of the body.



MORPHOLOGY AND BIOLOGY

Adult: The female has a wingspan of 45 to 65 mm and the body length is 25 to 28 mm long. The wings are whitish with some black stains which make a V-shape, is very characteristic in the forewings. The body is very robust, hairy and slightly yellow. The abdomen is very bulky and heavy, a characteristic that makes them unable to fly. Fine pectinate antennae.

The male is quite a lot smaller, having a wingspan of 35 to 40 mm and body length 18 to 20 mm. The wings have a background colour of ochre with stains in dark zig-zags, blackish-brown, abundant, above all in the forewings. The abdomen is much thinner than the females', almost conical, covered in ochre coloured hairs. They fly well. Pectinate antennae.



Adult male



Adult female

Egg laying: In the shape of yellow silken cocoons that are 3 or 4 cm long and 1.5 to 2 cm wide. They are made up of tiny eggs and the hairiness of the female abdomen, joined together with an agglutinative that secretes this. The number of eggs that each female lays ranges between 250 and 500.

Caterpillar: New-born caterpillars measure between 3 and 3.5 mm. They are very hairy and their general colouring is blackish. During their development they change colour, after moulting, but the greyish colour always predominates.

In the thoracic and first abdominal segments, the caterpillar shows dark blue tubercles, the other remaining abdominal segments are red, all with very obvious hairiness. During development the caterpillars will moult four or five times.

The females come from the caterpillars that have moulted five times, or rather, in six stages. The males moult four times, or to be more exact, in five stages. The size of the grown caterpillars ranges from 45 to 70 mm in length

Photos: © Faculty of Biology UCM

Chrysalis: A dark brown colour, with no silky cocoon. The apical end is provided with silky hairs, which are used to grip the bark. The chrysalis that result in female imagoes can be perfectly differentiated from the males, as they are a lot bigger and have an almost cylindrical abdomen. Meanwhile, the abdomens of the males is almost conical.

DETECTION AND MONITORING

1 trap per 9 hectares is to be used, placed in Holm oaks. A support can also be used.



EXHAUSTIVE MONITORING

The males of this species are captured with the aim of reducing mating, so that the non-copulated females will have unviable eggs. 3 traps per hectare are recommended.

NECESSARY MATERIAL

1. An **ECONEX G TRAP** (Code: TA028), **ECONEX POLILLERO** (Code: TA001) or **ECONEX GREEN POLILLERO** (TA027).
2. A pheromone diffuser **ECONEX LYMANTRIA (PORTHETRIA) DISPAR** (Code: VA142) that has 40 days' duration in normal field conditions.



ECONEX G TRAP

*(Description of the trap
on page 43)*



**ECONEX
POLILLERO**



**ECONEX
GREEN POLILLERO**

The ECONEX GREEN POLILLERO trap is specially designed to optimise the camouflage of the trap in areas that require it.

The **ECONEX POLILLERO** trap is made of a plastic polymer that is resistant against ultraviolet rays, with a shelf-life of 6 to 7 years. It contains a yellow funnel with a green lid and a white base all set together.

It is the most suitable trap for the majority of Lepidoptera, especially the biggest moths when there are a lot of them, due to its large capacity.

On the inside of the base a small amount of olive oil can be placed, so that the insects remain trapped. The pheromone diffuser is placed in a small cage located in the centre of the lid. The trap is provided with two hooks to be able to hang it.



ECONEX POLILLERO



ECONEX POLILLERO
installed in the field

PERIOD OF USE

In spring 1 trap per 9 hectares can be placed for pest detection and observation of its populations. Through thresholds of tolerance in each area, the moment to adopt control measures is later defined.

DAMAGES

With important defoliations, the trees growth decreases. But, what is most important is the loss of the acorns annual production in the grasslands and open woodlands with livestock exploitation.





Rhynchophorus ferrugineus

www.rhynchophorusferrugineus.eu

RHYNCHOPHORUS FERRUGINEUS · Red palm weevil



The Red Palm Weevil is an invasive exotic species and phytosanitary quarantine species which is present in Spain since 1995, when it was detected in Granada and Malaga.

This insect, originally from the tropical regions of Asia and Polynesia, has extended continuously through other areas of the planet, colonising different species of palm trees.

Currently, it is one of the main pests that affect palm trees in the Middle East and North Africa. From these areas, through traditional palm tree exporters to Europe, is where the insect has been introduced onto the Iberian Peninsula.

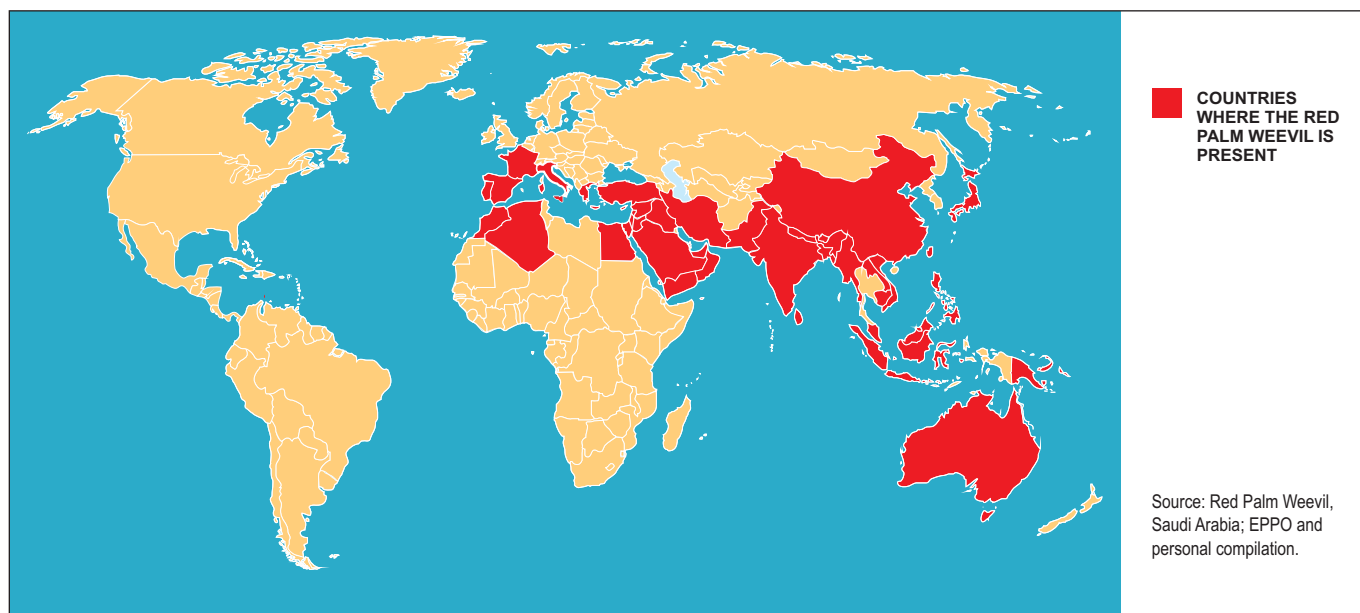


Adult male

Photo: Susi Gómez

The existence of important palm groves in the Iberian East makes it necessary to pay special attention to this insect.

GLOBAL DISTRIBUTION



Saudi Arabia, Algeria, Aruba, Australia, Bangladesh, Bahrain, Burma, Cambodia, China, Cyprus, Egypt, United Arab Emirates, Spain, the Philippines, France, Greece, India, Indonesia, Iraq, Iran, the Solomon Islands, Israel, Italy, Japan, Jordan, Kuwait, Laos, Malaysia, Morocco, Myanmar, Oman, Pakistan, Papua New Guinea, Portugal, Samoa, Singapore, Syria, Sri Lanka, Taiwan, Thailand, Turkey, Vietnam and others.

