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Research Article

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Ontogenesis and Ontogenetic Structure of Hordeum Bulbosum in Uzbekistan (Poaceae L)

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Abstract

With the destruction of natural ecosystems, wild relatives of cultivated plants, the diversity of which ensures food security for the growing population of the Earth, are irretrievably disappearing. Changes occurring in nature, and in particular climate warming, are the most common of the various threats to the planet's biological diversity. In this regard, the conservation of plant genetic resources as part of natural communities - in situ - becomes an urgent task. The purpose of our study is to identify the ontogeny and ontogenetic structure of Hordeum bulbosum in the changing mountain conditions of Uzbekistan. The phytocenotic characteristics of the cenopopulations were established and the age status of the studied species was assessed. The ontogeny of Hordeum bulbosum is characterized by a simple complete ontogeny. The duration of the large life cycle is 10-11 years. The ontogenetic spectra of Hordeum bulbosum have been revealed. The studied coenopopulations are normal, but incomplete. The absence of seedlings (CP 5, 7, 8) and senile (CP 7, 8) fractions is associated with the irregularity of seed propagation and the inability of the species to go through the stages of ontogenesis. The main threat is climate change and anthropogenic influence on plant cenopopulations.

Keywords: Wild Relatives, Coenopopulation, Ontogenetic Structure, Mountains of Uzbekistan, Hordeum Bulbosum

1. Introduction

Wild relatives are valuable materials that can be used to adapt crops to changing environmental conditions and human needs. Still, the threat to natural populations of wild plant species is steadily increasing due to their overexploitation and disappearance of habitats [1].

The study of cenopopulations of valuable plants is a current direction for researchers. To maintain and preserve plant resources, it is necessary to assess biodiversity, in particular, to study the state of plant populations. In recent years, the study of rare and endangered plant species and the status of their populations in Uzbekistan has increased [2-7]. However wild relatives of cultivated plants in Uzbekistan are poorly studied. The threat to natural populations of wild relatives is steadily increasing due to their overexploitation and climate change [8-10].

Uzbekistan is part of the Central Asian genetic center of the origin of cultivated plants and a large number of species of agricultural plants were formed here. It is home to several types of vegetable crops, in particular onions (Alluim cepa), carrots (Daucus carota), radishes (Raphanus sativus), spinach (Spinacia oleraceae), coreander (Coreandrum sativum), basil (Ocimum basilicum) and other crops [11].

According to O.S. in the flora of Uzbekistan, there are 222 wild relatives of cultivated plants, belonging to 24 families belonging to 102 genera. It makes up 5% of the total flora of Uzbekistan (4350 species). The Poaceae family includes 270 species belonging to 90 genera [12,13]. Of these, 27.55% are considered wild relatives of cultivated plants [14]. It includes the main food plants (wheat, rice, corn, and others, less widely cultivated - rye, barley, oats, sorghum, millet, etc.), which also provide valuable food for animals.

Hordeum is one of the most important grain crops in Uzbekistan and has been widely studied in the national economy for feed, food purposes, and as a raw material for industry [15].

Uzbekistan is the birthplace of many types of barley and is part of the genetic center of the formation of wild barley species. Annual and perennial wild species of barley grow here [16]. It is the primary center of origin of such species as Hordeum spontaneum C.Koch., Hordeum bulbosum L., Hordeum leporinum Link., Hordeum turkestanicum Nevski, etc. [17].

Based on the above, it becomes clear that it is necessary to study the wild relatives of cultivated plants in natural conditions.

2. Method

Studies of the coenopopulation of H. bulbosum were carried out in the foothills and mountain ranges of the Republic of Uzbekistan: Alai Range, Kuramin Range, Turkestan Range, Zarafshan Range, Gissar Range, Babatag Range. A total of 8 coenopopulations were studied (Table 1).

The climate of Uzbekistan is characterized by continentality, aridity, and scarcity of water resources. The average temperature in winter (January) ranges from – 8 0C to +3 0C, in mountainous areas it drops to - 16 0C. The absolute minimum air temperature is - 35 0C. In summer, a Turanian tropical air mass is formed on the flat part of the republic. The air becomes dry and hot and precipitation does not fall. In summer (July) the temperature in the northern regions is + 26 -32, while in the south it reaches + 41 - 42 0C. The absolute maximum temperature is + 50 0C. The study area does not differ sharply in air temperature and precipitation. The average maximum air temperature is from 28.3 to 30.10C, the average minimum temperature ranges from -0.2 to +2.2 0C. The average annual precipitation per year is 378 - 629 mm (https://ru.climate-data.org/asia/uzbekistan-161/) (Table 1).

