International Journal of
Plant Biology

MDPI

Article

Iris pumila L. and the State of Its Populations in the Samara Region (Southeast of the European Part of Russia)

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Abstract: The current state of the coenotic populations of *Iris pumila* L. (Iridaceae) were studied in the southeast of the European part of Russia (Samara Region). The phytocenotic confinement and population structure of the species were assessed. *I. pumila* preferred growing in steppe zonal communities. In total, 118 species of vascular plants were found in the communities, where *I. pumila* has been registered, and of which 34 (28.8%) were included into the Red List of the Samara Region and 8 species into the Red List of the Russian Federation. In the study area, populations of *I. pumila* were represented by a significant number of individuals and were in a stable state. According to the "delta-omega" criterion, the populations were mature (47.0%), transitional (23.5%), maturing (17.6%), and aging (11.9%), which testified to the diversity of population structure and thus to a satisfactory state of the species in the Samara Region. The populations recovered mainly due to individuals of vegetative origin, but this process was rather slow. Under unfavorable conditions, *I. pumila* populations were characterized by a vegetative settled way of life. Fires, grazing, and destruction of habitats had a significant impact on the population structure and absolute abundance in the Samara Region.

Keywords: *Iris pumila* L.; rare species; plant communities; population; Samara Region

Citation: Mitroshenkova, A.; Ilyina, V.; Senator, S.; Zibzeev, E.; Kozlovskaya, O. *Iris pumila* L. and the State of Its Populations in the Samara Region (Southeast of the European Part of Russia). *Int. J. Plant Biol.* **2023**, *14*, 593–611. https://doi.org/10.3390/ijpb14030046

Academic Editor: Adriano Sofo

Received: 17 May 2023
Revised: 29 June 2023
Accepted: 30 June 2023
Published: 5 July 2023

1. Introduction

The conservation of biological diversity on a planetary scale is impossible without identifying and further considering the ecological, biological, and population features of specific representatives of the biota as well as taking into account the ecological and coenotic conditions of their habitats. The comparison of the features of the development of certain individuals and their populations throughout the range seems interesting and reasonable; however, it is impossible without initial and very important stage of such work, which is the study of the species and its phytocenotic environment at specific loci. The accumulation of data on various aspects of the biology and ecology of species makes it possible to compare and to analyze various characteristics in the future, in particular, to identify features and patterns of development at the organismal, species, population, and coenotic levels. Generally, studying the features of biology and ecology of rare species (including plants) makes it possible to assess their state in various environmental conditions, including under anthropogenic load, and thus to conclude on their protection status. *Iris pumila* L., which has a rather extensive range, due to its reducing number in many regions, may be named as one of such species. The data obtained in our study are important for revealing the mechanisms of adaptation of the species to changing environmental conditions.

I. pumila L. is a short-rhizome herbaceous polycarpous hemiephemeroid growing in the south of Central Europe, the Balkan Peninsula, in Moldova, Ukraine, Crimea, the

Caucasus and Transcaucasia, north-west Kazakhstan, and Asia Minor [1–4] (Figure A1). In Russia, it may be found in almost all black earth regions and reaches of the Southern Urals, where it is replaced by a closely related species *I. glaucescens* Bunge, in the lower reaches of the Volga and Eastern Ciscaucasia, by *I. scariosa* Willd. ex-Link. [2]. However, despite the wide distribution, populations of *I. pumila* isolated from each other due to intensive plowing of the steppe and forest-steppe zones [4]. It is believed that steppe plants may not be adapted to habitat fragmentation since the steppe originally covered vast continuous areas [5]. In this regard, population studies of steppe plants are of significant interest, which make it possible to assess their current state [6–8].

Phytocenotically, *I. pumila* is associated primarily with forb-bunch-grass, sod-grass and sagebrush-bunch-grass steppes and, to a lesser extent, with their halophytic and petrophytic varieties. Currently, it is reported that the species has a fairly wide resistance to the effects of such factors as soil moisture and acidity, its salt regime, soil carbonate content, humidity, frost, and average annual precipitation [9,10]. The factors limiting the distribution of the species are habitat disturbances, such as road construction, trampling, lack of grazing, and competition, with invasive alien species [11] as well as the illumination, air regime of the soil, and its nitrogen content [9].

I. pumila is included into European Red List of Vascular Plants as Data Deficient [11]; in the Red List of the Russian Federation [12], it has the status 3b (rare), as well as in the regional Red Lists of the subjects, where it grows, including the Red List of the Samara Region with status 5, a recovering species [13].

The species was studied for a long time by a number of researchers [4,14–22]. In particular, the species morphology was described in detail [18,23–28] along with its seed productivity [29] and phytocenotic confinement [30]. *I. pumila* is a diagnostic species for a number of steppe vegetation associations [31–33]. Information about the structure of *I. pumila* populations is still scarce [23,34,35].

The study aims to describe the population of *I. pumila* and the phytocenotic conditions of the species habitat in the central part of the range (Samara Region, Russia). The originality of the topic is associated with the replenishment of data on the species using various research methods (population ecology, geobotanical description, and floristics). The research novelty covers the comprehensive approach in studying the species populations and its phytocenotic confinement in the Middle Volga Region, where such work has not been performed earlier.

The study contributes to the issues of population biology and ecology, including the assessment of the direction, duration, intensity, and causes of successional changes in the communities with the species participation, and the identification of a variety of living conditions and responses of *I. pumila* at the population level to anthropogenic impact.

2. Materials and Methods

Samara Region is located in the southeast of the European part of Russia in the middle reaches of the Volga River (51.394780–54.678116° N; 47.927147–52.566598° E). Botanically and geographically, the territory is located on the border of the European broad-leaved forest and Eurasian steppe regions. The climate is temperate continental with an average monthly temperature of −13.8 °C in January and 20.7 °C in July. The average annual temperature is 3.8 °C, and the average annual precipitation is 372 mm [36].

The study of steppe plant communities, where *I. pumila* has been registered, was carried out in the Samara Region in 2017–2020 (Figure A2). The processing and interpretation of the obtained geobotanical descriptions was performed from the standpoint of the dominant approach [37–39]. All geobotanical descriptions were carried out within the natural contours of plant communities; the projective cover was estimated according to the Drude abundance scale.

Latin plant names are assigned in accordance to the 'Plants of the World Online' database (POWO, URL: http://www.plantsoftheworldonline.org/ (accessed on 15 May 2023)). Soil types are given according to the Classification and Diagnostics of Soils of the

USSR [40]. Plants were identified using taxonomic keys [1,41,42]. Coordinates of the loci, where geobotanical descriptions were performed, were determined with the Gauss–Krüger system using a GPS device.

Ontogenetic and spatial structure of coenotic populations was assessed according to accepted methods of population ecology [43–50]. When describing the population structure, main ontogenetic stages of the analyzed individuals were taken into account. Based on the data obtained on the quantitative ratio of individuals of different ages in populations, ontogenetic (age) spectra were constructed. For a detailed description of the ontogenetic structure of populations, the main demographic indicators were used: the replenishment index (I_{Rep}), the recovery index (I_{Rec}), and the aging index (I_{Age}). The state of the populations was assessed using the 'delta-omega' criterion [51].

3. Results and Discussion

1. Phytocenotic features of *Iris pumila* habitats

I. pumila is a rather drought-resistant species and phytocenotically most closely related to the subzonal types of true (forbs-bunch-grass), arid (bunch-grass), and desert-like (sagebrush-bunch-grass) steppes. Due to current mass plowing of zonal steppes, *I. pumila* is more common in their edaphic (petrophytic, psammophytic, and halophytic) habitats and in non-zonal communities of steppe ravines and river valleys. In the ravines and on the slopes of the valleys, the populations of *I. pumila* are confined to more or less gently sloping watersheds, upper and middle parts of the steppe slopes, as well as to the edges of low-growing shrubs.

In total, eight steppe communities with *I. pumila* L. are described in the Samara Oblast: *Stipa pulcherrima* + herbae stepposae [+ *Iris pumila*]; *Festuca valesiaca* + herbae stepposae [+ *Iris pumila*]; *Stipa capillata* + herbae stepposae [+ *Iris pumila*]; *Festuca valesiaca* + *Artemisia marschalliana* [+ *Iris pumila*]; *Festuca valesiaca* + *Stipa pennata* [+ *Iris pumila*]; *Galatella villosa* + *Festuca valesiaca* [+ *Iris pumila*]; *Helictotrichon desertorum* + herbae stepposae [+ *Iris pumila*], and *Agropyron desertorum* + *Iris pumila* + *Gypsophila altissima*. Their ecological and phytocenotic features are given below.