AFFECTED SPECIES OF PALM TREES

The insect colonises a large number of species of palm tree. In the countries of origin it is referenced in Coconut Palms (*Cocos nucifera*) and Guinea Palm trees (*Elaeis guineensis*) amongst many others. Nevertheless, in Spain it stands out mainly because of its attacks on the Canary Palm tree (*Phoenix canariensis*) and the Date Palm (*Phoenix dactylifera*), which is the most representative of our palm trees. It also affects the Washingtonia Palm (*Washingtonia spp.*).



MORPHOLOGY AND BIOLOGY

Rhynchophorus ferrugineus is a coleopteron belonging to the Curculionidae family.

Adult: Its size is quite big, reaching between 2 and 5 cm long. The insects of this family are characterised for having an extended head in the shape of a beak ("face"), where the antennae are positioned in the shape of a reddish mace.

The pre-thorax shows some very visible black stains of variable size and shape. Along the elytrons the linear markings are emphasised, also in black.

The males are differentiated from the females by a "comb", thick and few hairs on the end of the beak.



Photo: Susi Gómez

Adult females



Photos: Susi Gómez



Egg: It is oval-shaped. The egg-laying is done individually on the soft tissue of the palm tree's crown. It measures between 1 and 2.5 mm long. On average, the females lay between 300 and 400 eggs.

Larva: It develops on the inside of the palm tree's living tissues, until reaching between 3 and 5 cm in size. At the beginning it has a creamy white colour that in the last stage acquires a darker tone. It is clearly apodous (with no legs). Its general aspect is pear-shaped, which gives it a chubby look. The head, which is brown, has very powerful jaws that allow it to perforate the vegetable tissues of its host.

Pupa: It is found mainly at the base of palm trees, surrounded by a good sized oval cocoon (4 to 6 cm long), and made by the larva with fibres from the same palm tree. In which case, it is not easy to detect the insect if the area where it has inserted itself is not opened.



Foto: Susi Gómez



Aspects of its biology

Its capacity for reproduction is very important. In Spain the complete cycle, from egg to adult, has a duration of three and four months.

The adults do not tend to abandon the palm tree where they have developed, until it is practically destroyed. So, there can be various generations inside the same specimen, where at any given moment all the phases/stages of the plague can be found.

The adults have a very high ability for flying, which allows them a great capacity for the dispersion and colonisation of new palm trees. They seem to show a preference for hurt or weak palm trees. Once the first adults arrive at a suitable palm tree, the males generate an aggregation pheromone that attracts many red palm weevils of both sexes.

The females deposit their eggs in holes made with their face (or beak), in wounds made during the harvest, pruning and desuckering

SYMPTOMS AND DAMAGES IN THE CANARIAN PALM TREE

The most common symptom that may suspect an insect attack is the withered look of the leaves at the centre of the crown, which can eventually dry up and remain hanging on the ground.



Fotos: Susi Gómez



Symptom of young leaves drying or hanging

Symptom of cut leaves on a Canarian palm tree

In very severe attacks the crown of the tree ends up drying and causes the death of the palm tree. By pulling down the affected outer leaves, they fall off with ease. In the leaf base, galleries of larvae can be observed and frequently the pupae cocoons.

On opening the crown of a palm tree with an advanced degree of infection, there are plenty of larvae of various sizes in a mass of fermenting tissue that gives off an unpleasant and peculiar smell.



Final phase of Phoenix canariensis



Final phase of Phoenix dactylifera

Photos: Susi Gómez

The affected palm tree dies in the short term due to the meristem or palm heart being totally destroyed, with its interior in decomposition.



Foto: Econex



Photo: Susi Gómez

Mass death

Life cycle: **Eggs:** less than 1 week. **Larva:** approximately 4 to 6 weeks. **Pupa:** approximately 2 or 3 weeks. **Adults:** approximately 12 to 16 weeks.

Source: Leaflet "Curculiónido Ferruginoso o Picudo Rojo de las Palmeras", published by the Conselleria d'Agricultura, Pesca i Alimentació of the Generalitat Valenciana.



THE RHYNCHONEX® SYSTEM

The Rhynchonex® system consists of using traps, pheromones and kairomones for the detection and monitoring of the Red Palm Weevil: *Rhynchophorus ferrugineus*.

Scientific investigation has demonstrated that the weevils find the host palm trees through the sense of sight and smell.



DETECTION AND MONITORING

We will use **1 to 3 RHYNCHONEX® traps** per hectare (at least 1 per plot), placed preferably buried in the ground. In case of not being able to bury the trap, the **CROSSTRAP® MINI** trap is recommended (*description on pages 14-15*).

The traps placed to carry out the detection of *Rhynchophorus ferrugineus*, should be placed 100 metres apart from each other. Up to 1 trap per 10 hectares can be placed.

The traps should be placed throughout the year, especially in spring, summer and autumn, given that the activity of the pest increases with the temperature.

EXHAUSTIVE MONITORING

For exhaustive monitoring the number of traps per surface area is increased, according to the location and uniformity of the plots: approximately 1 RHYNCHONEX® or CROSSTRAP® MINI trap every 50 metres. This translates into a density of **4 to 6 RHYNCHONEX® or CROSSTRAP® MINI traps** per hectare.

Using traps with pheromones and kairomones, the *Rhynchophorus ferrugineus* females and males are captured, in a proportion of 2/3 females and 1/3 males. By capturing both adult males and females, mating is reduced.

The females that are captured tend to already be fecundated. Therefore, capturing these females is very effective in reducing the egg-laying on the palm trees. Each insect captured is an insect less on the palm tree.

NECESSARY MATERIAL

RHYNCHONEX® or **CROSSTRAP®** **MINI** traps.

RHYNCHONEX® 7.5 traps

The **RHYNCHONEX®** traps are humid traps that are used together with pheromones and kairomones, for the detection and monitoring of the Red Palm Weevil *Rhynchophorus ferrugineus*.

They are made of a plastic polymer that does not emit odors when heated by the effect of the sun, and they support ultraviolet rays, with a half-life of 6 to 7 years.

They are made up of three easily adjustable parts, a base, a lid and a special hanger to hang the **RHYNCHONEX® ATTRACTANTS KIT 90 DAYS** diffuser.

The traps include a rhombus-shaped plastic mesh, which is especially designed to simulate the roughness of the trunk of the palm tree. This makes it easier for the Red Palm weevils to enter into the trap.



RHYNCHONEX® 7.5
trap (Code: TA146)



RHYNCHONEX® 7.5 PACK (Code: TA249).
Pack containing 6 traps **RHYNCHONEX® 7.5**



Attractants diffuser
RHYNCHONEX®
ATTRACTANTS KIT 90
DAYS placed in a
RHYNCHONEX® 7.5 trap

The **RHYNCHONEX® 7.5** trap has a volume of 7.5 liters. The frusto conical shape of the base of the trap is red and has 4 perpendicular holes with measurements of 3 x 7 cm, so the insects can enter in easily. The lid is also red and has 2 entrance holes with 3 x 7 cm measurements.

It is a wet trap, so it should be filled with water up to 2/3 of their volume.

PLACEMENT AND HANDLING

The **RHYNCHONEX®** traps are wet traps, so they should be filled with water up to 2/3 of their volume, and they should be placed half-buried to the entrance holes, and preferably in the shade, since they retain humidity for longer.

Using the wet **RHYNCHONEX®** traps, the red date palm weevill dies by drowning in the water.

It is recommended to cover the traps a little bit with palm tree leaves, to increase humidity and avoid excessive evaporation.



In case of not being able to use buried RHYNCHONEX® traps (being in areas where they can be manipulated by unauthorized persons, or should be out of the reach of children in public parks and gardens) it is recommended to use the **CROSSTRAP® MINI** traps.