To assess the phytocenotic confinedness of cenopopulations, geobotanical descriptions of communities were carried out on 100 m2 plots using traditional geobotanical methods (Ponyatovskaya 1964). Latin names of plant species are given according to the latest summary and by the international taxonomic database POWO (https://powo.science.kew.org) [18]. When identifying age-related conditions, we used the methodological principles and approaches outlined in the works of [19]. When determining the age structure of cenopopulations, according to standard criteria, the following age states were taken into account: juvenile (j), immature (im), virginal (v), young generative (g1), middle generative (g2), old generative (g3), senile (s). The structure of cenopopulations was studied using the generally accepted method [20,21]. Transects were laid 10 meters long, they were divided into areas of 1 m^2. Each cenopopulation has from 10 to 30 sites of 1m^2 each. The ontogenetic structure of cenopopulations was determined as the ratio in the cenopopulation of individuals of different ontogenetic states. An individual was taken as a counting unit. The cenopopulation type was determined according to the classification of [22,23].

3. Findings and Discussions

3.1 Description of Plant Communities of Hordeum Bulbosum

Hordeum bulbosum L. is a valuable forage and ancient agricultural plant [24]. Hordeum bulbosum has a wide range. It is common in Western and Central Asia. A perennial plant that grows in a temperate biome (https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:405169-1).

№ CP	Geographic locations CP	Average long-term ^{0}C	Average maximum ^{0}C	Average minimum ^{0}C	Precipitation, mm
1	Alai Ridge, Namangan region, Pap district	15.7	30.1	0.7	348
2	Kuramin ridge, Tashkent region, Pskent district	14.1	27,0	1,2	582
3	Turkestan Ridge, Jizzakh region, near the Malguzar (Jizzakh) river	14,2	27,4	1,3	423
4	Turkestan Ridge, Jizzakh region, near the Kulsuvsoy (Zaamin) river	13,2	26,0	0,1	629
5	Turkestan Ridge, Jizzakh region, Farish district (Goliblar)	15,1	28,3	2,0	378
6	Zarafshan Ridge, Samarkand region, Urgut district	11,5	23,8	-1,0	563

7	Gissar Ridge, Kashkadarya region, Dekhkanabad district, Karadakhana village	12,1	24,3	-0,2	494
8	Babatag Ridge, Surkhandarya region, village Madaniy Khordik (Uzun)	14,6	27,1	2,2	450

Table 1: Characteristics of Plant Communities of the Studied Species

In Uzbekistan, H. bulbosum is well adapted to local soil and climatic conditions, especially moisture deficiency, and low air humidity, and is highly drought-resistant [25]. This allows it to grow in different environmental conditions - on the side of the road, on different types of gray soils with different mechanical compositions. However, due to harsh climatic conditions - limited precipitation, high temperature, and low air humidity, H. bulbosum is not found in Bukhara, Navoi, Khorezm regions, and the Republic of Karakalpakstan, [26].

The first cenopopulation (CP 1) was studied in the Alai ridge, Namangan region, Pap district, near the village of Madaniyat, at an altitude of 984 meters above sea level on a rocky gravel slope. The phytocenosis is dominated by Artemisia ferganensis Krasch. ex Poljakov., Hordeum bulbosum L., Capparis spinosa L. The total projective cover of the plant is 35%. 31 plants are registered in the plant community. The second cenopopulation (CP 2) was identified in the foothills of the Kuramin ridge, Tashkent region, Pskem district, near the village of Gultepa, at an altitude of 903 meters above sea level on gray soil. The plant community is dominated by Carex pachystylis J.Gay, Plantago lanceolata L., and Hordeum spontaneum K. Koch. The projective cover of the phytocenosis is 90%. The third cenopopulation (CP 3) is described in the Turkestan ridge, Jizzakh region, Zaamin district, near the Molguzar river, at an altitude of 476 meters above sea level on dark gray soil. The floristic consists of 76 higher vascular species, and the projective cover of the plant is 35%. The phytocenosis is dominated by Phlomis thapsoides Bunge, Alhagi pseudalhagi (M.Bieb.) Desv. ex Wangerin. The fourth cenopopulation (CP 4) was studied in the Turkestan ridge, Jizzakh region, Zaamin district, near Kulsuvsay, at an altitude of 2050 meters above sea level on grey earth. There are 34 species in the plant community, and the projective cover is 80%. Floristic composition: 34 species. The fifth cenopopulation (CP 5) is described in the Turkestan ridge, Jizzakh region, Farish district, in the village of Baland Osmon, at an altitude of 984 meters above sea level on gray soil. The floristic composition is 32 species, dominated by Juglans regia L., Crataegus turkestanica Pojark., Prunus bucharica (Korsh.) Hand.-Mazz., Arctium umbrosum (Bunge) Kuntze. Projective cover of the plant - 50%. The sixth cenopopulation (CP 6) was studied in the Zarafshan ridge in the Samarkand region, in the Urgut district, at an altitude of 1005 meters above sea level on dark gray soil. The phytocenosis is dominated by Prunus spinosissima (Bunge) Franch., Phlomis thapsoides Bunge, Poa bulbosa L. The floristic composition is 44 species, the total projective cover is 35-40%. The seventh cenopopulation (CP 7) was determined in the Gissar ridge, Kashkadarya region, in the Dekhkanabad district, at a height of 1098 meters above sea level on dark gray soil. The last cenopopulation (CP 8) was studied in the Babatag ridge, Surkhandarya region, at an altitude of 1422 meters above sea level on a stone gravel slope. Floristic composition 20 species, dominant Hordeum spontaneum K.Koc., Inula grandis Schrenk ex Fisch. & C.A.Mey., Haplophyllum bungei Trautv. The total projective coverage is 80-84% (Fig. 1; Table 2).

