LIFE14/NAT/IT/001128 STOPVESPA
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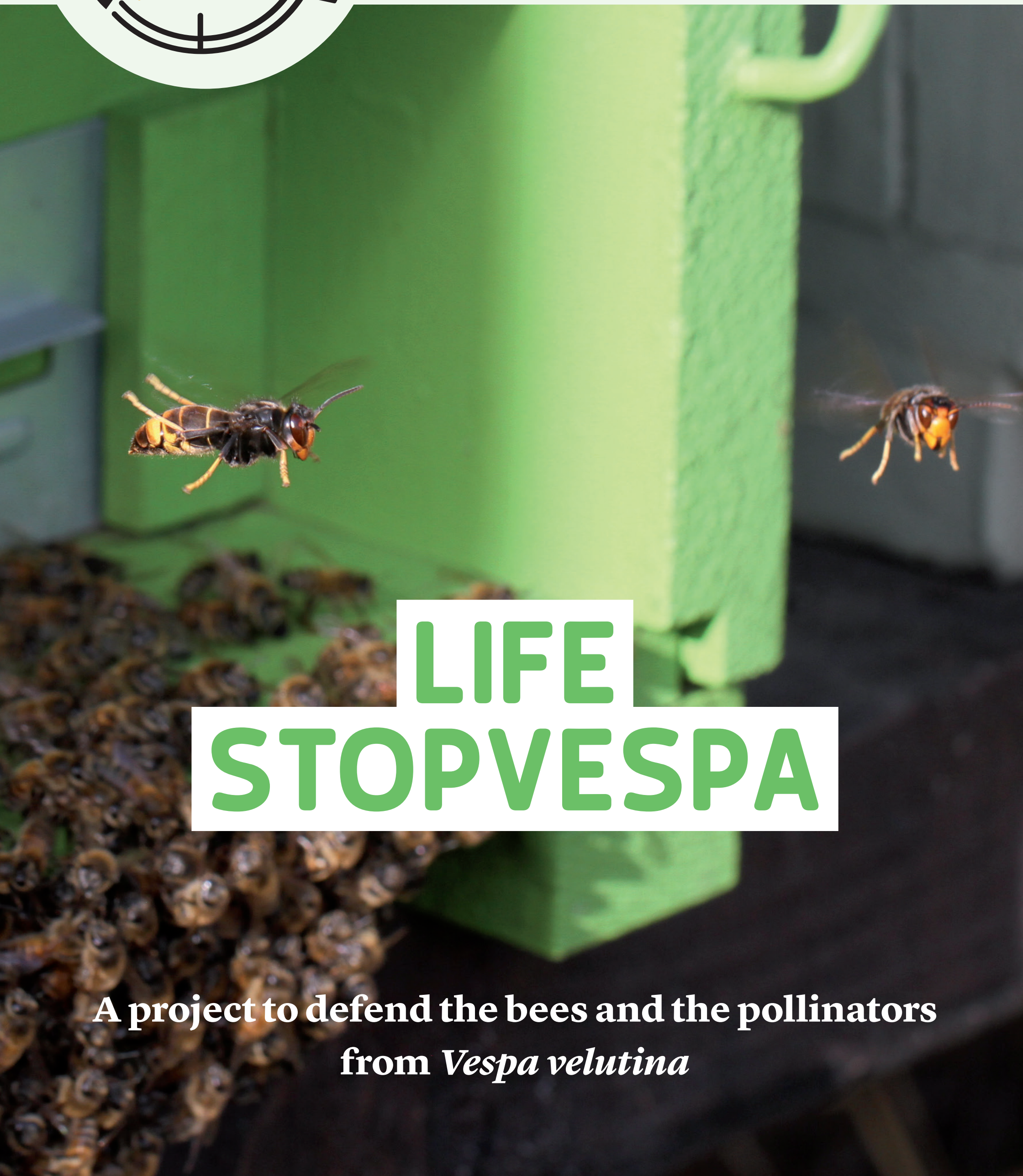

