ECOLOGICAL CHARACTERISTICS OF THE ASIATIC SPINY-TAILED LIZARD (CHLAMYDOTIS MACQUEENII) POPULATION IN THE KYZYLKUM DESERT"

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Abstract.*The impact of habitat and land use on the populations of the Asian shrike (Chlamydotis macqueenii, IUCN "vulnerable") has not been extensively studied. These birds are rare, secretive, and highly hunted, making accurate estimates of their numbers difficult. In the spring of 2024, male shrike tuvalogs were studied at 231 points in the 14,300 km² area of the Central Kyzylkum National Park. The study developed four sets of models that correlated male bird numbers with: Vegetation structure (shrub height and soil type), Shrub mass, Shrub species composition, and Satellite-based land cover (GLOBCOVER data). Each model also included relief unevenness. According to the results, the strongest effect was observed in vegetation structure factors; followed by shrub species composition and shrub mass. The GLOBCOVER model showed the least fit. Male shrike tuvalogs were most abundant in low shrubs, gravelly soil, and flat areas. The most birds were Salsola rigida shrubs, followed by Salsola arbuscula and Astragalus; Artemisia was lower in the areas, and Calligonum was the least abundant.*

Keywords: globcover*, distance, migration, Akaike information criterion, Sinai Peninsula*

Аннотация*. Влияние среды обитания и землепользования на популяции азиатского сорокопута (Chlamydotis macqueenii, «уязвимый» вид по классификации МСОП) до сих пор не изучалось. Эти птицы редки, скрытны и подвергаются интенсивной охоте, что затрудняет точную оценку их численности. Весной 2024 года самцы тувалогов-жуланов изучались в 231 точке на площади 14 300 км² Центрально-Кызылкумского национального парка. В исследовании были разработаны четыре набора моделей, которые коррелировали численность самцов птиц со следующими факторами: структурой растительности (высотой кустарников и типом почвы), массой кустарников, видовым составом кустарников и спутниковым земельным покровом (данные GLOBCOVER). Каждая модель также включала неровности*

рельефа. Согласно результатам, наибольшее влияние наблюдалось в факторах структуры растительности; за ними следовали видовой состав кустарников и масса кустарников. Модель GLOBCOVER показала наименьшее соответствие. Самцы сорокопутовых тувалогов были наиболее многочисленны в низкорослых кустарниках, на щебнистой почве и на ровных участках. Больше всего птиц было на кустах солянки жёсткой (Salsola rigida), за ними следовали солянка древовидная (Salsola arbuscula) и астрагалы (Astragalus); меньше всего было полыней (Artemisia), а наименее многочисленным был джузгун (Culligonum).

Ключевые слова: *глобальное покрытие, расстояние, миграция, критерий информации Акаике, Синайский полуостров*

INTRODUCTION

Humans have always interacted with nature and cannot exist without it. The development of life on Earth is largely influenced by the interaction between human society and nature, and in the anthropogenic era, human impact on nature has accelerated rapidly. The rapid advancement of science and technology, coupled with increasing information availability and limited time for its use in education, necessitates technological approaches in learning processes. Nature is currently undergoing a crisis, and preventing it is the responsibility of every conscientious individual. Protecting nature ensures the well-being of humanity and future generations. Expanding protected areas, preserving ecologically valuable natural objects and complexes, and conserving rare and endangered species of flora and fauna have been prioritized by Uzbekistan's government through Presidential Decree PQ-131 of February 16, 2022, and Cabinet Resolution No. 534 of September 16, 2022. The Central Kyzylkum National Nature Park, under the Ministry of Natural Resources, spans 1,200,000 hectares, with a protected core area of 694,205.5 hectares, located in Navoi region, Uchquduq district, "Altintau" F.U.Y.

Recent efforts focus on preserving and restoring natural habitats, improving ecological conditions, and promoting sustainable use of natural resources. Scientific research into fauna has been conducted, and from 2024–2025, we monitored and analyzed the Asiatic houbara bustard in the Central Kyzylkum National Nature Park in collaboration with my supervisor, Abralov Olim Sobirovich.