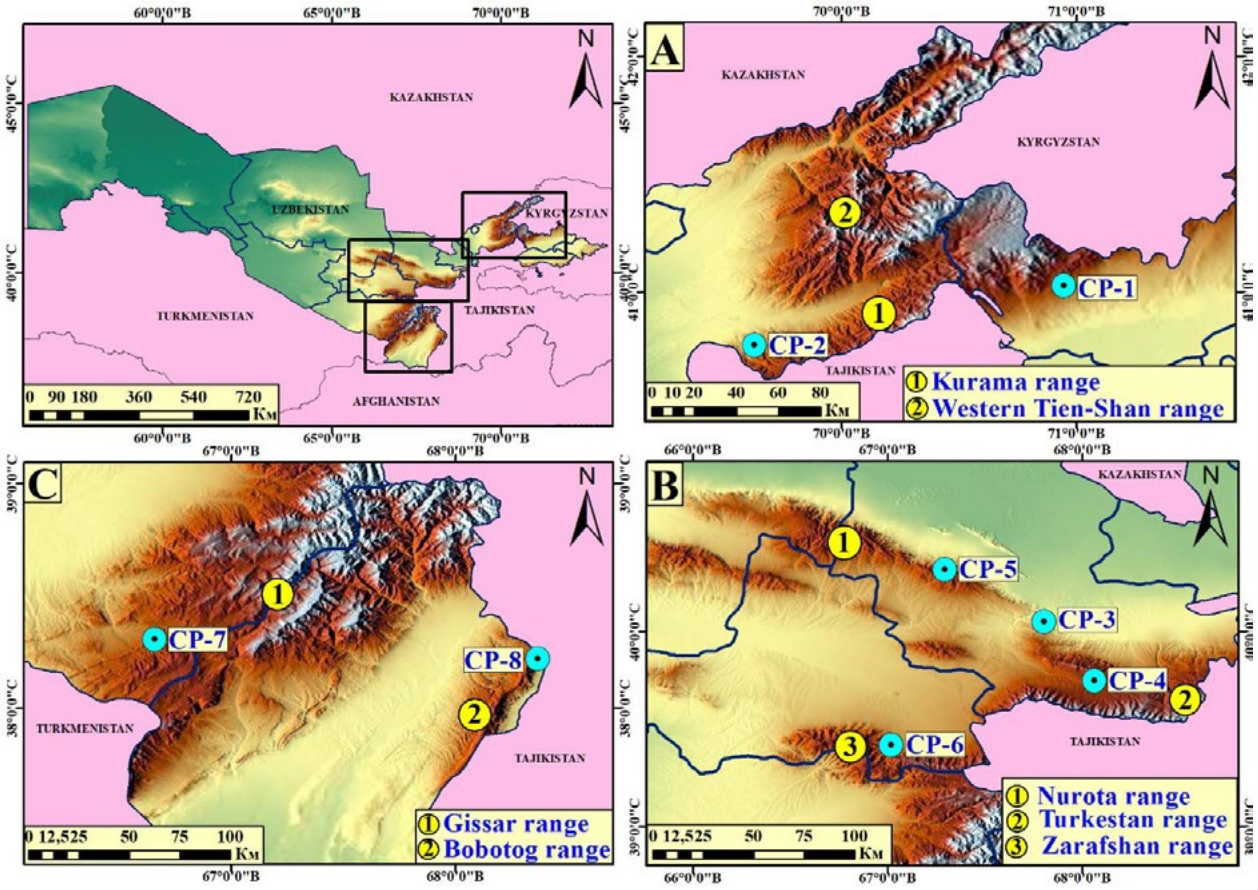

Figure 1: Distribution of Hordeum Bulbosum Studied Cenopopulations

№ CP	Geographic locations CP	Geographical coordinates/ Elevation/m	Community/ dominant species	The nature of the substrat e	Total projective cover, %	The projective cover of this species,%
1	Alai Ridge, Namangan region, Pap district	N: 41.026917 E: 70.944680 H - 984 m. a.s.l.	Artemisia ferganensis, Hordeum bulbosum, Capparis spinosa	stone-gravel	35 %	≤ 35
2	Kuramin ridge, Tashkent region, Pskent district	N: 40.774608 E: 69.627014 H - 903 m. a.s.l.	Carex pachystylis, Plantago lanceolata, Hordeum spontaneum	gray earth	90 %	≤ 10

