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FIRST RECORDS OF THE INVASIVE AMERICAN WASP *ISODONTIA MEXICANA* (HYMENOPTERA: SPHECIDAE) IN SERBIA

ALEKSANADAR ĆETKOVIĆ[1*], BRANKA ČUBRILOVIĆ[1], MILAN PLEĆAŠ[1], ANĐELKA POPOVIĆ[1], DRAGIŠA SAVIĆ[2] and LJUBIŠA STANISAVLJEVIĆ[1]

1 University of Belgrade, Faculty of Biology, Studentski trg 16, 11000 Beograd, Serbia
* Corresponding author e-mail: acetkov@bio.bg.ac.rs
2 National Park "Fruška Gora", Zmajev trg 1, 21208 Sremska Kamenica, Serbia
E-mail: dragita@gmail.com

Abstract

The first verified occurrences of the invasive American sphecid wasp, *Isodontia mexicana* (Saussure, 1867), in Serbia are reported. It was first collected from a trap-nest sample in the northern surroundings of Belgrade in 2010. During 2012, we recorded well-established, abundant populations in the central city area of Belgrade, its surroundings, and also at a single site on the Fruška Gora Mt. We briefly review the circumstances and course of its recent eastward and northeastward spreading in Europe since1990, from Slovenia and Croatia to Hungary and Austria. Establishment of *I. mexicana* in northern Serbia and its probable range expansion further south represent the expected continuation of its spreading throughout western Europe, following its initial introduction into southern France around 1960.

KEY WORDS: *Isodontia mexicana*, Sphecidae, Serbia, first record, invasive species.

Introduction

Isodontia Patton, 1880 represents one of the two genera included in the Sphecini. It is distributed worldwide with more than 60 recognised species (PULAWSKI, 2012). In most of the Palaearctic, it is represented by only two native species, *I. paludosa* (Rossi, 1790) and *I. splendidula* (A. Costa, 1858) (BITSCH *et al*., 1997; BITSCH, 2010; PULAWSKI, 2012). Both are present in Europe, mainly in more southern zones: the Mediterranean and partly sub-Mediterranean (BITSCH *et al*., 1997; HYMIS, 2006-2012). None of them is recorded from Serbia, but they are probably present in southernmost areas. The third species, *I. mexicana* (de Saussure, 1867), was accidentally introduced into Europe, where it became established first in France in the early 1960s (KELNER-PILLAUT, 1962; HAMON *et al*., 1988). *Isodontia mexicana* is native to the western hemisphere, namely to North

America (mainly east of the Rocky Mountains, but also in Arizona and Mexico) and through Central America. It was also introduced into some Pacific islands (Oahu, Hawaii and Midway Atoll) around the middle of the 20th century (BOHART & MENKE, 1963; cited after DISCOVER LIFE, 2012). Most recently, in 2004 it was recorded from the Fars Province in southern Iran (FALLAHZADEH, 2005, 2008). This occurrence seems likely to be a result of its earlier introduction into neighbouring western areas (Iraq, Kuwait) due to the massive American military presence and associated supply transportation since the early 1990s.

Like other members of *Isodontia*, *I. mexicana* is a nonfossorial sphecid, nesting in natural cavities such as old bee holes, hollow branches and stems, but also in crevices between stones. Its vernacular name "Grass-carrying wasp" comes from their habit of bringing grass blades to line their nests. Like most other Sphecini, they provision their offspring with ensiferan Orthoptera, usually tree crickets (Gryllidae) and katydids (Tettigoniidae) (BOHART & MENKE, 1976; O'NEILL & O'NEILL, 2003; DISCOVER LIFE, 2012; ENCYCLOPEDIA OF LIFE, 2012). At genus level, the most common prey are *Oecanthus*, *Conocephalus* and *Phaneroptera* (BOHART & MENKE, 1976), all taxa of moderate to small body size. In Germany, RENNWALD (2005) recorded these and several others, of which *Metrioptera*, *Meconema* and even the large *Tettigonia* were also common.

