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Crucial Conservation of Birds and Bats: Providing Ecosystem Services in Egypt

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ABSTRACT

This study surveyed Egypt's key regions, the Nile Valley and Delta, the Western Desert, the Eastern Desert, and the Sinai Peninsula. The 2020–2023 survey was focus on bat and bird reproductive and foraging areas.The study also records keystone species, particularly apex predators. Avian species, known as natural pest controllers, are being assessed to determine if their population has fallen or remained steady and to determine the causes. Egypt has 20 bat species and 501 bird species that naturally control pests. *Rousettus aegyptiacus*, *Rhinopoma microphyllum*, *Rhinopoma cystops*, *Asellia tridens*, *Taphozous perforates*, *Taphozous nudiventris*, *Pipistrellus kuhlii*, and *Plecotus christii* were identified from Egyptian bat and bird species. Pharaoh Eagle Owl (*Bubo ascalaphus*), Little Owl (*Athene noctua*), Barn Owl (*Tyto alba*), Yellow-billed Kite (*Milvus migrans* Aegyptius), Black-Winged Kite (*Elanus Caeuleus*), Cattle Egret (*Bubulcus ibis*), and Common Kestrel (*Falco tinnunculus*) are also important bird species that reproduce in these areas. This invasive species kills all young and eats eggs, preventing them from performing vital ecosystem services. Since bats are coronavirus reservoirs, the continuous coronavirus campaign in Egypt between 2018 and 2022 eliminated more than ten *R. aegyptiacus* colonies. Bats and birds have little effect on humans, hence do not justify unjustifiable punishment. It must strictly follow Law 4/1994 (amended by Law 9/2009), which protects all Egyptian bats and birds. It needs government and non-government cooperation to control exotic bird species like the House Crow and Common Mayna.

Keywords: Birds, Bats, Egypt, Pest control, Green-pesticide-free method.

INTRODUCTION

Pesticides are highly efficient chemical compounds manufactured to counteract any factor that poses a threat to the production, storage, and processing of agricultural products, pastures, and vectors. They augment agricultural productivity by safeguarding crops and cattle from pests, diseases, weeds, and parasites. Pesticides postulate farmers with a cost-effective alternative, enabling them to compete in a highly competitive market (Choudhary *et al.*, 2018). Nevertheless, target organisms absorb a noteworthy number of pesticides, air and water still disperse a significant portion, which is detectable in soil, surface water, and groundwater.

From a practical viewpoint, the natural world provides us with a wide range of advantages, referred to as ecosystem services, which directly enhance our overall welfare. Bats and birds are widely recognized for their substantial contributions to the supply of ecosystem services, which include the regulation of arthropod populations, the dispersal of seeds, and the promotion of plant reproduction. For instance, birds offer four distinct categories of ecological services: provisioning, regulating, cultural, and supporting (Whelan

et al., 2008). Bats also make contributions to human well-being. The value of these services provided by bats can be measured by economists through evaluating changes in human wellbeing, both positive and negative, that result from variations in their availability.

Ecosystem services are natural processes that are advantageous to humans (Whelan *et al.*, 2008). In the transportation and agriculture sectors, pesticides, particularly herbicides, are employed extensively. Insecticides and herbicides are employed to maintain the turf on golf courses, cricket pitches, and sports fields. Termites and woodboring insects are responsible for causing damage to residences and other wooden structures. Insecticides are a method of protecting against this damage (Aktar *et al.*, 2009). Non-target species, including organisms that perform essential ecological functions in ecosystems, are perpetually exposed to pesticide residues or byproduct effects due to the persistence and accumulation of certain pesticides in the environment (Aktar *et al.*, 2009). The debate regarding the environmental implications of neonicotinoids, a pesticide that is widely recognized, has been ongoing since the late 1990s, when French beekeepers began attributing the chemicals to the decline of honeybee colonies (Goulson, 2014). The authors demonstrate that the levels of neonicotinoids found in ambient samples accurately predict regional patterns of population reduction in insect-eating birds by utilizing long-term data sets on avian populations in the Netherlands. In other words, regions with elevated neonicotinoid contamination have experienced a more rapid decline in bird populations (Goulson, 2014).

Current research has suggested that neonicotinoid insecticides have a detrimental effect on non-target invertebrate species. Invertebrates are indispensable for the rearing of progeny and are a significant component of the diets of numerous bird and bat species during the breeding season (Hallmann *et al.*, 2014). Concerns have been raised regarding the direct effects of neonicotinoids on non-target vertebrate species (Goulson, 2013). The distribution of cotton-growing areas in Egypt resulted in the widespread application of pesticides, which is likely to have contributed to a substantial decrease in the populations of Black Kite, Black-shouldered Kite, Senegal Thick-knee, Pied Kingfisher, Kestrel, and Barn Owl in the cotton-growing regions of the Nile Delta and portions of the Nile Valley, primarily between Sohag and Beni Suef (Mullié and Meininger, 1985). Hooded Crows and Cattle Egrets have also experienced substantial population declines in the Nile Delta (Ghabbour, 1976).