3	Turkestan Ridge, Jizzakh region, near the Malguzar (Jizzakh) river	N: 40.054473 E: 67.799167 h - 476 m. a.s.l.	Phlomis thapsoides, Alhagi pseudalhagi	dark gray soil	30-35 %	≤ 3
4	Turkestan Ridge, Jizzakh region, near the Kulsuvsoy (Zaamin) river	N: 39.749648 E: 68.060193 h - 2050 m. a.s.l.	Juniperus seravschanica, Juniperus semiglobosa, Festuca valesiaca	gray earth	70-80 %	≤ 5
5	Turkestan Ridge, Jizzakh region, Farish district (Goliblar)	N: 40.321838 E: 67.290573 h - 984 m. a.s.l.	Juglans regia, Malus sieversii, Crataegus turkestanica, Cousinis umbrosa	gray earth	40 %	≤ 5
6	Zarafshan Ridge, Samarkand region, Urgut district	N: 39.419341 E: 67.015972 h - 1005 m. a.s.l.	Prunus spinosissima, Phlomis thapsoides, Poa bulbosa	dark gray soil	84	≤ 1
7	Gissar Ridge, Kashkadarya region, Dekhkanabad district, Karadakhana village	N: 38.307137 E: 66.656093 h - 1098 m. a.s.l.	Poa bulbosa, Hordeum bulbosum, Artemisia annua	dark gray soil	35-40	≤ 5

8	Babatag Ridge, Surkhandarya region, village Madaniy Khordik (Uzun)	N: 38.221271 E: 68.364559 h - 1422 m. a.s.l.	Hordeum spontaneum, Inula grandis, Haplophyllum bungei	stone gravel	85	≤ 25

Table 2: Characteristics of Plant Communities of the Studied Species

3.2 Ontogenesis and Life Cycle of Hordeum Bulbosum

The ontogeny of Hordeum bulbosum has been studied in the Kurama ridge, Tashkent region, in the Pskent district.

Seeds. The caryopsis is oval, length 1.5 - 2.5 mm, width 9 - 11 mm. The absolute weight of 1000 seeds is 11.5 g. The grain of bulbous barley is capable of germinating in a wide range of temperatures - from +5 to +30 - 35 0C. Laboratory germination at a temperature of 5 - 20 0C is 90 - 99%, at a temperature of + 30 - 35 0C seed germination sharply decreases [27].

Sprouts. Seedlings of Hordeum bulbosum are uniaxial, rosette plants 4-6 cm long, consisting of a coleoptile and 1 - 2 short leaves, and an embryonic root. Seed germination is observed at the end of February. Mass germination was observed at the end of March. The coleoptile continues to grow until the first and second true leaves appear. The length of the coleoptile is 1.5 - 2 cm. The length of the leaves of seed origin is 2.0 - 2.3 cm, width 2 - 3 mm. After the first narrow linear leaf appears, a second leaf grows. At this stage, the plants still retain their connection with the grain. The roots consist of germinal and unbranched adventitious roots. The length of the root system is 6 - 8 cm.

Juvenile plants. At the beginning of the juvenile stage, part of the coleoptile begins to dry out. Plant height is 8 - 12 cm. Plants have 3 - 4 close internodes. The length of the leaves is from 3 cm to 2.5 cm, width is 3 - 4 mm. The connection with the grain remains. The length of the root system is 14-16 cm, second-order roots are formed (Fig. 2). The duration of the juvenile stage is 23-24 days.

Immature plants. In the immature state, the plant develops side shoots. The length of the lateral shoots of the first order is 24.1 ± 0.5 cm. In plants, lateral buds develop in the axil of the first and second lower leaves located below the bulb (in the tillering zone) at a depth of 2 - 2.5 cm. These are future shoots of the second order. The bud is closed from above in front of the leaf, like a closed bud (Serebryakova, 1961). In the juvenile state, 2 - 3 lateral shoots are formed on the main shoot. The length of the side shoots is 17.4 ± 0.5 cm. The leaves are pubescent with short and sparse hairs. The leaves are 5 to 9 cm long and 4-5 mm wide. In the immature state, the main shoot continues and a bulb of second-order shoots appears. The roots of the main shoot reach 29.7 ± 0.9 cm, and the second shoot 24.2 ± 0.7 cm. The duration of the immature age state lasts 26 - 28 days.

In mid-May, individuals enter the virginal state. Adult virginal plants differ from immature plants in larger leaves, bulbs, plant height, number of shoots, and dead leaves. In this age state, the shoots branch up to the third order. The number of dead leaves is about 7 - 8 pieces. At the base of the bulb, on the main shoot and second-order shoots, buds are laid in the sheath of the 3 - 4 lower leaves, which continue to develop after summer dormancy. After summer dormancy, rosette shoots of the first and second order, 14.7 ± 0.4 cm long, appear in the plant. Rosette shoots have up to 4 leaves. Autumn leaves do not droop.

