

# New records of non-native vascular plant taxa from Iceland

**Pawel Wasowicz<sup>1</sup>**

*<sup>1</sup>Icelandic Institute of Natural History, Borgir við Norðurslóð,  
IS-600 Akureyri, Iceland*

**ABSTRACT:** 15 new taxa of non-native vascular plants were recorded in Iceland (during the last five years: 2013-2017). Here, the most important data on first records were described: including exact location, herbarium voucher, collector name and comments summarising some more important details. Each newly recorded species was described in terms of its status (casual vs. naturalised alien) and impact category. The most probable pathway of introduction was also assigned to each taxon. The present paper presents information on spatial and temporal trends in species immigration as well as some basic statistics

**KEYWORDS:** non-native species, Iceland, invasive plant species,

## INTRODUCTION

It is well known that the impact of non-native taxa on the environment is mostly negative (PIMENTEL et al. 2005). There is a vast literature describing the impacts of particular non-native species that details specific kind of harm (VILÀ et al. 2011). In fact, the catalogue of environmental damage caused by introduction of non-native species is so long that it could hardly be reproduced in a single paper. Non-native species have a huge impact on both population and ecosystem levels. The population level impacts arise due to predation, herbivory, parasitism, disease, competition etc. (MOONEY & CLELAND 2001), while impact on ecosystem level can alter the biogeochemistry of ecosystems, soil chemistry, plant-plant and plant-microbe interactions (WEIDENHAMER & CALLAWAY 2010), water and/or fire regimes (BROOKS et al. 2009) and habitat

structure (ZEDLER & KERCHER 2004). Those impacts have often been demonstrated to cause significant reduction in both native populations (sometimes to the level of extinction, see e.g.: BLACKBURN et al. 2005; REASER et al. 2007), and also the area occupied by native ecosystems (STOHLGREN et al. 1999). It seems that public attention focus more on non-native animals than plants, however, the latter more often cause impacts that could be irreversible. The damage caused by non-native species differs significantly between regions and it seems that Arctic and sub-Arctic areas can be considered almost free of negative impacts caused by them (HELLMANN et al. 2008). While there are currently very few non-native species in the Arctic, more are expected to come with climate change and increased human activity (MELTOFTE 2013). It seems therefore essential to keep a record of all new non-native species coming to these areas in order to allow approach based on prevention, early detection and rapid response (ARIAS STEERING COMMITTEE 2017).

Recent studies focused on non-native species in the vascular flora of Iceland have shown that the impact of non-native species is far less severe here, than in countries of the continental part of Europe (WASOWICZ et al. 2013). However, increasing human pressure on ecosystems (due to e.g. rapidly growing tourism) will inevitably result in increased arrival and establishment of non-native plant species (WASOWICZ 2016). The present study aims to provide updated information on non-native plant taxa found in recent years in Iceland: exact data on first location, most probable pathway of arrival, species impact categories and status of all the taxa.

#### MATERIALS AND METHODS

The data on the occurrence of new non-native plants in Iceland have been continuously collected by the author during field studies or by personal contacts with botanists and other persons.

Classification of pathways of introduction follows WASOWICZ (2014), species status was assessed using criteria described by WASOWICZ et al. (2013) while species impact categories were established following BLACKBURN et al. (2014).

#### RESULTS AND DISCUSSION

- *Arabidopsis thaliana* (L.) Heynh. (Icelandic: Vormelablóm)

*First records:* **(1)** Deildartunguhver (64.663750 N, 21.410380 W), tourist road by hot springs and greenhouse, 7.06.2015, Hjörtur Þorbjörnsson (VA21379, AMNH); **(2)** Deildartunguhver (64.663750 N, 21.410380 W), tourist road by hot springs and greenhouse, 8.06.2015, Helmut Wittmann (VA21375, AMNH)

*Most probable pathway of introduction:* transport (tourism)/ agriculture

*Comments:* It is not easy to decide whether the species came to Iceland with

tourists visiting a hot spring located nearby or accidentally imported with some goods used on a farm also located in close vicinity. The species was found growing in geothermal area (MANDÁKOVÁ et al. 2017) and it is not known whether it will be able to colonise colder areas around.

*Status:* Casual alien

*Impact category:* Minimal (**ML**). The species could be an asymptomatic host of Alfalfa mosaic virus (BALASUBRAMANIAM et al. 2006)

- *Arnica chamissonis* Lessing (Icelandic: Klettagullblóm)

*First record:* Valhúsaheð Seltjarnarnesi (64.15247 N, 21.991740W), wasteland, 14.08.2017, Erling Ólafsson (det. P. Wasowicz) (VA21562, AMNH) (first observation by Dóra Jakobsdóttir Guðjohnsen, 02.09.2016)

*Most probable pathway of introduction:* horticulture

*Comments:* Probably a garden escape, but able to sustain small population consisting of several individuals in the same place for several years.