In the natural environment, it is recommended to use only the **CROSSTRAP® MINI** trap, due to its high specificity.

FOOD ATTRACTANT

The combination of food and pheromones increases the efficiency of the system: dates, sugar cane, apples and bananas are foods that can be used in the RHYNCHONEX® trap.



© Luis Marques

Adding vegetables products rich in sugar to the water (apples, bananas or dates) increases the level of catches

RHYNCHONEX® DECOY (Code: TA180)

This is a plastic red palm beetle. It is 5 cm in size and is placed on the outside of the RHYNCHONEX® trap and used as bait, complementing the signal emitted by the attractants.



RHYNCHONEX® DECOY
placed in a trap



CROSSTRAP® MINI traps

For trapping in the natural environment or if you are not able to use the buried RHYNCHONEX® trap, it is recommended to use the **CROSSTRAP® MINI WITH DRY COLLECTION CUP** trap (Code: TA204).

The CROSSTRAP® MINI WITH DRY COLLECTION CUP trap is a suspended trap that captures insects in flight and is very effective from spring to autumn. The design and the slippery coatings of the trap stop the captured insects from escaping. The trap does not require any type of liquid and does not need a food attractant. The insects die on the inside of the collection cup through dehydration, which makes handling it easier. The traps can be hanged from natural or artificial supports, but always at a sufficient distance away from the palm trees.

The trap consists of a polypropylene lid, 33 cm in diameter with a central carabiner attached to a steel spring. Two reinforced PVC sheets are held in place by four steel springs in the lid's upper section, serving as shock absorbers against strong winds. This helps to avoid damage to the trap. In the lower section, the reinforced PVC sheets are held in place by a polypropylene funnel, 30 cm in diameter and four steel springs. The collection cup for the captured insects is in the lower section of the funnel and is attached by metal screws.

The PVC sheets, funnel and collection cup are treated with a slippery film to significantly increase captures and prevent the pests from escaping.

The unfolded trap measures 33 cm in diameter and 146 cm in height. Once folded the trap measures 33 cm in diameter and 40 cm in height.

The trap can last up to 7 years due to its highly resistant components.



Attractants diffuser
RHYNCHONEX®
ATTRACTANTS KIT 90 DAYS
placed in a CROSSTRAP®
MINI WITH DRY
COLLECTION CUP trap

POSITIONING AND USE:

The traps should be suspended horizontally with a rope in-between two trees or from one of the branches, taking care that the trap does not come into contact with the tree trunk.

In this way, the trap does not knock against the tree and break, therefore ensuring that the insects are able to distinguish the trap from the tree trunk and go to the trap. Keep them at least 5 meters away from the palm trees. It is best to install them in areas without palm trees.

The trap is activated by placing the attractants diffuser RHYNCHONEX® ATTRACTANTS KIT 90 DAYS hung in the holes of one of the PVC sheets with the clips provided.



Rhynchophorus ferrugineus captured in a
CROSSTRAP® MINI WITH DRY COLLECTION
CUP trap

The height of the installed trap is not of importance, as long as the collection cup does not touch the ground or any other object. A metal support designed specifically for this purpose is also available: **ECONEX CROSSTRAP® SUPPORT** (Code: TA147).

Attractants diffuser RHYNCHONEX® ATTRACTANTS KIT 90 DAYS (Code: VA263)

Kit consisting of a **RHYNCHONEX® PHEROMONE 90 DAYS** diffuser and a **RHYNCHONEX® KAIROMONE 90 DAYS** diffuser, in the same blister, for *Rhynchophorus ferrugineus*, with a duration of 90 days and an identification label to place on the traps with the date of placement and replacement of the kit. It is sold in boxes of 6 units.



Boxes containing 6 units of **RHYNCHONEX® ATTRACTANTS KIT 90 DAYS**

Each box contains an explanatory leaflet about the biocontrol of the pest.

RHYNCHONEX® PHEROMONE 90 DAYS: Is a pheromone diffuser of *Rhynchophorus ferrugineus* with a mixture of 4-methyl-5-nonanol and 4-methyl-nonanone. It has a duration of 90 days in field conditions..

RHYNCHONEX® KAIROMONE 90 DAYS: Is a kairomone diffuser of *Rhynchophorus ferrugineus* made up of ethyl acetate. It has a duration of 90 days in field conditions.

Scientific research has shown that the synergistic action of pheromone and kairomone acting together increases significantly the number of catches, increasing them by 2.5 to 5 times.



RHYNCHONEX® ATTRACTANTS KIT 90 DAYS. Packaging, kit and identification label

The kit should be stored in its original packaging and it is recommended to keep it in the fridge at 4° C in which case it can last up to 2 years.

FACTORS THAT INFLUENCE IN THE AMOUNT OF TRAPS NEEDED

An important factor is the size of the plantations. In small and irregular plantations a larger number of traps is required than in plots with more uniform and larger surface areas.

Another important factor is the distance between some plots to others. In cases like this, the boundaries of the plots have to be reinforced. This means a density of up to 3 traps per hectare could be needed.



ADVICE ON PLACING THE TRAPS

- It is recommended to space the traps 50 to 100 m apart.
- The RHYNCHONEX® traps that are placed in the shade retain the humidity for longer. The CROSSTRAP® MINI traps can be installed in both shady areas and sunny areas, preferably outside the plots.

IMPLEMENTING MEASURES

1. Regular check-ups of the palm trees in affected areas.
2. In palm trees where an infestation of Red Palm Weevil is suspected or detected, one must proceed rapidly to its sanitation and protection through an authorised phytosanitary treatment.
3. All the dead palm trees and damaged tissues must be destroyed, in accordance with the regulations.
4. When pruning in spring and summer, an authorised phytosanitary treatment must be used after pruning. Only prune during winter preferably, as it is the period the pest has the least activity. The remains of the pruned trees should always be shredded, cut into pieces or burnt..
5. Clean the crown of the palm tree of leaves to allow regular inspection.
6. It is important not to plane down or shave the tree trunk, as it encourages infestations.
7. The palm trees affected with illnesses, such as putrefaction of the leaves and shoots are more prone to an infestation by the Red Palm Weevil. Therefore, they should be treated with a fungicide and an insecticide, as it is essential to stop the Weevils from depositing their eggs in these areas
8. Within an eradication strategy or integrated control measure, capturing the Red Palm Weevil adults with the RHYNCHONEX® SYSTEM is fundamental
9. Dedicate time to training, to get to know well the biology and ecology of the insect, as well as, the RHYNCHONEX® SYSTEM for the detection and monitoring of *Rhynchophorus ferrugineus*.



Applying phytosanitary products



Sanitation

Photo: Susi Gómez

RESULTS

Application of an integrated control strategy for the Red Palm Weevil (*Rhynchophorus ferrugineus*).