LIFE STOPVESPA

A project to defend the bees and the pollinators from *Vespa velutina*

Realized with the contribution of the LIFE
PROGRAMME of the European Commission

Cover image: M. Porporato

Insects in safeguard of biodiversity

Since the '90s, the scientific community has been urging the public opinion with the aim to increase its awareness on topics of environmental relevance such as the consequences of climate change and biodiversity losses, which are factors that are causing irreparable damages to both natural environments and human society alike.
On this matter, more and more often the bees are mentioned for their role as ***bioindicators*** *and for their contribution with the* ***pollination activity*** *for the preservation of* ***biodiversity****. In these pages, we will try to understand the meaning and importance of biodiversity, and why it is strictly related with honeybees, on which we will focus most of our attention.*
*The introduction of a new species, defined as "****invasive****", that preys upon insect species, is an additional risk to the fragile equilibrium of honeybee colonies, which are already damaged by the indiscriminate use of pesticides and by habitat loss.*
By the end of this read, each one will be more informed on environmental matters and could contribute firsthand to the preservation of the environment and the biodiversity.

What does biodiversity mean?

A LITTLE KNOWN MEANING

Biodiversity is the variety of living organisms that populate the Earth, and it is measured at the level of genes, species, populations and ecosystems. All together, these levels form an incredible variety of organisms, plants, animals and ecosystems, all connected one to the other, and all essential. Also humans are part of the biodiversity and benefit from it. Thanks to biodiversity, Nature is able to give us food, water, energy and resources for our daily life.

HOW MUCH BIODIVERSITY THERE IS IN THE WORLD

Several studies affirm that the number of living species on our planet could vary from 4 to 100 million, but only a small portion is known (1.5-1.8 million).

A WORLD IN DANGER

It has been estimated that an average of 50 species disappear from the planet every day. The extinction is a natural event, however the problem rise when its rate increase too much: currently, biodiversity is decreasing at a rate of 100 to 1,000 times faster than in the past. This leads to the hypothesis that we are facing an extinction rate higher than what our planet has experienced in the last 65 million years – even higher than the one that caused the end of dinosaurs.

Italy, land of biodiversity, but of many threatened species

Among European countries, Italy is one of the countries with the highest amount of biodiversity, hosting respectively half and a third of all plant and animal species of Europe, respectively. However, this abundance is seriously threatened and parts of it is at risk of being hopelessly lost.

WHAT ARE THE GROUPS AT RISK OF EXTINCTION?

31% OF THE VERTEBRATES

15% OF VASCULAR PLANTS

22% OF NON-VASCULAR PLANTS (ALGAE, LICHENS AND MOSSES)

BIODIVERSITY IS THREATENED

The main factors that contribute to the loss of biodiversity, for both animals and plants, on a global scale are:

• habitat destruction, degradation, and fragmentation
• introduction of alien invasive species
• climate change
• pollution
• indiscriminate use of natural resources

How to stop biodiversity loss

During the United Nations meeting held in Rio de Janeiro in 1992, a treaty was written: the **Convention on Biological Diversity**, which until now has been signed by 193 nations. In 2003, during the Sixth International Conference of the Nations that signed the Convention, 123 governments committed their political agenda to significantly reduce biodiversity losses at a local, regional and national scale. Since 2010, Italy has adopted a national strategy for biodiversity, following the commitments of the 1992 treaty.

Small actions, big results

Each of our **daily actions** has an effect on biodiversity. Therefore, there is no need to completely change our lifestyle and habits to make the difference. Small actions are very important, starting from reducing our impacts on the environment and the carbon footprint, through buying local and seasonal products, reducing energy consumption and waste production.

Biodiversity and invasive alien species

The term "alien" is not only relegated to science fiction: it can be found in the real world as well, and has different meanings according to the context in which it is used. Generally, it indicates anything foreign to a specific environment. The introduction of alien species is one of the main causes of biodiversity losses in ecosystems. These species can cause huge damage to **indigenous species** – species native of a certain area – by competing for the resources, by predation, by spreading pathogens and by causing genetic pollution.

In Europe, there are more than 12,000 **alien species**, and roughly 15% of them is causing serious damage to biodiversity, becoming then an **alien invasive species**. Due to those species, **one in five European native species is threatened by extinction**. It has been calculated that, in the last 400 years, **more than half of the extinctions that occurred have been caused by invasive alien species**.

