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Taphrorychus hirtellus Eichhoff (Curculionidae: Scolytinae, Dryocoetini) a new species to the Italian fauna, with a key to the *Taphrorychus* species of Europe

ELEONORA CRESTA[1,2,6], MASSIMO FACCOLI[3], FEDERICA GIARRUZZO[1,7], EMANUELE DI SIERO[1,8], ENRICO RUZZIER[2,4], NICOLÒ DI SORA[1,*] & STEFANO SPERANZA[1,5]

[1]*Department of Agriculture and Forest Sciences (DAFNE)—University of Tuscia, Via S. Camillo de Lellis, 01100 Viterbo, Italy*
[2]*NBFC, National Biodiversity Future Center—Piazza Marina 61, 90133 Palermo, Italia*
[3]*Department of Agronomy, Food, Natural Resources, Animals and the Environment (DAFNAE)—University of Padova, Agripolis, Viale dell'Università 16, 35020 Legnaro (PD), Italy*
massimo.faccoli@unipd.it; https://orcid.org/0000-0002-9355-0516
[4]*Department of Science—University of Roma Tre, Viale G. Marconi 446, 00146 Rome, Italy*
enrico.ruzzier@uniroma3.it; https://orcid.org/0000-0003-1020-1247
[5]*Centro de Estudios Parasitológicos y de Vectores (CEPAVE, CONICET-UNLP)—Boulevard 120 1900, La Plata B1900, Argentina*
speranza@unitus.it; https://orcid.org/0000-0003-0106-3938
[6] *eleonora.cresta@unitus.it; https://orcid.org/0009-0003-8511-089X*
[7] *federicagiarruzzo@yahoo.it; https://orcid.org/0009-0002-9719-9716*
[8] *emanueledisiero@yahoo.it; https://orcid.org/0009-0002-8820-5168*
[*]*Corresponding author: nico.disora@unitus.it; https://orcid.org/0000-0003-2125-9137*

Abstract

Taphrorychus hirtellus Eichhoff (Coleoptera, Curculionidae, Scolytinae), a European scolytine beetle previously documented in Central and Southeastern Europe, Turkey (type locality), and Algeria, is recorded for the first time in Italy. Specimens were collected in April and May 2021 in the Circeo National Park (Latium Region, central Italy) in multifunnel traps baited with a blend of quercivorol, α-copaene, ethanol and α-pinene. The species, considered native, is a new addition to the Italian fauna. In addition to the faunistic record, an identification key to the European *Taphrorychus* species is provided.

Key words: bark beetle, native species, Central Italy, mixed-oak forest

Introduction

The introduction and establishment rate of non-indigenous Scolytinae is increasing globally and is mainly attributed to the rise in international trade and climate change (Lantschner *et al*. 2020; Pureswaran *et al*. 2022). Over the last few years, several non-native species of Scolytinae have been recorded in Europe (Kirkendall & Faccoli 2010; Faccoli *et al*. 2012; Faccoli *et al*. 2016; Barnouin *et al*. 2020; Colombari *et al*. 2022; Gallego *et al*. 2022; Ruzzier *et al*. 2022; Marchioro & Faccoli 2022; Marchioro *et al*. 2022; Mas & Johnson 2023; Sanchez *et al*. 2023), some of which are of phytosanitary interest (e.g. Fiala *et al*. 2021; Ruzzier *et al*. 2021a; Ruzzier *et al*. 2022). For this reason, a series of initiatives and monitoring were launched to monitor and detect non-native scolytines in the European Union.

Between 2018 and 2022 a large-scale survey was carried out in France, Italy, and Spain as part of the European LIFE project SAMFIX (SAving Mediterranean Forest from Invasions of *Xylosandrus* beetles and associated pathogenic fungi—LIFE17 NAT/IT/000609) (Gallego *et al*. 2017, 2022; Contarini *et al*. 2020). This project allowed the recording of multiple non-native target scolytine beetles, and also enabled the collection of multiple by-catch species. As emphasized in recent studies (Mas *et al*. 2023), by-catch specimens provide valuable insights into the dynamics of species introduction or result in important faunistic records for rare or hard-to-sample native species. The analysis of the material collected in Italy (Latium) in 2021 led to the identification of *Taphrorychus hirtellus*

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Eichhoff, a species previously not recorded for this country. The present contribution reports the first records of this bark beetle in Italy. The identification of *T. hirtellus* is challenging due to its morphological similarities with other species. In fact, it can easily be mistaken for more widespread species, such as *Xyleborinus saxesenii* Ratzeburg and *Taphrorychus bicolor* Herbst. For such reasons, a detailed description of *T. hirtellus* and a dichotomous key for the species of *Taphrorychus* in Europe (not including European Russia) are provided.

