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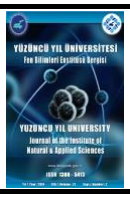

Research Article

Biological Features of Crested Lark, *Galerida cristata* in Isparta Province (Türkiye)

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Abstract: In the present study The Crested Lark (*Galerida cristata*) was observed in Isparta using standard ornithological field techniques in 2023. Four observation stations with distinct environmental characteristics were selected to assess the species behavioral and ecological traits. The study, conducted in central Isparta found that the species exhibit compatible intraspecific and interspecific relationships, display euryphagous feeding habits, and occupies a beneficial role in agricultural ecosystems due to their adaptability to human-modified environments. Additionally, the Crested Lark serves as a critical component within local food chains. These findings underscore its ecological and ornithofaunistic significance in the region. However, in this study was observed key threats to the species' persistence, including the widespread use of agrochemicals in farming practices, as well as habitat fragmentation, degradation, and loss. Also, this research highlights the importance of understanding the biological requirements of the Crested Lark to inform conservation strategies aimed at safeguarding the species and ensuring its survival for future generations.

Keywords: Biodiversity, Galerida cristata, Isparta, Ornithofauna, The Crested Lark

Isparta Kent Merkezindeki Tepeli Toygar (Galerida cristata)'ın Biyolojik Özellikleri

Öz: Bu çalışmada, Tepeli Toygar (*Galerida cristata*), 2023 yılında Isparta'da standart ornitolojik arazi teknikleri kullanılarak gözlemlenmiştir. Türün davranışsal ve ekolojik özelliklerini değerlendirmek için farklı çevresel özelliklere sahip dört gözlem istasyonu kurulmuştur. Isparta'nın merkezinde yürütülen çalışma, türün tür içi ve türler arası uyumlu ilişkiler sergilediğini, örifaj beslenme alışkanlıkları sergilediğini ve insan eliyle değiştirilmiş ortamlara uyum sağlayabilmesi nedeniyle tarımsal ekosistemlerde faydalı bir rol oynadığını ortaya koymuştur. Ayrıca, Tepeli Toygar lokal besin zincirlerinde kritik bir bileşen olarak hizmet vermektedir. Bu bulgular, türün bölgedeki ekolojik ve ornitofaunistik önemini vurgulamaktadır. Bununla birlikte bu çalışmada, türün devamlılığı için temel tehditler; tarım uygulamalarında yaygın olarak kullanılan tarım kimyasallarının yanı sıra habitat parçalanması, bozulması ve kaybı gözlenmiştir. Ayrıca, bu araştırma, türün korunması ve gelecek nesiller için hayatta kalmasının sağlanmasına yönelik koruma stratejileri hakkında bilgi vermek, Tepeli Toygarın biyolojik gereksinimlerini anlamanın önemini vurgulamaktadır.

Anahtar Kelimeler: Biyoçeşitlilik, Galerida cristata, Isparta, Ornitofauna, Tepeli toygar

1. Introduction

From the poles to the equatorial forests, from the deserts to the centers of the oceans, and from the highest mountains to the hearts of our cities, birds are everywhere. With approximately 10,000 species, birds are among the most conspicuous forms of animal life. Of all animal classes, birds are one of the most well-known, as humans have long used them for food, communication, and decoration. Furthermore, birds play a vital role in ecosystems. They are important agents of biological control,

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preying on pests such as rodents, and are essential for maintaining ecological balance, especially through their position in the food web. However, over the last three centuries, industrial development and anthropogenic impacts have degraded habitats and disrupted this natural balance (Tabur & Ayvaz, 2010).

Birds exhibit distinct habitat preferences (Cody, 1981), making them valuable bioindicators of environmental change. The characteristics of these habitats, along with other environmental factors, significantly influence population abundance and distribution (Newson et al., 2008). Consequently, a robust understanding of avifaunal ecology is essential for effective conservation, planning, and environmental assessments (Khan & Pant, 2017).

With 530 recorded bird species, Türkiye boasts a remarkable diversity of ornithofauna (Kiziroğlu, 2023). This ecological richness is attributed to the country's wide range of habitats, which provide ideal conditions for birds to feed, breed, and find shelter (Kiziroğlu, 2019).

Globally, the order Passeriformes is the most species avian group, containing 6,694 of the world's 11,195 bird species. Within this order, the family Alaudidae (larks) includes 21 genera (IUCN, 2024). This family is well-represented in Türkiye, with 16 recorded species, including those from the genus Galerida (Furtun et al., 2021).

