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Updating data on the sycamore seed bug, *Belonochilus numenius* (Say, 1832) (Hemiptera: Lygaeidae) in Spain

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Abstract

Belonochilus numenius is a Nearctic seed bug living on different species of *Platanus* (Platanaceae). It was first found in Europe in 2008 and since then it has spread rapidly across the continent. It is likely that this rapid expansion has been favored by the widespread presence of its *Platanus* spp. host plants, which is used everywhere as an ornamental tree. In July 2015, *B. numenius* became an urban pest for the first time, becoming a public nuisance in Barcelona city (Spain), and thus forcing the Municipal Technical Services to undertake treatment. Because of these facts, we wanted to update available information about *B. numenius* in Spain and to summarise control actions carried out in some urban areas affected in Catalonia. Information sources consulted include published references, observations by the authors or by others graciously communicated to the authors, and the review of photos available through the Biodiversidad Virtual sharing website. All this information was collated from 2008 to the present, resulting in over a hundred Catalan municipalities where the species has been detected. Information is also provided on management treatments including effective alpha-cypermethrin treatments and selective pruning experiments. Trunk injection treatments with abamectin were very effective against the sycamore lace bug (*Corythucha ciliata*), but they were not effective against *B. numenius*.

Key words: Alien species, urban pest, urban entomology, urban parks and green areas, sycamore seed bug, Catalonia, Iberian Peninsula, true bugs, trunk injection.

Resum

El belonòquil del plàtan *Belonochilus numenius* (Say, 1832) (Hemiptera, Lygaeidae): actualització de les dades a Espanya

Belonochilus numenius és un ligeid neàrtic que viu sobre diferents espècies del gènere *Platanus*. Va ser trobat per primera vegada a Europa al 2008 i d'aleshores ençà, s'ha escampat ràpidament per tot el continent. Sens dubte aquesta ràpida expansió s'ha vist afavorida per la presència generalitzada de la seva planta hoste, que és utilitzada arreu com a arbre ornamental. Al juliol de 2015, *B. numenius* esdevé per primera vegada una plaga urbana, causant greus molèsties a la ciutat de Barcelona, que varen obligar als Serveis Tècnics Municipals a realitzar tractaments. Arran d'aquests fets, s'ha volgut actualitzar la informació sobre *B. numenius* a Espanya, i resumir les accions de control dutes a terme en alguns nuclis de població afectats a Catalunya. Les fonts d'informació han estat la bibliografia, les observacions dels autors, o bé les d'altres persones que amablement els hi han comunicat, i la revisió de fotografies disponibles a la xarxa a través de la plataforma Biodiversidad Virtual. Tota aquesta informació, aplegada des del 2008 fins a l'actualitat, permet assenyalar més d'un centenar de municipis catalans on s'ha detectat l'espècie. Quan a la gestió, s'informa d'experiències efectives per mitjà de tractaments amb alfa-cipermetrina, o amb esporga selectiva. Els tractaments per injecció a tronc amb abamectina van ser molt efectius contra el tigre del plàtan (*Corythucha ciliata*), però no ho van ser contra *B. numenius*.

Paraules clau: Espècies invasores, plagues urbanes, entomologia urbana, espais verds urbans, ligeid del plàtan, Catalunya, Península Ibèrica, heteròpters, injecció al tronc.

Introduction

The sycamore seed bug *Belonochilus numenius* (Say, 1832) is a Nearctic species which has rapidly spread since first recorded in Europe (Matocq, 2008; Gessé *et al.*, 2009; Aukema *et al.*, 2013; Werner, 2014).

