



Back to the Wild: Retrospective Evaluation of Rehabilitation and Pre-release Processes in Barn Owl (*Tyto alba*) Chicks

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Abstract: In this study, the eight-week rehabilitation process of Barn owl (*Tyto alba*) nestlings until their release into the wild was evaluated based on weekly developmental stages. Between 2023 and 2025, sixteen Barn owl nestlings, estimated to be 3-4 weeks of age (mean weight 233.4 ± 10.3 g) and having fallen from their nests, were admitted to Clinic of Department of Wild Animal Diseases, Faculty of Veterinary Medicine, Ondokuz Mayıs University. The owls were monitored individually in a clinical setting and underwent a structured rehabilitation programme considering weekly physical development indicators such as plumage, balance, body weight, reflexes, flight ability, and prey handling skills. Feeding plans were age-adjusted, starting with small pieces of meat and progressing to whole meaty bones while monitoring pellet-casting behaviours. Housing was transitioned from temperature- and light-controlled incubators ($0.8 \times 1 \times 0.6$ m) to spacious, naturalistic flight and exercise areas ($4 \times 10 \times 4$ m). From the eighth week onwards, flight training and predatory feeding behaviours were systematically evaluated, with minimal human contact maintained to reduce imprinting. Statistical analysis revealed significant weight increases between consecutive periods ($p < 0.001$). While two owls died during rehabilitation, fourteen were released without complications. All surviving owls were released using the "hard release" method at twelve weeks of age, upon reaching a mean weight of 340.0 ± 12.0 g. The findings suggest that an age-based weekly care approach can support the development of flight, prey manipulation, and natural behaviours in Barn owls. This study is one of the studies presenting weekly, literature-based data on Barn owl rehabilitation in Türkiye.

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Yaban Hayatına Dönüş: Peçeli Baykuş (*Tyto alba*) Yavrularında Rehabilitasyon ve Doğaya Salım Öncesi Süreçlerinin Retrospektif Değerlendirilmesi



Öz: Bu çalışmada, *Tyto alba* yavrularının doğaya salınmalarına kadar geçen sekiz haftalık rehabilitasyon süreci, haftalık gelişim evrelerine göre değerlendirildi. 2023-2025 yılları arasında, 3-4 haftalık oldukları ve yuvadan düştükleri tahmin edilen (ortalama ağırlık $233,4 \pm 10,3$ g) on altı yavru peçeli baykuş Ondokuz Mayıs Üniversitesi Veteriner Fakültesi Yabani Hayvan Hastalıkları Ana Bilim Dalı Kliniği'ne getirildi. Baykuşlar klinik ortamda bireysel olarak izlendi ve tüy, denge, vücut ağırlığı, refleksler, uçuş yeteneği ve av kavrama becerileri gibi haftalık fiziksel gelişim göstergelerini dikkate alan yapılandırılmış bir rehabilitasyon programına tabi tutuldu. Beslenme planları yaşa göre ayarlanarak, küçük et parçalarıyla başlandı ve pelet atma davranışları izlenerek bütün etli kemiklere doğru ilerlendi. Barınma, sıcaklık ve ışık kontrollü inkübatörlerden ($0.8 \times 1 \times 0.6$ m) geniş, doğal uçuş ve egzersiz alanlarına ($4 \times 10 \times 4$ m) doğru değiştirildi. Sekizinci haftadan itibaren, iz bırakmayı azaltmak için minimum insan teması sağlanarak uçuş eğitimi ve av ile beslenme davranışları sistematik olarak değerlendirildi. İstatistiksel ölçümlerde, ardışık dönemler arasında önemli ağırlık artışları belirlendi ($p < 0,001$). Rehabilitasyon sırasında iki baykuş hayatını kaybetmiş; on dört baykuş komplikasyonsuz şekilde serbest bırakıldı. Hayatta kalan tüm baykuşlar, ortalama $340,0 \pm 12,0$ g ağırlığa ulaştıklarında ve on iki haftalık olduklarında "sert salım" (hard release) yöntemi kullanılarak serbest bırakıldı. Bulgular, yaşa dayalı haftalık bir bakım yaklaşımının, peçeli baykuşlarda uçuş, av manipülasyonu ve doğal davranışların gelişimini destekleyebileceğine işaret etmektedir. Bu çalışma, Türkiye'de peçeli baykuş rehabilitasyonu hakkında haftalık, literatüre dayalı veriler sunan çalışmalardan biridir.