Community *Stipa pulcherrima* + herbae stepposae [+ *Iris pumila*] (loci nos. 1 and 9; Table A1, Figure A3). The descriptions were performed on 7 June 2017 at the right bank of the Kozak River, on the top of a hill located 1.7 km southwards off the village Sok and 5.6 km southwestwards off the village Sergievsk, PA, "Mountains on the Kazachka River" and on 26 July 2017 on the left bank of the Elkha River on the hill slope, 4 km westwards off the village Chekalino, valley-drainage geosystem of the Sok River (Sergievsky District). Total projective cover (hereinafter, TPC) varied from 70 to 90%. The number of species per locus was 47. The aspect was variegated pale green. The grassing was weak. The soil was dry, loose, chernozem type, with medium and coarse gravel. The herbage was composed of three sub-tiers. Loci nos. 25–28 were characterized by similar parameters (Table A2).

In the sub-tier I (1-2 m), along with sparse tall grass (*Asparagus officinalis* L., *Centaurea diffusa* Lam., *C. scabiosa* L., *Echinops ritro* subsp. *meyeri* (DC.) Kouharov, *Rhaponticoides ruthenica* (Lam.) M.V. Agab. and Greuter, and *Verbascum chaixii* subsp. *orientale* Hayek), there were single shrubs: *Chamaecytisus ruthenicus* (Fisch. ex Wol.) Klásk., *Krascheninnikovia ceratoides* (L.) Gueldenst., *Prunus fruticosa* Pall., *P. tenella* Batsch, and *Rosa majalis* Herrm.

Sub-tier II (35—70 cm) was formed by the main edificator of the community, *Stipa pulcherrima* K.Koch (cop_3). The other grasses were characterized by minor abundance and did not even act as a co-edificator (*Stipa korshinskyi* Roshev., *S. pennata* L., *Festuca valesiaca* Schleich. ex Gaudin (sp.), and *Rostraria cristata* (L.) Tzvelev (sp.)). Motley grasses were represented by *Medicago falcata* subsp. *romanica* (Prodán) Hayek, *Hedysarum grandiflorum* Pall. (sp.-sol.), and *H. razoumowianum* Helm and Fisch. ex DC. (sp.-sol.), and forbs by *Centaurea scabiosa*, *Filipendula vulgaris* Moench, *Galium ruthenicum* Willd., *Genista tinctoria* L., *Gypsophila altissima* L. (sp.-sol.), *Jurinea ewersmannii* Bunge, *Salvia stepposa* Des.-Shost. and *Verbascum chaixii* subsp. *orientale*.

In sub-tier III (up to 30 cm), species characterized by high occurrence and abundance were *Iris pumila*, *Euphorbia seguieriana* Neck., *Onosma simplicissima* L. and *Potentilla incana* P.Gaertn., B.Mey. and Scherb. Species of short grasses that were found scarcely: *Anemone sylvestris* L., *Campanula sibirica* L., *Eremogone procera* (Spreng.) Rchb., *Linum flavum* L., *Psephellus sumensis* (Kalen.) Greuter, *Scorzonera austriaca* Willd. and *Vincetoxicum hirundinaria* subsp. *stepposum* (Pobed.) Markgr. Species found only once were *Adonis volgensis* Steven ex DC., *Allium rotundum* L., *A. strictum* Schrad., *Alyssum gymnopodum* P.A. Smirn., *A. lenense* Adams, *Aster alpinus* L., *Astragalus onobrychis* L., *A. tenuifolius* L., *A. testiculatus* Pall., *Fritillaria ruthenica*, *Galatella angustissima* (Tausch) Novopokr., *G. villosa* (L.) Rchb.f., *Globularia bisnagarica* L., *Jurinea ledebourii* Bunge, *Lomelosia isetensis* (L.) Soják, *Nepeta ucranica* L., *Nonea pulla* (L.) DC., *Onobrychis arenaria* (Kit.) DC., *Oxytropis pilosa* (L.) DC., *Pedicularis kaufmannii* Pinzger, *Pentanema hirtum* (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico and M.M.Mart.Ort., *P. salicinum* (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico and M.M.Mart.Ort., *Polygala comosa* Schkuhr, *Scorzonera hispanica* L., *Serratula coronata* L., *Tanacetum kittaryanum* subsp. *sclerophyllum* (Krasch.) Tzvelev, *Taraxacum serotinum* (Waldst. and Kit.) Poir., *Thalictrum simplex* L., *Thymus marschallianus* Willd., *Trinia multicaulis* (Poir.) Schischk. and *Viola ambigua* Waldst. and Kit.

Community *Festuca valesiaca* + Herbae stepposae [+ *Iris pumila*] (loci nos. 2 and 18; Table A1, Figure A4). The descriptions were made on 7 June 2017 and 15 June 2019, 1 km northeastwards off Sernovodsk town, on the top of the Sernovodsk Upland, the valley-drainage geosystem of the Surgut River (Sergievsky district). Locus size 20–25 m^2. TPC 90%. The average number of species in the descriptions was 19. The aspect variegated green. Average grassing. The soil was dry, crumbly, chernozem type, dusty, fine to coarsely gravel. Loci nos. 21, 23, 29, 34 were characterized by similar parameters (Table A2).

The herbage was composed of three sub-tiers. Sub-tier I (100–120 cm) was presented by sparse shrubs *Caragana frutex* (L.) K.Koch (sp.-sol.) and *Chamaecytisus ruthenicus* (once).

Sub-tier II (35–70 cm) was formed by *Festuca valesiaca* (cop_3), the main edificator of the community. *Astragalus danicus* Retz., *A. onobrychis*, *Bromus inermis* Leyss., *Cichorium intybus* L., *Galium verum* L., *Gypsophila altissima*, and *Medicago falcata* subsp. *romanica* were characterized by high occurrence but low abundance.

I. pumila dominated in the III sub-tier (up to 30 cm). Low-grass species such as *Achillea setacea* Waldst. and Kit., *Allium rotundum*, *Erysimum cuspidatum* (M.Bieb.) DC., *Lappula squarrosa* (Retz.) Dumort., *Nonea pulla*, Scorzonera austriaca, and *Veronica prostrata* L.; Allium strictum, *Galatella villosa*, and *Euphorbia seguieriana* were found only once each.

Community *Stipa capillata* + Herbae stepposae [+ *Iris pumila*] (loci nos. 3 and 19; Table A1, Figure A5). Descriptions made on 7 June 2017 and 15 June 2019, on the top of the slope of the western exposure of the hill, 3 km southeastwards off Sernovodsk and 3.5 km eastwards off the village Sukhodol, PA "Sernovodsky Shikhan" (Sergievsky District). Locus size 20–25 m^2. TPC 90%. The average number of species in the descriptions was 24. The aspect variegated pale green. The grassing was weak. The soil was dry, loose, chernozem type, with medium and coarse gravel. Loci nos. 22, 24, 33, 35 were characterized by similar parameters (Table A2).

The herbage was composed of three sub-tiers. In sub-tier I (100–120 cm), single *Chamaecytisus ruthenicus* shrubs were noted along with sparse tall grasses (*Asparagus officinalis*, *Echinops ritro* subsp. *meyeri*, and *Seseli libanotis* (L.) W.D.J.Koch).

Sub-tier II (35–70 cm) was formed by *Stipa capillata* L. (soc.), the main edificator of the community. Cereals were presented by *Festuca valesiaca* and *Bromus inermis*, legumes, by *Medicago falcata* subsp. *romanica*, forbs, by *Artemisia marshalliana* Spreng., *Filipendula vulgaris*, *Galium verum*, *Gypsophila altissima*, and *Origanum vulgare* L. *Allium strictum* dominated in sub-tier III (up to 30 cm), and *I. pumila* was also presented with high occurrence and abundance, as well as *Onosma simplicissima* and *Thymus marschallianus* (sp.). Lower abundance was inherent to *Achillea setacea*, *Allium rotundum*, *Euphorbia seguieriana*, *Galatella villosa*, *Nonea pulla*, *Potentilla incana*, *Scorzonera austriaca*, and *Veronica prostrata*.

Community *Festuca valesiaca* + *Artemisia marschalliana* [+ *Iris pumila*] (loci nos. 4 and 5; Table A1). Descriptions were performed on 30 April–2 May 2017, 7 km northwestwards off

the village Polyakov, on the margin of the right slopes of the PA "Balka Kladovaya", the valley-drainage geosystem of the Talovka River (Bolshechernigovsky District). Locus sizes 25 m^2. TPC 80–90%. The average number of species was 14. The aspect brown-greenish. The grassing is average. The soil was dry, crumbly, chernozem type, dusty, fine to coarse gravel. Loci nos. 30–32 were characterized by similar parameters (Table A2).

The herbage was composed of two sub-tiers. Sub-tier I (35–70 cm) was formed by *Festuca valesiaca* (cop_3) and *Artemisia marshalliana. Agropyron desertorum* (Fisch. ex Link) Schult., *Bromus inermis*, *Euphorbia semivillosa* (Prokh.) Krylov, *Jacobaea erucifolia* (L.) G.Gaertn., B.Mey. and Scherb. and *Knautia arvensis* (L.) Coult. were characterized by high occurrence and low abundance.

