

ECOLOGICAL AND PHYTOCENOTIC CHARACTERISTICS OF CRAMBE EDENTULA IN THE SOUTHERN USTYURT REGION

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ABSTRACT

Crambe edentula occupies some of the harshest ecological niches of the Southern Ustyurt region, where gypsum-rich soils, dry ravines, and erosion-prone slopes create highly unstable habitats. Based on four identified cenopopulations, the study reveals that the species demonstrates notable ecological plasticity, as it survives under varying soil conditions, vegetation structures, and degrees of erosion. Although the species becomes dominant only in sparsely vegetated communities, it persists even in competitive shrub-dominated habitats by occupying microrefugia such as ravine edges and sheltered areas beneath bushes. Nevertheless, herbivory and intense geomorphological processes reduce its reproductive potential and population stability. Overall, the analysis shows that the long-term survival of Crambe edentula depends on a delicate balance between erosion, competition, and grazing pressure within the Ustyurt landscapes.

The Southern Ustyurt region, with its sharply eroded landscapes and gypsum-rich soils, represents one of the most ecologically demanding areas of Central Asia. Nevertheless, Crambe edentula successfully survives in this harsh environment, forming four distinct cenopopulations across Kaplonqir, Shorja, and the northern and eastern parts of Lake Sarikamish. Because these areas differ notably in their soil structures, dominant vegetation, and erosion intensity, they collectively reveal the remarkable ecological plasticity of the species. Furthermore, the comparative analysis of these sites allows us to understand how Crambe edentula adapts to varying degrees of stress, competition, and habitat instability.

To begin with, the first cenopopulation (CP1) is located in the Qoplonqir chinks and occupies a small area of 0.25 hectares. Although the terrain consists of uneven slopes and dry ravines, the soil composition—namely gypsum-mixed sandy loam with many small stones—creates a rather unstable environment. Even so, Crambe edentula forms the only dominant community here, contributing 3% to the total vegetation cover. The floristic composition includes 18 species, yet the overall cover remains sparse at just 7–8%. This is partly because

water erosion continually washes away fine soil particles, and partly because grazing animals often feed on the plant's reproductive shoots. Consequently, despite being the dominant species, Crambe edentula tends to concentrate at protected micro-sites such as ravine edges and beneath shrubs like Lycium ruthenicum, while avoiding the heavily eroded central zones of the ravine [3, 238-243].

In contrast, the second cenopopulation (CP2) occupies a much larger area of 2.5 hectares in the Shorja. Here, the plant grows within a fescue-saxaul-pine community, where competition from woody xerophytes is much stronger. Because the soil contains a lime-gypsum mixture that forms a hard crust when dry, root penetration becomes difficult, which ultimately limits the abundance of Crambe edentula. As a result, the species appears only as a participant rather than a dominant. Moreover, the presence of wild herbivores further reduces its vegetative mass and flowering structures. Even though vegetation cover increases to 12%, the ecological pressures are more complex due to the influence of animals, soil crusting, and the presence of dominant species such as Caragana grandiflora, Haloxylon aphyllum, and Salsola orientalis. Thus, CP2 demonstrates that Crambe edentula performs less successfully in communities where shrub competition is strong [5, 261-267].

Moving further north, the third cenopopulation (CP3) displays the richest ecological structure. Covering 3.5 hectares in the northern Sariqamish chinks, it occupies both highly gypsum-rich rocky terraces and large dry ravines sloping toward the lake. Because the terrain is actively eroding, rockfalls often damage the plant directly, burying mature individuals under large limestone blocks. Nevertheless, vegetation cover is highest here (15%), and the species coexists with a diverse assemblage of shrubs, semi-shrubs, and perennial grasses. More importantly, the community contains Salsola chiwensis, a species listed in the Red Book of Uzbekistan, which greatly increases the conservation significance of this site. The dominance of Haloxylon aphyllum and Artemisia diffusa suggests that CP3 is characterized by intermediate disturbance—strong enough to reduce woody competitors in some areas, yet mild enough to maintain stable soil patches where Crambe edentula can survive. Therefore, CP3 provides the clearest example of how the species benefits from mixed substrate conditions and varying erosion intensities [4].

Finally, the fourth cenopopulation (CP4), located in the eastern Sariqamish ravines, occupies only 0.5 hectares. Despite its small size, the site has a distinct ecological identity. The soil consists of fine sands mixed with gypsum and fragments of limestone, creating a light and easily eroded substrate. As a result, vegetation is sparse (11%), and annual plants are particularly rare. Instead, semi-shrubs dominate the community, especially Artemisia terrae-albae and Atraphaxis spinosa. Because erosion is the main limiting factor and competition from annual plants is minimal, Crambe edentula persists here as an accompanying species, benefiting from the reduced competition but facing constant substrate instability. Thus, CP4 highlights the species' ability to tolerate erosion but also its difficulty in achieving dominance under rapidly shifting soil conditions.

Taken together, these four cenopopulations illustrate that Crambe edentula thrives best in habitats where erosion is present but not excessively destructive, where soil mixtures contain gypsum or limestone components, and where competition from woody shrubs remains moderate. Moreover, the species tends to concentrate in microhabitats that provide

partial protection—such as ravine edges, shrub bases, or areas with reduced soil movement. Conversely, it becomes less competitive in communities dominated by Caragana or Haloxylon, where denser root systems and canopy shade suppress its growth. Additionally, herbivory remains a major biological pressure across all sites, repeatedly damaging generative organs and limiting successful reproduction.

In conclusion, Crambe edentula demonstrates a high degree of ecological resilience across the Southern Ustyurt, yet its long-term stability depends on the balance between erosion, competition, and herbivory. Although the species can tolerate harsh soils and unstable terrain, excessive slope movement or sustained grazing can significantly reduce population size. Therefore, these cenopopulations should be monitored regularly, particularly those situated in erosion-prone chinks. With continued study, it will become possible not only to safeguard Crambe edentula within its natural habitats but also to use its ecological patterns as a model for understanding plant survival strategies in extreme desert landscapes.

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