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INTRODUCTION

Owls are distributed across all continents except Antarctica with the Barn owl (*Tyto alba*) specifically

exhibiting a cosmopolitan distribution adapted to diverse habitats ranging from deserts to marshlands (Bruce, 1999). The Barn owl (*Tyto alba*) is recognized as a resident species especially along the coastal lines and low-altitude

agricultural lands of Türkiye (Göçer & Johnson, 2018; Kirwan et al., 2008). When cases admitted to wildlife first aid and rehabilitation centers in Türkiye are examined, it has been reported that birds constitute the majority of orphaned animals in need of care (Kandır and Gül, 2020). Among these orphaned nestlings, owls are one of the most sensitive groups in the rehabilitation process. However, studies providing a comprehensive protocol on the weekly developmental parameters and release criteria of these nestlings in Türkiye are quite limited. Most species are nocturnal, and all are predatory birds that feed on carrion only when necessary. They hunt using both their vision and hearing, and the plumage of many species is adapted for silent or near-silent flight. The Barn owl utilizes its facial ruff to amplify sounds and relies on the time and intensity differences perceived by its asymmetrical ears to pinpoint prey locations with high precision (Knudsen and Konishi, 1979). Specifically, the comb-like serrations on the leading edge of the wing feathers disrupt air turbulence, effectively suppressing aerodynamic noise during hunting (Bachmann et al., 2011). As their legs develop, young owls become increasingly active and mobile, climbing within the nest and moving around its surroundings. This behaviour often results in nestlings leaving the nest before they are fully capable of flight. Moreover, unlike many other raptors, juvenile owls of most species tend to remain with their parents for a comparatively longer period after fledging, during which they learn and refine their hunting skills (Fosco, 2020). Rehabilitation and reintroduction programmes aimed at conserving endangered species and vulnerable populations have increased significantly in recent years (Carter & Newbery 2004; Lezana et al., 2022). The diet of Barn owls (*Tyto alba*) frequently consists of vertebrates and insects (Winkler et al., 2020). Consequently, members of the Tytonidae family play a crucial role in controlling rodent and insect populations. Due to this predation pressure, Barn owls are increasingly recognized as effective biological control agents in agricultural landscapes, reducing the need for chemical rodenticides (Kross et al., 2016). At the same time, owing to population declines driven by various factors, Barn owls are often bred in captivity or raised in wildlife rehabilitation centres as part of conservation initiatives (Fajardo et al., 2000; Chien & Ritchison, 2005; Motro, 2011; Saufi et al., 2020; Winkler et al., 2020; Lezana et al., 2022). However, studies have reported that captive-reared individuals exhibit lower survival rates in the wild compared to those rehabilitated after prior exposure to natural environments (Scott & Carpenter, 1987; Lezana et al., 2022). Environmental and climatic disruptions, habitat degradation, and anthropogenic pressures frequently result in injuries or necessitate rehabilitation, particularly among younger individuals, due to their vulnerability. Furthermore, collisions with vehicles on roadways represent a major cause

of mortality and injury for this species, particularly for dispersing juveniles (Grilo et al., 2012). Wildlife rehabilitation is a systematic process that encompasses the provision of appropriate care and veterinary treatment, the restoration of flight and hunting abilities, and, ultimately, the release of individuals into their natural habitats. The effectiveness of this process directly determines the animals' ability to re-adapt and survive in the wild (Leighton et al., 2008). In some countries, detailed analyses of rehabilitated and released Barn owls have investigated dispersal patterns, survival rates, and mortality (Fajardo et al., 2000). These studies have revealed that mortality is particularly high during the initial post-release period. Nonetheless, pre-release training involving live prey has been shown to significantly enhance survival rates (Fajardo et al., 2000). Monitoring methodologies are therefore of critical importance in evaluating the success of rehabilitation. Advanced technological tools such as satellite tracking represent effective methods for documenting the post-release movements, dispersal, and survival of juvenile Barn owls (Slankard et al., 2021). Furthermore, pre-release programmes designed in accordance with species-specific behaviours, including hunting and roosting protocols, hold the potential to enhance post-release adaptation and survival (Lezana et al., 2022). In this context, the present study aims to evaluate the effects of an eight-week systematic rehabilitation programme on the flight and prey-handling capabilities, stress management, and pre-release readiness of juvenile Barn owls that had fallen from their nests and were brought to the clinic in need of care. We anticipate that the findings will contribute both scientifically and practically to rehabilitation practices, offering novel insights to the existing body of literature.