Sub-tier II (up to 30 cm) was sparse, represented by *I. pumila* and *Adonis volgensis*, *Artemisia austriaca* Jacq., *Eremogone procera*, *Ferula tatarica* Fisch. ex Spreng., *Galatella villosa*, *Ornithogalum fischerianum* Krasch., *Phlomis herba-venti* subsp. *pungens* (Willd.) Maire ex DeFilipps, *Tulipa biebersteiniana* Schult. and Schult.f.

Community *Festuca valesiaca* + *Stipa pennata* [+ *Iris pumila*] (loci nos. 6–8, 10, 11, Table A1, Figure A6). Descriptions were performed on 30 April–2 May 2017, 7 km north-westwards off the village Polyakov, on the margin of the right slopes of the PA "Balka Kladovaya", the valley-drainage geosystem of the Talovka River and 5 km south-westwards off the village Polyakov "Urochishche Bastandyk" (Bolshechernigovsky District); on 26 July 2017, on the left bank of the Elkha River on the slope of a hill, 4 km westwards off the village Chekalino, valley-drainage geosystem of the Sok River; and on 11 June 2018, on the southern slope of the Soksky Yars in the vicinity of the village Krasnoselskoe (Sergievsky District). Locus sizes were 30–70 m^2. TPC from 70 to 90%. The average number of species was 19. The aspect variegated green. The grassing was weak. The soil was dry, loose, chernozem type, coarse gravel with traces of fallen, almost no rags. The vertical structure of communities was two-tiered.

The shrub tier, 100–120 cm, TCP 10–15%, formed by *Bassia prostrata* (L.) Beck, *Cotoneaster laxiflorus* J.Jacq. ex Lindl., *Prunus fruticosa*, *P. tenella*(sp.), and *Spiraea crenata* L.

The herbage was represented by two or three sub-tiers. Sub-tier I (100–120 cm) was sparse, formed by *Rhaponticoides ruthenica* (sp.-sol.) and *Verbascum chaixii* subsp. *orientale.*

Sub-tier II (35–70 cm) was formed by *Festuca valesiaca* (cop_3) and *Stipa pennata* (cop_2). *Artemisia marschalliana* (sp.-sol.), *Ferula tatarica*, and *Jacobaea erucifolia* were characterized by high occurrence; less common were *Echinops ritro* subsp. *meyeri*, *Galatella angustissima*, *Galium ruthenicum*, *Phlomoides tuberosa* (L.) Moench, *Tanacetum corymbosum* (L.) Sch.Bip. and *Seseli tortuosum* L.

Sub-tier III (up to 30 cm) was formed by *Adonis volgensis*, *Allium strictum*, *Artemisia austriaca*, *Astragalus wolgensis* Bunge, *Ephedra distachya* L., *Gagea minima* (L.) Ker Gawl., *Galatella villosa*, *Rindera tetraspis* Pall., *Tulipa biebersteiniana*, and *T. suaveolens* Roth. Less often, by *Achillea nobilis* L., *Anemone sylvestris*, *Aster amellus* L., *Euphorbia seguieriana*, *Galium verum*, *Globularia bisnagarica*, *Hedysarum razoumowianum*, *Hypericum perforatum* L., *Onosma simplicissima*, *Oxytropis pilosa*, *Pentanema hirtum*, *P. salicinum*, *Pimpinella tragium* Vill., *Psephellus sumensis*, *Lomelosia isetensis*, *Thymus marschallianus*, *Valeriana tuberosa* L. and *Viola ambigua*. *I. pumila* formed small clumps, and its projective cover in pinnate-feather grass-fescue communities ranged from 10 to 15%.

Community *Galatella villosa* + *Festuca valesiaca* [+ *Iris pumila*] (loci nos. 12–14, Table A1, Figure A7). The descriptions were made on 25 July 2018 on the right bank of the Sukharka River on the slopes of a hill, 2 km northwards off the village Sukhar Matak, 4.3 km eastwards off the village Novoe Yakushkino, PA "Isaklinskaya Upland Forest-Steppe" (Isaklinsky District). Locus size 30–70 m^2. TPC 70–90%. The average number of species was 19. The aspect variegated green. The grassing was weak. The soil was dry, loose, chernozem type, with coarse gravel, almost no rags. Loci nos. 36 and 37 were characterized by similar parameters (Table A2).

The vertical structure is single-tier. The herbaceous tier was represented by three sub-tiers.

Sub-tier I (100–120 cm) was sparse, represented by *Artemisia salsoloides* Willd., *Asparagus officinalis*, *Cephalaria uralensis* (Murray) Schrad. and *Rhaponticoides ruthenica*. In addition to herbaceous species, *Bassia prostrata* and *Prunus tenella* shrubs take part in the formation of this sub-tier.

Sub-tier II (35–70 cm) was formed by the co-edificator, *Festuca valesiaca*. *Agropyron desertorum*, *Artemisia marschalliana*, *Goniolimon elatum* (Fisch. ex Spreng.) Boiss., *Rostraria cristata*, and *Lomelosia isetensis* were noted with high occurrence in addition to fescue.

Sub-tier III (up to 30 cm) was formed by *Galatella villosa*. *Allium strictum*, *Alyssum gymnopodum*, *A. lenense*, *Ephedra distachya*, *Eremogone procera*, *Euphorbia seguieriana*, *Hedysarum grandiflorum*, *Nepeta ucranica*, *Oxytropis floribunda* (Pall.) DC., *O. spicata* (Pall.) O.Fedtsch. and B.Fedtsch., *Potentilla incana*, *Psephellus sumensis*, *Reseda lutea* L., *Salvia stepposa*, *Tanacetum kittaryanum* subsp. *sclerophyllum*, *Thymus marschallianus*, and *Veronica incana* L. were also present with high occurrence but low abundance. *I. pumila* had high occurrence, and its projective cover varied from 10 to 20%.

Community *Helictotrichon desertorum* + Herbae stepposae [+ *Iris pumila*] (loci nos. 15–17, Table A1). Descriptions were made from 21 May–16 August 2019 at the top of the southeastern slope of the hill, 1.5 km southeastwards off the village Tukshum, the Pustynovka natural landmark, PA "Mountain Lysaya" and in the vicinity of the village of Zelenogorsky (Elkhovsky District). Locus size 20 m^2. TPC 90%. The number of species was 21. The aspect variegated pale green. The grassing was weak. The soil was dry, loose, calcareous gray chernozem, with medium to coarse gravel. The vertical structure was single-tiered. The herbage was represented by three sub-tiers.

Community *Agropyron desertorum* + *Iris pumila* + *Gypsophila altissima* (locus no. 20, Table A1). The description was made on 11 May 2020. The upper part of the slope in the Sokol'iy Gory massif, the Kozeyrog natural landmark, PA "Sokol'i Gory and the Volga River bank between the Studyony and Koptev ravines (Samara city)". Locus size 25 m^2. TPC 90%. The number of species was 28. The aspect variegated bright green. The grassing was average. The soil was dry, loose, calcareous chernozem of a gray-whitish hue, with medium to coarse gravel. The vertical structure of communities was two-tiered.

Shrub tier, 100–120 cm, with up to 20% projective cover represented by *Chamaecytisus ruthenicus*, *Prunus fruticosa*, *P. tenella*, and *Spiraea crenata.*

The herbaceous tier occupied up to 80% of the coenosis area and was represented by two sub-tiers. Sub-tier I, 35–70 cm, formed by *Agropyron desertorum*, the edificator of the community. *Agropyron desertorum*, *Artemisia marshalliana*, *Gypsophila altissima*, *Jurinea ewersmannii*, *Rostraria cristata*, and *Jacobaea erucifolia* had high occurrence, but low abundance.

In the second sub-tier (20–30 cm), *I. pumila* dominated, and its projective cover reached 55% of TCP. *Astragalus zingeri* Korsh. and *Psephellus sumensis* also had high abundance. Other registered species had a relatively low abundance (*Adonis volgensis*, *Ephedra distachya*, *Euphorbia seguieriana*, *Fritillaria ruthenica* Wikstr., *Gagea minima*, *Hieracium virosum* Pall., *Scorzonera austriaca*, *Silene baschkirorum* Janisch., *Thalictrum simplex*, *Thesium ramosum* Hayne, *Thymus marshallianus*, *Tulipa biebersteiniana*, *Valeriana tuberosa*, and *Viola ambigua*).

