Development of interactive maps of geolocations of native plants of Kazakhstan and the living collections of the Mangyshlak experimental botanical garden

Akzhunis Imanbayeva ¹, Ivan Belozerov¹, Zhanna Musaeva¹, and Gulnara Hasanova¹

¹ RSE “Mangyshlak Experimental Botanical Garden” of SC MES RK, Aktau, 130000, Kazakhstan

Abstract. The purpose of this article is to identify problems, demonstrate results and assess the prospects for compiling interactive digital maps of native plants of Kazakhstan and the MEBG living collections, to be distributed through the Internet. Here we present four interactive maps: MEBG collections in the 10th sub-district of Aktau; herbarium specimens of plants from the Garden’s gene pool; samples of the herbarium of the natural flora of Western Kazakhstan and plants of the natural flora of Kazakhstan. Standard web programming languages are used to compile Internet maps. The creation of html pages and server versions of databases is carried out automatically in specially developed computer program modules. They are compiled in MEBS for the dry conditions of Mangistau.

1 Introduction

Over the past 12 years, employees of the Mangyshlak Experimental Botanical Garden (MEBG) have developed and implemented 4 botanical computer programs ("BD-PLANT-KZ" [1], "DlnCeR", "PLANT-EST-KZ", "Feno-S") [2,3], which are intended not only for the study of flora and vegetation - in-situ, but also for registration and diagnostics of the prospects of plants of the collection gene pool - ex-situ, inventory and comparative study of the aesthetics of green devices; accounting, storage, processing of materials from long-term phenological observations [4].

The staff of the institution, starting in 2021, began to pay significant attention to the modernization of developed local computer programs in terms of creating network applications, electronic guides and Internet geolocation maps of collection taxa, plants of natural flora and herbarium specimens.

2 Materials and Methods

In the first phase of the project, the main page of the MEBS portal was designed with the domain name "https://dincer.kz/". The main page had four links to the server versions of the computer programs "BD-PLANT-KZ", "DD-PLANT-KZ", "DlnCeR", "Feno-S", and "PLANT-EST-KZ" (Fig. 1). The lower control menu consisted of nine buttons to send email messages with and without attachment to the site administrator, send messages by WhatsApp,
view images, open interactive maps, print information, obtain the QR code of the botanical garden, and obtain a variety of reference information, including price lists for seeds, seedlings, and fertilizers, and prices for services provided. Flex technology was introduced into the software codes used for the site to enable compatibility of the MEBS digital model with mobile devices [5-7].

Fig. 1. Home page of the MEBS computer program portal.

In all developed web pages and databases (DB), the taxonomy of plants is based on the classification of A. Takhtajan [1]. To simplify the entry of systematic units, the program uses the list of genera by R.K. Brummitt [2]. Geobotanical classification by I.N. Safronova [3] in “BD-PLANT-KZ” is used to work with plant populations of the desert zone of Kazakhstan (vegetation type, group of formations, formation, association).

Four programming languages were used to compile the Internet maps: HTML 4.0 and 5.0, JavaScript API 2.1, and PHP v7.3.19.

3 Results and Discussion

During the project implementation, a web page was created ("https://dincer.kz/index_pr_ris.html") for viewing graphic files (Fig. 2) available from the floristic ("BD-PLANT-KZ"), collection ("DInCeR"), and landscaping ("PLANT-EST-KZ") databases. A test version of the interactive map of the MEBS territory in the 10th sub-district of Aktau with elements of plant geolocation ("https://dincer.kz/index_pr_map_MEBS. html") was also developed, on which coordinate marks were assigned to 53 sections of the Garden painted in different colors. The map represented 11 structural units of the botanical garden: arboretum, rose garden, fruit growing department, tree nursery, administrative and economic complex, etc. (Fig. 3). Algorithms were developed for searching units by list, for printing and copying information to the Windows clipboard, downloading data in Word format to a local disk, generating a QR code, and viewing information in automatic slide show mode.

2
Based on the interactive map of the MEBS living collections, a map of geolocations of herbarium specimens was created. When labels and polygons of sections and sites are activated, the lists of plants available in the herbarium are displayed (Fig. 4). In total, the server version of the herbarium database contains information on 168 specimens from 57 genera and 31 families representing 5 structural units of the botanical garden. Herbarium specimens are illustrated by 162 scanned images.
For the first time, a map of geolocations of native plants of Kazakhstan was compiled (Fig. 5), on which the boundaries of 14 regions were shown and each region was assigned a different color ("https://dincer.kz/index_map_Flora_RK.html"). Reverse and forward geocoding by a special label, lists of regions, and administrative and floristic districts was implemented. Thus, today the server DB of this program contains complete information about more than six hundred plants from 276 genera and 70 families of the natural flora of Kazakhstan. The distribution map of the native flora of the Republic of Kazakhstan (Fig. 5) served as the basis for creating another interactive map of geolocations of herbarium specimens of the native flora of Western Kazakhstan available from the MEBG: "https://dincer.kz/index_map_Herbarium_MEBS_Flora.html" (Fig. 6). In addition to the regions of the Republic, there are marks of herbarium sampling sites according to the coordinates entered into the database in decimal degrees (275 in total) [8]. When you click on a herbarium mark in a special window, all information associated with the selected herbarium sample is displayed on the screen. Thus, this map now displays information for 502 herbarium specimens of 183 taxa of the natural flora of Western Kazakhstan. These taxa represent 119 botanical genera from 45 families; collected in 12 administrative districts of 3 regions of the country. There are 339 photographs of herbarium sheets.
Like all cartographic products compiled in recent years, the map of geolocations of herbarium specimens is equipped with a lower control menu to enable searching (Fig. 7-8) and displaying lists of plants by region, administrative and floristic unit [9], printing and sending information by e-mail (Fig. 9) and WhatsApp (Fig. 10), copying data to the Windows clipboard, obtaining a variety of reference information, etc [10].
4 Conclusion

The Internet geolocation maps compiled by the MEBS have passed all stages of State registration in the RSE "NIIs" of the Ministry of Justice of the Republic of Kazakhstan and are protected by the relevant security documents.

Further improvement and development of the Internet maps and server versions of botanical databases of computer programs for plant introduction will greatly simplify the search for introduced plant locations and for a variety of taxonomic, geographical, ecological, and biological information about taxa. Quick access to the most complete information about plants, especially about rare and endangered ones, helps to improve biodiversity conservation not only in Western Kazakhstan, but also in other regions of the country.

References