MATERIAL AND METHOD

Study Area and Samples: The sample of this study comprised 16 juvenile Barn owls (*Tyto alba*) that were admitted to the Clinic of Department of Wild Animal Diseases, Faculty of Veterinary Medicine, Ondokuz Mayıs University, between 2023 and 2025. All procedures were approved by the Ondokuz Mayıs University Animal Experiments and Local Ethics Committee (Approval No: 2025-70). The individuals were delivered by local residents and officials of the General Directorate of Nature Conservation and National Parks from different settlements at various times during the study period. In accordance with ecological protocols, nestlings found outside the nest should ideally be placed on a nearby branch for parental care. However, as the subjects in this study were brought to the center by citizens and official units after being removed from their locations, their initial environmental status could not be evaluated in situ. Upon admission, indicators such as plumage development, body weight, and general

morphology were recorded, and age estimation was performed, determining that the owls were approximately 3-4 weeks old at the time of presentation. Following physical and orthopaedic examinations, the pectoral muscles, keel bone condition, overall health status, and body condition scores were evaluated, after which the rehabilitation processes were initiated and the birds underwent rehabilitation for a total of 8 weeks. During the course of rehabilitation, two owls died at different stages; therefore, the findings and statistical analyses were based on the remaining 14 juveniles (Table 1).

Housing and Environmental Conditions: The owls were kept in an incubator ($0.8 \times 1 \times 0.6$ m), which allowed regulation of temperature and fresh air flow, and could be darkened with covering material, until they reached 4-8 weeks of age. Their living spaces were subsequently expanded in parallel with their developmental stages to accommodate their growth requirements. From the 8th week onwards, the owls were housed daily in an indoor flight enclosure ($3 \times 6 \times 3$ m), isolated from external noise and other potential stressors, and equipped with appropriately sized perches. Flight exercises were conducted in a separate flight aviary measuring $4 \text{ m} \times 10 \text{ m} \times 4 \text{ m}$.

Feeding Protocol: Feeding is planned according to the age and development of the chick. The process follows the feeding patterns found in nature as closely as possible. Since owls do not have a crop, feeding is performed when the gizzard is empty. To determine this, the lower abdomen was observed to check if it was empty and loose. The live weights of the animals were recorded daily.

At 3-4 weeks of age: Chicken meat and red meat cut into small pieces; and calcium carbonate and phosphorus (600 mg and 300 mg per 100 g of meat, respectively) were provided in 4-5 meals per day. Fresh water was provided at a dose of 50 ml/kg/day.

4-8 weeks of age: Meat pieces were served in larger sizes, mineral supplementation continued, and 3-4 meals were served per day. Feathers, skin, and cartilage pieces were added to the feed, and pellet formation was monitored.

8-12 weeks of age: Whole bone-in meat with simulated prey interaction, continued mineral supplementation, and 1-2 meals per day (Voluntary feeding began in full).

Flight Training and Prey Handling Practice: Flight training began at 8-12 weeks of age in an area measuring $3 \times 6 \times 3$ m and continued in an area measuring $4 \times 10 \times 4$ m. Turning, acceleration, and manoeuvring practices were evaluated. Live animals were not available for hunting practices. Instead, whole wings were provided for feeding, and the consumption patterns were monitored.

Release into the Wild: When the individuals reached 11-12 weeks of age and met the pre-determined release criteria-including complete plumage development,

adequate flight stamina, and successful food manipulation performance-they were ringed by a licensed ringer and released into the wild at 12 weeks of age. The release process was carried out in cohorts based on the admission dates and developmental rates of the individuals (Table 1). The seven nestlings admitted in 2023 and the five nestlings in 2025 were released as groups upon completing their 8-week rehabilitation. In contrast, the four individuals admitted separately in 2024 were released individually as soon as each bird reached the required physiological maturity. All birds were released via the 'hard release' method into a rural area of the Atakum district, which serves as a suitable ecotone habitat where forest edges and open agricultural fields intersect. This location was specifically selected due to the known presence of a wild *Tyto alba* population and an abundance of small rodents. While passive monitoring was initiated through ringing to allow for individual identification in the event of potential future recaptures, active post-release tracking (e.g., telemetry) was not conducted. Therefore, the efficacy of the process was evaluated based on pre-release developmental indicators and the attainment of physiological maturity required for independent survival.

