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FIRST RECORD OF *DITTRICHIA GRAVEOLENS* (ASTERACEAE, INULEAE) IN CHILE

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Abstract. Santilli, L.; N. Lavandero, O. Montes & N. Lustenhouwer. 2021. First record of *Dittrichia graveolens* (Asteraceae, Inuleae) in Chile. *Darwiniana*, nueva serie 9(1): 31-38.

Dittrichia graveolens is reported for the first time for the flora of Chile and for the Southern Cone. A brief description as well as illustrative pictures of the species and the habitat are provided. Furthermore, we present a map of the site where the population was found and a short key to the species of *Dittrichia* present in Chile. Insights about its potential invasiveness are discussed.

Keywords. Exotic flora; invasive species; South America; Southern Cone; weed.

Resumen. Santilli, L.; N. Lavandero, O. Montes & N. Lustenhouwer. 2021. Primer registro de *Dittrichia graveolens* (Asteraceae, Inuleae) en Chile. *Darwiniana*, nueva serie 9(1): 31-38.

Dittrichia graveolens se reporta por primera vez para la flora de Chile y para el Cono Sur. Se provee una breve descripción e imágenes ilustrativas de la especie y su hábitat. Adicionalmente, se presenta un mapa del sitio donde se encontró la población y una clave de las especies de *Dittrichia* presentes en Chile. Se discute su potencial invasor.

Palabras claves. Cono Sur; especies invasoras; flora exótica; maleza; Sudamérica.

INTRODUCTION

The genus *Dittrichia* Greuter belongs to the Asteraceae and includes five species native to the Mediterranean basin (Brullo & de Marco, 2000), two of which are currently widespread in other regions (Parsons & Cuthbertson, 2001; Brownsey et al., 2013a; Lustenhouwer et al., 2018). They are annual or perennial herbs, with glandular and hairy indumentum, simple leaves, female ligulate flowers and hermaphrodite tubular flowers. *Dittrichia* differs from the closely related genus *Inula* L. by the presence of cylindrical achenes abruptly contracted below the pappus, and pappus-hairs

connate near the base, versus angled achenes, not abruptly contracted below the pappus, and simple and free pappus-hairs (Brullo & de Marco, 2000). Regarding their ecology, species of *Dittrichia* are generally associated with synanthropic places, rocky coastal habitat, cultivated land and gravel riverbeds (Brullo & de Marco, 2000). Due to their adaptation to disturbed open habitats as well as their efficient seed production and dispersal (Parolin et al., 2014), species of *Dittrichia* are considered invasive in California (Brownsey et al., 2013a; DiTomaso & Brownsey, 2013), Australia (Parsons & Cuthbertson, 2001) and recently colonized areas of Europe (DAISIE, 2020).

Recording new introductions of exotic species is essential given the important threat biological invasions represent for local biodiversity (Ehrenfeld, 2010; Pyšek et al., 2012). In Chile, between 106 and 116 introduced species of Asteraceae have been reported at the country level (Fuentes et al., 2013; Ray et al., 2014; Rodríguez et al., 2018). No species of *Dittrichia* had been recorded for South America until Novoa (2017) reported the presence of the first naturalised species of the genus, *Dittrichia viscosa* (L.) Greuter, in an urban environment in Curauma, Chile (Valparaíso Region).

The aim of the present work is to report the presence of *Dittrichia graveolens* (English: stinkwort; Spanish: olivardilla) for the exotic flora of Chile.

MATERIALS AND METHODS

On June 2020, a user of iNaturalist, an online social network of people sharing biodiversity data (<https://www.inaturalist.org/>) brought an unknown plant species to the attention of the community that was photographed on the riverside of Río Mapocho, within the city of Santiago, Chile (<https://www.inaturalist.org/observations/50942000>). The species was identified by the community as *Dittrichia graveolens* (L.) Greuter. To confirm the identity of the species and to evaluate its population size, a field survey was conducted in the whereabouts of the previous finding in December 2020, over an area encompassing approximately 10,000 m² (Fig. 1). A second locality for *D. graveolens* was recorded on the nearby hill of Cerro San Cristobal (Fig. 1).

