



A New Genus Record for the Flora of Turkey: *Reynoutria* (Polygonaceae)

Fergan KARAER¹, Salih TERZİOĞLU^{2*}, Hamdi Güray KUTBAY³

¹Department of Science, Faculty of Education, Ondokuz Mayıs University, Samsun, ²Department of Forest Botany, Faculty of Forestry, Karadeniz Technical University, Trabzon, ³Department of Biology, Faculty of Art and Science, Ondokuz Mayıs University, Samsun, Turkey

¹<https://orcid.org/0000-0003-3781-2128>, ²<https://orcid.org/0000-0003-4146-3514>, ³<https://orcid.org/0000-0001-9511-9159>

✉: sterzi@ktu.edu.tr

ABSTRACT

This paper describes *Reynoutria* as a newly recorded genus of Dock Family (Polygonaceae) to Turkey. Specimens of *R. japonica* Houtt. (Polygonaceae) were collected from Terme/Bazlamaç (Samsun). Adding this new genus, the number of genera in Turkish Flora reached to 11 and the identification key for genera of Polygonaceae was updated. In addition, Turkish name, detailed description, photographs, locality information and geographical distribution map of the species were given in the present study.

Research Article

Article History

Received : 10.12.2019
Accepted : 23.01.2020

Keywords

New record
Polygonaceae
Reynoutria
Samsun
Turkey

Türkiye Florası için Yeni Bir Cins Kaydı : *Reynoutria* (Polygonaceae)

ÖZET

Bu çalışmada, Madımakgiller familyası (Polygonaceae)'nın bir cinsi olan *Reynoutria* Türkiye için yeni kayıt olarak tanıtılmaktadır. *R. japonica* Houtt. (Polygonaceae) türüne ait bitki örnekleri Terme/Bazlamaç (Samsun) yöresinden toplanmıştır. Bu cinsin de ilavesiyle familyanın Türkiye florasındaki cins sayısı 11'e yükselmiş ve familyanın cins anahtarı yeniden hazırlanarak sunulmuştur. Ayrıca türün Türkçe adı, detay tanımlaması, fotoğrafları, lokasyon bilgileri ve ülkemizdeki yayılış haritası bu çalışmada verilmektedir.

Araştırma Makalesi

Makale Tarihçesi

Geliş Tarihi : 10.12.2019
Kabul Tarihi : 23.01.2020

Anahtar Kelimeler

Yeni kayıt
Polygonaceae
Reynoutria
Samsun
Türkiye

To Cite : Karaer F, Terzioğlu S, Kutbay HG 2020. A New Genus Record for the Flora of Turkey: *Reynoutria* (Polygonaceae). KSU J. Agric Nat 23 (3): 606-610. DOI: 10.18016/ksutarimdog.vi.657654.

INTRODUCTION

The family *Polygonaceae* Juss. (Buckwheat or Dock family) encompasses about 50 genera and 1200 species worldwide and distributed mainly in temperate zone of the Northern Hemisphere and rarely in tropical regions (Heywood, 1978; Freeman and Reveal, 2005). This family has already been reported that it consists of nine native and one naturalized genus in Turkish flora (Keskin, 2012). *Reynoutria* Houtt. is closely related to genera such as *Fallopia* Adans, *Calligonum* L. and *Fagopyrum* Mill. *Reynoutria japonica* Houtt. (Japanese knotweed), a noxious weed in Turkey, grows naturally in Japan, Eastern Asia, China, Korea and Taiwan (Beerling et al., 1994; Bailey, 2003). As ornamental plant, it was introduced into Europe from Japan and Eastern Asia in the 19th century (Conolly, 1977; Pyšek and Prach, 1993). International Union for Conservation of Nature (IUCN) ranked this species as one of the most invasive 100 organisms of the world (Lowe et al., 2000). It is also recognised as one of the

worst invasive alien species (IAS) at a European scale (Nentwig et al., 2017; Fennel et al., 2018) and according to the DAISIE database it is one of the 18 most invasive plants in Europe (Kirpluk et al., 2019). This study aimed to record the genus *Reynoutria* and its species (*R. japonica*) to the alien vascular flora of Turkey.

