

**FAST SPREAD OF *DITTRICHIA GRAVEOLENS* (ASTERACEAE) IN SOUTH-WESTERN POLAND****Katarzyna KOZŁOWSKA-KOZAK<sup>1</sup>, Maciej KOZAK<sup>2</sup>, Artur PLISZKO<sup>3\*</sup>**<sup>1,2</sup>Łużycka Str. 51/153, Kraków PL-30-658, Poland<sup>3</sup>Jagiellonian University, Institute of Botany, Department of Taxonomy, Phytogeography and Palaeobotany, Gronostajowa Str. 3, Kraków PL-30-387, Poland\*Corresponding author. E-mail: [artur.pliszko@uj.edu.pl](mailto:artur.pliszko@uj.edu.pl)**Abstract**Kozłowska-Kozak K., Kozak M., Pliszko A., 2019: Fast spread of *Dittrichia graveolens* (Asteraceae) in south-western Poland. – *Botanica*, 25(1): 84–88.

In 2013 and 2018, the occurrence of alien *Dittrichia graveolens* was confirmed within 126 road sections (1-kilometre) of the A4 highway in the Lower Silesian Province and Silesian Province, south-western Poland. During five years the increase in abundance has been recorded within 50 sections (52.1%), a decrease within 11 sections (11.5%), whereas within 35 sections (36.5%) it remained unchanged. New data suggest that *D. graveolens* is fully established in the Polish flora, and it should be classified as a potentially invasive species.

**Keywords:** alien plant, biological recording, Central Europe, geographical distribution, potentially invasive species, road transport.

**INTRODUCTION**

*Dittrichia graveolens* (L.) Greuter (Asteraceae) is an annual and strongly aromatic plant with a camphor-like smell, reaching a height of 50 cm (PARSONS & CUTHBERTSON, 1992). It is native to the Mediterranean area with an extension to the Western Atlantic European coast and Middle East (BRULLO & DE MARCO, 2000). It has been introduced to north-western and Central Europe, North America, South Africa and Australia, where is treated as naturalized or invasive (BROWNSEY et al., 2013a; KIRÁLY et al., 2014; KOCIÁN, 2015; PLISZKO & KOCIÁN, 2017; RANDALL, 2017; ATHA et al., 2019 and references therein). In its native range, it occurs mainly in riparian woodlands, on margins of tidal marshes, vernal pools, and alluvial floodplains, whereas in its secondary range, it is usually found on arable and abandoned fields, roadsides, in wasteland, levees and gravel mines (GIVEN, 1984; BRULLO & DE MARCO, 2000; BROWNSEY et al., 2013a; KIRÁLY et al., 2014). Moreover, it can be associated

with nitrophilous communities of the class *Stellarietea mediae* (BRULLO & DE MARCO, 2000). It is also worth to note that *D. graveolens* can be poisonous to sheep (PHILBEY & MORTON, 2000) and cause contact allergic dermatitis in humans (THONG et al., 2008).

According to KOCIÁN (2015 and references therein), road transport is one of the most important pathways of introduction and spread of *D. graveolens* in Central Europe. It has been recorded along the highways in Austria, Germany, Slovenia, the Czech Republic, Slovakia, and Poland (FRAJMAN & KALIGARIČ, 2009; KIRÁLY et al., 2014; KOCIÁN, 2014, 2015; PAGITZ & LECHNER-PAGITZ, 2015; PLISZKO & KOCIÁN, 2017; WRÓBEL & NOBIS, 2017). In Poland, the first stand of *D. graveolens* was found on the roadside verge of the S52 expressway (formerly known as S1) near Ogrodzona, Silesian Province, in 2013 (KOCIÁN, 2015). A total of eight localities of *D. graveolens* have been confirmed in Poland so far and they are situated along the highways in the Silesian Province and Lesser Poland Province (PLISZKO &

KOCIÁN, 2017; WRÓBEL & NOBIS, 2017). Moreover, PLISZKO & KOCIÁN (2017) have stated that *D. graveolens* is establishing in Poland and its impact on native species should be monitored. In this study, we aimed to report 23 new records of *D. graveolens* in Poland and indicate its fast spread along the A4 highway in the south-western part of the country.