The Lark family (Alaudidae) is represented worldwide by approximately 100 species that typically inhabit open environments such as steppes, meadows, deserts, and shrublands. Among these, the Crested Lark (*Galerida cristata*) has a particularly broad distribution, ranging from North and Central Africa through Asia Minor and Central Asia to Europe (Guillaumet et al., 2006). While its native habitat consists of semi-desert and steppe vegetation, the species has demonstrated remarkable adaptability successfully colonizing human-modified landscapes such as agricultural fields, urban areas, and transportation corridors like roadsides and railways (Roselaar, 1988; Birdlife International, 2023).

Most research on the Crested Lark has been concentrated in European countries like the Czech Republic and Poland, as well as in Iran. In Türkiye, despite being a common species, it has experienced a significant population decline since the mid-20th century (De Juana et al., 2004; Birdlife International, 2023). However, there is a notable lack of research on its biology and ecology within the country. Given its close association with agricultural areas, the Crested Lark serves as a key focal species for detecting environmental problems and guiding conservation planning.

2. Material and Methods

The Crested Lark (*Galerida cristata*) is a medium-sized passerine with a length of 17–19 cm, a wingspan of 29–38 cm, and a body weight of 35–50 g (Figure 1). Its geographic range is extensive, spanning from North Africa across the Arabian Peninsula and Europe to Central Asia. The species is monogamous; while the female is solely responsible for nest construction and incubation, both parents participate in caring for the offspring (Furtun et al., 2021).

Figure 1. Crested Lark front (a) and back view (b).

This study was conducted in Isparta province, situated in the Lakes Region of southern Türkiye. The province covers an area of 8.933 km² with an average elevation of 1.050 meters (Isparta Governorship, 2024).

Bird surveys were conducted using the point count method, systematically scanning a 1 km diameter area from the center of each station. To document diurnal activity, observations were conducted at various times, specifically between 07:00 and 18:00 in winter and from 07:00 to 20:00 in spring and summer. Early morning surveys were prioritized to detect individuals leaving their nests. Field equipment included a Canon 700D camera with a 300 mm lens and 50x30 binoculars.

Four observation stations were established along a gradient of human disturbance, primarily within the agricultural landscapes preferred by the species. The first station was situated near human settlements and was characterized by a complex habitat matrix of agricultural land, farms, a railway line, scattered trees, and roadside shrubbery. In contrast, the second station featured fewer settlements and was composed mainly of agricultural fields, secondary roads, and a few small orchards. The third station represented a more remote environment, located far from major roads and settlements and consisting primarily of agricultural lands and orchards. Finally, the fourth station located in an uninhabited area but was immediately adjacent to a major highway, representing a different type of anthropogenic pressure. The locations of all four stations are depicted in Figure 2.

Figure 2. Selected observation stations.

3. Results

A total of 135 individuals were recorded over the course of the study. The abundance and distribution of the Crested Lark were uneven across the observation areas (Table 1). The highest population densities were consistently found at stations located near human settlements and along roadsides. In active agricultural zones, a small number of individuals were observed foraging in fields during planting periods.

Behavioral observations revealed low interspecific competition, as the larks foraged alongside other species without apparent spatial conflict. Population numbers peaked during the breeding season, at which time individuals became highly concentrated near human settlements. During this period, their activities, including both nesting and foraging, were localized in the immediate vicinity of their nest sites.

Table 1. Minimum and maximum numbers of individuals observed in 2023

Observation Stations	1	2	3	4
January	2-4	1-2	1-3	1-3
February	4-6	1-3	2-3	1-2
April	7-13	5-6	2-4	1-4
May	8-11	5-6	3-4	2-6
June	7-10	7-8	1-4	3-5
July	5-9	4-6	1-5	2-6

Table 1. Minimum and maximum numbers of individuals observed in 2023 (continued)

August	4-7	4-5	2-4	3-5
September	4-7	2-4	1-3	2-4
October	5-7	4-5	1-4	2-4
November	4-6	2-4	2-3	1-3
December	3-5	1-2	2-3	1-2

Significant variation in individual abundance was observed among the four stations. Station 1 consistently supported the highest population density, likely because its habitat characteristics provided optimal foraging and nesting opportunities. Conversely, Station 4 had the lowest abundance, suggesting that its environment lacked the key biological requirements to support a stable population. The intermediate populations at Stations 2 and 3 appeared to be seasonal; these areas were primarily utilized during the planting season, a period of temporarily high food availability. For the remainder of the year, a combination of higher predation risk and scarce food resources may have rendered these habitats less favorable.

Social flocking was a prominent diurnal activity, primarily for foraging purposes. These feeding aggregations were most frequently observed at Station 1, near livestock farms and human settlements. This behavior intensified during the breeding season, likely driven by the increased energetic demands of raising young (Figure 3a).