The main hostplants for *B. numenius* are different species and hybrids of plane trees, *Platanus* spp. (Platanaceae), and despite its common name it is not generally associated with sycamores (*Acer* spp., Aceraceae). Plane trees are very commonly used as an ornamental tree along streets and parks in many European cities. It is likely that the accessibility to such



Fig. 1. *Belonochilus numenius* on plane tree seed ball. Photo: J. M. Riba (St. Pere Pescador, Catalonia, 6 August 2015).

an easily available food plant has largely contributed to the rapid expansion of the sycamore seed bug in Europe. Details on the general biology of the species in field and laboratory conditions were studied by Wheeler (1984). *Belonochilus numenius* feeds on the seeds inside the ripe and unripe seed balls as both nymphs and adults (Fig. 1).

In July 2015, outbreaks of the sycamore seed bug were observed in three locations in NE Iberian Peninsula, including Barcelona city (Spain). Due to the fact that the seeds are not important for the propagation of urban plane tree, the presence of *B. numenius* is not a matter of plant health. In urban green areas, a plant-feeding insect becomes a pest when its populations cause economic losses, affects urban plantings in terms of functionality, aesthetics or monumentality, and/or becomes a public nuisance to urban citizens (Chauvel, 1998), thus generally leading to public complaints. As the sycamore seed bug did fit those requirements, the insect achieved pest status, and several control actions were adopted.

The aim of the present work is to update the information available so far in Spain, specifically focusing on Catalonia where, as far as we know and according to all consulted literature and web information, *B. numenius* has reached for the first time the status of an urban pest in Europe. Short notes on control experiences are also included. The knowledge of where and when the species is recorded may help to prevent future outbreaks.

Material and methods

A thorough bibliographic and webographic review was performed to gather all available information on *B. numenius* as alien species in Europe. In the case of Catalonia, new citations are based on personal observations by the authors and from colleagues. Because *B. numenius* is a species very easy to recognize on pictures, we also include citations of *B. numenius* from records in the Spanish photograph sharing website Biodiversidad Virtual uploaded up until September 24th, 2015. Determination of these species photographed in Biodiversidad Virtual until 2015 were verified by Luis Vivas (<http://www.biodiversidadvirtual.org>).

Results and discussion

The sycamore seed bug was reported for the first time in the Palaearctic from specimens collected in October 2008 in France (Corsica and Hérault) (Matocq, 2008). However, it was collected prior to this in the Iberian Peninsula in summer 2008 at two localities in the province of Barcelona (Castelldefels and Barcelona city) (Gessé *et al.*, 2009). Samples previously observed in July 2008 in Mallorca were reported much later (Baena & Torres, 2012). Since then, the sycamore seed bug has been recorded as alien species from the following European countries (in alphabetical order): Austria,

Table 1. New records of *B. numenius* in Catalonia. Data are presented according to collecting or observation date. The code BV- number refers to the photograph number of the image uploaded in Biodiversidad Virtual website. The following short names indicate the personal observations of: IM, Izaskun Martí; JR, Josep M. Riba; MG, Marta Goula. Full personal names in the last column are stated for those colleagues who graciously communicated personal data. Numbers in the third column identify municipalities, and correspond to the map in the figure 2.