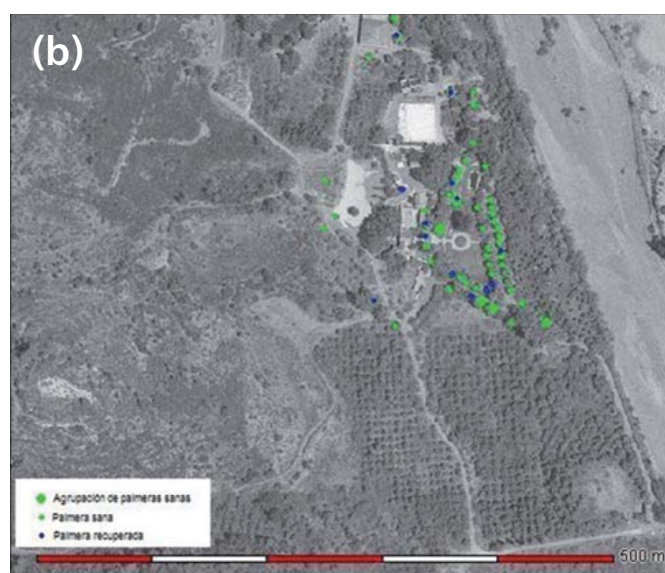
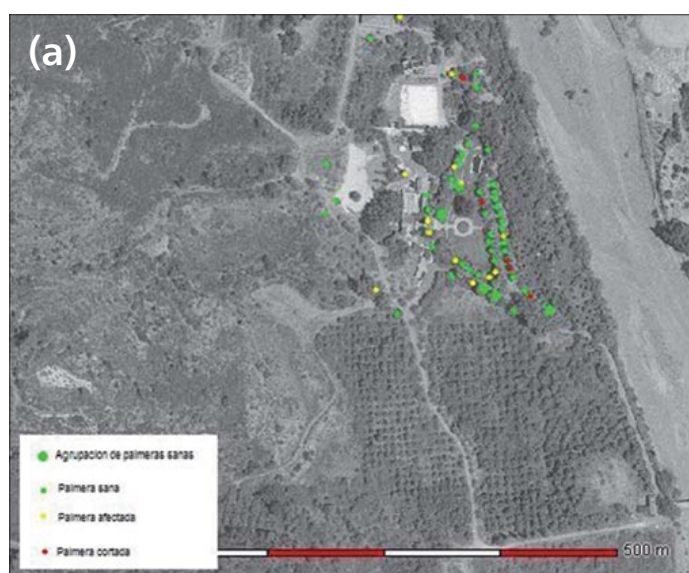
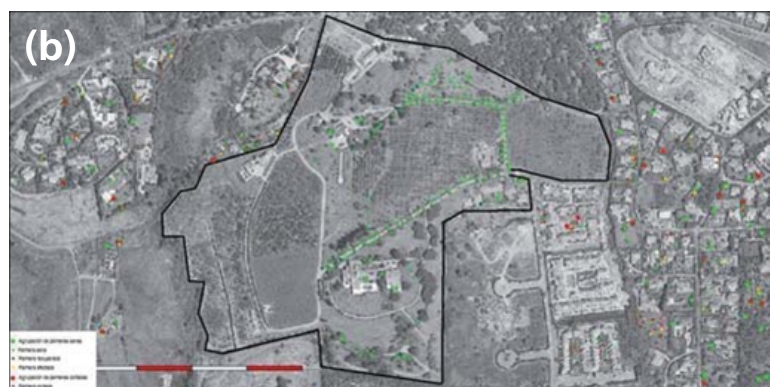
Susi Gómez Vives, Michel Ferry (Phoenix Station): Research Centre for the palm tree and agriculture in Oasis – Elche (Spain).



Orthophotos of **Finca El Batatal** and adjacent properties.

a) Situation at the beginning of applying the strategy, in March 2007.

b) Situation in January 2009. In green the palm trees have no symptoms, in yellow the palm trees have symptoms and in red the palm trees are removed.



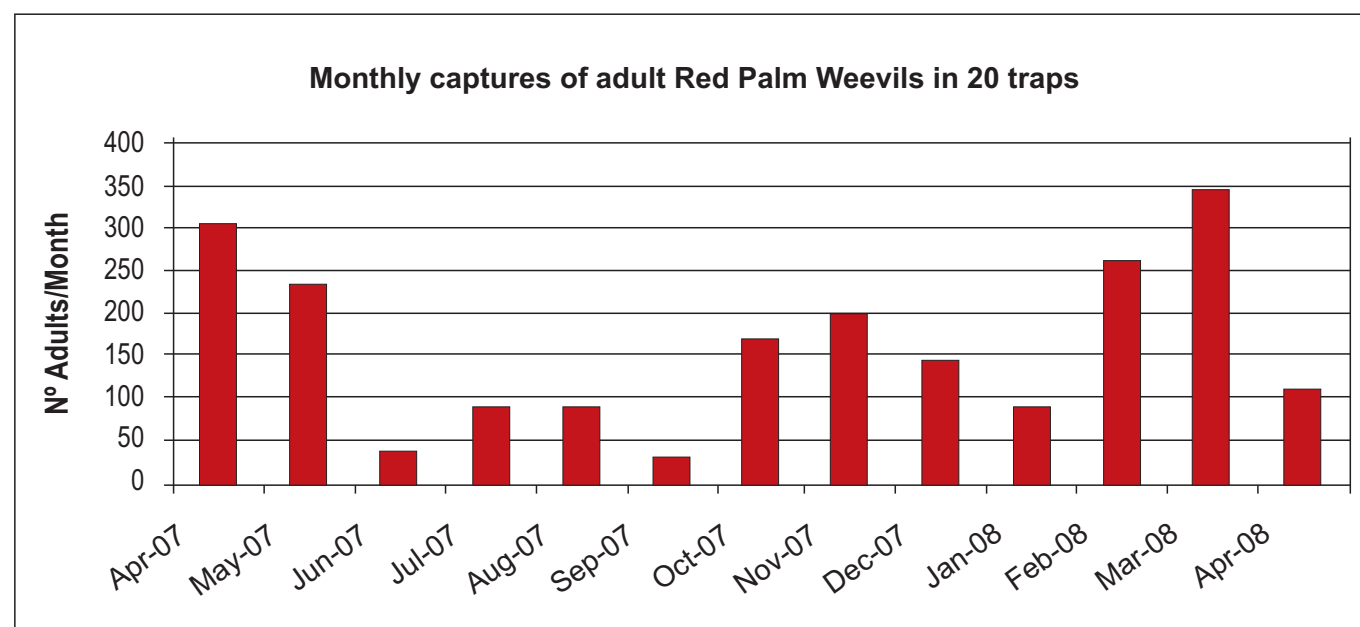
Orthophotos of **Finca la Concepción**.

a) Situation at the beginning of applying the strategy, in March 2007.

b) Situation in January 2009. In green the palm trees have no symptoms, in yellow the palm trees have symptoms and in red the palm trees are removed.

Total captures of *Rhynchophorus ferrugineus* in the olfactory traps:

	Total number of captured adults	Average captures per trap	Standard deviation of captures per trap	Percentage of females captured	Percentage of males captured
Finca El Batatal (between March 2007 and January 2009)	3136	63.35	21.26	66.11 %	33.89 %
Finca La Concepción (between July 2007 and December 2008)	1077	198.15	76.89	64.68 %	35,32 %

Number of adults captured per month during a year of monitoring in Finca El Batatal**Results of the application of an integrated control strategy**

	Number of palm trees monitored	Number of palm trees infested at the beginning	Percentage of recuperated palm trees	Percentage of recuperated palm trees after mechanical sanitation	Number of newly infested palm trees
Finca El Batatal	201	10	100 %	—	0
Finca La Concepción	140	14	86 %	80 %	0

CONCLUSIONS

- The increasing number of newly infested palm trees by the Red Palm Weevil on the Mediterranean coast, despite great efforts carried out by the Plant Health Authorities with regard to the elimination of infested specimens and foliar treatments, shows that it is not possible to control this pest with only one type of treatment or intervention. It is necessary the application of a well-defined and programmed integrated control strategy.
- The application of an integrated control strategy not only allows the infected palm trees to recuperate, but also to prevent the dispersal of the pest.
- This integrated control strategy is based on regular inspections carried out on palm trees, the installation of a network of traps for exhaustive monitoring, the implementation of mechanical or chemical sanitation for infested palm trees and preventive treatments for all the palm trees in the area.



June 2007: palm tree recovering after sanitation in March 2007



January 2009: Palm tree recuperated

Photos: Susi Gómez



Insect Biocontrol with Bats

ECONEX NEST FOR BATS

THE BAT, AN ALLY AGAINST PESTS

The first fossils that are known to belong to Chiropterans go back about 53 million years.