## MATERIALS AND METHODS

Field studies were conducted along the A4 highway in south-western Poland in 2013 and 2018. The stretch of the A4 highway between Legnica-East junction (92 km of A4) and Mysłowice-Brzęczkowice junction (350 km) was investigated. Additional observations were carried out to the west of Legnica, between Krzywa junction (62 km) and Legnica-East junction (92 km). In the above-mentioned years, the whole examined part of the highway was checked twice in both directions, on both sides of the road, more carefully on the left side due to the fact that the plant grew mainly along the middle strip. Since stopping on the highway is generally forbidden, the observations were taken from a car driving at the speed of about 100 km/h. In order to collect herbarium specimens, the car was stopped for a moment in an emergency bay. Moreover, it should be pointed out that *D. graveolens* has a very characteristic habit and is clearly visible even at high speed; however, it is possible to overlook some individuals. The presence of *D. graveolens* within the 1-kilometre road sections of the highway was noted, using the kilometre posts. A similar methodology was used by KOCIÁN (2014). The abundance of *D. graveolens* was estimated in each section based on a 4-point scale: 0 – no individuals, 1 – low abundance (1 – 100 individuals per 1 km), 2 – individuals in small scattered groups (100–500 individuals per 1 km), 3 – numerous individuals distributed uniformly along the roadside verges (more than 500 individuals per 1 km). The approximate rate of spread of *D. graveolens* was analysed in the stretch of the A4 highway, which was examined both in 2013 and 2018 (258 km between Legnica-East and the Mysłowice-Brzęczkowice junctions). *Dittrichia graveolens* was identified using morphological characters provided by BRULLO & DE MARCO (2000). A map of distribution of the species in Poland was prepared based on the ATPOL cartogram

method (ZAJĄC, 1978), where the basic cartogram unit is a square of 10 km side. A map of *D. graveolens* occurrence along the A4 highway was prepared using the ATPOL grid adapted to GIS (CZERNECKI & JABŁOŃSKA, 2015). The records of known occurrence of *D. graveolens* in Poland followed KOCIÁN (2015), PLISZKO & KOCIÁN (2017) and WRÓBEL & NOBIS (2017). Voucher specimens of *D. graveolens* (*leg.* K. Kozłowska-Kozak & M. Kozak) are deposited at the Herbarium of W. Szafer Institute of Botany of the Polish Academy of Sciences in Kraków (KRAM).

## RESULTS AND DISCUSSION

In 2013 and 2018, the occurrence of *D. graveolens* was confirmed within 126 road sections (1-kilo-

Table 1. The abundance of *Dittrichia graveolens* in 1-kilometre road sections along the A4 highway in the years 2013 and 2018, in south-western Poland. Explanations: – – no data on abundance; 0 – no individuals, 1 – low abundance (1–100 individuals per 1 km), 2 – individuals in small scattered groups (100–500 individuals per 1 km), 3 – numerous individuals distributed uniformly along the roadside verges (more than 500 individuals per 1 km)

1-kilometre section of the A4 highway	Abundance of <i>Dittrichia graveolens</i>	
	2013	2018
62–68, 76–78, 80–81, 84–91	-	3
69, 72, 82	-	2
70–71, 73–75, 79, 83	-	1
92, 96	0	3
93, 97, 150–152, 184, 289–290, 347	0	2
148, 153, 158, 160, 177, 180, 189, 288, 291, 295–296, 300, 304, 310–312, 315–318, 322, 327	0	1
95, 98, 102, 137	1	3
94, 109, 134, 136, 146–147, 149, 176, 297	1	2
99, 101, 105, 126	2	3
142	3	2
143	3	1
127, 130–131, 321, 325	2	1
157, 161, 175, 324	1	0
100, 103–104, 106–108, 110–125, 129, 138, 141	3	3
132, 140, 144	2	2
128, 133, 135, 139, 145, 155, 323	1	1

