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Findings and New Locations of Alien Vascular Plant Species in the South of Primorsky Krai

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Abstract—New data on the distribution of alien species in the south of Primorsky krai are presented. For the first time, *Digitalis grandiflora* Mill. is indicated in the composition of an alien flora—a species that has escaped from culture, currently occupying a significant area in the arboretum of the Gornotaezhnaya station of the Far Eastern Branch of the Russian Academy of Sciences (Ussuriysk city district, Primorsky krai). This species is a new alien to the entire territory of the Far East. In an anthropogenically transformed territory, *Digitalis grandiflora* is an epecophyte according to the degree of naturalization. It was revealed that *Pilosella floribunda* (Wimm. et Grab.) Fr. is actively being introduced to the exposition areas of the arboretum of the Gornotaezhnaya station, forming extensive loci with a projective coverage of up to 70%. It has been established that a new alien species for the flora of the Ussurisky Reserve is *Carduus acanthoides* L., found at a considerable distance from previously found places of growth outside the protected area. The information on new habitats of other species of alien plants in the territory of Primorsky krai identified by us in the period from 2019 to 2023 is presented.

Keywords: alien flora, alien species, floral findings, Russian Far East, Primorsky krai

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INTRODUCTION

In recent years, alien plants, as a result of anthropogenic transformation of the environment and climate change, pose a significant threat to the conservation of biological diversity. The high competitive ability of many alien species leads to the suppression and displacement of native species from plant communities and disruption of the functioning of various ecosystems. Such alien species, characterized by aggressive spread in new territories, are invasive and cause damage to agricultural complexes and aggravate environmental disasters (McGeoch et al., 2010; Lemke et al., 2013). Study of the implementation alien species in the composition of regional floras is a relevant area of research of both domestic (Shishkin, 1936; Vorobyov, 1954; Vinogradova et al., 2010; Mikhailova et al., 2022) and foreign specialists (Richardson and Pyšek, 2012; Teofilovski and Ćušterevska, 2022; Pringle, 2023).

The active development of the Far Eastern regions is currently leading to a noticeable increase in the invasive activity of alien plants. Of all the subjects of the Far Eastern Federal District (FEFD), Primorsky krai is the leader in the number of alien and invasive plant species. This is facilitated by the significant development of agricultural lands, the predominant number of settlements, and many road, rail, and sea transport intersections. The flora adventization index of Primorsky krai is the highest in the Far Eastern Federal District and amounts to 24.7% (Kozhevnikov and Kozhevnikova, 2014; Kozhevnikova, 2021). Since the 1980s and to this day, in Primorsky krai, researchers have been searching for alien species and assessing their distribution and the consequences of invasion (Buch et al., 1981; Nechaeva, 1984; Kozhevnikova and Kozhevnikov, 2016; Fedina, 2017; Kolyada, 2020). In 2021, the *Black Book of the Flora of the Far East* was published (Vinogradova et al., 2021), which provides information on the distribution, habitats, and invasive status of 117 alien plant species in the Far Eastern Federal District.

The most complete list of adventive flora of the Primorsky krai is presented in the general summary *Illustrated Flora of the Primorsky Territory (Russian Far East)* (Kozhevnikov et al., 2019), according to which 648 alien plant species grow in Primorsky krai out of 768 species known for the Russian Far East.

The purpose of this study was to identify new places of growth of alien plant species and assess their invasive status in the south of Primorsky krai.

MATERIALS AND METHODS

Identification of alien species in the south of Primorsky krai (Vladivostok city district (VGO), Ussuriysk city district (UGO), Nadezhdinsky district, Shkotovsky district, Khasansky district) was carried out using route-descriptive and stationary methods in 2019–2023. Invasive status is given according to the scale given in the *Black Book of the Flora of the Far East*: 2—alien species that are actively spreading and naturalizing in disturbed, seminatural and natural habitats; 3—alien species currently spreading and naturalizing in disturbed habitats; in the course of further naturalization, some of them will apparently be able to penetrate into seminatural and natural communities (Vinogradova et al., 2021). The degree of naturalization of alien plants was assessed using the scoring system proposed in the work of Vinogradova et al. (2014). To determine the distribution of alien species, we used published sources, herbarium collections (VLA, VBGI), and electronic resources (iNaturalist..., 2023; Plantarium..., 2023).

