The Data Base of the Flora of Uzbekistan Komil TOJIBAEV *¹⁾, Natalya BESHKO¹⁾, Farhod KARIMOV ¹⁾, Avazbek BATOSHOV ¹⁾, Orzimat TURGINOV ¹⁾ and Dilnoza AZIMOVA ²⁾

Abstract: Uzbekistan is located in the center of Eurasia. Deserts occupy almost 85% of the territory; mountains and foothills cover about 15%. The flora includes more than 4250 species, but the check-list is still incomplete and the floristic data for several regions of Uzbekistan is imperfect. Since 2011 the compiling of digital database of the flora of Uzbekistan was running. This work is based on the field surveys, analysis of TASH herbarium materials and all available published sources with application of GIS software. During 2011-2013, 91 new findings were detected and 8 species new for science were founded. Contents of the database will be required for implementation of the "National Strategy and Action Plan of Biodiversity Conservation", for development of the protected areas system, for identification of important plant areas, for ecological monitoring and education as well as a background of new edition of the "Flora of Uzbekistan and the Red Data Book of Uzbekistan" etc.

Key Words: Data base, Endemic, Flora, Phytogeography, Uzbekistan

1. Introduction

The Republic of Uzbekistan is located in the center of the Eurasia. The flora accounts more than 4250 species of vascular plants including large numbers of endemic, endangered and globally important species. The floristic data for several regions of Uzbekistan is imperfect and studies are continuing. The six-volume edition the Flora of Uzbekistan (1941-1962) contains 4148 species (including of 3663 native and 485 alien species). However, this publication became considerably obsolete. During the last 50 years more than 450 new species and 3 new genera were described, significant changes took place in the plant taxonomy, the information on distribution of many plant species was comprehensively updated, and numerous invasive species became adapted to the territory of Uzbekistan. Since then, the process of intensive desertification and loss of vulnerable components of local biodiversity is occurring. Since 1963, the publication of the Conspectus Florae Asiae Mediae was launched by botanists of the Soviet Union. It played great role in understanding of flora of this territory. This megaproject was completed in 1993 with publication of the last (10th) volume. The area of distribution of species was indicated by natural (not political and administrative) regions, particularly, by mountain ridges, the majority of which has trans-boundary position.

After disintegration of the Soviet Union and ratification of the UN Convention on Biological Diversity (CBD) and Convention to Combat Desertification (CCD) by five Central Asian new independent states, the main objectives of botanical research in national level are the inventory and analysis of the floristic diversity, evaluation of endemic, rare and endangered species in accordance with IUCN Red List Categories and Criteria. However, absence of online digital sources complicates implementation of this objective. Generally, the floristic data exist in the "hard copy" format such as printed publications, scientific reports, dissertations and herbarium collections. Over a period of independence, the current list of flora was compiled and published only in Kyrgyzstan (Lazkov and Sultanova, 2011).

Uzbekistan is most densely populated country in Central Asia. The problem of desertification and degradation of natural ecosystems is a very critical issue in Uzbekistan. During the last decades, environmental impact of human activities significantly increased. Overgrazing, clear-cutting of trees and shrubs, reclamation of large areas for agriculture, minerals extraction, construction, unregulated collection of medical and other economic valuable plants, "wild" recreation are the most significant threats to the flora and vegetation cover in Uzbekistan. The database of the flora of Uzbekistan will enable us to assess the actual condition of the plant diversity, to analyze the changes, to identify the hot spots of most valuable plants (Important Plants Areas), to evaluate the status of endemics and rare species according to IUCN Red List Categories and Criteria, and to develop recommendations on the conservation of biodiversity and ecosystems.

The Central Herbarium of Uzbekistan (TASH) is an important source for compilation of the database of the flora of Uzbekistan. It is the largest herbarium collection of Middle-Asian species worldwide with more than 1.5 million

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herbarium specimens collected since 1840. The absence of a consistent digital source of available information on the plant diversity of Uzbekistan is a serious shortcoming for the practical activities of the nature conservation agencies and protected areas, as well as for monitoring, education and scientific research.

2. Methodological Basis

Thefield surveys were performed within the entire territory of Uzbekistan by traditional transect methods with collection of herbarium specimens and photographing of plants in nature. The coordinates of plants species location were recorded using GPS devices. The "Flora of Uzbekistan" (1941-1963), the "Conspectus Florae Asiae Mediae" (1963-1993) and monographic treatments of certain families and genera are used for plant species identification.