Materials and methods

Specimens cited in this paper were collected in traps deployed in the Circeo National Park (Latium Region, Central Italy) between March and October 2021 (Fig. 1). A trapping system was implemented using black multifunnel traps, baited with a blend of quercivorol (1 ml), α-copaene (2 ml) (Synergy, Canada), ethanol (5 ml) and α-pinene (1 ml) (Sanidad Agricola Econex, Spain). Monitoring was set up in two sites in the Circeo National Park: "Quarto Freddo" site (SCI IT6040017), a 464 hectares area located in the northern face of Circeo Promontory at about 160 m above sea level (41°14'08″ N, 13°04'40″ E), covered by a dense forest of *Ostrya carpinifolia* (Betulaceae), *Quercus ilex* (Fagaceae), *Quercus suber* (Fagaceae), *Fraxinus ornus* (Oleaceae), *Arbutus unedo* (Ericaceae), *Pistacia lentiscus* (Anacardiaceae), and *Ruscus aculeatus* (Asparagaceae); "Selva del Circeo" Natural Reserve site (SCI IT6040014), a 3300 hectare area of lowland forest of UNESCO relevance (41° 20' 21" N, 13° 02' 39" E), dominated by the oak deciduous forest of *Quercus robur* (Fagaceae), *Q. cerris*, *Q. frainetto* and the evergreen oak species *Q. suber* and *Q. ilex* (Lovari & Cassola 1975; Chirici *et al*. 2014).

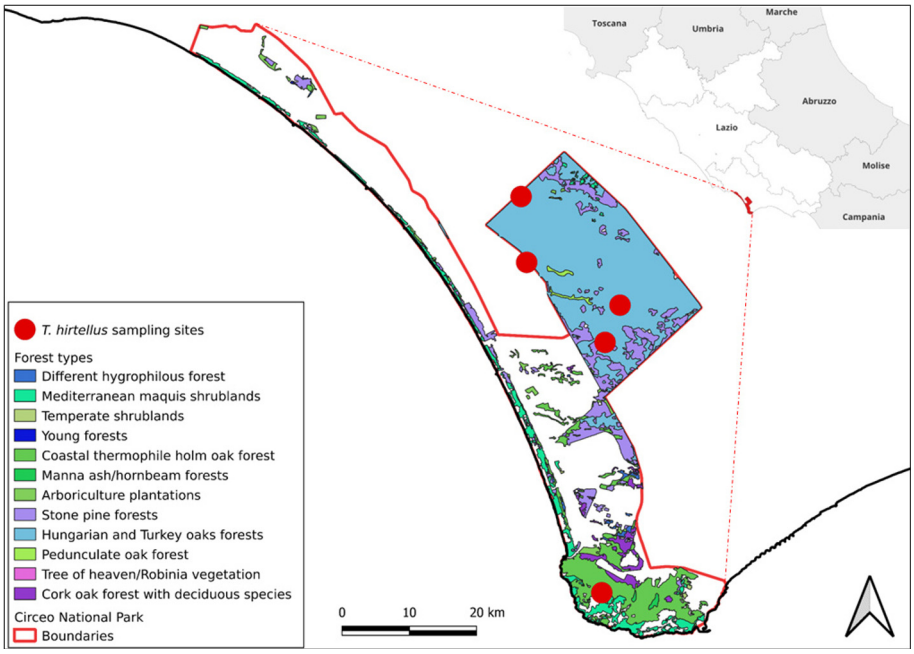

FIGURE 1. Locations of traps (red points) with captures of *T. hirtellus* in the Circeo National Park from March to October 2021. Scheme adapted from the Latium region forest types map elaborated by Chirici *et al*. (2014).

A total of 16 specimens were trapped between mid-April 2021 and early May 2021. All specimens are deposited in the following collections:

DAFNE–Department of Agriculture and Forest Sciences, University of Tuscia, Viterbo, Italy.

DAFNAE–Department of Agronomy, Food, Natural Resources, Animals and Environment, University of Padua, Legnaro (PD), Italy.

Specimens were observed and photographed (Fig. 2) using a Leica Ergo Transmitted Light Base Camera (Model TL5000—DMC 5400—M205C) (University of Tuscia). To observe the species more in detail, a specimen (1 ex. TR7_3) was photographed (Fig. 3) using a SEM Tabletop, Model TM 1000 (University of Padua).