MATERIAL and METHOD

Some specimens of *Reynoutria* Houtt were collected in June of 2014, during the fieldwork of a project (supported by Republic of Turkey Ministry of Agriculture and Forestry, General Directorate of Nature Conservation and National Parks) in A6 Samsun province, National Biodiversity Inventory and Monitoring. After checking the literature, it was concluded that the specimens of *R. japonica* were previously unknown in Turkey (Keskin, 2012). Additionally, all specimens were cross-checked according to the relevant literature (Bimová et al.,

2004; Lee, 2002; Mack et al., 2000; Pyšek and Prach, 1993; Pyšek, and Richardson, 2000; Pyšek et al., 2003; Rejmánek, 1995; Richardson et al., 2000). The specimens were also cross-checked with the specimens of Polygonaceae in different herbaria (E, OMUB, KATO, GAZI, ANK, HUB, ISTE and ISTF). The specimens of new findings were kept at the OMUB and KATO Herbaria.

RESULTS and DISCUSSION

Reynoutria Houtt., Nat. Hist. 2 (8): 639 (1777).

Perennial, rhizomes thick, stems erect, stout, hollow. Ocrea oblique, leaves simple, alternate, petiolate, blade ovate or ovate-elliptic, margin entire. Inflorescence axillary, paniculate, flowers unisexual, perianth persistent, 5-parted including 2 inner and 3 outer, tepals accrescent, winged on abaxial surface in female flowers, stamens 8, styles 3; stigmas fimbriate, achenes ovoid, trigonous.

Reynoutria can be distinguished from the related genera, *Fallopia* and *Fagopyrum*, by its not twining stems, wingless achenes, bisexual flowers, broadly cuneate-rounded and truncate leaves and fimbriate stigmas. However, identification key in the Flora of Turkey and the East Aegean Islands not includes these taxa (Davis, 1967). Thus, key to genera of Polygonaceae was rearranged below for the Turkish vascular flora:

1. Shrub or rarely subshrub
2. Stems twining5. *Fallopia*
2. Stems not twining
3. Stamens 10-18; fruit covered with stiff, tuberculate, intertwined bristles, leaves small, scaly; styles 42. *Calligonum*
3. Stamens 6-8; fruit not covered with bristles, leaves large, not scaly; styles 2 or 3
4. Stamens inserted at the mouth of the perianth; fruit with three bilobed wings8. *Pteropyrum*
4. Stamens inserted at the base of the perianth; fruit unwinged.....1. *Atraphaxis*
1. Annual or perennial, sometimes with woody stocks herbs
5. Achenes with wings
6. Tepals 4; stigma 2, stamens 4-5; achenes biconvex, leaves mostly all basal, reniform to triangular-cordate, long-petiolate6. *Oxyria*
6. Tepals 6; stigma 3, stamens 9; achenes trigonous not horned at base; leaves palmately veined.....10. *Rheum*
5. Achenes without wings
7. Flowers unisexual, bisexual
8. Leaves broadly cuneate, rounded, truncate stigmas fimbriate9. *Reynoutria*
8. Leaves, hastate, sagittate or cordate, stigmas not fimbriate

9. Leaves cordate; fruiting perianth segments with hard spiny tip.....3. *Emex*
9. Leaves hastate or sagittate; stigmas penicillate, fruiting perianth segments without hard spiny tips11. *Rumex*
7. Flowers hermaphrodite
10. Perianth segments 6, the inner much larger than the outer in fruit; stamens 6.....11. *Rumex*
10. Perianth segments 5; tepals not enlarged in fruit, rarely enlarged, becoming fleshy, all \pm equal in fruit; stamens 8
11. Achenes trigonous, much longer than or rarely equalling persistent perianth stamens usually 34. *Fagopyrum*
11. Achenes trigonous or biconvex, shorter than or rarely longer than persistent perianth stamens usually 87. *Polygonum*

Reynoutria japonica Houtt., Nat. Hist. 2(8): 639 (1777). (Figures 1, 2).