*Status:* Casual alien

*Impact category:* Minimal (**ML**).

- *Dianthus gratianopolitanus* Vill. (Icelandic: Laugadrottning)

*First record:* Valhúsaheð Seltjarnarnesi (64.15298 N, 21.99209 W), wasteland, 2.09.2016, Dóra Jakobsdóttir Guðjohnsen (observation)

*Most probable pathway of introduction:* horticulture

*Comments:* Probably a garden escape. No herbarium material was collected and species was identified from photographs.

*Status:* Casual alien

*Impact category:* Minimal (**ML**).

- *Fragaria moschata* Duchesne (Icelandic: Moskusjarðarber)

*First record:* Stóragjá – Mývatnssveit (65.637066 N, 16.910332 W), along the path in the southern end of Stóragjá, in grasses. Population of approx. 20 plants, August 2015, Pawel Wasowicz (VA21376, AMNH)

*Most probable pathway of introduction:* transport (tourism)

*Comments:* The natural distribution of this species covers Southern, Central and Eastern Europe (HULTÉN & FRIES 1986), it prefers forests, forest edges and requires moist and sheltered sites. It was Silke Werth who has first found it growing in Iceland near tourist path in the Mývatnssveit area. Unintentional introduction by tourists or agriculture (less probable) seems to be the most plausible explanation of its occurrence.

*Status:* Casual alien

*Impact category:* Minimal (**ML**).

• *Lonicera periclymenum* L. (Icelandic: skógartoppur)

*First record:* Fagurhólsmýri (63.87699 N, 16.64049 W), between rocks in steep cliffs, 04.08.2017, Andrzej Pasierbinski (VA21515, AMNH)

*Most probable pathway of introduction:* horticulture (?)

*Comments:* A single, large plant has been found growing between rocks in the steep cliffs in Fagurhólsmýri area in S Iceland. It is difficult to say what is the pathway of introduction of this species. A garden escape or an intentional introduction due to its aesthetic values seems to be most plausible explanations.

*Status:* Casual alien

*Impact category:* Minimal (**ML**).

• *Primula elatior* (L.) L. (Icelandic: huldulykill)

*First record:* Vífilsstaðahlíð Heiðmörk, (64.056790 N, 21.867240 W), 2014, Rannveig Thoroddsen (observation)

*Most probable pathway of introduction:* horticulture / transport

*Comments:* The species was first found in Vífilsstaðahlíð in Garðabær (SW Iceland) along a walking path. A garden escape or intentional introduction due to aesthetic values are most probable explanations.

*Status:* Casual alien

*Impact category:* Minimal (**ML**). There is no direct evidence that the species could cause environmental harm, however, due to its long expected population lifetime and high spreading potential the species has been classified as having a "potentially high impact" by the Norwegian Black List 2012 (GEDERAAS et al. 2012).

• *Primula veris* L. (Icelandic: sífjarlykill)

*First record:* Mógilsá Kjalarnesi (64.209530 N, 21.704830W) 2014, Aðalsteinn Sigurgeirsson (observation)

*Most probable pathway of introduction:* forestry (intentional introduction)

*Comments:* The species has been found growing in a plantation of non-native conifers.

*Status:* Casual alien

*Impact category:* Minimal (**ML**).

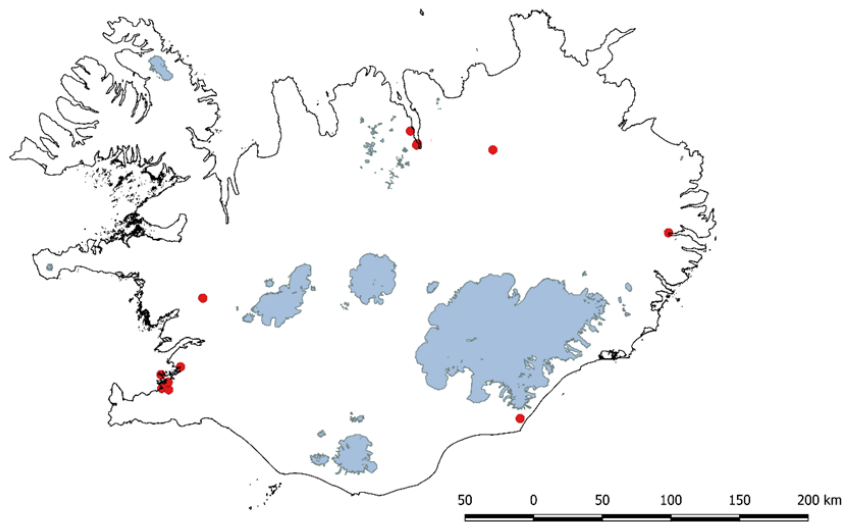


FIGURE 1. Location of new records of non-native vascular plant taxa treated in this paper.