<i>Date</i>	<i>Locality</i>	<i>Municipality reference number</i>	<i>Province</i>	<i>Source of citation</i>
2008-Sep-09	Barcelona city	1	Barcelona	Clavell (BV-58128)
2009-Jul-02	Barcelona city	1	Barcelona	Clavell (BV-89048)
2010-Aug-27	Barcelona city	1	Barcelona	Clavell (BV-166999)
2011-May-13	Barcelona city	1	Barcelona	Sesma (BV-212878)
2011-Jun-18	Barcelona city	1	Barcelona	Santaefemia (BV-610823)
2011-Jul-13	Barcelona city	1	Barcelona	Clavell (BV-266296)
2011-Jul-22	Sant Adrià del Besòs	2	Barcelona	JR
2011-Jul-22	Badalona	3	Barcelona	JR
2011-Aug-05	El Rourell	4	Tarragona	Solé (BV-256627)
2011-Sep-02	Barcelona city	1	Barcelona	Clavell (BV-283020)
2012-Aug-12	Barcelona city	1	Barcelona	Clavell (BV-413017)
2012-Oct-23	El Prat de Llobregat	5	Barcelona	Esteban (BV-416672)
2013-Aug-01	Barcelona city	1	Barcelona	Clavell (BV-518329)
2013-Sep-27	Sant Just Desvern	6	Barcelona	JR
2013-Oct-09	Barcelona city	1	Barcelona	Guerrero (BV-524483)
2014-Jul	Terrassa	7	Barcelona	JM.Fernández
2014-Sep-11	Sant Martí Sarroca	8	Barcelona	MG
2014-Nov-16	Cal Rosal - Berga-Avià	9	Barcelona	MG
2015-Jul-02	Santa Coloma de Gramenet	10	Barcelona	Valladares (BV-714541)
2015-Jul-03	Barcelona city	1	Barcelona	Molina (BV-714539)
2015-Jul-12	Berga	11	Barcelona	Escobet (BV-719063)
2015-Jul-15	Lleida city	12	Lleida	Margalef, 2015
2015-Jul-16	El Prat de Llobregat	5	Barcelona	JR
2015-Jul-16	Sant Boi de Llobregat	13	Barcelona	JR
2015-Jul-16	Viladecans	14	Barcelona	JR
2015-Jul-16	Gavà	15	Barcelona	JR
2015-Jul-16	L'Hospitalet de Llobregat	16	Barcelona	JR
2015-Jul-17	Pineda de Mar	17	Barcelona	JR
2015-Jul-17	Malgrat de Mar	18	Barcelona	JR
2015-Jul-17	Blanes	19	Girona	JR
2015-Jul-17	Lloret de Mar	20	Girona	JR
2015-Jul-17	Tossa de Mar	21	Girona	JR
2015-Jul-24	Salou	22	Tarragona	JR
2015-Jul-24	Vila-seca	23	Tarragona	JR
2015-Jul-25	Sant Carles de la Ràpita	24	Tarragona	F.López
2015-Jul-28	Igualada	25	Barcelona	JR
2015-Jul-28	Balaguer	26	Lleida	JR
2015-Jul	L'Hospitalet de l'Infant	27	Tarragona	F.López
2015-Jul	Valls	28	Tarragona	F.López
2015-Jul	Vimbodí i Poblet	29	Tarragona	F.López
2015-Jul	Montblanc	30	Tarragona	F.López
2015-Jul	Els Pallaresos	31	Tarragona	F.López
2015-Jul	El Catllar	32	Tarragona	F.López
2015-Jul	La Riera de Gaià	33	Tarragona	F.López
2015-Jul	Altafulla	34	Tarragona	F.López
2015-Jul	Torredembarra	35	Tarragona	F.López
2015-Jul	Cambrils	36	Tarragona	F.López
2015-Jul	Tarragona city	37	Tarragona	F.López
2015-Aug-04	Mollet del Vallès	38	Barcelona	JR
2015-Aug-04	Alella	39	Barcelona	JR
2015-Aug-04	Cabrera de Mar	40	Barcelona	JR
2015-Aug-06	Mataró	41	Barcelona	JR
2015-Aug-06	Sant Pere Pescador	42	Girona	JR
2015-Aug-08	Sant Feliu de Guíxols	43	Girona	MG
2015-Aug-14	Manresa	44	Barcelona	JR

Table 1. Continuation.

