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REVIEW OF SPECIES OF THE GENUS *AEGILOPS* L. (POCEAE) IN CENTRAL ASIA

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Abstract. The article presents data on the distribution and species diversity of the genus *Aegilops* L. in the countries of Central Asia. Based on field research, literature sources, and analysis of herbarium specimens, six species of the genus are distributed in Central Asia (*Aegilops cylindrica*, *A. crassa*, *A. tauschii*, *A. triuncialis*, *A. juvenalis*). The species *Aegilops kotschyi* Boiss. is reported for the first time for the flora of Uzbekistan. Species of the genus *Aegilops* L., in addition to being wild relatives of cultivated wheat - one of the main food crops - are grazed by livestock on pastures in early spring. The results of this study will serve as a basis for future work on flora monitoring and regional cadastre assessments.

Keywords: *Aegilops* L., *Poaceae*, Central Asia, herbarium, identification key.

ОБЗОР ВИДОВ РОДА *AEGILOPS* L. (POCEAE) В СРЕДНЕЙ АЗИИ

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Аннотация. В статье представлены данные о распространении и видовом разнообразии видов рода *Aegilops* L. в странах Средней Азии. По данным полевых исследований, литературным данным и анализу гербарных образцов, в Средней Азии распространено 6 видов рода (*Aegilops cylindrica*, *A. crassa*, *A. tauschii*, *A. triuncialis*, *A. juvenalis*). Вид *Aegilops kotschyi* Boiss. указан впервые для флоры Узбекистана. Виды рода *Aegilops* L., помимо того, что являются дикими сородичами культурной пшеницы, которая является основной продовольственной культурой, поедаются скотом на пастбищах ранней весной. Результаты этих исследований послужат основой для будущих работ по мониторингу флоры и кадастра регионов.

Ключевые слова: *Aegilops* L., *Poaceae*, Средняя Азия, гербарий, ключ для определения вида.

ОРТА АЗИЯДАҒЫ *AEGILOPS* L. (POACEAE) ТУЫСЫНЫҢ ТҮРЛЕРІНЕ ШОЛУ

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Аңдатпа. Мақалада Орта Азия елдеріндегі *Aegilops* L. туысы түрлерінің таралуы мен түрлік алуантүрлілігі туралы деректер ұсынылған. Далалық зерттеулердің материалдарына, әдеби деректерге және гербарий үлгілерін талдауға сүйене отырып, Орта Азияда аталған туыстың 6 түрі таралғаны көрсетілді (*Aegilops cylindrica*, *A. crassa*, *A. tauschii*, *A. triuncialis*, *A. juvenalis*). *Aegilops kotschyi* Boiss. түрі Өзбекстан флорасы үшін алғаш рет көрсетіліп отыр. *Aegilops* L. туысының түрлері мәдени бидайдың жабайы туыстары болып табылуымен қатар, ерте көктемде жайылымдарда малмен де желінеді. Осы зерттеулердің нәтижелері флораны мониторингтеу және өңірлердің кадастрын жүргізу бойынша болашақ жұмыстарға негіз болады.

Түйін сөздер: *Aegilops* L.; *Poaceae*; Орта Азия; гербарий; түрлерді анықтау кілті.

Introduction. Central Asia (CA) is a historical and geographical region in Eurasia. In contrast to the broader historical and geographical region of Central Asia, the term Middle Asia is currently used to refer to Uzbekistan, Kyrgyzstan, Turkmenistan, Tajikistan, and Kazakhstan (Abduraimov et al., 2023b:97-101). Geographically, CA covers nearly 4 million km² and is located in the heart of the world's largest continent - Eurasia - serving as a crucial bridge between Europe, the Middle East, South Asia, and East Asia (Fig. 1). The CA region is typically characterized by a combination of high mountain ranges, vast plains, extensive deserts, and fertile valleys, which together shape its unique and diverse landscapes. In the southeast, the region includes the mountain systems of the Tien Shan and Pamir-Alai, whereas in the northwest it is dominated by lowlands concentrated on relatively flat terrain (Jilili et al., 2015).