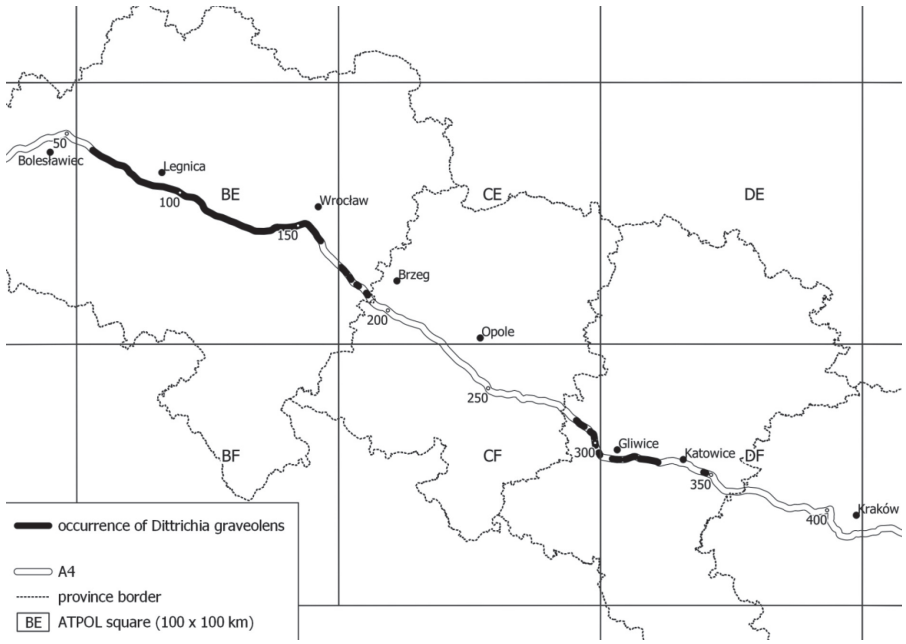


Fig. 1. The occurrence of *Dittrichia graveolens* along the examined part of the A4 highway in south-western Poland

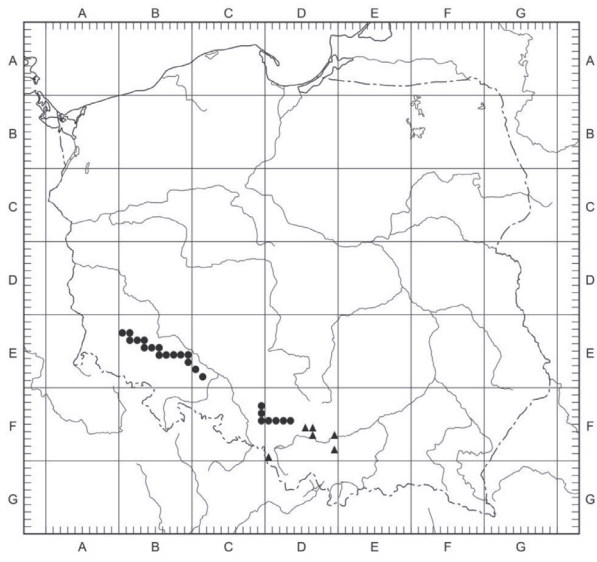


Fig. 2. Distribution map of *Dittrichia graveolens* in Poland using the ATPOL cartogram grid: ● – new records; ▲ – previously published records (PLISZKO & KOCIÁN, 2017)

metre) of the A4 highway in the Lower Silesian Province and Silesian Province, south-western Poland (Table 1, Fig. 1), which is 43.8% of the examined part of the highway (288 km). The new localities of *D. graveolens* are situated within 23 cartogram units (10 km squares) of the ATPOL grid (Fig. 2).

In 2013, the species was found within 63 road

sections, which is 24.4% of the examined part of the A4 highway. Analogical values for 2018 were 92 sections and 35.6%. During five years *D. graveolens* has expanded its range to another 29 sections, which is an increase of 46.0%. Moreover, the increase in abundance was recorded within 50 sections (52.1%), a decrease within 11 sections (11.5%), while within 35 sections (36.5%) it remained unchanged (Table 1).

