

Sighting report and eating habits of the American Peregrine Falcon (*Falco peregrinus anatum*) in the southeastern region of the state of Hidalgo, Mexico

Reporte de avistamiento y hábitos alimenticios del Halcón Peregrino Americano (*Falco peregrinus anatum*) en la región sureste del estado de Hidalgo, México

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Abstract:

The sighting and photographic record of American Peregrine Falcon (*Falco peregrinus anatum*) is reported in the southeastern region of the state of Hidalgo, in the municipality of Tulancingo de Bravo. The search for reports of sightings of the Peregrine Falcon in the region is few. Therefore, the objective of this work is to report the sighting and eating habits in the area. Observation days starting in March 2021, and ending in December 2023. A total of ninety-one records of sightings of the Peregrine Falcon were write down, and based on photographic evidence as a feather remains found in the area. Likewise, the pellets collected in the area allowed us to identify the feeding habits of the Peregrine Falcon. The birds were used as a biological indicator for ecological disturbances, the presence of the Falcon in the municipality could indicate that the ecological imbalance is not yet so severe.

Keywords:

Pellets, biodiversity, observation, *Falco peregrinus anatum*

Resumen:

Se reporta el avistamiento y registro fotográfico del Halcón Peregrino Americano (*Falco peregrinus anatum*) en la región sureste del estado de Hidalgo, en el municipio de Tulancingo de Bravo. La búsqueda de reportes de avistamiento del Halcón peregrino, en la región es poca. Por lo que el objetivo de este trabajo es reportar el avistamiento y los hábitos alimenticios en la zona. Se realizaron jornadas de observación, desde marzo del 2021 a diciembre del 2023. Un total de noventa y un registros del Halcón peregrino fueron reportados. Con base a la evidencia fotográfica y una pluma encontrados en el área, se realizó la identificación, las egagrópilas colectadas en el área, permitieron identificar los hábitos alimenticios del Halcón peregrino. Debido a que las aves son empleadas como un indicador biológico para disturbios ecológicos, la presencia del Halcón en el municipio podría indicar que el desequilibrio ecológico aun no es tan severo.

Palabras Clave:

Egagrópilas, biodiversidad, observación, *Falco peregrinus anatum*

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1. Introduction

The Peregrine Falcon (*Falco peregrinus*) belongs to the order of the Falconiformes, it is a bird classified as a bird of prey or prey, which is widely distributed worldwide, due to its ease of adapting to different types of ecosystems and, it plays the role of top predator in the food chain of the ecosystem where it is found, through aerial hunting at speed, precision, and aerodynamic force [1].

Currently in America, the populations of Peregrine Falcons are wild; however, they have been threatened by habitat conditions caused by environmental pollution, hunting for illegal trade, and trophy hunting [2]. In Mexico, three different subspecies have been reported: a) Tundra Peregrine Falcon (*Falco peregrinus tundrius*), which is found mainly in the arctic tundra of North America, ranging from Alaska to Greenland; b) Eurasian Peregrine Falcon (*Falco peregrinus peregrinus*), which is distributed from southern North America to the tundra of New Mexico, except in the northwestern area of the Pacific Coast; and, c) Peale's Peregrine Falcon (*Falco peregrinus pealei*) ranges from the west coast of North America, north of Washington, and as far west as Alaska [2].

Peregrine Falcon populations have been to characterize as few and rare, making them vulnerable to various human activities, urbanization, and natural threats; consequently, they remain under special protection and considered threatened [3]. Records from the National Audubon Society (AUDUBON) have shown that the Peregrine Falcon population has been affected by climate change, which has altered their distribution in America. This shift has forced the falcons to settle in new areas where they had not previously reported. The change in distribution promotes new adaptation of the Peregrine Falcon to different climates and breeding areas [4]. The maintenance of wild birds in captivity is a custom in the Mexican population that persists to this day. This situation has led to an increase in both formal and informal trade over recent decades, without effective strategies to regulate illegal trade [5]. The increase in urban sprawl has caused the loss and degradation of natural environments where various bird species live. This includes the illegal

extraction of wild birds from their natural habitats for commercialization, to satisfy the constant demand for offbeat bird species [6].

In Mexico there are different guidelines that help regulate processes, products, services and activities that help protect, guarantee, conserve and establish a legal framework regarding different activities carried out in Mexican territory, and which are known as the Mexican Official Standard (NOM) [7].

