

MORPHOLOGICAL VARIABILITY OF *IRIS PUMILA* (IRIDACEAE) IN THE LOWER VOLGA REGION AND THE SOUTH URALS

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The article presents the results of the analysis of 22 populations of dwarf iris (*Iris pumila* L.) from two regions – the South Urals (Republic of Bashkortostan) and the Lower Volga region (Saratov Region). It is found that the plants of *I. pumila* populations from the two geographical localities differ markedly from each other. The plants from the South Urals have taller generative shoots, larger structural elements of the flower and, in particular, longer and wider leaves. In turn, the plants from the Lower Volga region have larger diameter of the flower and diameter of the clone. Ordination by the methods of principal components and non-metric multidimensional scaling also convincingly separates the population samples from the two geographical areas. At the same time, a larger spread of points corresponding to the set of average values of morphological characteristics of the plants from the Lower Volga region indicates a greater heterogeneity of growing conditions of the species in this geographical area compared to the South Urals. In the Lower Volga region, the distribution of the morphological features variation along the geographical gradient is primarily affected by broad temperature amplitude. It is also aided by the altitude above sea level of the places where populations grow in this region. In the South Urals, the greater similarity of morphological parameters of the plants, regardless of the spatial position of populations in this geographical area, is primarily due to narrower temperature amplitude.

Key words: *Iris pumila*, Iridaceae, geographic variability, morphometric parameters, Lower Volga region, South Urals

REFERENCES

- Abramova L.M., Shirokikh P.S., Golovanov YA.M., Mustafina A.N., Kryukova A.V. 2019. K ekologii redkikh stepnykh vidov roda *Iris* na Yuzhnom Urale. [To the ecology of rare steppe species of the genus *Iris* in the Southern Urals]. – Vestnik Tom'skogo gosudarstvennogo universiteta. Biologiya. 48: 56–72 (In Russ.).
<https://doi.org/10.17223/19988591/48/3>.
- Alekseyeva N.B. 2008. Rod *Iris* (Iridaceae) v Rossii. [Genus *Iris* (Iridaceae) in Russia]. – Turczaninowia. 11 (2): 5–68 (In Russ.).
- Avramov S., Miljković D., Barišić Klisarić N., Živković U., Tarasjev A. 2017. Ontogenetic plasticity of anatomical and ecophysiological traits and their correlations in *Iris pumila* plants grown in contrasting light conditions. – Plant Species Biology. 32 (4): 392–402.
<https://doi.org/10.1111/1442-1984.12171>
- Barišić Klisarić N., Avramov S., Miljković D., Živković U., Tarasjev A. 2012. Ontogeny of flower parts on naturally growing *Iris pumila* clones: implications for population differentiation and phenotypic plasticity studies. – Russian Journal of Genetics. 48 (4): 556–560.
- Biye E.H., Cron G.V., Balkwill K. 2016. Morphometric delimitation of *Gnetum* species in Africa. – Plant Syst. Evol. 302: 1067–1082.
<https://doi.org/10.1007/s00606-016-1317-3>
- Boltenkov E.V. 2019. Typification of the Linnaean name *Iris pumila* (Iridaceae). – Willdenowia. 49 (2): 147–150.
<https://doi.org/10.3372/wi.49.49202>
- Cruz-Lustre G., Batista J.A.N., Radins J.A., Gonzalez A., Borba E.L. 2020. Morphometric analysis of the *Habenaria parviflora* complex (Orchidaceae). – Plant Syst. Evol. 306. Published online.
<https://doi.org/10.1007/s00606-020-01634-2>
- Fick S.E., Hijmans R.J. 2017. WorldClim 2: new 1 km spatial resolution climate surfaces for global land areas. – International Journal of Climatology. 37 (12): 4302–4315.
- Finot V.L., Soreng R.J., Giussani L.M., Munoz R.G. 2018. A multivariate morphometric delimitation of species boundaries in the South American genus *Nicoraepoa* (Poaceae: Pooideae: Poaceae). – Plant Syst. Evol. 304: 679–697.
<https://doi.org/10.1007/s00606-018-1499-y>
- Hammer O., Harper D.A.T. 2005. Paleontological data analysis. Oxford. 351.
- Hammer O., Harper D.A.T., Ryan P.D. 2001. PAST: Paleontological statistics software package for education and data analysis. – Palaeontol. Electron. 4 (1): 1–9.
- Jolliffe I.T. 2002. Principal Component Analysis, 2nd edn. New York. 487.
- Khar'kova O.A., Grzhibovskiy A.M. 2014. Sravneniye dvukh nesvyazannykh vyborok c ispol'zovaniyem paketa statisticheskikh programm Stata: neparametricheskkiye kriterii. [Comparison of two unrelated samples using the Stata statistical software package: nonparametric tests]. – Ekologiya cheloveka. 4: 60–64 (In Russ.)
- Krasnaya kniga Respubliki Bashkortostan: v 2 t. T. 1. Rasteniya i griby. [Red Data Book of the Republic of Bashkortostan: in 2 volumes. Vol. 1. Plants and mushrooms]. 2011. Ufa. 384 p. (In Russ.)

