The pine forests of Rome: an ecosystem and a scenic beauty under threat

Giuseppe Scarascia-Mugnozza[1] & Riccardo Paganini[2]
[1]EFI Biocities & University of Tuscia
[2]SmarTrees srl

Pinus pinea in the Italian and Rome landscapes

Stone pine forests (*Pinus pinea* L.) as well as individual trees of this beautiful Mediterranean pine have characterized the Italian landscape since Roman and pre-Roman times. Most landscape historians and naturalists believe that this pine is native to the eastern Mediterranean; and yet it was introduced and spread in central-southern Italy by the Etruscans and Romans, so that it became very common along the Italian coasts and an iconic element of the Italian landscape and in cities such as Rome and Naples. Since ancient times, therefore, this pine, with its typical flat and horizontally expanded crown architecture, often in contrast to the narrow, columnar crown of cypress (*Cupressus sempervirens* L.), has been used as a sacred plant and for aesthetic reasons. Stone pine has also been used for food, the production of pine nuts considered "food of the gods" and for timber such as masts for ships. It became valuable for the fight against soil erosion for the reforestation of the sand dunes along the Lazio and Tuscan coasts, and for the street trees of our cities. In Rome, pine trees and pine forests are so widespread that they have given their names to entire neighbourhoods (e.g. Pigneto), parks (Pineto with Pineta Sacchetti) and even forests, especially along the coast, such as the pine forests of CastelFusano, CastelPorziano and Ostia.

However, those trees and ecosystems, so precious and spectacular, are subject to numerous risks and dangers that challenge their vitality and, therefore, their resilience, with important implications for the safety of city infrastructure and people: forest fires that can spread to surrounding houses and infrastructure, favoured by the accumulation of dry or dead biomass; more frequent windstorms, with the fall of trees or large branches along the routes most frequented by the population, to which older and larger trees are particularly affected; attacks by parasites, fungi and insects, often coming from other continents, and transported ever faster, thanks to the exponential growth of global travel and transportation; inadequate or even incorrect management of city trees along the streets, squares and in parks. In the last few years, a new parasite has also arrived in Italy, the pine tortoise scale, which is causing very serious damages to our pine forests and to our tree-lined avenues, typical of many districts of Rome.

Figure 1 – *Pinus pinea* (Italian stone pine) forests in Rome.

An alien pest devastating Italian stone pine trees and forests

The pine tortoise scale (*Toumeyella parvicornis* (Cockerell)) is an insect native to North America which has recently expanded its range towards Central America and the Caribbean islands. It then arrived in Italy, around Naples, probably in 2014, from where, in the total absence of natural parasites and, above all, in the presence of favourable climatic conditions, in a few years it expanded towards other regions, including Lazio and the metropolitan area of Rome, without encountering obstacles to its rapid diffusion.

Presently, *T. parvicornis* is found in the regions around Naples and Rome, where it has devastated most of *P. pinea* street trees, parks, and forests. According to the EFSA Panel on Plant Health the pine tortoise scale is also present in other regions of Central Italy and was recently also found in Southern France, although it is debated whether it spread from Italy or was a separate introduction.

The monitoring data collected in recent years have shown how the territorial expansion proceeds with worrying speed, by as much as 4 to 5 km per generation, mainly due to the passive diffusion of the first juvenile stage due to the action of the wind, as already noted in its native area and in other invaded territories. This tortoise scale, with round shape, brown colour and approximately 4–5 mm long as an adult, is particularly harmful because in optimal climatic

conditions, it can have continuous generations, up to 3–4 per year, thus expanding exponentially the population and therefore parasitic attacks on pine trees.

Being so small, the individuals, especially young ones (nymphal instars), can also be easily transported by the wind, by other animals or even by motor vehicles, which allows their rapid diffusion even in areas contaminated only recently. Therefore, in city districts the most affected trees are found along the main roads, highways and around parking lots. Having reached the new settlement site, the nymph fixes itself to the substrate through the biting-sucking mouthparts. The male specimens settle generally on the pine needles while the females lie on the woody part of the young shoots of the plant, but it is not uncommon to find females on the needles and males on the twigs. The adult male, winged and already sexually mature, begins to move freely in search of a mature female partner with which to mate. Generally, the egg-adult cycle lasts about 8 weeks, and the first eggs of the season hatch in spring, around May, but the generations often overlap from the second onwards, thus almost all the phenological stages may be present on a given tree at the same time. Although *T. parvicornis* exhibits a remarkably wide climatic tolerance, occurring in tropical, subtropical, and temperate areas, meteorological conditions generally control its diffusion during the growing season. In fact, hot temperatures above 35°C and drought conditions significantly limit its growth cycle. Cool temperatures and heavy rainfall, particularly in spring, result in a much-delayed breeding season by physically removing the young individuals from the pine twigs.

