

## *Tussilago farfara* (Asteraceae) in the South of the Far East of Russia

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**Abstract**—The paper provides information on the distribution of coltsfoot (*Tussilago farfara* L.) in the south of Primorsky krai (the Russian Far East). It is established that, in the study area, the species is massively found along the roadsides and inhabits anthropogenic landscapes (gardens, abandoned fields, wastelands in cities and towns), and a single case of introduction into the forest biocenosis on the territory of the Ussuri Nature Reserve is noted. According to the degree of naturalization, the species can be attributed to epiphytes, the self-renewal and naturalization of which is possible only among anthropogenic vegetation in disturbed and artificial habitats. It is necessary to continue monitoring of its distribution in the region to prevent the introduction into natural biocenoses.

**Keywords:** *Tussilago farfara*, distribution, the Far East, Primorsky krai, Ussuri Nature Reserve

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### INTRODUCTION

The problem of biological invasions of alien plant species is becoming increasingly urgent, since their introduction threatens regional biodiversity and leads to floristic contamination and changes in natural ecosystems (Richardson et al., 2000; Richardson and Pyšek, 2012; Dronin, 2017).

In the Russian Far East, the emergence and spread of alien plant species began in the 19th century and was due to its intense development, the arrangement of large cities, the development of agriculture, the greening of settlements, the construction of railways and highways, etc.

Currently, in the Primorsky krai, especially in its southern part, the process of resettlement of alien and potentially invasive plant species is under way, and this is due to a radical transformation of natural ecosystems as a result of anthropogenic impact and catastrophic fires (Antonova, 2009; Kozhevnikov and Kozhevnikova, 2011; Kolyada and Kolyada, 2017a, 2017b, 2018). Along with invasive plants in the region, cases of invasion of associated insects were noted (Kuprin et al., 2018; Kolyada and Kolyada, 2019).

This work is devoted to the study of settlement in Primorsky krai of coltsfoot (*Tussilago farfara*), widespread in temperate regions of Eurasia, North Africa, Western and Eastern Siberia, the Caucasus, Transcaucasia, Central Asia, Turkey, East China, Japan, the Korean Peninsula, and North America (*Sosudistye...*,

1992). In recent years, coltsfoot has been intensely spread in the south of Primorsky krai (*Flora...*, 2006; Kozhevnikov and Kozhevnikova, 2011).

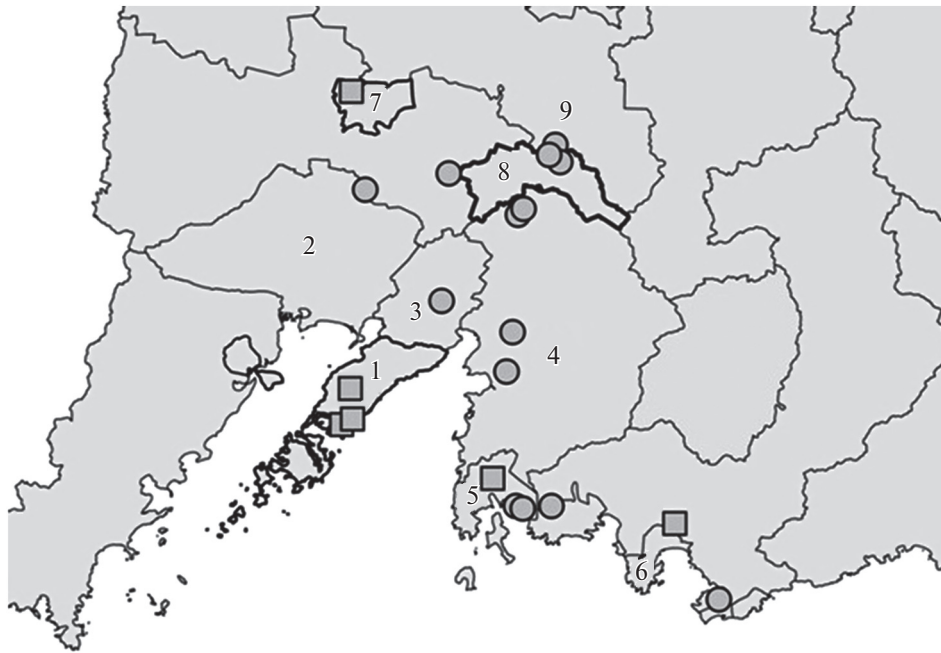
The purpose of the work is to study the distribution of coltsfoot in Primorsky krai and to identify the degree of its naturalization in the region.