- *Pulmonaria mollis* Hornem. (Icelandic: floslyfjurt)

*First record:* Akureyri, Glerágil neðra (65.689240 N, 18.102280 W) 11.06. 2015, In grasses close to the bridge over Glerá river in Akureyri. Pawel Wasowicz (VA21345, AMNH)

*Most probable pathway of introduction:* horticulture

*Comments:* Two plants were found growing in Akureyri within patches of disturbed vegetation in the city centre. Most probably a garden escape.

*Status:* Casual alien

*Impact category:* Minimal (**ML**). There is no direct evidence that the species could cause environmental harm, however, due to its long expected population lifetime and high spreading potential the species has been classified as having a “potentially high impact” by the Norwegian Black List 2012 (GEDERAAS et al. 2012).

- *Ribes spicatum* Robson (Icelandic: skógarrifs)

*First record:* Hlaðir Hörgárdal (65.772 N, 18.212 W) July 1913, Ólöf á Hlöðum (VA21407. AMNH)

*Most probable pathway of introduction:* horticulture

*Comments:* Some old records (however, confirmed by specimens) were found during herbarium queries in AMNH. The species is also found nowadays as a garden escape but is has not been mentioned by WASOWICZ et al. (2013).

*Status:* casual alien

*Impact category:* Minimal (ML).

• ***Rosa acicularis*** Lindl. (Icelandic: heiðarós)

*First record:* Reyðarfjörður (65.034667 N, 14.23850 W) fertile slope, within the town, 2013, Erlín Jóhannsdóttir (det. Vilhjálmur Lúðvíksson) (VA21326, AMNH)

*Most probable pathway of introduction:* horticulture

*Comments:* Found growing in the town of Reyðarfjörður (E Iceland). It seems that this species, having a Holarctic distribution in northern regions of Asia, North America and NE Europe (HULTÉN & FRIES 1986), is a garden escape or an intentional introduction due to its aesthetic values.

*Status:* Casual alien

*Impact category:* Minimal (ML). No evidence on environmental harm available, classified as "low impact" species by GEDERAAS et al. (2012).

• ***Rumex heterophyllus*** C.F.Schultz

*First record:* Kópavogslækur neðan Digranesvegur (64.106390 N, 21.879330 W), along the stream, 18.07.2011, Hörður Kristinsson (VA21268, AMNH)

*Most probable pathway of introduction:* transport

*Comments:* *R. heterophyllus* was first found growing along the stream in Kópavogur (SW Iceland) in a highly disturbed vegetation plots. Transport of goods seems to be most probable pathway of introduction since the species not used in horticulture.

*Status:* Casual alien

*Impact category:* Minimal (ML). Known as non-native, agricultural weed from Canada (DARBYSHIRE 2003), otherwise no data on environmental harm are available.

• ***Jacobaea vulgaris*** Gaertn. (Icelandic: bikarþulur)

*First record:* Hafnarfjörður - Óseyrarbraut (64.06368 N, 21.97096 W), storage space - EIMSKIP, close to the harbour, 11.09.2013, Rannveig Thoroddsen (VA21253, AMNH)

*Most probable pathway of introduction:* transport

*Comments:* First records come from highly disturbed harbour area in Hafnarfjörður (SW Iceland) and transport of goods is almost a self-evident explanation for this introduction.

*Status:* Casual alien

*Impact category:* **MR (major)**. The plant is considered invasive in N America, Australia and New Zealand (BAIN 1991).

• *Senecio viscosus* L. (Icelandic: kvoðupulur)

*First record:* Hafnarfjörður - Óseyrarbraut (64.06388 N, 21.969510 W), wasteland by Óseyrarbraut str., close to harbour, by a pile of pallets, 11.09.2013, Rannveig Thoroddsen (VA21254, AMNH)

*Most probable pathway of introduction:* transport

*Comments:* First records come from highly disturbed harbour area in Hafnarfjörður (SW Iceland) and transport of goods is almost a self-evident explanation for this introduction.

