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First report of *Toumeyella parvicornis* (Cockerell) in Europe (Hemiptera: Coccidae)

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Toumeyella parvicornis (Cockerell), the Pine tortoise scale, is reported for the first time from Europe. Pre-imaginal instars and adults were observed starting from the fall of 2014 in several municipalities of Campania (Italy). Since the species is recorded as a harmful pest of several pine species in North America and the Caribbean, the presence of this alien insect in Europe is alarming and represents a possible major threat for native pine species and related economic activities.

Scale insects are one of the most commonly transported groups of insects in plant trade and at the same time are one of the most successful invasive groups of insects (Pellizzari *et al.*, 2005; Malumphy *et al.*, 2012). Here we report the occurrence of *Toumeyella parvicornis* (Cockerell), the Pine tortoise scale, in southern Italy infesting *Pinus pinea* L. in urban environments. Italy is one of the most invaded of European countries by alien insects (Inghilesi *et al.*, 2013) and this new record updates the list of the established Coccoidea in the country to 50 species (Mazzeo *et al.*, 2014).

During the last months of 2014, severe infestations of a sap feeding insect, producing huge amount of honeydew with impressive sooty mould development, were observed on stone pines (*P. pinea*) in Naples and neighboring municipalities (Campania, Italy). Abundant colonies of a soft scale insect were collected in many sampling sites. All slide mounted specimens (i.e., adult females and males, male tests and first-instar nymphs), representative of the collected samples, were ascribed to a species of the genus *Toumeyella* Cockerell associated with Pinaceae (Hamon & Williams, 1984; Hodgson, 1994; Kondo & Pellizzari, 2011; Miller & Williams, 1995; Sheffer & Williams, 1990), namely *T. parvicornis*. The genus *Toumeyella* has a wide distribution in the Nearctic and Neotropical Regions, with most species being described from the USA (Williams & Kondo, 2008). Currently there are 18 named species included in this genus, which are distributed in Brazil (3 spp.), Canada (2 spp.), Colombia (1 sp.), Cuba (2 spp.), Guatemala (1 sp.), Mexico (6 spp.), Puerto Rico (1 sp.), Turks & Caicos Islands (1 sp.), the USA (9 spp.) and Venezuela (1 sp.) (Kondo & González, 2014; Ben-Dov *et al.*, 2015).

Four species of *Toumeyella* live on *Pinus* spp.: *T. parvicornis*, *T. pini* (King), the striped pine scale, *T. pinicola* Ferris, the irregular pine scale, and *T. virginiana* Williams & Kosztarab, the Virginia pine scale (Williams & Kondo, 2008). The Pine tortoise scale has two forms, the typical bark form and a leaf form (Hamon & Williams 1984; Kondo & Pellizzari, 2011) (Fig. 1a–c). This species can be easily separated from other congeneric species by the characteristic dorsal bilocular pore clusters present on the adult female, with other minor differences on the antennae, anal plates and spiracular furrows (Fig. 2a–c) (Hamon & Williams, 1984; Williams & Kosztarab, 1972). *Toumeyella* species can be also distinguished by morphological characters of the first instars (Figs 1d, 2d) and male tests (Miller & Williams, 1990; Sheffer & Williams, 1990). *T. parvicornis* was originally described from Florida (USA), on *Pinus palustris* and *P. taeda* but is now known from Canada, Mexico, and all of the USA and is an important pest of several *Pinus* species (Clarke, 2013). Recently, *T. parvicornis* has been accidentally introduced into Puerto Rico (Segarra-Carmona & Cabrera-Asencio, 2010) and Turks and Caicos Islands, where it has become a severe pest of *Pinus caribaea* (Malumphy *et al.*, 2012). *T. parvicornis* shows great environmental adaptability and an easy acceptance of new hosts, and this might allow the species to spread quickly into new territories. It is considered a destructive species infesting the most vigorously growing succulent twigs. In the northern parts of its range, the pine tortoise scale has one generation per year whereas four generations are typical for southern Georgia, USA (Clarke, 2013). In Turks and Caicos Islands, where even a fifth generation is possible, the impact of *T. parvicornis* has been severe. As reported by Malumphy *et al.* (2012), some of the infested areas contain no live trees or seedlings whilst other areas have a few live pines amongst dead and moribund trees. The rapid population growth rate of pine tortoise scale in Caribbean pine forests has been attributed to a combination of warm climatic conditions and a lack of natural enemies (Malumphy *et al.*, 2012).



FIGURE 1. *Toumeyella parvicornis* (Cockerell), adult females on pine twig; b, females, leaf forms; c, adult female with typical tortoise shell aspect; d, first instars on pine needle.

In Italy, the invasiveness of *T. parvicornis* has not yet been assessed. Up to now, no mortality of stone pine has been observed. The situation in Campania (Fig. 3) is particularly severe in some urban areas, where scale infestations are spreading rapidly. Detailed biological studies are in progress. It appears that the insect may have a multivoltine life-cycle in southern Italy. Preliminary field observations, carried out in the second half of 2014, allowed the collection of all life stages, with eggs still present at the end of November. The investigated populations of *T. parvicornis* showed a significant overlapping of generations. Moreover, *T. parvicornis* did not stop development during the winter months in most of the sampled areas, probably due to unusually high temperatures during the last winter season. The phenological plasticity of this alien soft scale could help to explain the severe infestation recorded on pine trees.