A number of Egyptian agricultural products have been rejected, notified, and alerted to the US and EU (European Union), Africa, and Arabian markets as a result of the presence of pesticide residue in excess of the permitted levels. The objective of this investigation is to evaluate the presence of keystone species of bats and birds, including *Rousettus aegyptiacus*, *Rhinopoma microphyllum*, *Rhinopoma cystops*, *Asellia tridens*, *Taphozous perforates*, *Taphozous nudiventris*, *Pipistrellus kuhlii*, and *Plecotus christii*. Keystone species populations of birds, such as the Pharaoh Eagle Owl (*Bubo ascalaphus*), Little Owl (*Athene noctua*), Barn Owl (*Tyto alba*), Yellow-billed Kite (*Milvus migrans Aegyptius*), Black-Winged Kite (*Elanus Caeuleus*), Cattle Egret (*Bubulcus ibis*), and Common Kestrel (*Falco tinnunculus*). Egypt has not conducted this investigation in the past few decades. I therefore conducted this investigation to determine whether the decline of those populations was due to the use of unregulated pesticides over the past few decades or to other factors.

MATERIALS AND METHODS

1-Study area description:

Egypt relies heavily on the fertile Nile Valley and Delta for its sustenance. The Nile, the longest river on Earth, travels in a northward direction, forming a narrow valley and a

delta shaped like a fan before it reaches the Mediterranean Sea. Over thousands of years, the Nile's abundant alluvial soil has made this area ideal for agriculture. The Western Desert extends westward from the Nile Valley to Libya. The region is characterized by intense heat, aridity, sand dunes, rocky plateaus, and isolated oases. The Western Desert harbors a diverse array of desert flora and fauna that have successfully acclimated to the challenging conditions of the arid landscape. East of the Nile Valley, the Eastern Desert borders the Red Sea.

The region is characterized by rugged terrain and mountains, including the Eastern Desert Highlands. This desert also harbors mineral riches and showcases breathtaking desert landscapes. The Sinai Peninsula is a triangle-shaped landmass located between the continents of Asia and Africa. The Mediterranean Sea to the north, the Gulf of Suez to the west, and the Red Sea to the south delimit the region. The Sinai Peninsula is predominantly arid, characterized by mountainous terrain in the southern region and coastal lowlands adjacent to the Red Sea. Tourists frequently visit this location because of its stunning beaches, coral reefs, and significant landmarks like Saint Catherine's Monastery.

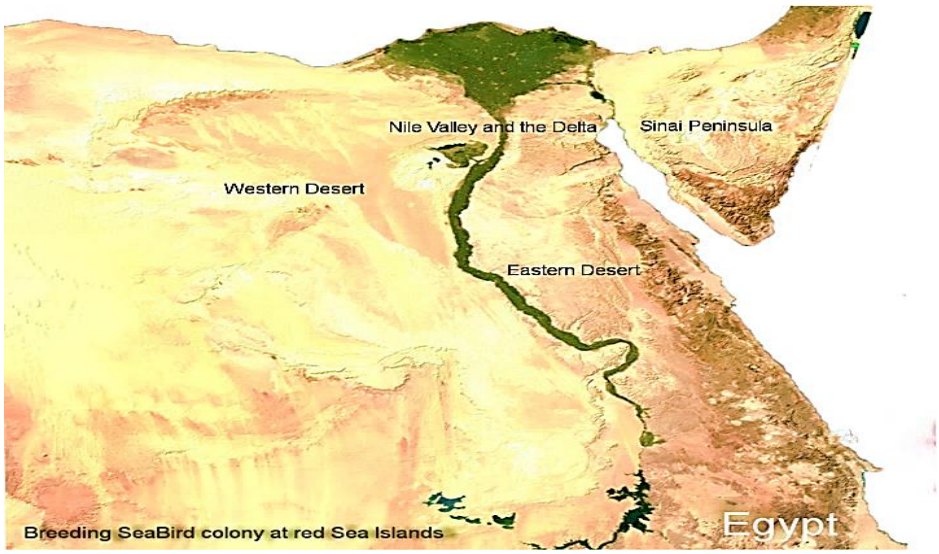

Figure 1. displays the four primary regions: The Nile Valley and the Delta, the Western Desert, the Eastern Desert, and the Sinai Peninsula.

In the period of 2020 to 2023, we visited 65 locations in Egypt's four geographical regions, Nile Valley, Delta, Wetlands, Oases, and Sahara. I employ Nikon and Canon 7D cameras, Olympus binoculars and telescopes, and a 4x4 vehicle. The coordinates of bat roosting locations and Key Stone Birds nesting sites will not be displayed with precision due to conservation concerns.

