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Nota Curta / *Short Note*

Trophic interactions between Japanese mock orange *Pittosporum tobira* and autochthonous frugivorous birds in a town in Catalonia

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Invasive species are one of the most serious anthropic disturbances threatening the preservation of our ecosystems. One such example are plant invasions, especially those linked to the ornamental plant and gardening industries. Trophic interactions between the seeds of allochthonous plants and native frugivorous species are of special interest as they could represent a key element in the dispersion of invasive plants into nearby ecosystems. In this note we provide a brief compilation of trophic interactions between native frugivorous bird species and the seeds of the Japanese mock orange *Pittosporum tobira* in an urban environment that were noted during the Spanish COVID-19 outbreak. Our observations reveal the possibility that the seeds of this plant are dispersed by the native birds that ingest its seeds whole. In addition, we report that European Blackbirds and Blackcaps were the most frequently observed species and highlight the ease with which these birds are able to exploit a non-native trophic resource.

Key words: *Pittosporum tobira*, trophic interactions, invasive plants, alien species, frugivorous birds.

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The spread of allochthonous invasive organisms is a worldwide threat to ecosystem and species conservation (Lambdon *et al.* 2008, Keller *et al.* 2011). The key factor in the establishing of species outside their natural ranges is the trade in wild organisms (Weber 2017). In the case of plants, the horticultural and ornamental plant industries facilitate the introduction, propagation and invasion of a vast number of allochthonous plant species (Niemiera & Holle 2009, Padullés *et al.* 2015). Once invasive plants become established in a novel territory, the halting of their expansion and control of the negative impacts they have on native ecosystems is extremely complex (Richardson *et al.* 2000, Andreu & Vilà 2010).

Seed dispersal mediated by vertebrates is commonplace since seeds provide a valuable food resource for the animals involved (Herrera 1995). The trophic interaction between native frugivorous animals and animal-dispersed exotic seeds could be a critical step in the effective colonization of invasive plants (Richardson *et al.* 2000, Kolar & Lodge 2001, Bartuszevige & Gorchov 2006). The implications of these new assemblages of invasive plants and local bird dispersers are as yet unpredictable but will affect previously established dispersal networks (Traveset & Richardson 2006). Birds are one of the most important dispersal vectors of plants, including invasive taxa (Renne *et al.* 2002).

The Japanese mock orange *Pittosporum tobira* is an evergreen shrub found in Japan and China that is regarded as an invasive species in the Mediterranean region. The flowers of this shrub bloom during the Mediterranean spring (April-May) and fructification starts from Au-

Table 1. Trophic interactions between bird species and Japanese mock orange seeds. We describe the observations of seed intake and dispersal effectiveness of the detected bird species according to the main references in the text.
Compilació d'interaccions tròfiques de les espècies d'ocells amb les llavors del pitòspor japonès. S'inclouen les característiques d'ingestió de la llavor observades i el caràcter dispersor de les espècies d'ocell d'acord amb les referències citades al text principal.

Bird species	Number of trophic interactions	Number of whole seed intakes	Dispersal effectiveness
T. merula	18	18	Effective disperser
S. atricapilla	9	5	Effective disperser
S. melanocephala	6	-	Effective disperser
E. rubecula	3	3	Effective disperser
S. vulgaris	1	1	Effective disperser

gust onwards. Its fruit consist of a subglobular capsule of about 1.2 cm in diameter, with a thick exterior shell (varying in colour from greenish to dark yellow while growing), that houses a cluster of bright red seeds (Wu *et al.* 1994, Ferrero & Donat-Torres 2011, Erskine-Odgen *et al.* 2016).

On 25 March, the author observed a male Blackcap *Sylvia atricapilla* feeding on Japanese mock orange seeds. The observation took place in the context of the general quarantine period imposed due to the COVID-19 outbreak in Spain. A short survey was designed with two objectives: identify the bird species feeding on Japanese mock orange seeds and estimate the intensity of interaction for each bird species. The study area is a highly urbanized landscape, characterized by a matrix of buildings, roads and private gardens located in the municipality of Castelldefels (Barcelona, Catalonia). The observer's position offered excellent views of four patches of Japanese mock orange, the largest occupying 71.5 m^3, and the others 23.8, 8.9 and 5.7 m^3. Nine specific censuses were conducted that identified the total number of feeding interactions between the mentioned plant – whose fruits were visible from the observer's position (not quantified exactly but hundreds in total) – and local birds. Even though fructification starts in August, most seeds were available for birds in March and April, as fruits mature in autumn or winter (Idžojtić 2019). The censuses were performed on 28 and 29 March, and 4, 5, 11, 12 and 18 April (mornings), and 1 and 3 April (afternoons). Morning censuses took place at 8:00–10:00 and afternoon censuses at 16:00–18:00, giving a total of 18 observation hours.

We defined trophic interactions as the intake of a whole or part of a seed by a bird. The observation of the same bird individual repeatedly feeding on the same Japanese mock orange patch was not considered a different trophic interaction. Nonetheless, we noted a fresh trophic interaction if the same bird moved to another patch or if it left the area but then returned to the same patch.

