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Coleophora santonici Baldizzone & Takács (Lepidoptera, Coleophoridae), new species from Hungary bred from *Artemisia santonicum*

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[2] *Contribution to the knowledge of Coleophoridae CLII*

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Abstract: The work describes *Coleophora santonici* Baldizzone & Takács, sp. nov., a species bred from *Artemisia santonicum* L., 1753 (Asteraceae) in Hungary. The new species belongs to the *C. ptarmicia* Walsingham, 1910 group based on shared features of the genitalia, and is most similar to *C. santolinella* Constant, 1890. Biological data on the life cycle, larval case and habitats of the species are provided and illustrated. COI barcode sequences were also obtained for *Coleophora santonici* and loaded into the BOLD System and NCBI gene bank.

Keywords: Asteraceae - *Coleophora santolinella* - Cytochrome oxydase 1 barcode - host plant.

INTRODUCTION

Currently, more than 1540 species of Coleophoridae are known in the world (Baldizzone, unpublished data). Of this total, about 600 are found in Europe, where this family of Lepidoptera has always attracted the attention of researchers owing in particular to its larval cycle, which normally occurs in a mobile case. However, even though the European *Coleophora* fauna is remarkably well known compared to that of other continents, many species still remain to be described on the basis of material already preserved in museums and private collections. It is expected that others will be discovered with an increase in research, in particular with breeding, a practice that often makes it possible to find species that are rarely encountered in nature, both through direct harvesting and with the use of lamps and light traps.

Hungary is located in the Pannonian biogeographical area within the Palearctic Region. Several *Coleophora* species have been described from this region in the last 70 years (Gozmány, 1954, 1955; Baldizzone, 1983). A total of 211 species of Coleophoridae have been recorded in Hungary to date. Of these, one belongs to the genus *Augasma* Herrich-Schäffer, 1853 and 210 belong to the genus *Coleophora* Hübner, 1822 (Szabóky & Takács, 2021). Several *Coleophora* species have been discovered in Hungary during the last two decades, e.g. *C. impalella* Toll, 1961, *C. lessinica* Baldizzone, 1980, *C. nigridorsella* Amsel, 1935, *C. jaernaensis* Björklund & Palmqvist, 2002 (Hübner, 1822; Herrich-Schäffer, 1853; Baldizzone, 1980; Amsel, 1935; Björklund & Palmqvist, 2002; Baldizzone & Tokár, 2008; Buschmann *et al.,* 2014; Buschmann & Pastorális, 2018; Szabóky & Takács, 2021).

The Hungarian authors of this paper recently bred a small-sized *Coleophora* species belonging to the *C. ptarmicia* Walsingham, 1910 (Walsingham, 1910) species group from *Artemisia santonicum* L., 1753 (Asteraceae). Studies of the external morphology, genital structures and molecular aspects (COI), carried out in collaboration with the first author, have shown that it represents a new species, which is described below.

MATERIAL AND METHODS

Field work and rearings were conducted in Hungary. Larvae of the new species were reared and overwintered on *Artemisia santonicum* plants removed from the field and planted in the garden of Attila Takács. All larval cases

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were kept in separate tulle bags attached to the plants in order to prevent escape. A few days before the expected time of emergence the cases were relocated to separate plastic vials, where a suitable degree of humidity was maintained.

All the material was collected or observed by the Hungarian authors. The holotype and three paratypes are to be deposited in the Hungarian Natural History Museum, Budapest. The remaining paratypes are deposited in the research collections of Baldizzone (Asti, Italy), Takács (Velence, Hungary) and Szabóky (Budapest, Hungary).

The Euparal slide mounts of dissected genitalia were photographed with a Bresser 5.0 camera attached to a Bresser BioScienze 40-1000x trinocular microscope, using a Leitz PL Fluotar 6.3 / 0.20 objective. The CombineZP program was used for stacking layers into deep-focus images and the resulting images were edited in Corel PaintShop Pro. Images of adults and larval cases were photographed with a Canon 450 D camera attached to a Carl Zeiss Stemi-2000 binocular stereomicroscope; images were edited with Adobe Photosop CS6. Morphological terms follow Baldizzone (2019).

For DNA extraction specimens were killed and stored in 70% alcohol (Table 1). DNA was isolated with Quick-DNA Tissue/Insect Miniprep Kit (Zymo Research) according to the recommended protocol of the manufacturer. Amplification of the COI barcode region was performed with the primers LCO-1490 and HCO-2198 (Folmer *et al.,* 1994). The PCR products were purified using the USB ExoSAP-IT® PCR Product Clean-Up reagent (Affymetrix) and amplicons were sequenced bidirectionally (BaseClear B.V., the Netherlands). The new sequences were assembled with Staden Package 2.0.0b9. Sequences were inspected and translated in translate tool of ExPASy Bioinformatics Resource Portal (Artimo *et al.* 2012) to verify that they were free of stop codons.

One of the aims of our molecular study was to explore the genetic distances between these Hungarian specimens and all available morphologically similar *Coleophora* taxa from the BOLD System database based on their CO1 barcode regions. We used sequences of *C. ptarmicia* Walsingham, 1910, *C. santolinella* Constant, 1890, *C. solidaginella* (Staudinger, 1859) and *Coleophora conyzae* Zeller, 1868 for our analysis. The multiple sequence alignment was carried out by ClustalW (Larkin *et al.,* 2007), with default parameters with these downloaded gene sequences. The most appropriate model of nucleotid substitution was determined with MEGA7 (Kumar *et al.,* 2016) under the Bayesian Information Criterion (BIC). The Tamura-3-parameter model with Gamma Distribution (T92+G) (Tamura, 1992) was selected for our phylogenetic reconstruction and distance analysis. Phylogenetic tree was constructed with the Neighbour-Joining (NJ) method (Saitou & Nei, 1987) implemented in Mega 7 with the default initial rearrangement settings. To obtain an estimate of the support for each node, a bootstrap analysis using 1000 replicates was performed. Bootstrap support is given on appropriate clades in the NJ tree.

Abbreviations

AT = Attila Takács, Velence, Hungary.
Bldz = Giorgio Baldizzone, Asti, Italy.
CsSz = Csaba Szabóky, Budapest, Hungary.
HNHM = Hungarian Natural History Museum, Budapest, Hungary.
IgR = Ignác Richter, Malá Čausa 289, Slovakia.
PG = genital preparation.

