

## **Bats : Ecological and Economic Importance; Role of Bats in Agriculture with Special Reference to Jammu and Kashmir (India)**

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### **ABSTRACT**

The paper discusses ecological economic importance of bats in our ecosystem. Bats play a significantly important role in agriculture. In the study area of district Rajouri bat species have been studied to play an important ecological and agricultural role as prey and predators, arthropod suppression, seed dispersal, pollination, material and nutrient distribution, and recycle. They have great advantage in economic terms also. Even though bats are among gentle animals providing many positive ecological and economic benefits, few species have negative effects. The paper also discusses the positive impacts due to the presence of bat species in Rajouri district. There is a considerable population of microchiroptera and Megachiroptera in village Phalayana and village Dassal of district Rajouri which play an important role in the ecology of the

area that has been discussed in the paper thoroughly. Insect-eating bats should be encouraged by planters as they help control herbivorous and disease-carrying insects, while fruit bats pollinate flowers and disperse seeds of many useful plants and shade tree species. As bats are among the most overlooked in spite of their economical and ecological importance, their conservation is mandatory.

**Keywords** Bats, Ecological interventions, Ecological importance of Bats, Economic importance of Bats, Role of Bats in Agriculture.

### **INTRODUCTION**

Estimating the economic importance of bats in agricultural systems is challenging but economic consequences of losing bats could be substantial. For example, a single colony of 150 big brown bats (*Eptesicus fuscus*) in Indiana has been estimated to eat nearly 1.3 million pest insects each year, possibly contributing to the disruption of population cycles of agricultural pests (Whitaker 1995). Farmers and agriculture can benefit tremendously from bats. Pests, such as the corn earthworm moth, infest commercial plants ranging from melons to corn, soybeans to cotton. Bats directly impact our own food by eating bollworms, mosquitoes, and larvae harmful to agricul-

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ture reducing the need for toxic pesticides. Bats can potentially be attracted by providing a water source, consider installing bat houses to provide shelter, use bat-friendly lightning. Maintaining a fresh water supply can benefit both bats and agriculture. Improving or restoring water infrastructure can provide water for cattle and other livestock as well as water for wildlife. Land health can be improved through better grazing planning practices. These practices are critical to deal with the tough challenges of drought. Even though bats are among gentle animals providing many positive ecological and economic benefits few species have negative effects.

The sudden emergence of the highly pathogenic SARS coronavirus (SARS-CoV) has once again reignited interest in the study of coronavirus biology and pathogenesis. Severe acute respiratory syndrome (SARS) represents the 21<sup>st</sup> century's first pandemic of a major transmissible disease with the earlier unknown cause. Previously the pandemic started in November 2002 and was brought under control by July 2003, after it had spread to nearly 33 countries on 5 continents, resulting in >8,000 infections and >700 deaths (Peiris et al. 2004). The outbreaks were caused by a newly emerged coronavirus, now known as the SARS coronavirus (SARS-CoV).

In late 2003 and early 2004, sporadic outbreaks were reported in the region of the People's Republic of China where the 2002-2003 outbreaks originated (Liang et al. 2004). However, molecular epidemiologic studies showed that the viruses responsible for the 2003-2004 outbreaks were not the same as those isolated during the 2002-2003 outbreaks (Song et al. 2005). The deadly coronavirus disease 2019 (COVID-19) outbreak caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) was reported for the very first time in December 2019, in Wuhan province of China (Khan et al. 2020). From there the COVID-19 has rapidly spread from its epicenter to global scale and now is decisively recognized as a pandemic by the World Health Organization (2020). It has become a major threat to world health, fauna, economy and environment. The fast transmission rate and lack of vaccines for this deadly SARS-CoV-2, led to a major global health emergency. The prevailing situations of pandemic and