Let's learn some terminology

Red squirrel

Eurasian collared dove

Palm weevil

NATIVE (INDIGENOUS) SPECIES

Species that **naturally** populate an environment without having been introduced by humans, either intentionally or accidentally.

EXOTIC SPECIES

Species **introduced** into an area where they do not occur naturally, without necessarily causing damage to the receiving ecosystem.

INVASIVE ALIEN SPECIES

Species **introduced**, either voluntarily or accidentally, by humans into an environment differing from the area of natural presence, **causing issues** from the ecological, economic and social points of view or to human health.

Bees and men, a bond that goes back for centuries

The relation between humans and bees started a very long time ago and it developed into **apiculture**, keeping bees to harvest what they produce. Bees **do not produce just honey** but also pollen, propolis, royal jelly, wax and venom, and provide also plant pollination, which is a fundamental service for the ecosystem.

By pollinating several wild plants and crops, bees improve and maintain **biodiversity**. Scientific studies show that more than 75% of all the food globally produced relies somehow on animal pollination. Specifically, bee-mediated pollination has an estimated value of:

153 billions at a global level
14.2 billions in Europe
1.5 billions in Italy
(all values in Euro; sources INRA, UFZ, FAI)

BEES AS SENTINELS FOR ECOSYSTEMS AND PEOPLE

The bees, as they fly to gather nectar, pollen, water and resin, get in contact with a wide variety of materials in the environment: soil, vegetation, air and water. With this capillary sampling activity, bees are regarded as accurate bioindicators for the environment. Their sensibility towards pesticides, often resulting in sudden death, can be used as a warning for humans as well.

THE ITALIAN LEGISLATION RECOGNIZE BEEKEEPING AS AN ACTIVITY OF NATIONAL INTEREST, USEFUL FOR THE PRESERVATION OF NATURAL ENVIRONMENT, ECOSYSTEMS AND AGRICULTURE. ONE LAW IN PARTICULAR (L. 313/2004) AIMS TO GUARANTEE NATURAL POLLINATION AND BIODIVERSITY OF BEE SPECIES.

The first invasive hornet species in Europe

Bees in Europe are facing a new enemy, adding a threat to the already present habitat loss and pathogen rise.

Vespa velutina, also known as the "yellow-legged hornet", is an **invasive alien species** native of South-East Asia. Reported for the first time in 2004, it is believed that the species reached France traveling with a shipment of clay pots from China. The expansion in France was dramatic, gaining roughly 100 km every year, and quickly reaching Spain, Portugal, Belgium, Germany, Great Britain, and Switzerland. In 2012, some hornets were discovered for the first time also in Italy in Liguria, just next to the French border.

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Why it is so dangerous

Bees are among the preferred prays of the yellow-legged hornet: they represent 33% of its total diet in rural areas, but they could increase to 66% in urban environments, where other prays are rare. *Apis mellifera* subspecies present in Europe are completely vulnerable to this new and unexpected enemy, unlike the eastern honeybee (*Apis cerana*) that, by co-evolving for thousands of years with the hornet, has developed some defense behaviours.
The yellow-legged hornet primarily catches foraging bees returning to the hive. They hunt by hovering in front of the hive entrance, grasp the bees on the fly and kill them with their jaws. Afterwards, the hornet lands nearby and starts trimming the prey, removing parts with little or no value. Normally only the thorax is kept because it is rich in muscle tissues, which are required for flying; the thorax will be mashed up and used as food for the development of the brood inside the nest.
The predation activity towards the bee colonies leads to a decrease of the colony health, by slowing down or blocking its activity as well as reducing the bee number. With less foraging bees and food sources, the queen reduces her egg-laying rate and the colony gathers less supplies for the winter months. Jointly, these factors may well severely weaken a colony and ultimately lead to its collapse.

WHY SHOULD WE FIGHT IT?