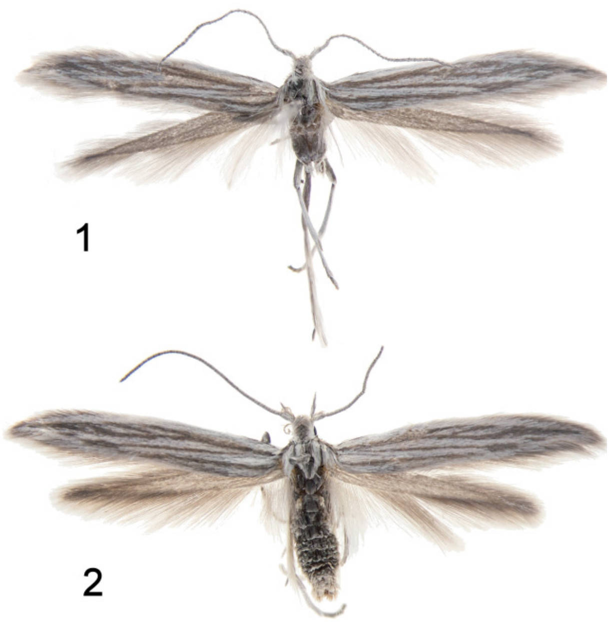
RESULTS AND DISCUSSION

Taxonomy

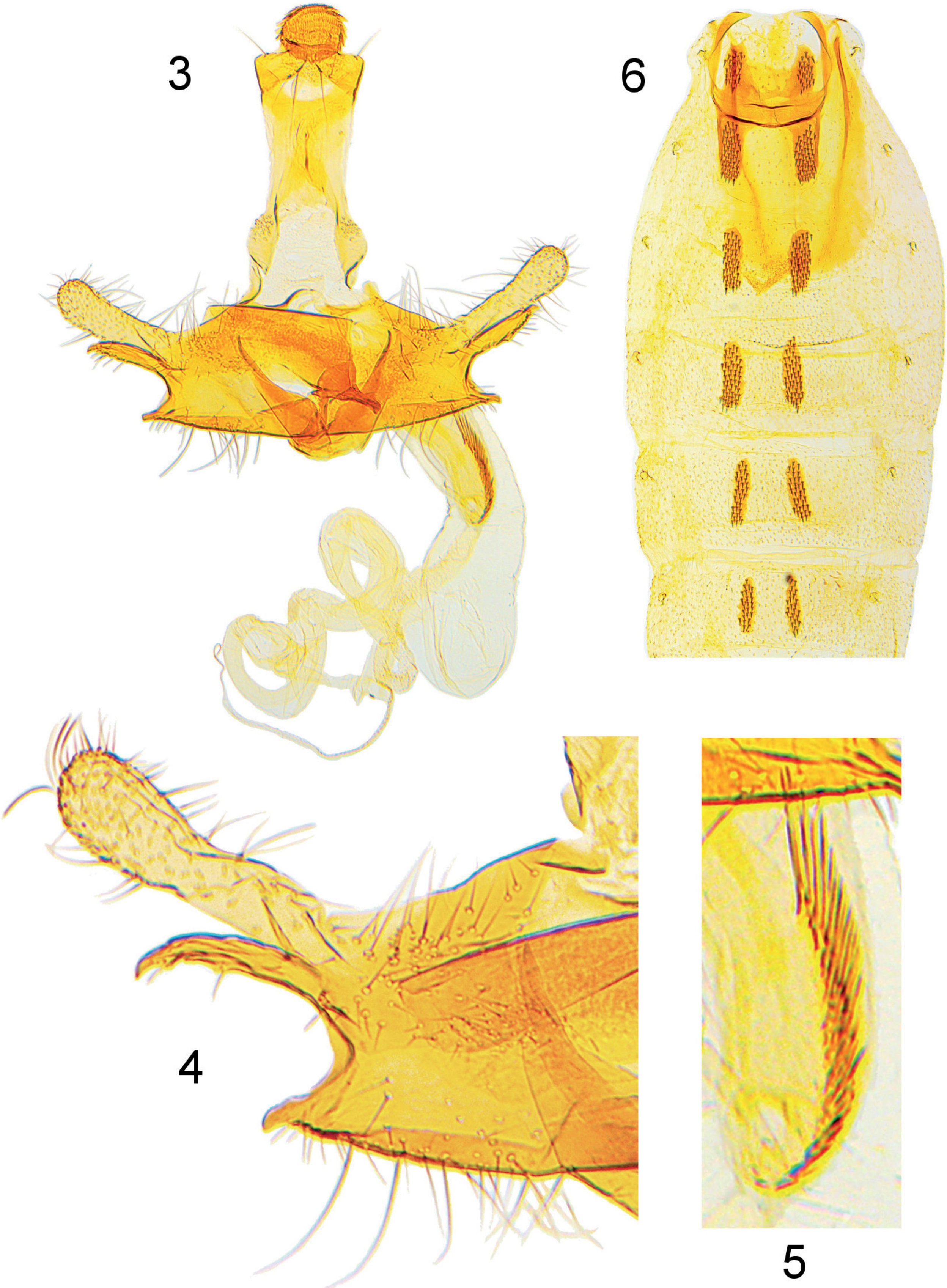
***Coleophora santonici* Baldizzone & Takács sp. nov.**
Figs 1-9, 18-21

Holotype: ♂, (PG Bldz 17180) Hungary, Fejér megye, Pákozd, [47°12’59”N, 18°34’15”E]) 26.06.2020, light trap, leg. A. Takács, deposited in HNHM.

Paratypes: 65 ♂, 17 ♀, all from Hungary: 1 ♀, Fejér megye, Sárszentágota [46°58’08.0”N, 18°33’07.4”E] 10.06.2020 light trap, leg. A. Takács. – 1 ♂ (PG Bldz 17175), same locality, 25.06.2020, ex larva *Artemisia santonicum*, leg. A. Takács. – 1 ♂ (PG Bldz 17373), 1 ♀ (PG Bldz 17370), same locality, ex larva *Artemisia santonicum*, leg. A. Takács. – 1 ♂ (PG Bldz 17371), same locality, 5.06.2021, leg. A. Takács. – 1 ♂, 1 ♀ (PG Bldz 17372), same locality, 8.06.2021, ex larva *Artemisia santonicum*, leg. A. Takács. – 3 ♂,



Figs 1-2. Adults of *C. santonici* sp. nov. (1) Holotype ♂. (2) Paratype. ♂ A. Takács” (photos by A. Takács).



Figs 3-6. Male genitalia of *C. santonici* sp. nov. (3) GP Bldz 17180, holotype. (4) GP Bldz 17373, paratype, enlarged detail of valva and phallotheca. (5) Enlarged detail of cornuti. (6) Abdominal segments 1-6.