Since the initial establishment in Europe, this exotic species started to spread, first within France (HAMON *et al.*, 1988). It took more than two decades to reach the neighbouring countries. The first record outside France was from northern Italy in 1985 (SCARAMOZZINO & PAGLIANO, 1987), followed by northern Spain in 1986 (HAMON *et al*., 1988) and southern Switzerland in 1989 (AMIET, 1989; AMIET & MORETTI, 2002). Since that time, *I. mexicana* has continued to spread more rapidly: 1990 in southwestern Slovenia (GOGALA, 1995), 1993 in westernmost Croatia (GUSENLEITNER, 1996), 1997 in southwestern Germany (WESTRICH, 1998), 2001 in western Hungary (JÓZAN, 2002), 2003 in northeastern Austria (ZETTEL, 2003) and finally 2010 in Belgium (BARBIER, 2012). Following the initial colonisation, *I. mexicana* became firmly established and more or less widespread in many of the invaded countries. Hence, it is now recorded from most of France, including Corsica (BITSCH, 2010; BARBIER, 2012), mainland Italy and Sardinia (PAGLIANO *et al*., 2000; SCHMID-EGGER, 2003; NIOLU, 2010), Switzerland (VERNIER, 1995; AMIET, 2009), Slovenia (DOLLFUSS, 2008; GOGALA, 2011), throughout southwestern Hungary (JÓZAN, 2006, 2010), Istria and western Croatian coastlands (JÓZAN, 2006, 2009; DOLLFUSS, 2008), southwestern Germany (RENNWALD, 2005; WESTRICH, 2007), and Austria (ZOBODAT, 2005; WIESBAUER *et al*., 2011); see also PULAWSKI (2012) for more detailed recording evidence.

After being recorded in southeastern Hungary (GYURKOVICS, 2009), it was expected that *I. mexicana* would appear also in Serbia. In this paper, we are reporting about the first documented presence of this species, and we briefly discuss the wider context of its arrival in the northern part of the country.

Material and Methods

As usual with the first recording of a newly established species, encounters are accidental and not the result of any planned study or regular monitoring. We happen to have recorded specimens of *I. mexicana* within two different sampling approaches.

The first sample resulted from the large-scale survey of wild bee pollinators in semi-natural and agricultural landscapes around Belgrade, which took place in the seasons 2009–2011 (carried out by AĆ, BČ, AP, MP and LjS). We placed sets of 2–3 trap-nests made of common reed stems (*Phragmites*) in each of 16 study sites during 2009–2010 (April–October), each trap consisting of approximately 100–150 stems of variable diameter (at least 50 were large enough for the nesting of *Isodontia*). Trap-nests were operated throughout

the season. In autumn they were transferred into a climatic chamber for rearing in the next spring. Among 80 successful trap-nest samples, only one (from 2010) contained *I. mexicana*. In 2012, the occurrence of *I. mexicana* was recorded by accidental collecting and observing of diverse pollinators (bees and wasps) at a few locations in and around Belgrade (by AĆ, AP and MP). Unrelated to these pollinator studies, in the last 10 years DS performed regular photographic surveys throughout diverse locations at the Fruška Gora Mt., with an average intensity of about 70-80 working hours over 30 days per year (during June-August); only in 2012 did he record the presence of *I. mexicana*.

Figure 1. The female of *Isodontia mexicana* feeding on *Mentha longifolia*, at Paragovo site (Fruška Gora Mt, 2012) (photo: D. Savić).

Identifications were made with the help of standard keys for European *Isodontia* (SCARAMOZZINO & PAGLIANO, 1987; HAMON *et al.*, 1988; BITSCH *et al.*, 1997) and aided by numerous photographs available via internet (e.g. HYMIS forum, http://www.forum.hymis.de, and others). Being the only member of the genus *Isodontia* in central Europe, and one of the few representatives of the Sphecinae (DOLLFUSS, 1991; HYMIS, 2006-2012),

I. mexicana is easily and reliably recognised even on the basis of its colour (the completely black integument and the infuscate wings, usually with distinct blue-metallic reflections; Fig. 1).

The material studied is deposited in the collections of the Natural History Museum of Belgrade, Faculty of Biology of the University of Belgrade, and in the personal collection of A. Ćetković (Belgrade, SERBIA).

Our records are shown in the map on Fig. 2. For the analysis of the previous course of species' spreading eastward/northeastward in Europe, we have also included all traceable records in adjacent countries: Hungary, Croatia, Slovenia and Austria (GOGALA, 1995, 2011; GUSENLEITNER, 1996; JÓZAN, 2002, 2006, 2009, 2010; ZETTEL, 2003; ZOBODAT, 2005; DOLLFUSS, 2008; GYURKOVICS, 2009; WIESBAUER et al., 2011; PULAWSKI, 2012).

Results

From 2010–2012 we collected or recorded about 80 specimens of *I. mexicana*.