<i>Date</i>	<i>Locality</i>	<i>Municipality reference number</i>	<i>Province</i>	<i>Source of citation</i>
2015-Aug-17	Caldes de Malavella	45	Girona	JR
2015-Aug-17	Santa Coloma de Farners	46	Girona	JR
2015-Aug-17	Sant Miquel de Cladells	47	Girona	JR
2015-Aug-17	Arbúcies	48	Girona	JR
2015-Aug-17	Hostalric	49	Girona	JR
2015-Aug-20	Calonge	50	Girona	JR
2015-Aug-20	Palamós	51	Girona	JR
2015-Aug-20	Llagostera	52	Girona	JR
2015-Aug-20	Vidreres	53	Girona	JR
2015-Sep-04	Girona city	54	Girona	JR
2015-Sep-07	Vic	55	Barcelona	JR
2015-Sep-07	Figueres	56	Girona	R.Busquets
2015-Sep-08	Molins de Rei	57	Barcelona	JR
2015-Sep-08	Sant Cugat del Vallès	58	Barcelona	JR
2015-Sep-08	Granollers	59	Barcelona	JR
2015-Sep-08	Cardedeu	60	Barcelona	JR
2015-Sep-08	Sant Celoni	61	Barcelona	JR
2015-Sep-15	Olot	62	Girona	L.Olivet
2015-Sep-21	Vulpellac	63	Girona	JR
2015-Sep-21	La Bisbal	64	Girona	JR
2015-Sep-21	Pals	65	Girona	JR
2015-Sep-21	Torroella de Montgrí	66	Girona	JR
2015-Sep-21	Viladamat	67	Girona	JR
2015-Sep-21	Sant Martí d'Empúries	68	Girona	JR
2015-Sep-21	Camallera	69	Girona	JR
2015-Sep-21	Llampaies	70	Girona	JR
2015-Sep-22	Cervera	71	Lleida	JR
2015-Sep-22	Tàrraga	72	Lleida	JR
2015-Sep-22	Lleida city	12	Lleida	JR
2015-Sep-22	Cardona	73	Barcelona	JR
2015-Sep-22	Solsona	74	Lleida	JR
2015-Sep-23	La Seu d'Urgell	75	Lleida	P.Garreta
2015-Sep-25	Vilafranca del Penedès	76	Barcelona	C.Prats
2015-Sep-25	Sant Martí Sarroca	78	Barcelona	C.Lacabra
2015-Sep-28	Vilanova i la Geltrú	77	Barcelona	D.Garcia, JR revised
2015-Sep-29	Sant Pere de Ribes	78	Barcelona	C.Prats
2015-Sep-29	Mura	79	Barcelona	M. Roca-Cusachs
2015-Oct-02	Castelló d'Empúries	80	Girona	R.Busquets
2015-Oct-03	Sallent	81	Barcelona	JR
2015-Oct-03	Balsareny	82	Barcelona	JR
2015-Oct-03	Navàs	83	Barcelona	JR
2015-Oct-03	Artés	84	Barcelona	JR
2015-Oct-03	Les Masies de Voltregà	85	Barcelona	JR
2015-Oct-03	Sant Hipòlit de Voltregà	86	Barcelona	JR
2015-Oct-03	Sant Quirze de Besora	87	Barcelona	JR
2015-Oct-03	Ripoll	88	Girona	JR
2015-Oct-03	Sant Joan de les Abadesses	89	Girona	JR
2015-Oct-03	La Vall de Bianya	90	Girona	JR
2015-Oct-03	Besalú	91	Girona	JR
2015-Oct-03	Banyoles	92	Girona	JR
2015-Oct-04	L'Escala	93	Girona	JR
2015-Oct-04	Empuriabrava	94	Girona	JR
2015-Oct-04	Roses	95	Girona	JR
2015-Oct-05	Sitges	96	Barcelona	C.Prats
2015-Oct-06	Garriguella	97	Girona	JR
2015-Oct-06	Llançà	98	Girona	JR
2015-Oct-06	Vilabertran	99	Girona	JR
2015-Oct-06	Cabanes	100	Girona	JR
2015-Oct-06	Sant Climent Sescebes	101	Girona	JR

Table 1. Continuation.

