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INTERSPECIFIC HYBRIDIZATION AND INVASIVENESS OF *PILOSELLA AURANTIACA* (L.) F. SCHULTZ ET SCH. BIP. IN LATVIA

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Genus *Pilosella* Hill is known as one of taxonomically most problematic genera from Asteraceae family. Morphological revision of plant material indicated that there are four species with orange-red flowerheads known in Latvia – one basic species and three hybridogenous species (hybrids): *Pilosella aurantiaca* (L.) F. Schultz et Sch. Bip., *Pilosella* × *fuscoatra* (Nägeli et Peter), *Pilosella* × *roxolanica* (Rehm.) Soják and *Pilosella* × *stoloniflora* (Waldst. et Kit.) F.W.Schultz et Sch.Bip. Based on the collected material in field studies as well as herbaria and published data of other researchers, the identification key was created. Because of cultivating the species as ornamental plant it has naturalized far beyond the natural distribution range. Assessing the overall situation, it can be concluded that *P. aurantiaca* and its hybrids are a potential invasive species for Latvia in future.

Key words: genus *Pilosella*, Latvia, hybridogenous species (hybrids), *Pilosella aurantiaca*, *Pilosella* × *fuscoatra*, *Pilosella* × *roxolanica*, *Pilosella* × *stoloniflora*.

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INTRODUCTION

Hybridization is a common process nowadays for many plant species and its' impact in evolutional processes of speciation is essential. On the one hand, it can be viewed as creative force that may form new species (Coyne & Orr 2004, Seehausen 2004, Hegarty & Hiscock 2005, Wissemann 2006), on the other, hybridization may lead parental species to extinction (Kothera et al. 2007, Field et al. 2009, Vit et al. 2014). Hybridization between species of genus *Pilosella* is common, all species actively hybridize in direct contact (Krahulcová et al. 2000).

P. aurantiaca is a perennial flowering plant, native to alpine regions of Central, Nothern and Southern Europe (Loomis & Fishman 2009, Stace et al. 2015). The species is cultivated as ornamental plant and has naturalized in the Baltic countries, the Republic of Belarus, European part of Russia, the United Kingdom, Belgium, Iceland and many other countries. Occur in grassy and waste habitats, meadows, waysides, cultivated land, up to 2600 m above sea level (Blamey & Grey-Wilson 1989, Tikhomirov 2000, Kukk & Gudžinskas 2003, Chrtek 2004). *P. aurantiaca* was introduced in North America more than a century ago, and now is considered as invasive plant from Florida to Alaska. Also is considered

as invasive plant in New Zealand and Australia (Loomis & Fishman 2009). Populations of invasive specimens of genus *Pilosella* range in size from small (0.01 ha) roadside patches to large, contiguous infestations of 150 ha or more in large openings, on abandoned farmlands, and in pastures and meadows, and at many locations completely dominates (Wilson et al. 2006). *P. aurantiaca* was cultivated in gardens since 1629 and for the first time was recorded from natural habitat in 1793 in the United Kingdom. Nowadays it occurs evenly throughout the territory (Preston 2002). Over 500 localities of *P. aurantiaca* are known from the British Isles, and a hybrid with native *P. officinarum* (*Pilosella* × *stoloniflora*) also has been found (Clement et al. 1994).

In Europe total number of hybrids with *P. aurantiaca* is 22. This number includes known hybrids that combine morphological features of four basic species (Bräutigam 2002).

In Ukraine are known some hybrids such as *Pilosella* × *blyttiana* (Fries) F.W.Schultz et Sch.Bip, *Pilosella* × *fuscoatra* (Nägeli et Peter), *Pilosella* × *roxolanica* (Rehm.) Soják and *Pilosella* × *stoloniflora* (Waldst. et Kit.) F.W.Schultz et Sch.Bip that combine morphological features of two basic species, but other hybrids, such as *Pilosella* × *rubripilosella* (G.Schneider) Soják and *Pilosella* × *plaicense* (Wołoszez.) Soják combine morphological features of three basic species (Tikhomirov 2002).

Two species with orange-red flowerhead in Latvia has been mentioned in "Flora of the Baltic countries" – *P. aurantiaca* and P. × *stoloniflora* (Kukk & Gudžinskas, 2003).