Studying rare and secretive species is challenging. Modeling habitat suitability helps evaluate environmental factors and determine distribution and relative abundance, crucial for conservation and management. Accurate population estimation is particularly important for species like the Asiatic houbara, which inhabits desert and semi-desert areas from Egypt (Sinai Peninsula) to Mongolia. Unregulated

hunting during migration and wintering has caused population declines, particularly in Kazakhstan, leading the IUCN to classify the species as Vulnerable. Additionally, agricultural activities, overgrazing, and human interference negatively affect local populations. Current conservation largely relies on captive breeding and reintroduction programs (e.g., in Uzbekistan by Saudi Arabian representatives). Management and habitat quality enhancement are also critical for preserving wild populations.

Key questions addressed in this study were: 1) How does houbara abundance vary across habitats? 2) How does human activity (e.g., livestock grazing) affect these numbers? Assessing local population density provides a baseline for monitoring future changes. Studies on the African houbara (*Chlamydotis undulata*) have shown avoidance of human settlements, roads, wells, herder camps, and croplands, though such effects were not always detected in Iran and Uzbekistan. Previous studies were often small-scale, focusing on male display areas, nests, or tracks. The Central Kyzylkum National Nature Park, with varied topography, vegetation, and soil, required landscape-level investigation. Earlier estimates of the entire Asiatic houbara population ranged from 39,000–52,000, with 77% in Kazakhstan and 15% in Uzbekistan, but these were outdated and methodologically weak. Reliable updated data were needed.

Methods

Study Area

The study was conducted in the Central Kyzylkum National Nature Park, Uchquduq district, Navoi region, Uzbekistan (41°28'04"N, 62°41'01"E, 170–400 m above sea level). The terrain is mainly flat or gently sloping, bordered by low mountains to the north and east, and sandy areas to the southeast. Vegetation consists mostly of drought-tolerant shrubs, with soil types (gypsum, sand, clay) creating a mosaic landscape. In spring, vegetation density is highest near water, while much of the desert sees little livestock grazing.

Sampling of Houbara

Houbara bustards are cautious and secretive, making them difficult to detect. During the breeding season (March–May), males display courtship “dances,” visible from long distances, providing an opportunity for observation. From March 24 to May 19, 2025, observations were conducted at 194 points, each surveyed twice. Points were randomly selected with GPS, avoiding unsuitable locations (e.g., swamps, mountains). Four main shrub communities were included: *Artemisia* (halophytes), *Salsola* spp., *Astragalus*, and *Calligonum*. Minimum distance between points was 4 km to avoid repeated counting and spatial autocorrelation. Each

observation lasted 30 minutes using binoculars and telescopes (20–60×). Data recorded for each bird included sex, age, number, distance (up to 1,400 m with laser rangefinder), activity (flying, walking, standing, hiding, displaying), and observation time. Wind strength (0–3) was noted, and no observations occurred during rain or fog.

Detectability and Density Estimates

Detection probability depends on date, observation day, time (morning/evening), wind, shrub height, and terrain roughness. These were analyzed using DISTANCE 6.0 software with half-normal detection functions. Bird densities were stratified by shrub community.

Habitat and Land Use Variables

Seven factors potentially affecting bird numbers were studied:

- Terrain roughness
- Soil type (clay, sand, gravel, gypsum)
- Shrub species composition
- Shrub height and density
- Satellite-derived land cover (GLOBCOVER)
- Grazing intensity (sheep density)
- Artificial landscape features (roads, settlements, water sources)

Statistical Modelling

Data were analyzed in R 3.0.2 using GLMMs (Poisson distribution). Each point was included as a random effect due to repeated surveys. Four model sets were constructed: vegetation structure (shrub height + soil type), shrub assemblages, shrub species composition (MDS), and satellite-derived GLOBCOVER data. Sheep density and terrain roughness were also included. Model fit was assessed using AIC.