FIGURE 2. Stereo microscope photographs of *Taphrorychus hirtellus*, female. (A) Dorsal view. (B) Lateral view.

Taphrorychus hirtellus Eichhoff

Taphrorychus mecedanus Reitter

Specimens examined: 1 ex. Circeo National Park, Selva del Circeo Trap TR1_1, 41°20’34”N 13°00’54”E, 22.iv.2021, leg. F. Giarruzzo (DAFNE); 1 ex. Circeo National Park, Selva del Circeo Trap TR1_2, 41°20’34”N 13°00’55”E, 22.iv.2021, leg. F. Giarruzzo (DAFNE); 1 ex. Circeo National Park, Selva del Circeo Trap TR1_4, 41°20’33”N 13°00’56”E, 22.iv.2021, leg. F. Giarruzzo (DAFNE); 1 ex. Circeo National Park, Selva del Circeo Trap TR1_5, 41°20’33”N 13°00’56”E, 22.iv.2021, leg. F. Giarruzzo (DAFNE); 2 exx. Circeo National Park, Selva del Circeo Trap TR6_1, 41°21’48”N 13°00’47”E, 16.iv.2021, leg. F. Giarruzzo (DAFNE); 2 exx. Circeo National Park, Selva del Circeo Trap TR6_1, 41°21’48”N 13°00’47”E, 07.v.2021, leg. F. Giarruzzo (1 ex. DAFNE) (1 ex. DAFNAE); 1 ex. Circeo National Park, Selva del Circeo Trap TR6_3, 41°21’47”N 13°00’46”E, 16.iv.2021, leg. F. Giarruzzo (DAFNE); 1 ex. Circeo National Park, Selva del Circeo Trap TR6_4, 41°21’47”N 13°00’45”, 16.iv.2021, leg. F. Giarruzzo (DAFNE); 1 ex. Circeo National Park, Selva del Circeo Trap TR6_5, 41°21’46”N 13°00’44”E, 07.v.2021, leg. F. Giarruzzo (DAFNE); 1 ex. Circeo National Park, Quarto Freddo Trap TR7_3, 41°22’03”N 13°02’38”E, 14.iv.2021, leg. F. Giarruzzo (DAFNE); 1 ex. Circeo National Park, Selva del Circeo Trap PP2_1, 41°19’42”N 13°03’15”E, 03.v.2021, leg. F. Giarruzzo (DAFNE); 2 exx. Circeo National Park, Selva del Circeo Trap PP2_10, 41°19’44”N 13°03’16”E, 14.iv.2021, leg. F. Giarruzzo (1 ex. DAFNE) (1 ex. DAFNAE); 1 ex. Circeo National Park, Selva del Circeo Trap PP5_12, 41°19’01”N 13°03’02”E, 12.iv.2021, leg. F. Giarruzzo (DAFNE).

Female. Body elongated (1.6–1.8 mm), subcylindrical in shape. Pronotum slightly longer than wide, rounded anteriorly, curved profile with marked summit at the pronotal disc (Fig. 4A) and, in lateral view, clearly inclined anteriad (Fig. 4B–C). Anterior half asperate, with abundant low-relief granules, lightly hooked profile, arranged concentrically in non-parallel rows, gradually replaced by small punctiform granules and then to more or less distinct punctuation in posterior half. Basal and marginal area smooth, shagreened, semi-shining in-between the punctures. Antennae with 5-segmented funicle (including pedicel) and flat lenticular club; three slightly recurved, well-marked sutures on external face (Fig. 4D). Elytra parallel, with disc flat, declivity broadly rounded, with level suture or low