The spread of *Vespa velutina* has to be stopped since the species has no natural enemies in Europe and it can cause serious damage to both environment and beekeeping. For this reason, the European Union recently **blacklisted** the yellow-legged hornet, officially recognizing it as an invasive alien species that should be kept under control and possibly eradicated as it could cause consistent economic and environmental damage (Regulation EU 1143/2014, 1141/2016). The total economic damage caused in Europe by invasive alien species adds up to **12 billion € every year.**

NOT ONLY HONEYBEES ARE THREATENED

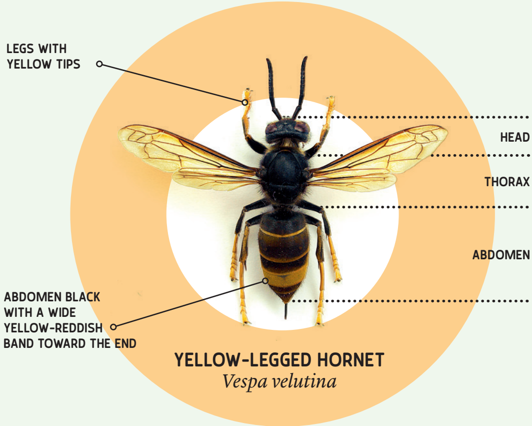
Honeybees are not the only insect species preyed by *Vespa velutina*. Many other useful insects, such as **wild pollinating bees** (e.g. solitary bees) and other wasp species, that act as biological control agents, are preyed by the hornet.
Moreover, we should not forget that the yellow-legged hornet is dangerous for humans just as much as native hornets are. Normally they are not very aggressive, but they become very dangerous in close proximity of the nest, where they could perform group attacks that may create serious consequences, especially for allergic people.
Finally, adult wasps feed on **carbohydrates**, so they can damage ripening fruits and berries.

Let's compare bee predators

Vespa velutina, the yellow-legged hornet, is a new invasive species of hornet that could be easily confused with the European hornet, *Vespa crabro*, even if its appearance and flight behaviour are quite distinctive. By carefully observing the insects, it is possible to distinguish the two species.

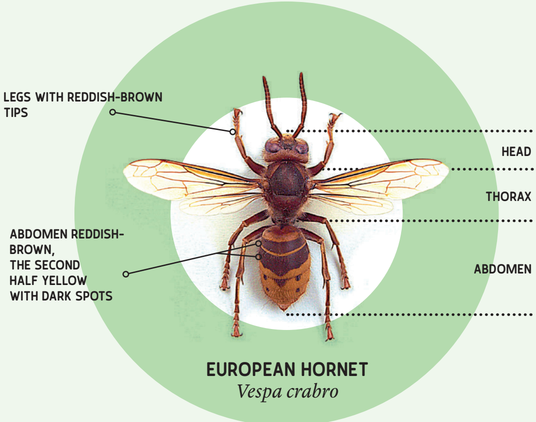
VESPA VELUTINA

The yellow-legged hornet is characterized by a dark brown thorax, almost verging on black. The first three abdominal segments are dark brown, with the terminal part yellow or orange. The fourth segment is almost entirely yellow/orange, and the terminal part darkens, becoming dark red/brown. The legs are dark too except for the distinctive yellow tarsi (the terminal part of the legs). This detail has gained the hornet its common name "yellow-legged hornet". The head is black and the face yellow. The antennae are black on the upper side and brown on the lower one. The workers' length can vary between 19 to 30 mm.



VESPA CRABRO

The European hornet is characterized by a red and dark brown abdomen, which becomes yellow with dark spots towards the terminal part. These spots are characteristic of each individual. The legs are completely brown. The head is yellow, with a darker orange/brown tint in the upper portion. The antennae are reddish brown. The workers' length can vary between 20 to 25 mm, while queens can reach 50 mm.



How the nests are made

VESPA VELUTINA NESTS

The yellow-legged hornet grows its colonies inside papery texture nests. Initially, the nests are as small as a ping-pong ball but, in autumn, they could reach 80-100 cm of diameter. The shape of the nests could be different, either circular or extended on the horizontal plane. Generally, the nests are built on trees, but they can also be found in the outer side of buildings and sometimes inside manholes, canopies or near the ground.
The distinctive characteristic that allows us to recognize the nests from those of *Vespa crabro* is the lateral position of the entrance hole, with an exception during the initial stage of construction, when it is placed on the bottom.

