

SHORT NOTE

**A first report of introduced non-native damselfly species
(Zygoptera, Coenagrionidae) for Belgium****Tim Adriaens^{1,*} & Geert De Knijf¹**¹ Research Institute for Nature and Forest (INBO), Kliniekstraat 25, B-1070 Brussels, Belgium.

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KEY WORDS: alien species, non-native species, introduction pathways, Odonata, damselflies, *Ischnura senegalensis*, *Pseudagrion microcephalum*

The introduction and spread of invasive alien species (IAS) constitutes one of the most important drivers affecting global biodiversity and ecosystem services (1). The rate of biological invasions is accelerated by the worldwide movement of people and goods (2). It is widely recognized that an important first step in developing a strategy for addressing the IAS problem is to document alien species already present as well as those likely to arrive in a particular region. Therefore, reporting on the occurrence of the non-invasive segment of non-native species remains important, since non-natives can become established and behave invasive in time. Moreover, data on pathways and commodities of introductions are crucial to inform preventive strategies to reduce the arrival of new and potentially damaging alien species (3). Information on the routes and mechanisms of invasions is also used in alien species risk assessments, management, monitoring and surveillance (4). Pathway analysis represents a first and important step of curtailing the accidental spread of non-native species and is becoming increasingly important with the newly adopted European Union regulation No 1143/2014 on the prevention and management of the introduction and spread of IAS (5, 6). This regulation includes provisions for the drafting of

action plans on priority pathways of unintentional species introductions. Here, we report on the introduction of two species of damselfly alien to Belgium: *Ischnura senegalensis* and *Pseudagrion microcephalum*.

One *Ischnura senegalensis* (RAMBUR, 1842) individual emerged from a small home aquarium (28 litre, 28 °C) in Buggenhout (East Flanders) on 19 March 2013. This animal died five days later. The aquarium was used for rearing *Betta* fish and contained some waterplants. The native range of *I. senegalensis* includes the (sub)tropical belt from Africa to Japan. The species is widespread, often abundant and is resistant to anthropogenic pressures such as disturbance and pollution. *Ischnura senegalensis* occupies a broad range of stagnant and slow-flowing habitats and also occurs in saline waters (7, 8). In its Asian range, it is quick to colonise and is often found in ponds in urban areas (9). Reports of natural occurrences closest to Belgium are from Mauritania, Egypt and Israel (10). Also, presence of the species on the Canary Islands has been confirmed (11). The species was reported as incidental for Finland (12), Germany (13, 14) and Great Britain (15). The combination of bright green thorax underside and antehumeral stripes, markings on segment 2, and the black abdomen bearing a bright blue ring on segment 8 provide good field characteristics for the adult male *I. senegalensis* (16, 17). Females are polymorphic and identification needs to be confirmed by examination of the hind margin of the pronotum (18).

TABLE 1

Records of two non-native damselflies in Belgium. Pathway terminology based on HULME *et al.* (2008) (25).

Species	Locality	Date	Pathway	Commodity
<i>Ischnura senegalensis</i>	Buggenhout (East Flanders)	19-24 March 2013	Contaminant	Live plant material
<i>Pseudagrion microcephalum</i>	Opitter (Limburg)	24 Feb 2012; 15 March 2012	Contaminant	Live plant material

Two *Pseudagrion microcephalum* (RAMBUR) larvae were observed in an aquarium (240 litre, 25 °C) of a private house in Opitter (Limburg, Flanders) from November 2011. The aquarium was designed to represent an Asian freshwater habitat. The materials for aquascaping had been ordered online (Aquarium-Planten.com) and comprised the following plants, ferns and mosses: *Vallisneria spiralis*, *Microsorium pteropus*, *Blyxa japonica*, *Vesicularia montagnei*, *Vesicularia dubyana*, *Limnophila aromatica*, *Vesicularia* sp., *Riccardia chamedryfolia*. The plant material was delivered early November 2011. Two individuals, at least one female, emerged on 24 February 2012. Both of them died, one during emergence, the other several days later. A third larva was observed on March 14th 2012, but did not succeed to emerge. The native range of *P. microcephalum* includes India, South East Asia, China, Japan, Indonesia, New Guinea and Australia (19, 20). The species is widespread in its native range and occurs in freshwater ponds, lakes and streams (21). *Pseudagrion microcephalum* was one of the most frequently encountered exotic damselfly taxa in glasshouses of a plant trader near Wels, Austria (22) and in aquaria in western Germany (23). The genus *Pseudagrion* comprises over 140 species worldwide (24). There is much variation between the species and they are prone to specialisation resulting in many endemics.