MATERIALS AND METHODS

The study included plants that were collected during the field studies throughout different regions of Latvia from 2014 to 2018 and all specimens collected during the research are deposited at herbaria of Institute of Life Sciences and Technology, Daugavpils University (DAU) (Evarte – Bundere et al. 2019).

Also data from the herbaria of the Laboratory of Botany, Institute of Biology, University of Latvia (LATV), historical herbaria of the Museum of Botany, University of Latvia (RIG) and the private collection of A. Opmanis was used. The collection of the genus *Pilosella* in DAU consists of 1117 specimen sheets collected since 1966 till 2018, and 1189 in LATV collected since 1947 till 2016. Only nine herbarium sheets of *P. aurantiaca* and hybrids in both herbaria are deposited. The oldest specimen of *P. aurantiaca* is known from 1987.

Personal observations and several descriptions from local floras and publications (Kukk & Gunžinskas 2003, Tikhomirov 2000, Tikhomirov 2002) for identification of herbarium material have been used.

For identification such features as presence/absence of simple/glandular/stellate hairs, length of simple hairs, color of flowers and acladium are primarily recked.

RESULTS

Pilosella aurantiaca (L.) F.W.Schultz et Sch.Bip. 1862, Flora, 45: 426; Шляков, 1989, Фл. евр. ч. СССР, 8: 351; Kukk et Gudžinskas, 2003, Fl. of the Bal. Coun. 3: 100.

Hieracium aurantiacum L. subsp. *aurantiacum*, Zahn, 1923, Engl. Planzenreich, 82, (IV.280): 1242; P.D.Sell et C.West, 1976, Fl. Europ. 4: 374.

P. aurantiaca is a cultivated species, naturalised locally in region, more common in disturbed habitats. Species has unique morphological characteristics and easily differs from hybrids. Hybrids sometimes grow independent and form stable populations, without the presence of parental species.

Pilosella aurantiaca produces hybrids *Pilosella* × *fuscoatra*, *Pilosella* × *roxolanica* and *Pilosella* × *stoloniflora* by hybridizing with native species *P. onegensis*, *P. vaillantii* and *P. officinarum*. Hybrids between two (or more) species are

usually variable and do not obtain uniform morphologic features, often similar to one of the parental species.

Morphological features: Perennial plant, all ligules purplish or orange-red. Rosette leaves with numerous simple hairs on upper surface, simple and disperse stellate hairs beneath. Acladium < ¼ of stem height. Stem covered with glandular hairs only in upper part of stem (singular bright or dark long glandular hairs occur in the middle of the stem) (Fig. 1).

Distribution: five locations of this species are known in Latvia. Four of these locations are with anthropogenic origin, one location was noticed in natural habitat in wooded dunes. It was collected for the first time in Līgatne district, Tītmaņi by A. Opmnis in 1987 and in the same year in Ugāle by I. Lodziņa (LATV 97749), later the locality was checked, and herbarium material collected in 1989 (LATV 97749). Later, in 1994 was collected in Jelgava by I. Straupe (LATV 112849). Four years later, in 1998 was collected in Rīga, Vecāķi by V. Šulcs (LATV 111609). In 2011 was collected in Jēkabpils by N. Romanceviča (DAU 100002921) (Fig.3).

Identification key of hybridogenous species of *P. aurantiaca* is provided below. Identification key is intended only for *P. aurantiaca* and its' hybrids. Hybrids of *P. aurantiaca* can be recognized by the amount of orange-red in the ligules.

Key to the species

1. Leaves with stellate hairs above ....***Pilosella* × *roxolanica***
- Leaves without stellate hairs above.....2.
2. Leaves with dense stellate hairs beneath, acladium > ¼ of stem height, or with single capitulum.....***Pilosella* × *stoloniflora***
- Leaves with disperse stellate hairs beneath, acladium < ¼ of stem height, capitulum numerous.....3.