2-Analyses and model selection:

We first grouped all the studies by the type of environmental service and then discriminated them by the following cofactors: region, bats, and birds type use of habitats, and methods. We considered several levels within each cofactor according to different aspects of bat ecology. The response variable was the number of studies per ecosystem service.

We tested for differences in the assessment of the 4 ecosystem services using a generalized linear mixed model (GLMM; Stasinopoulos and Rigby 2007). This method allowed us to compare the number of studies per ecosystem service among biogeographic regions, habitats, and methods employed. We used 2 sets of GLMM, one to determine which

cofactors were fixed or random, and the other to determine the contribution of each fixed effect on the response variable. These 2 GLMMs allowed us to (1) identify the main cofactors used to assess ecosystem services by bats, (2) assess nonlinear impacts of the cofactors, (3) detect thresholds statistically, and (4) test across a broad set of statistical families to ensure the best fit for the data.

RESULTS AND DISCUSSION

A-Bats:

Our survey in Egypt documented only eight out of the country's 20 bat species. The recorded species are *Rousettus aegyptiacus*, *Rhinopoma microphyllum*, *Rhinopoma cystops*, *Asellia tridens*, *Taphozous perforates*, *Taphozous nudiventris*, *Pipistrellus kuhlii*, and *Plecotus christii*.

1- Egyptian Fruit Bat (*Rousettus aegyptiacus*):

Fruit bats *Rousettus aegyptiacus* in Egypt (Picture 1.) are renowned for their role in pollinating fruit tree blossoms, namely those of dates and mangoes. The most populous colony was located in Damietta, with about 10,000 individuals. This was followed by 6,000 individuals in Giza and 5,000 individuals in Cairo. In contrast, the smallest colony was found in Port Said, consisting of a mere two individuals (Figure 2). Egyptians have a strong aversion towards these bats due to their tendency to vandalize monuments and ancient Egyptian decorations with their excrement. (Madkour, 1977a). IUCN status: least concern.

Rousettus aegyptiacus, often known as the Egyptian Fruit Bat, was described by Geoffroy (1810). Commonly found in cultivated regions, such as orchards and farms in the Nile Valley and Delta. The southernmost documented occurrence of the nominate subspecies in Egypt is near Aswan (Qumsiyeh, 1985). Matings are timed to align with Egypt's major fruiting seasons (such as banana, mango, grapes, and figs) in order to provide energy for the processes of gestation, nursing, and spermatogenesis in males.

Picture 1. Egyptian Fruit Bat (*Rousettus aegyptiacus*).

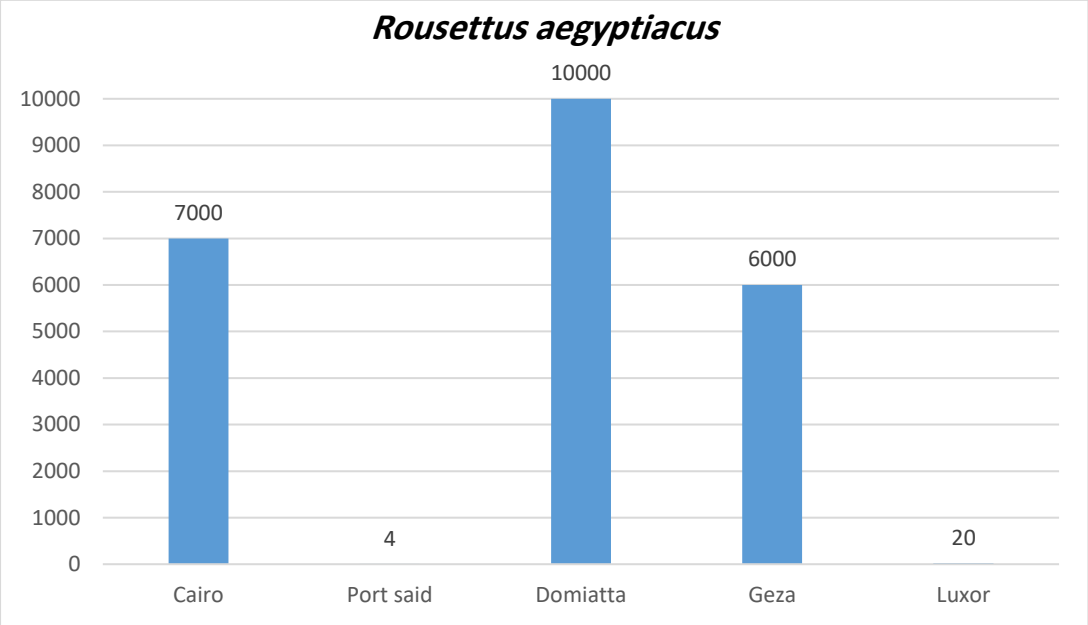

Figure 2. Total counts of *Rousettus aegyptiacus* individuals.