<i>Date</i>	<i>Locality</i>	<i>Municipality reference number</i>	<i>Province</i>	<i>Source of citation</i>
2015-Oct-06	Agullana	102	Girona	JR
2015-Oct-06	La Jonquera	103	Girona	JR
2015-Oct-06	Pont de Molins	104	Girona	JR
2015-Oct-07	Calella	105	Barcelona	JR
2015-Oct-07	Sant Pol de Mar	106	Barcelona	JR
2015-Oct-07	Canet de Mar	107	Barcelona	JR
2015-Oct-07	Arenys de Mar	108	Barcelona	JR
2015-Oct-07	Arenys de Munt	109	Barcelona	JR
2015-Oct-07	Caldes d'Estrac	110	Barcelona	JR
2015-Oct-07	Sant Vicenç de Montalt	111	Barcelona	JR
2015-Oct-07	Sant Andreu de Llavaneres	112	Barcelona	JR
2015-Nov-07	Bellver de Cerdanya	113	Lleida	JR



Fig. 2. New records of *B. numenius* in Catalonia. Numbers in the figure refer to the third column in table 1.

Bulgaria, Czech Republic, France, Germany, Hungary, Italy, Monaco, Portugal, Slovakia, Spain and Switzerland (Werner, 2014). Werner (2014) should be consulted for detailed information on these records. Additional records not included in Werner (2014) are as follows: Germany (Munich, 2013-Sep-10; Bräu, 2014), Portugal (Madeira, Funchal, 2014-Sep-14; Rabitsch & Heiss, 2015) and Spain (Madrid city, 2014-Aug-02; Alcorcón, 2014-Sep-24; Costas *et al.*, 2015). It is only a matter of time before the insect is found in every single European country, provided that the host plant is present and the environmental factors give the appropriate conditions for survival of this insect. The report from Azores (Terceira, Angra do Heroísmo, J. Ribes 2010-Apr-01), published by Ribes (2010) should be ignored, as the specimen belongs in fact to the lygaeid *Orsillus depressus* (Mulsant & Rey, 1852) (Aukema *et al.*, 2013).

Several unpublished new localities have been reported in Spain. By means of photographs uploaded onto the Biodiversidad Virtual sharing website, the species has been recorded in the province of Valencia (Paterna: Fumanal, 2012; Valencia city: Vivas, 2013), Zaragoza (Zaragoza city: Bourrut, 2014) and Granada (Trevélez [at 1486 m, 2015-Sep-14]: Rabitsch, personal communication). Details of all new unpublished information concerning Catalonia are given in Table 1, and shown on the map in figure 2.

Belonochilus numenius as an urban pest

Belonochilus numenius has low potential damage, with no phytosanitary risk for EU Member States (Steinmüller *et al.*, 2014). Moreover, this insect has not been classified as a quarantine pest in European and Mediterranean Plant Protection Organization (EPPO A1 and A2 Lists), and it is not present in the EPPO Alert List (EPPO, 2015).

The first recorded occurrence of *B. numenius* as urban pest took place in Badalona (Barcelona province) in 2011, which affected the plane trees of a very restricted area. Control strategies in Badalona in 2011 were not applied because the outbreak was of short duration.

In July 2015, the sycamore seed bug was reported as a public nuisance in three areas in NE Iberian Peninsula: Barcelona city, El Prat de Llobregat and Blanes. The effects were mainly related to insects entering houses in large numbers having been attracted by lights at night, or accumulating in balconies or on urban furniture, and also disturbing clients in cafeterias terraces in open areas, either at day or at night. In these places, where the species produced very high outbreaks and disturbed the citizens, *B. numenius* achieved pest status. In these three localities, the situation generated numerous public complaints, and municipalities were required to respond to them.