Records in 2010: northern surroundings of Belgrade, southeast of the settlement Ovča; trap-nest operated from April to October, fixed on small groups of trees within the mainly open, herbaceous agricultural landscape. In one trap-nest containing 143 reed stems (about 80 being wide enough for *Isodontia*), only 22 stems were inhabited by solitary Hymenoptera, 10 of them by *I. mexicana*. We found 51 cocoons, 1–7 per each inhabited reed stem (median: 6). From the cocoons, 35 imagines emerged during 2011, and 2 more were found dead (enclosed in their pupal cocoons). For unknown reasons the other individuals failed to develop. The established sex ratio was nearly balanced: 20♀ and 17♂.

Records in 2012: Belgrade – central area: Botanical Garden "Jevremovac", 04.06.2012, 1♀ observed; 07/10.07.2012, 3♀ 3♂ collected and more than 25 additional specimens observed within less than 2 hours, on flowers of *Mentha* spp. and on several species of Apiaceae; Belgrade, Ada near Crvenka, 29.07.2012, several specimens observed; Belgrade, Karaburma, 10.08.2012, 1♀ collected; Fruška Gora Mt, Paragovo, 07/08.08.2012, 1♀ collected, several specimens observed (Fig. 1; see also SAVIĆ, 2012), all on flowers of *Mentha longifolia*, only at one humid site; not observed at other similar locations on Fruška Gora Mt.

Discussion

Both areas (Belgrade and surroundings and Fruška Gora Mt) were covered by relatively extensive field surveys from 2008–2011. Thus absence of records prior to 2010, and the availability of only one record from 2010–2011 allow the fairly precise dating of the establishment of *I. mexicana* in this region. Apparently, the species became quite numerous in 2012, as it is recognizable from observations at one favourable site in the very urban centre of a large city (Belgrade). Based on numerous pictures available from throughout Europe on the Internet (e.g. HYMIS FORUM, http://www.forum.hymis.de, and others), it is obvious that both sexes of *I. mexicana* often visit diverse common flowering plants, so they can be easily recorded when present.

It is of interest to consider the spatio-temporal dynamics of the eastward spreading of *I. mexicana* that preceded its arrival in Serbia. On the basis of the shortest linear distance, the first record from Belgrade (Ovča) is about 150 km south of Szeged in SE Hungary (first record in 2009), and about 270–280 km southeast of two close localities in SW Hungary, Lábod (2004) and Lad (2006), respectively. Looking further

into the past, the closest known records west of Belgrade lie about 380 km apart in western Hungary (2001: Szarvaskend near Körmend) and about 490 km apart in central Slovenia (1993: Ljubljana). Apparently, the pace of *I. mexicana* spreading eastwards within the wider area of the Pannonian Plain is increasing. This also seems obvious from the sequence of previous findings: from westernmost Slovenia (first record in 1990) to the easternmost location in Croatia (in 2001) with an approximate distance of 260 km. Similarly, it took 11–14 years to move 270–290 km from westernmost Slovenia (1990) to western and southwestern Hungary (Szarvaskend in 2001, Lábod in 2004). It is only in the first three years following its detection in Slovenia (1990-1993) that it has spread about 70 km eastwards within this country and about 80-130 km southeastwards, to the closest locations in Croatia. The spread into northeastern Austria more probably happened from western Hungary (130 km distance between respective first records; 2001–2003), than from Slovenia (as suggested by ZETTEL (2003), who was unaware of published Hungarian records).