*Status:* Casual alien

*Impact category:* Minimal (**ML**). *S. viscosus* is considered a weed of wasteland and disturbed sites, especially open sandy and gravelly places in N America (Canada, USA) (FLORA OF NORTH AMERICA EDITORIAL COMMITTEE 2006) as well as in Falkland Islands (Malvinas) (VARNHAM 2006). It has been classified as “high impact” species by GEDERAAS et al. (2012) due to its long population lifetime and high spreading potential.

• *Solidago gigantea* Ait. (Icelandic: tröllagullhrís)

*First record:* Dalsbraut, Akureyri (65.68045 N, 18.11645W) roadside, in grasses, 25.08.2016, Mariusz Wierzgon (VA21390, AMNH)

*Most probable pathway of introduction:* horticulture

*Comments:* Large patches, evidently growing for some time, were found in Akureyri (N Iceland) along one of the main roads. Most probably a garden escape.

*Status:* Casual alien

*Impact category:* **MR (major)**. This N American species is considered invasive in continental Europe as well as in Fennoscandia (WEBER & JAKOBS 2005; GEDERAAS et al. 2012)

• *Solidago virgaurea* L. (Icelandic: gullhrís)

*First record:* Öskjuhlíð - S part (64.12788 N, 21.92028 W), in a lupine (*Lupinus nootkatensis*) patch, 4.09.2016, Kristbjörn Egilsson (observation)

*Most probable pathway of introduction:* horticulture

*Comments:* First records come from a heavily disturbed area in Reykjavík, most probable a garden escape.

*Status:* Casual alien

*Impact category:* Minimal (**ML**).

Recently published, comprehensive study focused on Icelandic non-native flora (WASOWICZ et al. 2013) has shown that the number of new alien plant records increases with time with a reasonably stable rate of approx. three new taxa per year. The present results seems to confirm this trend showing stable increase in the number of new taxa records at a mean rate of 2.6 species per year (from 2013 to 2017). First records of newly recorded non-native taxa tend to concentrate in SW Iceland (Reykjavík and nearby towns) and generally within urbanised areas (Figure 1). Two new records seem to deviate from this general trend (*A. thaliana* and *F. moschata*). In both cases, however, new locations are near touristic attractions, where the propagule pressure is high. Analysis of most probable introduction pathways showed that no major changes in their relative significance were noted during the investigated period, when compared with the data published previously (WASOWICZ 2014). Horticulture, transport and forestry were identified as pathways of introduction for newly recorded taxa.

## REFERENCES

- ARIAS STEERING COMMITTEE 2017. Arctic Invasive Alien Species - strategy and action plan. – Conservation of Arctic Flora and Fauna, Akureyri.
- BAIN, J.F. 1991. The biology of Canadian weeds.: 96. *Senecio jacobaea* L. – Canadian Journal of Plant Sciences 71: 127-140.
- BALASUBRAMANIAM, M., IBRAHIM, A., KIM, B.S. & LOESCH-FRIES, L.S. 2006. *Arabidopsis thaliana* is an asymptomatic host of Alfalfa mosaic virus. – Virus Research 121: 215-219.
- BLACKBURN, T.M., ESSL, F., EVANS, T., HULME, P.E., JESCHKE, J.M., KÜHN, I., KUMSCHICK, S., MARKOVÁ, Z., MRUGAŁA, A., NENTWIG, W., PERGL, J., PYŠEK, P., RABITSCH, W., RICCIARDI, A., RICHARDSON, D.M., SENDEK, A., VILÀ, M., WILSON, J.R.U., WINTER, M., GENOVESI, P. & BACHER, S. 2014. A Unified Classification of Alien Species Based on the Magnitude of their Environmental Impacts. – PLoS Biology 12: e1001850.
- BLACKBURN, T.M., PETCHY, O.L., CASSEY, P. & GASTON, K.J. 2005. Functional diversity of mammalian predators and extinction in island birds. – Ecology 86: 2916-2923.
- BROOKS, M.L., D'ANTONIO, C.M., RICHARDSON, D.M., GRACE, J.B., KEELEY, J.E., DITOMASO, J.M., HOBBS, R.J., PELLANT, M. & PYKE, D. 2004. Effects of invasive alien plants on fire regimes. – BioScience 54(7): 677-688.
- DARBYSHIRE, S.J. 2003. Inventory of Canadian Agricultural Weeds. – Agriculture and Agri-Food Canada, Ottawa.
- FLORA OF NORTH AMERICA EDITORIAL COMMITTEE 2006. Flora of North America North