To document the finds, herbarium material was collected. Herbarium specimens were transferred to the herbarium collections: Federal Scientific Center for Biodiversity of Terrestrial Biota of East Asia of the Far Eastern Branch of the Russian Academy of Sciences (FEB RAS) (VLA), Botanical Garden-Institute of the FEB RAS (VBGI).

The names of families, genera, and species are given in accordance with the International Index of Scientific Names of Plants (International Plant Names Index..., 2023).

RESULTS AND DISCUSSION

As a result of botanical research, one new alien species, previously not recorded not only in Primorsky krai but also throughout the Far East, was identified. New locations of alien plants known to the south of Primorsky krai have been established.

A New Alien Species for the Flora of the Russian Far East

Digitalis grandiflora Mill. (Scrophulariaceae)

A perennial, short-rhizomatous herbaceous plant up to 120–150 cm tall.

Natural range: Central Europe, Mediterranean, European part of Russia, Caucasus, Western Siberia.

Invasive status in Primorsky krai—2.

According to the degree of naturalization, it is an epecophyte; according to the vector of invasion, it is an ergasiophyte.

D. grandiflora as a medicinal plant containing cardiac glycosides was sown with seeds in a nursery arboretum of the Gornotaezhnaya Station of the FEB RAS (GTS FEB RAS) in the 1960s, then transplanted to the "Reproduction" section of the arboretum (intentional introduction). In the 1990s, seeds spread to neighboring areas.

Currently the population *D. grandiflora* has very significantly expanded the territory of its growth in the arboretum of the GTS and occupies more than 1.5 ha. The average coenopopulation density is 60 individuals of different ages per 1 m^2. Under the canopy of a natural forest (oak tree (*Quercus mongolica* Fisch. ex Ledeb.) with Dahurian birch (*Betula davurica* Pall.) mixed shrub), *D. grandiflora* penetrates up to 10 m. The perennial overwinters in a rosette state and begins active vegetation in the second ten days of April. The successful settlement of the alien species was facilitated by uprooting the forest, plowing the soil, and mowing around the introduced trees and shrubs.

Our collection: Primorsky krai, village of Gornotaezhnoe, arboretum of the GTS FEB RAS, mass flowering (43°41′37″ N, 132°8′59″ E). June 27, 2023. L.A. Fedina, S.K. Malysheva (VLA, VBGI).

As an alien species, *D. grandiflora* for the territory of the Far Eastern Federal District is given for the first time.

New Locations of Alien Species

Pilosella floribunda (Wimm. et Grab.) Fr. (Asteraceae)

A perennial herbaceous plant up to 100 cm high with a stolon-forming rhizome.

Natural range: Europe, Mediterranean, European part of Russia.

Invasive status in Primorsky krai—2.

It is rare in Primorsky krai; according to the degree of naturalization, it is an epecophyte; the vector of invasion is an unintentional introduction.

In Primorsky krai, it is known from several places of growth: Ussuriysk city district (UGO), vicinity of the village of Monakino; Spassky district, vicinity of the village of Khavalynk; Oktyabrsky district, village of Zarechnoye (Plantarium..., 2023).

In Ussuriysk GO, *P. floribunda* on the territory of the village of Gornotaezhnoe meets sporadically (singly or in small groups) along roads, in fallow lands and near garden plots. In the arboretum of the State Arboretum of the Far Eastern Branch of the Russian Academy of Sciences, it appeared in the exhibition areas in the early 2000s. For 20 years, active settlement of this adventive species has been observed, and currently it occupies several areas of the arboretum with a total area of 0.5 ha, where during the flowering period it is a background species with a projective cover of up to 70%. The density of individuals of the species averages 10 plants (24 generative shoots) per 1 m^2, on several loci with an area of up to 10–15 m^2 plant density is maximum and amounts to 25 specimens (45 generative shoots) per 1 m^2.

Our collection: Primorsky krai, Ussuriysk GO, village of Gornotaezhnoe, arboretum of the GTS FEB RAS (43°41′36″ N, 132°8′60″ E). June 1, 2022. L.A. Fedina, S.K. Malysheva (VBGI).

Turritis glabra L. (Brassicaceae)

Annual or biennial herbaceous plant up to 1 (1.3) m tall, taproot monocarpic.

Natural range: Europe, Asia Minor, North America, North Africa.

Invasive status in Primorsky krai—2.

In Primorsky krai, *T. glabra* is rare; according to the degree of naturalization, it is an epecophyte; the vector of invasion is an unintentional introduction.