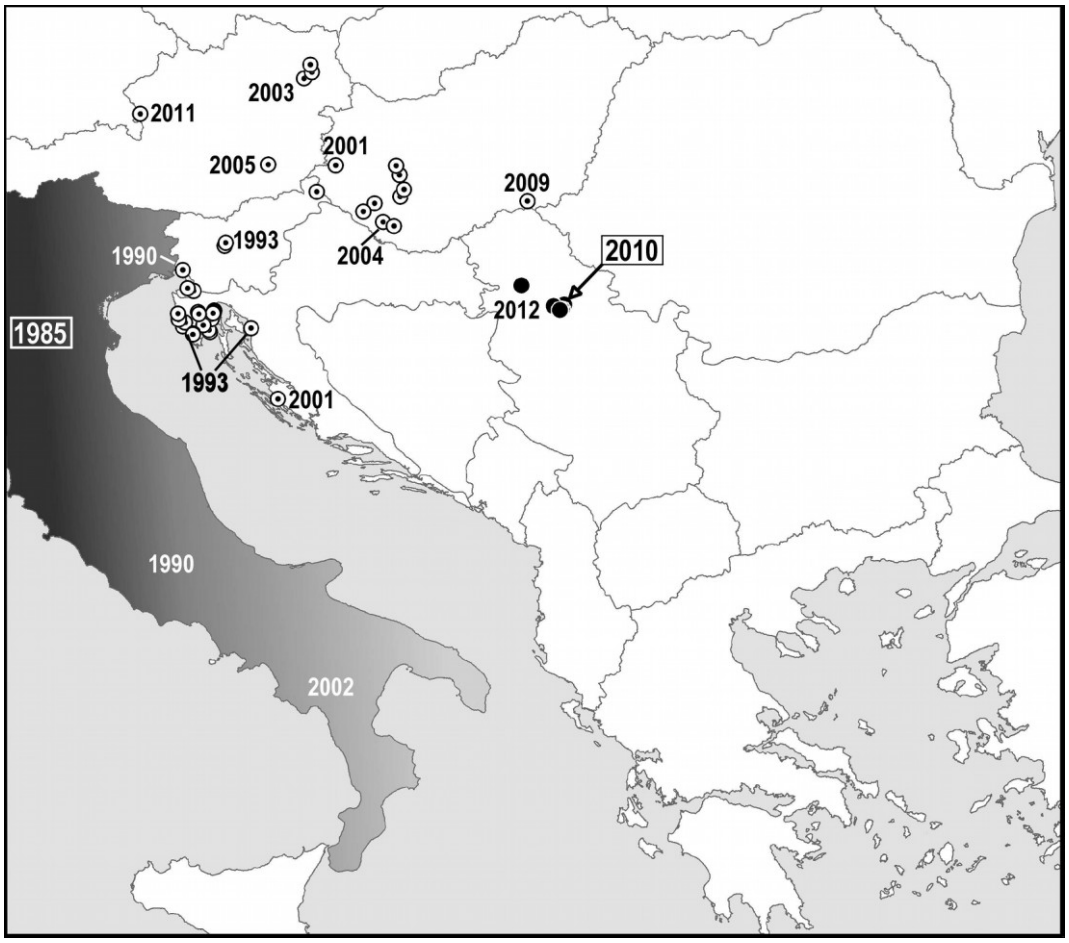

Figure 2. Distribution and spread of *Isodontia mexicana* in the eastern section of its European range. Legend: empty dots with point: published records; black dots: new records. Most characteristic years of first regional detections are indicated (those that best mark the approximate course of spread). Most of mainland Italy is now inhabited, so instead of individual records, we have indicated the approximate direction of past spread with grades of shading.

Generally, the current knowledge of the distribution and expansion history of most invasive insect species is largely influenced by the uneven activity pattern of entomologists in the field. Therefore, some of the regions within or adjacent to the area inhabited by *I. mexicana* (like Bosnia and Herzegovina, most of Croatia – except for its western coastland, most of eastern and northern Hungary, etc) are probably not covered by any recording, creating a biased impression of species expansion routes and dynamics. A similar situation is obvious for another exotic sphecid, *Sceliphron curvatum* (Smith), which had an analogous direction of spread through the southeast of Europe about 6-15 years earlier (cf. ĆETKOVIĆ et al., 2004, 2011; SCHMID-EGGER, 2005). In Slovenia, probably most of Austria, and areas of detection in Croatia and Hungary, it seems that recording intensity and coverage were sufficient in the course of the recent two decades to allow for a more reliable judgement. However, even in such cases we assume that the years of first recording regularly postdate the respective actual arrivals, and may be at best interpreted as possibly the earliest years of successful local establishment.

Furthermore, it should be assumed that some sequences of spread could have been facilitated by human transport, thus representing cases of secondary introductions on a smaller geographical scale within Europe, and not by natural dispersal (as in the much more elaborated case of *S. curvatum*). Also, it seems obvious that natural spreading may not always occur in all directions equally, particularly when severe physical barriers occur (like high mountain chains between Slovenia and Austria), nor does it necessarily follow the shortest way between two areas. Therefore, the best we can do in reconstructing the pathway of spreading is to use the available sequence of first records in well-covered areas (along some logical expansion axis) as an approximation of a likely route, but to interpret its dynamics only as a sequence of the latest reliably documented arrivals. In the case of *I. mexicana* in southeastern Europe, it seems that spreading from Slovenia through the Pannonian Plain eastwards and northeastwards takes place at an increasing pace (through Hungary and probably also through northern Croatia to Serbia), and that it also spreads from the westernmost Pannonian Plain westwards (into Austria north of the Alps), without any obvious indication of human-assisted "jump events". It has probably not yet reached the Czech Republic or Slovakia (where there are numerous active entomologists), and unexpectedly, it was not recorded further southeastwards along the Croatian coast, where diverse Sphecidae (including two exotic ones) have been extensively collected (e.g. DOLLFUSS, 2008; JÓZAN, 2009).