A morphological analysis was performed in order to confirm the identity of the specimens, which were compared against high resolution images of the type material of *D. graveolens* and the taxonomic revision of the genus *Dittrichia* (Brullo & de Marco, 2000). In addition, we consulted the botanical literature for possible records of the species for the country (e.g., Marticorena & Quezada, 1985; Matthei, 1995; Rodríguez et al., 2018; Zuloaga et al., 2019; Fuentes et al., 2020). Collected specimens were deposited at SGO (acronyms following Thiers, 2020).

We give a brief description of the species and of the localities where it is found growing and provide a key for the species of *Dittrichia* present in Chile. Terminology describing plant morphology follows Beentje (2016).

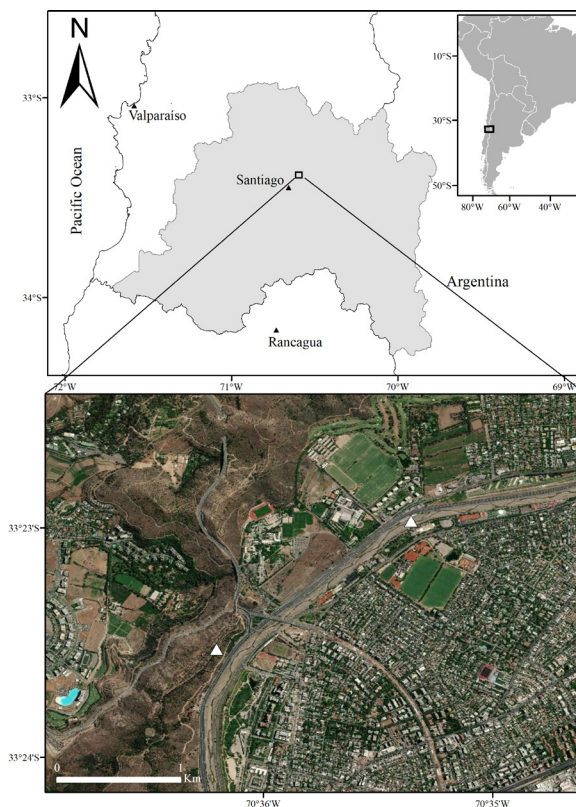


Fig. 1. Localities of *Dittrichia graveolens* found in Chile (white triangles). Left, Cerro San Cristóbal, Santiago and right, Río Mapocho, Santiago. Satellite Image source: Esri, DigitalGlobe, Geoeye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, GIS User Community. Color version at <http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/938/1205>

RESULTS AND DISCUSSION

***Dittrichia graveolens* (L.) Greuter, Exsicc. Genav.**
 Conserv. Bot. Distrib. Fasc. 4: 71. 1973. ≡
Erigeron graveolens L., Cent. Pl. I.: 28. 1755.
 TYPE: "Habitat Monspelii" (lectotype, LINN-994.4, digital image! Available in: <http://linnean-online.org/10083>; designated by Grierson in Davis (ed.), Fl. Turkey 5: 72. 1975). Fig. 2A-E.

Plant annual, herbaceous erect, up to 60 cm high, covered in glandular hairs, with a strong camphor scent. Leaves up to 60 × 8 mm, linear-lanceolate, mostly conduplicate, sessile to subamplexicaul, margins subentire. Capitulescence terminal and



Fig. 2. *Dittrichia graveolens*. **A**, habit. **B**, side view of a capitulum. **C**, top view of a capitulum. **D**, close-up of achenes. **E**, adaxial (above) and abaxial (below) side of a leaf. Color version at <http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/938/1205>

axillary, capitulum involucre up to 7 mm, 6 mm diam.; calyculus covered in glandular hairs, bracts reflexed, each bract up to 6×1.5 mm; phyllaries with hyaline margins, glandular, up to 7×1 mm. Female flowers yellow, ligulate, slightly protruding the involucre. Hermaphrodite flowers yellow, tubular, erect. Achenes up to 2 mm, covered in hairs; pappus up to 4 mm.