2- Greater mouse–tailed bat (*Rhinopoma microphyllum*):

Rhinopoma microphyllum often recognized as the greater mouse–tailed bat (Picture 2.), was identified by Brünnich (1782). The ancient mosque in Cairo had the lowest number, 200 individuals, while the maximum number was 8000 in El Minya Governorate (Figure 3). Vulnerable by IUCN status.

Picture 2. Greater mouse–tailed bat (*Rhinopoma microphyllum*).

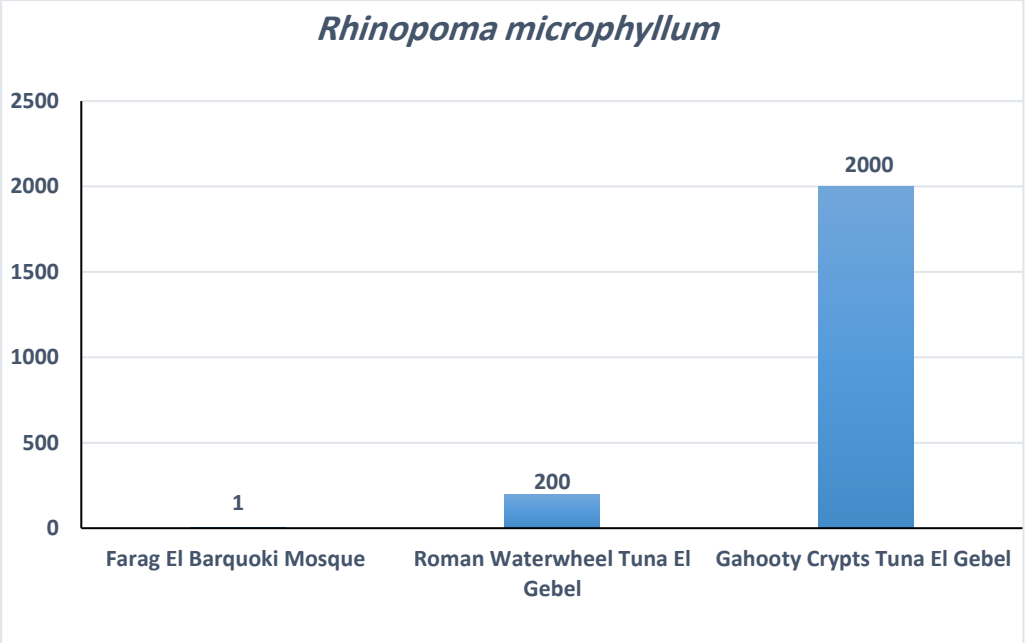

Figure 3. Total counts of *Rhinopoma microphyllum* individuals.

3- Egyptian mouse–tailed bat (*Rhinopoma cystops*):

Rhinopoma cystops often recognized as the Egyptian mouse–tailed bat (Picture 3), was identified by Thomas (1903). With 8000 individuals, El Minya governorate had the largest number, while Luxor governorate had 40 lactating females in July and August (Figure 4). Least concern by IUCN.

Picture 3. Egyptian mouse–tailed bat (*Rhinopoma cystops*).

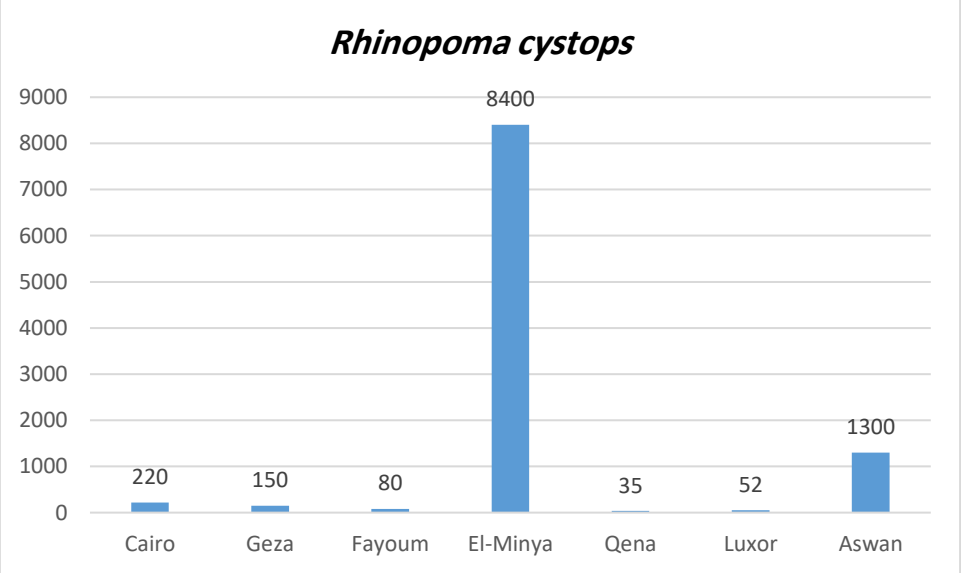

Figure 4. Total counts of *Rhinopoma cystops* individuals.