Both species are widespread and common generalists in their native ranges and often occur in anthropogenically disturbed habitats there. Larvae of both species were accidentally imported as contaminants of live plant materials

for use in aquariums and ponds (Table 1). These cases represent the first documented introductions of non-native Odonata for Belgium. The vast majority of non-native invertebrates in Europe are introduced unintentionally as contaminants, hitchhikers or stowaways, and roughly three quarters of the invasive alien species that came into the EU unintentionally entered via these pathways (25).

VALTONEN (1985) (12) already mentioned the emergence of both species at an aquarium shop in Tampere (Finland) (*P. microcephalum* in 1982 and 1983; *I. senegalensis* in 1983 and 1984). These represent the first documented records of both species for Europe (22). The specimens arrived as larvae (or eggs) in water plants from Singapore. Successful larval development was also reported in London greenhouses (Great Britain) (15).

WASSCHER & BOS (2000) (26) presented the first synthesis of Odonata introductions in Europe and mentioned 20 species. This number further increased to 41 taxa by 2013 (22). In this 13-year study in glasshouses *P. microcephalum* and *I. senegalensis* were among the most commonly encountered damselflies. Furthermore, LAISTER *et al.* (2014) showed that a large proportion of exotic odonates originate from eggs or larvae associated with aquarist trade of live plant materials. Other forms of introduction, such as accidental import of live imagines as hitchhikers in banana boxes, on airplanes (e.g. 7) or on ships (27), or deliberate releases for biocontrol (28), are comparatively rare. The majority of species were

of Southeast Asian origin, with many species emerging from home aquaria and glasshouses. Thus, the occurrences of both species reported here are well in line with general introduction histories of other damselflies in Europe.

Despite available reports, the DAISIE and NOBANIS species registries, which represent some of the most comprehensive and up-to-date registers of non-native species in Europe, currently do not comprise any non-native Odonata. Odonata are also lacking from the European Alien Species Information Network (EASIN), which compiles data from various European IAS databases (29). One reason for this might be that, so far, none of the reported accidental introductions of damselflies and dragonflies in Europe has resulted in established populations of non-natives and the phenomenon is therefore regarded as not ecologically relevant (22). However, introductions of non-native dragonflies into similar climate zones outside their native range may lead to the establishment and expansion of odonates (30, 31, 32). Secondly, whilst impacts of other non-native species such as zebra mussel *Dreissena polymorpha* (Pallas, 1771) and exotic crayfish on several species of dragonflies have been documented (e.g. 33, 34, 35), we could not find reports of introductions of dragonflies with negative impact on native biota (cf. 36). Introductions of non-native Odonata are therefore usually regarded as incidental and benign. Nonetheless, in Japan, *Ceriagrion auranticum ryukyuanum* (Asahina, 1967) established and spread outside its main range following accidental introductions with aquatic plants (32). Here, despite lack of evidence on impact (pers. comm. N. Ishizawa), eradication is ongoing based on the argument of potential impact on the threatened *C. nipponicum* (ASAHINA, 1967) (pers. comm. R. Futahashi).

Several authors have shown Odonata to expand their distribution ranges as a result of increasing temperatures (37, 38). Therefore, with global warming, successful establishment of accidentally introduced damselflies with live plant materials or as aquarium escapes remains a

possibility. Subsequently, as both larval and adult Odonata can be important keystone predators (39, 40, 41), there would be the potential for impact on native biota. As many introductions of non-native Odonata occur indoors, accidental import is likely to be underestimated. Adult dragonflies and damselflies are highly mobile organisms. Long distance dispersal events, autonomously or aided by air currents, are not uncommon in this group (42). Therefore, in Odonata, there is also the probability of confusing human-mediated spread with autonomous species dispersal. Currently, tropical plants for aquarists are mainly imported to Europe from Singapore, Indonesia and Thailand (22, 43). However, the introduction of plant material from temperate regions (e.g. North America, China) could pose a risk for temperate zones in Europe. With regards to the species described here, we hypothesize that these subtropical species have the potential to establish at least in the mediterranean bioregion in Europe. We recommend that non-native Odonata should be incorporated in the registers of non-native species introductions in Europe.

ACKNOWLEDGEMENTS

We thank Dries Coolen and Martine De Bondt for information on the findings of damselflies in their aquaria. We are grateful to Vincent Kalkman and Gerolf Laister for confirmation of species identifications and to Robby Stoks and Martin Schorr for providing additional references. We thank Naoya Ishizawa and Ryo Futahashi for information on damselfly eradication in Japan. The authors wish to thank two anonymous reviewers for their insightful comments.

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Received: November 29th, 2014

Accepted: February 3rd, 2015

Branch editor: Hilde Eggermont