Diagnosis. *D. graveolens* differs from *D. viscosa* in having an annual (vs. perennial) life cycle, subentire (vs. serrate) leaf margins, and reflexed (vs. appressed) bracts of calyculus.

References. For a detailed description see Brullo & de Marco (2000).

Iconography. See Sibthorp & Lindley (1837: 866); Brullo & de Marco (2000: 349, Fig. 1E; 350, Fig. 2E; 351, Fig. 3E; 352, Fig. 4E; 353, Fig. 5E-6E); Preston (2007: 472).

Distribution and habitat. *Dittrichia graveolens* is native to the Mediterranean basin, extending east to north-west India (Brullo & de Marco, 2000). Coinciding with recent climate change in central Europe, the species is currently undergoing a dramatic northward expansion of its native range which now includes the UK (BSBI, 2020), the Netherlands (Stouthamer, 2007), and Poland (Kocián, 2015). This range expansion may in part have been promoted by the rapid evolution of earlier flowering time in northern populations over the past few decades (Lustenhouwer et al., 2018). Outside its native range, *D. graveolens* has a long history of colonizing regions with a Mediterranean climate on other continents, including Australia (since the 1860s; Parsons & Cuthbertson, 2001), South-Africa, California (first recorded in 1984; Preston, 1997), and now Chile. According to Brullo & de Marco (2000), it is considered a nitrophilous species, adapted to anthropic habitats, and occurs mainly on arid soils, where it grows during the summer and autumn period. As *Dittrichia graveolens* is not listed in the catalogue of the vascular flora of Chile (Marticorena & Quezada, 1985; Matthei, 1995; Rodríguez et al., 2018; Fuentes et al., 2020) or in the Flora of the Southern Cone (Zuloaga et al., 2008; Zuloaga et al., 2019), this is the first record for the flora of the Southern Cone.

In Chile, we observed *Dittrichia graveolens* growing on the riverside of Río Mapocho and in Cerro San Cristobal, within the city of Santiago Metropolitan Region (Fig. 1). The former area is characterised by a natural riverbank of sand and rocks with vegetation composed of an assemblage of native and exotic shrubs and herbs such as *Baccharis salicifolia* (Ruiz & Pav.) Pers., *Centaurea melitensis* L., *Dysphania ambrosioides* (L.) Mosyakin & Clemants, *Eschscholzia californica* Cham., *Helenium aromaticum* (Hook.) L.H. Bailey, *Hirschfeldia incana* (L.) Lagr.-Foss., *Nicotiana acuminata* (Graham) Hook., *Oenothera stricta* Ledeb. ex Link, *Pennisetum* sp., *Ricinus communis* L., *Tessaria absinthioides* (Hook. & Arn.) DC.,

Verbascum thapsus L., and *Verbascum virgatum* Stokes (Fig. 3A). In Cerro San Cristobal, *D. graveolens* grows on rocky soil on the side of the road running across the hill, with *Ailanthus altissima* (Mill.) Swingle, *Acacia dealbata* Link, *Eucalyptus globulus* Labill.

Observations. At least 1000 individuals at various stages of development were found growing in Río Mapocho, where dry plants from the previous season were also observed (Fig. 3B). Seven additional individuals were observed in Cerro San Cristobal (Fig. 3C).

Uses. *Dittrichia graveolens* has been widely used in traditional and modern medicine for its antifungal, antibacterial, anti-inflammatory, insecticide and sedative properties (Maxia et al., 2008; Aghel et al., 2011; Mazandarani et al., 2014; Miladinović et al., 2016). It is also known to be poisonous to livestock (Philbey & Morton, 2000) and causes contact allergic dermatitis in humans (Thong et al., 2008).