### MATERIALS AND METHODS

Field studies were conducted in 2015–2018 by the traditional route reconnaissance method. Over 100 settlements in 11 administrative districts of Primorsky krai were examined. In addition, herbarium collections stored at the Federal Biodiversity Center of the Far Eastern Branch of the Russian Academy of Sciences, Vladivostok (VLA), were investigated. The material collection points were mapped by a GPS navigator (Garmin 60-CX), and a distribution map was constructed in ArcView GIS, version 3.2. The degree of naturalization of coltsfoot into natural and disturbed phytocenoses was evaluated according to the work of Vinogradova et al. (2014).

### RESULTS AND DISCUSSION

In Primorsky krai, coltsfoot was recorded in 13 settlements or their environs, as well as in the Ussuri Nature Reserve (now a branch of the Federal Biodiversity Center of the Far Eastern Branch of the Rus-



**Fig. 1.** Places of finds of *T. farfara* in Primorsky krai (squares denote the places of finds within the boundaries of settlements, and circles denote the finds outside of settlements). (1) Vladivostok, (2) Nadezhdinsky district, (3) Artyomovsky city district, (4) Shkotovsky district, (5) Fokino, (6) Nakhodka, (7) Ussuriysk, (8) Ussuriysky Reserve, (9) Mikhailovsky district.

sian Academy of Sciences) (Fig. 1); a brief description of some cenopopulations of this plant is given in Table 1.

For the first time, coltsfoot was cited by Vorobyova (1954) for the Okeanskaya station (Vladivostok), as one of the alien species “firmly rooted in the local flora.” In an article by Nechaeva (1984) devoted to the adventitious flora of Primorsky krai, this species was not indicated; apparently, it was omitted, since earlier there was information about its single finds at Okeanskaya station in 1962 (Vorobyov, 1982; Voroshilov, 1982). These data are confirmed by herbarium collections stored in the herbarium of the Federal Biodiversity Center of the Far Eastern Branch of the Russian Academy of Sciences (VLA). Thus, coenopopulations from the Okeanskaya station can be considered the initial population. At present, 19 places of growth of coltsfoot have been found in Primorsky krai. It spread most intensely in the urban environment (Vladivostok) and occupies open, well-lit habitats (wastelands, flower beds at bus stops, road embankments, etc.). Over a 50-year period, the species spread more than 100 km to the north (from the initial population) to Ussuriysk, more than 120 km to the northeast to the Mikhailovsky district, and more than 200 km to the east to Wrangel (Nakhodka urban district) (Fig. 1, Table 1).

In 2015, single specimens of *T. farfara* in the Ussuri Reserve were first noted in the upper course of the Artyomovka River (Suvorov Forestry) on scree. The scree was formed in 2013 as a result of the collapse of a part of a hill (300 × 120 m) covered with a native coniferous-

deciduous forest (Fedina, 2018). On the talus, individual damaged trees and shrubs are preserved: *Pinus koraiensis* Siebold et Zucc., *Abies holophylla* Maxim., *Sambucus racemosa* L., *Philadelphus tenuifolius* Rupr. et Maxim., *Acer barbinerve* Maxim., *A. mono* Maxim. A significant area is occupied by *Aralia elata* (Miq.) Seem., as well as by grassy species: *Oxalis acetosella* L., *Viola collina* Bess., *Chelidonium asiaticum* (Hara) Krachulkova; the plot is surrounded by indigenous coniferous-deciduous forest.

In 2016, the number of coltsfoot in this habitat ( $S = 3.6$  ha) amounted to several dozen flowering and fruiting specimens. In early May 2017, the entire scree was occupied by numerous (up to 50 specimens) scattered groups, and in 2018, they transformed into a continuous cover. The size of the cenopopulation amounted to more than 600 specimens.

Thus, in the period 2015–2018, *T. farfara* actively spread over the scree and occupied an area of about 0.1 ha. The distribution of the species under the canopy of the primary forest was not recorded, since the total density of the crowns of the forest stand was very high—0.8. Therefore, by the degree of naturalization, the species can be attributed to epiphytes (according to the classification of Vinogradova et al. (2014)).

