# FEEDING ECOLOGY OF THE STRIPED HYENA (*HYAENA HYAENA*) IN THE TLEMCEN HUNTING RESERVE, ALGERIA

BENTABET, K.[1*] – MOSTEFAI, N.[1] – DE SMET, K.[2] – EDDINE, A.[1] – BOUHENNI, A.[1] – LARABI, F.[1]

[1]*Laboratory of water conservatory management soil and forest, Faculty of Nature and Life Sciences, Earth and Universe Sciences, University of Tlemcen, Tlemcen, Algeria*

[2]*Society of North African Big Carnivores Stichting, Drabstraat 288, BE-2640 Mortsel, Belgium*

[*]*Corresponding author*
*e-mail: khadidja.bentabet@univ-tlemcen.dz; phone: +213-553-151-076*

(Received 14th May 2025; accepted 10th Jul 2025)

**Abstract.** The striped hyena (*Hyaena hyaena*) is the only hyenid species present in Algeria. It is a near-threatened large carnivore and is poorly studied in North Africa. This study investigates the trophic ecology in the Tlemcen hunting reserve (2156 ha) in north-western Algeria through scat analysis. Over a span of three years (2016–2019). 197 scat samples were collected and analysed, allowing us to identify 740 prey items classified into 37 taxa using the identification keys and a reference hair collection. The obtained results were expressed as the frequency of occurrence and biomass percentage. Animal remains were the most common component of the diet, accounting for 95.9% of biomass, in which *Sus scrofa* was the most consumed prey, while plant remains contributed only 4.1%. Prey diversity was highest in summer with 31 items and lowest in winter with 18 items. These findings confirm the hyena's generalist and opportunistic feeding behaviour, emphasizing its ecological role. Its dietary flexibility should be considered in conservation strategies for the species in Algeria and North Africa.
**Keywords:** *striped hyena, trophic ecology, scat analysis, prey diversity, conservation*

## Introduction

The Hyaenidae family is one of the smallest in the order Carnivora. It plays a crucial role in ecosystems as scavengers and active predators. It consists of only four extant species, each classified under a separate genus: spotted hyena (*Crocuta crocuta*), striped hyena (*Hyaena hyaena*), brown hyena (*Parahyaena brunnea*) and aardwolf (*Proteles cristata)* (Wozencraft, 1993). One of the key representatives of this family is the striped hyena, which has the largest geographical distribution compared to other hyena species, ranging from East and Northeast Africa, through the Middle East, Caucasus region, Central Asia, and into the Indian subcontinent (Mills and Hofer, 1998). They are scavengers by habit (Prater, 1971; Kruuk, 1976; Macdonald, 1978; Boitani and Bartoli, 1986; Mandal et al., 2018; Bahandari et al., 2020). As one of the largest scavengers, they play a fundamental role in the ecosystem service of removing carcasses and clearing carrion in tropical ecosystems (Kruuk, 1976; Rieger, 1981; Mills and Hofer, 1998; Gupta et al., 2009; Bhandari et al., 2020). Despite its broader distribution range compared to other hyenas species, very few studies have been reported from this species in North Africa. In this region, only a limited number of studies are available (e.g., Derouich et al., 2020; Ahmim et al., 2021; Selmoun et al., 2024). Most research on the species has been carried out in other parts of its range, including East Africa (Kruuk, 1976; Leakey et al., 1999; Wagner, 2006), Palestine (Macdonald, 1978; Skinner and Ilani, 1979; Bouskila, 1984; Kerbis-Peterhans and Horwitz, 1992), Jordan (Qarqaz et al., 2004), Turkey (Kasparek et al., 2004), Armenia (Khorozyan et al., 2011), India (Davidar, 1990; Gupta et al., 2009; Harihar et al., 2010; Singh et al., 2010).


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

It has been documented as a near-threatened species by the International Union for the Conservation of Nature (IUCN) (Abi Said and Dloniak, 2015), 'vulnerable' in the Mediterranean region (Temple and Cuttelod, 2009). In Algeria, the striped hyena is the only hyaenidae species present. After the extinction of the Barbary lion (*Panthera leo leo)* and the North African leopard (*Panthera pardus)*, it remains the last large carnivore in Algeria. It is classified as a protected species under national wildlife conservation laws, such as law No. 04-07 of August 14, 2004. According to Wagner (1841), the striped hyena was once very abundant, with a widespread distribution reaching the coast. However, after the 1980s, the species experienced a significant population decline, reflecting a contraction of its range (confirmed by De Smet (1983), and Kowalski and Kowalska (1991)). In the past decade, the striped hyena has reappeared in almost all mountainous and forested areas with a remarkable density, as well as in other regions, such as the steppe and the high plateaus, (Ahmim, 2019; Benameur et al., 2019). As a scavenger, despite their importance, their place in the food chain and their role in ecosystems regulations remains poorly understood in Algeria and North Africa. There are a few in Kenya based on diet and distribution and others in Algeria that are based on geographical distributions (Wagner, 1841; De Smet, 1983; Ahmim, 2019; Benameur et al., 2019; Derouich et al., 2020) and habitat suitability (Selmoun et al., 2024). Trophic ecology is one of the significant parameters for understanding the behavior and conservation status of any particular species. Our study aims to investigate the diet and the feeding habits of striped hyena inside the Tlemcen hunting reserve, in the north-west of Algeria. This research will provide us with information about their trophic interactions, habitat use, and dependence on natural versus anthropogenic food sources. These findings will benefit conservation by defining significant food resources, establishing possible threats related to food availability, and guiding habitat management programs to promote the long-term survival of the species.