The first collections of this plant in Primorsky krai date back to 1860; later, the species spread from the southern (Khasansky) to the northern (Terneysky, Kavalerovsky, Dalnegorsky) regions of the krai; it is found on the islands of Russky, Putyatin, and Furugelma (Vinogradova et al., 2021). In the city of Ussuriysk, the species is known from the collections of I.K. Shishkin from 1922: Ussuriysk, Suifunskaya hill, bush. June 23, 1922 (MHA); there were no other finds of this plant for this area. Currently in UGO, *T. glabra* grows along the side of the road and near the vegetable gardens in the village Gornotaezhnoe and in the arboretum of the Gornotaezhnaya Station of the Far Eastern Branch of the Russian Academy of Sciences.

We have collected the following: Primorsky krai, Ussuriysk GO, village of Gornotaezhnoe, arboretum of the GTS FEB RAS (43°41′25″ N, 132°9′17″ E. June 25, 2023. L.A. Fedina, S.K. Malysheva (VBGI).

Carduus acanthoides L. (Asteraceae)

Perennial herbaceous plant up to 70 cm tall, taproot monocarpic.

Natural range: Europe, the European part of Russia. Caucasus, Asia Minor, Western Siberia.

Invasive status in Primorsky krai—2–3.

It is very rare in Primorsky krai; according to the degree of naturalization, it is an epecophyte; the vector of invasion is unintentional introduction.

It was first found by D.P. Vorobyov in 1951 on pebbles and willows in the Shkotovsky district near the Kangauz station (Anisimovka station). In 2022, *C. acanthoides* was discovered in the Ussurisky Nature Reserve opposite the Anikina Pad cordon. This find is a new addition to the adventitious flora of this protected area (Bezdeleva and Fedina, 2006). In 2023, we noted it in the village of Kaymanovka (UGO) on the side of the road (43°38′1″ N, 132°14′13″ E); in the city of Ussuriysk near the bridge over the Komarovka River (43°46′48″ N, 131°57′38″ E); and in Vladivostok, Snegovaya Pad microdistrict, slopes and local area (43°9′59″ N, 131°57′28″ E).

Our collection: Primorsky krai, Shkotovsky district, Ussurisky Reserve, Anikina Pad cordon, side of a dirt road (43°40′3″ N, 132°30′12″ E). August 29, 2022. L.A. Fedina, (VLA, VBGI).

For Ussuriysk GO, *C. acanthoides* as an alien species has been listed for the first time.

Campanula rapunculoides L. (Campanulaceae)

Perennial herbaceous plant up to 70 cm tall, short-rhizome polycarpic.

Natural range: Scandinavia, Europe, European part of Russia, Caucasus, Western Siberia.

Invasive status in Primorsky krai—2–3.

It is very rare in Primorsky krai; according to the degree of naturalization, it is an epecophyte, and according to the vector of invasion, it is an ergasiophyte.

It was first noted in Primorsky krai in 1972 in the city of Vladivostok, on the territory of the academic campus. Since the 1990s *C. rapunculoides* has begun to actively spread throughout the Vladivostok GO; it is found in the Lazovsky Nature Reserve, Nakhodka, and Dalnegorsk (Vinogradova et al., 2021). On the territory of UGO in the village Gornotaezhnoe as an ornamental plant, it was sown in the 1990s; as a result of cultivation in house flower beds, it becomes a strong weed owing to abundant self-seeding. From private farmsteads, *C. rapunculoides* spread (self-dispersal) to the territory of the arboretum of the State Technical University of the Far Eastern Branch of the Russian Academy of Sciences. Currently, this alien species in the arboretum occupies an area of 2 × 2 m; the projective cover is 80%; the height of generative individuals is 60–70 cm; it blooms and bears fruit annually.

Our collection: Primorsky krai, Ussuriysk GO, village of Gornotaezhnoe, arboretum of the GTS FEB RAS (43°41′25″ N, 132°9′15″ E). July 7, 2023. L.A. Fedina, S.K. Malysheva (VBGI).

Hesperis matronalis L. (Brassicaceae)

Perennial herbaceous plant up to 1.2 m tall, taproot polycarpic.

Natural range: Eastern Europe, Southwest Asia, North Africa.

Invasive status in Primorsky krai—2.

It is very rare in Primorsky krai; according to the degree of naturalization, it is an epecophyte, and according to the vector of invasion, it is an ergasiophyte.