## CONCLUSIONS

Thus, in Primorsky krai, *T. farfara* actively spreads in anthropogenic-disturbed territories (roadsides, abandoned fields and meadows, city parks and public

**Table 1.** Finds and characteristics of coenopopulations of *T. farfara* in Primorsky krai

No.	Town, district	Coordinates	Remark
1	Vladivostok	43°06' N, 131°59' E	Numerous groups are concentrated along the federal De Vries–Patrokl–Russky Ostrov highway on both sides of the highway, settled deep up to 15 m or more on rocky slopes
2	Same location, Snegovaya Pad' microdistrict	43°09' N, 131°59' E	On a vacant lot, single plants are noted along with <i>Ambrosia artemisiifolia</i> L. and <i>Acer negundo</i> L.
3	Same location, Patrokl microdistrict, Regional Perinatal Center	43°05' N, 131°57' E	Along the road to new buildings, opposite the center
4	Same location, Russky Ostrov	43°02' N, 131°53' E	Along the De Vries–Patrokl–Russky Ostrov highway, near the gas station
5	Same location, ul. Kalinina	43°06' N, 131°53' E	Along the Zolotoi Most–Russky Ostrov highway, at the bus stop
6	Same location, Gornostai Bay	43°06' N, 131°59' E	Along the De Vries–Patrokl–Russky Ostrov highway, noted together with <i>Ambrosia artemisiifolia</i> L.
7	Settlement of Artyomovsky, Artyomovsky city district	43°21' N, 132°06' E	Ditches of settlement roads and lawns
8	Settlement of Shkotovo, Shkotovsky district	43°19' N, 132°22' E	Along Nakhodka A-188 highway and village roads
9	Village of Romanovka, Shkotovsky district	43°13' N, 132°27' E	Along village roads
10	Village of Domashlino, Shkotovsky district	42°54' N, 132°29' E	Rocky mound near the road
11	Village of Smolyaninovo, Shkotovsky district	43°18' N, 132°26' E	Along Nakhodka A-188 highway
12	Village of Dushkino, Nakhodka urban district	42°55' N, 132°34' E	Embankment near Nakhodka A-188 highway
13	Nakhodka	42°50' N, 132°54' E	At shopping center
14	Fokino	42°50' N, 132°24' E	Along sand and clay quarries near beaches Pesochmitsa and Tikhookeanskaya Gavan'. A large population was noted at the edge of the oak forest at the gas station at the entrance to the city
15	Mikhailovsky district	43°44' N, 132°33' E	Along the ditches of the Shkotovo–Rettikhovka highway
16	Village of Caymanovka, Ussuriysky urban district	43°39' N, 132°14' E	On the side of the Ussuriysk–Kaymanovka bypass road
17	Ussuriysk	43°50' N, 131°56' E	Noted on Belyaev and Fadeev streets near private homes in a community with <i>Chelidonium asiaticum</i> (Hara) Krachulkova, <i>Melandrium album</i> (Mill.) Garcke <i>Linaria vulgaris</i> Mill., <i>Elytrigia repens</i> (L.) Nevski
18	Ussuri Nature Reserve, Suvorov Forestry, Shkotovsky District	43°41' N, 132° 03' E	On a rocky scree formed as a result of a rock collapse in 2013
19	Village of Wrangel, Nakhodka urban district	42°43' N, 133°05' E	VLA Herbarium

gardens, construction pits, etc.) and is noted in the Vladivostok, Artyomovsky, Nakhodka, and Ussuriysky urban districts; in the city of Fokino; and in the Shkotovsky, Nadezhdinsky, and Mikhailovsky districts of Primorsky krai. Self-renewal of the species occurs only among anthropogenic vegetation and in artificial habitats; there has been a case of self-renewal among natural vegetation in protected areas (Ussuri Nature Reserve); therefore, it is necessary to continue monitoring its distribution in the region to prevent large-scale introduction into natural biocenoses.

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#### CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

#### COMPLIANCE WITH ETHICAL STANDARDS

The article does not contain any studies involving animals in experiments performed by any of the authors.