The information about herbarium specimens including locality, date of collection, collector and identificator's name was entered into the Microsoft Excel tables and was integrated into the Microsoft Access database. The most representative herbarium specimens for every species are scanned with the Herbscan device. The data are geo-referenced and imported into ArcGIS 9.3, transformed to a point map layer and saved as a shape file (shp). A WGS84 Geographic coordinate system was used as a reference datum. The point shape file was used to create a series of thematic maps to show the spatial distribution of plant species.

The annotated list of the flora of Uzbekistan and lists of flora for the botanical-geographical and administrative regions of the country are being compiled on the basis of analysis of herbarium collections and published floristic data.

Families are arranged in accordance with the newest APG system (2012) (http://www.mobot/org/research/APweb/welcome.html. Accepted names of plant species are given as www.ipni.org and www.theplantlist.org). Authors of the species are spelled in accordance with Brummit and Powell (1992).

The re-evaluation of national threat categories for endemic and rare species is carrying out according to IUCN Red List Categories and Criteria Version 3.1 (2001, 2012).

3. Results and Discussion

The main idea of our work is to analyze all available floristic data (uppermost TASH herbarium materials) and to compile information on taxonomy, morphology, ecology, geographical distribution, economic significance and status of species into the digital database. A great amount of material was accumulated during the entire history of botanical study of



Fig. 1. Botanical and Geographical regions of Uzbekistan. Mountainous Middle Asian Province: 1 - Western Tien Shan, 2 -Fergana, 3 - Fergana-Alai, 4 - Nurata, 5 - Kuhistan, 6 -Gissaro-Darvaz, 7 - South-Western Gissar, 8 - Near-Pjandzh, Turan Province: 9 - Upper-Syrdarya, 10 - Middle-Syrdarya, 11 -Kyzylkum, 12 - Bukhara, 13 - South Near-Aral, 14 - Aral, 15 -Ustyurt.

Uzbekistan. We can use data of more than one and half century for assessment of the process of desertification and transformation of flora and vegetation cover of Uzbekistan. This objective is achieved, to the best advantage, by application of GIS software which combines conventional operations with databases with options of visualization and spatial geographical analysis. The establishment of the digital database based on GIS is a large-scale work that has no analogy in Middle Asia. This project has state financing and co-financing by the GEF Small Grants Program which partially covers the needed expenses.

The matrix for accumulation of data on distribution of plant species is the scheme of phytogeographical phytochoria of Uzbekistan developed by authors (**Fig. 1**). This scheme is built on the basis of the natural boundaries of phytogeographical regions, analysis of species composition, distribution patterns of endemic and sub-endemic taxa, and characteristics of landscapes and vegetation cover. Basic works of different authors devoted to the problem of phytogeography of Central Asia including the latest publications (Rachkovskaya *et al.*, 2003) are used.

The analysis of all available materials on plant diversity of Uzbekistan showed the deficiency of floristic data for many regions of the country (Fig. 1). The flora of some mountainous and desert areas, for example, the South-Western Tien Shan, the Nuratau mountains, the lower part of the Amu Darya river basin, were well studied. The remaining territory of Uzbekistan was partially studied or investigations are running at present. For these regions, there are only the disembodied data (herbarium specimens, various scientific reports, articles etc.). For lack of floristic data we cannot use the system of grid cells for mapping of plant species distribution, which is used, for example, in the long-term

 Table 1. Quantity of species, herbarium specimens and new findings for certain genus of flora of Uzbekistan entered into data base.

Genus	Species	Herbarium specimens	Number of new records
Iris	31	569	
Allium	101	2012	7
Acer	3	506	
Ferula	55	854	8
Eremurus	31	847	
Jurinea	34	443	2
Cousinia	131	2834	7
Silene	47	379	2
Dianthus	17	124	
Carex	42	1332	
Astragalus	268	7080	6
Lathyrus	9	371	
Trigonella	7	386	
Hedysarum	28	430	4
Onobrychis	12	782	1
Oxytropis	63	1117	3
Euphorbia	35	1006	2
Andrachne	3	241	
Fritillaria	7	166	
Tulipa	26	603	2
Alcea	5	341	
Althaea	5	124	
Atraphaxis	8	494	3
Poly gonum	26	203	
Rumex	14	153	
Delphinium	19	351	
Ranunculus	35	577	

project "Atlas Florae Europaeae" (AFE).