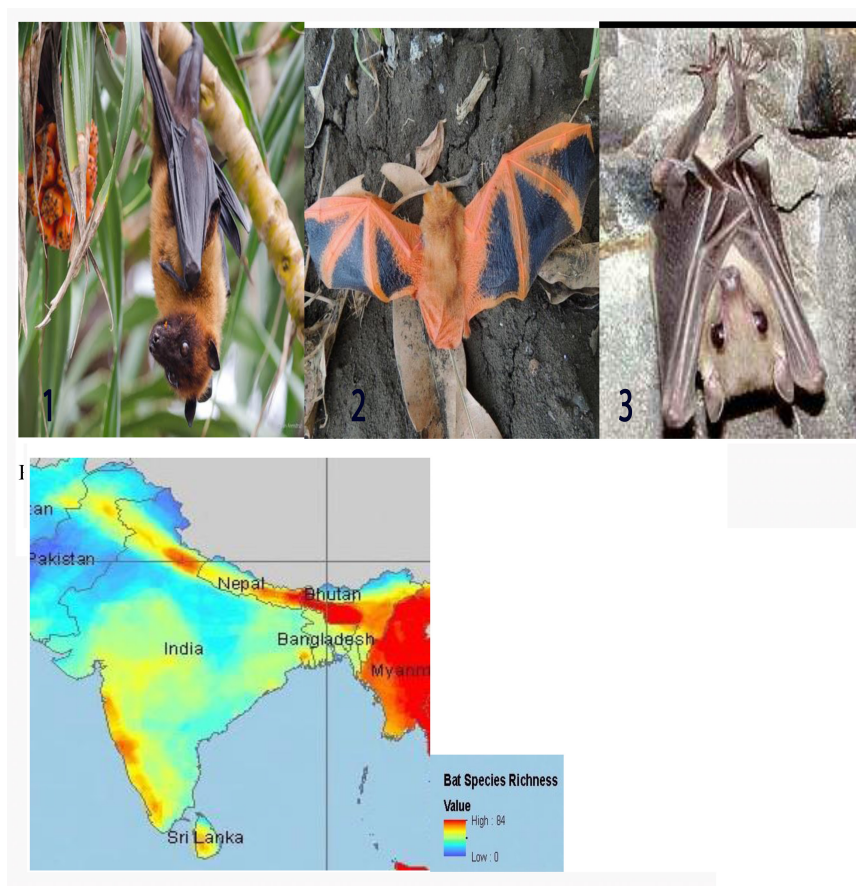
lock-down which scared the public, and has initiated a psychological stress among the people in almost every part of the world (Cohen and Kupferschmidt 2020). Similar to SARS-CoV-2, other viruses such as severe Acute Respiratory Syndrome Coronavirus (SARS-CoV), the dangerous Middle East Respiratory Syndrome Coronavirus (MERS-CoV), The Marburg virus and the dangerous Ebola virus, have also caused major outbreaks in recent history.

### **SARS like Coronaviruses in bats**

Bats are studied to be the main source for this deadly disease transmission. Such viruses are reported to have been naturally found in bats, especially coronaviruses which make up approximately 31% of the viruses in bats as reported by Allocati et al. 2016, Afelt et al. 2018. Humans are infected by these viruses either by direct consumption or contact or through the intermediate hosts (Chan et al. 2013, Allocati et al. 2016). The higher species diversity in bats (over 1400), their strong and higher resistance to viral infections, longer lifespan spanning over 30 years on average and migratory factor makes them a major reservoir for pathogens and therefore, their chances to transmit pathogens to other species are very high in large areas (Allocati et al. 2016, Frick et al. 2019, Branerjee et al. 2020). Nearly 5717 bat-associated animal viruses were detected upto the year 2016, in a total of 207 bat species, in 77 different countries (Allocati et al. 2016). There is an urgent need for regular and efficient monitoring, studying and surveillance in localities where in human beings and bats share a common habitat.

### **Bat population in India**

One of the most ecologically diverse countries in the world, India is renowned for its majestic wildlife and studies of its natural history abound, but the bats of India have hardly ever been studied and mentioned and very little is known about them. Bats are an important part of our biodiversity but have not been studied extensively. With at least 109 species India has an incredibly vast diversity of bat species. This includes one of the largest bat species in size in the world, the Indian flying fox (*Pteropus giganteus*);



**Fig. 1.** Bat species richness in India, Source : (IUCN, Batsworld.com). **Fig. 2.** Indian Flying Fox. **Fig. 3.** Painted Bat.

one of the most colorful bats in the world, the orange and black color painted bat (*Kerivoula picta*) and one of the rarest species, Salim Alis fruit bat (*Latidens salimalii*). The habits and habitats of India's bats are very diverse. Right from the higher altitudes of the Himalayan mountains up to the dry deserts of the Northwest, to the moist tropical forests of the east and South, there are bats that feed on fruit, nectar, insects, frogs and even other bats also. In India the majority of bats population are in north eastern states of the country. The species richness is also present in the north eastern region.