The first collections of *H. matronalis*, as a "fugitive" from culture, in Primorsky krai was dated 1974 (village of Anisimovka, Shkotovsky district). Most of the collections of this alien species were produced in the Vladivostok urban district, including in specially protected areas (SPNA): Vladivostok, SPNA BSI FEB

RAS, the lower part of the slope with western exposure, roadside June 18, 2015. S.V. Nesterova (VBGI).

We noted the species in UGO (2022–2023) along roads in villages of Dubovy Klyuch (43°39′44″ N, 132°7′53″ E), Kondratenovka (43°37′38″ N, 132°9′52″ E), and Gornotaezhnoe (43°41′46″ N, 132°8′33″ E). In the latter, it was also found on the side of the road at a distance of more than 1.5 km from the populated area. In the Khasansky district, this alien species was identified along roadsides in the villages of Barabash (43°11′10″ N, 131°29′43″ E), Slavyanka (43°9′59″ N, 131°57′28″ E), and Zanadvorovka (43°18′28″ N, 131°35′50″ E) and on the descent to the sea on the territory of the hotel complex Teploe More (43°51′18″ N, 131°25′14″ E, village of Slavyanka). In Nadezhdinsky district, it also occurs along roadsides in the villages of Razdolnoe (43°34′20″ N, 131°56′33″ E), Nezhino (43°27′22″ N, 131°46′15″ E), and Volno-Nadezhdinskoye (43°22′38″ N, 131°58′40″ E).

Our collection: Primorsky krai, Vladivostok, along the slopes along Basargina street (Patrokl district) flowering, single (43°4′28″ N, 131°56′49″ E). June 5, 2023. L.A. Fedina (VBGI).

Echium vulgare L. (Boraginaceae)

Annual or biennial herbaceous plant up to 1 m tall, taproot monocarpic.

Natural range: Europe, Mediterranean, Caucasus, Asia Minor.

Invasive status in Primorsky krai—2.

It is rare in Primorsky krai; according to the degree of naturalization, it is an epecophyte; the vector of invasion is unintentional introduction.

E. vulgare was first collected by I.K. Shishkin in 1920 in the vicinity of Nikolsk-Ussuriysk (now Ussuriysk, UGO). In the 1930s, I.K. Shishkin reported that "viper's bugloss is occasionally cultivated as a honey plant, but is easily included in wild groups." The author cited this view from the settlements of the modern UGO: Voroshilov (Ussuriysk), village of Novo-Nikolskoye (village of Novonikolsk), village of Rakovka, village of Popovka (Shishkin, 1936).

We noted that in 2022 *E. vulgare* was found sporadically along the side of the road in the village of Gornotaezhnoe (43°41′55″ N, 132°9′59″ E, UGO). In the Khasansky district, it grows in the village of Slavyanka near the children's institution on the street 50-let Oktyabrya (43°9′59″ N, 131°57′28″ E, a few specimens). It is also found in Vladivostok on the slopes along the street Kirova, 2 (43°10′6″ N, 131°54′42″ E) and street 50-let VLKSM (43°5′56″ N, 131°55′45″ E) in several places, quite abundantly.

Our collection: Primorsky krai, Ussuriysk (UGO), Raduzhny microdistrict, near the bus stop, numerous specimens, mass flowering (43°44′21″ N, 132°9′17″ E). July 12, 2023. L.A. Fedina (VBGI).

Phacelia tanacetifolia Benth. (Hydrophyllaceae)

Annual or biennial herbaceous plant up to 70 cm tall, taproot monocarpic.

Natural range: North America.

In Primorsky krai, it is found very rarely as a weed; in terms of the degree of naturalization, it is an ephemerophyte, and in terms of the vector of invasion, it is a xenoergasiophyte.

In Europe, in the European part of Russia, in the Caucasus, in Siberia, and in the Russian Far East, *Ph. tanacetifolia* is grown as a melliferous or ornamental plant. In places of cultivation, it often runs wild and spreads as a weed in disturbed habitats (Doronkin, 1997; Gubanov et al., 2004). On the territory of the Far Eastern Federal District, it is indicated as an alien species for Khabarovsk and Primorsky krais, as well as for Sakhalin Island (Kozhevnikov, 1991; Antonova, 2009; Lozhnikova et al., 2023). In the southern part of Primorsky krai (Nadezhdinsky district), isolated locations outside the culture have been noted (Kozhevnikova and Kozhevnikov, 2017). We found *Ph. tanacetifolia* in the village of Gornotaezhnoe (UGO), along the border of the nursery under the canopy of bird cherry thickets; single specimens were in the flowering phase (43°41′42″ N, 132°9′18″ E, June 27, 2023).