VESPA CRABRO NESTS

The nests of the European hornet have also a similar papery texture and, initially, they are of the same size like a ping-pong ball. *Vespa crabro* builds the nests in cavities or sheltered places that protect them from bad weather (tree holes, chimneys, wall cavities, shutters, windows, doors, etc.). The shape of the nest always depends on the shape of the cavity where it is built, but the distinctive characteristic is the position of the entrance hole, always on the bottom of the nest.

Learning about the life history of *Vespa velutina*

The life history of *Vespa velutina* starts in **spring** with the construction of the nest by the foundress queen that survived the winter; this nest is generally defined "**primary nest**". If the nest is located in an unsuitable and disturbed area, the colony could subsequently abandon it and rebuild the nest in a safer position, generally higher from the ground. When the nest reaches the size of 25 cm and the entrance hole is laterally positioned, it is generally defined "**secondary nest**". With the increase of the colony members, the nest is progressively enlarged until reaching its maximum size by the end of autumn. On average, the colonies are composed of 6,000 hornets, but they may reach more than 13,000 units in a year.

From August on, the colony begins to produce the reproductive individuals that will give continuity to the species: initially the males and subsequently the future queens, which are in average 200 per nest but can reach also 500 new founder queens.

The new queens, after mating with one or more males, search for a sheltered place suitable to overwinter in a dormancy state known as diapause. Between late autumn and early winter, the old queen, the males, and the workers progressively die and the colony collapse.

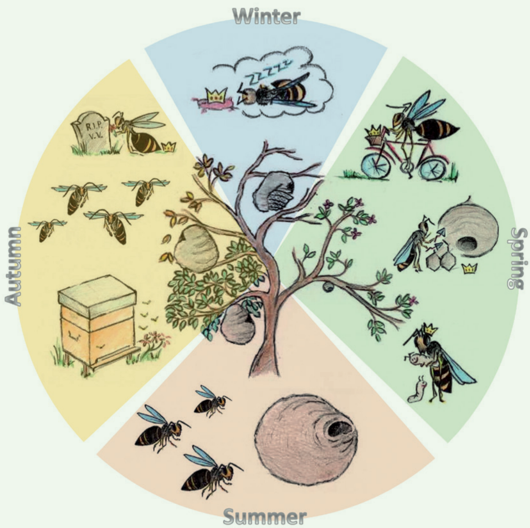


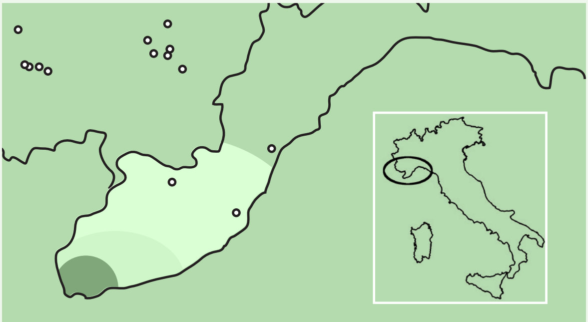
PHOTO 1: M. PORPORATO - PHOTO 2: S. ANFOSSO - PHOTO 3: L. CROCE - PHOTO 4: G. GRASSO

A project to contain the invasion

Since 2007, the Department of Agricultural, Forest and Food Science (DISAFA) of the University of Turin monitored the spread of the yellow-legged hornet in Italy. This activity allowed to define the **LIFE STOPVESPA** project, which was approved and financed by the European Commission in 2015. The project, coordinated by DISAFA, involves as associated beneficiaries the Polytechnic University of Turin (Department of Electronics and Telecommunications), the apiary of the Benedictine Fathers Holy Mary Abbey of Finalpia (Savona) and the Beekeeping Association of Piedmont (ASPROMIELE).
The planned actions will allow to collect and elaborate data about *Vespa velutina*, monitoring its diffusion, define an early warning and rapid response system and develop new intervention procedures for nest detection and neutralization, in particular a harmonic radar able to track the hornets flying back to their nests.
The monitoring network and the communication activities will also involve beekeepers and their Associations, Parks, Regions and Provinces, Civil Defence Units, Authorities and citizens in general.