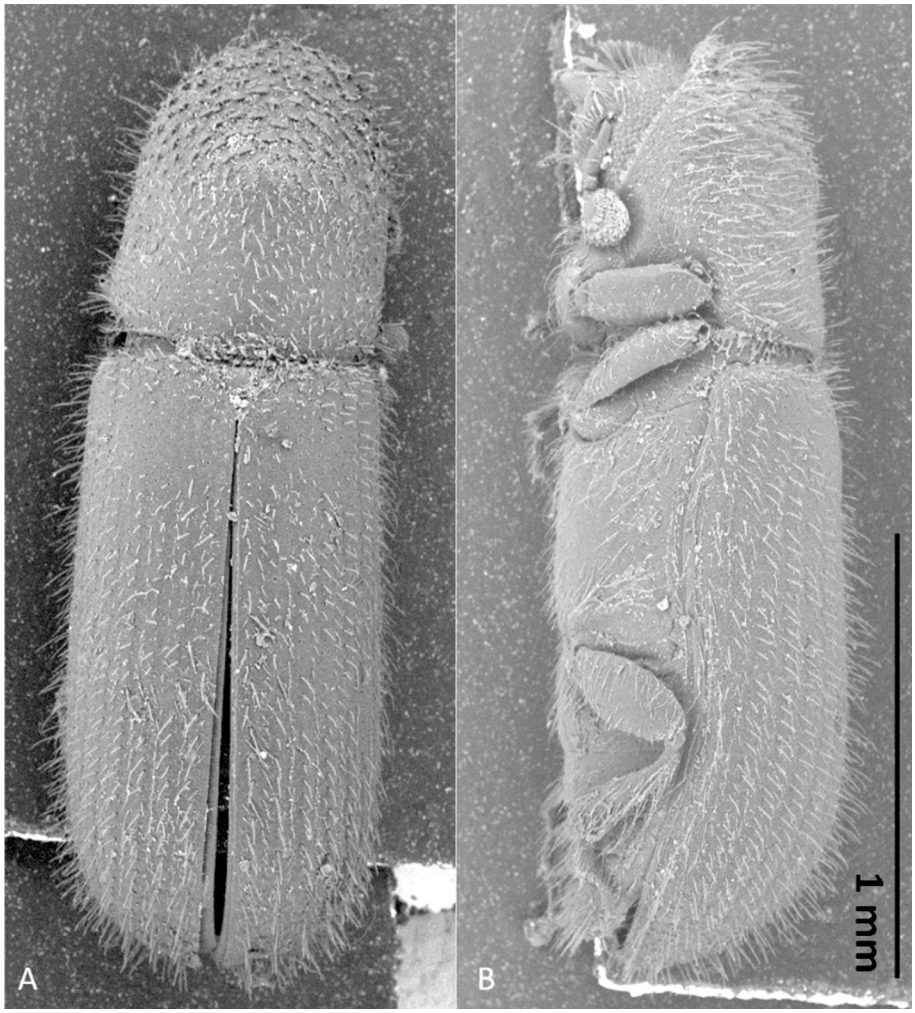

FIGURE 3. SEM photographs of *Taphrorychus hirtellus*, female. (A) Dorsal view. (B) Lateral view.

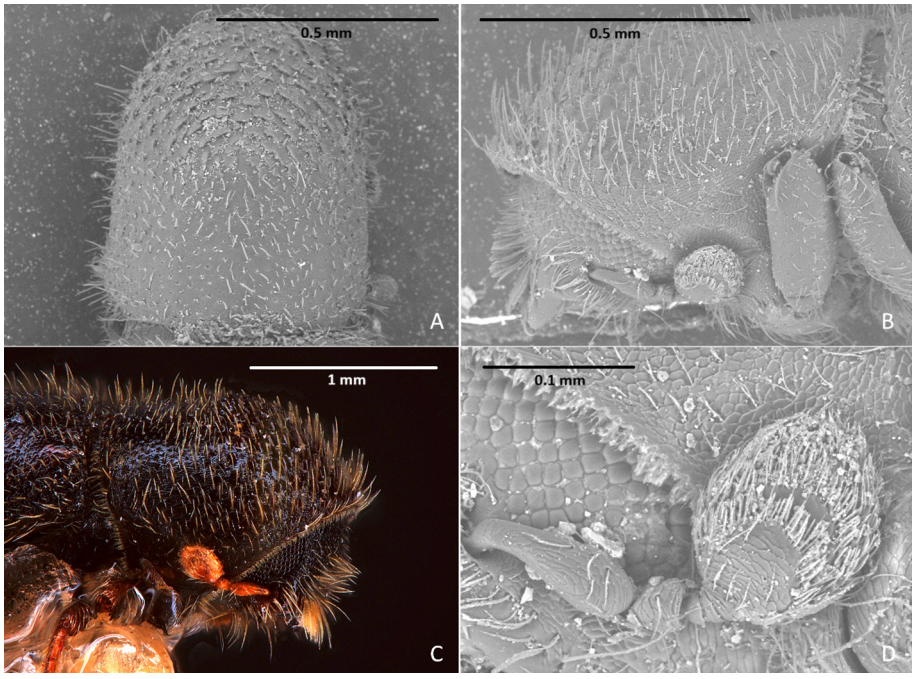

FIGURE 4. Female of *Taphrorychus hirtellus* (A) pronotum dorsal view, pronotum and head detail lateral view by (B) SEM and (C) stereo microscope, (D) antenna detail.