In total, 118 species of vascular plants are found in the communities, where *I. pumila* is registered, and of which 34 (28.8%) are rare and are included in the Red List of the Samara Region [13]: *Adonis volgensis*, *Alyssum lenense*, *Astragalus macropus*, *A. tenuifolius*, *A. volgensis*, *Aster alpinus*, *Cephalaria uralensis*, *Ephedra distachya*, *Eremogone procera*, *Ferula tatarica*, *Galatella angustissima*, *Goniolimon elatum*, *Jurinea ewersmannii*, *J. ledebourii*, *Linum flavum*, *Nepeta ucranica*, *Ornithogalum fischerianum*, *Oxytropis floribunda*, *Rindera tetraspis*, *Lomelosia isetensis*, *Silene baschkirorum*, *Stipa korshinskyi*, *Tanacetum sclerophyllum*, *Tulipa biebersteiniana*, *T. suaveolens*, and *Valeriana tuberosa*; *Artemisia salsoloides*, *Astragalus zingeri*, *Fritillaria ruthenica*, *Globularia bisnagarica*, *Hedysarum grandiflorum*, *H. razoumowianum*, *Stipa pennata*, and *S. pulcherrima*, which are also included into the Red List of Russian Federation [12].

Data obtained during our studies when analyzing the phytocenoses, where *I. pumila* is presented, allow to characterize this species as stenobiont in relation to climatic conditions

and as hemistenobiont in relation to soil and phytocenotic conditions, which generally corresponds to previous results presented in the monograph by L.A. Zhukova et al. [51]. Climate is a limiting environmental factor for the development and conservation of *I. pumila* populations; this suggestion is also consistent with the data by A.V. Kryukova and L.M. Abramova [29], who have revealed the dependence of various parameters of *I. pumila* specimens on weather conditions.

As a rule, *I. pumila* does not reach high abundance in communities, and it is an assectator. Similar data have been obtained by other researchers, for example, in the Rostov Region [52]. In the habitats under anthropogenic pressure, vegetative sedentary life is characteristic of this species, noted also by other authors as the ability to stay for a long time in a certain area with weakly expressed vegetative reproduction [19]. Under optimal conditions, *Iris* populations are characterized by vegetative mobility (i.e., the ability to reproduce vegetatively).

2. Population features of *Iris pumila*

In habitats, where conditions are optimal or close to optimal, the surveyed populations of *I. pumila* have full-membered ontogenetic spectra (at the time of the study, senile individuals and seedlings may be absent in the population). Under stress conditions, the populations are incomplete (most often there are no individuals in the initial stages of ontogenesis: seedlings, juveniles, and immature ones), so their ontogenetic spectra are fragmentary unimodal centered or right-handed.

Demographic features of surveyed *I. pumila* populations are presented in Table A2. Some differences in the aging index (0.0–0.25) indicate the unequal rate of aging of individuals in different coenotic populations. A recovery index ranging as 0.10–0.70 and a slightly smaller replenishment index both indicate the species stability in studied plant communities and generally favorable conditions for the populations' renewal in the region.

According to the 'delta-omega' classification of populations [50], 47.0% of the studied populations of *I. pumila* are mature, 23.5%, transitional, 17.6%, maturing, and 11.9%, aging. Different types of populations have been recorded at some loci: maturing, mature, and aging (Sernovodny Shikhan, nos. 26–28); maturing, mature, and transitional (Mulin Dol, nos. 29–31, and Mountain Mogutova, nos. 34–36). In our opinion, this is associated with different habitats (a variety of phytocenotic conditions), quantitative parameters of the population (the number of individuals and the total number of coenotic populations at particular locus), and the difference in the degree of anthropogenic load in different population loci. For example, at Sernovodny Shikhan (nos. 26–28) and Mulin Dol (nos. 29–31), the studied loci are subject to grazing, recreation, and steppe burns; on Mountain Mogutova (nos. 34–36), these are quarrying, recreation, and camping. All maturing coenotic populations (nos. 27, 30, 36) are characteristic of areas that have been traversed by steppe fires. Most of mature coenotic populations (nos. 21, 25, 26, 32, 33, and 37) are found in phytocenoses affected by cattle grazing. Only the mature coenotic population no. 34 (Mountain Mogutova) grows under the influence of recreational load. The transitional type of populations (nos. 22, 23, 31, and 35) is noted in habitats with low grazing and weak recreational use. However, the coenotic population no. 31 is characterized by the presence of a high proportion of sub-senile individuals, which may be associated with fires in 2006, 2012, and 2019. Aging coenotic populations (nos. 24 and 28) are recorded in the areas with low or no anthropogenic load, the development of turf grasses, the accumulation of steppe felt, and a high projective soil cover with herbage.

Similar to other range loci, *I. pumila* populations in the Samara Region are characterized by the dependence of the types of ontogenetic spectra (and, accordingly, the type of population) on the anthropogenic load intensity. For example, an increase of the pasture load on the populations of *I. pumila* causes an increase of the number of generative individuals (g1–g3), exhibiting disappearance of young individuals (j–im), and a practical absence of seed renewal in the Republic of Kalmykia [29]. The vulnerability of the plants to grazing due to the superficial position of its rhizomes is also noted in the Rostov Region [17]. Similar tendency is characteristic of *I. pumila* populations in the Samara Region.

I. pumila populations are stable in most of the surveyed loci. Demographic features indicate a rather low efficiency of renewal in populations, and both recovery and replenishment indices are less than 1.0. The replenishment is generally sufficient to maintain the absolute abundance; as the anthropogenic load increases, the populations are steadily aging, and the population recovery is significantly reduced.

The spatial distribution of individuals in the *Iris* population is most often aggregated. The average population density of generative specimens is 2.3 individuals per 1 m^2; in total for entire population and all age groups, 2.8 individuals per 1 m^2.

Currently, *I. pumila* populations are in satisfactory condition in the study area. As the anthropogenic load increases in the habitats of *I. pumila*, the share of generative individuals in populations increases, young individuals are eliminated, seed productivity decreases, seed renewal is practically absent, and vegetative reproduction is recorded but at low rates (3–4% of young individuals are found out in the total abundance per year). They also reported that the vegetative propagation of *Iris* is more significant for its stable position in phytocenoses than seed propagation, for example, in the Republic of Kalmykia [29]. At the same time, seed reproduction occurs rather randomly.

According to our data, population characteristics of *I. pumila* in the Samara Region are quite similar to that in the Volgograd Region [53]. However, there are differences in the parameters of the demographic structure when comparing with the populations of the Saratov Region [34], where a left-sided ontogenetic spectrum with a predominance of the initial stages of ontogeny prevails, which indicates a fairly high diversity of ontogenetic spectra of populations within the range. However, the authors agree that the populations of the species are unstable under the influence of grazing, fires, and recreation.

4. Conclusions

In the Samara Region, the intensity of anthropogenic disturbance of habitats is not the only limiting factor for *I. pumila* populations. In general, factors such as significant fragmentation of the range, small absolute abundance of most populations, vulnerability to grazing, and low and highly fluctuating seed productivity over the years pose a potential threat to the species.

Local populations of *I. pumila* grow in various associations that differ in the degree of development, vertical and horizontal structure, and floristic composition. As a rule, *I. pumila* does not reach high abundance in communities, and it is an assectator. In the Samara Region, *I. pumila* is a part of eight steppe zonal communities: (*Stipa pulcherrima* + herbae stepposae [+ *Iris pumila*]; *Festuca valesiaca* + herbae stepposae [+ *Iris pumila*]; *Stipa capillata* + herbae stepposae [+ *Iris pumila*]; *Festuca valesiaca* + *Artemisia marschalliana* [+ *Iris pumila*]; *Festuca valesiaca* + *Stipa pennata* [+ *Iris pumila*]; *Galatella villosa* + *Festuca valesiaca* [+ *Iris pumila*]; *Helictotrichon desertorum* + herbae stepposae [+ *Iris pumila*]; and *Agropyron desertorum* [+ *Iris pumila* + *Gypsophila altissima*]). In these communities, its populations are represented by a significant number of individuals, and they are in a stable state, with a variety of ontogenetic spectra. Populations growing in relatively favorable conditions are characterized by satisfactory indicators of absolute abundance, population density, and plant vitality, which together ensure the possibility of its long-term stable existence.

However, it has been found that *I. pumila* populations even characterized by high abundance and population density still need protective measures and reduction of agricultural and recreational use in their habitats. Population features indicate sufficient stability of the species in plant communities under low and medium anthropogenic pressure on the soil and vegetation cover. As the anthropogenic pressure increases, the *Iris* population disappears from the communities due to its low reproductive rates, when seed reproduction is practically absent, and individuals of vegetative origin make a small contribution to the population replenishment (less than 4% of new individuals are formed annually). Under optimal conditions, *Iris* populations are characterized by vegetative mobility; under unfavorable conditions, vegetative sedentarization appears.