#### **Bats in district Rajouri (J & K)**

Looking for bats one does not have to go to deep forests or caves but they are present in the army can-

tonment area of Phalayana near Rajouri town (Figs 1—7). There is a considerable population of fruit eating bats in Rajouri, village Phalayana, village Das-sal. These fruit bats (*Pteropus giganteus*), commonly known as the Indian flying fox, may be seen on top of large number of Eucalyptus trees on and around Rajouri. Microchiroptera and Megachiroptera are commonly seen in these localities. Photography and survey in this area is strictly prohibited due to security reasons and permission to enter army cantonment is also not permitted. But these bats can be seen from road also 5 kms from Rajouri town going towards-Jammu. Bats are an important part of the ecology of Rajouri, as they perform various functions for the sustenance of a stable and bio diverse ecosystem in and around the town area, many of these important functions are discussed in the paper. The ecological





Fig. 4, 5 and 6. Bats hanging from trees near Rajouri (J & K).

and economic importance associated with bats is tremendous.

### Ecological importance of bats

Bats have long been postulated to play important ecological roles in prey and predator, arthropod suppression, seed dispersal, pollination, material and nutrient distribution, and recycle Kunz et al. 2011).

**1. As Predators :** Bats have diverse patterns of feeding in which some select among available prey while others are generalist predators, feeding on a wide diversity of taxonomic groups. They also opportunistically consume appropriately sized prey depending on availability with in a preferred habitat (Anthony and Kunz 1977). Their prey size can vary from 1

mm (midges and mosquitoes) to as large as mm long (beetles and large moths) based on the species of bat (Anthony and Kunz 1977 Kurta and Whittaker 1998).

**2. Prey for Vertebrates :** Although there are relatively few observations of animals feeding on bats, a number of vertebrate predators like fish, amphibians, birds, reptiles and mammals prey on bats throughout the world. The main bat predators are owls, hawks, falcons, snakes, and mammals such as raccoons, ringtails, and opossums. In some countries like New Zealand, forest-floor dweller bats are frequently predated by the introduced rats, feral cats, and weasel Daniel and Williams 1984).

**3. Pollination :** In addition to insect suppression through predation, some bat species primarily the two

families of bats (Pteropodidae in the Old World and Phyllostomidae in the New World) play important roles in plant pollination (Kunz et al. 2011). Although bat pollination is relatively uncommon when compared with bird or insect pollination, it involves an impressive number of economically and ecologically important plants.

**4. Guano Mining :** Guano from bats has long been mined from caves for use as fertilizer on agricultural crops due to its high concentrations of limiting nutrients like nitrogen and phosphorus. It provides some of the world's finest natural fertilizers (Tuttle and Morino 2005). About 950 bat guano products show a market demand for the product.

**5. Seed Dispersal :** Bats are crucial to the survival of the world's tropical forests. Enormous expanses of rain forest are cleared every year for logging, agriculture, ranching and other uses. Fruit-eating bats are uniquely suited for dispersing the seeds of "pioneer plants" from which a diverse and healthy forest can re-emerge (Buddenhagen 2008). Thus, the economic value contributed by bats in maintaining forests is tremendous.

**6. Aesthetic and Bat Watching Tourism :** Wildlife watching is simply an activity that involves watching wildlife to identify and observe their behavior and appreciate their beauty. It differs from other forms of wildlife-based activities like hunting and fishing (Tapper 2006). Although perhaps not as widely practiced as bird watching, bat watching is currently growing as a recreational activity. Similar to other wildlife watching tourism, it also generates income in the form of entrance and permit fees, personal payments to the guides, drivers and scouts and payment for accommodation, and other services (Tapper 2006).

**7. Education and Research :** Although extremely difficult to quantify, it is important to recognize the extraordinary value of bats to ancient and contemporary traditions and science. The current study of bat echolocation and locomotion has provided inspiration for novel technological advances in biomedical ultrasound, sensors for autonomous systems, and wireless communication and BATMAVs (bat-like motorized aerial vehicles) Muller and Kuc 2007). Bats

contributed a lot to the field of biomimetic, which is the science of modelling cutting-edge technologies based on natural forms (Muller and Kuc 2007).

