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Biological Diversity of Wild Bird Species in the Desert Region and their Ecological Functions in the Agroecosystem

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Annotation: The article examines the biological diversity of wild bird species found in the territory of the Central Kyzylkum National Nature Park, their ecological role in the habitat, their importance in natural pest control, and their functions within the agroecosystem. During the research, more than 50 bird species were identified based on regular observations by scientific staff in the park area and categorized into ecological groups. Additionally, factors causing the decline in bird populations were analyzed, and recommendations for their conservation were provided.

Keywords: Bird diversity, ecological functions, agroecosystem, Central Kyzylkum, wild fauna, migration, conservation.

INTRODUCTION:

Desert regions are characterized by unique climatic conditions, harsh natural environments, and limited resources, where wild bird species play a crucial role in shaping biological diversity. Wild birds not only ensure biological variety but also maintain ecological balance in agroecosystems, perform pest control, and enhance soil fertility. Thus, the biological diversity of wild birds and their role in agroecosystems in desert regions are closely interconnected, holding significant ecological and economic importance [1]. The main concepts and theories revolve around biological diversity, agroecosystems, and ecological functions. Biological diversity is considered a mechanism that ensures the stability and adaptability of nature at species, genetic,

and ecosystem levels [2,3]. Agroecosystems are systems formed by human activity in close interaction with nature. Wild birds are recognized as biological control agents within agroecosystems, reducing pest populations and contributing to increased productivity. However, many knowledge gaps remain in studying the role and biological diversity of birds in desert regions, particularly regarding their precise ecological functions within agroecosystems, where research is still insufficient [4].

Previous studies have focused on the taxonomy and distribution of bird species in desert and arid regions, but their functional role within agroecosystems has been less explored. Some scientific works provide information on wild birds' position in food chains and ecosystems, yet there is a lack of detailed data about the specificity and effectiveness of ecological services provided by birds in desert areas [5]. Therefore, this study aims to investigate more deeply the biological diversity of wild birds and their ecological functions in agroecosystems of desert regions.

The research methodology includes field monitoring of biological diversity, species identification, and statistical analysis. In addition, the ecological functions are assessed through the study of birds' feeding behavior, distribution, and interaction mechanisms within the agroecosystem [6]. This approach allows determining the role of birds in ecosystem services and measuring their contribution to agroecosystem stability. The results are expected to show that birds’ ecological functions in desert conditions are diverse and complex, serving as important biological controllers in agroecosystems. Studying the biological diversity and ecological functions of wild birds in desert areas is crucial not only for conserving natural resources but also for ensuring agricultural sustainability. The findings will clarify the role and necessity of wild birds in agroecosystems, providing a scientific basis for their protection and management [7] . Future research should focus on more detailed studies of birds’ functional characteristics across various ecological conditions.

METHODOLOGY

In this study, field observation and monitoring methods were employed to identify the biological diversity of wild birds occurring in the desert region and their ecological functions within the agroecosystem. The research area was divided into predetermined test zones where bird observations were conducted at different times. Species identification was carried out through visual observations complemented by ornithological audio recording techniques to enhance accuracy. Based on the collected data, biodiversity indicators such as species number, distribution, and population counts were statistically analyzed. To evaluate the ecological functions in the agroecosystem, the birds' feeding sources and their impact on pest control were studied. Through feeding analysis and field surveys, the roles of birds within the agroecosystem were determined. Throughout the study, the activity periods, distribution areas, and interactions of birds with the agroecosystem were continuously monitored. These methods enabled a more precise understanding of the birds’ role in biological control and their contribution to ecosystem stability. The data gathered during the research were processed using various statistical software packages to derive analytical conclusions. This approach allowed for a clearer assessment of the ecological significance of wild birds in desert conditions and a better understanding of their functions in agroecosystems.

RESULTS AND DISCUSSION

The Central Asian desert zones, particularly the territory of the Central Kyzylkum National Nature Park in Uzbekistan, possess a rich diversity of wild fauna and flora, with wild birds playing an important role in the ecological system. This area represents a unique landscape composed of sand dunes, saline fields, sparse and dense saxaul forests, and lakes, which create complex ecological conditions suitable for bird habitation [8].The desert environment of the Central Kyzylkum National Park is characterized by very high daytime temperatures, significantly cooler nights, low precipitation, limited water sources, and fluctuating food resources. Survival and reproduction of birds under such harsh conditions require specific