Statistical Analysis: Data are presented as the mean \pm standard deviation (mean \pm SD). Before the main analysis, the normality of the data was confirmed using the Shapiro-Wilk test, and the homogeneity of variances was verified. To evaluate the growth and physical development of the owls over time, One-Way Repeated Measures ANOVA was employed, as the same individuals were measured across sequential time points. Repeated Measures ANOVA was selected over linear mixed models because the dataset for the surviving individuals ($n=14$) was complete, and the assumption of sphericity was met (verified by Mauchly's test). The two individuals that died during the process were excluded from the statistical growth analysis to maintain a balanced design. When a significant difference was detected, post-hoc comparisons with Bonferroni correction were performed specifically between consecutive periods (Period 1 vs. Period 2, Period 2 vs. Period 3, Period 3 vs. Period 4) to monitor week-over-week development. Statistical significance was set at $p < 0.05$.

FINDINGS

Out of 16 admitted chicks, 14 completed the protocol without complications (Table 1). As specified in the methodology, the two individuals that died within the first two weeks were excluded from the longitudinal weight analysis to maintain statistical homogeneity. During the rehabilitation process, the behavioural and physical development of the individuals was recorded on a weekly basis. When they were first brought in, they were completely covered in white baby feathers, but at 6 to 8 weeks of age,

they began to show signs of adult plumage in shades of brown and grey (Figure 1). During the same time period, it was observed that they were able to eat oral food without any assistance. Weekly body weight measurements showed that the growth process progressed regularly and steadily. Individuals with an average live weight of 233.4 ± 10.3 g in the first week of the rehabilitation process reached an average weight of 340.0 ± 12.0 g before release at 12 weeks. The fastest increase was observed at 6-8 weeks of age (Rehab period 2), during which both muscle development and feathering accelerated. From 10 weeks of age onwards, weight gain slowed down and weight values approached

adult levels. Statistical measurements were conducted to compare live weight increases between consecutive periods, and statistically significant increases were determined between periods 1-2 ($p < 0.001$) and 2-3 ($p < 0.001$). Live weight increases between periods 3-4 ($p > 0.05$) were not statistically significant. Detailed information is presented in Table 2. During the last two weeks of rehabilitation, the individuals developed their natural skills such as free flight, directional maneuvers, and food manipulation in large flight areas. All individuals were ringed in the 12th week and released into the wild using the 'hard release' method.

Table 1. Demographic data and clinical outcomes of Barn owl (*Tyto alba*) chicks admitted for rehabilitation.

| Year | Location (Samsun) | Number of Individuals | Age on Admission (Weeks) | Outcome | Mortality (Post-admission) |
|--------------|-------------------|-----------------------|--------------------------|-----------------------------|-------------------------------|
| 2023 | Atakum | 7 (Same brood) | 3-4 weeks | 6 Released / 1 Died | 1st week (Poor condition) |
| 2024 | 19 Mayıs | 4 (Individual) | 3-4 weeks | 3 Released / 1 Died | 2nd week (Individual) |
| 2025 | Kavak | 5 (Same brood) | 3-4 weeks | 5 Released | - |
| Total | | 16 | 3-4 weeks | 14 Released / 2 Died | Total Mortality: 12.5% |



Figure 1: Morphological changes observed in the rehabilitation process of Barn owl (*Tyto alba*) chicks according to weeks. The general appearance of individuals aged 3-4 weeks, 5-7 weeks, 8-10 weeks, and 11-12 weeks are presented from left to right. The visual was representatively generated using artificial intelligence based on the available photographs to provide a clearer presentation.