relief. Striae and interstriae faint; elytra matt, no apparent punctuation except faintly indicated laterally. Minute granules on interstriae 1, 3 and 5 of declivity, uniform in size (Fig. 5). Elytral vestiture covers entirely the surface of disc and declivity. Fine whitish bristles setae, long, not very dense, more numerous on the pronotal slope and on the elytral declivity, longer on the interstriae, horizontally oriented. Species with sexual dimorphism, strongly evident in the area of the frons where females show a very dense brush of clustered yellow or white long setae, pointed forward in the centre of frons.

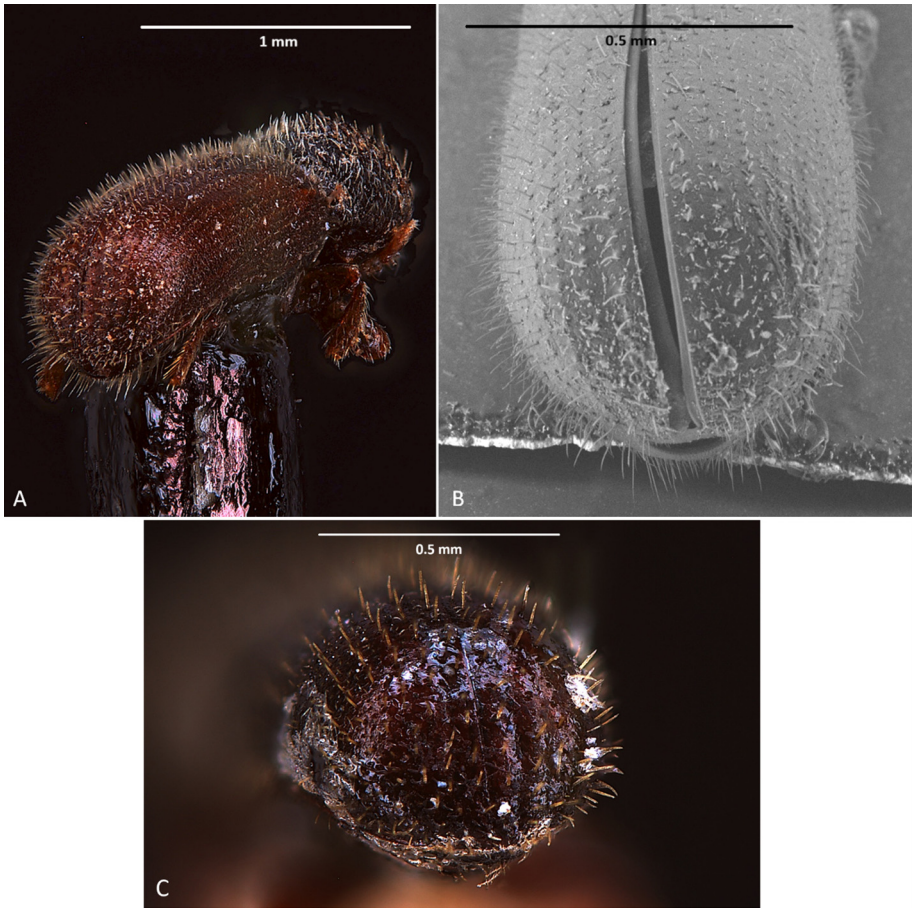

FIGURE 5. Postero-lateral view of *Taphrorychus hirtellus* photographed by (A) stereo microscope and (B) SEM. (C) Detail of the declivity of *T. hirtellus* specimen.

Male. Pronotum longer than wide (1.7–1.8×), frons granulate with fine, sparse and flexible setae.

Distribution. Previously recorded from Bulgaria, Bosnia Herzegovina, Croatia, Czechia, Hungary, Montenegro, Republic of North Macedonia, Romania, Serbia, Slovakia (Balachowsky 1949), as well as Turkey (mid-Black Sea region) and Algeria (Knížek 2009; Tuncer *et al*. 2017).