## Material and methods

### *Study area*

The investigation of the trophic ecology of the Striped Hyena (*Hyaena hyaena*) was conducted in the Tlemcen Hunting Reserve (THR), which is one of the four critically important reserves dedicated to animal biodiversity conservation in Algeria. It is officially designated as a game conservation zone, where all forms of hunting and anthropogenic activities are strictly forbidden to ensure the protection of wildlife. It is located in the North-western part of Algeria, about 46 km from the sea and 26 km south-west of the city of Tlemcen (*Fig. 1*). The THR is situated exactly between a latitude of 34°43’45.47’’N to 34°47’28.22’’N and a longitude of -1°26.3’32.55’’E to -1°30’21.62’’E. It lies within an area of 2156 ha with a perimeter of 25 km and at an average altitude of 1050 m. The reserve is enclosed by a wire mesh fence, although several sections are damaged, creating openings that may allow the movement of medium and large sized mammals, including *Hyaena*. This partial permeability may influence the ecological dynamics by facilitating faunal exchanges between the reserve and surrounding landscape. It is characterised by a typical mountain forest ecosystem classified as a semi-arid bioclimatic zone with temperate to cold winters. It forms part of the state forest of Hafir and encompasses the highest and most densely wooded region of Tlemcen Mountains, with vegetation predominantly composed of three species of Oaks: *Quercus suber*, *Q. ilex,* and *Q. faginea*. The reserve hosts 137 wild species, classified into 20 mammals. Among them, around 50


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

European fallow deer (*Dama dama*) are kept in semi-captivity. The Barbary sheep (*Ammotragus lervia*) and Cuvier's gazelle (*Gazella cuvieri*) are also present, with 17 individuals and 4 pairs released in 2019 in semi-captivity. For the Barbary sheep, it should be noted that around a hundred individuals live in captivity. The wild boar (*Sus scrofa*) is also well represented, with more than one hundred individuals. In addition to these 20 mammal species, the reserve is home to 9 species of reptiles, 5 amphibians, 78 bird species, and 25 species of insects (Mostefai, 1996) highlighting the biodiversity.

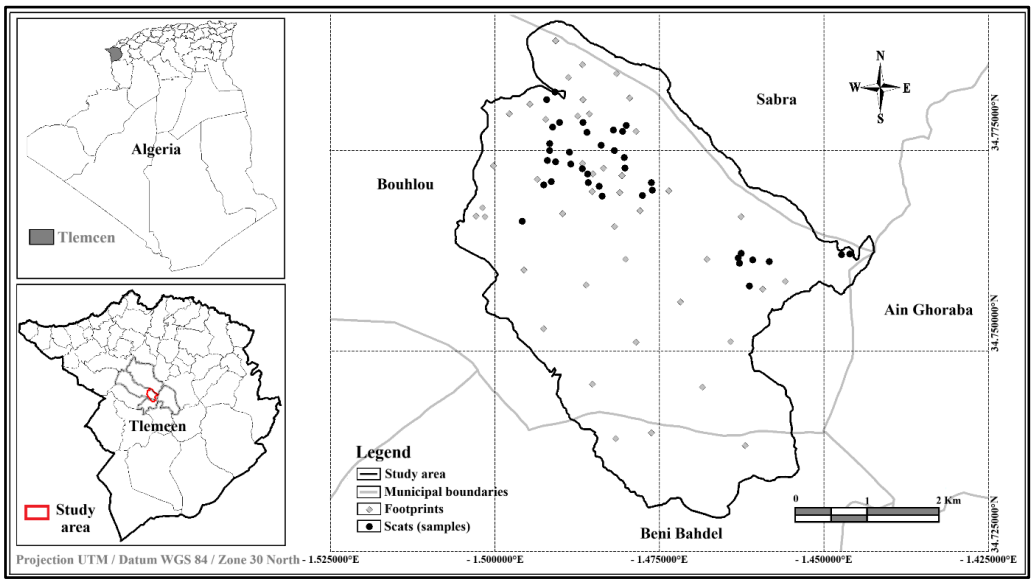


***Figure 1.*** *Location of the Tlemcen hunting reserve in Algeria*

### *Scat identification, collection, and analysis*

The majority of studies surrounding the diet of striped hyena were done using scat analysis (Wagner, 2006; Mandel et al., 2018). In total, 197 scats were collected in the forest trails, transects and roads that cover the whole study area for a period of 3 years from November 2016 through October 2019. Hyena scats were identified based on patterns of shape, size and colour, usually oval or cylindrical in shape, and white or off-white in colour (Bopanna, 2013). The white colouration is due to the high calcium content, which is associated with their bone-eating behaviour (Rieger, 1981). The territories frequented by the striped hyena were monitored by track counts, visually and by camera traps. Each collected scat sample was labelled with the date and the location and then placed in a warm and dry place to avoid damage to their contents. Once the scats were dried we recorded their physical parameters like weight width and length. The striped hyenas' scats were analysed using the protocol used by Hamdine et al. (1993) and Eddine et al. (2017). The first step was to sterilise the faeces in an oven at 118°C for one hour to eliminate the risk of contamination by parasites commonly found in carnivore faeces. Subsequently, the scats were soaked in water for 24-48 h, washed and broken up throughout a sieve of 200 µm to prevent losing the food items. Prey leftovers were put in an oven at 60°C for 24 hours to dry. Following this, the dry weights of all the faeces were measured. The food remains of each scat such as hairs, bones, feathers and vegetable matter (fruits, seeds and grass) were separated and classified.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

Hair samples were examined using a Euromax microscope, OXION series with a magnification of (10*40) and identified by comparing them with reference materials (Day, 1966; Faliu et al., 1980; Debrot et al., 1982; Eddine et al., 2017). The identification of seeds and fruits was carried out with the help of specialists and compared with our reference collection. To estimate the seasonal variation in the ingested prey, the results were grouped into three-month intervals corresponding to the standard seasons in the Mediterranean region (Eddine et al., 2017). To analyse the diet composition, we used several statistical parameters. The frequency of occurrence (Fi %) represents the number of occurrence of every prey type divided by the total numbers of scats analysed, expressed as a percentage (Leopold and Krausman, 1986; Ansorge et al., 2006; Azevedo et al., 2006; Eddine et al., 2017), while the relative frequency of occurrence (Fr %) represents its proportion relative to the total occurrence of all prey items. It is calculated by dividing the number of occurrences of a given item by the total occurrences of all prey items, multiplied by 100 (Mostefai et al., 2003; Amroun et al., 2006). The biomass estimation (BM %) quantifies the dietary contribution of each prey consumed by the striped hyena in terms of weight (Goszczynski, 1974). *Table 1* shows the digestibility coefficient used to calculate the biomass, obtained by multiplying the dry weight of each item by its corresponding coefficient (Goszczyński, 1974; Fairey et al., 1987; Jędrzejewska and Jędrzejewski, 1998; Ansorge et al., 2006; Lanszki et al., 2009; Borkowski et al., 2011; Eddine et al., 2017).