Table 2. Average live weights and weight gains of owls during rehabilitation (n=14).

| Rehab Week | Weight (g), (Mean \pm SD, g) | Gain (g/2 weeks) (Mean \pm SD, g) | Process |
|----------------------|--------------------------------|-------------------------------------|-------------|
| Week1(3-4 w. old) | 233.4 ± 10.3 | | |
| Week2 | 248.6 ± 10.5 | 15.2 ± 1.5 | Period 1+ |
| Week3 | 273.6 ± 11.0 | | |
| Week4 | 298.6 ± 11.2 | 25.0 ± 1.8 | Period 2*+x |
| Week5 | 310.8 ± 11.5 | | |
| Week6 | 323.0 ± 11.6 | 12.2 ± 1.1 | Period 3x |
| Week7 | 331.5 ± 11.8 | | |
| Week8 (11-12 w. old) | 340.0 ± 12.0 | 8.5 ± 0.9 | Period 4 |

* The period during which the greatest increase in live weight occurs.

+ , x: Statistically significant increase between them ($p < 0.001$).

DISCUSSION AND CONCLUSION

This study provides one of the first detailed datasets on the rehabilitation and growth indicators of Barn owl chicks in the Black Sea region of Türkiye. Wildlife rehabilitation studies in the literature are often limited to a

small number of cases or individual reports. The assessment rehabilitation and release of 14 out of 16 individuals (87.5%) could be interpreted as an indication that the implemented protocol may have contributed to the improvement of pre-release readiness indicators. This sample group of 14 individuals increases the scientific

power of the developmental statistics and establishes a reliable reference range for similar rehabilitation cases.

Given that wildlife rehabilitation literature frequently relies on a limited number of individual reports, our cohort of 14 released Barn owls could provide a more representative dataset for identifying regional developmental trends. During the 8-week rehabilitation period, significant body weight increases ($p < 0.001$) were recorded along with qualitative improvements in postural control and flight behaviours. While these findings suggest that the nestlings reached physiological maturity within the clinical setting, it must be explicitly stated that post-release outcomes were not monitored. Therefore, the observed developmental progress is limited to pre-release indicators and does not allow for definitive conclusions regarding long-term survival success in the wild. Ultimately, such developmental trajectories suggest that the implemented care may have effectively facilitated the birds' ability to reach physiological maturity at rates consistent with those observed in healthy wild populations.

The decision to begin the rehabilitation process for birds of prey is one that must be made carefully and systematically, as it depends on factors such as animal welfare, the case-dependent likelihood of successful treatment, treatment costs, and available clinical facilities (Griffiths et al., 2010; Cooke et al., 2023). The reintroduction of raptor species that have been in prolonged contact with humans back into the wild can be a challenging process due to their adaptation to humans, loss of natural instincts, and reduced hunting abilities (Cooke et al., 2023). In this study, the behavioural and physical development of Barn owls (*Tyto alba*) chicks observed during the 8-week rehabilitation process is consistent with similar studies reported in the literature (McNabb, 1996; Cooke et al., 2023). The fact that the chicks were completely covered in white down when they were first brought in and began to show signs of adult plumage from the 6th to 8th week, may indicate that their natural development processes continued healthily in the rehabilitation environment. Similarly, the ability to feed orally without support and weekly body weight measurements confirms that growth and development were regular and stable. The rapid weight gain recorded between 6 and 8 weeks of age in the studies is thought to represent a critical period for feathering and muscle development, a finding that has been reported similarly in previous studies (Fosco, 2020; Lezana et al., 2022). The slowing of weight gain rate, which begins to be determined two weeks before release, is consistent with the individuals approaching adult weight and can be considered an indicator of approaching physical maturity prior to release. It should be recognized that achieving a specific body mass may not serve as the sole release criterion for every individual.