4- Trident leaf-nosed Bat (*Asellia tridens*):

Asellia tridens recognized as the trident leaf-nosed bat (Picture 4), was identified by Geoffroy, (1813). Largest was in Luxor at an old building, lowest was 12 in a man-made cave (Figure 5). The species migrates seasonally to avoid food shortages and does not hibernate. Beetles and moths rule semi-desert prey. (Dietz and Kiefer, 2016). Photos of pesticide- or water-contaminated Luxor roosting site deaths.

Picture 4. Trident leaf-nosed Bat (*Asellia tridens*).

Figure 5. Total counts of *Asellia tridens* individuals.

5- Lesser Tomb Bat (*Taphozous perforates*):

Taphozous perforates documented as the trident leaf-nosed bat (Picture 5), was identified by Geoffroy (1818). Two hundred individuals are located in the south of the Red Sea, while the highest is located in the Giza governorate (Figure 6).

Picture 5. Lesser Tomb Bat (*Taphozous perforates*).

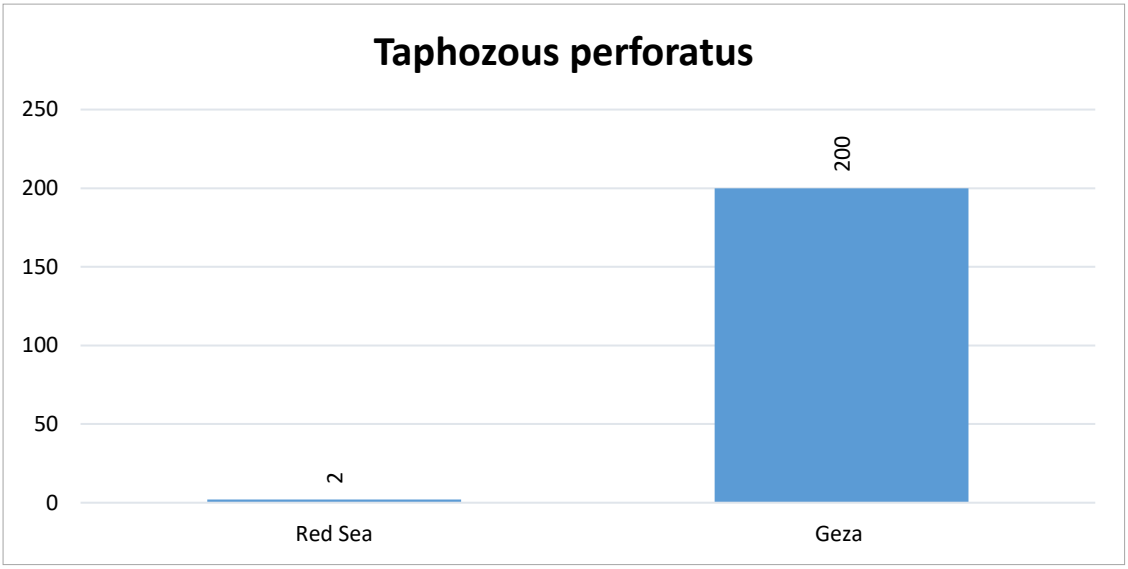

Figure 6. Total counts of *Taphozous perforates* individuals.

6- Naked-rumped Tomb bat (*Taphozous nudiventris*):

Taphozous nudiventris recorded as the naked-rumped tomb bat (Picture 6), was identified by Cretzschmar, (1830). Madkour (1977a) documented that the species observed in the Tanta Cotton field feed on cotton worms and butterflies. These species play a vital role as keystone species in delivering ecosystem services in cotton fields in the Delta region. Nevertheless, this particular species was exclusively observed in Sohag, where it had a population of 400 individuals, and in Luxor, where it had a population of 25 individuals (Figure 7).

Picture 6. Naked-rumped Tomb bat (*Taphozous nudiventris*).