At the same time, CA is deeply landlocked and represents the largest arid region within the temperate and warm-temperate zones of the Northern Hemisphere. The climate is largely arid or semi-arid and is strongly influenced by westerly atmospheric circulation patterns; the region is also known as a "water tower" (Chen et al., 2016:35-58). The presence of the Tien Shan mountain system forms an ecological barrier that obstructs the circulation of westerly winds and affects the distribution of precipitation across the region (Ma, et al., 2021:781; Hu et al., 2018:38; Liu et al., 2019:9). The Tien Shan and Pamir-Alai ranges create a humid island within the surrounding arid environment, which is crucial for maintaining oasis stability, conserving water resources, and supporting the development of diverse flora.

Floristically, CA belongs to the Irano-Turanian region and shows the greatest similarity to its western part, which extends from the Anatolian Plateau to the Tien Shan and the Pamirs (Manafzadeh et al., 2017:92). The mountains of CA support approximately 7,000 species of vascular plants, accounting for more than 75% of the total plant diversity of the region (Kamelin, 1973; Pan, 2021). Vegetation types are represented mainly by semi-desert and steppe ecosystems at both low and high elevations and are characterized by substantial endemic diversity (Manafzadeh et al., 2017:92).

Wild grasses constitute the main component of pastures and serve as forage plants readily consumed by all types of livestock (Usupbayev, 2017:149-153). Several studies have investigated wild relatives of cultivated plants distributed across CA. Such research has been conducted by prominent botanists, including A. D. Dzhangaliev (Dzhangaliev, 2008:10), G. T. Sitpayeva (Sitpayeva, 2010:38), M.A. Yesimbekova (Yesimbekova et al., 2015:5-18; Yesimbekova et al., 2004:38-41; Yesimbekova, 2014:25-27), A. A. Imanbayeva (Imanbayeva, 2018:148-154), A. B. Adzhiyev (Adzhiyev, 2023:27), Abduraimov et al. (Abduraimov et al., 2022:592; Abduraimov et al., 2023 a:1668-1675), and A. K. Usupbayev (Usupbayev, 2022). Among wild grasses, species of the genus Aegilops L. are of particular importance: their representatives are regarded as wild relatives of cultivated wheat and also constitute major forage plants in pastures.

Worldwide, the genus Aegilops L. comprises about 25 species. The main centres of origin are considered to be Southwest Asia, Central Asia, and the Mediterranean region (Kilian et al., 2011:1-76). Two-thirds of the species originate from these regions (Hedge et al., 2002:608-614). Species of this genus are mainly distributed in Georgia, Armenia, Azerbaijan, and northern Iran (Van, 1994:530), as well as in Cyprus, Lebanon, Israel, Syria, Iraq, southeastern Turkey, southwestern Iran, and northwestern Jordan (Lelley et al., 2000:661-668).

The results on the distribution of Aegilops species in CA countries are based on published literature data, analyses of herbarium specimens, and the outcomes of field surveys.

Materials and methods. This study used specimens from herbarium collections in Kazakhstan (AA, PPIU, KG, KSPI), Kyrgyzstan (FRU), Tajikistan (TAD, KHOR), Turkmenistan (ASH), and Uzbekistan (TASH, SAMDU), as well as collections of Lomonosov Moscow State University (MW) and the Komarov Botanical Institute (LE). Additional research sources relevant to this topic were also consulted. Standardized scientific plant names and the authorship of species, genera, and families follow the International Plant Names Index (IPNI, 2024) and Plants of the World Online (POWO, 2024). To verify the distribution of each taxon, we systematically examined the floras of each Central Asian country and reviewed occurrence records based on the Global Biodiversity Information Facility (GBIF, 2024). Species occurrence point maps were generated using ArcGIS (version 10.6).

When compiling the identification key, we used Flora of the USSR [1934], Guide to the Plants of Middle Asia [1968], and N. N. Tzvelev's Grasses of the USSR [1976].

Results and discussion. Herbarium specimens of *Aegilops* L. species from international databases (GBIF, Virtual Herbarium) were also analysed. The materials collected during field surveys, together with herbarium specimen analyses and literature data, indicate that six species of this genus occur in Middle Asia: *Aegilops cylindrica, A. crassa, A. tauschii, A. triuncialis, A. juvenalis* and *A. kotschyi*. An identification key to *Aegilops* L. species distributed in Middle Asia was developed and refined during the study (Table 1).