Daytime perching on elevated structures, such as fences, rocks, and high ground, was observed but was not a frequent behavior (Figure 3b). The limited time allocated to this activity is likely a result of the species' intense diurnal schedule, with most daylight hours dedicated to foraging and parental care.

Figure 3. Feeding individuals (a), individual on fan (b).

At Station 2, individuals periodically climbed onto soil mounds (Figure 4a-b), whereas at Station 1, they were observed perching on rocks (Figure 4c).

Figure 4. Resting (a), on bump (b), perching (c).

The Crested Lark utilized the entire study area for both foraging and roosting, demonstrating effective spatial partitioning to minimize overlap with other sympatric species (Figure 5a).

The typical flight pattern during feeding was undulating, with short flights between different areas. This was especially noticeable at Station 1, where the larks would take off and land quickly to

catch insects near livestock waste. This behavior highlights their sudden maneuverability and agility (Figure 5b).

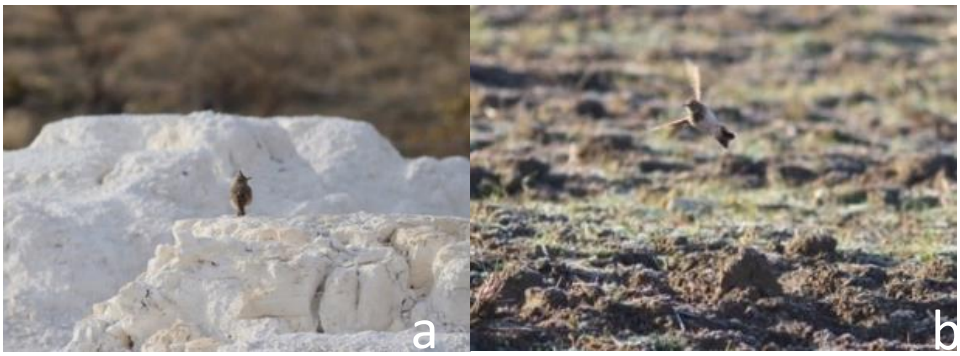

Figure 5. An individual resting on a lime pile (a), an individual suddenly taking off during feeding (b).

During the breeding season, males perform elaborate aerial displays for both territorial defense and courtship (Figure 6a). These displays are characterized by a combination of complex songs and agile flight patterns, including short, rapid flights and sudden, acrobatic maneuvers. Such behaviors are critical for advertising the male's fitness to potential mates and deterring rival males.

The study also documented short-distance, non-migratory movements between stations, such as from Station 1 to the alternative habitats at Station 2 (Figure 6b). These shifts appear to be opportunistic, allowing individuals to access temporary resources or rest when conditions in their primary territory are suboptimal. The species' characteristic rapid and direct flight enables this efficient movement across open landscapes, facilitating the search for food, mates, and suitable breeding sites.

Figure 6. Courtship behavior (a), image of individual starting to fly (b).

As a diurnal species, the Crested Lark is active throughout the day, with its daily routine involving frequent, short flights between key resource patches such as roadsides, livestock farms, and human settlements. Seasonal shifts in habitat use were also evident. During the winter, for instance, individuals concentrated their activity along roadsides and near settlements.

The species is predominantly a ground-forager, a behavior observed consistently across all stations (Figure 7). Its diet appears to consist mainly of seeds, grains, and terrestrial insects, as documented at Station 1. When faced with food scarcity or high interspecific competition, the Larks demonstrated flexibility by shifting their foraging efforts to alternative habitats, such as agricultural fields and orchards.

The Crested Lark exhibited a high degree of constant vigilance. This was characterized by short, abrupt movements and rapid head-turning to scan the surroundings while perched. On the ground, they moved with quick, running steps rather than walking, allowing for rapid repositioning. Social behavior also appeared to play a role in defense; pair-bonding persisted outside the breeding season (as observed at Station 4), which likely enhances vigilance through cooperative threat detection.