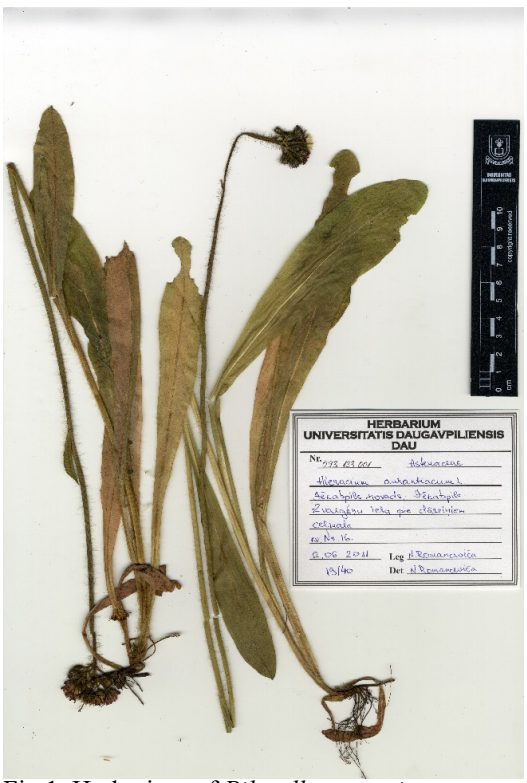

Fig.1. Herbarium of *Pilosella aurantiaca*.

Fig.2. Herbarium of *Pilosella* × *roxolanica.*

3. Flower ligules purplish or orange red, simple hairs on stem < 4 mm, on leave upper side < 2 mm.....***Pilosella aurantiaca***

- Orange-red or outer ligules orange-red and inner ligules yellow, simple hairs on stem 2,5 – 3 mm, on the upper side of leaves < 1,5 mm..... .....***Pilosella* × *fuscoatra***

Pilosella* × *fuscoatra (Nägeli et Peter) [=*Pilosella aurantiaca* × *Pilosella onegensis*]

Pilosella × *fuscoatra* (Nägeli et Peter) Soják, 1971, Preslia, 43(2): 184; Шляков, 1989, Фл. евр. ч. СССР, 8: 372

Hieracium fuscoatrum Nägeli et Peter, 1885, Hier. Mitt.-Eur., 1: 315; P.D.Sell et C.West, 1976, Fl. Europ. 4: 374, pro hybr.

Distribution: new hybridogenous species to flora of Latvia. Observation is known only from one location in Latvia, Nīgrande district, near Kalni, collected by D. Krasnopolska in 2018 (DAU 100004026) (Fig.4).

Pilosella* × *roxolanica (Rehm.) Soják [=*Pilosella aurantiaca* × *Pilosella vaillantii*]

Pilosella × *roxolanica* (Rehmann) Soják, 1971, Preslia, 43(2): 185; Шляков, 1989, Фл. евр. ч. СССР, 8: 365.

Hieracium guthnickianum Hegetschw. 1840, Fl. Schweiz: 781 auct. non.; P.D.Sell et C.West, 1976, Fl. Europ. 4: 374 pro hybr.

Distribution: new hybridogenous species to flora of Latvia. Observation is known from one location in Lavia, Rauna district, Rauna, collected by D. Krasnopolska in 2017 (DAU 100002920) (Fig. 5). First time collected by A. Opmanis in 2015. Location has been checked later several times by D. Krasnopolska in 2017 and 2019.

Pilosella* × *stoloniflora (Waldst. et Kit.) F.W.Schultz et Sch.Bip. [=*Pilosella aurantiaca* × *Pilosella officinarum*]

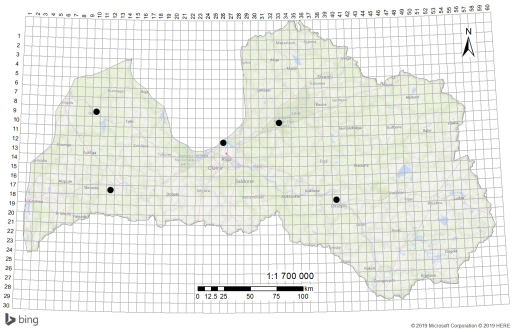

Fig.3. Distribution of *Pilosella aurantiaca*.