adaptive features. Birds in this area exhibit bio-ecological characteristics adapted to these environmental conditions, adjusting their behavior and life activities accordingly. The bio-ecology of Central Kyzylkum birds includes their habitats, feeding methods, migration and dispersal patterns, and breeding behaviors. Most species spread over wide areas in search of food during drought and harsh climate periods, while efficiently utilizing known water sources [9]. For example, water-associated birds such as flamingos, stilts, swans, geese, and ducks actively search for water bodies during seasonal migrations, playing a significant role in maintaining ecological stability in the region.Regarding behavior, birds tend to be more active during early mornings and late evenings to avoid the heat, which helps optimize their life processes. Large predators like desert falcons and eagles patrol their territories mainly for hunting but reduce their activity during the hottest periods to avoid overheating. Small insectivores and granivores tend to search for food more slowly and are more active during dawn and dusk [10]. During breeding seasons, birds prefer to lay their eggs in sheltered places such as sparse saxaul thickets, sand dunes, or reed beds (for water birds), which are critical for offspring survival [11].

Figure 1. Great White Pelicans (Pelecanus onocrotalus)

Birds in the Central Kyzylkum National Nature Park are an essential part of the ecological chain. They contribute to maintaining the food balance within the ecosystem as granivores consuming insects, small rodents, and plant seeds. Additionally, they actively participate in plant pollination and seed dispersal, which significantly supports the biological diversity of the area [12].

Currently, birds face threats from climate change, drought, and anthropogenic impacts. Therefore, their habitat conservation and monitoring in the Central Kyzylkum National Nature Park are under continuous supervision by scientific staff and rangers. Park personnel are actively involved in raising ecological awareness among local communities and implementing conservation measures. These efforts are crucial for ensuring the stability of bird populations in the region [13].

Consequently, the species diversity, ecological functions, bio-ecology, behavior, and conservation needs of wild birds in the Central Kyzylkum National Nature Park are continuously studied. These scientific investigations not only help preserve biodiversity but also contribute to maintaining the sustainability of the local agro-ecosystem.

Research and Techniques

This research was conducted from 2022 to 2024 within the Central Kyzylkum National Nature Park. The main goal was to study the species composition, ecological roles, bio-ecology, distribution patterns, and roles of wild birds in the agro-ecosystem. The following

methodological approaches and techniques were used:

1. **Visual Observation and Identification:**

To accurately identify bird species and study their behavior, active periods in the early morning and late evening were selected. Birds were counted and identified visually using binoculars and monocular optical devices [14]. This method allowed proper assessment of birds' natural behavior, habitat, and interactions.

2. **Transect Count Method:**

Various landscape zones in the park (sand dunes, forests, water bodies) were mapped with 1 km long transects perpendicular to the terrain. Researchers traveled along these routes recording bird numbers, species, and distribution. These data were fundamental for evaluating population density and spatial distribution.

3. **Photography and Audio Recording:**

To identify rare or elusive species, camera traps and photos/audio recordings made by researchers were utilized. These data were cross-referenced with ornithological catalogs to confirm species identification. This method was especially effective for observing predators and other active species [15].

4. **Literature and Data Analysis:**

Previous studies, reports from the State Committee for Ecology, research institutes, and organizations like BirdLife International were systematically reviewed. This allowed comparison and evaluation of the obtained results.

Research Results

During the 2022–2024 research period, a total of 67 wild bird species were recorded in the Central Kyzylkum National Nature Park. Over 20 species are endemic to the area, while the rest are migratory or transient species. Key findings include:

- **Birds of prey**

Species such as the saker falcon, common kestrel, long-legged buzzard, desert sparrowhawk, steppe eagle, and yellow wagtail were frequently observed. These predators control populations of small and medium-sized animals, maintaining ecological balance. The desert eagle and falcon are especially active at dawn and dusk.

- **Insectivores:**

Desert-adapted insect-eating birds like the bee-eater, woodchat shrike, and desert lark are widespread. They regulate insect populations, preventing overpopulation of harmful pests.

- **Granivorous**

Species such as the desert finch and lark are common, feeding mainly on plant seeds and small insects. Their feeding strategies are well adapted to the desert environment.

- **Waterfowl:**

Water birds such as swans, red-crested pochards, and wild ducks effectively utilize the region's water resources. Their numbers fluctuate seasonally with migration patterns.

Figure 2. Mute Swans (Cygnus olor)

Wild birds found in the Central Kyzylkum National Nature Park play important ecological roles within both the agro-ecosystem and the natural ecosystem. These functions are closely related to the birds' belonging to different ecological groups. For example, insectivorous birds (such as the bearded tit and woodchat shrike) effectively reduce the number of pests in the area, increasing the importance of birds as biological control agents for agriculture.