According to NOM-059- ECOL- 2010, which focuses on environmental protection-native species of Mexico of wild flora and fauna-risk categories and specifications for their inclusion, exclusion or change-list of species at risk; currently a total of 392 bird species under the risk category: 152 are subject to "special protection" (Sp), 95 are considered "in danger of extinction" (D), 126 are "threatened" (T), and 19 species are classified as "probably extinct in the wild" (E) [7]. In Mexico, diurnal birds of prey, which include the orders Accipitriformes, Cathartiformes, and Falconiformes, are in category of risk or special protection [8, 9].

The delimitation of protected areas where the Peregrine Falcon has been limited by human activities that could endanger the bird populations living there [10]. These areas provide protection and promote environmental repopulation through management and conservation activities; they also generate research initiatives that enhance the scientific dissemination of biological knowledge, ecological functions, and public awareness about the damage to wild bird species. This helps inform and preserve the wildlife of the area [11]. Based on the above, the objective of this work is to report on the sighting of the Peregrine Falcon in the region of Tulancingo de Bravo, Hidalgo.

The state of Hidalgo is comprised mainly of semi-desert areas; The sighting report was made in the southeast region of the state, in the municipality of Tulancingo de Bravo, which has an area of 290.4 km² [12], place where the Ciudad Universitaria Tulancingo (C.U.T.) of the Autonomous University of the State of Hidalgo is located (20° 03'S, 98° 22'O). The C.U.T is located adjacent to the Tulancingo river. Tulancingo de Bravo mainly has a temperate to cold

climate, with records of an average annual temperature of 14°C, a rainfall of 500 to 553 millimeters (mm) per year, generating enough humidity that favors the appearance of occasional fog; the hydrology is given by the Chico de Tulancingo River, which is formed by the Metztitlán River and the Hiscongo River; as well as the Rio Grande de Tulancingo formed by the San Lorenzo River other bodies of water known as the Moctezuma River, Cazones River, San Marcos River and the sub-basins of the Metztitlán River, a temperate dry, and warm climate predominates, the temperature can fluctuate from 10 to 24 °C; and a forest ecosystem predominates [13]. To report the presence of the Peregrine Falcon, elevated areas such as the edges of buildings, treetops with trunks without foliage, nearby bodies of water, light poles, the radio antenna, and the steel turnbuckles observed, sites with the greatest possibility of observation. Walks and observation days conducted within the C.U.T., from Monday to Friday from 08:00 to 11:00 and from 17:00 to 18:30. Data of number of times was the Falcon observed in March 2021 until December 12, 2023, were record [14,15]. For the identification of the species, CELESTRON UPCLOSE G2 20x5 binoculars used, later the photographic was capture conducted with a Nikon D3500 Digital camera and a Nikon AF-P NIKKOR 70-300 mm lens.

During the months in which the observations were made, the radio antenna (approximately fifty meters high) was the preferred site for the Peregrine Falcon to observe, hunt and feed. The photographic capture allowed the morphological identification (**Figure 1**).

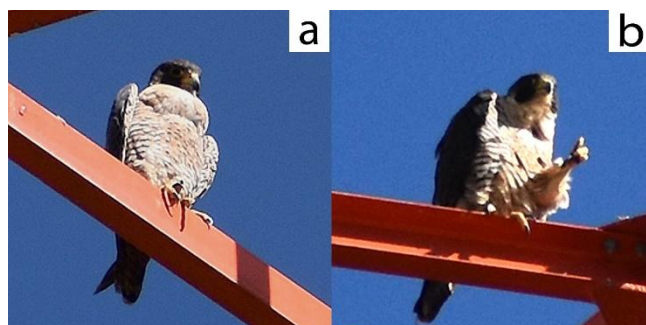


Figure 1. Photograph of a Peregrine Falcon perched on a radio antenna at Tulancingo University City. **a)** Note the head with the presence of dark plumage and the base of the beak visibly light in color; roasted

tip dark in color; **b)** The wing feathers are dark in color, the chest is cream in color, and the head has dark plumage such as thick sideburns, which extend to the region of the cheeks. Photography: Zepeda-Velazquez AP.

In 2021, a total of fifty-one were sightings obtained, while in 2022 only twenty-three were sightings recorded, and in 2023 just seventeen. This resulted in a total of ninety-one sightings in the area. Upon reviewing the area where the base of the radio antenna is located, in 2021, a total of twenty (100%) different pellets identified and collected. 15 pellets (75%) contained feathers, and bone remains of different species of passerines (**Figure 2**) and medium-sized birds, while 5 pellets (15%) contained short, fine, grey hair, like those identified in small mammals of the order Rodentia.