Pákozd, 8.VI.2021, ex larva *Artemisia santonicum*, leg. A. Takács; in coll. Baldizzone, Asti. 1 ♀, Fejér megye, Pákozd, (PG IgR30786), 26.06.2020, light trap, leg. A. Takács, det. I. Richter as *Coleophora* sp. – 1 ♀, same locality, 1.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 2 ♂, 1 ♀, same locality, 8.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♀, same locality 11.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 3 ♂, 4 ♀, same locality, 19.05.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂, Fejér megye, Sárszentágota, 25.06.2020, ex larva *Artemisia santonicum*, leg. A. Takács. – 1 ♂, same locality, 26.06.2020, ex larva *Artemisia santonicum*, leg. A. Takács. – 2 ♂, same locality, 5.05.2021, ex larva *Artemisia santonicum*, leg. A. Takács. – 5 ♂, 1 ♀, same locality, 5.06.2021, ex larva *Artemisia santonicum*, leg. A. Takács. – 2 ♂, 3 ♀, same locality, 6.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂, same locality, 7.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂, same locality, 8.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂, same locality, (PG IgR31784), 22.06.2021, light trap, leg. A. Takács, det. I. Richter as *Coleophora ptarmicia* Walsingham, 1910. – 1 ♂, Békés megye, Bélmegyer, fáspuszta, [46°53'41.8"N, 21°11'07.4"E] 03.06. 2021, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♀, same locality, 18.06.2021, ex larva, *Artemisia santonicum*, leg. A. Takács; in coll. A. Takács, Velence. – 3 ♂, Fejér megye, Sárszentágota, 10.06.2020, ex larva, *Artemisia santonicum*, leg. A. Takács. – 6 ♂, Fejér megye, Pákozd, 15.6.2020, ex larva, *Artemisia santonicum*, leg. A. Takács. – 1 ♂ (PG IgR30942), same locality, 15.6.2020, ex larva, *Artemisia santonicum*, leg. A. Takács, det. I. Richter as *Coleophora ptarmicia* Walsingham, 1910. – 1 ♂, same locality, 16.06.2020, ex larva, *Artemisia santonicum*, leg. A. Takács. – 7 ♂, same locality, 29.05.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 5 ♂, same locality, 4.06.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 6 ♂, same locality, 6.06.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 4 ♂, Békés megye, Bélmegyer, fáspuszta, 29.05. 2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 2 ♂, same locality, 4.06.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky; 1 ♂, same locality, 5.06.2021, ex larva, *Artemisia santonicum*, leg. Cs. Szabóky. – 2 ♂, Jász-Nagykun-Szolnok megye, Tiszafüred, [47°32'24.8"N, 20°52'33.6"E] 8.06.2021, ex larva, *Artemisia santonicum*, leg. A. Patalenszki; in coll. Cs. Szabóky, Budapest.

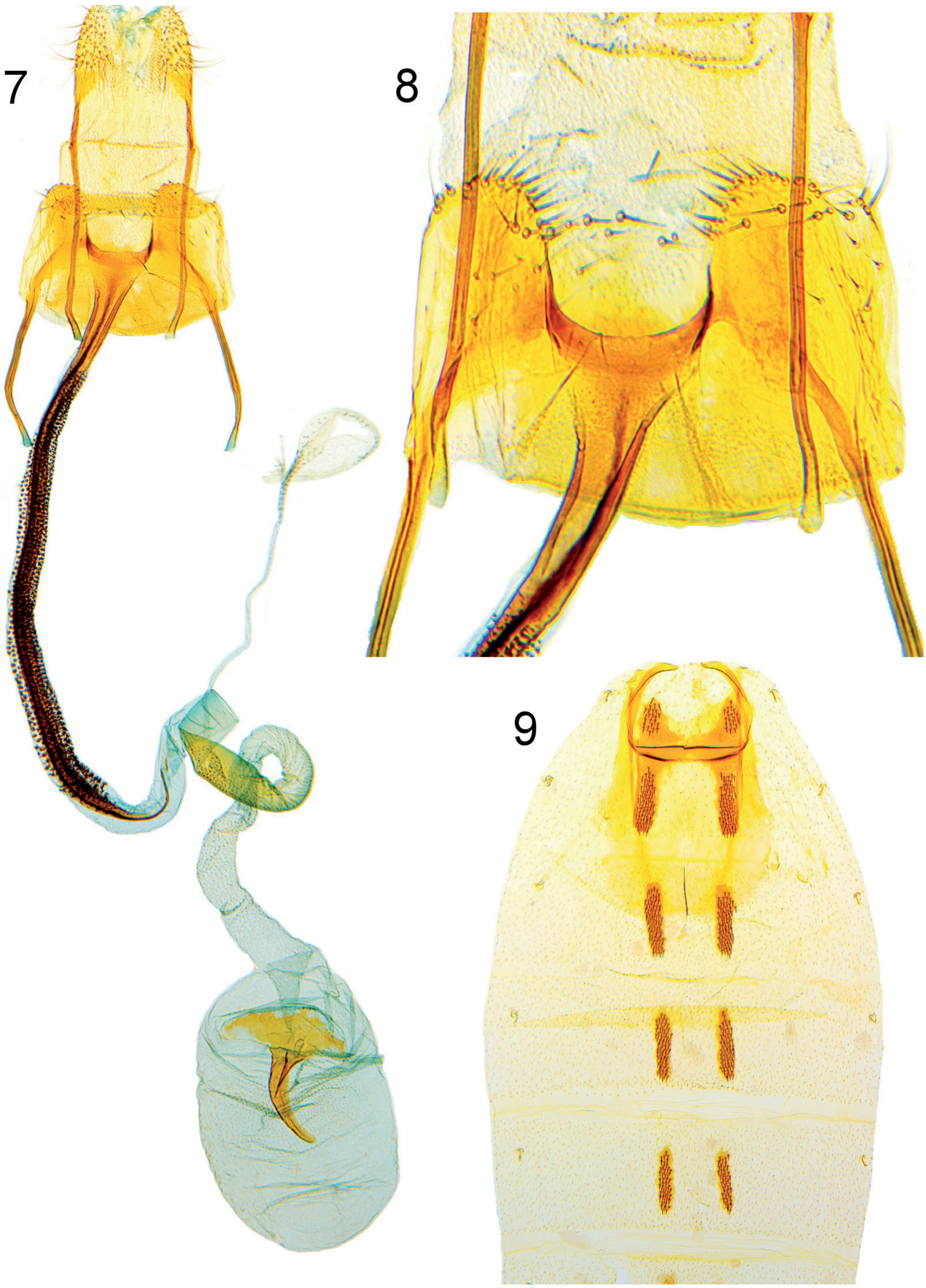
Diagnosis: The species is characterized by the forewing with a mixture of brown and white streaks, the brown ones being more or less positioned along the veins whereas the white streaks are mostly in the interveinal areas. The genital structure of the male is similar to that of *C. santolinella* Constant, 1890 (Figs 10-13). The tegumen is slightly longer and the pedunculus is a little more dilated on the outside; the horn-shaped protuberance in the dorsal angle of the sacculus is slightly smaller and sharper; the cornuti are much more numerous and more regular in shape than those of *C. santolinella*, where there is a marked difference in the length of the 2-3 apical ones which are much longer than the others. In the female genitalia of *C. santonici* sp. nov., the sterigma is longer and narrower than that of *C. santolinella* (Fig. 14-16); the ostium bursae is slightly smaller; the spinulate part of the ductus bursae and the medial line are shorter; the proximal part of the ductus is thinner and more sclerified; the corpus bursae is oval and not elongated; and the signum is much more irregular and less wide in the laminar part and much larger and longer in the pedunculate part.