***Table 1.*** *Coefficient of digestibility of different items categories (Goszczyński, 1974)*

| Items categories | Coefficient of digestibility |
|---|---|
| Adult and large mammals ( wild and domestic) | 118 |
| Medium sized mammals | 50 |
| Small mammals | 23 |
| Birds | 35 |
| Reptiles | 18 |
| Plants materials | 14 |
| Insects | 5 |

Additionally, to make our results more robust and interpretable, we included Shannon's and the equitability indexes in the dietary analysis.

-Shannon's diversity index (H'), which considers both the richness and the relative abundance of prey items, was calculated using the following equation:

$$H' = -\sum p_i \log_2 p_i \quad \text{(Eq.1)}$$

where $p_i$ represents the proportion of each prey item in the diet.

-The equitability index (E) was calculated to evaluate how evenly prey species were represented in the diet. It was computed as:

$$E = H' / H_{max} \quad \text{(Eq.2)}$$

With the maximum diversity (Hmax) defined as:

$$Hmax = \log_2 S \quad \text{(Eq.3)}$$


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

where S is the total number of prey species. *Hmax* represents the maximum possible diversity when all prey species are equally abundant.

Higher values of E (close to 1) indicate a generalist diet, whereas lower values (near 0) suggest dietary specialisation.

Seasonal variations in the prey species composition in the diet of striped hyena were assessed using the chi-square test ($\chi^2$-test). The test statistic was calculated using following equation:

$$\chi^2 = \sum \frac{(obs - exp)^2}{exp} \quad \text{(Eq.4)}$$

where *obs* and *exp* represent the observed and expected frequencies of prey items, respectively.

The test was applied to evaluate whether the distribution of prey species varied significantly across seasons. Degrees of freedom were calculated as df = (r−1) (c−1), where r is the number of rows (prey item) and c the number of columns (seasons). Statistical significance was determined at a threshold of $p < 0.05$. All analyses were performed using (Excel).

### *Illustrative use of camera traps*

To confirm the presence of potential prey species and complement dietary data, two camera traps (Maginon Wildcamera WK2 HD, 640×480 pixels) were deployed. They were placed in different localities, selected based on random movement patterns in the reserve such as tracks and scats.

## Results

A total of 197 scat samples of striped hyena *(Hyaena hyaena*) were collected and analysed, providing significant insights into its dietary habits within the study area. We identified a total of 740 prey items, which comprised 37 distinct taxa, as well as soil and organic waste. These identified prey were classified into nine categories (wild mammals, domestic mammals, insects, birds, reptiles, fruits and seeds, other plants, organic waste and soils) (*Fig. 2*). We found 14 mammal species including two domestic species: sheep (*Ovis aries*) and cows (*Bos taurus*). *Table 2* lists all identified mammals species and also shows 14 instances of plant (the majority of which refer to fruits and seeds of *Chamaerops humilis, Arbutus unedo, Prunus persica, Ceratonia siliqua, Juniperus oxycedrus, Rosa sp., Prunus armeniaca, Cucumis melo, Citrullus lanatus*). Only three families of insects were identified (*Carabidae, scarabidae* and *Buprestidae*), and one domestic bird (*Gallus gallus domesticus*).

In the diet of striped hyena (*Fig. 3*) animals make up a significant portion of its food requirements, with wild mammals representing the largest component. They account for 27.76% of relative frequency of occurrence. In contrast, animal remains (wild and domestic) account for 41.89% and vegetable remains (fruit and seed, other plants) for 39.89% of relative frequency, while soil and organic waste contribute with 11.35% and 7.3%, respectively. *Table 2* shows that, in term of biomass, animals' remains represent the overwhelming majority in the trophic ecology of striped hyena, accounting for 95.90% while plant remains represent only 4.12%.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

***Table 2.*** *Diet composition of striped hyena (Hyaena hyaena) in Tlemcen hunting reserve*

| Prey item | n | FR (%) | BM (%) | FI (%) |
|---|---|---|---|---|
| **Wild mammals** | **201** | **27,16** | **78,89** | **83,76** |
| Sus scrofa | 68 | 9,19 | 36,29 | 34,52 |
| Vulpes vulpes | 21 | 2,84 | 14,80 | 10,66 |
| Dama dama | 10 | 1,35 | 6,13 | 5,08 |
| Oryctologus cuniculus | 29 | 3,92 | 8,80 | 14,72 |
| Lepus capensis | 4 | 0,54 | 1,24 | 2,03 |
| Felis catus | 2 | 0,27 | 0,65 | 1,02 |
| Felis lybica | 6 | 0,81 | 0,58 | 3,05 |
| Genetta genetta | 3 | 0,41 | 1,95 | 1,52 |
| Hystrix cristata | 4 | 0,54 | 0,98 | 2,03 |
| Atelerix algirus | 2 | 0,27 | 1,02 | 1,02 |
| Apodemus sylvaticus | 14 | 1,89 | 1,92 | 7,11 |
| Rattus rattus | 17 | 2,30 | 2,41 | 8,63 |
| Mus musculus | 15 | 2,03 | 1,54 | 7,61 |
| Lemniscomys barbarus | 5 | 0,68 | 0,45 | 2,54 |
| Mustela nivalis | 1 | 0,14 | 0,13 | 0,51 |
| **Domestic mammals** | **24** | **3,24** | **14,36** | 12,18 |
| Bos Taurus | 12 | 1,62 | 7,63 | 6,09 |
| Ovis aries | 12 | 1,62 | 6,73 | 6,09 |
| **Undetermined animals** | **15** | **2,03** | **1,27** | 7,61 |
| **Birds** | **11** | **1,49** | **1,16** | 5,58 |
| **Insects** | **57** | **7,70** | **0,19** | 28,93 |
| **Reptiles** | **2** | **0,27** | **0,02** | 1,02 |
| **Subtotal (animal remains)** | **310** | **41,89** | **95,90** | **-** |
| **Fruits and Seeds** | **102** | **13,78** | **2,02** | 51,78 |
| Chamaerops humilis | 31 | 4,19 | 0,09 | 15,74 |
| Juneperus oxycedrus | 9 | 1,22 | 1,03 | 4,57 |
| Rosa sp | 7 | 0,95 | 0,03 | 3,55 |
| Ceratonia siliqua | 10 | 1,35 | 0,12 | 5,08 |
| Arbutus unedo | 15 | 2,03 | 0,32 | 7,61 |
| Prunus persica | 13 | 1,76 | 0,27 | 6,6 |
| Prunus armeniaca | 6 | 0,81 | 0,07 | 3,05 |
| Citrullus Lanatus | 2 | 0,27 | 0,03 | 1,02 |
| Oléa eureupea | 1 | 0,14 | 0,00 | 0,51 |
| Solunum lycopersicum | 4 | 0,54 | 0,02 | 2,03 |
| Cucumis melo | 3 | 0,41 | 0,02 | 1,52 |
| Vitis vinifera | 1 | 0,14 | 0,01 | 0,51 |
| **Other plant remain** | **160** | **21,62** | **1,73** | 81,22 |
| Quercus ilex | 39 | 5,27 | 0,27 | 19,8 |
| Quercus faginea | 12 | 1,62 | 0,08 | 6,09 |
| Quercus Suber | 2 | 0,27 | 0,07 | 1,02 |
| Grass | 98 | 13,24 | 1,14 | 49,75 |
| Forage | 9 | 1,22 | 0,17 | 4,57 |
| **Undetermined plants** | **30** | **4,05** | **0,37** | 15,23 |
| **Subtotal (plants remains)** | **290** | **39,19** | **4,12** | **147,21** |
| **Soil** | **84** | **11,35** | **-** | 42,64 |
| **Organic waste** | **54** | **7,30** | **-** | 27,41 |
| **Grand total** | **740** | **100,00** | **100,00** | **-** |