IN PROGRESSIVE EXPANSION

The main **expansion areas** are the **west of Liguria** and the **south of Piedmont**, but in 2016 some adults have been found also in the provinces of Turin and **Rovigo**.



PAY ATTENTION TO HITCHHIKING

Beside natural diffusion, *Vespa velutina* may spread also by **passive transport** of founder queens (accidental human transport).
From colonized areas, the insects may "travel" hidden inside different kinds of goods (hay, straw, wood, plant material, etc.) along the main transport routes, establishing new populations even hundreds of miles away.

THE LIFE PROGRAMMES ARE THE FINANCIAL INSTRUMENT INSITUTED BY THE EUROPEAN UNION TO SUPPORT MULTI-YEAR PROJECTS FOR THE CONSERVATION OF THE ENVIRONMENT AND NATURE THROUGHOUT ITS TERRITORY. SINCE FEW YEARS, THE LIFE PROGRAMMES SUPPORT ALSO PROJECTS THAT AIM TO CONTROL INVASIVE ALIEN SPECIES AND REDUCE THE NEGATIVE IMPACTS THAT THESE SPECIES EXERT ON ENVIRONMENT AND BIODIVERSITY.

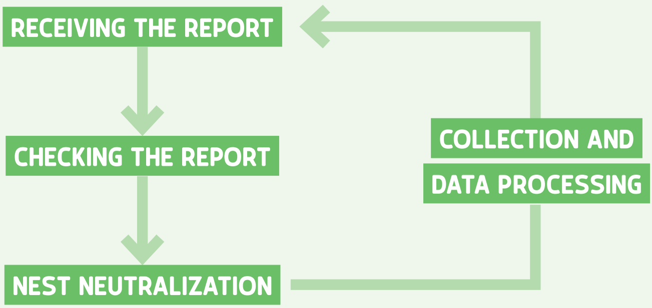
How STOPVESPA will act

The project schedules to contain the expansion of the yellow-legged hornet, by adopting a rapid and effective response strategy, with the **organization of a system able to monitor and control** the populations. Specific trained teams act in the control activities, in order to **neutralize the colonial nests**.
The development of a **harmonic radar** will allow to increase the efficacy of nest monitoring, especially in areas where people have difficulties to observe and report them.

The management of *Vespa velutina*

The LIFE STOPVESPA project is developing a rapid response model for the effective management of *Vespa velutina* in Liguria and Piedmont.
The management strategy, which must take the **simplicity of the procedures** and **rapidity of action** into account, must be **exportable at the national level** if the species will spread to other Italian regions and must be **economically viable**.

At the moment, the most effective system seems to be the one adopted by some French departments, with a management at the level of local administrations. The reports arrive by telephone (toll-free telephone number) or by e-mail to a local operator (e.g. Region, Province, Association of Municipalities), who cares to verify the reports through other local operators. If it is confirmed that the nest belongs to *Vespa velutina*, a request of intervention is sent to a trained neutralization team or to Civil Defence Units, Firemen, private companies,..., depending on the type of intervention planned.



ACTIONS SCHEDULED BY THE LIFE STOPVESPA PROJECT

- **Coordination** of the reports, **management** of the interventions and data processing.
- Development of an **Early Warning and Rapid Response System**.
- **Nest monitoring** and detection with the use of the **harmonic radar**.
- Public awareness throughout **communication and environmental education activities**.
- **Nest neutralization with trained teams** operating in Liguria and Piedmont.
- Possibility to act in small areas of **other Italian regions** with the **Vespa Emergency Team**.
- **Assessment of the impacts** caused by *Vespa velutina* on **beekeeping** and **biodiversity**.
- Establishment of a widespread **monitoring network**.