Figure 2. Peregrine falcon pellets. **a)** Ball of feathers and bones; **b)** remains of dermis and proximal,

medial, and distal phalanges of a species of bird less than the peregrine falcon; **c)** remains of a bird's wing, showing the humerus (4.3 cm), radius (4.1 cm)/ulna (4.2 cm) and feathers; **d)** remains of feathers and compacted hollow bones, unknown bird; **e)** Left forelimb remains, where the ulna of an unknown bird can be seen; **f)** Skull of a bird without a beak, probably belonging to a Californian Townail (*Melospiza crissalis*); **g)** right hind limb (femur, tibia-fibula, tarsus, metatarsus, phalanges and claws), probably from a pigeon (*Columba* spp.); **h)** remains of skin and plumage, probably from a domestic pigeon (*Columba livia*); and **i)** skeletal remains of the pelvis (ischium and coccygeal vertebrae), femur and part of the fibula, unknown bird. Photography: Zepeda-Velazquez AP.

In 2022, 100% (13) of the pellets collected belonged to larger birds compared to those in 2021. Among the remains were a left forelimb with exposed ulna, a medium-sized beakless bird skull approximately 6 to 12 cm in size, feather remains, a right hindlimb (femur, tibia-fibula, tarsus, metatarsus, phalanges, and claws), as well as skeletal remains of the pelvis (ischium and coccygeal vertebrae), part of a femur, and a tibia (5.1 cm) (Figure 2i).

A 19.3 cm long feather (from the tip of the feather to the tip of the calamus) was found, featuring yellow bars between dark brown to light brown bars, with a brown tip and no white at the distal tip of the feather (Figure 3). No pellets collected in 2023.



Figure 3. Peregrine falcon feathers, found near the base of the radio antenna. Feather of the caudal rectrices, better known as tail feathers. Photography: Zepeda-Velazquez AP.

The Peregrine Falcon is distributed worldwide, due to its ease of adapting to different types of habitats in different ecosystems [1], due to its adaptability the

Falco genus and the *peregrinus* species present morphological adaptations that are developed based on geographic area, diet composition, and differences in northern latitudes [16,17]. The description of the Peregrine Falcons focused on phenotype of head and face with broad sideburns, back and wings, with dark plumage [18]. The black or bluish-grey plumage occurs in the cranial area accompanied by thick sideburns, which extend from the skull cap, temporal area and in the region of the cheeks, while in the dorsal-medial-caudal portion and coccygeal area, extending to the tail fins; the chest and abdomen are white or cream with horizontal black stripes, while on the underside of the wings a white color with dark spots has been identified [19].

In this research work, we identified that the observed bird had thick sideburns in the face, with bluish-black plumage with a distribution towards the forehead, crown, nape, and mantle extending to the upper tail region. While from the chin area to the abdomen there is a cream color with dark-colored spots in patterns, like elongated bars. The coloration of the rhanthotheca and rictus present a yellow color that fades as the beak approaches the gonion and the chin begins, while the culmen of the beak presents a dark color that gradually fades as it approaches the region of the nostrils, while the legs show a marked yellow color (**Figure 1**); consistent with the description of the Peregrine Falcon [17, 20, 21].

The caudal rectrices feather (**Figure 3**) presents a light brown gradient color from the beginning of the beards and a saturated dark brown crest towards the tip of the feather, without presenting another color at the tip, while the beards presented an ill-defined barring. Blasco and Heinz [20] mention that the determination of the age of a Peregrine Falcon is made based on the presentation of the dark colored bars in the ventral region; while in the rectrices, the bars present a lighter color; as the age of the bird increases, the dark color becomes more present, and the barring goes from vertical to horizontal; the vertical barring in the ventral zone is present in juvenile Falcons and depending on the weeks of life, the tail can present a white tip and poorly defined barring [18]. The wear on the tip of the found feather did not present a white color, but it did present an

irregular yellow-brown-white barring. With the evidence obtained, such as the photograph of the specimen at the top of the antenna, the lack of detail in the image and the wear of the tip, the age of the specimen cannot be determined (**Figure 1**), but due to the coloration and barring, it is assumed to be a juvenile specimen (**Figure 3**).

According to subspecies reported in Mexico, the American Peregrine Falcon is characterized by a medium to large size; coloration upperparts dark blue gray, with a slightly darker crown and nape, and underparts white to pale with thin, dark bars; also, they are present in North America, mainly in cliff regions and urban areas [22]. Meanwhile, Eurasian Peregrine Falcon presents a similar morphology, compared with the American Peregrine Falcon, but the Eurasian Peregrine Falcon is present in Europe and Asia, including mountains, cliffs, and urban areas [2]. Finally, Tundra Peregrine Falcon is smaller compared with other subspecies and showed an overall pale coloration with a white face and less dense bars on the underparts [22]. All these morphologic differences indicated that the Peregrine Falcon present in Tulancingo de Bravo, Hidalgo, is an American Peregrine Falcon.