FR%: relative frequency of occurrence, FI%: frequency of occurrence, BM%: biomass proportion, n: number of occurrence of each food item) N=197, N: number of faeces analysed


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

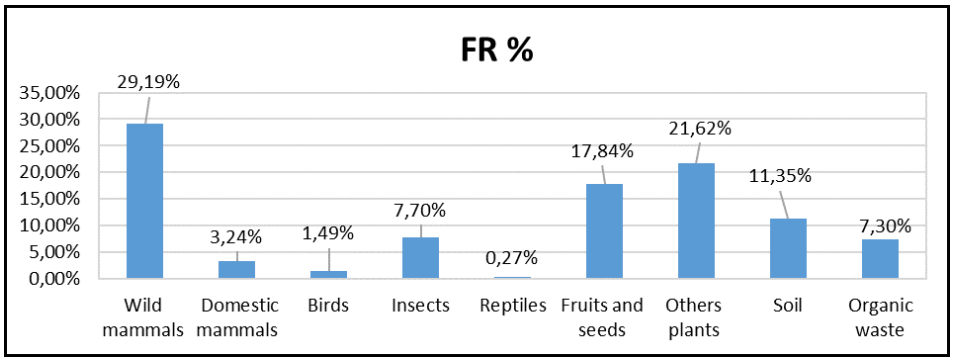


***Figure 2.*** *Distribution of food categories in the diet of striped hyena in Tlemcen hunting reserve*


***Figure 3.*** *Camera trap image of striped Hyena in Tlemcen hunting reserve (Maginon Wildcamera WK2 HD)*

Among those striped hyena scats collected in the hunting reserve, the majority (up to 84%) contained between two and six prey items. More specifically, 27.92% contained four prey items, 21.83% contained three prey items, 18.27% contained two prey items, 16.24% contained five prey items, and 11.17% contained six prey items. A smaller proportion of scats contained a single prey item (3.05%), while fewer contained eight (1.02%) or nine (0.51%) prey items (*Fig. 4*).

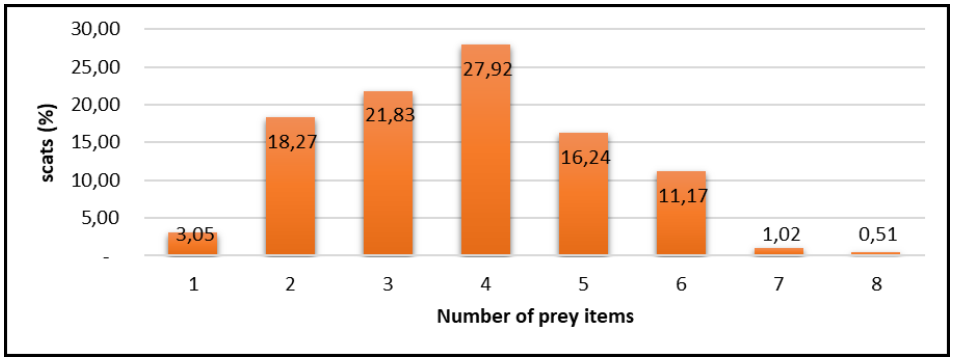


***Figure 4.*** *Percentage of prey items in the striped hyena scats*


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

In terms of seasonal variations, *Table 3* shows that the relative frequency of occurrence of animal material were higher in winter, spring and autumn with 45.36%, 46.15% and 39.30%, respectively; compared with those of plant remains, while the opposite were observed in summer (47.76% FR of plant material). Birds and insects were recorded in all seasons, showing a higher occurrence during the summer (2.24% and 9.7% respectively) compared to other seasons (birds 0.5% in winter and insects 3.06% in autumn). Reptiles were also present in the diet of the striped hyena with very low proportion (1.03%) in spring and absent in the other season.