T. parvicornis is a naturally controlled insect in its original geographic area but being new in Europe, where it is considered an “alien” species, its populations do not encounter other natural predators or parasitoids that can function as natural limiters. As a result, it can cause great damage on our pine trees and pine forests.

The abundant production of honeydew, a sugary exudate produced copiously, especially by adult females, with subsequent formation of sooty mould, reduces the photosynthetic capacity of the leaves, results in early needle death and reduced or lack of growth of the annual shoots. In an urban environment, infestations can also cause great discomfort for residents and users of urban forests and trees, as honeydew and sooty mould smear with dirt and disfigure surfaces, artefacts, and related recreational spaces under the pine crowns.

Figure 2 – Dead pine trees in the Castelporziano Reserve, near Rome, after attack by *Toumeyella parvicornis.*

Pines, within a few years, their crowns reduced to a few apical tufts, become highly susceptible to other parasitic attacks, among which attacks by the pine shoot beetle, *Tomicus destruens* (Wollaston). The pine shoot beetle has been the main pest attacking *Pinus pinea* during the past 30 years in Italy, but its impact has become less evident after the spread of the tortoise scale from 2014. However, it is still a dangerous pest for pine trees, while its symptoms become apparent as soon as individual pine trees become weakened by the attack of tortoise scale.

The species *Pinus pinea* seems to be highly susceptible to the tortoise scale; however, other pine species seem also to be affected by this scale, for example *Pinus sylvestris L.*, *Pinus pinaster* Aiton, *Pinus nigra laricio* (Poir.) Maire and *P. mugo* Turra in Europe, while in North America and Central America important host species are *Pinus caribaea* Morelet, *Pinus contorta* Douglas ex Loudon and *Pinus elliottii* Engelm..

Figure 3 – Old females of *T. parvicornis* on a small branch and on needles of stone pine, all covered by sooty mould.

Is it possible to control this insect or limit its damage?

It is possible to carry out treatments on the foliage, although these treatments should be limited to plants in nurseries or to single trees of high landscape value. This caution is advised to avoid hindering the establishment, some years later, of a biological control, as occurs in the area of origin. In urban areas, canopy treatment, even with products that can be used in biological control, clearly requires in-depth assessments of opportunities. Furthermore, given the overlapping of generations, a strategy based only on the use of products of natural origin is difficult to propose, since it is necessary to resort to repeated interventions. In the past few years in Italy there has been a rapid diffusion of treatments based on injections of pesticides directly into the trunk or branches of trees, so-called endotherapy interventions. The pesticides used to combat tortoise scale on pine trees are based on abamectin and various co-formulants. Abamectin is the only active substance presently authorized in Italy for the treatments against *T. parvicornis*. From the results of experimental applications of endotherapy intervention carried out so far on *T. parvicornis* in conifers, it appears that not all techniques of supplying the insecticide to the tree guarantee the effectiveness of the treatment. This aspect remains to

be explored in a more consistent way to search for the most valid and most effective application method to control the tortoise scale.

Scientific research is also focusing on biological control methods, controlling a parasite by exposing it to other insects or microorganisms that are predators of the harmful species. At the moment the only predators found with moderate activity on *T. parvicornis* are a coccinellid beetle (*Cryptolaemus montrouzieri*) and a small wasp (*Metaphycus flavus*). However, the action of these predators is still too limited to represent a danger for the pine tortoise scale, partly because these insects are not specialized predators on *T. parvicornis*, so they could prefer to feed on other prey.

Figure 4 – An individual *Cryptolaemus montrouzieri* predator chasing the nymphs of *T. parvicornis*.

The presence of natural predators must certainly be protected when one is forced to intervene with pesticides to reduce infestations. The biological control of tortoise scale represents, in many cases, an interesting and a certainly effective solution, but difficult to apply, particularly in urban areas, which requires careful planning before undertaking large application of biological control methods at large scale on areas of several hectares.