Description: Wingspan 10.5-11.5 mm (n=all 83 specimens). Head white, suffused beige on dorsum, frons beige. Antenna: scape beige on outer side, brown on inner side, with tuft of short erect scales; flagellum white, ringed white and light beige on distal 1/3. Labial palpus greyish brown, white on the dorsal surface, the third article, dark brown at the apex, about as long as the second. Proboscis of normal shape. Thorax white, beige in middle. Tegula white, almost completely suffused beige. Forewing colour a mixture of brown and white streaks, along costa, radial veins, central part, where the wide streak is divided by a thin, longitudinal, beige line, along dorsum; costal fringes white at base, brownish grey in middle, white at apex; dorsal fringes grey with white basal part. Female forewing slightly more lanceolate than that of male. Hindwing grey, fringes light grey. Abdomen white.

Abdominal structures (Figs 6, 9): Anterior lateral struts about 4 times as long as posterior ones. Transverse strut thin and linear on proximal edge, curved and less sclerotized in middle on distal edge. Tergal disks (3rd tergite) length about 4 times their width, covered with about 65 small conical spines.

Male genitalia (Figs 3-5): Gnathos knob globular. Tegumen medially constricted, pedunculus expanded externally. Transtilla short, thin and curved, joined in middle. Valvula suboval, bristling with long setae in middle and short setae on curved lower edge. Cucullus long and slender, slightly thinner at base. Sacculus broad and low, with slightly curved ventral edge, short pointed protuberance in ventral angle and curved, pointed protuberance just over half length of cucullus in dorsal angle. Phallotheca conical, more sclerotized laterally. Cornuti 12-14, gathered at base in a formation about half as long as vesica, spines of progressively greater length in direction of phallotheca.

Female genitalia (Figs 7-8): Papillae anales elongate oval. Apophyses posteriores about twice as long as anteriores. Sterigma trapezoidal, twice as wide as high, more sclerified in central area around ostium bursae,



Figs 7-9. Female genitalia of *C. santonici* sp. nov. (7) GP Bldz 17370, paratype. (8) GP Bldz 17372, paratype, enlarged detail of sterigma, ostium bursae and colliculum. (9) Abdominal segments 1-5.

distal edge deeply hollowed by sinus vaginalis, with many short and robust setae. Ostium bursae broad, oval, opening in middle of sterigma. Colliculum cup-shaped, long, wider in distal part, narrowed in proximal one, strongly sclerotized on external edges with a medial line. Ductus bursae long: distal part about 4 times length of sterigma, covered with small spines, except in anterior transparent and curved section where medial line begins; proximal part of ductus membranous, finely spiculate and widened towards corpus bursae; corpus bursae large, oval with one large, leaf-shaped signum with laminar part with an irregular, jagged edge and a long and robust pedunculate part.

Remarks: The *Coleophora ptarmicia* group is characterized by genital structures that are quite similar, especially in the male, while in the females the differences are more pronounced. In Europe *C. ptarmicia* is the most widespread species (Baldizzone, 2019). *Coleophora santolinella* is distributed only in part of the western Mediterranean area. In Asia, *C. paraptarmica* Toll & Amsel, 1967, described from a male from Afghanistan, is similar in genitalia to the European species, with minor differences. Falkovitsh (1973) published a few lines on the presence *C. paraptarmica* in Turkmenistan and on the plant from which he had bred it, *Artemisia turanica* Krasch., along with a drawing of the larval case, which is similar to that of *C. ptarmicia*. The first author (GB) had received as a gift a pair of specimens *C. paraptarmica* from Falkovitsh and subsequently, on the basis of their genitalia structures, in particular that of the female, had identified numerous specimens of this species from Afghanistan, Turkey, Pakistan, Iran and Syria (Baldizzone, 1994). Wolfgang Glaser had also bred specimens (in part in coll. Baldizzone) from Turkey on *Artemisia maritima* L., attributing them to this species. In the light of current knowledge, including genetic studies which have highlighted a good number of probably undescribed species from Russia, the Near and Middle East, Central Asia, all determinations of "*paraptarmica*" need to be reconsidered.

Molecular diagnosis: Interspecific distances ranged from 0.085 to 0.166 with *C. ptarmicia* and *C. conyzae*, respectively (Table 2). The results of our molecular analysis correlate well with morphological and genital features and support the status of *C. santonici* as a distinct, new species. It is worth noting that *C. ptarmicia* displayed a remarkable intraspecific variation (0.104) compared to another geographically widespread species, *C. conyzae* (0.008) (Table 2). Furthermore, its recovered haplotypes did not form a monophyletic cluster (Fig. 17). The genetic distance between the two haplotypes was 0.098 (Table 3). The genetic distance between the Russian haplotype of *C. ptarmicia* and the Hungarian haplotypes of *C. santonici* - which are located in the same clade - was 0.035 and 0.037, respectively. A similar intraspecific genetic distance was observed for the haplotypes of *C. santolinella* (0.029). Moreover, it should be noted that the genetic distances between the *C. solidaginella* and *C. conyzae* haplotypes also seemed to be very low (pairwise distance: <0.001-0.009, Table 3). These results

Table 1. *Coleophora santonici* specimens from Hungary used for molecular analyses. Host plant: *Artemisia santonicum*.