This species is listed for the first time as an alien plant for the Ussuriysk GO.

Tussilago farfara L. (Asteraceae)

A perennial herbaceous plant up to 20 cm tall, with a long branched rhizome.

Natural range: Western Europe, the European part of Russia, Western and Eastern Siberia, Kazakhstan, Asia Minor, North Africa.

Invasive status in Primorsky krai—2.

In Primorsky krai, it is often found, and according to the degree of naturalization, it is an epecophyte, and according to the vector of invasion, it is a xenoergasiophyte.

For the first time, *T. farfara* was discovered D.P. Vorobyov in 1950 in the vicinity of Vladivostok. Researchers began to record the active spread of this alien species throughout the region in the early 2000s, including in protected areas (Fedina, 2018; Fedina et al., 2019; Vinogradova et al., 2021).

We have discovered numerous specimens of the species in Vladivostok in the new Snegovaya Pad microdistrict (Admiral Gorshkov street (43°10′4″ N, 131°57′22″ E), Admiral Smirnov street (43°9′53″ N, 131°57′34″ E)), March 22, 2023. Cenopopulations of the species occupy slopes in the local area of new buildings, extend near the highway at the entrance to this area, and also extend under the canopy of the surrounding natural forest at a distance of up to 2 m. On Admiral Smirnov street, *T. farfara* grows on asphalt

pavement near a new building. A significant coenopopulation with an area of 50 m^2 was identified on Vyselkova street, 64 (43°9′3″ N, 131°57′20″ E) on the slopes around the building.

In the Nadezhdinsky district, the species was found in the village of Razdolnoe along Lazo street along roadside slopes (43°32′50″ N, 131°53′57″ E, April 22, 2023). It was also identified in the Ussuriysk GO (environs of the village of Kaymanovka) on the road to the Ussurisky Nature Reserve, along the edge of a ditch in the amount of 15 fruit-bearing plants (43°38′1″ N, 132°14′13″ E, May 24, 2023); Ussuriysk (UGO), Kartonnyi kombinat district, slope of an overgrown quarry, a few specimens, vegetation (43°46′34″ N, 132°3′9″ E, July 12, 2023).

By self-resettlement (escaping from culture), *T. farfara* appeared in the arboretum of the GTS FEB RAS. The first population is numerous; it numbers more than a hundred plants and occupies an area of 10 × 10 m on the slope of the southeastern exposure of the East Asian site (43°41′34″ N, 132°9′6″ E). The second population is less numerous; it was discovered at the Old Arboretum site (43°41′35″ N, 132°9′14″ E, northern slope, 5 × 8 m). The alien perennial for the first time was identified for this specially protected area.

Our collection: Primorsky krai, Ussuriysk GO, village of Gornotaezhnoe, arboretum of the GTS FEB RAS, mass flowering (43°41′34″ N, 132°9′6″ E). April 25, 2023. L.A. Fedina, S.K. Malysheva (VBGI).

CONCLUSIONS

As a result of floristic research, new data on the distribution of alien species in the south of Primorsky krai was obtained. It was determined that *Digitalis grandiflora* is a new adventive species for the flora of the Far East. *Digitalis grandiflora* has been growing in the arboretum of the Gornotaezhnaya station of the Far Eastern Branch of the Russian Academy of Sciences for more than 50 years, occupying a vast area and penetrating into the forests of natural origin that delimit the exhibition areas. Also, *Pilosella floribunda* is noted as an aggressive weed in introduction plantings. In 2023, for the first time, the alien species *Tussilago farfara* was discovered on the territory of the arboretum of the GTS FEB RAS. A new species of vascular plants for the adventitious flora of the Ussurisky Nature Reserve is *Carduus acanthoides*. Most of the alien species studied appeared in new localities as a result of accidental introduction. *Campanula rapunculoides*, *Digitalis grandiflora*, and *Hesperis matronalis* settled from cultivated plantings. The biotopic distribution of alien species is local and associated with populated areas and transport routes. According to the distribution strategy, species that have established themselves in a new territory and spread further (epecophytes) predominate. Invasion into forest communities is observed for *Digitalis grandiflora* and *Tussilago farfara*, but they have not yet caused significant damage to the species diversity of these communities. Findings of alien species in specially protected areas (arboretum of the GTS FEB RAS, Ussurisky Nature Reserve) require further monitoring.