Technology in the service of tradition

In rescue of the bees and the Italian beekeeping tradition, the Polytechnic University of Turin is developing a new prototype of **harmonic radar** able to track the flight of hornets equipped with a suitable passive transponder (tag), in order to locate their nests.
The harmonic radar transmits a series of short **pulses** at a given frequency and receives in response the signal retransmitted by the small **tag** attached to the back of the hornets (the tag is a small copper wire appropriately connected to a diode).
The harmonic radar allows following the signals received from the hornets equipped with the transponder directly on a laptop screen and record their track, eliminating other signals due to environmental noise.
The tests carried out have shown that **the transponder does not affect the flying abilities** of the hornets or limit their functions, thus allowing to **find again the same specimen even after several days**.

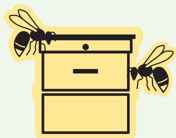
THE DISTANCE BETWEEN THE HORNETS EQUIPPED WITH THE TRANSPONDER AND THE RADAR IS CALCULATED BY EVALUATION OF THE TIME REQUIRED BY THE SHORT IMPULSE TRANSMITTED BY THE RADAR TO BE RECEIVED AND RETRANSMITTED BACK TO THE RADAR AT A DOUBLE FREQUENCY, THOUSAND TIMES PER SECOND.
THE TRANSPONDERS’ ANGULAR POSITION (AZIMUTHAL) IS CALCULATED BY EVALUATING THE ARRIVAL DIRECTION OF THE PULSES EMITTED BY THE RADAR AND RECEIVED DURING EACH ROTATION, WHICH LAST ABOUT ONE SECOND.
THIS LARGE AMOUNT OF INFORMATION IS ANALYZED IN REAL TIME AND ALLOWS TO IDENTIFY THE PREFERENTIAL FLIGHT DIRECTIONS OF THE HORNETS, WHICH INDICATE THE POSITION OF THE NEST.

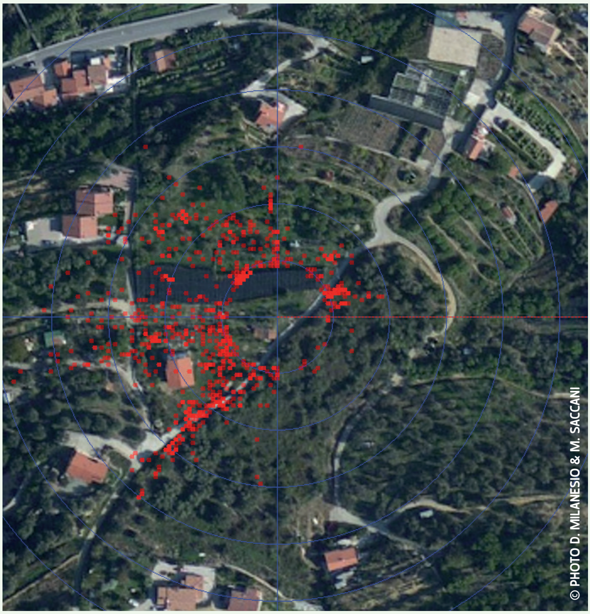
RAPID AND EFFECTIVE OPERATIONS

The transponders are fixed to the hornets using a special glue without anesthesia, so that the insects can fly again immediately. The radar survey allows observing the tracks of the flying hornets in real time.

The aim of the new prototype of harmonic radar, developed by the LIFE STOPVESPA project, is to succeed in following the hornets up to 500 metres of distance. The radar is movable, therefore it can be repositioned along the hornets' flight path if the nests are beyond the range of detection.

The radar has been designed and realized in order to operate in different types of environments, even in rugged areas rich in vegetation. For this reason the radar coverage on the vertical plane allows to scan an area with a high angle in respect to the horizontal plane.

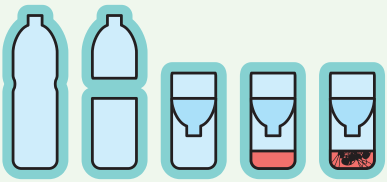




Your help is important

The chances of success in the control of an invasive species are higher if the **number of citizens willing to observe and report is greater**.
Everyone can collaborate in the monitoring action of *Vespa velutina*, by placing traps with beer since March in the environments usually frequented, checking them periodically to record the presence or the absence of the yellow-legged hornet. Beekeepers, the subjects directly damaged by this species, can monitor in particular near their beehives, but not only there.