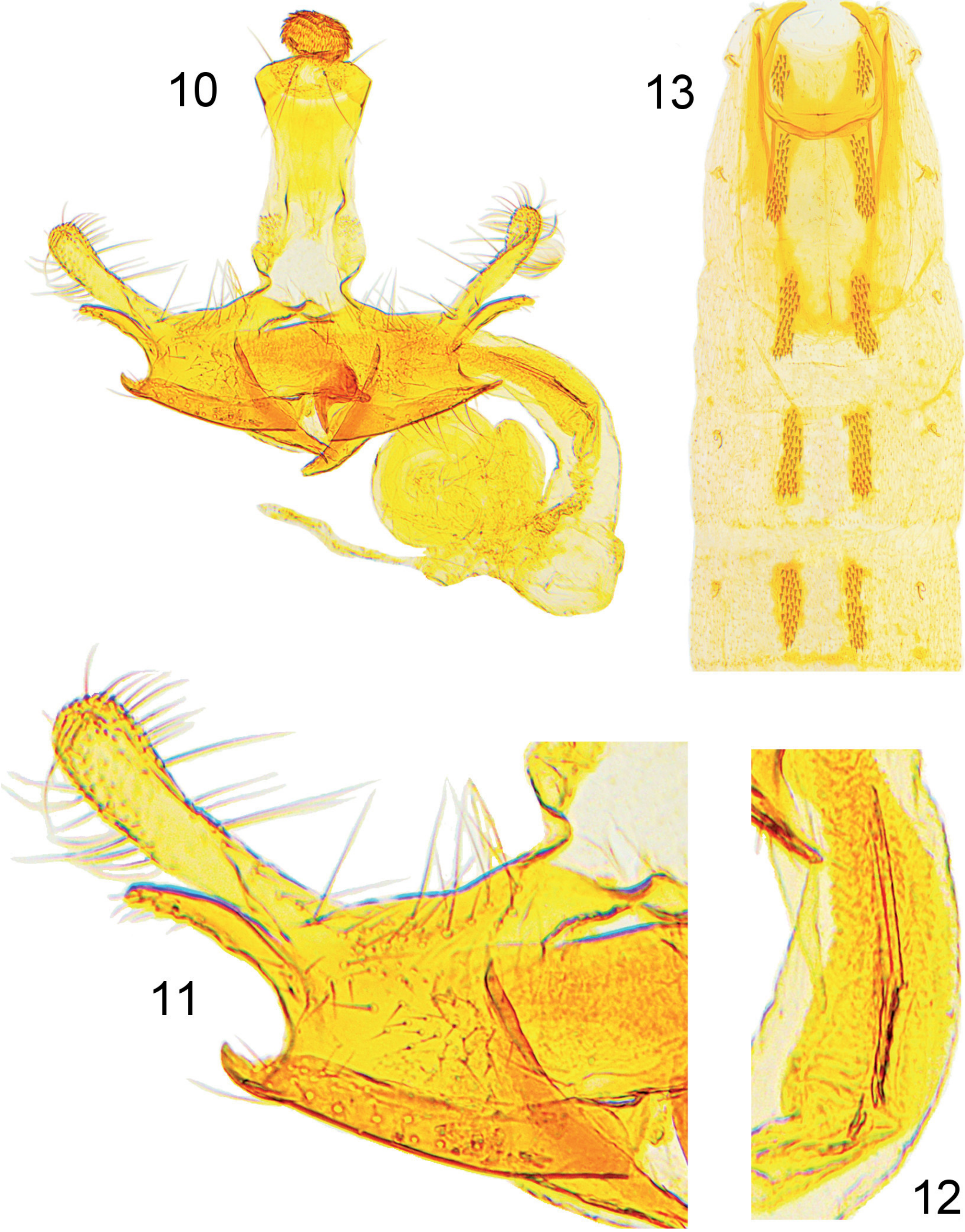
Locality	Longitude	Latitude	Date of collection	Collector	NCBI GenBank code	Stage
Sárszentágota	46°58'07"N	18°33'07"E	17.10.2020	A. Takács	MZ664316	larva
Pákozd	47°12'59"N	18°34'15"E	26.05.2021	A. Takács	OK335987	larva
Sárszentágota	46°58'07"N	18°33'07"E	05.06.2021	A. Takács	OM420279	ex larva, imago
Bélmegyer	46°53'41"N	21°11'07"E	18.06.2021	A. Takács	OM420280	ex larva imago
Pákozd	47°12'59"N	18°34'15"E	01.06.2021	A. Takács	OM420275	ex larva, imago

Table 2. Interspecific T92+G divergences between *C. santonici* and four similar species (in genitalia morphology), based on the analysed section of the COI gene sequence. The number of examined specimens are in parentheses. Maximum intraspecific variations are given in diagonal grey cells.

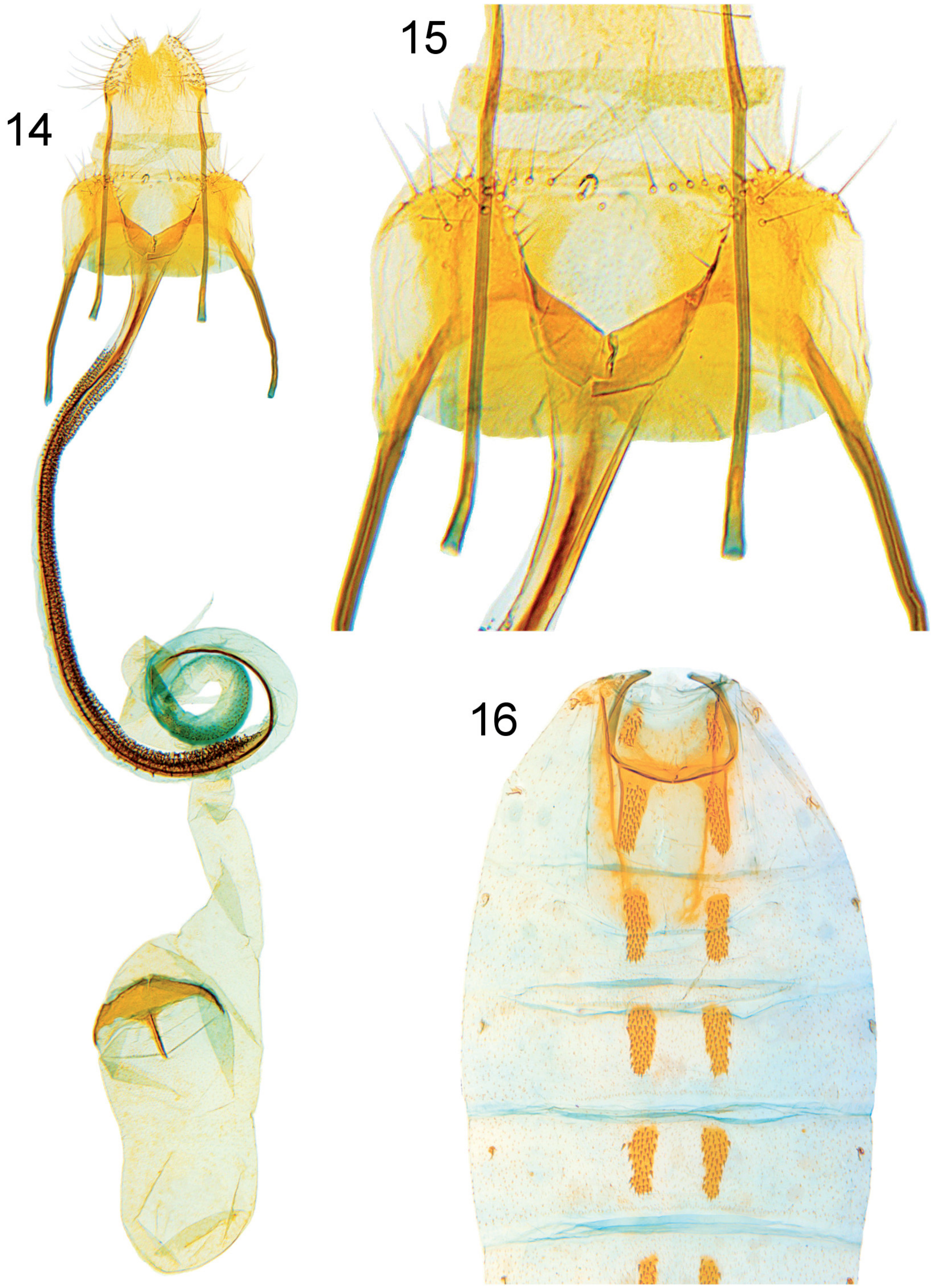
	santonici	*ptarmicia*	*santolinella*	*solidaginella*	*conyzae*
santonici sp. nov. (5)	0.002				
ptarmicia (2)	0.085	0.104			
santolinella (2)	0.144	0.125	0.029		
solidaginella (1)	0.150	0.153	0.164	-	
conyzae (7)	0.166	0.164	0.181	0.006	0.008