#### REFERENCES

- Antonova, L.A., *Konspekt adventivnoi flory Khabarovskogo kraya* (A Summary of the Adventitious Flora of the Khabarovsk Territory), Vladivostok: Far East Branch, Russ. Acad. Sci., 2009.
- Dronin, G.V., Alien plant species in the Syzranka River basin, *Izv. Sarat. Univ., Nov. Ser., Chem., Biol., Ecol.*, 2017, vol. 17, no. 1, pp. 98–102.
- Fedina, L.A., The stranger *Tussilago farfara* (Asteraceae) in the Ussurian Nature Reserve (Primorsky Krai), *Bot. Zh.*, 2018, vol. 103, no. 7, pp. 919–922.
- Flora Rossiiskogo Dal'nego Vostoka: dopolneniya i izmeneniya k izdaniyu "Sosudistye rasteniya Sovetskogo Dal'nego Vostoka" (1985–1996)* (Flora of the Russian Far East: Additions and Modifications to the Edition "Vascular Plants of the Soviet Far East" (1985–1996)), Kozhevnikov, A.E. and Probatov, N.S., Eds., Vladivostok: Dal'nauka, 2006, vols. 1–8.
- Kolyada, N.A. and Kolyada, A.S., Occurrence of potentially invasive species box elder (*Acer negundo* L.) in the south of the Russian Far East, *Russ. J. Biol. Invasions*, 2017, vol. 8, pp. 41–44.
- Kolyada, N.A. and Kolyada, A.S., Occurrence of *Amorpha fruticosa* L. in the south of the Russian Far East, *Russ. J. Biol. Invasions*, 2018a, vol. 9, pp. 53–56.
- Kolyada, N.A. and Kolyada, A.S., *Robinia pseudoacacia* L. (Fabaceae Lindl.) in the south of the Russian Far East, *Russ. J. Biol. Invasions*, 2018b, vol. 9, pp. 215–218.
- Kolyada, N.A. and Kolyada, A.S., Findings of the invasive species *Acanthoscelides pallidipennis* (Motschulsky, 1874) on *Amorpha fruticosa* L. in Primorsky Krai, *Russ. J. Biol. Invasions*, 2019, vol. 10, pp. 157–159.
- Kozhevnikov, A.E. and Kozhevnikova, Z.V., Complex of adventitious plant species as a component of the natural flora of the Russian Far East: diversity and spatial changes in the taxonomic structure, *Komarovskie Chteniya*, 2011, no. 58, pp. 5–36.
- Kuprin, A.V., Kolyada, N.A., and Kasatkin, D.G., New invasive species *Acanthoscelides pallidipennis* (Motschulsky, 1874) (Coleoptera: Bruchidae) in the fauna of the Russian Far East, *Far East. Entomol.*, 2018, no. 360, pp. 25–28.
- Nechaeva, T.I., Adventitious flora of Primorsky Krai, *Komarovskie Chteniya*, 1984, no. 31, pp. 46–99.
- Richardson, D.M. and Pyšek, P., Naturalization of introduced plants: ecological drivers of biogeographical patterns, *New Phytol.*, 2012, vol. 196, pp. 383–396.
- Richardson, D.M., Pyšek, P., Rejmanek, M., Barbourm, M.G., Dane, P.F., and West, C.J., Naturalization and invasion of alien plants: concepts and definitions, *Divers. Distrib.*, 2000, no. 6, pp. 93–107.
- Sosudistye rasteniya Sovetskogo Dal'nego Vostoka* (Vascular Plants of the Soviet Far East), Kharkevich, S.S., Ed., St. Petersburg: Nauka, 1992, vol. 6.
- Vinogradova, Yu.K., Kuklina, A.G., and Tkacheva, E.V., *Invazionnye vidy semeistva Bobovykh. Lyupin, Galega, Robiniya, Amorfa, Karagana* (Invasive Species of the Legume families Lupin, Galega, Robin, Amorpha, and Karagan), Moscow: ABF, 2014.
- Vorob'ev, D.P., Inflow and weedy plants in Primorsky Krai, *Komarovskie Chteniya*, 1954, no. 4, pp. 3–22.
- Vorob'ev, D.P., *Opredelitel' sosudistykh rastenii okrestnosti Vladivostoka* (Determinant of Vascular Plants in the Vladivostok's Vicinity), Leningrad: Nauka, 1982.
- Voroshilov, V.N., *Opredelitel' rastenii Sovetskogo Dal'nego Vostoka* (Determinant of Plants in the Soviet Far East), Moscow: Nauka, 1982.

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