AGARICOID FUNGI DIVERSITY IN RUSSIA: EXPERIENCE AND RESULTS OF LITERATURE DATA COMPILATION

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РАЗНООБРАЗИЕ АГАРИКОИДНЫХ ГРИБОВ В РОССИИ: ОПЫТ И РЕЗУЛЬТАТЫ ОБОБЩЕНИЯ ЛИТЕРАТУРНЫХ ДАННЫХ

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Summary: database summarizing 717 literary sources on the distribution of agaricoid fungi in Russia has been created using Google Sheets. All data were updated according to the current taxonomic status and geographic units. A checklist of 2926 species with synonymy and distribution in Russian regions has been prepared.

Keywords: fungal biodiversity, funga, Agaricomycetes, database, Google Sheets

At a time when the number of scientific publications on biodiversity is increasing year by year, it is extremely important to compile checklists that update the results of previous studies. In Russia, there are no up-to-date compilations summarizing information on fungal biodiversity for large geographic regions and the whole country. For fungi of the USSR and Russia no analogs of the Flora of the USSR do exist. Some works dealt only with certain taxonomic groups at family level at most. One of the largest and most prominent non-taxonomic groups of fungi is agaricoid (“mushrooms”), which performs the most important functions of decomposers and mycorrhizal

symbionts in terrestrial ecosystems. In addition, they are widely known to the people, and are associated with the word “mushrooms” in the mass consciousness.

Due to the development of information technologies that allow teamwork remotely in a unified data format, it has become possible to realize a large-scale project – the synthesis of primary information from existing publications (numerous, scattered and sometimes difficult to access) and the creation of a national check-list of agaricoid fungi on this basis. The information included allows: 1) to estimate the general number of agaricoid species registered from the territory of every Russian administrative region and the Federation in total; 2) to estimate spatial study coverage and subsequently reveal blank spots (unstudied, poor studied regions); 3) to provide researchers in the fields of mycogeography and fungal taxonomy with the information on species distribution through the checklist as well as the full references list.

The data sources were scientific publications containing information on agaricoid fungi distribution in Russia. The following steps were taken for appropriate publications selection: 1) issue archives of mycological journals mining; 2) analysis of Russian experts’ profiles within scientific bibliography databases; 3) analysis of reference lists in the publications selected during two previous steps. Also, references were obtained from the historical overviews of regional botany and mycological research (Vassilkov, 1953; Levitskaya, 1995; Nukhimovskaya, Kovalenko, 2001; Mukhin, 2008; Volobuev, Bolshakov, 2016).

We selected 717 publications (journal articles, book sections, monographs) containing data on species distribution. Unpublished data presented in dissertations, nature reserve annals and research reports were not included. Early publications were used only in the case of distinct data lack and the absence of more recent summary reviews for certain regions. A library of these publications is organized in EndNote, most of the works are digitized.

The data collection process was carried out using Google Sheets (Bolshakov et al., 2017).

A flat database was organized, consisting of three main tables:

• In the main data table, information according to the Darwin Core standard was entered: scientificName, acceptedNameUsage, bibliographicCitation, stateProvince, county, locality, identificationRemarks;

• Taxonomic classifier including main fields scientificName, parentNameUsage, acceptedNameUsage, taxonomicStatus, nomenclaturalStatus. Drop-down lists were created with the help of this table for effective and precise data entry and validation of taxa names in the scientificName field of the data table. Using VLOOKUP() the current names from the acceptedNameUsage field were automatically substituted.

• The references table includes complete data on all sources (bibliographic references). The main fields are taken from the EndNote scheme, from where the transfer to this table was made.

To create the taxonomic classifier used in our project, we imported all taxa of Agaricomycetes class in Darwin Core Archive format by means of 4Life WP4 Download Service of the Catalogue of Life (limited data with synonyms). Imported data have been cleaned. Agaricomycetes taxonomy in the Catalogue of Life is based on the main international database of fungal taxa Index Fungorum. To clarify and update the records, queries were made to the latter. Only taxa of agaricoid fungi genera are left according to the largest modern summary for agaricoid fungi of all Northern Europe Funga Nordica (Knudsen, Vesterholt, 2012). In case of differences in synonymy and taxonomic status of individual taxa, the opinion of Funga Nordica authors was taken instead of Index Fungorum opinion. For species absent from Funga Nordica, Index Fungorum data and a number of current taxonomic works were used.

Misprints and mistakes in fungal binomials and authors’ citation were not rare until the public nomenclature bases (such as Index Fungorum) came on the scene. Nomenclature control was performed, correcting mistakes in writing of authors of taxa: later homonyms, sanctioning of the name by Fries, isonyms, authors of rejected names, and others (Turland et al., 2018).

The administrative regions mentioned in the publications did not always match the current administrative division of Russia. Current administrative-territorial units were identified and recorded for entries with precise localities. In cases when it was not possible to determine localities within modern territories, broader regions (e.g. Leningrad Oblast with inclusion of St. Petersburg) or duplicated records (e.g. Voronezh Biosphere Reserve in Voronezh and Lipetsk Oblasts) were indicated.

Sources search, selection, and digitization, development of taxonomic classifier and data entry into the database took 30 months of work (since November 2016). Another 10 months (since February 2019) were spent to solving issues related to the interpretation of species that are absent in the original version of the taxonomic classifier, to clarify their current taxonomic status. Data cleaning, error detection and correction were carried out using OpenRefine tools.

As a result, the national database containing more than 80 thousand records and the updated taxonomic classifier with 7 thousand records was created. Storage and management of the resulting database is realized by means of Microsoft SQL Server 2016 on the server of the Botanical Institute of Russian Academy of Sciences.

A checklist of 2926 species with synonymy and distribution in Russian regions has been prepared, based on 717 scientific publications (up to 2019 inclusive). Information on the number of species and their distribution in the Russian regions has been integrated into a GIS system based on QGIS, thematic maps have been created.

The data obtained allow visualizing the study levels by region. More than 1 000 species are known in three most well studied regions: Primorsky Krai – 1 245 species, Krasnoyarsk Krai – 1 124 species and Leningrad Oblast – 1 118 species. Less than 100 species have been published for 22 regions, and for three of them 10 species are known to be less than 10: Republic of Dagestan – 2 species, Republic of Kalmykia – 3, Omsk Oblast – 4 species. There are absolutely no data on Republic of Ingushetia.

Thus, the “panoramic view” of the agaricoid fungi in the enormous territory of Eurasia was made for the first time. Further work on this project will focus on the analysis and publication of the data obtained in the public domain. In particular, the placement of data in GBIF will allow mycologists to access this information and find out fungi species have been revealed in Russia.

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