Based on these ecological traits of *T. parvicornis*, there are significant risks of economic damage were it to spread throughout Italy and into Europe. This pest could also negatively affect the stone pine nut production in pine stands already affected by other insect pests and fungi (Bracalini *et al.*, 2013; Cristinzio *et al.*, 2014). Investigations are thus necessary to: (i) assess both the pathway of introduction and the present distribution, to (ii) verify the presence of natural enemies, and to (iii) determine the possible impact of this alien scale insect on other native pine species in Europe, so as to develop control measures to contain the already established populations.

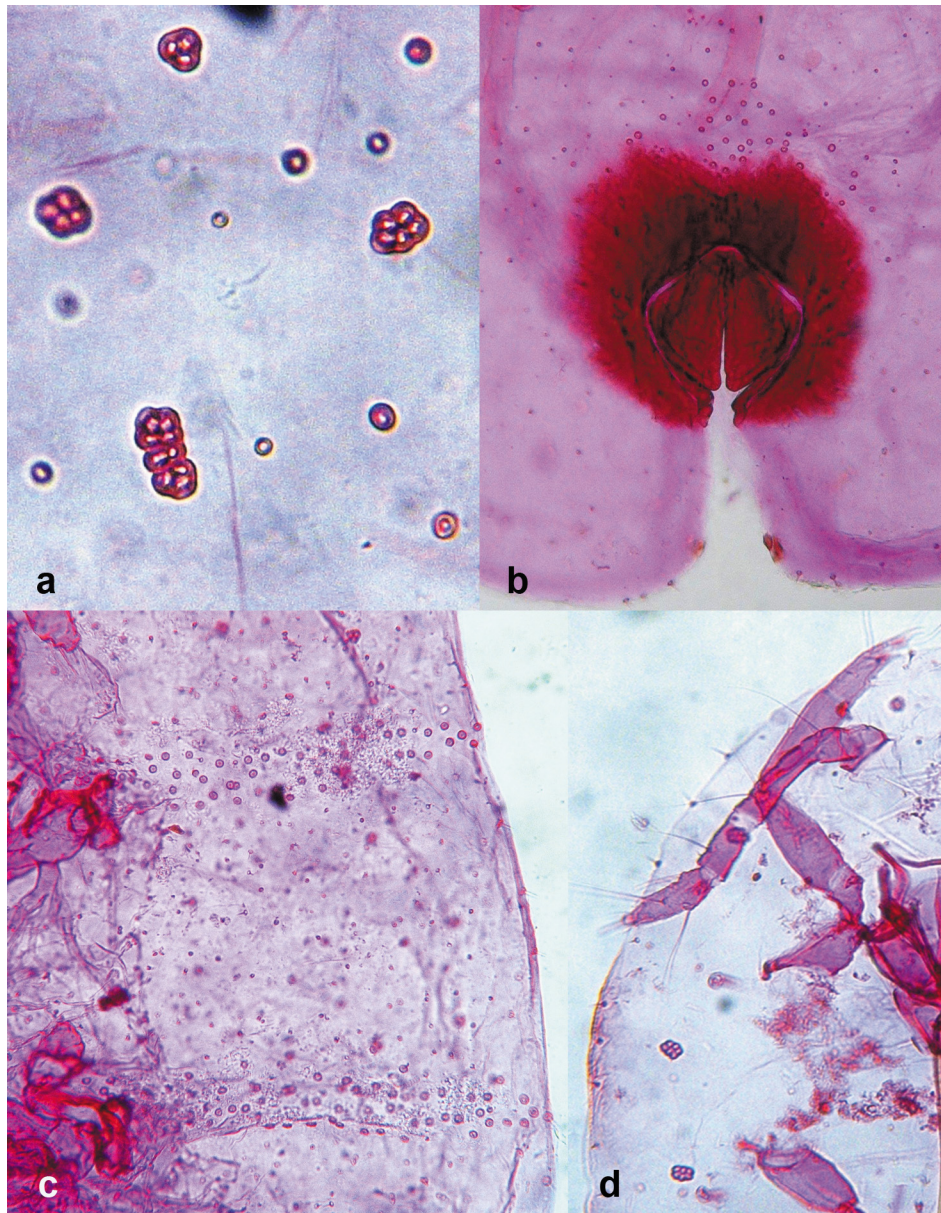


FIGURE 2. *Toumeyella parvicornis* (Cockerell), slide mounted female: a, dorsal bilocular pore clusters; b, anal plates; c, spiracular furrows with 5-locular pores; d, slide mounted first instar: antenna and dorsal submarginal pore clusters.