Host plants and phytosanitary relevance. *Taphrorychus* Eichhoff, comprises species feeding exclusively on broadleaved trees, mostly Fagaceae, Betulaceae, and Rosaceae (Balachowsky 1949; Marchioro *et al*. 2024). In particular, the main host trees of *Taphrorychus hirtellus* are *Quercus cerris*, *Q. frainetto*, *Q. petraea*, *Fagus sylvatica*, *F. orientalis* (Fagaceae) and *Corylus avellana* (Betulaceae) (Pfeffer 1995). The species has been recorded occasionally also on *Castanea sativa* (Fagaceae) (Bright & Skidmore 1997).

Taphrorychus hirtellus develops on felled or dried trees and branches, where it creates shallow and irregularly shaped maternal tunnels under the bark for oviposition. Each larva, feeding on plant tissue, hollows an independent larval gallery. These galleries, which spread out from the maternal ones, are slim, and deepen progressively until they reach the sapwood, often overlapping and irregularly intertwined (Wichmann 1912; Faccoli 2015). The species has no phytosanitary relevance, as previously noted by Roganovic (2012) and Tuncer *et al*. (2017). This may be further supported by present observations according to the locations where the species has been recorded.

Taphrorychus hirtellus differs from other Italian *Taphrorychus*, specifically *T. bicolor* Herbst and *T. villifrons* Dufour by its smaller size (1.6–1.8 mm), the reddish-brown colour of the body and the yellow coloration on the

legs and antennae, and most notably, by the distinctive punctuation of the elytra, which are completely absent. In fact, *T. bicolor* and *T. villifrons* are characterised by deep punctuation on the elytra and strongly setose appearance (Balachowsky 1949). In addition, according to Tuncer *et al*. (2017), *T. hirtellus* can be distinguished from *Taphrorychus ramicola* Reitter—species of comparable size (1.2–2.0 mm) and not recorded in Italy— by the shape of the pronotum. In *T. hirtellus*, the pronotum has a distinct median summit when viewed laterally. Its elytra appear less shiny and lacking in striae when compared to *T. ramicola* or *Taphrorychus minor* Eggers, a species endemic to Sardinia and central Italy that develops on *Q. ilex* (Gatti 2011).

Key to *Taphrorychus species* of Europe (not including European Russia; modified from Pfeffer, 1995)

Taphrorychus can be identified by a pronotum slightly longer than wide in dorsal view, with subparallel sides and a marked summit visible in lateral view. The apical half of the pronotum is asperate, while the basal half is punctate, smooth, slightly rugose and shagreened. The vestiture on the pronotum is similar to that covering the entire surface of elytral disc and declivity.

The following key, modified from Balachowsky (1949) and Pfeffer (1995), is intended to facilitate the identification of *Taphrorychus* occurring in Europe.