The data obtained may serve as additional scientific information, for example, for the 2nd edition of the Green List of the Samara Region. In addition, the results of this study indicate that it is necessary to carry out monitoring and implementation of additional measures for the protection of natural territorial complexes, identifying new territories as natural monuments of regional significance in the steppe communities, where *I. pumila* grows.

Author Contributions: Conceptualization, A.M., V.I., S.S. and E.Z.; methodology, A.M., V.I., S.S. and E.Z.: software A.M., V.I., S.S. and E.Z.; validation A.M., V.I., S.S. and E.Z.; formal analysis, A.M., V.I., S.S. and E.Z.; investigation, A.M., V.I., S.S. and E.Z.; resources, S.S. and E.Z.; data curation, O.K., E.Z. and S.S.; A.M., V.I., S.S. and E.Z.; writing—review and editing, O.K.; visualization, O.K.; supervision, O.K.; project administration, S.S. and O.K.; funding acquisition, S.S. and E.Z. All authors have read and agreed to the published version of the manuscript.

Funding: The study was funded by the state projects no. 122042700002-6 for the Tsitsin Main Botanical Garden, Russian Academy of Sciences and no. AAAA-A21-121011290026-9 for the Central Siberian Botanical Garden, Siberian Branch of the Russian Academy of Sciences. The Center for Collective Use "Herbarium of Main Botanical Garden RAS" was supported by the Ministry of Science and Higher Education of the Russian Federation, grant no. 075-15-2021-678.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement:

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Figure A1. *Iris pumila* L. is a species listed in the European Red List of Vascular Plants and the Red List of the Russian Federation.

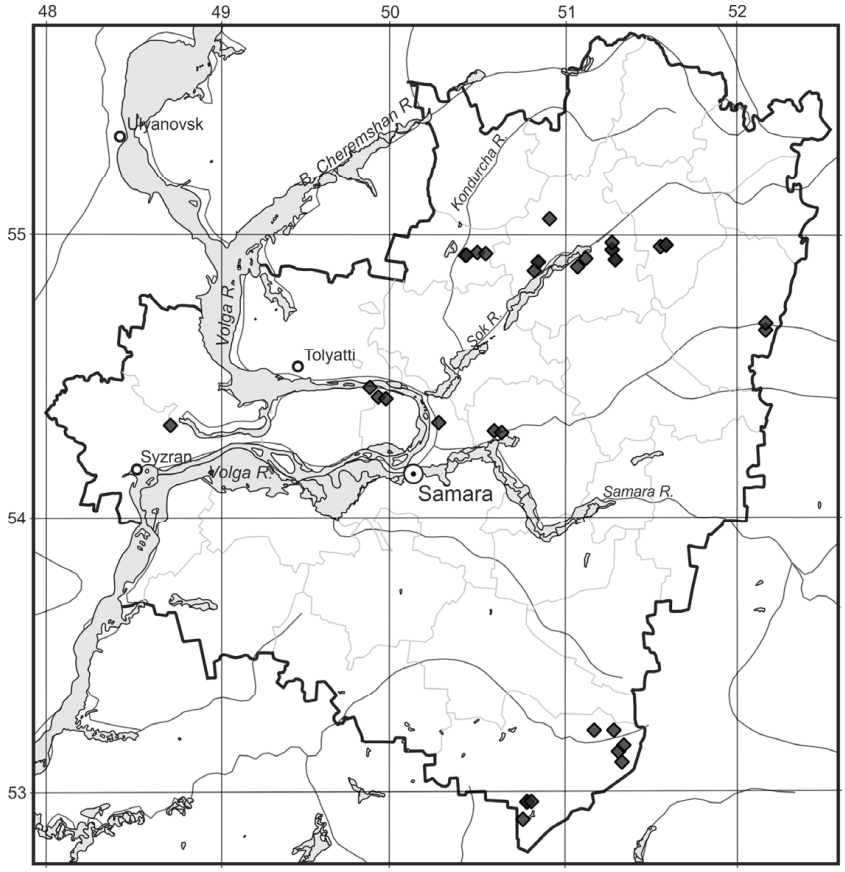

Figure A2. Map of the described communities with the participation of *Iris pumila* L.

Figure A3. A diverse and beautiful golden feather grass community (*Stipa pulcherrima* + Herbae stepposae [+ *Iris pumila*]).

Figure A4. Grass-type community (*Festuca valesiaca* + Herbae stepposae [+ *Iris pumila*]).

Figure A5. The mixed-grass community (*Stipa capillata* + Herbae stepposae [+ *Iris pumila*]).

Figure A6. Volga fescue-European feather grass community (*Festuca valesiaca* + *Stipa pennata* [+ *Iris pumila*]).

Figure A7. Volga fescue-goldilocks aster community (*Galatella villosa* + *Festuca valesiaca* [+ *Iris pumila*]).

Table A1. Geobotanical descriptions of steppe phytocenoses that include *Iris pumila* L. in the Samara Region, Russia.

Locus No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	Occurrence
PDate (dd.mm.yyyy)	07.06.2017	07.06.2017	07.06.2017	30.04.2017	02.05.2017	30.04.2017	01.05.2017	02.05.2017	26.07.2017	26.07.2017	11.06.2018	25.07.2018	25.07.2018	25.07.2018	21.05.2019	16.08.2019	16.08.2019	15.06.2019	15.06.2019	11.05.2020	
GPS coordinates of the locus (N)	53°53.762′	53°55.589′	53°53.511′	51°57.490′	51°57.644′	51°57.614′	51°53.747′	51°57.639′	53°53.039′	53°53.043′	54°02.003′	53°56.236′	53°5 6.571′	53°56.579′	53°55.001′	53°54.458′	53°54.455′	53°55.591′	53°53.513′	53°19.102′	
GPS coordinates of the locus (E)	051°06.847′	051°16.157′	051°17.301′	050°45.960′	050°46.035′	050°46.014′	050°44.558′	050°46.059′	050°50.012′	050°50.007′	050°54.003′	051°33.288′	051°35.250′	051°35.263′	050°28.420′	050°24.161′	050°24.550′	051°16.159′	051°17.303′	050°11.402′	
Locus size, m^2	100	20	20	25	25	70	30	70	100	100	100	100	100	100	100	100	100	25	25	25	
Total projective cover, %	90	90	90	90	80	90	70	80	70	60	40	50	40	60	90	80	80	90	90	90	
Number of species at the locus	47	17	22	13	15	16	18	22	44	34	31	28	25	30	40	28	28	21	25	28	
Species composition																					
Iris pumila	sp.	cop_1	sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	sp.	cop_1	sp.	cop_2	100
Festuca valesiaca	sp.	cop_3	sp.	cop_3	cop_3	cop_3	cop_3	cop_3	sp.	cop_3	cop_3	cop_2	cop_2	cop_2	.	sol.	sol.	cop_3	sp.	.	90
Galatella villosa	sp.	.	sol.	sol.	sol.	sol.	.	sol.	.	.	sol.	cop_3	cop_3	cop_3	sol.	sol.	sol.	sol.	sol.	.	75
Euphorbia seguieriana	sp.	.	sol.	.	.	.	.	.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	70
Artemisia marschalliana	.	.	sp.	cop_2	cop_2	sol.	sp.	sol.	.	.	.	sol.	.	sol.	sol.	.	sol.	.	sp.	sol.	60
Allium strictum	.	.	cop_1	.	.	.	sol.	sol.	sol.	sol.	.	sol.	.	sol.	.	sol.	sol.	sol.	cop_1	.	55
Gypsophila altissima	sol.	sp.	sol.	.	.	.	.	.	sp.	.	.	sol.	.	.	sol.	sol.	sol.	sp.	sol.	cop_1	55
Rhaponticoides ruthenica	.	.	.	.	.	sol.	.	sol.	sol.	sp.	sol.	sol.	sol.	sol.	sol.	.	.	.	.	sol.	50
Psephellus sumensis	sol.	.	.	.	.	.	.	.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	.	.	.	sp.	50
Eremogone procera	sol.	.	.	sol.	sol.	.	.	.	sol.	.	sol.	sol.	.	sol.	sol.	sol.	sol.	.	.	.	50
Rostraria cristata	sp.	.	.	.	.	.	.	.	.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	.	.	sp.	50
Potentilla incana	sol.	.	sol.	.	.	.	.	.	sp.	.	.	sol.	sol.	sol.	sol.	sol.	sol.	.	sol.	.	50
Thymus marschallianus	.	.	sp.	.	.	.	.	.	sol.	sol.	sol.	sol.	sol.	sol.	sol.	.	.	.	sp.	sol.	50
Asparagus officinalis	sol.	.	sol.	.	.	.	.	.	.	.	sol.	.	sol.	sol.	sol.	sol.	sol.	.	sol.	.	45
Echinops ritro subsp. *meyeri*	sol.	.	sol.	.	.	.	.	.	sol.	sol.	sol.	.	.	.	sol.	sol.	sol.	.	sol.	.	45

