

Importance of Bats (Order Chiroptera) in Agricultural Services

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Abstract

Bats (order Chiroptera) are one of the diverse mammal groups and distinguishing from other mammals by their real flight. Bats have long been postulated to play essential roles in agriculture including arthropod suppression, seed dispersal, pollination, biological indicator, organic fertilizer provider (guano) and improving soil structure, etc. However, most bat populations have recently been declined because of habitat destruction caused by anthropogenic activities. The natural ecosystem services provided by bats imply that it is necessary to take actions to the restoration of bat population and their habitats.

Keywords: Bats; Guano; Fertilizer

Introduction

Bats (order Chiroptera) are a diverse group of mammals available on every major land, except the Polar region and a few oceanic islands. Almost 1,232 species of bats have been identified in the world, meaning that one in five (21 percent) mammal species is a bat [1-3]. They are notable from other mammals by their evolution of true flight, as opposed to the gliding capabilities of mammals in other orders. Bats contribute to the ecosystem as primary, secondary, and tertiary consumers that help to maintain and sustain both natural and human-controlled ecosystems ranging from the simple to the complex. In recent years, increased evidence of anthropogenic activities such as depletion or destruction of forests and other terrestrial ecosystems, disturbances to caves, depletion of food resources, overhunting for bushmeat increased use of pesticides and the proliferation and operation of utility-scale wind energy facilities have contributed to unintended and, in some cases, unprecedented mortality of bats [3-8].

Bats have long been postulated to play essential roles in agriculture including arthropod suppression, seed dispersal, and pollination [3]. The determination of the agricultural values provided by bats is not easy except the studies on facilities provided directly to the production of goods and services consumed by humans, however, only recently have these ecosystem services begun to be thoroughly evaluated [3,9].

Discussion

Among the estimated 1,232 extant bat species, over two-thirds are either obligate or facultative insectivores gleaning insects from vegetation and water in cluttered forests to those that feed in open space above forests, grasslands, and agricultural landscapes [1]. A large volume of insects is normally consumed by insectivorous bats, often nearly their body weight each night, which translates into sizeable economic benefits, as many of the insects are agricultural pests [10]. Natural predators may not control 100% of forest and agricultural pests, but a combination of factors can keep populations, and therefore crop losses.

In tropical and subtropical habitats, some bat species also play important roles as pollinators and seed dispersers. Two families of bats i.e. Phyllostomidae (New World bats) and Pteropodidae (Old World bats) contain over 100 species of fruit eaters responsible for dispersing seeds from hundreds of species of tropical trees and shrubs [11]. The fruit bats of these two families are important as pollinators and seed dispersers for many economically valuable plants, many of which are used as dyes, fibers, food, medicine, ornament, and construction material [12,13].

Also, bats play a role as a biological indicator. The changes in the climate, for example, extremes of drought, heat, cold, precipitation, cyclone, and sea level rise, deterioration of water quality, agricultural intensification, loss and fragmentation of habitats, fatalities at wind turbines, disease, pesticide use, and overhunting could affect the bat populations that may also affect other taxa [14].

The fecal matter and urine of bats, mostly known as bat guano can be used as a fertilizer both indoor and outdoor gardening [15]. It contains roughly 10% N, 3% P and 1% K along with other minor and trace elements required for a plant's overall health [16]. Cave-dwelling salamander and fish populations and invertebrate communities, for example, are highly dependent upon the nutrients from bat guano [17]. Unlike synthetic gardening products, guano contains no fillers. The high nitrogen content is responsible for plants' healthy green color and their rapid growth after application. Phosphorous promotes root growth and flowering, and potassium encourages sturdy stems. Moreover, while most chemical fertilizers leach out of the soil soon after being applied, guano remains much more prolonged, enhances soil texture and slowly continuing to feed the plant. The application of different forms of bat guano over chemical fertilizers shows significant results to produce vegetables; however, careful handling of guano fertilizer is needed [18].

The ecological role of guano in nutrient redistribution over the landscape has already been investigated [19]. It has been expected that guano is spread over the landscape all overnight when insectivorous bats consume and digest rapidly energy-rich prey during flight time [20]. Thus, bats contribute to nutrient redistribution from nutrient-rich sources to nutrient-poor regions. The microbes can also increase water-holding capacity and airspace by loosening the soil. A colony of one million Brazilian free-tailed bats, *Tadarida brasiliensis*, in Texas could contribute 22,000 g of nitrogen in the form of guano, and moderate applications of guano in a controlled greenhouse experiment promoted growth in a grass species native to Texas (*Indian grass, Sorghastrum nutans*) [19].

The ecotourism development by bat roosts encourages roost site protection and at the same time education as well as awareness about bats which also helps to establish a local economy tied directly to protecting the bats. An example of the bat-maintained forest is Subic Bay Forest Watershed Reserve in the Philippines, the fastest growing industrial port in the Philippines, supporting USD 0.98 billion in international exports a year [21,22]. Costa Rica, Lao People's Democratic Republic, Madagascar, the Philippines, and North America are the best examples of bat roosting becoming an increasingly popular attraction for eco-tourists worldwide [23]. Many communities are overcoming their fears of local bat roosts and developing the roosts into tourist destinations. Perhaps the best-known example is Congress Avenue Bridge in Austin, Texas, United States of America [24].

The magnificent creature of the dark Bat plays a vital role in maintaining the balance of our agricultural ecosystem. However, there are many myths especially negative ones spreading around our society. Moreover, bats have been recognized as reservoirs of many emerging pathogens such as the Nipah virus, SARS, Ebola, and several other viruses that impact human and livestock health [25]. These viruses have emerged mainly due to human activities that alter the environment and bring bats, people, and livestock into closer contact [26]. We cannot solely blame the bats for this; it is the anthropogenic activity which has forced the bats to come into interaction with humans.

Conclusion

This mini-review reveals the critical role of bats in agriculture and the environment. Bat is a keystone species in the agricultural ecosystem. Bat is a major contributor in pollination and seed dispersal; it also works as an effective source of pesticide and good fertilizer which is enriched in nitrogen and phosphorous. Bats are excellent ecological indicators of habitat quality. Further research and valuing the bat as a vital part of the ecosystem is necessary for sustainable agricultural practice.

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