***Table 3.*** *Seasonal variations in term of striped hyena feeding in term of relative frequency*

| **Seasons** | **Summer (n=31)** | **Autumn (n=67)** | **Winter (n=49)** | **Spring (n=50)** |
|---|---|---|---|---|
| **Prey items** | **FR (%)** | **FR (%)** | **FR (%)** | **FR (%)** |
| Wild mammals | 19,40 | 27,95 | 30,77 | 27,84 |
| Domestic mammals | 3,73 | 3,49 | 4,95 | 2,58 |
| Undetermined animals | 1,49 | 3,06 | 2,20 | 1,03 |
| Birds | 2,24 | 1,75 | 0,55 | 1,55 |
| Insects | 9,70 | 3,06 | 7,69 | 11,86 |
| Reptiles | - | - | - | 1,03 |
| **Subtotal (animal remains)** | **35,82** | **39,30** | **46,15** | **45,36** |
| Fruits and seeds | 22,39 | 10,92 | 13,19 | 11,86 |
| Other plant material | 18,66 | 26,20 | 8,24 | 30,93 |
| Undetermined plants | 6,72 | 0,87 | 10,44 | - |
| **Subtotal (plant remains)** | **47,76** | **37,12** | **31,87** | **42,78** |
| Soil | 8,96 | 17,47 | 13,19 | 4,12 |
| Organic waste | 7,46 | 5,24 | 8,79 | 8,25 |
| **Grand total** | **100,00** | **100,00** | **100,00** | **100,00** |

According to the chi-square test ($\chi$ 2 =323.25 df= 120), the variation in the diet composition of striped hyena across seasons was highly significant ($p < 0.001$). Shannon's diversity index (H′) revealed clear seasonal variation in the diet with the highest diversity observed in summer (H'=2.88). In contrast, the lowest diversity occurred in winter (H'=1.98). Intermediate values were recorded in autumn (H'=2.69) and spring (H'= 2.62).

## Discussion

This study presents an overview of the striped hyena's diet in the Tlemcen hunting reserve, which is the first study on the trophic ecology of this species in Algeria and North Africa. That is why we to compared our results with those found in Asia and Africa.

In all the hyena scats analysed, 17 mammalian prey species were identified. Similarly, Bopanna (2013) in India found 19 mammalian prey species from 1460 scat samples. In contrast, this is a higher number compared to studies by Bahandari et al. (2020) in Nepal and Mandal et al. (2018) in India, which identified only 9 mammalian species from 68 and 86 scat samples, respectively. This discrepancy may be explained firstly by the diversity of ecosystems in the study regions, as different habitats can influence the composition of identified species to support varying levels of animal diversity. Additionally, the variation in prey diversity between regions and the number of scat


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

samples analysed could also account for the difference, with a larger sample size increasing the probability of capturing more species.

Our results showed that striped hyena feeds on vertebrates of various sizes, ranging from small to medium and large. They feed mainly on wild and domestic mammals, which agrees with the conclusion of previous studies on the diet of striped hyena in different regions (Kruuk, 1976; Leakey et al., 1999; Mandel et al., 2018; Bahandri et al., 2020; Mwebi et al., 2024). The high proportion of these feed categories can be explained by their very high energy values. The data from our study revealed that the diet of the striped hyena include wild boar, fallow deer, sheep and cattle (Large mammals), and red fox, rabbit, brown hare, cats, common genet, crested porcupine, North African hedgehog and European weasel (medium size mammals), rodents (small mammals), fruit and seeds, insects, birds, reptiles, soils and waste. The striped hyena's reliance on small mammals, insects, and fruits has also been reported (Kruuk, 1976; Wagner, 2006; Alam, 2011; Alam and Khan, 2015).Compared to other studies, the diet of striped hyena in Serengeti (Kenya) comprises buffalo (very large mammals), zebra, wildebeest, kongoni, topi (large mammals), Grant's gazelle, Thomson's gazelle, impala (medium sized mammals), dikdik, hare, springhare (small mammals), rodents, shrew (very small mammals), lizard, snake, tortoise (reptiles) and birds, insects, vegetable, as they prefer smaller mammal species (Kruuk, 1976). On the other hand, the diet of the striped hyena in the Gir National Park and Sanctuary (GNPS), in India, consist of sambar, chital, buffalo, cow, hare, rodent, civet, squirrel, wild boar, langur, dog, peafowl, birds, insects, fruits and grasses (Alam and Khan, 2015), this suggests that the availability of food items varies across its geographical distribution range.

However, wild boar (*Sus scrofa*) was the most common prey species eaten by hyenas with a frequency of occurrence of 34.52% and a biomass of 36.29%. This result is evident, especially when it is compared to the density of this species in the reserve observed during our field work. This finding throughout the year in significant proportions suggests that the hyena may actively hunt wild boar, but consumed mostly as carrion. Similarly to the study of Alam and Khan (2015), they found that wild boar constituted a large part of the diet of hyenas in the Gir National Park and Sanctuary (India). Thus, wild boars are considered a key prey species for hyenas.

Rabbits (*Oryctolagus cuniculus*) and Red fox *(Vulpes vulpes*) were the second most commonly consumed prey mammalian species by striped hyena (Fr: 3.92% and 2.84% respectively). The density of rabbits in our study area is not clearly known, it is present in the diet of the striped hyena throughout the year, and it can be attributed to the extensive agricultural lands surrounding the reserve. These farmlands provide a stable food source, which supports a continuous rabbit population, suggesting that the striped hyena may have exited the reserve through the damaged fence of the reserve and consumed them as carcasses or possibly killed them directly. European fallow deer (*Dama dama*) was the only cervidae present in the faecal samples, based on our own observations, two dead deer carcasses were discarded by foresters in the region and the appearance of this prey type in the faeces may indicate that these carcasses were consumed. Brown hare (*Lepus capensis*) represented a minor proportion. During our monitoring survey no hares were seen because they are crepuscular and nocturnal as mentioned by Chakraborty et al. (2006) and our survey was carried out during daylight hours. However, faeces of *Lepus capensis* were frequently found during the field strips, suggesting a high local abundance. Despite this availability, its low representation in the diet may be attributed to the difficulty of capturing this small, fast, and elusive prey. Cats (*Felis catus* and *Felis*


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

*lybica*), common genet (*Genetta genetta*) and the European weasel (*Mustela nivalis*) are also present in faeces analysed, however, it is unclear whether they were consumed as carrion or actively hunted and killed. According to Lanszki et al. (2009), and Nadeem et al. (2012) the proportion of domestic mammals in the diet of canids differ from region to another depending on the abundance of wild-living prey and the degree of livestock protection. In the current study, we found that domestic mammals contribute to the diet of the striped hyena with a very low proportion (Fr: 3.24 %) and a biomass of 14.36% indicating the important energetic value of this category. This low frequency can be explained by the low presence of this species in the study area. In contrast, the previous studies showed that the proportions of livestock in the diet of striped hyena is more important in Gir National Park Sanctuary in India according to Alam and Khan (2015), and Mandal et al. (2018) in North-western India with 20.74% and 10.72%, respectively. It remains higher in the pastoral region, where its density was notably remarkable (see Mwebi et al., 2024). During our fields survey two dead-cattle and one dead sheep carcasses were discarded by breeders in the region and the appearance of this prey type in the faeces may indicate that these carcasses were consumed. Sheep and goats could be hunted by the striped hyena as recorded by Mills and Hofer (1998) and Alam and Khan (2015).