The populations of *D. graveolens* hitherto reported from Poland are relatively small, ranging from several to several dozen individuals (PLISZKO & KOCIÁN, 2017). In many of the newly recorded localities, the abundance of the population was estimated up to several thousand individuals per kilometre. A total abundance in the examined part of the A4 highway in 2017 was not less than several hundred thousand individuals. Interestingly, the highest abundance of *D. graveolens* was observed along the oldest part of the A4 highway, which was built in the 1930s, between Krzyżowa (around 50 km) and Wrocław-Bielany (around 150 km) (KALIŃSKI, 2017 and references therein). The road surface of this part of the highway was renovated in 2002–2006. *Dittrichia graveolens* most likely was established in this area at least a few decades ago. The remaining parts of the A4 highway were put into use much later, mainly in the 1990s and

at the beginning of the 21st century, and the species was found there growing only sparsely, in groups of several to several dozen individuals, indicating the initial phase of colonization. The fast spread of *D. graveolens* along the highways in south-western Poland suggests that this plant is well adapted to roadside conditions. According to BROWNSEY et al. (2013b), one plant of *D. graveolens* produces up to 71 000 fruits, which can be dispersed by wind, water, animals, and machinery. The air movement caused by passing vehicles on highways facilitates the seed dispersal along the roadside verges. Moreover, GRAŠIČ et al. (2016) have evidenced that seeds of *D. graveolens* are able to germinate and also further develop in a wide range of NaCl concentrations, spanning from 0 to the extreme 10 g NaCl/L ( $\approx$  171 mM NaCl). The above-mentioned degree of salt tolerance explains the presence of *D. graveolens* on the roadsides of highways, which are often treated with salt to melt snow and ice in winter. Furthermore, *D. graveolens* can grow on soils contaminated with heavy metals and can accumulate mercury (HIGUERAS et al., 2003).

Analysing the history of its spread in Central Europe (FRAJMAN & KALIGARIČ, 2009; KIRÁLY et al., 2014; KOCIÁN, 2014, 2015; PAGITZ & LECHNER-PAGITZ, 2015; PLISZKO & KOCIÁN, 2017; WRÓBEL & NOBIS, 2017), presumably *D. graveolens* has been introduced to Poland from two directions, namely from the German border eastwards along the A4 highway and from the eastern part of the Czech Republic towards Silesia and Lesser Poland, along the S1 expressway. Nonetheless, to confirm the origin of the Polish populations of *D. graveolens* properly, a genetic study is needed. In conclusion, new data suggest that *D. graveolens* is fully established in the Polish flora and it should be classified as a potentially invasive species.