Mapping and Validation

Bird density maps were created based on model results using a grid of 1,836 × 1,836 m. Observations at 140 points in 2024 validated model predictions. Model accuracy was assessed via correlation (R^2) between 2024 and 2025 results.

Results

From 231 survey points in 2024–2025, 217 houbara (or small groups) were recorded, including 202 adults and 15 juveniles. Of the 211 adults identified, 94% were males. Females were rarely observed due to their secretive nesting behavior; therefore, analyses focused on males (unsexed birds proportionally added to male counts).Habitat analysis included 65,939 shrubs across 817 points (total distance: 155 km). Shrub height exceeded 45 cm in western and southern areas (mainly *Astragalus* and *Calligonum*) and was below 30 cm in *Artemisia*, *S. rigida*, and *S. arbuscula*

areas. PCA of soil types indicated two gradients: clay to sand and gravel to drifting sand. Each shrub community had characteristic soil: clay in *Artemisia* and *S. rigida*, firm sand in *Astragalus*, and drifting sand in *Calligonum* (18%).

Bird densities:

- Highest: *Calligonum* areas — 24 birds/km²
- Medium: *Astragalus* and *Artemisia* — 12–19/km²
- Lowest: *S. arbuscula* and *S. rigida* — 6–9/km²

Effective detection radius (EDR) averaged 1,036 m. Best detection model included time of day and survey phase. Wind and shrub height did not affect detectability. Average male density was 0.9 birds/km²; highest in *S. rigida* (0.22/km²), medium in *Astragalus* (0.15) and *S. arbuscula* (0.14), lowest in *Artemisia* (0.09) and *Calligonum* (0.04). Total estimated males: 820.

Habitat and Land Use Correlations

Vegetation structure model showed the strongest effects: male numbers were higher in low shrubs, gravelly soils, and flat terrain. Shrub assemblages model: most birds in *S. rigida*, least in *Calligonum*. Shrub species composition (MDS) showed some positive correlations but complex. GLOBCOVER gave no significant results. Density maps from the vegetation structure model matched 2024 observations best ($R^2 = 0.22$) and were validated in 2025 ($R^2 = 0.15$).

Discussion

Habitat Effects

In the Central Kyzylkum, male houbara were most abundant in flat, low-shrub, gravelly areas during the breeding season. These areas offer better visibility for display, predator detection, and energy-efficient movement. Optimal habitat = medium-low shrubs + flat, gravelly terrain. This aligns with studies of African houbara in the Canary Islands, which prefer flat terrain (<15% slope). This study is the first to show the influence of vertical vegetation structure (shrub height) on male density at landscape scale.

Shrub Community Differences

Males were most abundant in *S. rigida* areas (sparse, low vegetation with good visibility), moderate in *Astragalus* and *S. arbuscula* areas (covering over half the study area), and scarce in *Calligonum* and *Artemisia* areas. High shrub height in *Calligonum* limits display visibility; dense, low *Artemisia* may restrict nesting.

Males select vegetation structure for optimal visibility, not just species identity, consistent with lekking systems seen in other bustards (e.g., Great Bustard *Otis tarda*, Bengal Florican *Houbaropsis bengalensis*). Livestock grazing currently does not

significantly harm houbara habitats, but nest destruction and egg collection remain threats.

Population Estimate

Average male density: 0.14 birds/km² → 0.28 adults/km² assuming 1:1 sex ratio. This is higher than other Asian regions: Oman 0.03/km², Kazakhstan 0.01–0.15/km², China 0.12/km². Central Kyzylkum is thus a key population center.

CONCLUSION

This study provides the first detailed analysis of habitat requirements and limitations of the Asiatic houbara in its breeding range. Male density is strongly linked to vegetation structure (shrub height, sparsity, terrain flatness). Populations are highest in *S. rigida* and *Astragalus* areas, two times lower in *Artemisia*, and five times lower in *Calligonum*. Therefore, vegetation types and soil composition must be considered in population estimates. Males display in locations with optimal visibility and movement. Conservation priority should focus on *Salsola* and *Astragalus* dominated habitats, while sandy areas are of lower importance.

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