Table A1. *Cont.*

Locus No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Prunus tenella	.	.	.	.	.	sol.	sol.	sol.	sol.	sol.	.	.	sol.	sol.	.	.	.	.	.	sp.	40
Chamaecytisus ruthenicus	sol.	.	sol.	.	.	.	.	.	sol.	.	.	.	.	.	sol.	.	sol.	sol.	sol.	sp.	40
Ephedra distachya	.	.	.	.	.	.	sol.	sol.	.	sol.	.	sol.	sol.	sol.	sol.	.	.	.	.	sol.	40
Onosma simplicissima	sol.	.	sp.	.	.	.	.	.	sp.	sol.	sol.	.	.	.	sol.	.	sol.	.	sp.	.	40
Salvia stepposa	sol.	.	.	.	.	.	.	.	sol.	.	sol.	.	sol.	sol.	sol.	sol.	sol.	.	.	.	40
Hedysarum grandiflorum	sol.	.	.	.	.	.	.	.	sp.	.	sol.	sol.	sol.	sol.	sol.	.	.	.	.	.	35
Medicago falcata subsp. *romanica*	sol.	sp.	sol.	.	.	.	.	.	sol.	.	.	sol.	.	.	.	.	.	sp.	sol.	.	35
Scorzonera austriaca	sol.	sol.	.	.	.	.	.	.	sol.	.	sol.	.	.	.	.	.	.	sol.	sol.	sol.	35
Adonis volgensis	sol.	.	.	.	sol.	sol.	.	sol.	.	sol.	.	.	.	.	.	.	.	.	.	sol.	30
Agropyron desertorum	.	.	.	sol.	.	.	.	sol.	.	.	.	sol.	sol.	sol.	.	.	.	.	.	cop_3	30
Bromus inermis	.	sp.	sol.	sp.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	.	30
Galium ruthenicum	sol.	.	.	.	.	.	.	.	sol.	sol.	.	.	.	.	sol.	sol.	sol.	.	.	.	30
Galium verum	.	sol.	sol.	.	.	.	sol.	.	.	.	.	sol.	.	.	.	.	.	sol.	sol.	.	30
Jurinea ewersmannii	sol.	.	.	.	.	.	.	.	sol.	.	sol.	.	.	.	.	sol.	sol.	.	.	sol.	30
Lomelosia isetensis	.	.	.	.	.	.	.	.	sp.	sp.	sol.	sol.	sol.	sol.	.	.	.	.	.	.	30
Spiraea crenata	.	.	.	.	.	sol.	sol.	sol.	.	.	.	.	.	.	sol.	sol.	.	.	.	sp.	30
Stipa pennata	cop_1	.	.	.	.	cop_2	cop_2	cop_2	.	cop_2	cop_2	.	.	.	.	.	.	.	.	.	30
Stipa pulcherrima	cop_3	.	.	.	.	.	.	.	cop_3	.	sol.	.	.	.	sol.	sp.	sp.	.	.	.	30
Tanacetum kittaryanum subsp. *sclerophyllum*	sol.	.	.	.	.	.	.	.	.	.	sol.	sol.	sol.	sol.	.	sol.	.	.	.	.	30
Tulipa biebersteiniana	.	.	.	sol.	sol.	sol.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	sol.	30
Alyssum lenense	.	.	.	.	.	.	.	.	sol.	.	.	sol.	sol.	sol.	sol.	.	.	.	.	.	25
Ferula tatarica	.	.	.	sol.	sol.	sol.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	25
Genista tinctoria	sol.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	sol.	sol.	sol.	.	.	.	25
Hedysarum razoumowianum	sol.	.	.	.	.	.	.	.	sp.	sp.	sol.	.	.	.	sol.	.	.	.	.	.	25
Nepeta ucranica	sol.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	sol.	sol.	.	.	.	.	.	25
Nonea pulla	.	sol.	sol.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	sol.	sol.	.	25
Jacobaea erucifolia	.	.	.	sol.	sol.	.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	sol.	25
Achillea setacea	.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	.	20
Allium rotundum	.	sol.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	sol.	sol.	.	20
Alyssum gymnopodum	.	.	.	.	.	.	.	.	sp.	.	.	sol.	sol.	sol.	.	.	.	.	.	.	20
Artemisia salsoloides	.	.	.	.	.	.	.	.	.	.	sol.	.	sol.	sol.	sol.	.	.	.	.	.	20
Filipendula vulgaris	sol.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	sol.	.	.	.	sol.	.	20
Gagea minima	.	.	.	.	.	sol.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	sol.	20
Galatella angustissima	.	.	.	.	.	.	.	.	sol.	sol.	.	.	.	.	.	sol.	sol.	.	.	.	20
Goniolimon elatum	.	.	.	.	.	.	.	.	.	.	sol.	sol.	sol.	sol.	.	.	.	.	.	.	20
Jurinea ledebourii	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	sol.	.	.	.	20
Linum flavum	sol.	.	.	.	.	.	.	.	sol.	.	sol.	.	.	.	sol.	.	.	.	.	.	20

Table A1. *Cont.*

Locus No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	
Origanum vulgare	.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	.	sol.	.	20
Polygala comosa	sol.	.	.	.	.	.	.	.	.	.	sol.	.	.	.	sol.	.	sol.	.	.	.	20
Scorzonera hispanica	sol.	.	.	.	.	.	.	.	.	.	sol.	.	.	.	sol.	sol.	.	.	.	.	20
Stipa capillata	.	.	soc.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	.	soc.	.	20
Taraxacum serotinum	sol.	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	sol.	sol.	.	.	.	20
Thalictrum simplex	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	sol.	sol.	.	.	.	sol.	20
Verbascum chaixii subsp. *orientale*	sol.	.	.	.	.	.	sol.	sol.	.	sol.	.	.	.	.	.	.	.	.	.	.	20
Vincetoxicum hirundinaria subsp. *stepposum*	sol.	.	.	.	.	.	.	.	sol.	.	sol.	.	.	.	sol.	.	.	.	.	.	20
Viola ambigua	.	.	.	.	.	.	.	.	sol.	sol.	.	.	.	.	sol.	.	.	.	.	sol.	20
Anemone sylvestris	sol.	.	.	.	.	.	.	.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	15
Artemisia austriaca	.	.	.	.	sol.	sol.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	15
Aster alpinus	sol.	.	.	.	.	.	.	.	.	.	sol.	.	.	.	sol.	.	.	.	.	.	15
Astragalus macropus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	sol.	.	.	.	15
Astragalus onobrychis	.	sol.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	sol.	.	.	15
Astragalus wolgensis	.	.	.	.	.	.	sol.	sol.	.	.	.	.	.	.	sol.	.	.	.	.	.	15
Bassia prostrata	.	.	.	.	.	.	sol.	sol.	.	.	.	sol.	.	.	.	.	.	.	.	.	15
Campanula sibirica	sol.	.	.	.	.	.	.	.	sol.	.	sol.	.	.	.	.	.	.	.	.	.	15
Centaurea scabiosa	sol.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	sol.	.	.	.	15
Prunus fruticosa	.	.	.	.	.	.	.	.	sol.	sol.	.	.	.	.	.	.	.	.	.	sp.	15
Helictotrichon desertorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	cop_3	cop_3	cop_3	.	.	.	15
Oxytropis spicata	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	sol.	.	.	.	.	.	15
Rindera tetraspis	.	.	.	.	.	sol.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	15
Tulipa suaveolens	.	.	.	.	.	sol.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	15
Veronica incana	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	sol.	.	.	.	.	.	.	15
Veronica prostrata	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	.	15
Astragalus danicus	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	.	.	10
Astragalus testiculatus	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	10
Cephalaria uralensis	.	.	.	.	.	.	.	.	.	.	.	sol.	.	sol.	.	.	.	.	.	.	10
Cichorium intybus	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	.	.	10
Erysimum cuspidatum	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	.	.	10
Fritillaria ruthenica	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	10
Globularia bisnagarica	.	.	.	.	.	.	.	.	sp.	sp.	.	.	.	.	.	.	.	.	.	.	10
Pentanema hirtum	.	.	.	.	.	.	.	.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	10
Pentanema salicinum	sol.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	10
Knautia arvensis	.	.	.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10

Table A1. *Cont.*

Locus No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	
Lappula squarrosa	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	.	.	10
Ornithogalum fischerianum	.	.	.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
Oxytropis floribunda	.	.	.	.	.	.	.	.	.	.	.	.	sol.	sol.	.	.	.	.	.	.	10
Oxytropis pilosa	sol.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	10
Pedicularis kaufmannii	sol.	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	10
Phlomis herbaventi subsp. *pungens*	.	.	.	sol.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10
Reseda lutea	.	.	.	.	.	.	.	.	.	.	.	sol.	.	sol.	.	.	.	.	.	.	10
Seseli libanotis	.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	.	10
Valeriana tuberosa	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	10
Caragana frutex	.	sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	.	.	10
Achillea nobilis	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	5
Aster amellus	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	5
Astragalus tenuifolius	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Astragalus zingeri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sp.	5
Centaurea diffusa	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	5
Cotoneaster laxiflorus	.	.	.	.	.	.	.	.	.	sp.	.	.	.	.	.	.	.	.	.	.	5
Euphorbia semivillosa	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Hieracium virosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	5
Hypericum perforatum	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	5
Kraschenninnikovia ceratoides	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Onobrychis arenaria	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	5
Phlomoides tuberosa	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	5
Pimpinella tragium	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	5
Tanacetum corymbosum									.	sol.	.	.	.	.	.	.	.			.	5
Rosa majalis	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	5
Serratula coronata	sol.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Seseli tortuosum	.	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	5
Silenebaschkirorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	5
Stipa korshinskyi	cop_1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Thesium ramosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	sol.	5
Trinia multicaulis	.	.	.	.	.	.	.	.	sol.	.	.	.	.	.	.	.	.	.	.	.	5

Table A2. Features of the demographic structure of the Iris pumila L. populations.

