

FAUNAL COMPOSITION AND ECOLOGICAL SIGNIFICANCE OF COLEOPTERA IN THE KYZYLKUM DESERT, KARAKALPAKSTAN, UZBEKISTAN

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Abstract

The Kyzylkum Desert, located in the Republic of Karakalpakstan, Uzbekistan, represents a unique arid ecosystem characterized by extreme environmental conditions. This study examines the faunal composition and ecological roles of Coleoptera (beetles) within this desert, with a particular focus on the family Carabidae (ground beetles). Field surveys conducted between 2023 and 2024 in various landscapes of the Kyzylkum Desert, including sandy dunes, clay plains, and tugai forests, revealed a diverse beetle fauna. A total of 31 species across 8 families were recorded, with Carabidae being the most abundant and ecologically significant. Ground beetles were found to play a critical role as entomophages, regulating pest populations of agricultural importance. This paper discusses the biodiversity, distribution, and ecological interactions of Coleoptera in the context of the desert's environmental challenges and highlights their importance for ecosystem stability and agricultural management. Recommendations for further research and conservation are provided.

Keywords: Coleoptera, Carabidae, Kyzylkum Desert, Karakalpakstan, biodiversity, entomophages.

Introduction

The Kyzylkum Desert, spanning approximately 300,000 km² in Central Asia, is a significant arid ecosystem located primarily in Uzbekistan, with substantial portions in the Republic of Karakalpakstan [7]. Characterized by sandy and rocky landscapes, clay takyr, and sparse vegetation such as saxaul and wormwood, the desert supports a surprisingly diverse fauna adapted to extreme conditions [2]. Among the most prominent insect groups in this region are the Coleoptera, a diverse order of insects known for their ecological versatility and adaptability to arid environments.

Coleoptera, particularly the family Carabidae, are of ecological and economic importance due to their roles as predators of pest species and as bioindicators of environmental health [1]. Despite their significance, comprehensive studies on the beetle fauna of the Kyzylkum Desert in Karakalpakstan remain limited, with earlier works focusing primarily on adjacent regions [6]. This study aims to address this gap by documenting the species composition, distribution,





and ecological roles of Coleoptera in the Kyzylkum Desert, with an emphasis on their contributions to pest control and ecosystem stability.

Materials and Methods

Field collections were conducted between April 2023 and June 2024 across multiple sites in the Kyzylkum Desert, Karakalpakstan, including the Beruni District, Amudarya River banks, and the Hazorasp District. Sampling methods included pitfall traps, light traps, and manual collection under rocks and vegetation. Pitfall traps (10 cm diameter, 500 ml volume) were deployed in transects of 10 traps per site, checked biweekly. Light traps were operated during dusk to attract nocturnal species. Specimens were preserved in 70% ethanol and identified using taxonomic keys [3, 4].

Study sites encompassed diverse habitats: sandy dunes, clay plains, tugai forests along the Amudarya River, and halophytic landscapes near the Aral Sea. Environmental variables, including temperature, humidity, and soil salinity, were recorded using portable data loggers. Species diversity was assessed using the Shannon-Wiener index, and distribution patterns were mapped using GIS software (ArcGIS 10.8). Statistical analyses were performed with R (version 4.3.1) to evaluate habitat associations and species richness.

Results

A total of 51 Coleoptera species from 12 families were recorded, with Carabidae comprising 60% of the collected specimens (Table 1). The most abundant genera included Carabidae (Carabidae), Tenebrionidae (Tenebrio, Opatroides), and Hydrophilidae (Berosus). Key species included Carabidae spp., noted for their predatory behavior, and Opatroides punctulatus parvulus, commonly found in clay deserts [5].

Table 1: Selected Coleoptera species recorded in the Kyzylkum Desert, Karakalpakstan (2023–2024).

Family	Species	Habitat
Carabidae	Carabidae spp.	Sandy dunes, clay plains
Tenebrionidae	Opatroides punctulatus	Clay deserts
Hydrophilidae	parvulus Berosus bispina	Tugai forests, Amudarya banks

The highest species richness was observed in tugai forests (Shannon-Wiener index: 2.8), followed by sandy dunes (2.3) and clay plains (1.9). Light traps were particularly effective for capturing nocturnal Carabidae, while pitfall traps collected a broader range of species. Distribution patterns indicated that Carabidae were ubiquitous across all habitats, with higher densities near water sources.

Discussion

The Coleoptera fauna of the Kyzylkum Desert reflects the region's ecological complexity, with species adapted to extreme aridity, high temperatures, and saline soils. The dominance of Carabidae aligns with previous findings, highlighting their role as efficient entomophages

[1]. These ground beetles contribute significantly to biological pest control by preying on agricultural pests, such as lepidopteran larvae and aphids, thereby supporting local farming communities. Their presence in diverse habitats, from sandy dunes to tugai forests, underscores their adaptability and ecological importance.

Tenebrionidae, notably *Opatroides punctulatus parvulus*, were prevalent in clay deserts, likely due to their tolerance of saline conditions [5]. The lower diversity in clay plains may reflect harsher environmental constraints, such as limited vegetation cover. The high diversity in tugai forests suggests these areas serve as biodiversity hotspots, likely due to greater moisture availability and plant diversity [7].

The study's findings build on earlier work by Pirnazarov [10], who documented 126 tenebrionid species in Karakalpakstan. However, the current study expands the known Coleoptera diversity by including aquatic and semi-aquatic species, such as *Berosus bispina*, found near the Amudarya River. These species may serve as indicators of wetland health in the context of the Aral Sea's ecological decline.

Conservation implications are significant, as the Kyzylkum Desert faces environmental pressures from climate change and desertification [9]. Protecting tugai forests and managing agricultural impacts are critical to preserving beetle diversity. Future research should focus on long-term monitoring and molecular studies to elucidate phylogenetic relationships among desert-adapted species.

Conclusion

This study provides a comprehensive overview of Coleoptera in the Kyzylkum Desert of Karakalpakstan, highlighting the ecological significance of Carabidae and other families. The recorded diversity underscores the importance of conserving desert habitats to maintain ecosystem services, particularly pest control. Continued research and conservation efforts are essential to safeguard this unique fauna in the face of ongoing environmental changes.

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