Table 1. Identification key to species

No.	Diagnostic characters
1.	Spikelet glumes of all spikelets, except the uppermost one, without awns and teeth, or with two teeth, one of which is short (up to 1 mm long) and not apical, rather blunt, while the other is narrower and often continues into a straight awn up to 2.5 cm long ..... 2.
+	Spikelet glumes of all spikelets with 2--4(5) awns ..... 4.
2.	Spikelet glumes 4.5--8 mm long, with the apex appearing truncate, without teeth and awns ..... 3. *A. tauschii* Coss.
+	Spikelet glumes 7--10 mm long, with the apex bearing two teeth: one broad and short, the other narrower and often continuing into an awn ..... 3.
3.	Spikelet glumes at the apex with two teeth, one of which usually continues into an awn .... 1. *Aegilops cylindrica* Host.
+	Spikelet glumes at the apex with two teeth, without awns ..... 2. *A. crassa* Boiss.
4.	Spikes almost linear, consisting of 1--2 rudimentary spikelets and (3--)4--6(--7) fully developed, slightly inflated spikelets; at fruiting the spike axis disarticulates into segments at the point of attachment to each floret, as in the spikelets; densely covered with very short hairs; caryopses adhering to the floral glumes (lemmas/paleas) ..... 5. *A. juvenalis* (Thell.) Eig
+	Spikes lanceolate, markedly narrowing toward the apex; at fruiting usually breaking off at the base, rarely disarticulating into segments in the lower part; spikes not inflated; spike axis glabrous or 6--8 mm hairy ..... 5.
5.	Spikelet glumes with convex veins of almost equal thickness, the veins being about twice narrower than the intervals between them; awns usually slightly divergent; upper lemmas at the apex with two sharp awns about 0.5 mm long; caryopses adhering to the floral glumes ..... 6. *A. kotschyi* Boiss.
+	Spikelet glumes with 6--7 flattened veins strongly differing in thickness; the intervals between veins nearly equal in width; awns more strongly divergent from the spike axis; upper lemmas at the apex without awns or with awns up to 0.2 mm long; caryopses free ..... 4. *Aegilops triuncialis* L.

Section ***Cylindropyrum*** (Jaub. et Spach) Zhuk.

1. A. cylindrica Host. Gram. Aust. 2: 6 (1802), Fedchenko in Fl. Turkmenii 1: 194 (1932); Nevskiy in Fl. SSSR 2: 671 (1934); Drobov in Fl. Uzbek SSR 1: 295 (1941); E. Nikitin in Fl. Kirg. SSR 2: 213 (1950); Kuznetsova in Fl. Kazakh. SSR 1: 313 (1956); A. Korovin in Fl. Tadzhik. SSR 1: 336 (1957); Nikiforov in Opred. rast. Sr. Azii 1: 183 (1968); Tzvelev, Zlaki SSSR: 157 (1976).

Lectotype: (Hungary) Buda Pesthini [= Budapest], in Cttu [= Comitatu = County] Bekesiensi, Kitaibel 226 (BP).

Ecology. Occurs at elevations of 650-2100 m a.s.l. on shallow stony, gravelly, and soft grey soils (Fig. 1).

General distribution. Central Asia, Afghanistan, Iran, Iraq, Turkey, Southern Europe, and Northwestern Europe (Kilian et al., 2011:1-76; Van, 1994:530).

Distribution in Middle Asia: Kazakhstan (Almaty, Zhambyl, and Turkestan Regions; southern and southeastern Kazakhstan) (Chirkin et al., 2017:150-155; Abugalieva et al., 2018:36-40; Yesimbekova et al., 2015:5-18; Yesimbekova et al., 2004:38-41; Yesimbekova, 2014:25-27); Kyrgyzstan (Western Tien Shan, Northern Tien Shan, and the Fergana region) (Lazkov& Sultanova, 2014:126; Usupbayev, 2022); Tajikistan (I-T, M, E-S) (Arkadiusz&Marcin, 2020:558-561); Turkmenistan (Kushka, Tashkepri, Bami, Kempyrtyube, Kyzylalma) (Demidov, 2020:446); Uzbekistan (Kuramin, Chatkal, North Turkestan, Gissar, Zeravshan, Kugitang, Baysun,

Nuratau, Babatag, and Babadag ranges) (Mamatkasimov et al., 2025:1-15; Mamatkasimov et al., 2024:234) (Fig. 2).