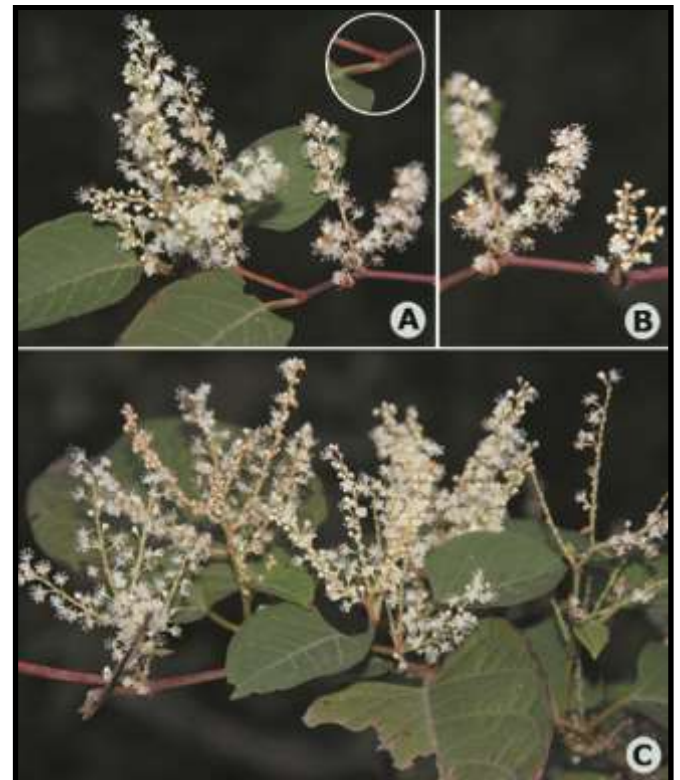


Figure 1. *Reynoutria japonica* A and B: Branches with leaves and axillar inflorescences and the base of the stem above each joint is surrounded by a membranous sheath; C: Inflorescence is erect raceme or panicle (photos by F. Karaer).

Şekil 1. *Reynoutria japonica* A ve B: Dallar yapraklı ve koltuklarda çiçek kurullu ve her eklemın yukarısındaki gövde tabanı bir zarsı kılıfla çevrilidir; C: Çiçek kurulu salkım veya birleşik salkım (Foto F. Karaer).

Syn.: *Fallopia compacta* (Hook.f.) G.H.Loos & P.Keil, *Fallopia japonica* (Houtt.) Ronse Decr., *Fallopia japonica* f. *colorans* (Makino) Yonek., *Fallopia japonica* var. *compacta* (Hook.f.) J.P.Bailey, *Fallopia japonica* var. *compacta* J. Bailey, *Fallopia japonica* var. *hachidoensis* (Makino) Yonek. & H.Ohashi, *Fallopia japonica* var. *uzenensis* (Honda) Yonek. & H.Ohashi, *Pleuropterus cuspidatus* (Siebold & Zucc.) H.Gross, *Pleuropterus zuccarinii* (Small) Small, *Polygonum compactum* Hook.f., *Polygonum cuspidatum* Siebold & Zucc., *Polygonum cuspidatum* var. *spectabile* Noter, *Polygonum hachidoense* Makino, *Polygonum reynoutria* Makino, *Polygonum reynoutria* f. *Colorans* Makino, *Polygonum sieboldii* de Vriese ex L.H.Bailey, *Polygonum zuccarinii* Small, *Reynoutria compacta* (Hook.f.) Nakai, *Reynoutria hachidoensis* (Makino) Nakai, *Reynoutria hachidoensis* var. *terminalis* Honda, *Reynoutria hachijoensis* Nakai ex Jotani, *Reynoutria hastata* Nakai ex Ui, *Reynoutria henryi* Nakai, *Reynoutria japonica* var. *compacta* (Hook.f.) Moldenke, *Reynoutria japonica* var. *hastata* (Nakai ex Ui) Honda, *Reynoutria japonica* var. *spectabilis* (Noter) Moldenke, *Reynoutria japonica* var. *terminalis* (Honda) Kitag., *Reynoutria japonica* var. *uzenensis* Honda, *Reynoutria uzensis* (Honda) Honda, *Tiniaria japonica* (Houtt.) Hedberg (TPL, 2019).