The traps that can be used to monitor the presence of *Vespa velutina* are simple to build: plastic bottles filled with **beer** at 4.7% of alcohol as bait are particularly effective and economic to catch the hornets, without causing damage by trapping **honey bees and other bees**. To allow non-target species escaping the traps, it is advisable to create some holes of 5.5 mm of diameter on the sides of the bottle and place a floater in the beer. The bait must be replaced every 15 days.



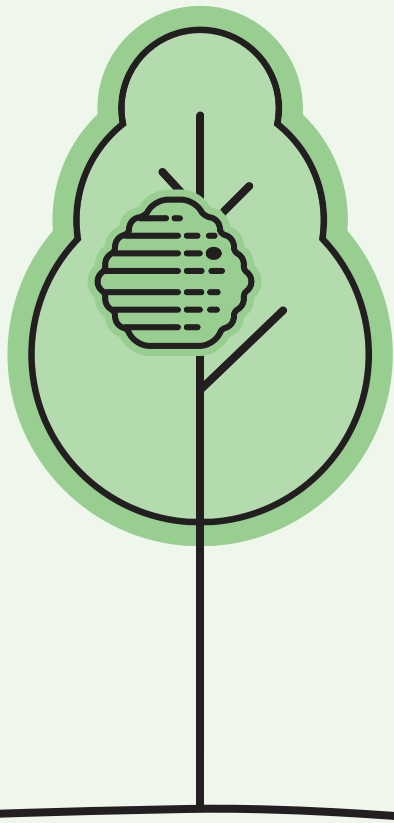
Construction of a bottle trap

Vespa velutina hunting in front of the hives

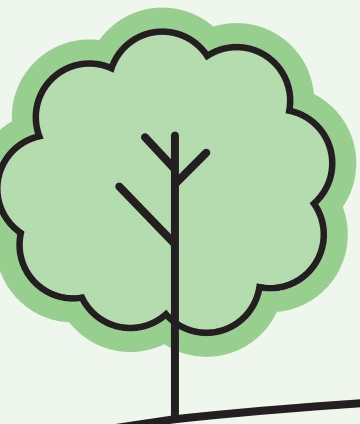
Bottle trap with protective cover

REPORTING IMMEDIATELY THE PRESENCE OF VESPA VELUTINA HUNTING IN FRONT OF THE HIVES, SYMPTOM OF THE PROBABLE PRESENCE OF A NEST NEARBY, MAY ALLOW TO RAPIDLY LOCATE THE COLONY AND AVOID ITS REPRODUCTION AND FURTHER DIFFUSION.

What not to do

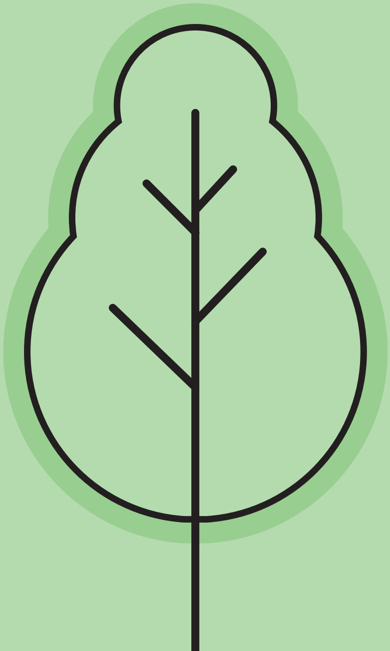


If you discover a colony of *Vespa velutina*, **do not get close to it**: the hornets may feel threatened and become aggressive attacking in mass.
Do not try to destroy the nest, contact the specialized staff trained to perform this kind of activity.



Only with everyone's help it is possible to effectively contain *Vespa velutina*.

Life STOPVESPA, a project for the bees, the beekeepers and biodiversity.



Report *Vespa velutina* observations
to the LIFE STOPVESPA project
The Vespa Emergency Team of LIFE STOPVESPA
is ready to act in case of necessity
www.vespavelutina.eu - info@vespavelutina.eu
telephone +39-011-6708586 - mobile +39-335-6673358