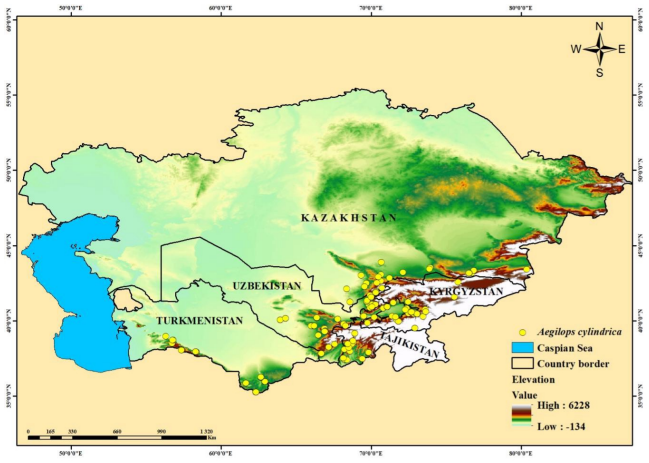

Figure 2. Distribution map of *Aegilops cylindrica* in Middle Asia

2. A. crassa Boiss. Diagn. Pl. Or., ser. 1, 7: 129 (1846); Fedchenko in Fl. Turkmenii 1: 194 (1932); Nevskiy in Fl. SSSR 2: 671 (1934); Drobov in Fl. Uzbek SSR 1: 295 (1941); E. Nikitin in Fl. Kirg. SSR 2: 213 (1950); Kuznetsova in Fl. Kazakh. SSR 1: 313 (1956); A. Korovin in Fl. Tadzhik. SSR 1: 336 (1957); Nikiforov in Opred. rast. Sr. Azii 1: 183 (1968); Tzvelev, Zlaki SSSR: 157 (1976).

Holotype: [Iran] Kotschy 248 (G-BOIS)

Ecology. Occurs at elevations of 600-1600 m a.s.l. on shallow stony and soft grey soils.

General distribution. Central Asia, Afghanistan, Iran, Iraq, the Middle East, Turkey, and the Caucasus (Kilian et al., 2011:1-76; Hedge et al., 2022:608-614; Van, 1994:530).

Distribution in Middle Asia: Kazakhstan (southern Kazakhstan; Turkestan, Shymkent, and Zhambyl Regions) (Urazaliev, 2018:484-490; Yesimbekova et al., 2015:5-18); Kyrgyzstan (Western Tien Shan; the Fergana region) (Lazkov& Sultanova, 2014:126; Usupbayev, 2017:149-153; Usupbayev, 2022); Turkmenistan (Kushka, Tashkepri, Bami, Kempyrtyube, Kyzylalma) (Demidov, 2020:446; Fedchenko, 1932:194-197); Uzbekistan (Chatkal, Kuramin, North Turkestan, Gissar, Zeravshan, Kugitang, Baysun, Nuratau, Babatag, and Eastern Alai ranges; in the basins of the Zarafshan and Tupalang rivers; in the relict mountains of Kyzylkum) (Mamatkasimov et al., 2025:1-15; Mamatkasimov et al., 2024:234) (Fig. 3).

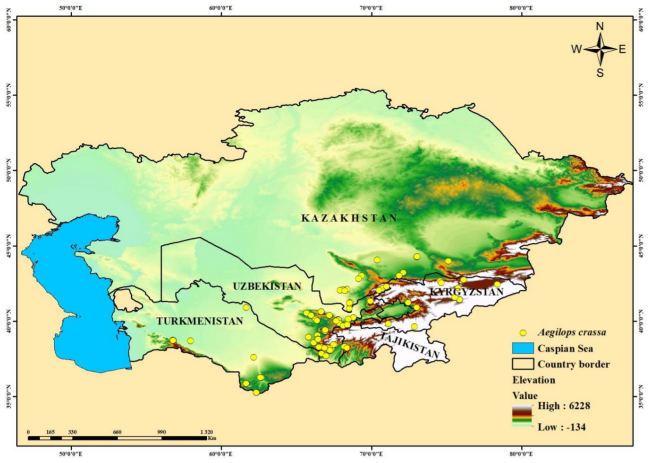

Figure 3. Distribution map of *Aegilops crassa* in Middle Asia

3. A. tauschii Coss. Not. Quelq. Pl. Crit. Rar. Nouv. 2: 69 (1849); Tzvelev, Zlaki SSSR: 157 (1976); Nevskiy in Fl. SSSR 2: 671 (1934); E. Nikitin in Fl. Kirg. SSR 2: 213 (1950); Nikiforov in Opred. rast. Sr. Azii 1: 182 (1968).