Table 3. Pairwise distances between *Coleophora* haplotypes based on the analysed section of the COI gene sequence (T92+G).

	OK335987	MZ664316	JF847408	MPEA323-08	KX048812	MPEA603-08	JF847405	ELACA236-10	DEEUR260-11	LNEL163-06	LNEL161-06	ELACA237-10
santonici sp.nov. (OK335987, Hungary)												
santonici sp.nov. (MZ664316, Hungary)	0.002											
ptarmicia (JF847408, Russia)	0.037	0.035										
ptarmicia (MPEA323-08, Italy)	0.126	0.122	0.098									
santolinella (KX048812, Spain)	0.145	0.141	0.123	0.123								
santolinella (MPEA603-08, France)	0.126	0.122	0.106	0.114	0.029							
solidaginella (JF847405, Spain)	0.141	0.137	0.137	0.146	0.152	0.151						
conyzae (ELACA236-10, Sweden)	0.160	0.155	0.155	0.155	0.172	0.170	0.007					
conyzae (DEEUR260-11, Austria)	0.160	0.155	0.155	0.155	0.172	0.170	0.007	0.007				
conyzae (LNEL163-06, Italy)	0.160	0.155	0.156	0.155	0.172	0.171	0.007	0.007	0.004			
conyzae (LNEL161-06, Italy)	0.165	0.160	0.161	0.160	0.177	0.176	0.009	0.009	0.002	0.002		
conyzae (ELACA237-10, Spain)	0.141	0.137	0.137	0.146	0.152	0.151	<0.001	0.007	0.007	0.007	0.009	
conyzae (GBMIN27228-13)	0.146	0.141	0.142	0.141	0.156	0.155	0.004	0.011	0.011	0.011	0.013	0.004



Figs 10-13. Male genitalia of *C. santolinella*. (10) GP Bldz 17444, Sardinia, Aritzo, 1200 m, ex larva *Santolina*, 10.VII.1978, leg. Hartig, coll. Baldizzone. (11) Enlarged detail of valva and phallotheca. (12) Enlarged detail of cornuti. (13) Abdominal segments 1-5.



Figs 14-16. Female genitalia of *C. santolinella*. (14) GP Bldz 13577, Sardinia, Domusnovas, Sa Duchessa, 350 m, 2.VII.2004, at light, leg., coll. Baldizzone. (15) Enlarged detail of sterigma, ostium bursae and colliculum. (16) Abdominal segments 1-5.

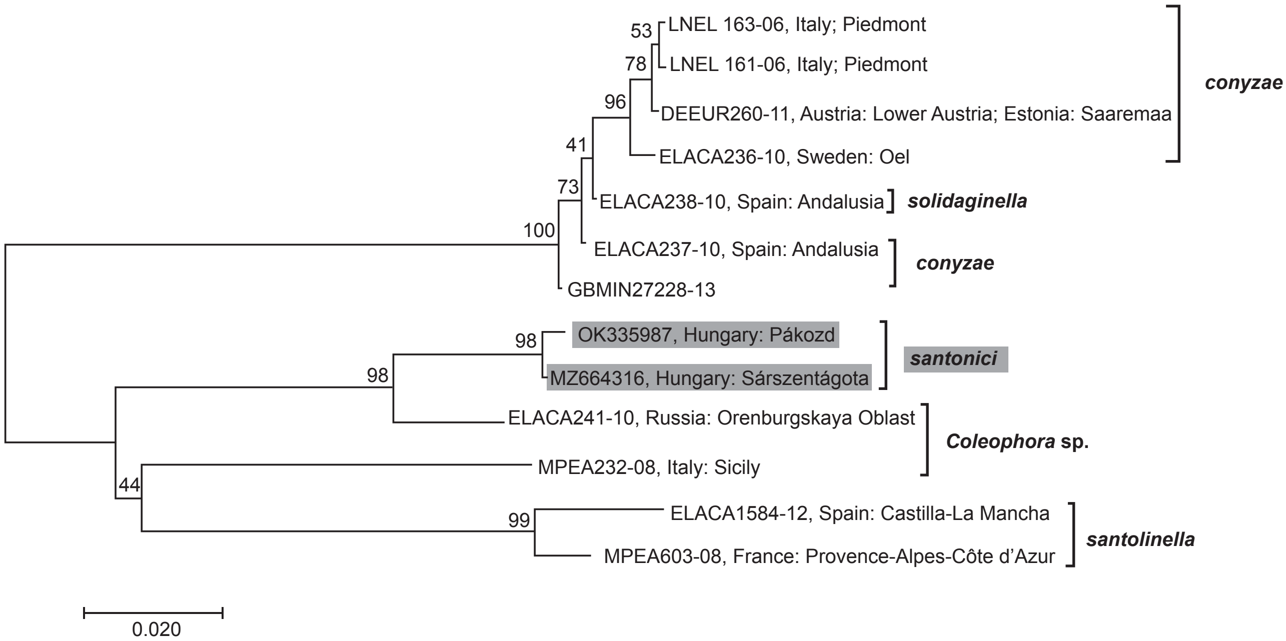


Fig. 17. Neighbor-joining tree of examined *Coleophora* specimens. Scale bar indicates 2% divergence of nucleotide substitutions.