Currently, more than 49,000 records on 1925 species were entered in the database including the largest genus of the flora of Uzbekistan - Astragalus (267 species), Cousinia (139), Allium (127), Gagea (more than 68), Oxytropis (63), Ferula (59), Artemisia (47), Jurinea (40), Eremurus (32) and others (Table 1). The work process showed that the great volume of TASH herbarium materials was not revised during the issuance of the "Flora of Uzbekistan", the "Conspectus Florae Asiae Mediae" and compilation of floristic check-lists of various regions of Uzbekistan. Thus, 47 new records for Uzbekistan were detected in the TASH collection (Tojibaev, 2010) as a result of study of the flora of South-Western Tien Shan. During 2011-2013 8 species new for science were found, 91 new records for Uzbekistan and great quantity of new findings for various phytogeographical regions were detected as a result of ours field expeditions and examination of TASH collection. This number of new findings is not a limit since the work continues.

In the Flora of Uzbekistan (Vvedenskiy, 1941) the Allium L. genus is represented with 68 species in the flora of Uzbekistan. According to latest data (Khassanov, 2008), onions of Uzbekistan account not less than 122 taxa (118 species and 4 sub-species). More than 2000 herbarium specimens belonging to 101 species of them are kept in TASH. Some species are represented only with holotypes stored in TASH, LE, GAT, LI and other herbariums worldwide. As a result of our work, 7 species of Allium (A. flavellum Vved., A. incrustatum Vved., A. lutescens Vved., A. platyspatum Schrenk, A. oreophylloides Regel, A. sordidiflorum Vved., A. viridiflorum Vved.) were added to the list of flora of Uzbekistan. Two new for science species (A. tatyanae F.O. Khass. & F. Karim. ined., A. reinchardii F.O. Khass. & F. Karim. ined.) were found during field surveys in 2011-2013. The similar situation is observed for many polymorphous genera of the flora of Uzbekistan. Thus, the genus Cousinia Cass. (Cherneva, 1962) is represented in Uzbekistan with 132 species that amount to more than half of all Central Asian species of Cousinia (262 species according to Cherneva (1993)). In TASH there are more than 2800 herbarium specimens of Cousinia collected from the territory of Uzbekistan.

As a results of our studies, the flora of Uzbekistan was supplemented with 7 species of *Cousinia* (*C. carduncelloides* Regel et Schmalh., *C. kokanica* Regel et Schmalh., *C. laniceps* Juz., *C. ninae* Juz., *C. pannosa* Winkl., *C. tonementella* Ledeb., *C. waldheimiana* Bornm.). The *Astragalus* L. is the largest genus of the flora of Uzbekistan and Central Asia. In TASH, it is represented with the greatest quantity of herbarium specimens. Around 7000 of them were collected from the territory of Uzbekistan.

The "Flora of Uzbekistan" contains 254 species (Gontcharov, 1955). According to the "Conspectus Florae Asiae Mediae", 257 species are recorded for Uzbekistan. We found that not less than 268 species grow in Uzbekistan. Out of them, 6 species were described after issuance of 6th volume of the *Conspectus* (Kamelin, 1981), 6 new records for Uzbekistan (*Astragalus artemisiformis* Rassul., *Astragalus bosbutooensis* E.Nikit. et Sudn., *Astragalus heterotrichus* Gontsch., *Astragalus sericeopuberulus* Boriss., *Astragalus taldycensis* Franch., Astragalus varzobicus Gontsch.) were detected during compilation of the database.

As a result of geo-referencing and import of the data to ArcGIS, the distribution map of monocotyledonous geophytes in the Fergana valley, distribution maps of tulip species of Uzbekistan, distribution maps of some rare and endemic species included into the Red Data Book of Uzbekistan, location map of new records and other have been prepared.

4. Conclusion

Thus, the database will be required for creating the cadaster of the flora of Uzbekistan and floristic GIS map, for implementation of the "National Strategy and Action Plan of Biodiversity Conservation", for development of protected areas system, for ecological monitoring and education, for the issuance of the new edition of the "Flora of Uzbekistan", and for re-evaluation of the national Red List of threatened species in accordance with current IUCN Red List Categories and Criteria, etc.

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