Rodents such as black rat (*Rattus rattus*), Mulo sylvest (*Apodemus sylvaticus*), house mouse (*Mus musculus*), and Barbary striped grass mouse *(Lemniscomys barbarus*) were also present in our analysis and this indicated that the striped hyena used it to compliment his diet which could be the result of predation. Insects could be ingested accidentally when the striped hyenas were feeding on carcasses or plants. Reptiles were present in very low frequency and appeared a few times in spring, indicating that they were an occasional prey.

Several studies have shown that plant material was strongly present in the diet of the striped hyena, and represented more than 39% of the relative frequency of occurrence with a biomass of 4.11%. Fruits and seeds such as *Chamaerops humilis, Juneperus oxycedrus Arbutus unedo, Prunus persica, Prunus armeniaca* and *Cucumis melo* are an easy-to-reach source of energy if they are available. Grass and plant remain (*Quercus ilex, Q. fagenea* and *Q. suber*) found in the faeces were ingested to facilitate digestion, eliminate toxins and sometimes provide water (Amroun et al., 2014). Organic waste and soils were significantly contributed to the food spectrum of the striped hyena. The high occurrence of soil in faeces is likely due to the consumed carcases mixed with soil.

Our results show the generalist and opportunist nature of the striped Hyena, which likely explains its omnipresence in the Tlemcen hunting reserve. We observed notable seasonal variation in the food categories consumed, particularly with a peak in summer (31) indicating greater prey abundance and suggesting that its diet may be more opportunistic and diverse in this season, and a drop in winter (18), which may be attributed to a decline in prey existence or resource accessibility, whereas autumn and spring show intermediate values, suggesting a transitional period in resources availability (*Fig. 5*).

Shannon's diversity index (H′) shows higher value in summer and autumn, indicating a more diverse range of food resources, in contrast the lower value in winter suggests a possible reduction in prey diversity or dietary specialization. Evenness index (E) indicates that food resources fluctuated with seasonal availability, further supporting the hyena's adaptable and diverse feeding behaviour throughout the year.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

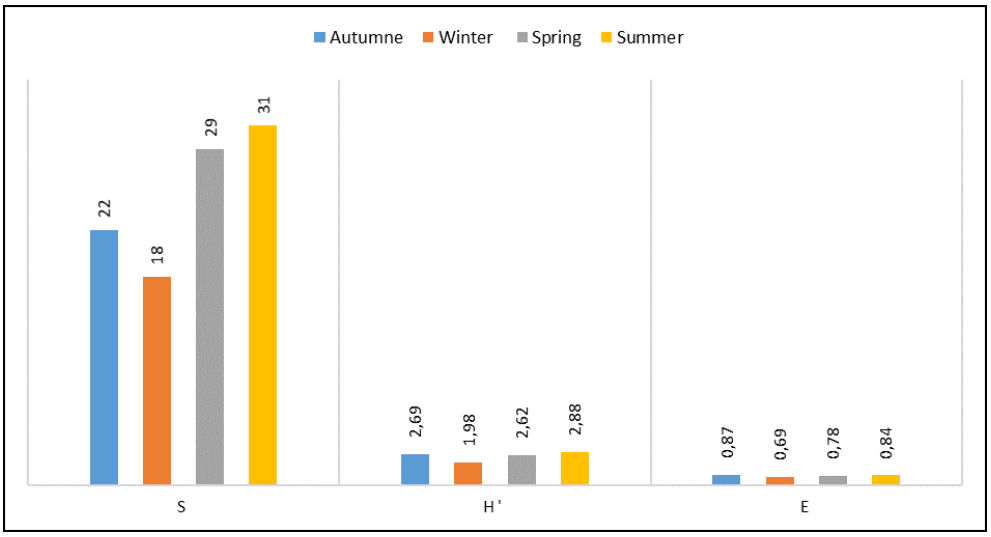


***Figure 5.*** *Prey species richness (S), Shannon's diversity index (H') and evenness index (E) of prey found in the Striped hyena (Hyaena hyaena) faeces during the study in the Tlemcen hunting reserve*

## Conclusion

Our results provide helpful data regarding the feeding ecology of the striped hyena (*Hyaena hyaena*) in Algeria, showing that it is an opportunistic and generalist predator and scavenger. The analysis showed that the wild boar (*Sus scrofa*) was the most frequently consumed prey. The findings identify the main food items, providing information on the trophic interactions of the species and its reliance on natural and anthropogenic food sources. Understanding these feeding patterns is essential since it offers an enhancement in habitat management, identification of impending threats as a result of food availability, and the reduction of human-wildlife conflicts. Because of the ecological importance of this species, further studies are needed to investigate dietary variation in different habitats, e.g., the steppe and semi-desert areas, to assess the impact of environmental factors on its feeding ecology, in an effort to implement effective conservation practices for its long-term survival. Additionally, conducting similar studies in bordering countries such as Morocco and Tunisia could serve to validate our findings, and contribute to an improved understanding of *Hyaena hyaena's* ecological role in North Africa.

## REFERENCES

[1] Abi Said, M., Dloniak, S. M. D. (2015): *Hyaena hyaena*. – The IUCN Red List of Threatened Species 2015: e.T10274A45195080. Downloaded on 20 June 2018.

[2] Ahmim, M. (2019): Les Mammières Sauvages d'Algérie. – Répartition et Biologie de la Conservation. Editions du Net, 289 p.