Lectotype: [Iberia] the illustration in J.Ch. Buxbaum, Plantarum minus cognitarum Centuria 1: Tab. 50, fig. 1 (1728).

Ecology. Occurs at elevations of 400-1800 m a.s.l. on shallow stony and gravelly soils.

General distribution. Central Asia, Afghanistan, northern and central China, Iran, Iraq, the Middle East, Turkey, Pakistan, Crimea, the North Caucasus, and the Western Himalayas (Kilian et al., 2011:1-76; Van, 1994:530; Wei et al., 2008:1525-1531; Maciej et al., 2017:1149; Zhou et al., 2021:774-786).

Distribution in Middle Asia: Kazakhstan (Almaty, South Kazakhstan, Zhambyl, Turkestan, and Shymkent Regions) (Yesimbekova et al., 2015:5-18; Urazaliev, 2018:484-490); Kyrgyzstan (Western Tien Shan, Northern Tien Shan, and the Fergana region) (Mamatkasimov et al., 2024:234; Usupbayev, 2022); Tajikistan (I-T) (Arkadiusz&Marcin, 2020:558-561); Uzbekistan (Chatkal, Eastern Alai, Nuratau, North Turkestan, Zeravshan, and Western Gissar ranges) (Mamatkasimov et al., 2025:1-15; Mamatkasimov et al., 2024:234) (Fig. 4).

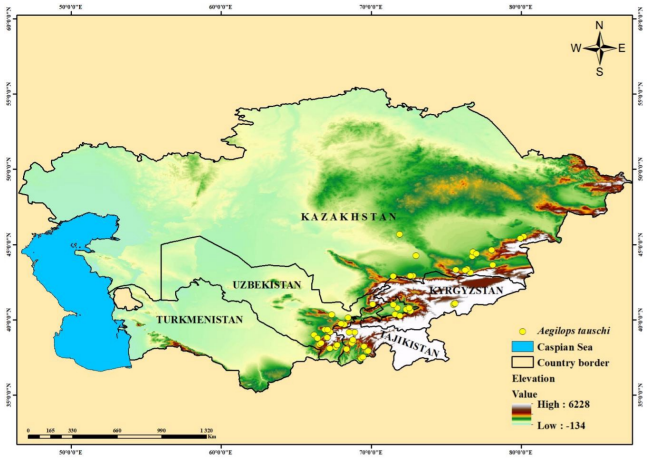

Figure 4. Distribution map of *Aegilops tauschii* in Middle Asia

Section ***Aegilops*** Tzvel.

4. A. triuncialis L. Three-awned goatgrass. Sp. Pl. 1: 1051 (1753); Fedchenko in Fl. Turkmenii 1: 194 (1932); Nevskiy in Fl. SSSR 2: 671 (1934); Drobov in Fl. Uzbek SSR 1: 295 (1941); E. Nikitin in Fl. Kirg. SSR 2: 213 (1950); Kuznetsova in Fl. Kazakh. SSR 1: 313 (1956); A. Korovin in Fl. Tadzhik. SSR 1: 336 (1957); Nikiforov in Opred. rast. Sr. Azii 1: 183 (1968); Tzvelev, Zlaki SSSR: 157 (1976).

Holotype: [Spain] Loelling 701/3 (LINN 1218.8).

Ecology. Occurs in foothills, along roadsides, and on stony and gravelly slopes of hills and plains at elevations of 400-2000 m a.s.l.

General distribution. Central Asia, Afghanistan, Iran, Iraq, the Middle East, Turkey, Pakistan, Crimea, the North Caucasus, and Southern Europe (Kilian et al., 2011:1-76; Kou et al., 2023:880; Van, 1994:530).

Distribution in Middle Asia: Kazakhstan (South Kazakhstan, Zhambyl, Turkestan, and Shymkent Regions) (Yesimbekova et al., 2015:5-18; Yesimbekova et al., 2004:38-41; Yesimbekova, 2014:25-27); Kyrgyzstan (Western Tien Shan, Northern Tien Shan, and the Fergana region) (Usupbayev, 2022); Tajikistan (I-T) (Arkadiusz&Marcin, 2020:558-561); Uzbekistan (Gissar, Kugitang, Zeravshan, Chatkal, Ugam, Kuramin, Baysun, Nuratau, and Babatag ranges; the Topalang, Sangzor, and Shahimardan rivers; and the inselberg mountains of Kyzylkum) (Mamatkasimov et al., 2025:1-15; Mamatkasimov et al., 2023:1305-1315; Mamatkasimov et al., 2024:234) (Fig. 5).