1 Pronotum subquadrate, with a distinctly marked median summit when viewed laterally; length 1.6–2.6 mm **2**
- Pronotum oblong, with no distinct summit when viewed laterally; length 1.2–2.0 mm . . . . . ***T. ramicola* (Reitter)**
2 Elytral declivity evenly arched in both sexes when viewed laterally; elytral declivity impunctate; elytral disc shagreened, without distinct rows of interstrial punctures; punctures faintly visible only along the sides of the elytra; interstrial setae seriate and robust; females without a dense tuft of setae on the frons; length <1.8 mm **3**
- Elytral declivity flat and gradually descending in males, gradually rounded in females when viewed laterally; elytral declivity with rows of interstrial punctures; elytral disc shining, with distinct and dense striae and interstriae; punctures clearly visible along the sides of the elytra; interstriae with sparse setae and bristles; females with a tuft of a setae on the frons; length >1.8 mm **4**
3 Elytral declivity matt, without rows of strial punctures; elytra surface finely shagreened, setose on the sides and with long, erect, rows of light color setae in between; elytral disc rugose and without tubercles; elytral declivity with minute and uniform granules on interstriae 1, 3 and 5; pronotum base matt, without evident punctuation; length 1.6–1.8 mm . . . . . ***T. hirtellus* ♀ Eichhoff**
- Elytral declivity shiny, with rows of strial punctures; elytra surface extremely and finely punctured, very finely setose; elytral disc is smooth and the first interstriae are covered with single tubercles; elytral declivity without granules; pronotum base shiny, with fine and dense punctuation; length 1.8 mm . . . . . ***T. minor* Eggers**
4 Frons bearing only sparse and short setae; elytral declivity appearing flat in lateral view, gradually descending, and clearly distinct from the elytral disc; males **5**
- Frons bearing a rounded tuft of dense setae; elytral declivity appearing moderately to steeply arched in lateral view, not flattened; females **8**
5 Elytral declivity clearly punctured, with sharper edges and with single or multiple rows of punctures; declivital interstria 1 with 5–9 granules; elytra ≤ 1.70× or ≥ 1.80× longer than wide **6**
- Elytral declivity very finely punctured, nearly smooth, semi-matt, with rounded edges and with three rows of fine granules; declivital interstria 1 with 5 or 6 distinct granules; elytra 1.70–1.75× longer than wide; length 1.8–2.4 mm . . . . . ***T. villifrons* ♂ (Dufour)**
6 Declivital interstriae 1 with 5 or 6 very fine granules; declivity with clear edges, surface shiny with 1–2 shallow striae; elytra 1.6–1.7× longer than wide with heavily punctured striae and interstriae; length 1.6–2.5 mm . . . . . ***T. bicolor* ♂ (Herbst)**
- Declivital interstriae 1 with 8 or 9 distinct granules; declivity with rounded edges, surface matt with clearly punctured striae; elytra 1.65–1.90× longer than wide with heavily punctured striae but very finely punctured interstriae; length 1.8–2.6 mm . . **7**
7 Elytra 1.8–1.9× longer than wide; elytral declivity steep and shiny; length 1.8–2.6 mm . . . . . ***T. alni* ♂ Pfeffer**
- Elytra 1.65–1.70× longer than wide; elytral declivity flatly curved and matt; length 2.0–2.2 mm . . . . . ***T. siculus* ♂ Eggers**
8 Elytral declivity irregular, with distinct rows of punctures; rows of granules are either absent or, if present, not necessarily aligned with declivital interstriae 1, 3 and 5; elytra 1.65–1.90× longer than wide **9**
- Elytral declivity smooth and uniform, with indistinct rows of punctures; rows of fine granules on declivital interstriae 1, 3, and 5; elytra 1.7–1.8× longer than wide; length 1.8–2.4 mm . . . . . ***T. villifrons* ♀ (Dufour)**
9 Elytral declivital interstriae bearing 8 or 9 granules in total; elytral striae strongly and densely punctured, while interstriae finely punctured; elytra 1.65–1.90× longer than wide **10**
- Elytral declivital interstriae without granules; elytral striae and interstriae strongly and densely punctured; elytra 1.80–1.85× longer than wide; length 1.6–2.5 mm . . . . . ***T. bicolor* ♀ (Herbst)**
10 Elytra 1.85–1.90× longer than wide; elytral declivity shiny; length 1.8–2.6 mm . . . . . ***T. alni* ♀ Pfeffer**
- Elytra 1.65–1.75× longer than wide; elytral declivity matt; length 2.0–2.2 mm . . . . . ***T. siculus* ♀ Eggers**

Checklist of *Taphrorychus* of Europe (not including European Russia)

Countries abbreviations follow ISO 3166-1 alpha-2 standard list.

***Taphrorychus alni* Pfeffer**

Distribution: E: FR (Southern France, Corsica) (Alonso-Zarazaga *et al*. 2023).

Host plants: *Alnus glutinosa.*

***Taphrorychus bicolor* (Herbst)**

Distribution: E: AT, BE, BA, BG, CH, CZ, DE, DK, ES, FR, GB, HR, HU, IT, LI, LT, ME, MK, NL, NO, PL, PT, RO, RS, RU, SE, SK, UA, "Caucasus", A: IR, KP, KR, TR (Alonso-Zarazaga *et al*. 2023).

Host plants: *Carpinus betulus*, *C. orientalis*, *Fagus orientalis*, *F. sylvatica*, *Quercus petraea*, *Q. robur*.

***Taphrorychus hirtellus* (Eichhoff)**

Distribution: E: BA, BG, CZ, HR, HU, IT, ME, MK, RO, SK, N: DZ, A: TR (Alonso-Zarazaga *et al*. 2023, this contribution).

Host plants: *Corylus avellana*, *Fagus orientalis*, *F. sylvatica*, *Quercus cerris*, *Q. frainetto*, *Q. petraea*.

***Taphrorychus minor* Eggers**

Distribution: E: IT, N: DZ (Alonso-Zarazaga *et al*. 2023).

Host plants: *Quercus ilex.*

***Taphrorychus ramicola* (Reitter)**

Distribution: E: BG, ST, "Caucasus", A: IR, SY, TR (Alonso-Zarazaga *et al*. 2023).

Host plants: *Carpinus orientalis*, *Corylus avellana*, *Fagus orientalis*, *Quercus cerris*.