It is thought that bats evolved from insectivorous tree-dwelling placental mammals that continued to develop their ability to glide.

This must have happened, 100 million years ago, according to many experts (when the dinosaurs were at their peak).

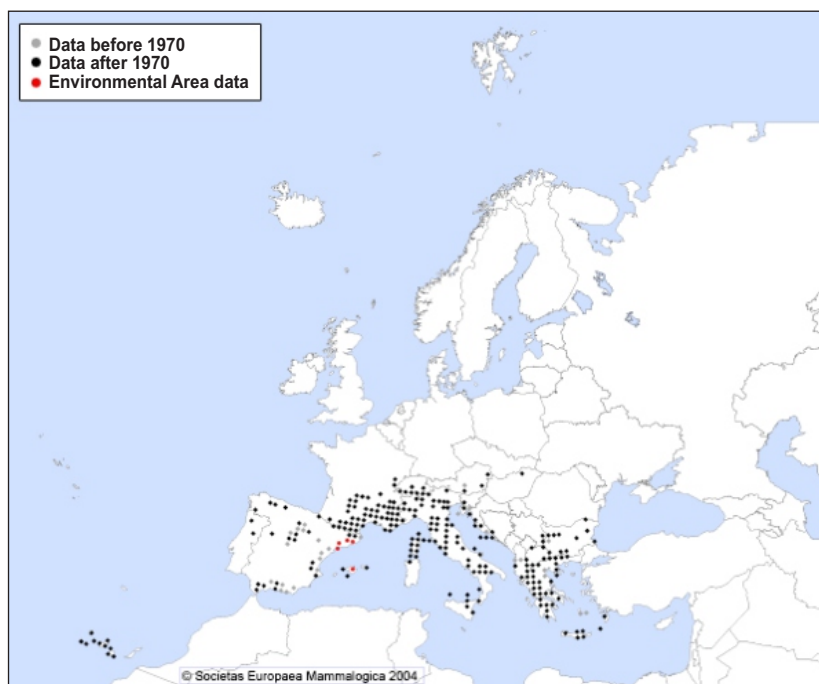
Since then they have changed, after rodents, into the group with most success amongst mammals (constituting approximately a quarter of all known species of mammals).

Around 1100 species of bats are distributed all over the world, except for the polar areas and some isolated islands.



Photo: © Joxerra Alhartzaga

Myotis bechsteinii hanging on a tree trunk just before flying.



European distribution of the species

The Chiropteran order is divided into two suborders: the Megachiroptera, are also known as flying foxes and the Microchiroptera are the only representatives of the order present in Europe.

ANATOMY OF A BAT FOR FLIGHT

The main feature that identifies this order of mammals is its capacity for active flight, unique amongst mammals (unlike gliding like some squirrels and flying lemurs) and it totally conditions its anatomy.

The bats have hands with very long fingers and in-between them is a membrane of skin (the patagium) which is joined to the back legs, resulting in enlarged wings that make it possible to fly. Other adaptations to the skeleton, muscles and metabolism ensure that these animals are able to fly.



The Microchiroptera or bats have also developed a surprising and complex system of orientation in the dark based on sound, similar to sonar.

This system, known as echolocation is based on the emission of sound at a high frequency. Bats make calls as they fly and listen to the returning echoes to build up a sonic map of their surroundings.

This system, together with very sharp vision, allows them to move and hunt in complete darkness.



Grey long-eared bat (*Plecotus austriacus*) before flight. The large size of its ears gives us an idea of the sensibility of its system of echolocation that allows it to capture insects in complete darkness between bushes.

BIOLOGICAL CYCLE OF BATS

At the end of summer males and females get together in the same shelters, where mating takes place. However, gestation does not begin until spring because the females store the male's sperm without fertilisation having occurred.



Bats mating

In winter, the availability of food decreases and the bats have two choices in order to survive: hibernate or migrate. The majority of the species opt for the first alternative, looking for cool places that allow them to enter into a state of deep sleep reducing their vital functions to a minimum, saving energy.

A few species decide to migrate to warmer areas, where they also enter into hibernation.

When winter has passed the females begin gestation and look for warm shelters for the development of the embryo and baby. The births take place at the end of spring and consist of one baby (except for noctule bats and the Common Bat that can give birth to twins). The babies become independent when they reach two or three months old and will not begin to reproduce until many years have passed (2 to 5 years in Spain depending on the species).

This lack of capacity for reproduction worsens if taken into account that they do not tend to breed every year. This is compensated partly due to their great longevity, given that they can live up to 20 or 30 years (the Horseshoe bats are the longest living in Europe, living for more than 30 years).



The males tend to remain separated from the females in cooler shelters, which allow them to save energy during the day, including entering into a state of lethargy during the day, known as torpor.

THE EATING HABITS OF BATS

Flying demands a high consumption of energy. For this reason bats are voracious predators, capable of consuming daily up to 30% of their body weight in food.

In Spain, practically all the species are strict insectivores, mainly eating moths, flies, mosquitos and beetles. Their prey is captured in the air, as well as, on the ground or between leaves depending on the species.

The Greater noctule bat, *Nyctalus lasiopterus*, is also capable of feeding on small birds during its nocturnal migratory flight.



INSECT BIOCONTROL WITH BATS

Not all bats spend the day in caves. They tend to use the gaps in the trees to shelter themselves. They also use abandoned mines, buildings, bridges and many other places. In reality, the wide variety of bats reflect the incredible diversity of species that exist.

The bats are very opportunistic and have adapted to their environment in creative ways to take advantage of the multitude of shelters available to them. However, human beings frequent the areas where the bats live; modifying or destroying their habitats.

WHY SHOULD I HANG NESTS FOR BATS?

Bats are an important part of our ecosystem. European bats are mainly insectivores and in areas where their populations are very significant, they provide a considerable reduction in plagues of insects.

For example, one bat alone can capture up to 1,200 mosquitos in an hour. However, human activities have caused a drastic reduction in bat populations in the last few years. The bat is a very misinterpreted animal, playing a key role in nature. If it disappears, there will be important changes in the ecosystem.

CHARACTERISTICS OF THE NEST

The **ECONEX NEST FOR BATS (Code: TA117)**, made of highly resistant wood, is specially designed to be able to hang it and handle the bad weather, made of good insulation. The wood is not treated due to the bats sensitivity to toxic products.

They can be placed in recreation areas, as well as parks, gardens and allotments. Benefitting the shelter and nesting of the bats will achieve to reduce the amount of infestations



Nest measurements:

Height: 49,50 cm.

Width: 22 cm.

Depth: 7 cm.

Entrance and exit of the nest: 20 x 1,90 cm.

Nest weight: 1,50 kilos.

Commercial Packaging:

Measurements: 60 x 40 x 35 cm.

Content per package: 6 nests.

Weight of the package: 10 kilos.



MONITORING BATS' NESTS

The lack of suitable shelters for breeding in recent reforestations or young woods significantly influences in the abundance and distribution of the forest species of chiropterans.

With this action specific nests for bats will be installed, with characteristics that allow the reproduction of these species in its interior.

Monitoring the occupancy of the nests also serves to evaluate the forest bat populations.

PLACING THE NESTS

The position of the nests will depend very much on the area, the latitude, the average temperature, etc. Generally, it is recommended to install the nests in places with 5 to 7 hours of sunlight.

Taking into account that the period of bat occupancy in the boxes (May – September) corresponds to the hottest in the year, it is not advisable to install the nests facing South unless the leaves protect them from exposure to the sun. That being the case, it is possible that the shelters reach non-optimal temperatures for its colonisation.