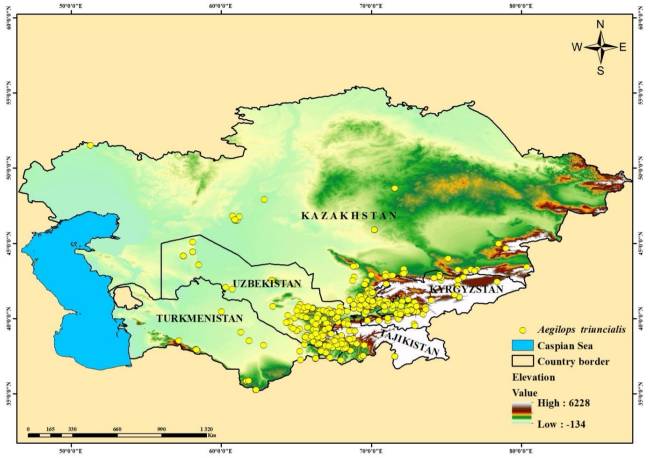

Figure 5. Distribution map of *Aegilops triuncialis* in Middle Asia

5. A. juvenalis (Thell.) Eig. Fedde, Repert. Beih. LV (1929); Fedchenko in Fl. Turkmenii 1: 196 (1932); Nevskiy in Fl. SSSR 2: 671 (1934); Drobov in Fl. Uzbek SSR 1: 296 (1941); Kuznetsova in Fl. Kazakh. SSR 1: 313 (1956); A. Korovin in Fl. Tadzhik. SSR 1: 336 (1957); Nikiforov in Opred. rast. Sr. Azii 1: 183 (1968); Tzvelev, Zlaki SSSR: 157 (1976).

Holotype: [France]. “Port Juvénal prope Montpellier”. Touchy s.n. (MPU)

Ecology. Occurs on fine stony, gravelly, and soft grey soils at elevations of 400-1800 m a.s.l.

General distribution. Iran, Iraq, Kazakhstan, Lebanon-Syria, Turkey, Turkmenistan, Uzbekistan, and Azerbaijan (Kilian et al., 2011:1-76; Kou et al., 2023:880; Van, 1994:530; Cabi & Doğan, 2009:447-452; Cabi & Doğan, 2016:667-672).

Distribution in Middle Asia: Uzbekistan (Kuramin, Baysun, Kugitang, and Babatag ranges) (Mamatkasimov et al., 2025:1-15); Turkmenistan (Farab, Batash Kanshar) (Demidov, 2020:446; Fedchenko, 1932:194-197) (Fig. 6).

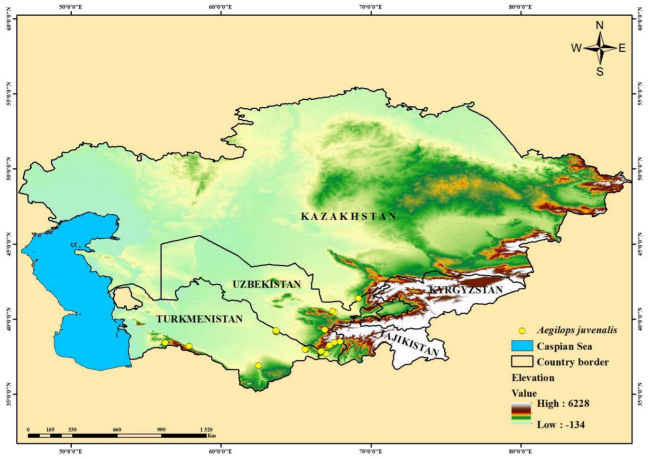

Figure 6. Distribution map of *Aegilops juvenalis* in Middle Asia

6. A. kotschyi Boiss. - Diagn., ser. 1, VII: 129 (1846); Nevskiy in Fl. SSSR 2: 673 (1934); Tzvelev, Zlaki SSSR: 157 (1976).

Lectotype: [Iran]. Kotschy 366a G-BOIS; isolectotypes: BM, C, E, FI, G, K, LE, OXF, P, PI, PRC, TUB). See p. 252.

Ecology. Occurs on fine stony, gravelly, and soft grey soils at elevations of 300-1200 m a.s.l.