Locus No.	I_{Rep}	I_{Rec}	I_{Ag}	Δ	ω	Type of Population	Geographical Area	GPS Coordinates of the Locus (N)	GPS Coordinates of the Locus (E)
21	0.26	0.28	0.08	0.50	0.71	mature	Natural monument "Kamenny Dol"	53°17.105′	050°35.312′
22	0.25	0.29	0.11	0.44	0.70	transitional		53°17.314′	050°35.423′
23	0.38	0.47	0.16	0.39	0.64	transitional	Natural monument "Gora Kopeika"	53°40.425′	052°09.246′
24	0.17	0.18	0.08	0.55	0.71	aging		53°40.386′	052°10.240′
25	0.24	0.26	0.08	0.48	0.72	mature	Natural monument "Zelenaya Gora"	53°53.147′	050°25.569′
26	0.23	0.28	0.17	0.51	0.71	mature	Natural monument "Syrnovodny Shikhan"	53°53.519′	051°17.404′
27	0.64	0.64	0.00	0.33	0.61	maturing		53°54.150′	051°17.508′
28	0.10	0.12	0.16	0.58	0.74	aging		53°53.354′	051°17.229′
29	0.35	0.35	-	0.41	0.74	mature	Natural monument "Mulin Dol"	52°05.529′	051°20.262′
30	0.66	0.70	0.04	0.30	0.65	maturing		52°06.160′	051°19.532′
31	0.33	0.47	0.25	0.48	0.62	transitional		52°07.146′	051°22.282′
32	0.09	0.10	0.10	0.52	0.81	mature	Natural monument "Kamenny Log-1, 2, 3"	52°13.408′	051°08.098′
33	0.15	0.15	-	0.50	0.76	mature		52°14.369′	051°11.458′
34	0.26	0.28	0.07	0.47	0.73	mature	Mount Mogutova, Samarskaya Luka National Park	53°25.182′	049°29.206′
35	0.47	0.48	0.02	0.37	0.67	transitional		53°25.018′	049°31.112′
36	0.54	0.55	0.02	0.34	0.66	maturing		53°25.081′	049°29.236′
37	0.19	0.19	-	0.45	0.81	mature	Gubinskie Vysoty Heights	53°17.468′	048°43.227′

Note. Δ is the age index; ω, the efficiency index; I_{Rep}, replenishment index; I_{Rec}, recovery index; I_{Ag}, aging index.

References

1. Webb, D.A.; Chater, A.O. *Iris* L. In *Flora Europaea 5*; Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M., Webb, D.A., Eds.; Cambridge University Press: Cambridge, UK, 1980; pp. 87–92.
2. Alekseeva, N.B. Genus *Iris* L. (Iridaceae) in Russia. *Turczaninowia* **2008**, *11*, 5–68. (In Russian)
3. Tarasjev, A.; Avramov, S.; Miljkovic, D. Evolutionary biology studies on the *Iris pumila* clonal plant: Advantages of a good model system, main findings and directions for further research. *Arch. Biol. Sci.* **2012**, *64*, 159–174. [CrossRef]
4. Dembicz, I.; Szczeparska, L.; Moysiyenko, I.I.; Wódkiewicz, M. High genetic diversity in fragmented *Iris pumila* L. populations in Ukrainian steppe enclaves. *Basic Appl. Ecol.* **2018**, *28*, 37–47. [CrossRef]
5. Dembicz, I.; Moysiyenko, I.I.; Shaposhnikova, A.; Vynokurov, D.; Kozub, L.; Sudnik-Wójcikowska, B. Isolation and patch size drive specialist plant species density within steppe islands: A case study of kurgans in southern Ukraine. *Biodivers. Conserv.* **2016**, *25*, 2289–2307. [CrossRef]
6. Vorontzova, L.I.; Zaugolnova, L.B. Population Biology of Steppe Plants. In *The Population Structure of Vegetation*; White, J., Ed.; Springer Dordrecht: Dordrecht, The Netherlands, 1985; Volume 3, pp. 143–173.
7. Lindenmayer, D.B.; Likens, G.E.; Andersen, A.; Bowman, D.; Bull, C.M.; Burns, E.; Dickman, C.R.; Hoffmann, A.A.; Keith, D.A.; Liddell, M.J.; et al. Value of long-term ecological studies. *Austral Ecol.* **2012**, *37*, 745–757. [CrossRef]
8. Kajtoch, L.; Ciéslak, E.; Varga, Z.; Paul, W.; Mazur, M.A.; Sramkó, G.; Kubisz, D. Phylogeographic patterns of steppe species in Eastern Europe: A review and the implications for conservation. *Biodivers. Conserv.* **2016**, *25*, 2309–2339. [CrossRef]
9. Parnikoza, I.Y.; Andreev, I.O.; Bublyk, O.M.; Spiridonova, K.V.; Gołębiewska, J.; Kubiak, M.; Kuczyńska, A.; Mystkowska, K.; Olędrzyńska, N.; Urasińska, B.; et al. The current state of steppe perennial plants populations: A case study on *Iris pumila*. *Biologia* **2017**, *72*, 24–35. [CrossRef]
10. Arkhipova, E.A.; Boldyrev, V.A.; Stepanov, M.V.; Shchukina, A.V. Ecological habitat conditions of species of the genus *Iris* L. in the Saratov region. In *Ecological Problems of Large River Basins—6: Materials of the International Conference Dedicated to the 35th Anniversary of the Institute of Ecology of the Volga Basin of the Russian Academy of Sciences and the 65th Anniversary of the Kuibyshev Biostation*; Rosenberg, G.S., Saxonov, S.V., Eds.; Kassandra: Togliatti, Russia, 2018; pp. 28–30. (In Russian) [CrossRef]
11. Khela, S. *Iris pumila* (Europe Assessment). The IUCN Red List of Threatened Species 2013: e.T203235A2762496. 2013. Available online: https://www.iucnredlist.org/species/203235/2762496 (accessed on 26 March 2023).
12. Bardunov, L.V.; Novikov, V.S. (Eds.) *Red Data Book of the Russian Federation (Plants and Fungi)*; KMK: Moscow, Russia, 2008. (In Russian)
13. Senator, S.A.; Saksonov, S.V. (Eds.) *Red Data Book of the Samara region. T. I. Rare Species of Plants and Fungi*; Publishing House of the Samara State Regional Academy: Samara, Russia, 2017. (In Russian)
14. Tarasjev, A. Impact of genet size and flowering stage on fruit set in *Iris pumila* L. clones in wild. *Acta Oecologica* **2005**, *27*, 93–98. [CrossRef]
15. Tarasjev, A.; Barisić Klisarić, N.; Stojković, B.; Avramov, S. Phenotypic plasticity and between population differentiation in *Iris Pumila* transplants between native open and anthropogenic shade habitats. *Genetika* **2009**, *45*, 1078–1086.
16. Vuleta, A.; Šešlija, D.; Tucić, B.; Manitašević-Jovanović, S. Seasonal dynamics of foliar antioxidative enzymes and total anthocyanins in natural populations of *Iris pumila* L. *J. Plant Ecol.* **2010**, *35*, 9–69. [CrossRef]
17. Fedyaeva, V.V.; Shmaraeva, A.N.; Shishlova, Z.N. Monitoring of *Iris pumila* L. populations in the Rostov region. *Belgorod. State Univ. Sci. Bulletin. Nat. Sci.* **2011**, *15*, 329–334. (In Russian)
18. Efimov, S.V.; Chernyshenko, O.V.; Kirpicheva, L.F.; Datsyuk, E.I. Crimean populations of dwarf iris (*Iris pumila* L.): Distribution and morphological features. *Lesn. Vestn. For. Bull.* **2012**, *4*, 7–12. (In Russian)
19. Indzheeva, L.A.; Baktasheva, N.M. Characteristics of *Iris pumila* L. cenopopulations in the Republic of Kalmykia. *Bull. Mosc. Reg. State Univ. Ser. Nat. Sci.* **2013**, *3*, 22–26. (In Russian)
20. Tucić, B.; Vuleta, A.; Manitašević-Jovanović, S. Exploring phenotypic floral integration in *Iris pumila* L.: A common-garden experiment. *Arch. Biol. Sci.* **2013**, *65*, 781–793. [CrossRef]
21. Twardovska, M.O.; Andreev, I.; Kunakh, V. Intraspecific chromosomal polymorphism of *Iris pumila* L. from the territory of Ukraine. *Cytol. Genet.* **2015**, *49*, 322–327. [CrossRef]
22. Vujić, V.; Avramov, S.; Tarasjev, A.; Barišić Klisarić, N.; Živković, U.; Miljković, D. The effects of traffic-related air pollution on the flower morphology of *Iris pumila*—Comparison of a polluted city area and the unpolluted Deliblato Sands (Nature reserve). *Appl. Ecol. Environ. Res.* **2015**, *13*, 405–415. [CrossRef]
23. Kryukova, A.V.; Abramova, L.M.; Mustafina, A.N. On the biology and ecology of rare species of irises in the steppes of the Southern Urals. *Samar. Luka Probl. Reg. Glob. Ecol.* **2018**, *271*, 271–275. (In Russian) [CrossRef]
24. Bublyk, O.; Andreev, I.; Parnikoza, I.; Kunakh, V. Population genetic structure of *Iris pumila* L. in Ukraine: Effects of habitat fragmentation. *Acta Biol. Cracoviensia Ser. Bot.* **2020**, *62*, 51–61. [CrossRef]
25. Bublyk, O.; Parnikoza, I.; Kunakh, V. Assessing the Levels of Polymorphism and Differentiation in *Iris pumila* L. Populations Using Three Types of PCR Markers. *Cytol. Genet.* **2021**, *55*, 36–46. [CrossRef]
26. Bublyk, O.; Parnikoza, I.; Kunakh, V. Level of polymorphism and population differentiation of *Iris pumila* L. according to three types of PCR-markers. *Cytol. Genet.* **2021**, *55*, 42–54. [CrossRef]
27. Kashin, A.S.; Parkhomenko, A.S.; Abramova, L.M.; Kondratieva, A.O.; Bogoslov, A.V.; Shilova, I.V.; Kryukova, A.V. Morphological variability of *Iris pumila* (Iridaceae). *Bot. Zhurnal.* **2022**, *107*, 180–197. (In Russian) [CrossRef]