Shrub like or woody based herbaceous perennial, adventitious roots thread-like. Rhizomes thickened, dark brown, knotty, up to 8 cm in diameter, spread laterally, ca. 7–20 m. Above ground stems numerous, smooth, erect, 1–2 (–3) m tall, stout, branched above, hollow, striate, papillate, often with red or purple spots, the base of the stem above each joint is surrounded by a membranous sheath. Petiole 1–2 cm, papillate; leaf blade ovate or broadly elliptic, 3–12(–14) × 4–9 cm, sub leathery, both surfaces glabrous, papillate along veins, base broadly cuneate, rounded or truncate, margin entire, apex acute or shortly acuminate. Inflorescence axillary, erect raceme or panicle, 3–8 (–15) cm long, bracts funnel-shaped, 1–2 mm, oblique, each 2–4-flowered, flowers borne in

fascicles, pedicels 3–4 mm, slender, articulate below middle. Flowers minute white, cream or greenish, occur in perianth, 5-parted. Stamens 8, longer than perianth in male flowers. 3 outer petals acrescent and winged on abaxial surface; styles 3; stigmas fimbriate in female flowers. Achenes black-brown, shiny, ovoid-ellipsoid, 4–5 mm. and included in persistent perianth. *Flowering 6–9, fruiting 7–10, field margins, roadsides.*

Collected locality: A6 Samsun - Terme, Bazlamaç district, *field margins, roadsides*, 210-315 m, 16.10.2014, F. Karaer 30135 (OMUB!), Ibid. 250-425 m, 15. xi. 2014, F. Karaer 30375 (OMUB!), (KATO 19251!) (Figure 2).

Turkish name: Japon Madımağı.

Reynoutria japonica is found in different habitats such as edge of road, wasteland and open woodland. Specimens were collected during the flowering and fruiting periods from semi natural populations near Bazlamaç district in Terme /Samsun province, Turkey. The following species were growing in association with *R. japonica* at its sites in Samsun: *Tagetes minuta* L., *Galinsoga parviflora* Cav., *Urtica dioica* L., *Cynodon dactylon* (L.) Pers., *Geranium robertianum* L. and *Sambucus ebulus* L.

The species belongs to the sect. *Reynoutria* (Houtt.) Ronse Decr., characterized by herbaceous perennial plants, with erect robust stems, well-developed thick rhizomes, large orbicular to broadly ovate leaves, deeply three-parted styles with fimbriate stigmas and a functionally dioecious breeding system.

The specimens were collected from a population of approximately 1.5 km² growing at the border of both sides of road and open woodland. The population have individuals from 0.5 to 1.2 m high.

Reynoutria japonica was determined by the Houttuyn (in 1777) and independently Siebold (in 1846) described it as *Polygonum cuspidatum* Sieb & Zucc. In recent times, this taxon is adopted Meissner's classification (in 1856) as *Fallopia japonica* var.

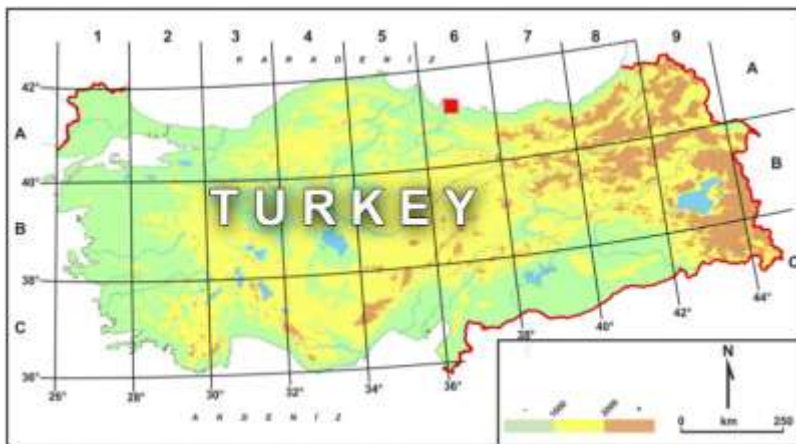


Figure 2. Distribution of *Reynoutria japonica* (■) in Turkey (adapted from Güner, 2014).

Şekil 2. *Reynoutria japonica* (■)'nin Türkiye'deki yayılışı (Güner, 2014'den uyarlanmıştır).

japonica; the classification and nomenclature of it has been changed, because of the historical complication (Beerling et al., 1994; Bailey and Conolly, 2000). Today, authors use different names. In Europe the species are recognized in two different generic names; *Reynoutria* and *Fallopia*. *Fallopia* combinations are on the standard list of British and German flora, while IPNI (2019) and Tropicos (2019) and other researchers use *Reynoutria* as a generic name (Mirek et al., 2002; Tokarska-Guzik, 2003, 2005).