Specimens examined

CHILE. **Región Metropolitana.** Santiago, Río Mapocho, entre Copec y Casa piedra, 33.382813 S, 70.589241 W, 670 m s.m., 15-XII-2020, Santilli & Lavadero 201215 (SGO); Santiago, Cerro San Cristobal, camino Federico Albert, entre mirador de la Pirámide y mirador El Sauce, 33.392135 S, 70.603394 W, 700 m s.m., 05-II-2021, Santilli & Lavadero 210205 (SGO).

Potential invasiveness

Field observations by the authors suggest that the individuals of *D. graveolens* found in 2020 likely established from seeds produced by individuals from the previous year that can still be observed on site bearing the dried capitula. This suggests that *Dittrichia graveolens* has surmounted abiotic and biotic barriers to survival and various barriers to natural reproduction, and for this reason can be considered naturalised according to the definition proposed by Richardson et al. (2000). However, following Pyšek et al. (2004), alien species are to be considered naturalised only once they sustain self-replacing populations for at least 10 years without or in spite of human intervention.

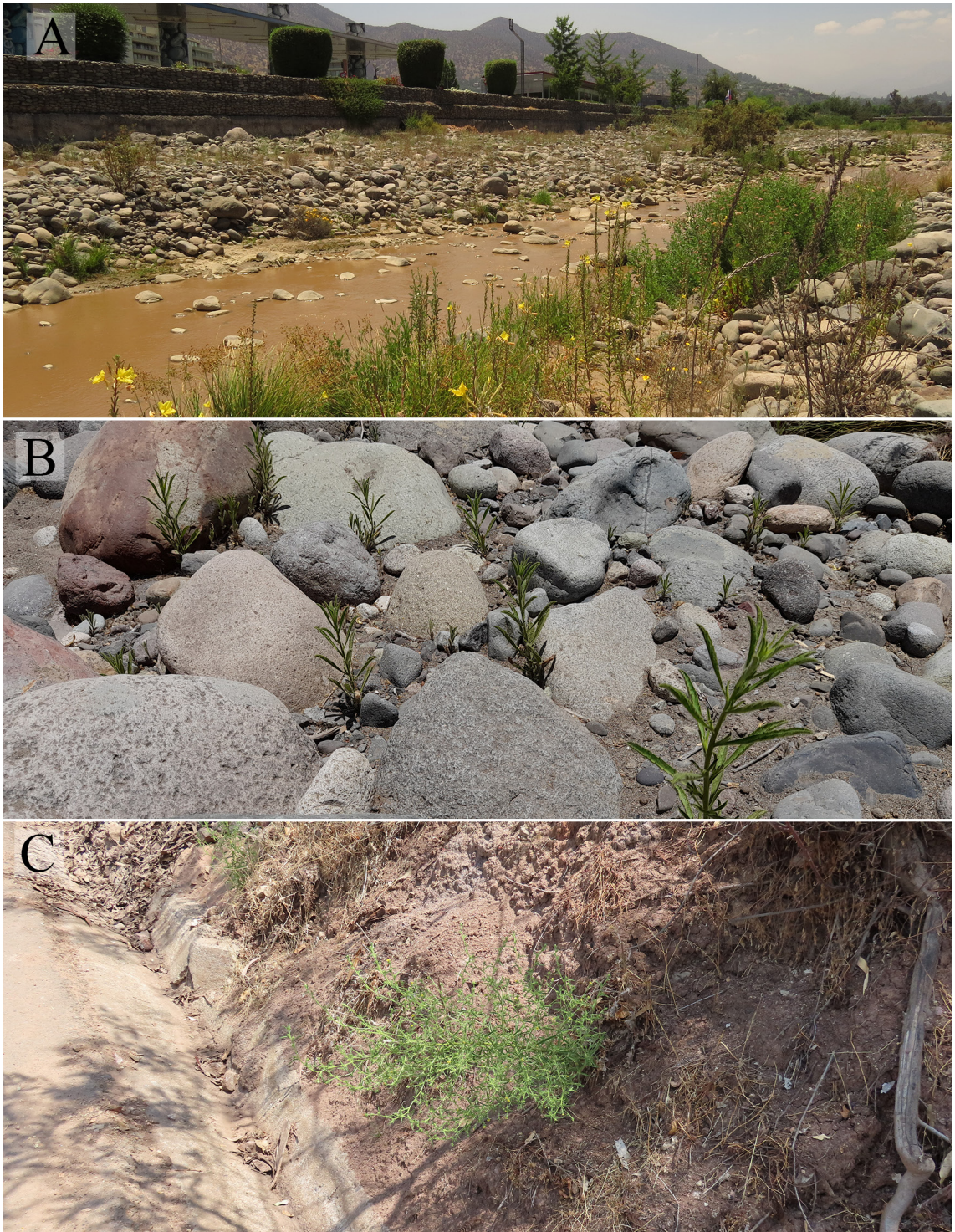


Fig. 3. *Dittrichia graveolens*. **A**, habitat showing a sandy-rocky substrate on the riverbank of Río Mapocho. **B**, detail of the natural regeneration in Río Mapocho. **C**, habitat showing a roadside with a rocky soil in Cerro San Cristobal. Color version at <http://www.ojs.darwin.edu.ar/index.php/darwiniana/article/view/938/1205>

The habitats where *D. graveolens* was observed, a gravel riparian environment and a roadside with low total vegetative cover (Fig. 3), match the optimal conditions reported in the literature for the plant to thrive. *Dittrichia graveolens* is in fact reported to establish well in high light conditions in disturbed areas (Brownsey et al., 2013a). While water cannot be excluded as a dispersal vector, it is well known that seeds of *D. graveolens* are largely dispersed by wind (Brownsey et al., 2013a). Given the large number of viable seeds that *D. graveolens* produces and the high availability of light in the adjacent area, we expect the population to keep growing with the possibility to expand its current distribution at least up and down stream in Río Mapocho and along the road in Cerro San Cristóbal. Not to be excluded is also the risk of invasion to other environments, as *D. graveolens* has been documented to invade overgrazed rangelands (Brownsey et al., 2013b).