The formation of new shoots is accompanied by the appearance of young roots. The root system of virginal plants reaches 34.8 ± 0.8 cm and branches up to the third order (Fig. 2). The duration of the virginal state is 1 - 2 years.

Young generative states. In the young generative state, the number of bulbs increases, the diameter of the turf becomes loose, and partial bushes are clearly visible. The number of generative shoots ranges from 2 to 5 pieces. The length of the generative shoots is 15.8 ± 0.4 cm—the bulbs of the generative shoot increase in comparison with vegetative ones. In the tillering zone, rosette shoots are formed under the bulb, which were laid in autumn. The root system is lengthened to 20 - 30 cm (Fig. 2). The young generative period lasts 1 - 2 years in natural conditions.

In the middle-aged state, the plant differs from young generative plants in the maximum increase in biomass and greater seed productivity. The length of generative shoots reaches 55 - 60 ± 0.4 cm. Generative shoots branch from 2 to 3 orders. The number of partial bushes increases and reaches 10.5 ± 0.3. The main bulb dies. The root system reaches up to 60 - 70 cm (Fig. 2). The duration of the age state is 3 - 4 years.

In old generative plants, passive shoot formation and weakened generative functions are observed. At this stage, most of the turf dies. The diameter of the turf increases to 14.8 ± 0.5 cm (including the dried parts). In each partial bush, the bulbs form 1 - 2 shoots. The number of generative shoots is from 2 to 4 pieces. The length of the generative shoots is 42 ± 0.4 cm. The length of the root system is 46.5 ± 0.5 cm (Fig. 2). The duration of the age-related state lasts 1-2 years.

In the senile state of the plant, single shoots are formed at the

bulb. There are no generative shoots. At the base of the bulb, 1-2 lateral buds are formed, but most of them die off in the summer. The root system does not penetrate deeper, its length is 25.8 ± 0.5 cm. The senile period lasts 0.5 -1 year.

Thus, in the herbaceous-ephemeral plant community in Hordeum bulbosum, the duration of ontogenesis lasts up to 10 - 11 years.

3.3 Population Structure of H. Bulbosum

For the first time, population studies of H. bulbosum were carried out in the Republic. The ontogenetic spectra of the studied cenopopulations of Hordeum bulbosum are diverse and are represented by the following types of spectrum: left-sided (CP 1, 4, 6, 8), centered (CP 2, 7) and bimodal (CP 3, 5).

Cenopopulations with a left-sided spectrum type. This variant of the spectrum is formed with abundant fruiting and rapid development of young individuals. In CP 1 and CP 8, the absolute maximum occurs in young generative individuals (22.37 - 25.0 %). Sufficient moisture on a rock-gravel slope promotes the rapid transition of juveniles to the next state. In CP 4, immature (23.38 %) individuals predominate, and in CP 6, virginal (25.51 %) individuals predominate (Fig. 3). The characteristic spectrum of H. bulbosum is left-sided. According to the left-sided ontogenetic spectrum is formed in vegetative rudiments with deep rejuvenation and with the vegetative and seed path of renewal [28].

Cenopopulations with a centered spectrum type. In CP 2, CP 5, and CP 7, the absolute maximum in the spectrum falls on middle-aged generative individuals (19.3 - 32.43%). Cenopopulations 2, 5, and 7 differ in the ratio of individuals of pregenerative fractions. In CPs 1 and 2, the absolute maximum in the spectrum falls on middle-aged generative individuals (20 % and 38 %, respectively). This is due to a gradual increase in the life expectancy of individuals in the generative period. Cenopopulations 2 and 7 differ in the ratio of individuals of pregenerative fractions. In cenopopulation 7, there are no seedlings, juvenile or senile individuals. This is due to overgrazing of the phytocenosis; the cenopopulation is located near the village of Karadakhana (Fig. 3).

Cenopopulations with a bimodal spectrum type. In CP 3, the first peak in the spectrum falls on virginal individuals, and the second peak is on middle-aged generative individuals. This cenopopulation was located near the Molguzar River, located along the bank of the Molguzar River with a steepness of 25-35 0. The accumulation of young individuals was observed in the upper part of the slope, and middle-aged individuals were noted in the middle part of the side. This spectrum option is considered a temporary version of the left - hand spectrum (Fig. 3).

All cenopopulations are of the normal type, but in CP 5, 7, 8 there are no seedlings in the spectrum; in cenopopulations 7 and 8 there are no senile fractions.