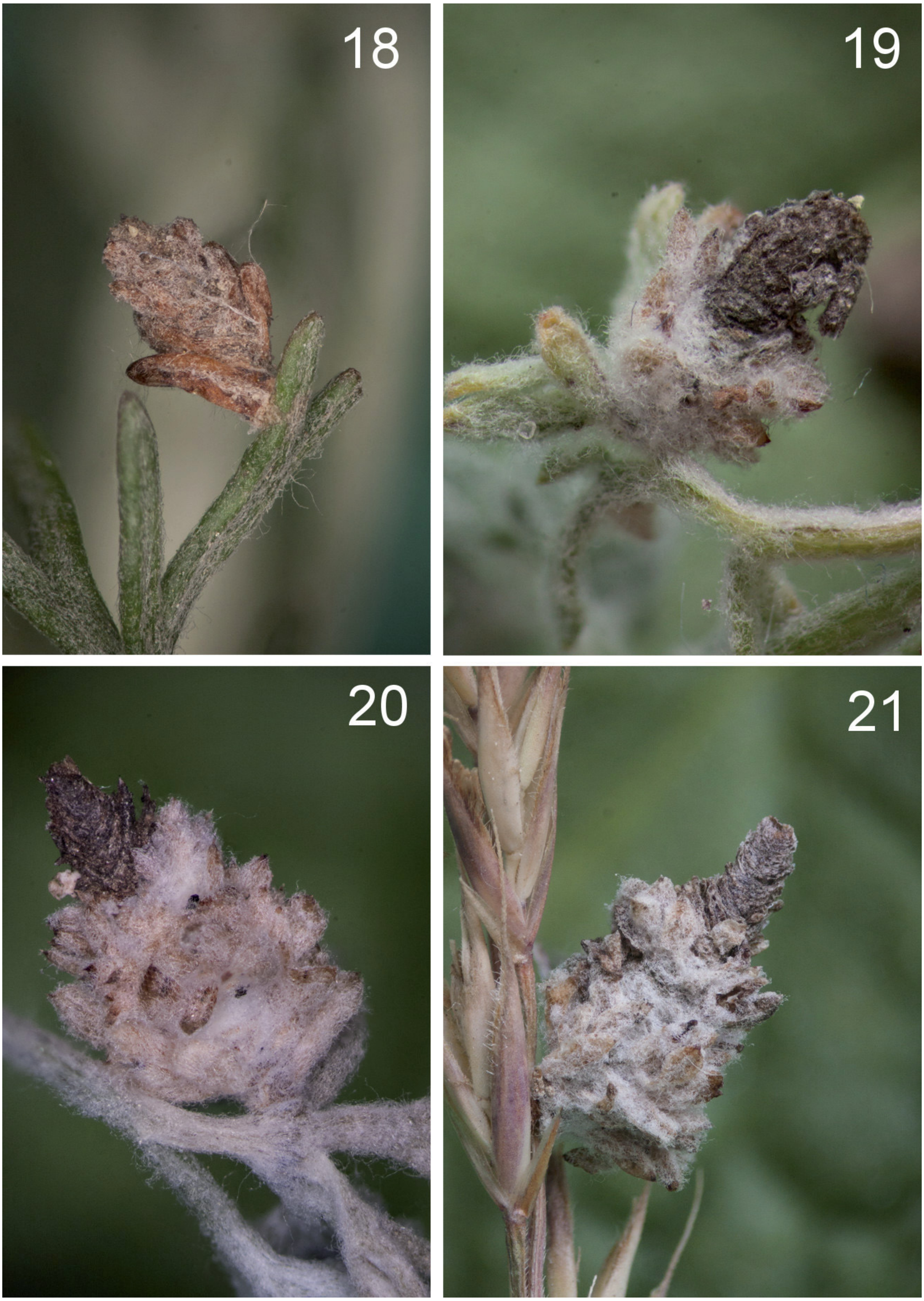
may suggest that the species status of these specimens should be revised.

Bionomy: The host plant is *Artemisia santonicum*. The larvae hatch from their eggs in late September and early October, making a 2 mm case from the leaves of the host plant until winter (Fig. 18). The larvae overwinter in the L1 stage at the base of the host plant. In spring, the larvae continue to build their cases from chewed fresh leaves (Fig. 19). The overwintering case is dark brown. In spring the larva enlarges its case, which becomes fluffy, silvery bronze. The L2 case is 4 mm, the L3 size is 6 mm (Fig. 20), and the L5 size is 8-9 mm. The mature larva climbs to a relatively tall plant and attaches the case to it, for pupation (Fig. 21). The mouth of the case is at a 40° angle to the longitudinal axis of the case. The anal opening is bivalved.
The pupal stage lasts two weeks. In this period, the cases are easy to find. Adults fly from late May to late June; they are diurnal, but they are also attracted to the lamp.
A total of 80 adults of *C. santonici* emerged from the cases grown on *Artemisia santonicum* and three specimens were captured with light traps, resulting in a total of 83 specimens.
The parasitoids that emerged from a few cases of *Coleophora santonici* have been identified as members of the families Braconidae, Eulophidae (*Tetrastichus* sp.), and Ichneumonidae, and the superfamily Chalcidoidea (Hymenoptera). All specimens are under study by specialists and to be deposited in the HNHM.