- Krasnaya kniga Rossiyskoy Federatsii (rasteniya i griby). [Red Data Book of the Russian Federation (plants and mushrooms)]. 2008. M. 855 p. (In Russ.)
- Krasnaya kniga Saratovskoy oblasti: Griby. Lishayniki. Rasteniya. Zhivotnyye. [Red Data Book of the Saratov Region: Mushrooms. Lichens. Plants. Animals.]. 2021. Saratov. 496 p. (In Russ.)
- Kryukova A.V., Abramova L.M., Mustafina A.N. 2018. K biologii i ekologii redkikh vidov irisov v stepyakh Yuzhnogo Urala [On the biology and ecology of rare species of irises in the steppes of the Southern Urals]. – Samarskaya Luka: problemy regional'noy i global'noy ekologii. 27 (4–1): 271–275 (In Russ.). <https://doi.org/10.24411/2073-1035-2018-10126>
- Kryukova A.V., Muldashev A.A., Golovanov Ya.M., Abramova L.M. 2014. Rasprostraneniye i fitotsenoticheskaya priurochennost' redkikh vidov roda *Iris* L. na Yuzhnom Urale [Distribution and phytocenotic confinement of rare species of the genus *Iris* L. in the Southern Urals]. – Nauchnyye vedomosti Belgorodskogo gosudarstvennogo universiteta. Ser. Yestestvennyye nauki. 23 (29): 5–11 (In Russ.).
- Kryukova A.V., Abramova L.M. 2018. Vliyaniye ekologicheskikh faktorov na izmenchivost' morfometricheskikh parametrov redkogo vida *Iris pumila* L. [The influence of environmental factors on the variability of the morphometric parameters of the rare species *Iris pumila* L.]. – Izv. Sarat. un-ta. Nov. ser. Ser. Khimiya. Biologiya. Ekologiya. 18 (2): 232–236 (In Russ.). <https://doi.org/10.18500/1816-9775-2018-18-2-232-236>
- Maia F.R., Goldenberg R. 2019. Morphometric analysis and the distinction between *Tibouchina hatschbachii* and *T. marumbiensis*: morphological differentiation driven from the past. – Plant Syst. Evol. 305: 169–180. <https://doi.org/10.1007/s00606-018-1560-x>
- Markov A.V., Ivniitskiy S.B. 2016. Evolyutsionnaya rol' fenotipicheskoy plastichnosti [the evolutionary role of phenotypic plasticity]. – Vest. Mosk. un-ta. Ser. 16. Biologiya. 4: 3–11 (In Russ.).
- Metody izucheniya tsenopopulyatsiy tsvetkovykh rasteniy. [Methods for studying cenopopulations of flowering plants. 2015. Saratov. 127 p. (In Russ.).
- Nobis M., Klichowska E., Nowak A., Gudkova P.D., Rola K. 2016. Multivariate morphometric analysis of the *Stipa turkestanica* group (Poaceae: Stipa sect. Stipa). – Plant Syst. Evol. 302: 137–153. <https://doi.org/10.1007/s00606-015-1243-9>
- Ocampo J., d'Eeckenbrugge G. 2017. Morphological characterization in the genus *Passiflora* L.: an approach to understanding its complex variability. – Plant Syst. Evol. 303: 531–558. <https://doi.org/10.1007/s00606-017-1390-2>
- Oksanen J., Blanchet F.G., Friendly M., Kindt R., Legendre P., McGinn D., Minchin P.R., O'Hara R.B., Simpson G.L., Solymos P., Stevens M.H.H., Szoecs E., Wagner H. 2020. vegan: Community Ecology Package. R package version 2.5–7. <https://CRAN.R-project.org/package=vegan> (Accessed 15.03.2021).
- Pemac D., Tucić B. 1998. Reaction norms of juvenile traits to light intensity in *Iris pumila* (Iridaceae): A comparison of populations from exposed and shaded habitats. – Plant Syst. Evol. 209: 159–176.