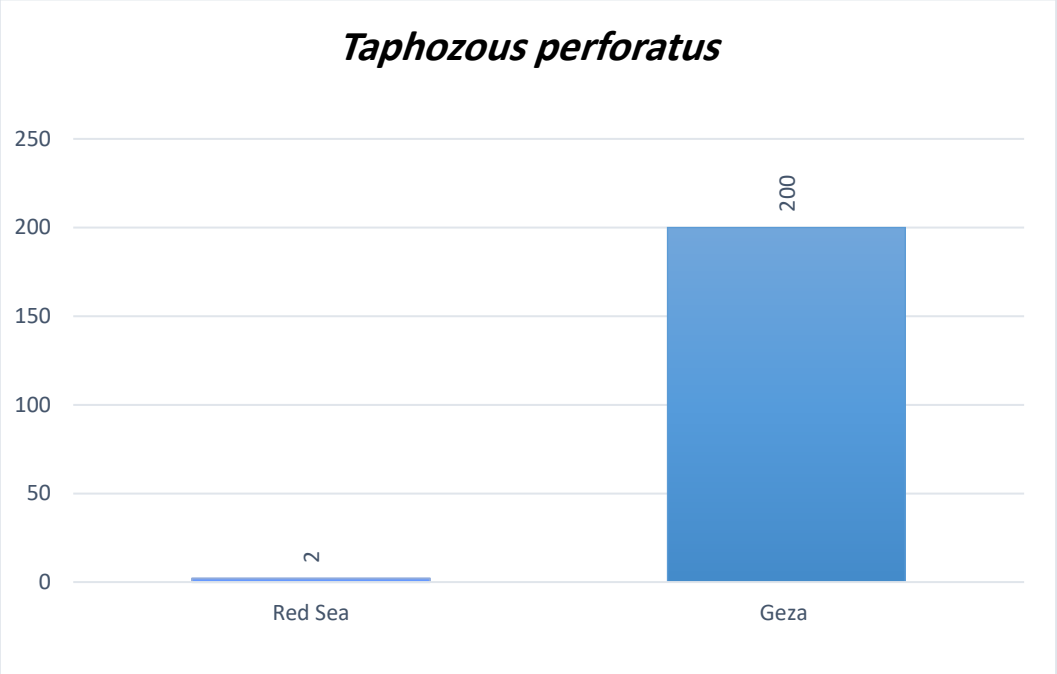

Figure 7. Total counts of *Taphozous nudiventris* individuals.

7- **Kuhl's Pipistrelle Bat (*Pipistrellus kuhlii):***

Pipistrellus kuhlii often recognized as the Kuhl's pipistrelle bat (Picture 7), was identified by (Kuhl, 1817). This species is commonly found in palm tree gardens, oases, and farmlands in all four regions. In Abbassa Sharquia governorate, the highest number of individuals registered was 50, but in Zamalik it was 20. Farafra Oasis in Hendi hotel garden had the smallest number of people, with only 6 observed (Figure 8).

Picture 7. Kuhl's Pipistrelle Bat (*Pipistrellus kuhlii).*

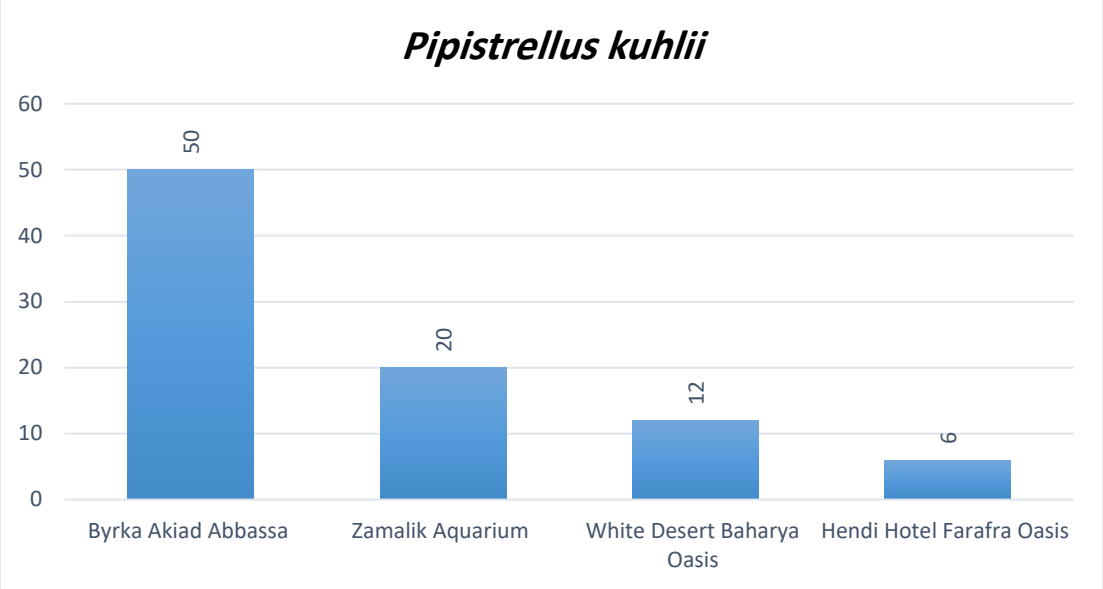

Figure 8. Total counts of *Pipistrellus kuhlii* individuals.

B-key stone birds:

The prominent bird species in Egypt that serve as effective pest controllers include the Pharaoh Eagle Owl (*Bubo ascalaphus*), Little Owl (*Athene noctua*), Barn Owl (Tyto alba), Yellow Billed Kite (*Milvus migrans Aegyptius*), Black Winged Kite (*Elanus Caeuleus*), Cattle Egret (*Bubulcus ibis*), and Common Kestrel (*Falco tinnunculus*).