General distribution. Afghanistan, Cyprus, Egypt, the Persian Gulf countries, Iran, Iraq, Kuwait, Lebanon-Syria, Libya, Oman, Palestine, Saudi Arabia, Sinai, Transcaucasia, Tunisia, and Turkey (Kilian et al., 2011:1-76; Van, 1994:530; Cabi&Doğan, 2009:447-452; Cabi&Doğan, 2016:667-672).

Distribution in Middle Asia: There are no published records of this species from Central Asia. However, in our study, analysis of specimens housed in the National Herbarium of Uzbekistan (TASH) showed that the first herbarium specimen of this species was collected by Kultiyasov in 1914 within the territory of the present-day Kashkadarya Region (Fig. 7).

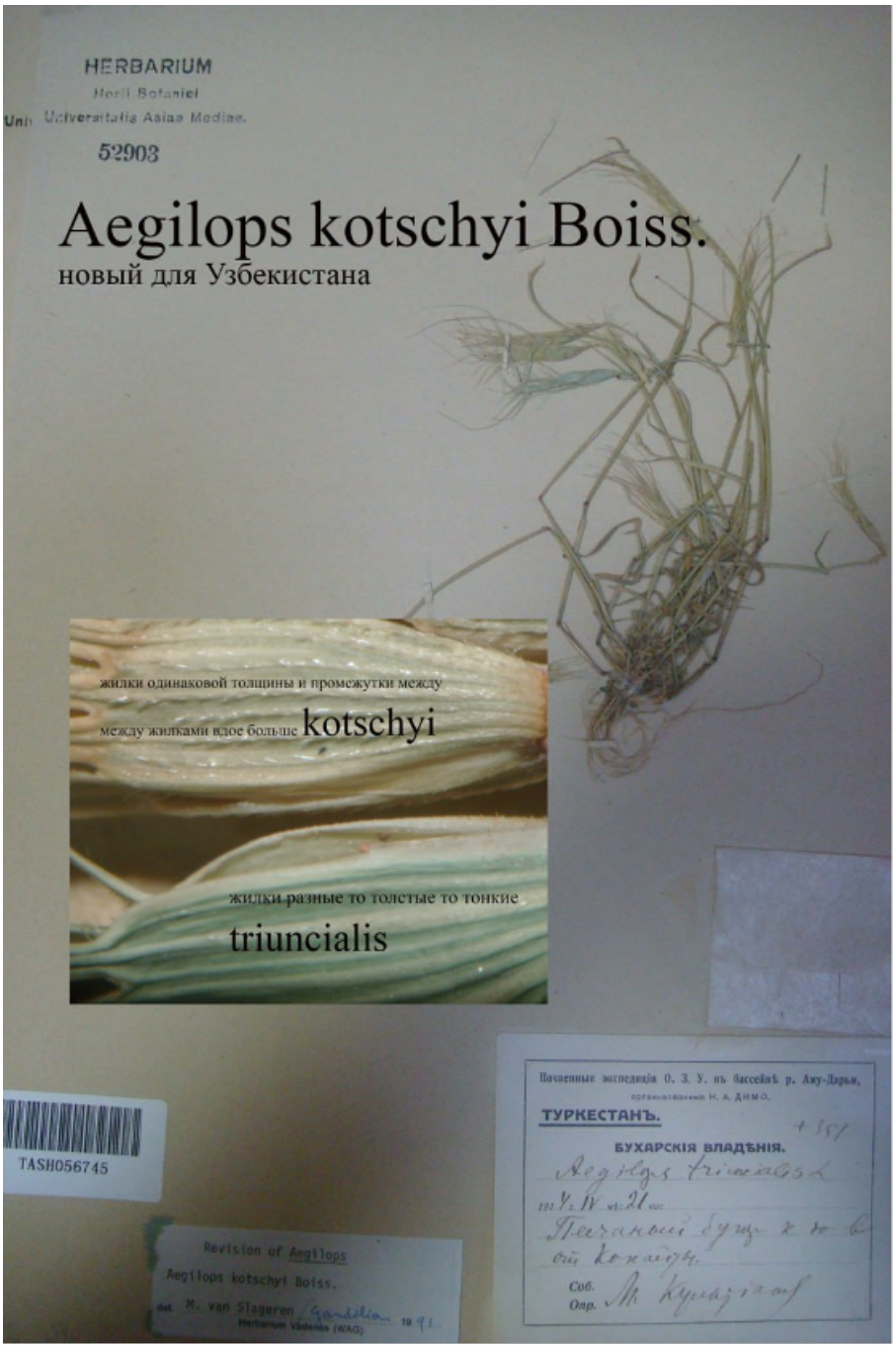

Figure 7. *Aegilops kotschyi* specimen collected in 1914

In 2023, during field surveys conducted by Uralov Rustam in the Surkhandarya Region, herbarium specimens of this species were collected and uploaded to the international database GBIF (https://www.gbif.org/occurrence/4929414183) (Fig. 8).