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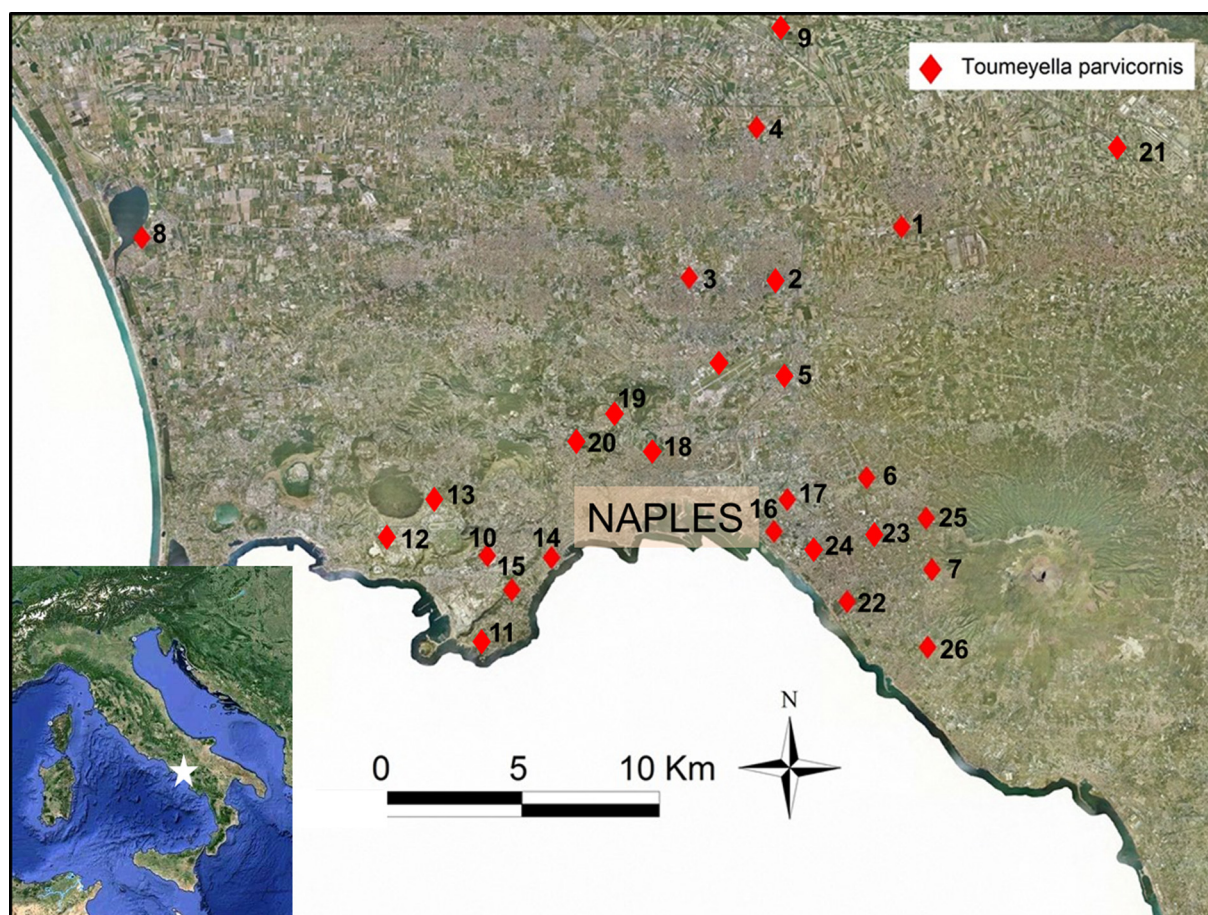


FIGURE 3. *Toumeyella parvicornis* (Cockerell), distribution map in Italy (Campania). Municipalities listed in alphabetic order with latitude and longitude coordinates of sample points [Acerra (1), 40°56'03"N, 14°21'59"E; Afragola (2), 40°54'46"N, 14°17'57"E; Arzano (3), 40°55'00"N, 14°16'28"E; Caivano (4), 40°57'59"N, 14°18'11"E; Casoria (5), 40°53'33"N, 14°19'06"E; Cercola (6), 40°51'12"N, 14°21'11"E; Ercolano (7), 40°49'12"N, 14°22'41"E; Giugliano in Campania (8), 40°55'43"N, 14°02'19"E; Marcianise (9), 41°00'17"N, 14°19'20"E; Napoli (10–20), 40°49'34"N, 14°11'18"E; 40°47'53"N, 14°10'47"E; 40°50'06"N, 14°08'48"E; 40°50'25"N, 14°09'34"E; 40°49'12"N, 14°12'11"E; 40°48'52"N, 14°11'58"E; 40°50'12"N, 14°18'44"E; 40°50'12"N, 14°18'51"E; 40°51'50"N, 14°15'47"E; 40°52'28"N, 14°14'18"E; 40°51'53"N, 14°13'36"E; Nola (21), 40°57'30"N, 14°27'46"E; Portici (22), 40°48'42"N, 14°20'37"E; San Giorgio a Cremano (23–24), 40°49'46"N, 14°20'19"E; 40°49'32"N, 14°20'48"E; San Sebastiano al Vesuvio (25), 40°50'12"N, 14°22'07"E; Torre del Greco (26), 40°47'52"N, 14°22'57"E].

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