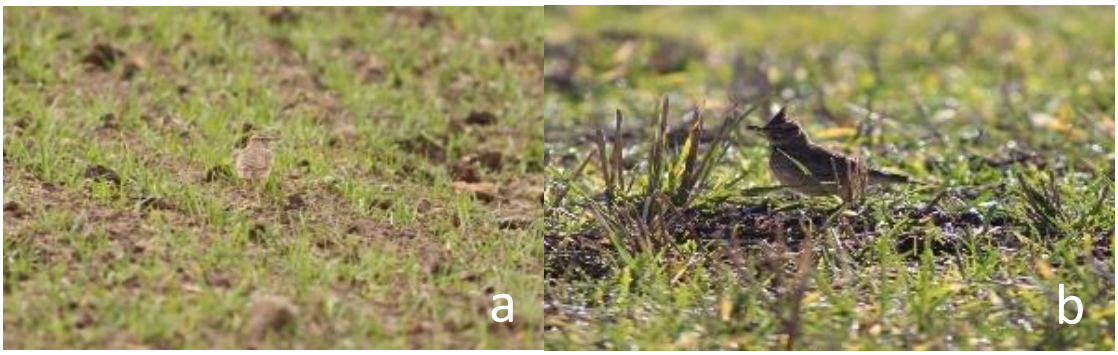

Figure 7. Feeding individuals (a-b).

The Crested Lark is an omnivorous ground-forager whose diet primarily consists of seeds, grains, and invertebrates. The relative importance of these food items shifts seasonally. During the breeding season, the diet is heavily supplemented with protein-rich insects, such as grasshoppers and caterpillars, to meet the high energetic demands of chick-rearing (Figure 8).

Foraging involves actively pecking and probing the soil to uncover food, with individuals relying on keen visual and auditory senses to locate prey. This strategy is adapted to seasonal availability; short flights are typically used to locate patches of seeds in winter and to pursue insects in summer. While the species obtains most of its water from its food, it was observed drinking directly from puddles and troughs during hot, dry periods, particularly at Station 2.

Figure 8. Perching behavior (a-b).

The Crested Lark displays a highly adaptable foraging ecology. It engages in opportunistic interspecific behaviors, such as following grazing livestock to feed on disturbed insects. The species' diet and foraging locations vary both seasonally and regionally in response to food availability and reproductive needs. This flexibility was evident at Station 1, where a diet rich in insects corresponded with the high insect abundance near livestock farms during the April-September breeding season. This adaptability allows the lark to successfully exploit diverse habitats, ranging from natural grasslands to highly modified agricultural and urban landscapes.

The species employs a multi-faceted suite of anti-predator behaviors to ensure its survival. It relies heavily on acute vision and hearing to detect threats. Unlike many species that immediately take flight, the Crested Lark was observed to respond to the presence of aerial predators, such as the Common Buzzard (*Buteo buteo*), by crouching and hiding. Its plumage provides excellent camouflage (crypsis), with colors and patterns that blend seamlessly with the soil and sparse vegetation of its open habitats.

Constant vigilance is maintained through several behaviors: perching on elevated vantage points to scan for danger, exhibiting alert postures while feeding, and using sharp alarm calls to warn conspecifics of approaching threats (Figure 9a). When a threat becomes imminent, the lark utilizes a rapid and agile evasive flight to escape, quickly seeking refuge in nearby cover (Figure 9b).

Socially, the species is typically found in pairs or small groups. During the breeding season, this social structure shifts to strong territoriality. Males aggressively defend their territory and nest sites from rivals and potential threats. This defense involves elaborate territorial displays, which include specialized vocalizations and conspicuous aerial flights, often performed near the nest site to deter intruders.

Figure 9. The threatened individual (a), gathering individuals taking off quickly (b).

In general, crested larvae use a combination of defensive strategies, protective behaviors and social interactions to minimize the risk of predation and ensure their survival in their diverse habitat.

Galerida cristata can join feeding flocks composed of individuals of different species. This association allows them to share information about food sources and potential threats, and sheer numbers can provide protection against potential predators. In some cases, they may share their breeding grounds with other species. This behavior, known as nest-site commensalism, allows multiple species to use limited nesting resources more efficiently.

Crested larks can respond to the alarm calls of other species in their environment. By listening to the alarm calls of other birds, they can more effectively detect and respond to potential threats, even if they are not directly targeted by predators.

It may also engage in competitive interactions, especially with other bird species occupying similar ecological niches or using similar resources. These interactions may involve competition for food, nesting space or territory.

It may participate in defensive behavior with other species against excessive predator risk. Defense may involve harassing and driving away predators by approaching them, making loud calls and sometimes even physically attacking them. Interspecific interactions play an important role in the ecology and behavior of the Crested Lark, influencing their feeding strategy, reproductive success and survival in their natural habitat. The species' behavior encompasses a wide range of activities and interactions essential for their survival and reproduction.

They use their beaks to peck and probe the soil in search of food. Foraging behaviors may include running short distances between foraging areas. Particularly at Stations 1 and 2, during the breeding period, males were observed to define and defend territories in nesting and courtship behaviors. They show territorial behavior such as calling from prominent perches, aerial flight and aggressive interactions with rival males.