28. Kryukova, A.V.; Mustafina, A.N.; Abramova, L.M. Comparative indicators of morphology and seed productivity in rare *Iris* L. spp. within their natural habitats and under cultivation in the Southern Urals. *Proc. Appl. Bot. Genet. Breed.* **2022**, *183*, 171–182. [CrossRef]
29. Kryukova, A.V.; Abramova, L.M. The Influence of Ecological Factors on Variability of Morphometric Parameters of Rare Species *Iris pumila* L. *Izv. Saratov. Univ. Chem. Biol. Ecol.* **2018**, *18*, 232–236. (In Russian) [CrossRef]
30. Kryukova, A.V.; Muldashev, A.A.; Golovanov, Y.M.; Abramova, L.M. Distribution and phytocenotic association of rare species of the genus *Iris* L. in the Southern Urals (Republic of Bashkortostan). *Belgorod State Univ. Sci. Bull. Nat. Sci.* **2014**, *2329*, 5–11. (In Russian)
31. Lysenko, T.M. To the characteristic of steppe vegetation of the Saratov area. *Izvestia Samarskogo Nauchnogo Centra RAN* **2010**, *12*, 61–66. (In Russian)
32. Demina, O.N. *Classification of Steppe Vegetation of the Don Basin*; Southern Federal University Press: Rostov-on-Don, Russia, 2015. (In Russian)
33. Demina, O.N.; Korolyuk, A.Y.; Rogal, L.L. Calcareous steppes of Rostov region. *Veg. Russ.* **2016**, *29*, 21–45. (In Russian) [CrossRef]
34. Semenova, N.Y.; Gorskov, S.P.; Semenova, E.A.; Trushov, D.A. Ontogenetic structure and phytocenotic confinement of *Iris pumila* L. cenopopulations in the Balashovsky district of the Saratov region. *Successes Mod. Sci.* **2016**, *5*, 115–118. (In Russian)
35. Ilyina, V.N. Structure and state of populations of *Iris pumila* L. in the Samara region. *Probl. Bot. South. Sib. Mong.* **2020**, *19*, 302–306. (In Russian) [CrossRef]
36. *The Climate of the Samara Region and Its Features for Climate-Dependent Sectors of the Economy*; Privolzhskoe UGMS: Samara, Russia, 2006; p. 168. (In Russian)
37. Komarova, V.L.; Lavrenko, E.M.; Korchagin, A.A. (Eds.) *Field Geobotany*; Academy of Sciences of the USSR: Leningrad, Russia, 1972. (In Russian)
38. Aleksandrova, V.D. (Ed.) *Methods for Isolating Plant Associations*; Nauka: Leningrad, Russia, 1971. (In Russian)
39. Alekhin, V.V. *Theoretical Problems of Phytocenology and Steppe Science*; Publishing House of Moscow State University: Moscow, Russia, 1986. (In Russian)
40. Egorov, V.V.; Fridland, E.N.; Ivanova, E.N.; Rozov, N.N.; Nosin, V.A.; Friev, T.A. *Classification and Diagnostics of Soils in the USSR*; Kolos: Moskow, Russia, 1977. (In Russian)
41. Fedorov, A.A. (Ed.) *Flora of the European Part of the USSR*; Nauka: Leningrad, Russia, 1974; pp. 1–6. (In Russian)
42. Fedchenko, B.A. (Ed.) *Flora of the Southeast of the European Part of the USSR*; Selkhozizdat: Leningrad, Russia, 1927; pp. 1–6. (In Russian)
43. Rabotnov, T.A. Life cycle of perennial herbaceous plants in the meadow cenoses. In *Trudy BIN RAN SSSR. Seria 3. Geobotanika*; Botanical Institute of the USSR Academy of Sciences: Moscow, Russia; Leningrad, Russia, 1950; Volume 6, pp. 77–204. (In Russian)
44. Uranov, A.A. The age spectrum of cenopopulations as a function of time and energy wave processes. *Nauchnye Dokl. Vyss. Shkoly. Biol. Nauk.* **1975**, *2*, 7–34. (In Russian)
45. Schemske, D.W. Plant populations. *Perspectives on plant population ecology. Science* **1985**, *227*, 405–406.
46. Zhukova, L.A.; Dorogova, Y.A.; Turmukhametova, N.V.; Gavrilova, M.N.; Polyanskaya, T.A. *Ecological Scales and Methods for Analyzing the Ecological Diversity of Plants: A Monograph*; Mari State University: Yoshkar-Ola, Russia, 2010. (In Russian)
47. Glotov, N.V. About the estimation of age structure in plants populations. In *Zhizn' Populyatsii v Geterogennoi Srede, 1*; Periodika Mary El: Yoshkar-Ola, Russia, 1998; pp. 146–149. (In Russian)
48. Osmanova, G.O.; Zhivotovsky, L.A. Ontogenetic spectrum as an indicator of the state of plant cenopopulations. *Bull. Russ. Acad. Sci. Biol. Ser.* **2020**, *2*, 144–152. (In Russian)
49. Zhivotovsky, L.A.; Osmanova, G.O. *Population Biogeography of Plants*; Vertola: Yoshkar-Ola, Russia, 2019. (In Russian)
50. Zhivotovskij, L.A. The ontogenetic state, effective density and classification of populations. *Ecology* **2001**, *1*, 3–7. (In Russian)
51. Zhukova, L.A. *Population Life of Meadow Plants*; Lanar: Yoshkar-Ola, Russia, 1995. (In Russian)
52. Shmaraeva, A.N.; Shishlova, Z.N.; Ermolaeva, O.Y. The state of the local population of *Iris pumila* L. in the specially protected natural area "Tuzlovsky slopes" (Rostov region). In *Biological Diversity of the Caucasus and the South of Russia. Proceedings of the XXII International Scientific Conference*; Alef: Makhachkala, Russia, 2020; pp. 198–202. (In Russian)
53. Suprun, N.A. Spatial structure of *Iris pumila* L. cenopopulations in the Volgograd region. *Probl. Bot. South. Sib. Mong.* **2022**, *21*, 187–191. (In Russian) [CrossRef]