- R Core Team. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. 2020. Available at: <http://www.R-project.org>. (Accessed 15.03.2021).
- Sharma S.K., Pandit M.K. 2011. A morphometric analysis and taxonomic study of *Panax bipinnatifidus* Seem. (Araliaceae) species complex from Sikkim Himalaya, India. – Plant Syst. Evol. 297: 87–98. <https://doi.org/10.1007/s00606-011-0501-8>
- Spaniel S., Zozomova-Lihova J., Marhold K. 2017. Revised taxonomic treatment of the *Alyssum montanum*-*A. repens* complex in the Balkans: a multivariate morphometric analysis. – Plant Syst. Evol. 303: 1413–1442. <https://doi.org/10.1007/s00606-017-1468-x>
- STATISTICA (data analysis software system), version 13 // StatSoft, Inc., 2001. <http://www.statsoft.com> (Accessed 15.03.2021).
- Tarasjev A., Avramov S. & Miljković D. 2012. Evolutionary biology studies on the *Iris pumila* clonal plant: advantages of a good model system, main findings and directions for further research. – Archives of Biological Sciences. 64: 159–174.
- Tarasjev A., Barisić Klisarić N., Stojković B., Avramov S. 2009. Phenotypic plasticity and between population differentiation in *Iris pumila* transplants between native open and anthropogenic shade habitats. – Genetika. 45 (8): 1078–1086.
- Torreçilla P., Acedo C., Marques I., Diaz-Pérez A.J., López-Rodríguez J.A., Mirones V., Sus A., Llamas F., Alonso A., Pérez-Collazos E., Viruel J., Sahuquillo Sancho M.D., Komac B., Manso J.A., Segarra-Moragues J.G., Draper D., Villar L., Catalán P. 2013. Morphometric and molecular variation in concert: taxonomy and genetics of the reticulate Pyrenean and Iberian alpine spiny fescues (*Festuca eskia* complex Poaceae). – Bot. J. Linn. Soc. 173: 676–706. <https://doi.org/10.1111/boj.12103>
- Tucić B., Pemac D., Avramov S. 2003. Plasticity to daylength of *Iris pumila* leaf phenological traits. – Popul. Ecol. 45: 31–39. <https://doi.org/10.1007/s10144-003-0137-9>
- Wickham H. 2016. ggplot2: Elegant Graphics for Data Analysis. New York. 268 p.
- Yefimov S.V., Chernyshenko O.V., Kirpicheva L.F., Datsyuk Ye.I. 2012. Krymskiye populyatsii irisa karlikovogo (*Iris pumila* L.): rasprostraneniye i morfologicheskiye osobennosti [Crimean populations of dwarf iris (*Iris pumila* L.): distribution and morphological features]. – Lesnoy vestnik. 4: 7–12 (In Russ.).
- Yoccoz N.G. 2012. Ecological monitoring. – In: Encyclopedia of Life Sciences. Published online. <https://doi.org/10.1002/9780470015902.a0023571>
- Yuritsyna N.A., Vasyukov V.M. 2014. New location of *Iris pumila* L. (Iridaceae) in the south of Privolzhskaya Hills. – Izvestia of Samara Scientific Center of the Russian Academy of Sciences. 16 (5): 143–144 (In Russ.)
- Zar J.H. 2010. Biostatistical analysis. New Jersey. 944 p.
- Zuur A.F., Ieno E.N., Elphick C.S. 2009. A protocol for data exploration to avoid common statistical problems. – Methods in Ecology and Evolution. 1: 3–14. <https://doi.org/10.1111/j.2041-210x.2009.00001.x>