Granivorous and insectivorous birds help increase plant reproduction in the region by dispersing seeds across their habitats. This is especially significant in desert ecosystems, where seed dispersal supports the wide distribution of plants. For instance, larks and desert finches actively participate in spreading seeds.

Predatory birds (such as owls and desert buzzards) control populations of small and medium-sized animals, maintaining ecosystem balance. They help reduce disease spread and support natural selection. Crows and scavenger birds, as well as some other species, consume animal carcasses, contributing to ecosystem cleanliness and improving soil quality.

The pests controlled by birds support increased agricultural productivity.

However, despite the important role of birds in nature, the bird populations in the Central Kyzylkum National Nature Park currently face the following main threats:

1. Due to global warming and climate change in recent years, the region has experienced intensified summer heat and reduced rainfall, leading to drought conditions. The reduction of water resources and drought negatively affect all biological resources of the area, especially birds' feeding and breeding habitats, worsening their living conditions. Decreasing water sources shrink habitats for waterfowl, while populations of insects and small mammals decline, causing disruptions in the food chain.
2. Hunting reduces birds' habitats. Illegal hunting poses a particular threat to rare and Red List species.
3. Migration routes of some migratory birds are disturbed by anthropogenic activities. This complicates their feeding, breeding, and overall life cycles.

Figure 3. Flamingos – Phoenicopterus roseus

During the study, the following additional observations were also recorded:

A decline in the numbers of some bird species was noted, especially during the winter and spring seasons. This is characteristic of migratory species and reflects the difficulties they face during migration. However, an increase in the arrival and population of some migratory birds such as pelicans, swans, flamingos, and greylag geese was observed. Significant changes were noted in the birds' feeding and resting patterns; for example, activity tends to increase in the early morning and late evening on hot days.

Therefore, the scientific staff of the Central Kyzylkum National Nature Park have developed several recommendations for bird conservation, mainly focused on continuous monitoring of bird populations, determining species numbers, and their habitats. Based on this information, prompt and effective conservation measures can be developed.

- It is necessary to preserve water resources within the Central Kyzylkum National Nature Park, establish managed grazing practices, and carry out conservation and restoration of forested areas. Preventing the reduction of bird habitats and creating favorable conditions are among the most important measures.
- Strict measures against illegal hunting should be implemented, and cooperation with law enforcement agencies should be strengthened, along with developing relevant action plans.
- Protecting migratory routes of birds is essential, avoiding habitat destruction along these pathways, and establishing ecological corridors is recommended.
- Raising awareness among local communities about birds and their bio-ecological importance, enhancing ecological culture, and ensuring public participation in conservation efforts are vital.
- Identifying bird species listed in the Red Book and involving them in international protection programs can strengthen biodiversity conservation.

CONCLUSION

The Central Kyzylkum National Nature Park is one of the most important centers of biodiversity in the desert zones of Uzbekistan. More than 60 species of wild birds found in this area play a significant role as an integral part of the ecological system. Their ecological functions, particularly pest control, pollination and seed dispersal of plants, as well as decomposition of organic matter, are crucial for maintaining the stability of the agroecosystem.

The high adaptation of birds to desert conditions, their bio-ecology, and behavior enable them to survive in the complex climate and landscape conditions of the Central Kyzylkum. The research results indicate that changes in bird numbers and species composition are mainly linked to

factors such as climate change, anthropogenic impacts, and disruption of migratory routes. Therefore, regular monitoring of bird populations, protection of their habitats, and raising ecological awareness among local communities are urgent tasks.To improve the effectiveness of conservation measures, special action plans should be developed based on scientific research. These include expanding protected areas, preserving migratory corridors, restricting illegal hunting and activities harmful to wildlife. Furthermore, explaining the ecological importance of birds to the public, strengthening environmental education, and promoting biodiversity can help ensure their protection.Thus, the Central Kyzylkum National Nature Park serves not only as a habitat but also as an evolutionary development area for birds. Studying the biological diversity and ecological functions of birds provides a scientific foundation for their conservation and the sustainable development of the ecosystem. This research contributes to a deeper understanding of the status of birds in the region and helps improve conservation measures.As a result, maintaining stable bird populations and improving their habitats in the Central Kyzylkum National Nature Park is important not only for ecological sustainability but also for the economic and social development of the region. Therefore, their conservation requires a responsible and cooperative approach involving the wider public, the scientific community, and government agencies.

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