- of Mexico, Volume 20: Magnoliophyta: Asteridae, Part 7: Asteraceae, Part 2: Asterales, Part 2 (Aster order). – Oxford University Press USA, New York.
- GEDERAAS, L., LOENNECHEN MOEN, T., SKJELSETH, S. & LARSEN, L.K. (eds) 2012. Alien species in Norway – with the Norwegian Black List 2012. – The Norwegian Biodiversity Information Centre, Trondheim.
- HELLMANN, J.J., BYERS, J.E., BIERWAGEN, B.G. & DUKES, J.S. 2008. Five potential consequences of climate change for invasive species. – *Conservation Biology* 22: 534–543.
- HULTÉN, E. & FRIES, M. 1986. Atlas of North European vascular plants (North of the Tropic of Cancer). – Koeltz Scientific Books, Königstein.
- MANDÁKOVÁ, T., THORBJÖRNSSON, H., PISUPATI, R., REICHARDT, I., LYSAK, A. & ANAMTHAWAT-JONSSON, K. 2017. Icelandic accession of *Arabidopsis thaliana* confirmed with cytogenetic markers and its origin inferred from whole-genome sequencing. – *Icelandic Agricultural Sciences* 30: 29–38.
- MELTOFTE, H. 2013. Arctic Biodiversity Assessment. Status and trends in Arctic biodiversity. – *Conservation of Arctic Flora and Fauna*, Akureyri.
- MOONEY, H.A. & CLELAND, E.E. 2001. The evolutionary impact of invasive species. – *Proceedings of the National Academy of Sciences of the United States of America* 98: 5446–5451.
- PIMENTEL, D., ZUNIGA, R. & MORRISON, D. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. – *Ecological Economics* 52: 273–288.
- REASER, J.K., MEYERSON, L.A., CRONK, Q., DE POORTER, M., ELREGE, L.G., GREEN, E., KAIRO, M., LATASI, P., MACK, R.N., MAUREMOOTOO, J., O'DOWD, D., ORAPA, W., SASTROUTOMO, S., SAUNDERS, A., SHINE, C., THRAINSSON, S. & VAITU, L. 2007. Ecological and socioeconomic impacts of invasive alien species in island ecosystems. – *Environmental Conservation* 34(2): 1–14.
- STOHLGREN, T.J., BINKLEY, D., CHONG, G.W., KALKHAN, M.A., SCHELL, L.D., BULL, K.A., OTSUKI, Y., NEWMAN, G., BASHKIN, M.A. & SON, Y. 1999. Exotic plant species invade hot spots of native plant diversity. – *Ecological Monographs* 69: 25–46.
- VARNHAM, K. 2006. Non-native species in UK Overseas Territories: a review. – *Joint Nature Conservation Committee Reports* 372: 1–35.
- VILA, M., ESPINAR, J.L., HEJDA, M., HULME, P.E., JAROSIK, V., MARON, J.L., PERGL, J., SCHAFFNER, U., SUN, Y. & PYSEK, P. 2011. Ecological impacts of invasive alien plants: a meta-analysis of their effects on species, communities and ecosystems. – *Ecological Letters* 14: 702–708.
- WASOWICZ, P. 2016. Non-native species in the vascular flora of highlands and mountains of Iceland. – *PeerJ* 4: e1559.
- WASOWICZ, P. 2014. Identifying and ascribing the relative significance of introduction pathways for non-native plants into Iceland. – *Environmental & Socio-economic Studies* 2: 28–37.
- WASOWICZ, P., PRZEDPELSKA-WASOWICZ, E.M. & KRISTINSSON, H. 2013. Alien vascular plants in Iceland: Diversity, spatial patterns, temporal trends, and the impact of climate change. – *Flora - Morphology Distribution Functional Ecology of Plants* 208: 648–673.
- WEBER, E. & JAKOBS, G. 2005. Biological flora of central Europe: *Solidago gigantea* Aiton. – *Flora - Morphology Distribution Functional Ecology of Plants* 200: 109–118.

- WEIDENHAMER, J.D. & CALLAWAY, R.M. 2010. Direct and Indirect Effects of Invasive Plants on Soil Chemistry and Ecosystem Function. — *Journal of Chemical Ecology* 36: 59–69.
- ZEDLER, J.B. & KERCHER, S. 2004. Causes and consequences of invasive plants in wetlands: opportunities, opportunists, and outcomes. — *CRC Critical Reviews in Plant Sciences* 23: 431–452.