Like other animal species, the Falcon's diet will depend on the habitat [10]. It has been reported that the Falcon's diet also varies with respect to age, young birds can consume more insects such as dragonflies (*Odonata* spp.), butterflies (*Lepidoptera* spp.) and beetles (*Coleoptera* spp.) compared to adult birds, however, its main food is meat, which is why it is considered carnivorous [18,17]. At least three hundred species of animals must report as a food source for the Peregrine Falcon, with pigeons (*Columbiformes*) being the most frequently hunted [17], other reported species include squirrels (*Sciuridae*), mice, and mice (*Muridae*); rabbits (*Leporidae*), small birds such as hummingbirds (*Trochilidae*), woodpeckers (*Picidae*), parakeets (*Psittaciformes*) and razorbills (*Alcidae*), bats (*Chiroptera*), swifts, shorebirds, passerines, small reptiles such as lizards and iguanas (*Squamata*), snakes of the genus *Culumbidae*, waterfowl such as herons (*Pelecaniformes*) and ducks (*Anatidae*), which is why it is known in Mexico as the "Halcón patero" or "duck peregrine" [5, 18, 22, 23].

Of the 100% (33) of pellets obtained through two years of observation, 84.5% (28) contained colored feathers (yellow, gray, dark brown to black), bone remains and claws attached to the phalanges; some remains seem to come from pigeons (*Columbidae*) (**Figure 2h**), however, it is necessary to carry out more specific studies to determine the species of birds found; while the remaining 15.5% had gray and thin hair similar to that of small rodents. The conformation of the pellets agrees with that reported by different authors, who also mention the consumption of distinct species of herons [15, 23, 24]. In this research work, no Cattle heron (*Bubulcus ibis*) carcasses or remains were found, even though it has been reported that heron colonies are found in the C.U.T., situation that can be explained because the herons take flight between 6:30 and 7:00 hours and they come back between 18:00 and 19:00 h, maybe species do not match intimate lapse [25].

Peregrine Falcon populations are scarce and rare, which has caused them to be vulnerable to anthropomorphic activities, increased urbanization areas, reduction of natural areas and global warming, which has affected the distribution of populations, leading the Peregrine Falcon to settle in geographic locations where poorly reported [26]. In the state of Hidalgo, diverse types of vegetation and ecosystems have identified; as well as the variation of climates in distinct locations in the region, which favor the Peregrine Falcon for its adaptation, establishment, and reproductive activities [16].

In the case of the municipality of Tulancingo de Bravo, it has a temperate, sub-humid climate and summer rainfall, with an average temperature of 14.8 °C and is located south of the central plateau, which cause constant climate variations due to altitude and mountain systems near the area; In addition to being located between hydrological basins from the Moctezuma River and Río de las Avenidas, a situation that favors the presentation of different types of vegetation such as coniferous and oak forests, cloud forests and xeric scrub [13]. The existence of protected geographical areas in the state of Hidalgo such as Peña del Aire, Hidalgo Mining Region Geopark, Barranca de Metztitlán Biosphere Reserve, Huasca de Ocampo, Peña de la

Muela y Zacatlan [27], favor the observation of the Peregrine Falcon.

In Tulancingo de Bravo, the report and record of sightings of the American Peregrine Falcon have documented on websites such as Naturalista.mx [27]. On ebird.org [28], there are records of two sightings without photographic or audio evidence. Meanwhile, the International Union for Conservation of Nature (IUCN) marks the presence of the Peregrine Falcon in the region as a resident but does not detail the number of observations [29]. This agrees with the observations made in Tulancingo de Bravo. In addition, predictive models suggest that the Peregrine Falcon could be present in the municipality due to favorable climatic conditions [30]. Therefore, this research work contributes to the photographic report of the presence of juvenile American Peregrine Falcon in Tulancingo de Bravo, Hidalgo, paving the way for more specialized scientific studies in ornithology.

2. Conclusions

Although the peregrine falcon's presence in different regions and its feeding habits has been widely studied, this work contributes to the knowledge of the species, highlighting some habits observed at Ciudad Universitaria Tulancingo.

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Conflicts of interest

The authors declare they have no conflicts of interest.

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