Figure 8. *Aegilops kotschyi* specimen collected in 2023

In the literature (Flora of Turkmenistan; Guide to the Plants of Middle Asia), there are no data on the occurrence of *Aegilops kotschyi* in Turkmenistan. However, the Global Biodiversity Information Facility (GBIF) database contains information on more than 10 specimens collected in this country (see GBIF occurrence records) (Fig. 9). Based on these data, we produced a map reflecting the distribution of this species in Central Asia (Fig. 9). https://www.gbif.org/ru/occurrence/4929414183, https://www.gbif.org/ru/occurrence/1300785042).

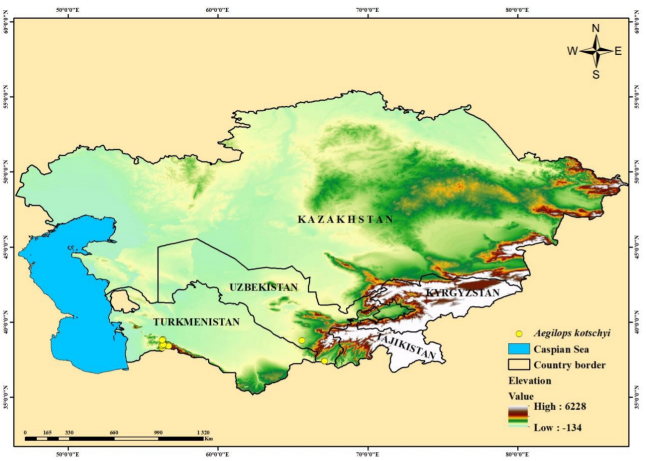

Figure 9. Distribution map of *Aegilops kotschyi* in Middle Asia

An analysis of species diversity of the genus *Aegilops* in the countries of Middle Asia was carried out. According to the results, Uzbekistan is the region with the highest species diversity:

six *Aegilops* species occur within its territory. Four species occur in Kazakhstan, Kyrgyzstan, and Turkmenistan, whereas three species are recorded in Tajikistan (Fig. 10).

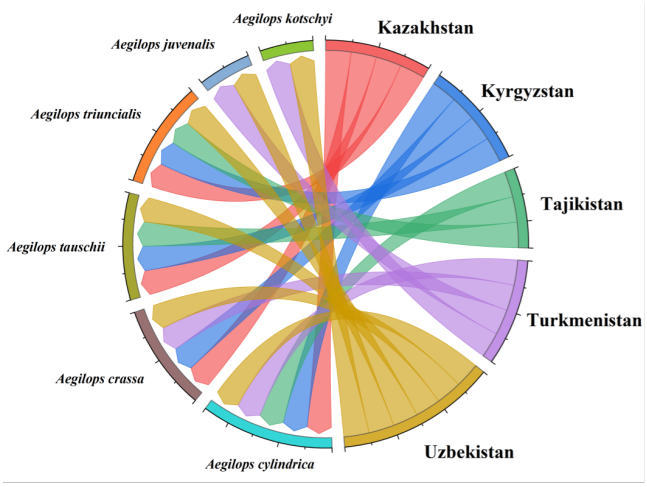

Figure 10. Species diversity of the genus *Aegilops* L.

Conclusion. Species of the genus *Aegilops* L. have been used by humans for several centuries. The Central Asian region is among the areas with the highest species diversity of *Aegilops*. Available herbarium collections, geobotanical data, and research evidence indicate that five species belonging to two sections of the genus are recorded in Middle Asia. According to their elevational distribution, *Aegilops cylindrica* and *A. juvenalis* occur at 400-1600 m a.s.l., *A. crassa* and *A. tauschii* at 1600-1800 m a.s.l., whereas *A. triuncialis* occurs at 2000 m a.s.l. and above.

Data on the distribution and current status of the five *Aegilops* species are used for species monitoring and for inventories of vascular plants. Natural population areas serve as the primary source material for breeding and genetic studies.

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