In the one hand Japanese knotweed spreads mainly by vegetative way, on the other hand it shows sexual reproduction by hybridization (Vichotová and Šerá, 2008). It easily establishes the monoculture by spreading clonally via rhizomes (Forman and Kesseli, 2003) that they are capable of extensive spread both horizontally and vertically. In riparian areas in south eastern Terme/Samsun, some sprouts of unidentified knotweeds do not emerge for 1 to 2 years all aboveground growth. Rhizome shoot production is in May, July, and September. It is gynodioecious in the Samsun.

Reynoutria japonica is commonly establishing in disturbed areas, including water sources, such as stream sides, in low-lying areas, waste places and roadsides, around old home sites and abandoned fields or gardens. However, its growth is limited by availability of sunlight (Beerling, 1993; Beerling et al., 1994; Mandák et al., 2004). Its wide distribution in the world refers that this species has a strong potential to be invasive in Turkey. Its distribution has already confined to only few very close localities in Terme where the potential waste places and farm lands occur. It is capable of easily producing new colonies via fruits, which can be dispersed by wind, and rhizomes. Once established, the populations of Japanese knotweed are extremely persistent especially in riparian areas. Control methods are expensive and extremely labor intensive. Mechanical methods followed by herbicide treatments have proven somewhat successful in heavily infested areas and biological control agents are not currently available (Klein, 2011). This is an extremely difficult vascular plant species in order to control because of its ability to regrow both from vegetative and generative parts.

ACKNOWLEDGEMENTS

We are indebted to the directors of the following herbaria; E, OMUB, KATO, GAZI, ANK, HUB, ISTE and ISTF. We also express our special thanks to Republic of Turkey Ministry of Agriculture and Forestry, General Directorate of Nature Conservation and National Parks for their financial supports.

Statement of Conflict of Interest

Authors have declared no conflict of interest.

Author's Contributions

The contribution of the authors is equal.

REFERENCES

- Bailey JP 2003. Japanese Knotweeds s.l. at Home and Abroad. L. Plant Invasions: Ecological Threats and Management Solutions. (Backhuys Publishers, Leiden: Eds. Child JH, Brock G, Brundu K, Prach P, Pyšek PM, Williamson WM) 183–196.
- Bailey JP, Conolly AP 2000. Prize-Winners to Pariahs – A history of Japanese Knotweed s.l. (Polygonaceae) in the British Isles. *Watsonia*, 23: 93–110.
- Beerling DJ 1993. The Impact of Temperature on the Northern Distribution Limits of the Introduced Species *Fallopia japonica* and *Impatiens glandulifera* in Northwest Europe. *Journal of Biogeography*, 20: 45–53.
- Beerling DJ, Bailey JP, Conolly AP 1994. *Fallopia japonica* (Houtt.) Ronse Decraene (*Reynoutria japonica* Houtt.; *Polygonum cuspidatum* Sieb. Zucc.). *Journal of Ecology*, 82: 959–979.
- Bimová K, Mandák B, Kasparova I 2004. How does *Reynoutria* Invasion Fit the Various Theories of Invisibility? *Journal of Vegetation Science*, 15: 495–504.
- Conolly AP 1977. The Distribution and History in the British Isles of some Alien Species of *Polygonum* and *Reynoutria*. *Watsonia*, 11: 291–311.
- Davis PH (ed.) 1967. Polygonaceae. Flora of Turkey and the East Aegean Islands. Vol. 2. Edinburgh University, Edinburgh, pp. 265–293.
- Fennel M, Wade M, Bacon KL 2018. Japanese knotweed (*Fallopia japonica*): an analysis of capacity to cause structural damage (compared to other plants) and typical rhizome extension. *PeerJ*, 6: e5246.
- Forman J, Kesseli R 2003. Sexual Reproduction in the Invasive Species *Fallopia japonica* (Polygonaceae). *American Journal of Botany*, 90: 586–592.
- Freeman CC, Reveal JL 2005. Flora of North America- Polygonaceae. Vol. 5. Oxford University Press, Oxford, pp. 216–221.
- Güner A 2014. Resimli Türkiye Florası, Cilt1. Nezahat Gökyiğit Botanik Bahçesi, Türkiye Flora Araştırmaları Derneği ve Türkiye İş Bankası Kültür Yayınları, İstanbul, 763s.
- Heywood VH 1978. Flowering Plants of the World, Oxford University Press, Oxford, p336.
- IPNI 2019. <http://www.ipni.org> (Accessed: 25 November 2019).
- Keskin M 2012. Polygonaceae. (Türkiye Bitkileri Listesi (Damarlı Bitkiler, İstanbul: Güner A. Aslan S. Ekim T. Vural M. Babaç MT) 757–764.
- Kirpluk I, Bomanowska A, Otreba A 2019. The spread of *Reynoutria* species (Polygonaceae) in Kampinos National Park and its vicinity (Central Poland).