In Barcelona, the insect was recorded all over the city, but Eixample and Sant Martí were most affected, because plane tree is almost the only ornamental species in these quarters. The pest situation in Barcelona city had quite important repercussions in the media (as examples in «www.lavanguardia.es» or «www.8tv.cat»), to the point that the Municipal Service of Parks and Gardens ordered control actions to stop

the pest. Control actions were based on night treatments with alpha-cypermethrin at 10 % v/w; alpha-cypermethrin is a pyrethroid insecticide authorized by the Spanish Ministry of Agriculture to control the tingid true bug *Corythucha ciliata* on plane trees located in parks and gardens. Treatments were performed from 8th July to 8th August 2015. A total of 30,000 trees were treated within the whole city of Barcelona, which included 8,203 trees in the Eixample and 14,447 trees in Sant Martí quarters. Since August 2015, public complaints and media coverage has decreased, thus empirically assuming that treatments applied and/or intrinsic insect life cycle dynamics reduced the public nuisance effects of *B. numenius* against citizens and visitors in Barcelona city.

In El Prat de Llobregat, a directed-spraying application was performed to the crown of the affected trees, using alpha-cypermethrin, successfully controlling both *C. ciliata* and *B. numenius*.

In Blanes, *B. numenius* outbreaks in July 2015 did not generate any direct control action, as it was understood that treatments in spring 2015 against *C. ciliata* could also solve the sycamore seed bugs outbreaks in summer 2015. In summer 2014, heavy infestations of *C. ciliata* occurred in a district zone in Blanes; thus, to prevent 2015 summer *C. ciliata* outbreaks once again, in May 2015, trunk-injected abamectin applications using ENDOterapia Vegetal® method were applied in that district zone. Abamectin is an insecticide with systemic and translaminar activities, that control pests at leaf level, but it does not move into fruiting bodies and therefore has no control effects on insects that develop on fruits (Byrne *et al.*, 2012; Dembilio *et al.*, 2014; De Liñán, 2015). As a consequence, in July 2015 there were no signs of *C. ciliata* presence on any of the treated trees inspected at leaf level, but adults and nymphs of *B. numenius* were very abundant on abamectin-treated plane tree fruits, thus proving that this insecticide is ineffective against the sycamore seed bug when it is injected in the trunk.

In El Prat de Llobregat, urban tree maintenance involves periodic selective pruning. Due to budget constrictions, during winter 2015 only trees from some of the districts within this municipality were pruned, while others were not. In summer 2015, *B. numenius* was clearly less abundant in the areas where plane trees were pruned the winter before; these trees exhibited lower fruit set, thus the population of sycamore seed bug was much lower than in areas where trees were not pruned. Tree pruning can be an alternative method to prevent future outbreaks for *B. numenius* in some very sensitive zones, but it should fit with the municipal budget; in addition to this, trees must be pruned properly, to avoid unnecessary damages in the future concerning wood rotting and its effects on wood structure level processes (Drenou, 2000; Bedker *et al.*, 2012).

Conclusions

The spread of the Nearctic alien species *B. numenius* in Spain has been dramatic along the Mediterranean coast of the Iberian Peninsula, and increasingly in inland regions. *Pla-*

tanus x acerifolia, is the plane tree species most commonly found all over Spain, as an ornamental tree along roads and urban parks and streets. Thus, it is very probable, as it has been already observed in Catalonia, that this insect species will spread everywhere in the country. It is worth noting that the species colonizes not only urban environments, but also field and mountain localities up to ca. 1500 m a.s.l. (Sierra Nevada, Spain; Rabitsch pers. comm.), thus exhibiting a good adapting life cycle. Provided that the environmental conditions fit those needed to complete its life cycle, further expansion of the insect within Europe is only a matter of time.

As the insect has already proved to be capable of becoming an urban pest, intrinsically associated to the fact that its food plant is presented where humans mostly live, it would be worth paying attention to the insect and their growing populations by means of monitoring in our urban areas with plane trees. As the insect develops most of its life cycle on the sycamore fruits, tree pruning may be considered as an effective control method, as field observations have already proved; moreover, pruning is a mechanical, non polluting control method. On the other hand, more research on trunk injection and new active ingredients may provide other possible control methods in the future.

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