1- Pharaoh Eagle Owl (*Bubo ascalaphus*) (Picture 8):

The recordings were made in the Delta, Western Desert, and Eastern Desert, all located on the edges of human cities but in close proximity to the desert border. The presence of nests has been documented at Hurghada (2 nests), Marsa Allam (1 nest), Idfu (3 nests), Sohag (1 nest), Asyout (1 nest), Cairo (1 nest), Dakhla Oasis (1 nest), and Siwa Oasis (1 nest). The population of the species is experiencing a significant decrease due to the high demand from falconers, who are willing to pay a substantial amount of money for it. It is projected that the price of the species will reach 3500 Egyptian pounds by 2024 (Figure 9).

Picture 8. Pharaoh Eagle Owl (*Bubo ascalaphus*).

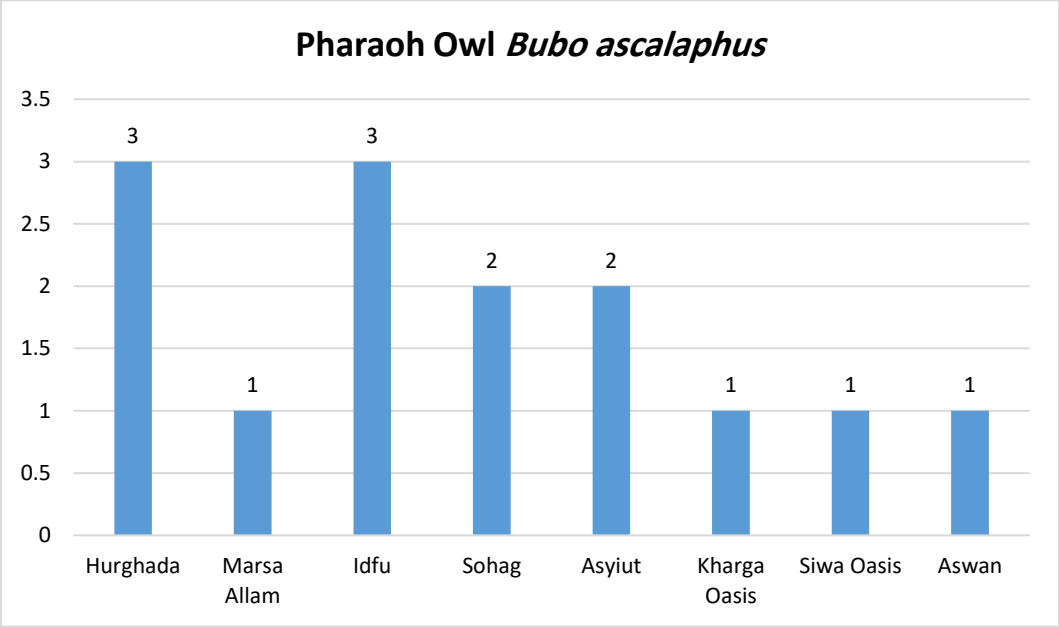

Figure 9. Total counts of Pharaoh Eagle Owl individuals.

2- Little Owl (*Athene noctua*) (Picture 9):

Common breeding inhabitant of cultivated areas, along desert fringes, and locally in rocky places; documented in four regions: The Nile Valley and Delta, the Western Desert, the Eastern Desert, and the Sinai Peninsula.

Picture 9. Little Owl (*Athene noctua*).

3- Barn Owl (*Tyto alba*) (Picture 10):

Recorded at 4 regions The Nile Valley and Delta, The Western Desert, and the Sinai Peninsula. It is particularly numerous in the Nile Delta. They are more concentrated near human habitations of all sizes, including Cairo, and in ruins throughout the Nile Delta and Valley.

Picture 10. Barn Owl (*Tyto alba*).

4- Yellow Billed Kite (*Milvus migrans Aegyptius*) (Picture 11):

Only 6 breeding nests were recorded from Aswan to Cairo, whereas the majority of the breeding colony was located in Abu Simbl, south of the Lake Nasser, with 53 active nests (Figure 12)**.**

Picture 11. Yellow Billed Kite (*Milvus migrans Aegyptius*).