The male displays short-distance flight, rapid wing-flapping movements and calls to impress the female. During breeding, the parents share incubation duties and care for the young after hatching.

Individuals communicate through a variety of vocalizations such as songs, calls and alarm signals. Melodic songs are used for territorial defense and courtship, while alarm calls alert nearby individuals to potential threats such as predators.

The Crested Lark uses a variety of anti-predator strategies to avoid detection and capture by predators. These can include vigilance behaviors, alarm calls and escape flights. For example, when feeding along roadsides, it shows vigilance behavior by first turning its back to the road when a car approaches and then moving away when the car approaches. They may also engage in flocking behavior to harass and drive away predators.

4. Discussion and Conclusion

Galerida cristata was observed in all stations. Considering the conservation status and population density, the species is not endangered. According to IUCN (2024), the species is evaluated in the LC (Least concern) category, but Lesinski (2009) stated that the reproduction rate decreased due to the increase in settlements and destruction of agricultural areas. The fact that no direct threat was observed in the study area does not mean that the species does not need protection. Especially due to the decrease in agricultural areas, we now see the species close to the city center. Feeding on seeds may cause it to be considered as an agricultural pest. However, the low number of individuals and the fact

that a significant part of its diet consists of insects will help to keep agricultural pest populations under control, so we can characterize it as farmer friendly.

Ahmad et al. (2023) emphasized the importance of planting flowering plants and fruit trees for resident bird species to continue their existence in the area. They also mentioned that trees will provide nesting and protection for birds. In this study conducted in Isparta, scattering seeds in agricultural areas will enable the species to easily access the food source. Since they build their nests on the ground, leaving stones and rocks in agricultural areas and structures consisting of shrub forms will allow them to nest and protect them.

Ahmad et al. (2023) recommended the establishment of artificial nests to support, protect and conserve bird fauna, and flowering plants and fruit trees to protect existing nests and facilitate natural nesting areas. Surveys on ornithological diversity, settlement status, and habitat should be conducted regularly. In this way, the reasons for population size, diversity and ecologically induced decline can be understood. However, the field studies carried out within the scope of this study revealed that the Crested lark nests on the ground and under shrubs, so natural shrub forms and rocky structures should be preserved between agricultural areas.

According to Kakalis et al. (2023), the absence of mammal and bird hunting in the region contributed to the population size. The reason for the significant decline of bird populations in agricultural areas in Europe in recent years is the small arable land per capita and vegetation destruction. In recent times, zoning of agricultural areas and the increasingly popular hobby gardens have led to the fragmentation of agricultural areas and the gradual shrinkage of arable lands. The relatively large agricultural areas in Isparta do not put serious pressure on the species. The absence of hunting activities near agricultural areas in the regions close to the center is an advantage for the species.

Donald et al. (2001) stated that birds are the most threatened in agricultural areas, and Hamza & Hanane (2021) emphasized the importance of effective management in agroecosystems to identify factors affecting bird diversity. Yaneva et al. (2020) stated that agriculture has a significant impact on the environment due to its importance among human activities and that agriculture contributes the most to biodiversity loss worldwide. Rapid population growth increases the demand for agricultural products and natural areas are transformed into agricultural land. For this reason, the region's agricultural policies need to be adjusted. Navarro et al. (2023) stated that the conservation of biodiversity and birds is possible through agricultural policies. Biodiversity and sustainability should be prioritized in regulations and effective agricultural policies should be implemented.

Pimentel et al. (1992) stated that the most important cause of biodiversity loss is the use of artificial fertilizers, and Hagman et al. (2012) emphasized that the populations of many animal species living in agroecosystems have declined. Vergel et al. (2022) stated that songbirds will become vulnerable for their limited heat tolerance, especially in a possible climate change scenario. Similarly, it is necessary to protect and develop the resources to meet the needs of birds in agricultural lands, especially during dry seasons in Isparta.

Determining the positive effects of *Galerida cristata* in agricultural areas is very important for raising awareness of farmers. Continuity of the population means that the system is functioning. The fact that the biology of the species has not been investigated before reveals this deficiency. *Galerida cristata*, the most common species in open arable areas will allow us to observe the effects of the negativities that may occur in agricultural management on the species. Regular monitoring of the species every year will allow the creation of a population data bank and comparison with the past over time.

Thesis Statement

This study is derived from Yiğit Anteplioğlu's Master's thesis.

Authors' Contribution Statement

Yiğit Anteplioğlu: Observations, Data collection and evaluation, Comparison of findings with literatüre. **Mehmet Ali Tabur:** Research subject, Data analysis and evaluation, Supervisior.

Conflict of Interest Statement

The authors declare that no conflict of interest exists.

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