### **Overlapping of bat population with human habitation**

Over the years, there has been a significant shift of bats population closer to the human habitation. As a result of an ever increasing population, urbanization and deforestation, declining biodiversity, the colonies of bats are trying to adapt and nest in the human inhabited village and city settlements and environments, in the vicinity of human habitation areas (Jung and Threlfall 2018 Li et al. 2019). Typically diverse environmental conditions are generated close to the human populations due to the above mentioned reasons, these changed environmental conditions makes it suitable for a diverse range of bat species to live and thrive there, not seen there before (Jung and Threlfall 2018), easy access to food could be the reason. Because of this, the number of bat species and the viruses present in bats will automatically rise up. The luminous lightings of the houses attract bats in search of insects and pests. Fruit eating bats are attracted towards gardens and fields. The dark areas in the house and barns attract the bats which live in caves.

When a number of bat species interact amongst themselves, their viruses also interact and are passed from one another, these deadly viruses will then be transferred to the human beings through different means such as : Direct hands contact, contamination of potable ground water by bat feces or urine, and infection to domesticated animals (Jung and Threlfall 2018). Also the characteristics that are very unique and specific in bats such as gathering or assemblage during the roosting process, their feeding practices and a very resilient immune systems help in the continued accumulation and mixing of different viruses in their body that may lead to formation of RNA viruses that are highly dangerous, recombinant, novel mutant, and reassortant (Chan et al. 2013).

Given the extremely fast transmission of this viral disease and its lack of vaccination, the only way to combat it is by using ecological intervention. Some of these ecological interventions are discussed below.

**1. Natural habitat conservation :** There is an urgent need to preserve and isolate the natural habitat of bats. Olivero et al. (2017) determined that deforestation on large scale has been related to viral outbreaks throughout the world. III practices of deforestation should be stopped everywhere immediately and compensatory afforestation should be done to give the habitat back to wild life. After the outbreak of such viral diseases millions and crores are spent only to counter the disease, to diagnose, vaccinate the patients and for eradication of the disease.

**2. Ban on Bat hunting and consumption :** Though Bat hunting and consumption is not so common in India but rapid transmission of such viral disease in our neighboring countries is a major cause of concern, nearly 56 species of bats are hunted for consumption purpose in Asia (Mildenstein et al. 2016) . In addition to that, live killing, and eating of under cooked meat of bats can be the utmost reason for such viral infections in humans (Chan et al. 2013).

**3. Controlling human population growth :** India is the second most populated nation in the world after China, China being the most populous country has seen three major bat origin COVs epidemics till now (Khan et al. 2020). According to the research many bat related viral infections have been seen and reported in lands with higher population density (Plowright et al. 2015).

**4. Universal ban of wildlife trade :** In spite of all the efforts of world environment and animal bodies to curb the menace of wildlife trade, it has not decreased but has been increasing each year. New viruses having pandemic potentials emerge largely due to the unorganized and illegal trade of wildlife as seen in the case of COVID-19 and similarly other outbreaks (Boseley 2020).

**5. Research, wildlife monitoring and survey :** Efficient and effective scientific research is the guiding light to any environmental problem. Universally it is very important to research and monitor the presence or absence of wildlife carrying viruses. Scientific surveys of bat population, inhabitation and migration may give instant knowledge with regards to the origin,

travel and spill overs that may have happened with regards to the virus containing materials associated with the wildlife in any particular area, country or continent.

## CONCLUSION

The COVID-19 pandemic has created a world-wide panic situation and bats are believed to be the main cause of this situation. Many of the severe illnesses like COVID-19 which have been reported because of the un-natural association that lies between the bats and human beings, give us an indication that there is an urgent need to adopt some preventive ecological intervention for the control of ecosystem in a swiftly dynamic world. There is a need to demarcate, preserve and conserve bats in their natural habitat because they are an important part of our ecosystem. The paper discusses ecological and economic importance of bats in our ecosystem and how without giving much thought bats are being blamed for the spread of the novel corona virus. Bats play an important ecological role as prey and predators, arthropod suppression, seed dispersal, pollination, material and nutrient distribution, and recycle. They have great advantage and disadvantage in economic terms also. Even though bats are among gentle animals providing many positive ecological and economic benefits, few species have negative effects. In the study area of Rajouri, because of the presence of bats and the positive ecological impacts they have, the region is rich in biodiversity. We need to understand the concept of co-existing with bats and the only way to do so is by respecting their territories. The pandemic of COVID-19 has gripped the world and brought everything to a stand-still, such an extra-ordinary situation definitely requires extra-ordinary measures to stop likewise pandemics in future. The steps given in this review paper shall prove to be decisive in restricting bats to their natural habitat and hence the viruses associated with them.

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