BIO-CONTROL OF THE PINE PROCESSIONARY WITH BATS

The majority of the bat species can potentially occupy the nests, even though some of them are not in the forest. For example, the fissuricolous and very often anthropophilic *Pipistrellus pipistrellus* and *Pipistrellus kuhlii* and the forest bats *Hypsugo savill*, *Nyctalus lasiopterus* can install themselves in the nests placed.

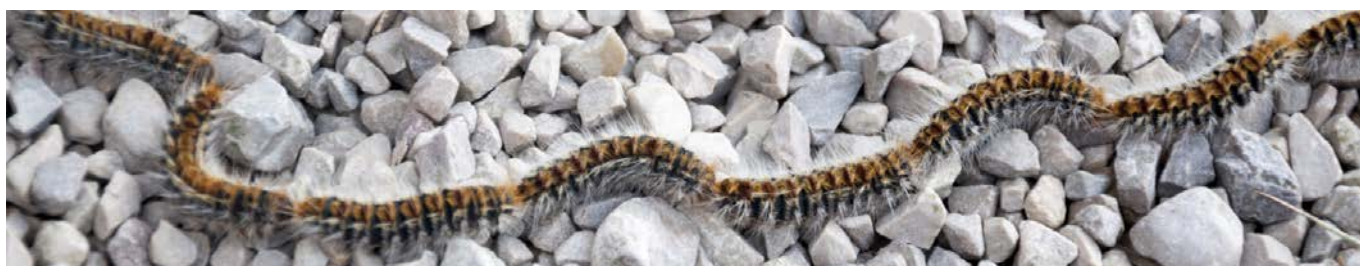
On the other hand, despite not being the most ideal to shelter *Myotis natterrei*, these could be sporadically used by the species during any period of the year. The diet of the species present in Spain is especially insectivorous. Only *Nyctalus lasiopterus* alternates the capture of insects with hunting passerine birds (Robins, Great tits...).

The trophic resources ingested by the bats depends on the type of habitat, the abundance of species of insects, the seasons, etc. Studies carried out on the diet of *Nyctalus leisleri* show that an important part of its diet is based on eating lepidopterans (13 – 46%) (Sullivan et al. 1993; Waters et al. 1999). These results are important for our objective. *Nyctalus leisleri* is a forest species whose presence has been verified on the Mediterranean coast.

The activity of this species begins very early, when night has not yet fallen, coinciding with the hours of activity of the Pine processionary moth (*Thaumetopoea pityocampa*). The forest character, the type of trophic resources it consumes and the ethology of *Nyctalus leisleri* increase the probability of capturing the Processionary moths. In the case of *Pipistrellus pipistrellus*, moths do not constitute a high fraction of their diet, representing approximately between 1 and 5% of its diet (Hoare 1991; Sullivan et al. 1993).

It must be taken into account that the trophic studies of *Pipistrellus pipistrellus* mentioned, have been carried out in Nordic latitudes where the abundance of Lepidopterans is scarce, existing notable differences regarding the eating behaviour of Mediterranean populations. On the other hand, it also must be taken into account that *Pipistrellus pipistrellus* is a pervasive species and does not select its prey nor its size. This means they feed on insects that are more abundant in each period of the year (Swift et al. 1985). This characteristic is very important, given that it acts as a regulator on the demography of insect populations.

The majority of the species detected in Spain hunt preferably in forest areas, forest clearings and forest edges. They also visit to a lesser extent fields and urbanised areas, where they can be observed catching their prey around the lights. Generally, their hunting grounds do not tend to be very far from the shelters they use, with the exception of *Tadarida teniotis*. It is capable of travelling very long distances and hunting at a great height (including 300 m above the ground).



The biological cycle of bats overlaps perfectly with the Processionary moth. The adult moths begin to fly and reproduce between June and September, a period in which the majority of the Chiropteran species have finished bringing up their offspring.

It is in this period of the year when a high depredation of insects happens due to a greater abundance of bats joining the adult population. Those that are born at the beginning of summer and the increased energy requirements of females and the young. The first, recuperating from lactation and the second, investing in their rapid growth, allowing them to survive winter with success.

SOURCES:

Luis Núñez Vázquez – Forest Health Service on the Balearic Islands.

Oscar de Paz y David Almena – Spanish Society for the Preservation and Study of Bats (SECEMU). Department of Zoology and Physical Anthropology. University of Alcalá de Henares (Madrid).

Egoitz Salsamendi, Joxerra Aihartza, Urtzi Goiti y Inazio Garin – Department of Zoology and Animal Cell Biology, University of the Basque Country.



Birds' nests



ECONEX BIRDS' NEST (Code: TA052)

The ECONEX BIRDS' NEST is made of wood and is especially designed to be able to hang it and withstand the elements. It can be placed in recreation areas, parks and gardens, as well as, farming plots, to benefit birds nesting and at the same time decreasing the amount of insects, both adults, larvae and pupae.

The birds, in addition to being great insectivores are also great destroyers of the seeds that turn into weeds.

MEASUREMENTS:

Width: 12.50 cm
Height: 18 cm
Depth: 15 cm
Entrance to the nest: 5.40 cm
Support at the entrance to the nest:
12.50 cm long and 1.10 cm diameter.



ECONEX NESTING BOX FOR INSECTIVOROUS BIRDS (Code: TA0190)



MEASUREMENTS:

Width: 12 cm
Height: 27.5 cm
Depth: 25 cm
Entrance to the nest: 3 cm
Support at the entrance to the nest:
2.5 cm long and 0.8 cm diameter.



ECONEX NESTING BOX FOR INSECTIVOROUS BIRDS (ECO) (Code: TA205)**MEASUREMENTS:**

Width: 16 cm / Height: 26 cm / Depth: 18 cm

Entrance to the nest: 3 cm

Support at the entrance to the nest: 1.4 cm height, 9.5 cm width and 1 cm depth.



THE BENEFITS OF INSECTIVOROUS BIRDS

Maintaining the natural balance in forests through the use of all the biological resources that nature has to offer us, is possible.

The insectivorous birds, whose task in the forest balance, as regulators of plagues is well known. It has been one of the most studied entomophagous animal groups. Some of these birds, like the Woodpeckers build nests with their powerful beaks; Tits, Chickadees, Nuthatches, Redstarts and Old World flycatchers are troglodytes. This means that they use natural gaps found in trees and thick branches to nest and protect themselves from bad weather or predators.

The importance of these birds is clearly reflected, by studying the stomachs of Bluebirds in which large quantities of *Tortrix viridiana* or *Catocala sp.* were found, amongst others.

Also, *Thaumetopoea pityocampa* caterpillars (Pine processionary) in their first stages, are very common in insectivores studied from autumn to winter. It has been estimated that the number of insects eaten by a couple of these birds in one year can be up to 5 kg.

These results show the usefulness of these birds in maintaining the biological balance in forests, which justifies the placement of artificial nests in forests. The nests successfully replace the lack of natural holes in trees, achieving a generalised increase in cave-dwelling, insectivorous bird populations. Also, their stability and presence in the forest ecosystem with the resulting benefit that this represents in the fight against harmful insects.



USING THE BIRDS' NESTS



The nests are used during campaigns to protect insectivorous birds, by increasing their populations through the installation of nests.

The use of nests is very generalised amongst Conservationist Societies, Ecological Groups, Universities, Vocational Schools, Town Halls, Education Centres, Summer Camps, Nature Classrooms, Youth Associations and in general anyone who is interested.

PLACING THE BIRDS' NESTS

There are no fixed rules on the most appropriate position the entrance hole to the nest has to have, given that it depends on a specific location. The East and South orientations are most common. Orientations frequently exposed to very strong winds, storms or any other unfavourable atmospheric conditions should be avoided.

In order to prevent slipping, it is advisable to install them in-between the secondary twigs of a branch or in the crotch of a tree. The height location seems to be irrelevant regarding the birds nesting. Although to avoid being handled by the inquisitive, in public places it is recommended that the nest be installed a minimum of 4 - 5 metres from the ground.