Beside the negative effects that this introduction might have on local biodiversity, the species is also known to taint animal products, be poisonous to livestock (Meadly, 1965; Philbey & Morton, 2000) and cause contact allergic dermatitis in humans (Thong et al., 2008). Brownsey et al. (2013b) showed that because of the absence of primary dormancy, the majority of seeds will germinate under favorable conditions after dispersal, thus an efficient strategy to eliminate the population would be the prevention of seed production for one or two years. This could be achieved mechanically by extirpation of the plants before they start flowering, which appears to be in response to photoperiod (Brownsey et al., 2013a; Lustenhouwer et al., 2018) and thus predictable. It is also important to investigate the point of introduction, as no local extirpation will be successful if an external source persists. The very rapid ongoing range expansion of *Dittrichia graveolens* in California and Europe illustrates that early detection and management efforts will be key to constrain the distribution of the species in Chile. Roadways are important corridors facilitating the spread of *D. graveolens* (e.g., Stouthamer, 2007; DiTomaso & Brownsey, 2013) and should be monitored near existing populations.

Final considerations

It is worth noting that this discovery was made possible due to the connection facilitated by a citizen science platform for sharing photographed digital vouchers (<https://www.inaturalist.org/>). One of the benefits of citizen science is that it encourages people to explore the environment and actively participate in collecting data for science, and by doing so democratising access to data and data production. Simultaneously, researchers can greatly benefit from the increasing availability of biological data that are being published and available for use.

Key to *Dittrichia* species occurring in Chile

1. Annual plant, leaves margin subentire, bracts of calyculus reflexed, phyllaries with hyaline margins, female flowers slightly protruding the involucre *D. graveolens*
1. Perennial plant, leaves margin serrate, bracts of calyculus appressed, phyllaries without hyaline margins, female flowers largely protruding the involucre *D. viscosa*

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