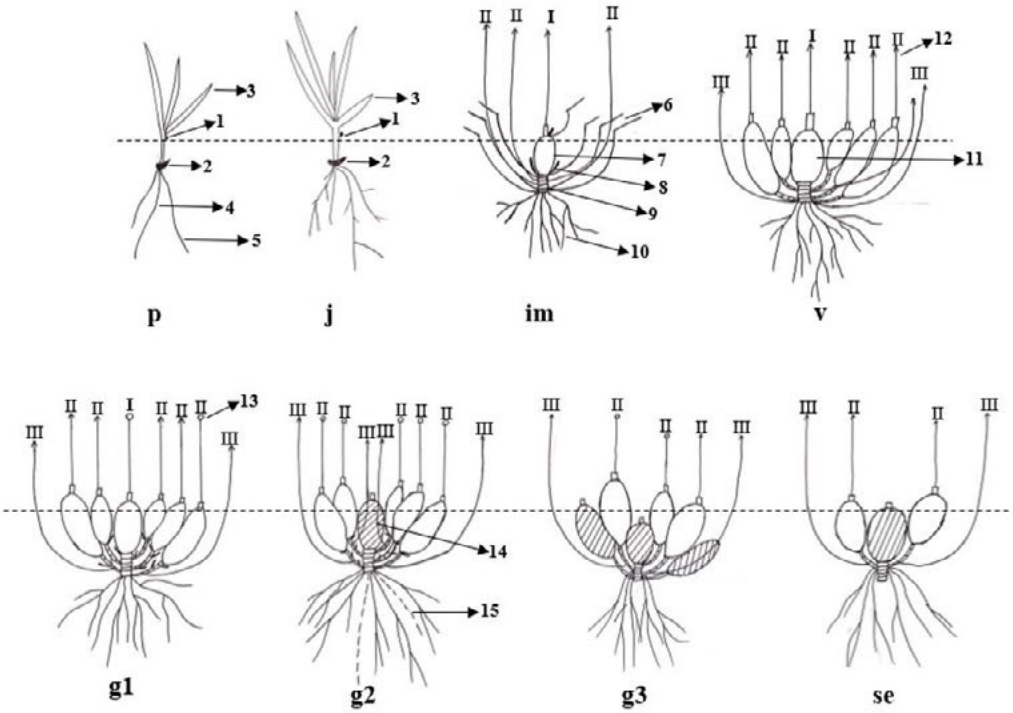

Figure 2: Ontogenesis stages and morphological characters of Hordeum bulbosum. 1-coleoptile, 2-kernel, 3-leaf, 4-germ root, 5-adventitious roots, 6-leaves, 7-bulb, 8-bud, 9-shortened internodes, 10-root, 11-main bulb, 12-generative shoot, 13 - vegetative shoot, 14 - dead bulb, 15 - dead roots

3.4 Impact of Climate Change on Hordeum Bulbosum in Uzbekistan

Precipitation affects seed germination, plant growth, and development. Ecosystems in semi-arid and arid landscapes change in response to arid climates [29]. Increased aridity and climate change contribute to the active process of plant transformation. The temperature in Uzbekistan increases by an average of 0.27 °C every ten years [30]. While global warming negatively affects the growth and development of the studied species, it has a positive effect on the growth and spread of

pests [31]. Damaged plants completely lose their ability to grow. Long-term climate change is one of the factors in the H. bulbosum crisis.