[3] Ahmim, M., Lakouachet, D., Aliane, D. (2021): Data on ethology and behavior of the striped hyena Hyaena hyaena (Linnaeus, 1758) under captive conditions in Algeria. – Biodiversity International Journal 5(1): 19-23.

[4] Alam, M. S. (2011): Status, ecology and conservation of striped hyena *Hyaena hyaena* in Gir National Park and Sanctuary, Gujarat. – PhD Thesis, Aligarh Muslim University, Aligarh, India.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

[5] Alam, M. S., Khan, J. A. (2015): Food habits of striped hyena (*Hyaena hyaena*) in a semi-arid conservation area of India. – Journal of Arid Land 7: 860-866.
[6] Amroun, M., Giraudoux, P., Delattre, P. (2006): A comparative study of the diets of two sympatric carnivores, the golden jackal (*Canis aureus*) and the common genet (*Genetta genetta*), in Kabylia, Algeria. – Mammalia 70(3): 247-254.
[7] Amroun, M., Oubellil, D., Gaubert, P. (2014): Trophic ecology of the golden jackal in Djurdjura National Park, Algeria. – Revue d'Ecologie (Terre et Vie) 69: 304-317.
[8] Ansorge, H., Kluth, G., Hahne, S. (2006): Feeding ecology of wolves *Canis lupus* returning to Germany. – Acta Theriologica 51: 99-106.
[9] Azevedo, F. C. C., Lester, V., Gorsuch, W., Lariviere, S., Wirsing, A. J., Murray, D. L. (2006): Dietary breadth and overlap among five sympatric prairie carnivores. – Journal of Zoology 269(1): 127-135.
[10] Benameur-Hasnaoui, H., Bounaceur, F., Ouabed, A., Aulagnier, S. (2019): Présence relictuelle de l'hyène rayée *Hyaena hyaena* (mammalia, hyaenidae) dans l'extrême nord-ouest Algérien. – Bulletin de la Société Zoologique de France 141(1): 51-59.
[11] Bhandari, S., Morley, C., Aryal, A., Shrestha, U. B. (2020): The diet of the striped hyena in Nepal's lowland regions. – Ecology and Evolution 10(15): 7953-7962.
[12] Boitani, L., Bartoli, S., Pleasance, S. (1986): The Macdonald encyclopedia of mammals. – London, MacDonald, 511p.
[13] Bopanna, I. P. (2013): Habitat use, ranging pattern and food habits of striped hyaena (*Hyaena hyaena*) in Kutch, Gujarat. – PhD Thesis, Wildlife Institute of India, Saurastra University, Rajkot, Gujarat, India.
[14] Borkowski, J., Zalewski, A., Manor, R. (2011): Diet composition of golden jackals in Israel. – Annales Zoologici Fennici 48(2): 108-118.
[15] Bouskila, Y. (1984): The foraging groups of the striped hyena (*Hyaena hyaena syriaca*). – Carnivore 7: 2-12.
[16] Chakraborty, S., Srinivasulu, C., Jordan, M., Bhattacharyya, T. P. (2005): *Lepus nigricollis* Cuvier, 1823. – In: Molur, S., Srinivasulu, C., Srinivasulu, B., Walker, S., Nameer, P. O., Ravikumar, L. (eds.) Status of South Asian Non-volant Small Mammals. Conservation Assessment and Management Plan (C.A.M.P.) Workshop Report (618 pp). Coimbatore, India: Zoo Outreach Organisation / CBSG-South Asia.
[17] Davidar, E. R. C. (1990): Observations at a hyena *Hyaena hyaena* Linn. den. – Journal of the Bombay Natural History Society 87: 445-447.
[18] Day, M. G. (1966): Identification of hair and feather remains in the gut and faeces of stoats and weasels. – Journal of Zoology 148: 201-217.
[19] De Smet, K. J. M. (1989): Studie van de verspreiding en biotoopkeuze van de grote Mammalia in Algerie in het kader van het natuurbehoud. – Thèse Landbouwkundige Wetenschappen, Rijksuniv. Gent, 355 p.
[20] Debrot, S., Fivaz, G., Mermod, C., Weber, J. M. (1982): Atlas des poils de mammifères d'Europe. – Institut de Zoologie, Université de Neuchâtel, Suisse.
[21] Derouiche, L., Bounaceur, F., Benamor, N., Hadjloum, M., Benameur-Hasnaoui, H., Ounas, H., Aulagnier, S. (2020): Distribution and status of the striped hyena *Hyaena hyaena* (Linnaeus, 1758) (Mammalia, Hyaenidae) in Algeria. – Mammalia 84(5): 421-428.
[22] Eddine, A., Mostefai, N., De Smet, K., Klees, D., Ansorge, H., Karssene, Y., Van der Leer, P. (2017): Diet composition of a newly recognized canid species, the African golden wolf (*Canis anthus*), in northern Algeria. – Annales Zoologici Fennici 54(5-6): 347-356.
[23] Fairey, J. S., Ward, D. P., Smal, C. M. (1987): Correction factors and mink faeces. – Irish Naturalist's Journal 22: 334-336.
[24] Faliu, L., Lignereux, Y., Barrat, J. (1980): Identification des poils de mammifères pyrénéens. – Doñana Acta Vertebrata 7(2): 125-212.
[25] Goszczyński, J. (1974): Studies on the food of foxes. – Acta Theriologica 19: 1-18.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