Consequently, the release decision-making process incorporated qualitative observations of behaviors such as the duration of self-feeding, flight proficiency in enclosed areas, and the maintenance of a natural wariness toward human presence. While these behavioral indicators were monitored to evaluate pre-release readiness, maintaining minimal human contact throughout the process was intended to preserve the owls' natural stress responses. Future studies could potentially benefit from more structured protocols to quantify behavioral independence and stress levels more precisely, which might offer a more comprehensive assessment of an individual's potential for successful reintegration. Encouraging natural behaviours such as free flight, navigation, and self-feeding in large flight tunnels during the final two weeks, minimizing human contact, and maintaining the owls' instincts as much as possible are highlighted as the most important components of rehabilitation. The acquisition of such natural skills significantly increases the chances of survival after release into the wild (Fosco, 2020; Cooke et al., 2023). The loss of two of the 16 *Tyto alba* chicks during the rehabilitation process appears to be largely related to the health and condition of the individuals when they were brought to the rehabilitation center. The fact that these two individuals had significantly low body weights and weak overall clinical findings at the time of arrival likely indicates malnutrition and delayed initial contact. Survival success in raptor chicks brought to rehabilitation centers may be directly linked to the initial condition of the individuals (Fajardo et al., 2000). In owls, which have limited metabolic reserves during the chick stage, even a few days' delay can increase the risk of mortality. In this context, we attribute the losses to late referral and poor initial condition rather than the care protocol. Post-release monitoring is crucial for evaluating rehabilitation outcomes. While telemetry provides real-time data on dispersal and survival, standard metal ringing (banding) remains a fundamental and widely used tool in ornithology for long-term population monitoring (Griffiths et al., 2010). In this study, all individuals were ringed prior to release to facilitate identification in potential future encounters. Although this passive monitoring method does not provide immediate data on post-release movements, it contributes to national databases and enables the assessment of longevity and dispersal distances in the event of recapture or recovery. Another factor affecting the success of post-release rehabilitation is the method used to release the birds. Whether to use soft-release or hard-release techniques may vary depending on the conditions under which the animals are rehabilitated, their age, and the available resources (Griffiths et al., 2010; Saufi et al., 2020). In a study conducted on tawny owls, it was reported that the hard-release method did not show a significant

difference in survival rates compared to the soft-release method for juvenile tawny owls (Griffiths et al., 2010). In studies evaluating different release methods in Barn owls, it was reported that the duration of rehabilitation and, more importantly, the age of the owls prior to release are important factors that can affect their survival success in the wild (Meek et al., 2003; Chien & Ritchison, 2005; Saufi et al., 2020). In this study, the hard-release method was preferred to prevent the potential risks associated with prolonged captivity, such as habituation to humans and loss of natural instincts (Cooke et al., 2023). Furthermore, previous studies on owls have reported that the hard-release method yields survival rates comparable to soft-release protocols when individuals are in good physical condition (Griffiths et al., 2010). Therefore, individuals were released immediately upon confirming that their prey handling, feeding, and flight capabilities had reached the desired level, without an additional acclimation period at the release site.

The primary limitation of this study is the reliance on passive ringing rather than active telemetry (e.g., GPS tracking). Consequently, post-release survival and long-term integration remains unknown and could not be directly quantified. This study is therefore limited to describing pre-release rehabilitation processes and immediate clinical outcomes, rather than making definitive claims about post-release success. However, the high pre-release condition scores, standardized hunting performance, and physiological readiness observed in our study may indicate that the chicks reached an appropriate level of biological preparedness for independent life at the time of release. While previous studies have reported variable outcomes for rehabilitated individuals (Meek et al., 2003), the standardized indicators presented here provide a useful baseline for evaluating rehabilitation outcomes in local Barn owl populations. Future studies incorporating GPS-based monitoring will allow a more comprehensive assessment of post-release survival and long-term success of these rehabilitation protocols.

In conclusion, this retrospective evaluation suggests that the implemented 8-week structured rehabilitation process for Barn owl chicks is associated with observable improvements in physical development, postural control, and flight proficiency. While the absence of a control group limits the ability to definitively quantify the specific impact of the programme, the clinical progression observed in the rehabilitated individuals provides preliminary evidence for the potential efficacy of such structured protocols. It is important to note that these observations focus on pre-release developmental indicators and do not allow for direct inferences regarding long-term post-release survival. Nevertheless, the advancements in motor skills and predatory behaviours noted during the

study suggest that the individuals reached a level of fitness deemed suitable for release. These findings highlight the potential role of standardised rehabilitation practices in wildlife management. It is thought that further prospective studies with comparative designs could better clarify the long-term contributions of these programmes to raptor conservation strategies in Türkiye.

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ETHICS COMMITTEE APPROVAL

All procedures were approved by the Ondokuz Mayıs University Animal Experiments and Local Ethics Committee (Approval No: 2025-70). This study was conducted with the permission of the Republic of Türkiye Ministry of Agriculture and Forestry, General Directorate of Nature Conservation and National Parks (Ref. No: E-72784983-288.04-220186, Date: 21.11.2025).

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