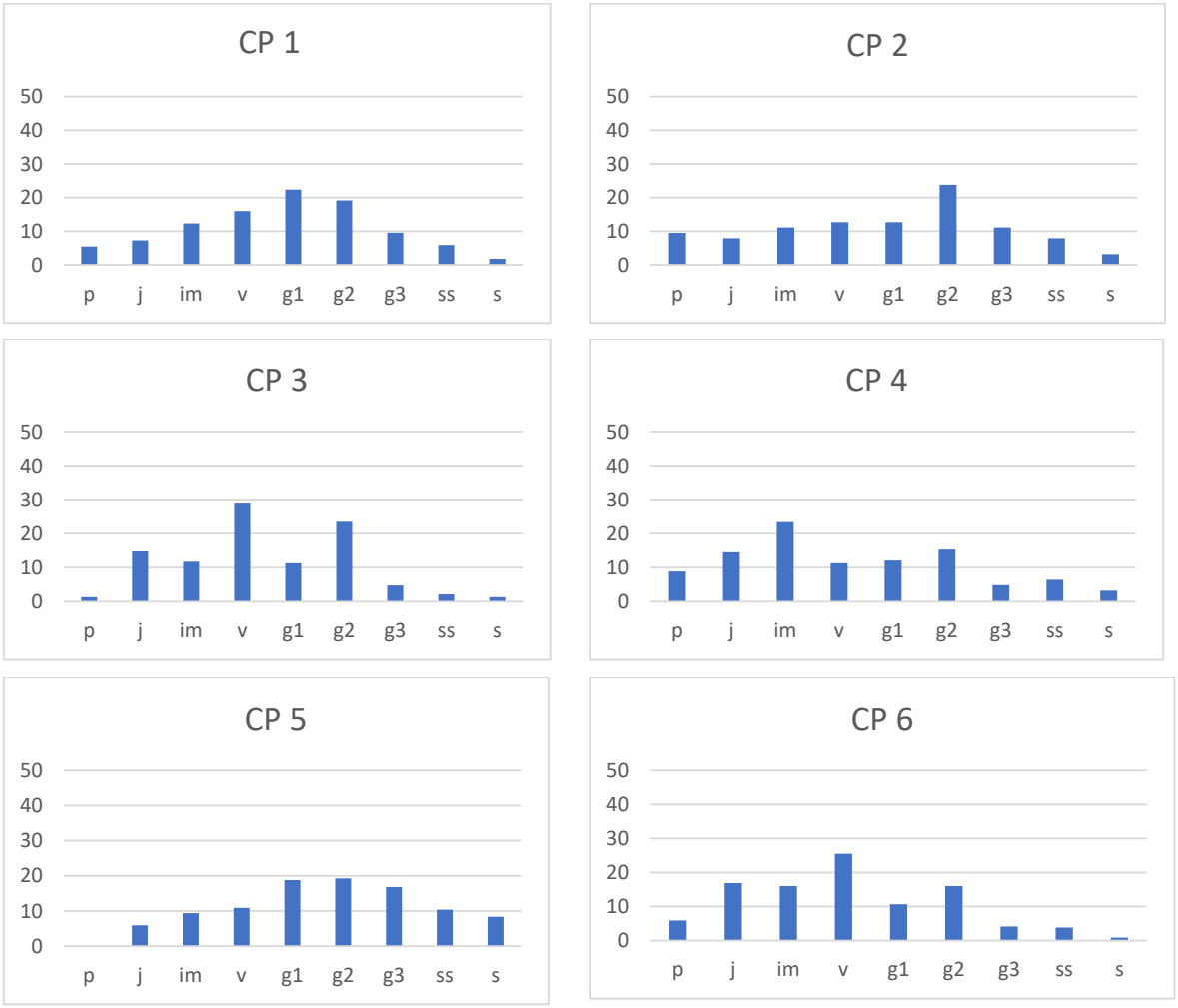

Figure 3: Ontogenetic Spectrum of Hordeum Bulbosum

4. Conclusion

The study of ontogeny shows that the total lifespan of H. bulbosum in natural conditions is 10-11 years. In the mountains and foothills, the species grows in different phytocenoses. H. bulbosum is considered a dominant or codominant in plant communities. The ontogenetic spectrum is left-sided (1 CP, 4 CP, 6 CP, 8 CP), centered (2 CP, 7 CP), and bimodal (3 CP, 5 CP). The centered and bimodal ontogenetic spectrum does not coincide with the characteristic one. The species belongs to xeromesophytes. Cenopopulations of H. bulbosum can reach a population optimum both under phytocenotic optimum conditions (Phlomis thapsoides, Alhagi pseudalhagi) and under extreme habitat conditions (Juniperus seravschanica, Juniperus semiglobosa, Festuca valesiaca). The populations studied are threatened by global warming, drought, and anthropogenic pressure. These factors negatively affect the population structure, therefore, in some cenopopulations, pregenerative and senile fractions were not found.

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References

1. Wild Relatives of Cultivated Plants, Contributing Editor Ruth D. Raymond. *Bioversity International*, (2006). – P. 2.
2. Akhmedov, A., Nomozova, Z., Umurzakova, Z., Turdiboev, O., Atayeva, S., & Jumayev, N. (2022). Assessment of the Current Condition of Populations of the Red List Species Botsch. & VVED.(Lamiaceae Lindl.) In *Nuratau Mountain Ridge, Uzbekistan. Ekológia (Bratislava),* 41(4), 322-328.
3. Temirov, E. E., & Rakhimova, N. K. (2022). The bioecological features of some species of the Cupressaceae introduced in the conditions of Tashkent city, Uzbekistan. *Biodiversitas Journal of Biological Diversity, 23*(10).
4. Rakhimova, T., & Rakhimova, N. K. (2022). Ontogenesis and ontogenetic structure of cenotic populations of Eremurus anisopterus (Asphodelaceae) in the Kyzylkum desert (Uzbekistan). *Botanica Pacifica, 11*(2), 39-44.