## REFERENCES

- ATHA D., WANG Z., BARRON C., LILJENGREN H., 2019: *Dittrichia graveolens* (Asteraceae) naturalized and invasive in New York State. – *Phytoneuron*, 4: 1–4.
- BROWNSEY R., KYSER G.B., DITOMASO J.M., 2013a: Stinkwort is rapidly expanding its range in California. – *California Agriculture*, 67: 110–115.
- BROWNSEY R.N., KYSER G.B., DITOMASO J.M., 2013b: Seed and germination biology of *Dittrichia graveolens* (Stinkwort). – *Invasive Plant Science and Management*, 6: 371–380.
- BRULLO B., DE MARCO G., 2000: Taxonomical revision of the genus *Dittrichia* (Asteraceae). – *Portugaliae Acta Biologica*, 19: 341–354.
- CZERNECKI B., JABŁOŃSKA K., 2015: Możliwości wykorzystania wskaźnika wegetacji NDVI w badaniach fenologii roślin. – In: LORENC H., USTRNUL Z. (ed.), *Klimat a społeczeństwo i gospodarka*. Polskie Towarzystwo Geofizyczne – Oddział Warszawski, Instytut Meteorologii i Gospodarki Wodnej: 191–207. – Warszawa.
- FRAJMAN B., KALIGARIČ M., 2009: *Dittrichia graveolens*, a new alien species of the Slovenian flora. – *Hladnikia*, 24: 35–43.
- GIVEN D.R., 1984: Checklist of dicotyledons naturalised in New Zealand 16. Compositae – tribes Vernoniae, Eupatorieae, Astereae, Inuleae, Heliantheae, Tageteae, Calenduleae, and Arctoteae. – *New Zealand Journal of Botany*, 22: 183–190.
- GRAŠIČ M., ANŽLOVAR S., STRGULC KRAJŠEK S., 2016: Germination rate of stinkwort (*Dittrichia graveolens*) and false yellowhead (*D. viscosa*) in relation to salinity. – *Acta Biologica Slovenica*, 59: 5–11.
- HIGUERAS P., OYARZUM R., BIESTER H., LILLO J., LORENZO S., 2003: A first insight into mercury distribution and speciation in the Almadén mining district, Spain. – *Journal of Geochemical Exploration*, 80: 95–104.
- KALIŃSKI J., 2017: Jak powstała autostrada A4? – *Zeszyty Naukowe Uniwersytetu Jagiellońskiego, Prace Historyczne*, 144: 833–855.
- KIRÁLY G., ELIÁŠ P., DÍTĚ D., 2014: Two thermophilic alien species new to the flora of Slovakia. – *Thaiszia – Journal of Botany*, 24: 125–134.
- KOCIÁN P., 2014: Nezpozorované a rychlé šíření lebedy různosemenné (*Atriplex micrantha*) a omanu smradlavého (*Dittrichia graveolens*) na dálnicích Moravy a Slezska (Česká republika). – *Acta Musei Beskidensis*, 6: 27–47.
- KOCIÁN P., 2015: *Dittrichia graveolens* (L.) Greuter – a new alien species in Poland. – *Acta Musei Silesiae Scientiae Naturales*, 64: 193–197.
- PAGITZ K., LECHNER-PAGITZ C., 2015: Neues zur Neophyten flora Nord- und Osttirols (Österreich). – *Neilreichia*, 7: 29–44.
- PARSONS W.T., CUTHBERTSON E.G., 1992: Noxious weeds of Australia. – Melbourne.

- PHILBEY A.W., MORTON A.G., 2000: Pyogranulomatous enteritis in sheep due to penetrating seed heads of *Dittrichia graveolens*. – Australian Veterinary Journal, 28: 858–860.
- PLISZKO A., KOCIÁN P., 2017: Further notes on the distribution of *Dittrichia graveolens* (Asteraceae) in Poland. – Acta Musei Silesiae Scientiae Naturales, 66: 259–262.
- RANDALL R.P., 2017: A global compendium of weeds. – Perth.
- THONG H.Y., YOKOTA M., KARDASSAKIS D., MAIBACH H.I., 2008: Allergic contact dermatitis from *Dittrichia graveolens* (L.) Greuter (stinkwort). – Contact Dermatitis, 58: 51–53.
- WRÓBEL A., NOBIS M., 2017: Spread of *Eragrostis albensis* (Poaceae) and *Dittrichia graveolens* (Asteraceae) in the southern Poland. – Acta Musei Silesiae Scientiae Naturales, 66: 117–120.
- ZAJĄC A., 1978: Atlas of distribution of vascular plants in Poland (ATPOL). – Taxon, 27: 481–484.

## GREITAS *DITTRICHIA GRAVEOLENS* (ASTERACEAE) PLITIMAS PIETVAKARIŲ LENKIJOJE

Katarzyna KOZŁOWSKA-KOZAK, Maciej KOZAK, Artur PLISZKO

### Santrauka

Svetimžemės *Dittrichia graveolens* rūšies paplitimas buvo tirtas 2013 ir 2018 m. išilgai A4 magistralės Žemutinės Silezijos ir Silezijos provincijose, Pietvakarių Lenkijoje. Buvo nustatytos 126 augavietės vieno km greitkelio ruožuose. Per penkerius metus

augalo paplitimas padidėjo 50 radaviečių (52,1 %), sumažėjo 11 (11,5 %), o 35 (36,5 %) nepakito. Nauji duomenys parodė, kad *D. graveolens* yra įsigalėjusi Lenkijos floroje ir turėtų būti traktuojama, kaip potencialiai invazinė rūšis.