The information provided about alien plants from new habitats is additional information to the data of the *Black Book of Flora of the Far East* (Vinogradova et al., 2021) and indicates the expansion of the ranges of alien species in Primorsky krai.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This work does not contain any studies involving human and animal subjects.

CONFLICT OF INTEREST

The authors of this work declare that they have no conflicts of interest.

REFERENCES

Antonova, L.A., *Konspekt adventivnoi flory Khabarovskogo kraya* (Synopsis of Adventive Flora of Khabarovsk Krai), Khabarovsk: Inst. Vod. Ekol. Problem Dal'nevost. Otd. Ross. Akad. Nauk, 2009.

Bezdeleva, T.A. and Fedina, L.A., Vascular plants, in *Flora, rastitel'nost' i mikobiota zapovednika "Ussuriiskii"* (Flora, Vegetation and Mycobiota of the Ussuriysky Nature Reserve), Vladivostok: Dal'nauka, 2006, pp. 79–134.

Buch, T.G., Kachura, N.N., Shvydkaya, V.D., and Andreeva, E.R., *Sornyye rasteniya Primorskogo kraya i mery bor'by s nimi* (Weeds of Primorye Territory and Measures to Combat Them), Vladivostok: Dal'nevostoch. Knizh. Izd., 1981.

Doron'kin, V.M., *Phacelia* Juss. Fatselia (Phacelia), in *Flora Sibiri* (Flora of Siberia), Novosibirsk: Nauka, 1997, vol. 11, pp. 98–99.

Fedina, L.A., Supplement to the flora of Ussuri Nature Reserve (Primorsky krai) since 2007 till 2016, *Komarovskie Chteniya*, 2017, vol. 65, pp. 55–59.

Fedina, L.A., *Tussilago farfara* (Asteraceae), an invasive species in the Ussuri Nature Reserve (Primorskii krai), *Bot. Zh.*, 2018, vol. 103, no. 7, pp. 919–922.

Fedina, L.A., Kuprin, A.V., and Ogorodnikov, E.M., *Tussilago farfara* (Asteraceae) in the South of the Far East of Russia, *Russ. J. Biol. Invasions*, 2020, vol. 11, no. 1, pp. 88–91.

Gubanov, I.A., Kiseleva, K.V., Novikov, V.S., and Tikhomirov, V.N., *Illyustrirovannyi opredelitel' rastenii Srednei Rossii* (Illustrated Identification Guide to Plants of Central Russia), vol. 3: *Pokrytosemennye (dvudol'nye: razdel'nolepestnye)* (Angiosperms (Dicots: Dioecytes)), Moscow: KMK, 2004.

iNaturalist. https://www.inaturalist.org/observations?place_id=any&taxon_id=950620. Accessed May 19, 2023.

International Plant Names Index (IPNI). https://www.ipni.org. Accessed May 20, 2023.

Kolyada, N.A., Black locust (*Robinia pseudoacacia* L., Fabaceae Lindl. in the secondary plant community in the Primorsky krai, *Astrakh. Vestn. Ekol. Obraz.*, 2020, no. 3 (57), pp. 190–196. https://doi.org/10.36698/2304-5957-2020-19-3-190-196

Kozhevnikov, A.E., Family Hydrophyllaceae, in *Sosudistye rasteniya sovetskogo Dal'nego Vostoka* (Vascular Plants of the Soviet Far East), Leningrad: Nauka, 1991, vol. 5, pp. 253–254.

Kozhevnikov, A.E. and Kozhevnikova, Z.V., Alien species of plants in flora of the Russian Far East and regional features of its geographical differentiation, *Vestn. Dal'nevost. Otd. Akad. Nauk SSSR*, 2014, no. 3 (175), pp. 12–19.

Kozhevnikov, A.E., Kozhevnikova, Z.V., Kwak, M., and Lee, B.Y., *Illustrated Flora of the Primorsky Territory (Russian Far East)*, Incheon: *Natl. Inst. Biol. Resour.*, 2019.

Kozhevnikova, Z.V. and Kozhevnikov, A.E., New records and rare alien species in the flora of Primorskii krai, *Komarovskie Chteniya*, 2016, vol. 64, pp. 208–218.