[26] Gupta, S., Mondal, K., Sankar, K., Qureshi, Q. (2009): Estimation of striped hyena *Hyaena hyaena* population using camera traps in Sariska Tiger Reserve, Rajasthan, India. – Journal of the Bombay Natural History Society 106(3): 284.
[27] Hamdine, W., Thevenot, M., Sellami, M., Desmet, K. (1993): Feeding ecology of the Genet (*Genetta genetta* Linne, 1758) in Djurdjura national park, Algeria. – Mammalia 57(1): 9-18.
[28] Harihar, A., Ghosh, M., Fernandes, M., Pandav, B., Goyal, S. P. (2010): Use of photographic capture-recapture sampling to estimate density of Striped Hyena (*Hyaena hyaena*): implications for conservation. – Mammalia 74(1): 83-87.
[29] Jędrzejewska, B., Jędrzejewski, W. (1998): Predation in vertebrate communities. The Bialowieza Primeval Forest as a case study. – Ecological Studies Vol.135, 1st ed. Springer-Verlag Berlin, 443 p.
[30] Kasparek, M., Kasparek, A., Gözcelioğlu, B., Çolak, E., Yiğit, N. (2004): On the status and distribution of the Striped Hyaena, *Hyaena hyaena*, in Turkey. – Zoology in the Middle East 33(1): 93-108.
[31] Kerbis Peterhans, J. C., Horwitz, L. (1992): A bone assemblage from a striped hyaena den (*Hyaena hyaena*) in the Negev desert, Israel. – Israel Journal of Zoology 37(4): 225-245.
[32] Khorozyan, I., Malkhasyan, A., Murtskhvaladze, M. (2011): The striped hyaena *Hyaena hyaena* (Hyaenidae, Carnivora) rediscovered in Armenia. – Folia Zoologica 60(3): 253-261.
[33] Kowalski, K., Rzebik-Kowalska, B. (1991): Mammals of Algeria. – Polish Academy of Sciences, Institute of Systematics and Evolution of Animals, Poland, 355 p.
[34] Kruuk, H. (1976): Feeding and social behaviour of the striped hyaena (*Hyaena vulgaris* Desmarest). – East African Wildlife Journal 14: 91-111.
[35] Lanszki, J., Giannatos, G., Heltai, M., Legakis, A. (2009): Diet composition of golden jackal during cub-rearing season in Mediterranean marshland in Greece. – Mammalian Biology 74(1): 72-75.
[36] Leakey, L. N., Milledge, S. A. H., Leakey, S. M., Edung, J., Haynes, P., Kiptoo, D. K., McGeorge, A. (1999): Diet of striped hyaena in northern Kenya. – African Journal of Ecology 37(3): 314-326.
[37] Leopold, B. D., Krausman, P. R. (1986): Diets of 3 predators in big bend National Park, Texas. – The Journal of Wildlife Management 50(2): 290-295.
[38] MacDonald, D. W. (1978): Observations on the behaviour and ecology of the striped hyaena, Hyaena hyaena, in Israel. – Israel Journal of Zoology 27(4): 189-198.
[39] Mandal, D., Qureshi, Q., Sankar, K. (2018): Diet of Striped hyena (*Hyaena hyaena*) in a semi-arid protected area of Western India. – Journal of Scientific Transactions in Environment and Technovation 11(3): 117-123.
[40] Mills, M. G. L., Hofer, H. (1998): Hyaenas. Status Survey and Conservation. – Action Plan, IUCN/SSC, Hyaena. Specialist Group, 156 p.
[41] Mostefai, N. (1996): Contribution à l'étude du régime alimentaire et de l'organisation spatiale de la genette (*Genetta genetta* L. 1758) dans la réserve cynégétique de Moutas - Tlemcen. – Thèse de Magister en Sciences agronomiques, INA, Alger.
[42] Mostefai, N., Sellami, M., Grenot, C. (2003): Contribution à la connaissance du régime alimentaire de la Genette commune (*Genetta genetta*) dans la réserve cynégétique de Moutas, Tlemcen (Algerie). – Bulletin de la Société Zoologique de France 128(3): 227-237.
[43] Mwebi, O., Ogara, W., Adhola, T., Fourvel, J., Brugal, J. (2024): Striped hyena *Hyaena hyaena* (Linnaeus 1758): feeding ecology based on den prey remains in a pastoralist landscape, southern Kenya. – Mammalia 88(5): 384-399.
[44] Nadeem, M. S., Naz, R., Shah, S. I., Beg, M. A., Kayani, A. R., Mushtaq, M., Mahmood, T. (2012): Season and locality related changes in the diet of Asiatic jackal (*Canis aureus*) in Potohar, Pakistan. – Turkish Journal of Zoology 36(6): 798-805.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary

[45] Prater, S. H. (1971): The book of Indian animals. – Bombay Natural History Society, Oxford University Press, Bombay.
[46] Qarqaz, M. A., Abu Baker, M. A., Amr, Z. S. (2004): Status and ecology of the Striped Hyaena, *Hyaena hyaena*, in Jordan. – Zoology in the Middle East 33(1): 87-92.
[47] Rieger, I. (1981): *Hyaena hyaena*. – The American Society of Mammalogists, Mammalian species 150: 1-5.
[48] Selmoun-Ourdani, K., Dheer, A., Karar, M., Fritas, S., Amroun, M., Zemmouri-Boukhemza, N., Wiesel, I. (2024): Understanding habitat suitability and road mortality for the conservation of the striped hyaena (*Hyaena hyaena*) in Batna (East Algeria). – Mammalia 88(5): 368-383.
[49] Singh, P., Gopalaswamy, A. M., Karanth, K. U. (2010): Factors influencing densities of striped hyaenas (*Hyaena hyaena*) in arid regions of India. – Journal of Mammalogy 91(5): 1152-1159.
[50] Skinner, J. D., Ilani, G. (1979): The striped hyaena Hyaena hyaena of the Judean and Negev Deserts and a comparison with the brown hyaena *H. brunnea*. – Israel Journal of Zoology 28(4): 229-232.
[51] Temple, H. J., Cuttelod, A. (2009): The Status and Distribution of Mediterranean Mammals. – IUCN: Gland, Switzerland and Cambridge, UK.
[52] Wagner, M. (1841): Reisen in der Regentschaft Algier in den Jahren 1836, 1837 und 1838. – Leopold Voss. Vol. 1.
[53] Wagner, A. P. (2006): Behavioral ecology of the striped hyena (*Hyaena hyaena*). – PhD thesis, Montana State University, Bozeman, Montana, USA.
[54] Wozencraft, W. C. (1993): Order Carnivora. – In: Wilson, D. E., Reeder, D. M. (eds.) Mammal Species of the World: A Taxonomic and Geographic Reference, 2nd ed., pp. 279-348. Washington D.C: Smithsonian Institution Press.


http://www.aloki.hu ● ISSN 1589 1623 (Print) ● ISSN 1785 0037 (Online)
DOI: http://dx.doi.org/10.15666/aeer/2305_86078620
© 2025, ALÖKI Kft., Budapest, Hungary