The right time to install the nests is in late autumn, so that the birds can use them for shelter during the winter period. Once they have been familiarised with their presence in the forest, they will be easily accepted for nesting next spring.



Services

MONITORING SERVICE FOR FOREST PESTS (Code: TA187)

SANIDAD AGRICOLA ECONEX S.L. has an expert technical team, made up of doctors and graduates of biology, technical engineers and technical specialists with a vast experience in forest entomology.

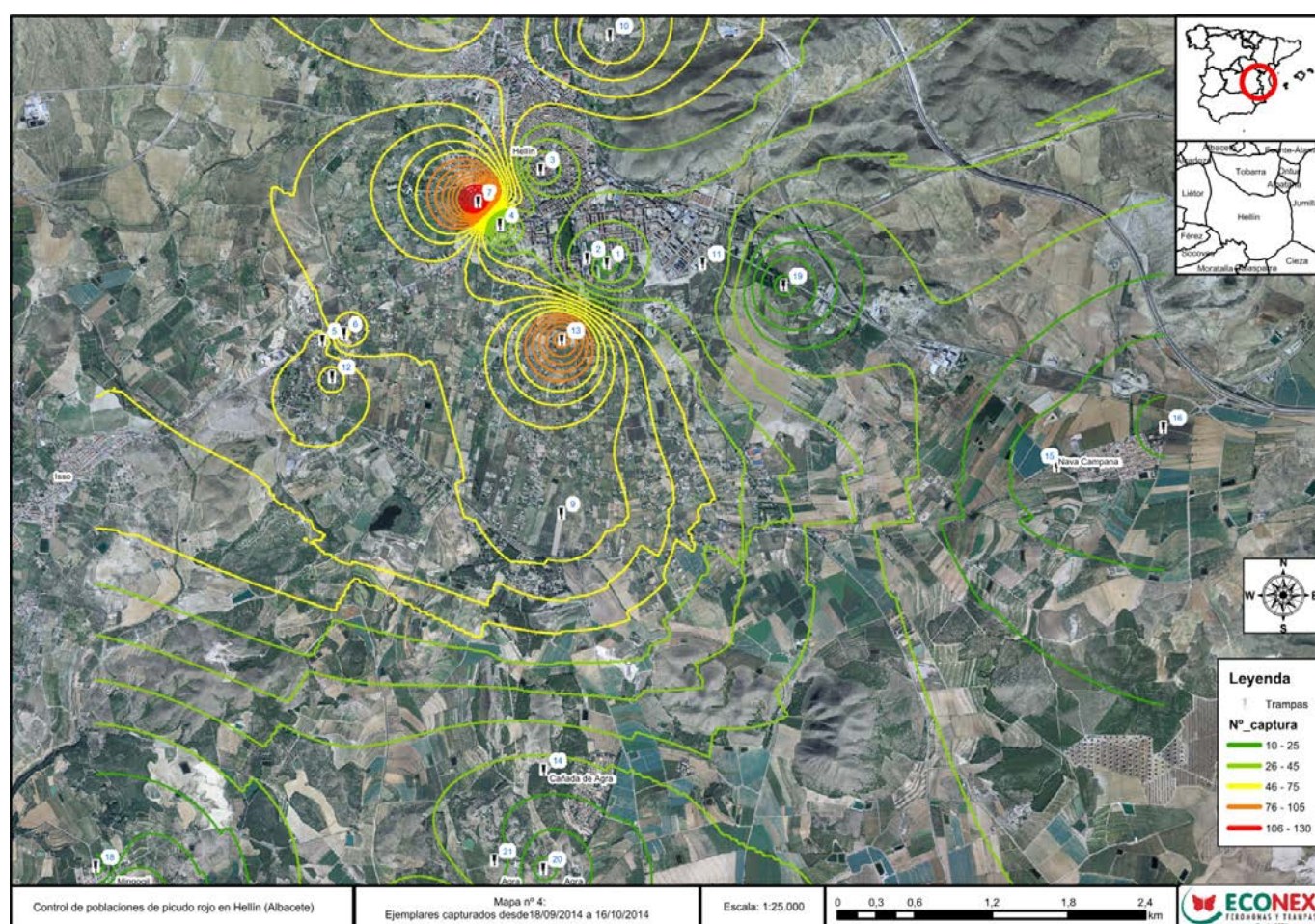


This human capital, equipped with vehicles and specialised material, permits ECONEX to offer its **Monitoring service for forest pests**, aimed at public and private forest health administrators, including universities and research centres



Although each service is personalised according to the client's needs (natural or forest environment, causing factor and type of damage), in general the service includes:

- Personal assistance from assigned personnel.
- Periodic and occasional field visits.
- Evaluation of damages, levels of infestation and thresholds of tolerance.
- Installation and trap monitoring.
- Evaluation and monitoring of the associated insect community (predators, parasitoids, competitors, commensals etc.).
- Digital map-making and modelling of the damage distribution.
- Writing reports.



With this service ECONEX covers the needs of highly qualified staff for problems relating to Forest Health.

In this way, the service offered is an important tool contributing to the knowledge or resolution of problems produced by organisms or harmful agents to forest plants, ornamental plants, unique and monumental trees, forests, protected natural areas and landscapes.

INSECT IDENTIFICATION SERVICE (Code: TA116)

SANIDAD AGRÍCOLA ECONEX, S.L. has an insect identification service that is specially directed towards all its clients and collaborators.

A good system of detection, monitoring and capturing pests begins with a precise identification of the insect causing the damages.

In addition to this service, we also advise our clients on the best strategies to follow to combat the identified pest with ecological methods.



INSTRUCTIONS FOR SENDING INSECTS

1. Describe as thoroughly as possible the environment where the insect to be identified is found, providing as many details as possible, including photos of the insect.
2. Whenever possible, a minimum of 2 or 3 samples should be sent.
3. Never mix various species in the same jar.
4. Place the adult insects in alcohol in an airtight jar. Butterflies and moths can be kept in a dry jar, inserting them with care not damage the wings into small envelopes.
5. Send the insects as soon as possible.
6. Send the packages so that they arrive on work days and if possible by 24h post. Protect the insects against possible blows during transport.
7. The sender should write as clearly as possible on the packet: Name, Address, City/Town, Postal Code and Telephone Number.

Samples should be sent to:

SANIDAD AGRÍCOLA ECONEX, S.L.
 Servicio de Identificación de Insectos
 C/ Mayor, Nº 15 Bis - Edificio ECONEX
 30149 SISCAR-Santomera · Murcia (Spain)



CONSULTANCY (Code: TA189)

ECONEX helps you to identify and investigate any problem related to the Biological Management of Forest Pests. It recommends the most appropriate measures for your specific case and provides the necessary assistance for the application of these aforementioned recommendations.



TRAINING (Code: FO001)

Specific Training Modules in Biological Management of Forest Pests for Courses and Training Programmes.



HUMAN RESOURCES (Code: RH001)

ECONEX is the first national company specialised in the Agricultural Employment market, covering with a high level of efficiency the process of recruitment and selection of qualified technicians, for their later incorporation into companies from the sector, regionally, nationally and internationally.

Agronomists · Agricultural technical engineers · Specialist agricultural technicians · Forest engineers · Technical forest engineers · Entomologists · Doctors of biology · Biologists...

Amongst other aspects, the selection process contemplates the needs of the position to be covered, the candidate's profile, personal, functional and technical development, interviews, references, reports...



PRODUCT SUPPLY

We supply all the necessary products for the Biological Management of Forest Pests.



In addition to having our own logistics network, ECONEX maintains good relations with the main national and international transport companies to be able to guarantee and offer the high level of service that their customers are used to in any part of the world.