Kozhevnikova, Z.V. and Kozhevnikov, A.E., New and rare alien plant species for the flora of the Russian Far East, *Komarovskie Chteniya*, 2017, vol. 65, pp. 89–102.

Kozhevnikova, Z.V., New and rare alien species of vascular plants in Primorskii krai, *Turczaninowia*, 2021, vol. 24, no. 4, pp. 186–201. https://doi.org/10.14258/turczaninowia.24.4.17

Lemke, D., Schweizer, C.J., Tadesse, W., Wang, Y., and Brown, J.A., Geospatial assessment of invasive plants on reclaimed mines in Alabama, *Invasive Plant Sci. Manage.*, 2013, vol. 6, no. 3, pp. 401–410.

Lozhnikova, O.O., Sabirova, N.D., and Sabirov, R.N., New alien plant species in the flora of Sakhalin Island, *Bot. Zh.*, 2023, vol. 108, no. 4, pp. 383–387. https://doi.org/10.31857/S0006813623040063

McGeoch, M.A., Butchart, S.H.M., Spear, D., Marais, E., Kleynhans, E.J., Symes, A., Chanson, J., and Hoffmann, M., Global indicators of biodiversity impact and policy responses, *Diversity Distrib.*, 2010, vol. 16, no. 1, pp. 95–108.

Mikhailova, S.I., Ebel', T.V., Sheremetova, S.A., and Ebel', A.L., Weeds in agrocenoses and grain products of the Kemerovo oblast, *Vestn. Krasnoyarsk. Gos. Agrar. Univ.*, 2022, no. 6 (183), pp. 58–64. https://doi.org/10.36718/1819-4036-2022-6-58-64

Nechaeva, T.I., Adventive flora of Primorskii krai, *Komarovskie Chteniya*, 1984, vol. 31, pp. 46–88.

Plantarium. https://www.plantarium.ru. Accessed May 19, 2023.

Pringle, J.S., Records of some adventive or naturalized plant species in Ontario, *Great Lakes Bot.*, 2023, vol. 61, nos. 3–4, p. 97–104. https://doi.org/10.3998/glbot.4117

Richardson, D.M. and Pyšek, P., Naturalization of introduced plants: Ecological drivers of biogeographical patterns, *New Phytol.*, 2012, vol. 196, pp. 383–396.

Shishkin, I.K., *Sornye rasteniya yuzhnoi chasti Dal'nevostochnogo kraya* (Weed Plants of the Southern Part of the Far Eastern Territory), Khabarovsk: Dal'giz, 1936.

Teofilovski, A. and Ćušterevska, R., Two new alien species of Boraginaceae in the flora of North Macedonia, *Maced. J. Ecol. Environ.*, 2022, vol. 24, vol. 2, pp. 59–63.

Vinogradova, Yu.K., Maiorov, S.R., and Khorun, L.V., *Chernaya kniga flory Srednei Rossii: chuzherodnye vidy rastenii v ekosistemakh Srednei Rossii* (Black Book of the Flora of Central Russia: Alien Plant Species in the Ecosystems of Central Russia), Moscow: KMK, 2010.

Vinogradova, Yu.K., Kuklina, A.G., and Tkacheva, E.V., *Invazionnye vidy semeistva Bobovykh. Lyupin, Galega, Robiniya, Amorfa, Karagana* (Invasive Species of the Legume Family. Lupine, Galega, Robinia, Amorpha, Caragana), Moscow: ABF, 2014.

Vinogradova, Yu.K., Antonova, L.A., Darman, G.F., Devyatova, E.A., Kotenko, O.V., Kudryavtseva, E.P., Lesik (Aistova) E.V., Marchuk, E.A., Nikolin, E.G., Prokopenko, S.V., Rubtsova, T.A., Khoreva, M.G., Chernygina, O.A., Chubar', E.A., Sheiko, V.V., and Krestov, P.V., *Chernaya kniga flory Dal'nego Vostoka: invazionnye vidy rastenii v ekosistemakh Dal'nevostochnogo Federal'nogo Okruga* (Black Book of the Flora of the Far East: Invasive Plant Species in the Ecosystems of the Far Eastern Federal District), Moscow: KMK, 2021.

Vorob'ev, D.P., Alien and weed plants in Primorsky krai, *Komarovskie Chteniya*, 1954, vol. 4, pp. 3–19.