So far, within the relatively species-poor European fauna of Sphecidae, as many as 4 exotic species have become established successfully and managed to spread considerably, mainly during the second half of the 20th century. All were routinely classified as invasive (DAISIE, 2008; RASPLUS et al., 2010; etc.), which may be arguable from the standpoint of the concept underlying the very term 'invasive' (as shown in the case of the Asian species of *Sceliphron*; see ĆETKOVIĆ et al., 2011, and the references therein). Apart from terminology, the key question is whether a newly-arrived member may cause adverse ecological impacts on native biota and ecosystems. Principal concern is usually focused on possible competition with closely related and/or ecologically similar taxa, as was suggested hypothetically by some authors, like TUSSAC & VOISIN (1989; cited from BITSCH et al., 1997) and GOGALA (2011); but see also HAMON et al. (1988) for the opposite example. In the case of *I. mexicana*, the prey taxa (Gryllidae and Tettigoniidae) are usually fairly abundant and diverse, while in most of Europe there are relatively few Orthoptera-hunting Sphecidae. Moreover, there are also other numerous and diverse orthopteran-eating native animals throughout Europe. Hence, it is questionable and always difficult to document and evaluate if one additional predator could have any significant impact within this complex trophic network. In the case of highly excessive population growth of *I. mexicana*, the more likely effect could be the increased predation pressure on some of the preferred prey taxa (e.g. *Oecanthus*, which is currently fairly abundant even in the core urban areas of Belgrade). To our best knowledge, nothing similar was documented anywhere in Europe, but this lack of evidence does not necessarily mean a lack of impact; therefore, more focused monitoring is needed.

Another type of impact may be also important: having a relatively hairy mesosoma, and being a frequent visitor of many flowering plants (obvious after a simple internet search for its photographs; see also the list of plants in: HAMON et al., 1988; RENNWALD, 2005), *I. mexicana* probably represents a powerful new pollinator. Many specimens observed or seen in photographs show changed colouration due to diffusely attached masses of pollen, much more frequently than most other wasps and other non-bee flower visitors. *I. mexicana* was recorded throughout its European range on several unrelated plant genera and families, both native and exotic, including some invasive taxa (e.g. *Solidago*). A more comprehensive study is necessary to establish its preferences in flower visitation and to evaluate its possible impacts on different plants and animals within complex pollination webs (for reviews of interactions between native and introduced plants and pollinators see: TRAVESET & RICHARDSON (2006), AIZEN et al. (2008) and MONTERO-CASTANO & VILA (2012).

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ПРВИ НАЛАЗ ИНВАЗИВНЕ АМЕРИЧКЕ ВРСТЕ *ISODONTIA MEXICANA* (HYMENOPTERA: SPHECIDAE) У СРБИЈИ

АЛЕКСАНДАР ЋЕТКОВИЋ, БРАНКА ЧУБРИЛОВИЋ, МИЛАН ПЛЕЋАШ, АНЂЕЛКА ПОПОВИЋ, ДРАГИША САВИЋ и ЉУБИША СТАНИСАВЉЕВИЋ

Извод

У раду је документовано прво појављивање америчке инвазивне врсте сфецидних оса, *Isodontia mexicana* (Saussure, 1867), у Србији. Врста је прво установљена на основу одгајивања узорака из гнезда-клопки, које су биле постављене у северној приградској зони Београда током 2010. У сезони 2012, регистровали смо бројне популације ове врсте, успостављене и у најужем централном делу Београда, као и на једној локацији на Фрушкој гори. Такође, у раду приказујемо околности и ток скорашње експанзије ове врсте у Европи, у правцу истока и североистока: од Словеније и Хрватске до Мађарске и Аустрије (од 1990/1993/2001/2003 до 2011). Успостављање *I. mexicana* у северној Србији и очекивано ширење ареала на југ представља регуларну последицу континуалне експанзије ове врсте у великом делу западне Европе, после иницијане интродукције у јужној Француској (где је прво детектована 1960).

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