5. Rakhimova, N. K., Rakhimova, T., Shomurodov, K. F., & Sharipova, V. K. (2023). The status of coenopopulations of Xylosalsola chiwensis (Popov) Akhani & Roalson and Scorzonera bungei Krasch. & Lipsch. on the Ustyurt plateau (Uzbekistan). *Arid ecosystems, 13*(2), 189-195.
6. Saribaeva, S. U., Shomurodov, K. F., & Abduraimov, O. A. (2022). Ontogenesis and ontogenetic structure of local populations of the Astragalus holargyreus Bunge (Fabaceae) of the narrow-local endemic of Kyzylkum. *Arid Ecosystems, 12*(1), 78-84.
7. Abduraimov, O. S., Maxmudov, A. V., & Abduraimov, A. S. (2022). Current state of local populations Tulipa greigii Regel (Liliaceae) in Uzbekistan. In *E3S Web of Conferences* (Vol. 351, p. 01093). EDP Sciences.
8. Abduraimov, O. S., Maxmudov, A. V., Kovalenko, I., Allamurotov, A. L., Mavlanov, B. J., Shakhnoza, S. U., & Mamatkasimov, O. T. (2023). Floristic diversity and economic importance of wild relatives of cultivated plants in Uzbekistan (Central Asia). *Biodiversitas Journal of Biological Diversity, 24*(3).
9. Saribaeva, S. U., Allamuratov, A., Mavlanov, B., & Mamatkosimov, O. (2023). Assessment of the State of the Allium praemixtum Vved. Cenopopulation (Amaryllidaceae) on the Ridges of Uzbekistan. *Arid ecosystems, 13*(4), 419-424.
10. Vavilov N.I. (1987). Centers of origin of cultivated plants. Moskow. *Nauka*. 33-126.
11. Zhukovsky P.M. (1971). Cultivated plants and their wild relatives. *Leningrad. Kolos. 751.*
12. Abduraimov Ozodbek S., Maxmudov Azizbek V., Kovalenko Igor, Allamurotov Akmal L., Mavlanov Bekzod J., Saribaeva Shakhnoza U. & Mamatkasimov Odilbek T. (2023). Floristic diversity and economic importance of wild relatives of cultivated plants in Uzbekistan (Central Asia). *Biodiversitas. 24* (3), 1668-1675.
13. Flora of Uzbekistan. (1941). *Tashkent: Academy of Sciences of the Republic of Uzbekistan. 567*.
14. Abduraimov O.S., Mamatqosimov O.T. & Allamuratov A.L. (2022). Poaceae - wild ancestors of cultivated plants (Navoi region). *Proceedings of the international scientific and practical conference "Integration of science, education and production - a pledge of development and progress" dedicated to the 5th anniversary of the establishment of the Navoi branch of the Academy of Sciences of the Republic of Uzbekistan.* 9-10 june 2022. Navoi. 6-9.
15. Abdullaev A.A. & Baymetov K. (2021). Preservation and use of the world's collections of cultivated plants and their wild relatives. *Science and innovative development. 3*. 65-72.
16. Kobylyanskaya K.A. (1999). Hordeum. In: Plant resources of Central Asia. - Tashkent: Fan.
17. Trofimovskaya A.Ya. (1972). Hordeum. Leningrad, Kolos.
18. Saltini A. (1996). The seeds of civilization: wheat, rice and corn in the history of human societies / Preface by Luigi Bernabò Brea. *Bologna: Avenue Media, 182*.
19. Baymetov, K. I., & Abdullaev, F. X. (2021). State of wild relatives of Hordeum (Horedeum L.) in Uzbekistan. *Academic Research in Educational Sciences, 2*(12), 1085-1095.
20. Ponyatovskaya, V.M. (1964). Accounting for abundance and features of species placement in natural plant communities. In *E.M. Lavrenko & A.A. Korchagina (Eds.), Field geobotany* (pp. 209–289). Moscow-Leningrad.
21. Cherepanov, S.K. (1999). Vascular Plants of Russia and Neighboring States, St. Petersburg: Mir i Sem'ya.
22. Rabotnov, T.A. (1950). Life cycle of perennial herbaceous plants in meadow coenoses. *Proceedings of the Biological Sciences, 3*(6), 7–204.
23. Uranov, A.A. (1975). Age diversity of phytocoenopopulations as the function of time and energetic wave processes. *Biological Sciences, 2*, 7–34.
24. Cenopopulation of Plants (Basic Concepts and Structure). (1976). Moscow.
25. Uranov, A.A. & Smirnova O.V. (1969). Classification and main features of the development of populations of perennial plants. *Bulletin MOIP, 74* (2), 119−134.
26. Makhmudov V. (1986). Biomorphological features of wild-growing perennial cereals, promising for introduction into cultivation in the adyrs of Uzbekistan. *Dissertation abstract of the doctor of philosophy (PhD) on biological sciences, Tashkent*.
27. Serebryakova T.I. (1961). Some patterns of bud and shoot formation in meadow grasses. Bulletin of Moskow Society of Naturalists. *Biological series. Moscow University Prees, Moscow. 66* (4). 42-53.
28. Zaugolnova L.B. (1994). The structure of populations of seed plants and problems of their monitoring: Dissertation abstract of the doctor of philosophy (DSc) on biological sciences. St. Petersburg. 70.
29. Padilla, F.M., Mommer, L., de Caluwe, H., Smit-Tiekstra, A.E., Visser, E.J. & de Kroon H. (2019). Effects of extreme rainfall events are independent of plant species richness in an experimental grassland community. *Oecologia, 191* (1), 177–190.
30. Khabibullaev B Sh., Shomurodov Kh. F. & Adilov B. A. (2021). Impact of long-term climate change on Moluccella bucharica (B. Fedtsch.) Ryding population decline in Uzbekistan. *Plant Science Today. 9*(2): 357–363.
31. Barford E. (2013). Crop pests advancing with global warming. Nature.