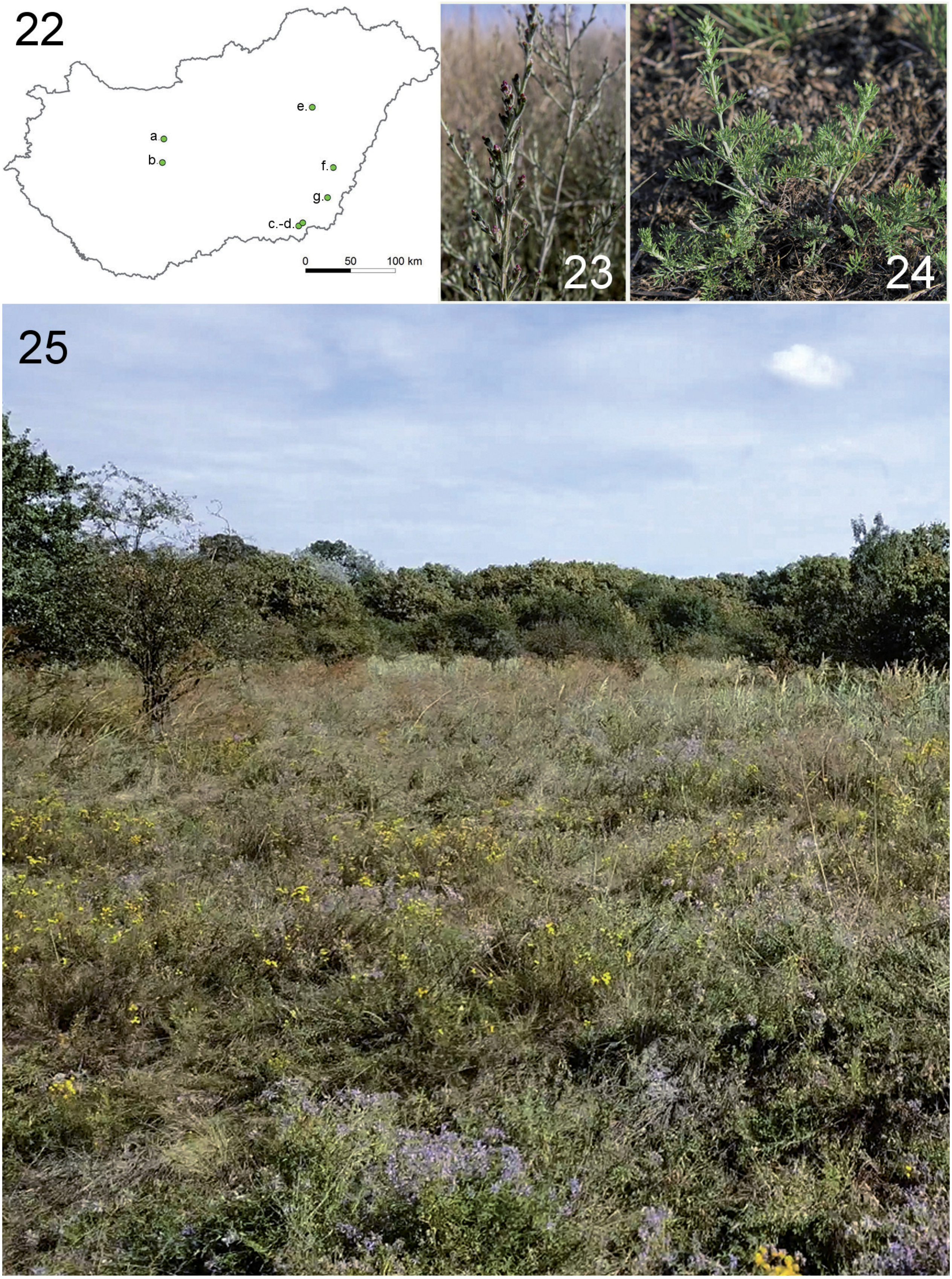
Distribution: The species has been collected only in Hungary. The description of the various habitats follows. All known habitats of *Coleophora santonici* are characterized by the salt steppe. The main association plant species is *Artemisia santonicum*. All sites are characterized by mosaicism and extreme rainfall and temperature fluctuations. The habitats are typically short grass worm steppes, with small patches of annual halophytic communities on saline plains, and mixed grassland meadow patches on fertile soil.

The habitat at Pákozd and Sárszentágota (Figs 22a, b): The first specimens of this species were trapped in an Artemisia salt steppe habitat near the village of Sárszentágota on June 12, 2020. The species was also found in the vicinity of Pákozd near Lake Velence on the same day. The habitats at both locations are characterized by short grass steppe on alkaline, solonetzic and solonchak soils. The vegetation is short (14-40 cm) and rather sparse with variable (30-80 %) ground cover. The variable soil conditions render the vegetation spatially heterogeneous. The dominant community is wormwood steppe, which is interspersed with patches of saline meadow and annual halophytic communities. The dominant plant species at both locations is *Artemisia santonicum* (Lendvai, 2021).

The habitat at Csanádalberti (Száraz-ér), Királyhegyes-Csikóspuszta (Blaskovics kripta), and Kosár-hát near Tiszafüred (Figs 22c, d, e): The habitat at Királyhegyes-Csikóspuszta (Blaskovics kripta) is overgrazed and thus degraded. About 70% of the habitat is invaded by *Phragmites australis* (Cav.) Trin. ex Steud., while the rest is dominated by a short grass steppe community of *Artemisia santonicum* and *Festuca valesiaca* Schleich. ex Gaudin s.l. that has developed on alkaline soils. The



Figs 18-21. Larval cases of *C. santonici* sp. nov. in progressive evolutionary stages. (18) L1 case before overwintering: Sárszentágota, 17.10.2020, 3 mm. (19) L2 case after overwintering: Sárszentágota, 4.04.2020, 4 mm. (20) L3 case: Sárszentágota, 8.04.2020, 6 mm. (21) Case before pupation: Bélmegyer, 8.06.2021, 8 mm (photos by A. Takács).



Figs 22-25. Biotopes, habitat and host plant of. *C. santonici* sp. nov. (22) Collection localities of *Coleophora santonici* sp. nov. (map by Kristóf Antal). (23-24) *Artemisia santonicum* (photos by Szabolcs Kis). (25) Habitat in Bélmegyer (photo by Gusztáv Boldog).

habitat west of Csanádalberti (at Száraz-ér) is also a short grass wormwood steppe with small patches of annual halophytic communities on alkali flats, and patches of mixed-grass meadow steppe on fertile soil. Habitat characteristics at Kosár-hát near Tiszafüred are similar. The vegetation is a mosaic of different communities developed in response to variable salt and moisture content of the soil (Borhidi, 2003). The dominant plant species in all three places is *Artemisia santonicum* (Borhidi, 2003).

The Habitat at Bélmegyer and Szabadkígyós (Figs 22f, g): The habitat of *Coleophora santonici* sp. nov. at Szabadkígyós (Kígyósi puszta) and near Bélmegyer is a mosaic of alkaline short grass steppe and a type of meadow steppe rich in tall forbs. The latter is found typically in the glades of pedunculate oak *Quercus petraea* woods as part of the forest steppe on alkali soil. The habitat is characterized by highly variable salt and moisture content of the soil. The vegetation is composed of plants of saline meadows, shortgrass alkaline steppe, and meadow steppe on chernozem soil, and rich in tall and erect fennel-like forbs. The habitat is prone to scrub invasion. Similar tall-forb communities with increasingly different species composition are broadly distributed in the eastern forest-steppe and steppe zone from Eastern Ukraine to the Altai Mountains (Borhidi *et al.,* 2012). The dominant plant species at both locations is *Artemisia santonicum* (Borhidi, 2003).

Etymology: The name derives from that of the host plant, *Artemisia santonicum*.

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