DESIGNING MADE-TO-MEASURE SOLUTIONS

We can create a solution for you, adapted to your specific needs.

EXHIBITION ROOM

ECONEX has a large PERMANENT EXHIBITION ROOM, where visitors can touch and experiment with ECONEX products, at the same time as obtaining detailed explanations for solving specific pest problems. Always through methods that are respectful to the environment, using pheromone diffusers to attract the pests and traps to capture them.





The **SANIDAD AGRÍCOLA ECONEX, S.L.** team



SANIDAD AGRÍCOLA ECONEX, S.L. Head Office

DELEGATIONS



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International Delegations:



GREECE



MEXICO



PERU



PORTUGAL



TURKEY



UNITED KINGDOM



URUGUAY



ECONEX GENERAL CATALOGUE

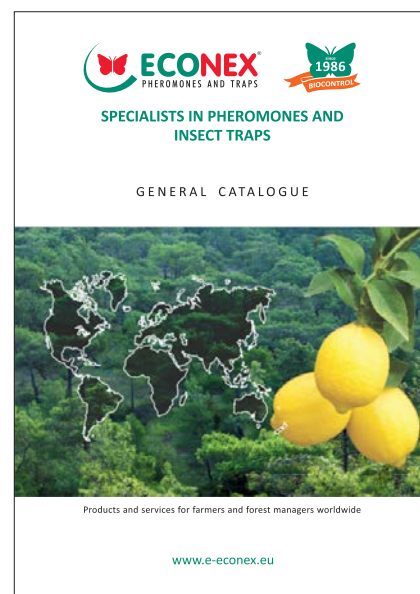
SANIDAD AGRÍCOLA ECONEX, S.L. is a Spanish technology-based company that was the brainchild of its founder Francisco Martínez Campillo in September 1985. In January 1986, it was established as an individual firm until the year 2000 when it assumed its current status as a limited company.

Specialising in pheromones and traps for the detection and monitoring of pests that affect agricultural crops, forests, stored products and environmental health. We investigate, develop, manufacture and commercialise our products, while always being committed to the environment.

From specialisation and constant study of possible improvements for the biological management of pests, with the most advanced technology and design in pheromone diffusers, traps for insects, auxiliary products, training and Human Resources department, ECONEX offers the result of many years of investigation and development, as well as the perfect amount of technical means and comprehensive advice.

We feel very proud of our team of experts, these being the cornerstone of the organisation and a most highly valued asset by our customers.

Therefore, our company continues to develop according to our master plan for growth in the future, this plan fundamentally includes: continuing to develop new products for the markets we serve; securing our position of technological leadership and continuing to promote the professional development of our team of professionals.



The **Econex Products and Services General Catalog** has an extension of 226 pages, and can be downloaded, in PDF format, from our website: www.e-econex-com.

It is also available in CD version (PDF format), which you can request for free.

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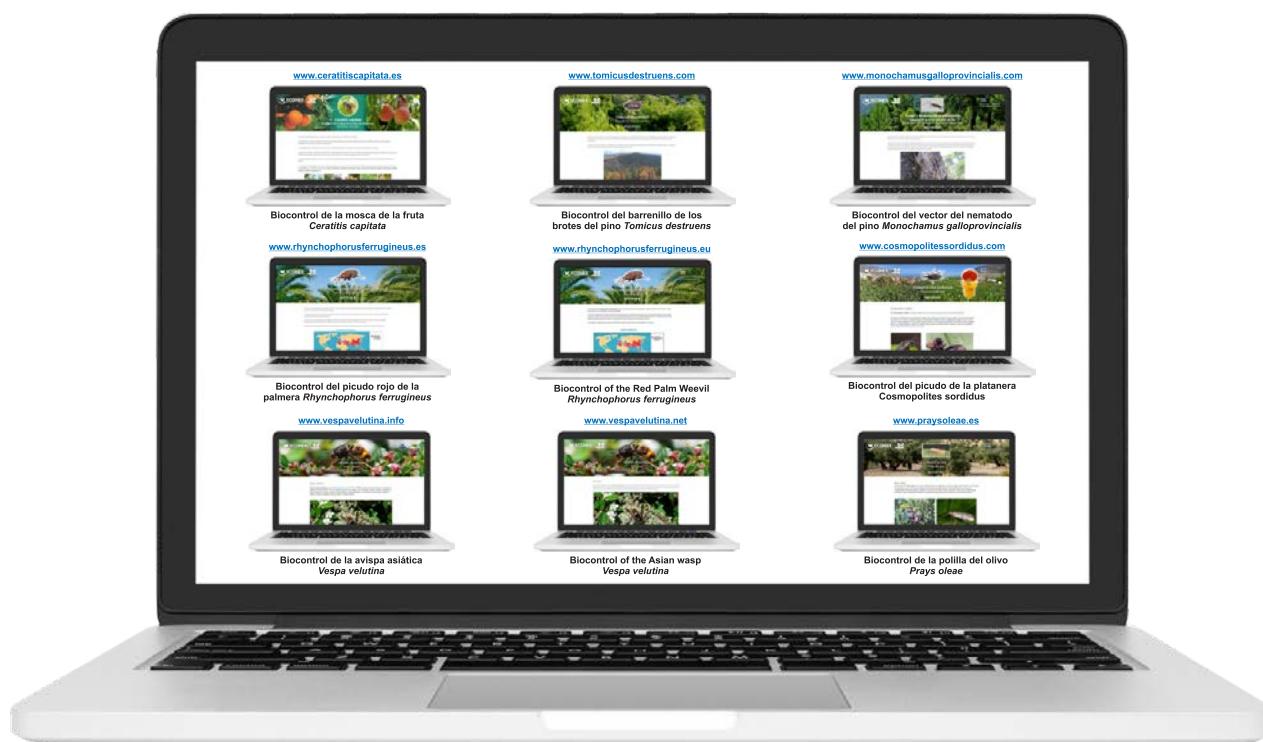
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ECONEX WEB RESOURCES

One of our main objectives we consider a priority in this company is **to educate our customers and help them find the best solutions for their problems with pests**. For which we are continuously developing **specific websites** of the most relevant agricultural and forest pests, in which we offer detailed information of their behaviour, morphological and biological characteristics, affected crops, damages they cause, and ECONEX solutions for their biocontrol.

These web resources can be accessed through the **"ECONEX WEBSITES"** section located at the top of our corporate website www.e-econex.eu.



CUSTOMER SERVICE

One of the more pleasing aspects we care about in our organization is that of customer care. For this reason ECONEX have a specific “**CUSTOMER SERVICE TELEPHONE**”.

The main purpose of this service is to manage our customers' orders as quickly as possible, as well as, providing more information and answering any query related to our products and services:

**ORDERS · BUDGETS · RATES · ADVICE · INFORMATION ·
GENERAL CATALOGUE · PHEROMONES · SPECIAL
ATTRACTANTS · TRAPS · NATURAL LURES · TRAINING ·
CONSULTING · SERVICES ...**

+34 900 502 401

Opening hours from Monday to Friday:
9 am – 2 pm and 4 pm – 7 pm



SALES CONDITIONS

ORDERS: They will be formalized by fax, e-mail, letter, telephone or through our online store.

SHIPMENTS: Freight paid from 300.00 euros on the Iberian Peninsula, for other destinations consult.

PAYMENT METHODS: Cash on delivery for small amounts, transfers and direct debit for large amounts.

DELIVERY TIME: Iberian Peninsula, 24/48 hours. Other destinations consult.

GUARANTEES: We assume any problem related to transportation, replacing any deteriorated merchandise.

24 / 48 h. Mainland Spain
Service

Please ask for other destinations



Customer Service: **+34 900 502 401**

www.e-econex.eu



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PRODUCTS MANUFACTURED IN SPAIN