The strong direct damaging effect (insect feeding) and indirect impact (sooty mould) on trees following massive infestations of *T. parvicornis* makes it essential in addition to resort to silvicultural interventions aimed at promoting suitable vegetative conditions of the trees. These include light pruning aimed at airing the foliage, rare irrigation interventions in the hottest

season, fertilization, and application of biostimulants and mycorrhizae. In summary, at the moment, the most suitable method to control infestations by pine tortoise scale consists of an integrated approach which combines technically sound cultivation treatments to improve the vegetative state of the damaged trees, with the most suitable type of intervention (interventions on the canopy, endotherapy on trees), according to the characteristics of the plantation site.

The situation in the Rome metropolitan area and future perspective

The first discoveries of the pine tortoise scale in the Rome area date back to 2018 in the southern quadrant of the city. Since then, the tortoise scale has been causing severe infestations and generating a major risk to the health and safety of the citizens. Data from the city of Rome (Environmental Department, Capital City of Rome) report a total number of about 60,000 stone pine trees in the city's public parks, gardens, and streets. The incidence of trees attacked by the tortoise scale is a worrying value of about 80%. Presently, it is increasingly common to find dead or dying trees still standing in many neighbourhoods of Rome, particularly in the southern Rome quadrant.

A recent national legislation act, issued in 2021, has made compulsory the control of the infestation of pine tortoise scale on public and private urban forests and trees of *P. pinea*. Therefore, the City of Rome has recently initiated a vast programme of endotherapy treatments of all the stone pine trees in public areas, parks, and streets under the control of the fifteen City municipalities. The treatments are being conducted by specialized forest consultants. Most of the pines standing along the city's streets and in the public parks were treated during spring-summer 2022. Some of those trees were also treated once more, in summer 2023. The treatments against insect infestation and damage have also raised considerable awareness and a wide interest and participation by group of citizens in different parts of the city, in some cases even with spontaneous fund raising by citizens' associations for trees in private parks and historical villas. After three years since the start of pest control, it can be concluded that results have been quite positive, so far. When the treated trees had crowns not already heavily damaged, i.e with less than 50% of the crown damaged, tree losses after treatment were negligible while most of trees were able to recover sufficiently healthy, vegetative condition. However, a critical issue concerns the need for law enforcement for quite a few cases of private properties and gardens where trees have not been treated yet, despite treatment being compulsory by law. It is unfortunate that those damaged, untreated trees are keeping the inoculum of pests and the risk of new infestation quite high.

However, the experience of insect control for the pine tortoise scale is promising as it can be concluded that endotherapy treatment has proved to be an important tool in fighting the damaging activity of this pest, especially in an urban context where interventions with treatments are strictly regulated by national laws. Endotherapy, in fact, reduces the dispersion of active insecticidal ingredients by drift, an aspect that could represent a valid alternative to manage plants in public areas. Given the actual lack of scientific information about other control solutions, endotherapy treatment with abamectin represents an effective strategy that is currently applicable, particularly if it is accompanied by other silvicultural interventions. Another aspect that may deserve further studies and research will be to explore the potential of genetic variation among provenance and progenies in relation to possible traits linked to pest tolerance. However, this endeavour would require a large international, cooperative programme among research institutions, private forest owners and public forest services.

Main references

Clarke SR, 2013. Pine tortoise scale. Forest Insect & Disease. Leaflet 57. United States Department of Agriculture, Forest Service

Di Sora N, Rossini L, Contarini M, Chiarot E, Speranza S. 2022. Endotherapic treatment to control *Toumeyella parvicornis* Cockerell infestations on *Pinus pinea* L. *Pest Management Science*. DOI 10.1002/ps.6876

EFSA Panel on Plant Health 2022. Pest categorisation of *Toumeyella parvicornis. EFSA Journal* 20(3):7146

Garonna AP, Scarpato S, Vicinanza F and Espinosa B, 2015. First report of *Toumeyella parvicornis* (Cockerell) in Europe (Hemiptera: Coccidae). *Zootaxa*, 3949, 142–146.

Malumphy C, Hamilton MA, Manco BN, Green PWC, Sanchez MD, Corcoran M and Salamanca E, 2012. *Toumeyella parvicornis* (Hemiptera: Coccidae) causing severe decline of *Pinus caribaea* var. *bahamensis* in the Turks and Caicos Islands. *Florida Entomologist*, 95, 113–119.