We observed 37 trophic interactions of autochthonous birds corresponding to five species feeding on Japanese mock orange seeds: 18 interactions involved European Blackbird *Turdus merula*, the remaining interactions involved Blackcap, Sardinian Warbler *Sylvia melanocephala*, European Robin *Erithacus rubecula* and Common Starling *Sturnus vulgaris* (Figure 1). All European Blackbird, European Robin and Common Starling interactions consisted of the intake of whole seeds, as occurred in most Blackcap interactions: however, we were unable to confirm whether or not the Sardinian Warblers ingested whole seeds (Table 1). At least three different European Blackbirds, three Blackcaps and two Sardinian Warbler individuals were distinguished during the censuses, some of which fed repeatedly on the studied patches of Japanese mock orange. Species such as Western Subalpine Warbler *Sylvia inornata*, Common Chiffchaff *Phylloscopus collybita*, Great Tit *Parus major*, Blue Tit *Cyanistes caeruleus*, Long-tailed Tit *Aegithalos caudatus*, Coal Tit *Periparus ater* and Eurasian Collared Dove *Streptopelia decaocto* were also spotted resting or visiting the Japanese mock orange patches but no evidence of any trophic interaction with the plant were noted. We used the second edition of Collins Bird Guide (Svensson *et al.* 2009) to identify all abovementioned taxa.

From these observations we can derive two important ideas: the probable dispersion of

Figure 1. (a) Japanese mock orange seeds, (b) Blackcap feeding on Japanese mock orange seeds and (c, d) sequence of a male European Blackbird feeding on Japanese mock orange seeds.
(a) Llavors de pitòspor japonès, (b) tallarol de casquet alimentant-se de les llavors de pitòspor japonès i (c, d) seqüència d'un mascle de merla alimentant-se de les llavors de pitòspor japonès.

the studied invasive plant by the detected bird species, and the possible benefits (along with evidence of flexible feeding behaviour) for the birds involved in periurban and urban areas with Japanese mock orange shrubs. Sylviidae, Turdidae and Muscicapidae are all regarded as effective dispersers unlike seed predators such as Fringillidae (Herrera 2001). Blackcaps, as well as species such as European Blackbird and European Robin, have been identified as alien plant dispersers in urban areas (Costa-Cruz *et al.* 2013). The same is true for the Common Starling, which is known to improve the germination possibilities of invasive plants (LaFleur *et al.* 2009). In closely related plants such as the Australian mock orange *Pittosporum undulatum*, the European Blackbird is considered to be one of its main dispersal vectors (Gleadow 1982). Alien garden shrubs in the European Mediterranean basin are frequented by small passerine frugivores such as Blackcaps (Debussche & Isenmann 1990). In the Azores archipelago, both

European Blackbirds and Blackcaps have been cited as important dispersers of both native and exotic flora (Parejo *et al.* 2014). There are many other examples of native birds acting as dispersive vectors of invasive plants (Hart *et al.* 2011).

Our brief study has interesting implications as it describes a native animal-exotic plant dispersal interaction in an urban landscape composed of isolated patches of both native and garden habitats. These patches can be understood as ecological islands where colonization-extinction processes are an essential part of species dynamics and seed dispersal affects the prevalence and dissemination of certain taxa (Traveset & Santamaría 2004, Cowie & Holland 2006, Werner 2011). The role of endemic Iberian birds in the dispersion of the plants mentioned in this study and other related invasive plants could be highly relevant, particularly in periurban areas where many gardens are adjacent to native ecosystems. Further research should focus on the possible impact of the dispersal of Japanese mock orange seeds by birds, and the managers of green areas should consider the implication of interactions between the studied plant species, bird communities and nearby natural habitats.

Resum

Interaccions tròfiques entre el pitòsfor japonès *Pittosporum tobira* i els ocells frugívors autòctons en una ciutat de Catalunya

Les espècies invasores són una de les pertorbacions antròpiques més rellevants per a la preservació dels ecosistemes. Dins d'aquelles trobem les plantes invasores, especialment vinculades a la indústria ornamental i a la jardineria. Les interaccions tròfiques entre les llavors de vegetals al·lòctons i espècies frugívores natives són d'especial interès i poden significar un vector clau per a la seva dispersió en els ecosistemes limítrofs. En la present nota s'evidencia una breu recopilació d'interaccions entre aus frugívores ibèriques i les llavors del pitòspor japonès *Pittosporum tobira* en una matriu urbana obtinguda durant el brot de COVID-19 a l'estat espanyol. Les observacions realitzades manifesten la possible dispersió per aus autòctones que consumeixen la llavor sencera d'aquesta espècie invasora a la conca mediterrània. Destaquen la merla comuna i el tallarol de casquet com les espècies observades amb major freqüència, així com la facilitat d'aquestes aus per aprofitar un recurs tròfic no autòcton.

Resumen

Interacciones tróficas entre el azahar de China *Pittosporum tobira* y las aves frugívoras autóctonas en una ciudad de Catalunya

Las especies invasoras son una de las perturbaciones antrópicas más relevantes para la preservación de los ecosistemas. Dentro de aquellas encontramos a las plantas invasoras, especialmente vinculadas a la industria ornamental y la jardinería. Las interacciones tróficas entre los frutos de vegetales alóctonos y especies frugívoras nativas son de especial interés, pudiendo significar un vector clave para la dispersión de las mismas en los ecosistemas aledaños. En la presente nota se evidencia una breve recopilación de interacciones entre aves frugívoras ibéricas y los frutos del azahar de China *Pittosporum tobira* en una matriz urbana obtenida durante el brote de COVID-19 en el estado español. Las observaciones realizadas manifiestan la posible dispersión por aves autóctonas que consumen la semilla completa de esta especie invasora en la cuenca mediterránea. Destacan el mirlo común y la curruca capirotada como las especies observadas con mayor frecuencia, así como la facilidad de estas aves para aprovechar un recurso trófico no autóctono.

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