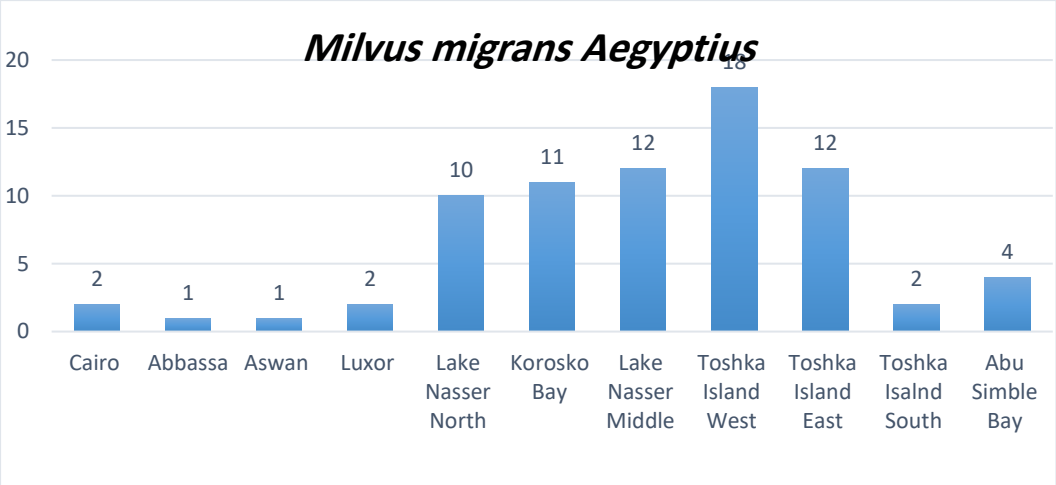

Figure 12. Total counts of Yellow Billed Kite individuals.

5- Black Winged Kite (*Elanus Caeuleus*) (Picture 12):

Faiyum is a rather common breeding resident in cultivated areas, particularly in the Nile Valley and Delta, the Western Desert, and on the Sinai Peninsula.

Picture 12. Black Winged Kite (*Elanus Caeuleus*).

6- Cattle Egret (*Bubulcus ibis*) (Picture 13):

Common breeding residents were documented in four regions: The Nile Valley and Delta, the Western Desert, the Eastern Desert, and the Sinai Peninsula. Under threads for invasive species such as Indian house crow, which attach the checks along the breeding colony in Hurghada and Suez during my survey. Also, constant burning of the reeds at the side of canals disrupts their habitats, preventing them from breeding.

Picture 13. Cattle Egret (*Bubulcus ibis*)

7- Common Kestrel (*Falco tinnunculus*) (Picture 14):

Common breeding resident in all five regions. The Nile Valley and Delta, the Western Desert, the Eastern Desert, and the Sinai Peninsula have all begun to breed in Red Sea resorts since the 2000s.

Picture 14. Common Kestrel (*Falco tinnunculus*).

In this survey, I learned that more than ten *R. aegyptiacus* colonies were culled as part of a coronavirus campaign in Egypt from 2018 to 2022, which is still ongoing because bats are considered the source and reservoir of coronaviruses. However, their impact on humans is quite modest and does not merit misguided persecution. (Keesing *et al.,* 2010). Many bat populations have declined as a result of illegal rules enacted in reaction to Covid and other diseases that spread without evidence. Many roosting structures, ancient Egyptian temples, and tombs have been cleaned with chemicals and hot shelly to remove all breeding bats. During the coronavirus outbreaks in Egypt, many residents were raided owing to the appearance of fruit bats in different communities.

There was no evidence of SARS-CoV-2 infection in the *Rousettus aegyptiacus* bat in Egypt over the period of investigation (Saeed *et al.,* 2021). Owls and crows are regarded unlucky in Egyptian tradition, and many have been slaughtered near human settlements. Many Pharaoh Owls, Barn Owls, and Crows were slaughtered from 2020 to 2023. In Hurghada and Suez, invading species like as House Crow (*Corvus splendens*) attack multiple nesting colonies of local birds such as Cattle Egret *(Bubulcus ibis*), killing all chicks and eating all eggs. Furthermore, Common Myna *Acridotheres tristis* affects breeding house sparrow and palm dove colonies along the Suez-Ismailia Road, preventing them from providing ecosystem services. The government and local non-governmental organizations should work together to protect keystone bird and bat species while also controlling invasive species that kill chicks and eat eggs. Using natural pesticide controllers like bats and birds can help to avoid trade issues.

Conclusion:

According to the results of a Bat and Bird Survey from 2020 to 2023, there has been a decline in Bat populations due to the culling of all species at roosting sites in Temples and Tombs and abundant houses in the last five years because bats are regarded as the source and reservoir of coronaviruses without scientific evidence, as well as the overuse of pesticide chemicals that have killed non-target vertebrate species. Bird numbers are dwindling, with Pharaoh's eagle owls being the most in-demand species due to high prices. Many of the dangers to bats and birds are directly tied to expanding human populations, which put additional strain on land, food, and other resources, resulting in the deterioration or loss of Bats and Birds habitat and natural resources. Egypt's Law 4/1994 (updated by Law 9/2009) protects all bats and birds. Furthermore, bats are considered terrible omens in Egyptian culture, and most people will strive to remove them, putting fruit bats in danger. Several activities and steps must be taken to protect night and day roosting spaces and prevent bat culling from ancient monuments.

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