- Chornomors'k. Bot. Z., 15 (1): 17–25.
- Klein H 2011. Japanese knotweed, https://accs.uaa.alaska.edu/wp-content/uploads/Fallopia_japonica_BIO_FAJA2.pdf (Accessed: 6 December 2019).
- Lee CE 2002. Evolutionary Genetics of Invasive Species. Trends in Ecology and Evolution, 17: 386–391.
- Lowe S, Browne M, Boudjelas S, De Poorter M 2000. 100 of the World's Worst Invasive Alien Species. A selection from the Global Invasive Species Database. Invasive Species Specialist Group (ISSG).
- Mack RN, Simberloff WM, Lonsdale H, Evans MC, Bazzaz FA 2000. Biotic Invasions: Causes, Epidemiology, Global Consequences, and Control. Ecological Applications, 10 (3): 689–710.
- Mandák B, Pyšek P, Katerina B 2004. History of the Invasion and Distribution of *Reynoutria* Taxa in the Czech Republic: A Hybrid Spreading Faster Than its Parents. Preslia, 76: 15-64.
- Mirek Z, Piękoś-Mirkowa H, Zajac A, Zajac M 2002. Flowering Plants and Pteridophytes of Poland. A Checklist, W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.
- Nentwig W, Bacher S, Kumschick S, Pyšek P, Vilà M 2017. More than “100 worst” alien species in Europe. Biological Invasions, 20(6): 1611-1621.
- Pyšek P, Brock JH, Bímová K, Mandák B, Jarošík V, Koukolíková I, Pergl J, Štěpánek J 2003. Vegetative Regeneration in Invasive *Reynoutria* (*Polygonaceae*) Taxa: The Determinant of Invisibility at the Genotype Level. American Journal of Botany, 90: 1487–1495.
- Pyšek P, Prach K 1993. Plant Invasion and the Role of Riparian Habitats: A Comparison of Four Species Alien to Central Europe. Journal of Biogeography, 20: 413-420.
- Pyšek P, Richardson DM 2000. The Biogeography of Naturalization in Alien Plants. Journal of Biogeography, 33: 2040–2050.
- Rejmánek M 1995. What Makes a Species Invasive? (Plant Invasions: General Aspects and Special Problems, SPB Academic Publishing, Amsterdam: Eds. P. Pyšek, K. Prach, M. Rejmánek, M. Wade) 3-13.
- Richardson DM, Pyšek P, Rejmanek M, Barbour MG, Panetta FD, West CJ 2000. Naturalization and Invasion of Alien Plants: Concepts and Definitions. Diversity and Distributions, 6: 93-107.
- Tokarska-Guzik B 2003. The Expansion of some Alien Plant Species (Neophytes) in Poland. (Plant Invasions: Ecological Threats and Management Solutions, Backhuys Publishers, Leiden:Eds. L. E. Child, J. H. Brock, G. Brundu, K. Prach, P. Pyšek, P. M. Wade, M. Williamson) 147-167.
- Tokarska-Guzik B 2005. The Establishment and Spread of Alien Plant Species (kenophytes) in the flora of Poland, Wydawnictwo Uniwersytetu Śląskiego, Katowice.
- TPL 2019. The Plant List <http://www.theplantlist.org/tpl1.1/record/kew-2428745> (Accessed: 6 December 2019).
- Tropicos 2019. <http://www.tropicos.org/NameSearch.aspx> (Accessed: 12 June 2019).
- Vichotová N, Šerá B 2008. Allopathic Properties of Knotweed Rhizome Extracts. Plant Soil and Environment, 54: 301–303.