***Taphrorychus siculus* Eggers**

Distribution: E: BA, IT (Sicily), SZ (Alonso-Zarazaga *et al*. 2023)

Host plants: *Alnus* sp.

***Taphrorychus villifrons* (Dufour)**

Distribution: E: AT, BE, BG, CH, CZ, DE, ES, FR, GB, HR, HU, IT, MK, PT, RU, RS, SK, UA, "Caucasus", N: DZ, EG, LY, MA, TN, A: AM, IR, TR (Alonso-Zarazaga *et al*. 2023).

Host plants: *Carpinus betulus*, *C. orientalis*, *Castanea sativa*, *Fagus orientalis*, *F. sylvatica*, *Quercus canariensis*, *Q. castaneifolia*, *Q. castaneifolia* var. incana, *Q. cerris*, *Q. frainetto*, *Q. ilex*, *Q. lusitanica*, *Q. robur*, *Q. suber*.

Conclusions

The scientific literature about the European Scolytinae fauna is increasing, thanks to advancements in collecting techniques and extended trapping studies designed to identify and monitor the spread of non-native species. Italy in particular hosts one of the highest numbers of non-native coleopteran species in Europe, largely to its peculiar climatic conditions (Underwood *et al.* 2009; Kirkendall & Faccoli 2010; Roques 2010; Marini *et al.* 2011; Ruzzier & Colla 2019; Ruzzier *et al.* 2020a; Ruzzier *et al.* 2020b; Ruzzier *et al.* 2021b; Mola *et al.* 2023; Ruzzier *et al.* 2023a, 2023b, 2023c). The numerous monitoring campaigns conducted in recent years to investigate invasive species (Scalera 2009) are gradually contributing to bridge the gaps in our understanding of local fauna. In many cases (Hauptman *et al*. 2019; Colombari & Battisti 2023; Holuša *et al*. 2023), native species have also been identified during these studies. However, the distribution of both alien (Kirkendall & Faccoli 2010) and native species (e.g., Dal Cortivo 2024) belonging to this group remains poorly known.

Comprehensive faunistic studies are therefore essential to assess the richness and the ecology of both native and introduced species. The lack of large-scale studies at the European level, coupled with the availability only of regional taxonomic keys, which are sometimes outdated (*e.g.* Balachowsky 1949; Nunberg 1954), further complicates the accurate identification of these species. As a consequence, collected specimens may be misidentified, especially when their origin is not clearly known.

In addition, due to the high morphological similarity within the Scolytinae (Cognato *et al.* 2009), frequent misidentifications have been observed at both the generic and species levels, particularly within the tribes Xyleborini, Dryocoetini, Ipini and former Cryphalini (Knížek 2007).

Some populations may be too small or too localized to be detected through trapping activities. Additionally, certain species may not respond to the chemical compounds typically used in baited traps for monitoring protocols. In our view, *T. hirtellus*, is likely native to Italy, as suggested by its findings in areas bordering Italian territory, where it does not cause significant damage to host plants. Moreover, it has probably been overlooked or misidentified as one of its congeneric species found in Italy (*T. bicolor*, *T. villifrons*, and *T. minor*).

Based on the results, more extensive and targeted monitoring could help the creation of a detailed distribution map of *T. hirtellus* in Italy, particularly in oak forests dominated by *Q. cerris* and *Q. frainetto*, which Pfeffer (1995) identified as its most suitable host plants. Monitoring projects focused on local faunal studies are essential for advancing our understanding of native species and for the development of conservation strategies for species, confined to specific localities, such as *T. hirtellus*.

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APPENDIX I

E Europe
AT Austria
BE Belgium
BA Bosnia-Herzegovina
BG Bulgaria

CH Switzerland
CZ Czech Republic
DE Germany
DK Denmark
ES Spain (incl. Gibraltar)
FR France (incl. Corse, Monaco)
GB Great Britain (incl. Channel Is.)

HR Croatia
HU Hungary
IT Italy (incl. Sardegna, Sicilia, San Marino)
LI Liechstentein
LT Lithuania
ME Montenegro
MK Macedonia (North)
NL The Netherlands
NO Norway

PL Poland
PT Portugal
RO Romania
RS Serbia
RU Russia:
SE Sweden
SK Slovakia
TR Turkey
UA Ukraine

N North Africa
DZ Algeria
EG Egypt
LY Libya
MA Morocco (incl. Western Sahara)
TN Tunisia

A Asia
AM Armenia
IR Iran
KP North Korea
KR South Korea
SY Syria
TR Turkey