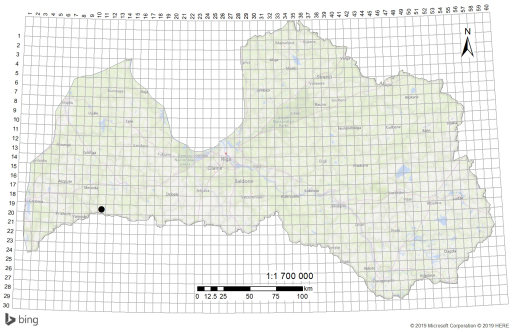

Fig.4. Distribution of *Pilosella* × *fuscoatra.*

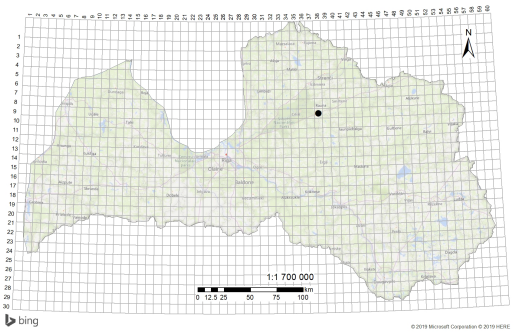

Fig.5. Distribution of *Pilosella* × *roxolanica.*

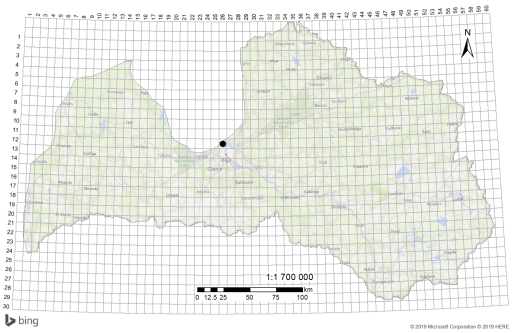

Fig.6. Distribution of *Pilosella* × *stoloniflora.*

Pilosella × *stoloniflora* (Waldst. et Kit.) F.W.Schultz et Sch.Bip. 1862, Flora, 45: 423; Шляков, 1989, Фл. евр. ч. СССР, 8: 372; Kukk et Gudžinskas, 2003, Fl. of the Bal. Coun. 3: 100.

Hieracium stoloniflorum Waldst. Et Kit. 1812, Pl. Rar. Hung. 3: 303, t. 273; P.D.Sell et C.West, 1976, Fl. Europ. 4: 375 pro hybr.

Distribution: new hybridogenous species to flora of Latvia. A single location of this species was found in Rīga, Mangaļsala, in 1979 by Lodziņa (LATV 52605) (Fig.6).

DISCUSSION

Hybrids that combine morphological features of three basic species according to Tikhomirov (2002) are present in Ukraine. As it is known, *P. aurantiaca* is very common native species in Ukraine and it actively hybridizes with other species of genus *Pilosella*. As a result, six hybridogenous taxa are known. At the same time, four species – one basic species and three hybridogenous taxa (hybrids): *Pilosella aurantiaca*, *Pilosella* × *fuscoatra*, *Pilosella* × *roxolanica* and *Pilosella* × *stoloniflora*, with orange-red flowerheads are known in Latvia, after morphological revision of herbaria materials. Only one locality is known for each hybrid, due to the fact that one of the parental species – *P. aurantiaca*, meets relatively rare Two of three hybrids in the flora of Latvia were reported for the first time.

Hybrids sometimes grow independently, without parental species presence and form stable populations. More often they grow together with parental species. That is the reason why it is very important to explore *P. aurantiaca* locations – its' hybrids may be more common than it is considered at the moment.

According to Loomis & Fishman (2009) *P. aurantiaca* now is considered as invasive in North America from Florida to Alaska, in New Zealand and Australia, where treat native communities. Because of cultivating the species as ornamental plant it has naturalized far beyond the natural distribution range. At once, Latvia species started to cultivate as ornamental plants in 20th century. Exact year of import of the species in Latvia is unknown. The first sample was collected in Ventspils district, Ugāle, quite recently, in 1987. At the same time, the hybrid – *P.* × *stoloniflora* was collected in 1979. Precise details on the origin of *P. aurantiaca* in Latvia are unknown. However, current distribution and literature data suggests that it might be introduced relatively recently, most likely in 60's or 70's of the 20th century.

Due to the active interspecific hybridization and the presence of a large number of hybrids, which is observed throughout Europe and beyond, it can be assumed that, as ornamental plant, not only *P. auranticaca*, but also its' hybrids, can be imported. Assessing the overall situation, it can be concluded that *P. aurantiaca* and their hybrids are a potential invasive species for Latvia in future.

At the moment, only a small number of locations, mainly near populated areas, in the territory of Latvia are known. Although in some places, for example, in Rauna, where only a hybrid – *P.* × *roxolanica* is found, species are clearly naturalized, form large populations and are completely dominant. In view of the foregoing, it is very important to monitor the spread of *P. aurantiaca* and its' hybrids.

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