

Bats and the Benefits They Provide

Bats, still a required decor component for Halloween, are increasingly recognized as the important creatures that they are. Bats are important predators and pollinators in ecosystems throughout the world. The benefits they provide humans are substantial - both in terms of controlling insect pests and pollinating economically important crops.

Redacted from the 2011 Annals of the New York Academy of Science, [Ecosystem services provided by bats](#) by Thomas H. Kunz, Elizabeth Braun de Torrez, Dana Bauer, Tatyana Lobova, and Theodore H. Fleming.

Various species of prominent agricultural insect pests have been found in the diets of bats based on identification of insect fragments in fecal samples and stomach contents. These insects include, but are not limited to,

- June beetles (Scarabidae),
- click beetles (Elateridae),
- leafhoppers (Cicadellidae),
- planthoppers (Delphacidae),
- the spotted cucumber beetle, (*Diabrotica undecim- punctata*, Chrysomelidae),
- the Asiatic oak weevil (*Cyrtopistomus castaneus*, Curculionidae),
- and the green stinkbug (*Acrosternum hilare*, Pentatomidae)

Loss of Bats Equals Loss to Humans

Based on the dietary composition, minimum number of total insects per guano pellet, number of specific agricultural pest species in each pellet, and the number of active foraging days per year, Whitaker calculated that a colony of 150 big brown bats (*Eptesicus fuscus*) in the midwestern United States annually consumes approximately 600,000 cucumber beetles, 194,000 June beetles, 158,000 leafhoppers, and 335,000 stinkbugs. Subsequently, assuming that each female cucumber beetle lays 110 eggs,⁸⁶ this average-sized bat colony could prevent the production of 33,000,000 cucumber beetle larvae (corn rootworms), which are severe crop pests (*See below*).

While these calculations include a large number of assumptions and ignore various sources of natural variation, this study took the extra step of translating ecological data into a form more readily appreciated by the public. With the addition of data on corn rootworm damage to crops in the study area, an economic value for this colony could be estimated.

A common challenge in these investigations is the overwhelming lack of basic ecological information regarding foraging behavior and diet for many species of bats.

Although bat pollination is relatively uncommon compared with bird or insect pollination in angiosperms, it involves an impressive number of economically and/or ecologically important plants (Table 4). In arid habitats in the New World, two families, Agavaceae and Cactaceae, have enormous economic and ecological value. Many species of paniculate Agave rely heavily on phyllostomid bats for pollination, and many of these same bats are also major pollinators and seed dispersers of columnar cacti.

Three species of *Leptonycteris* bats are especially important in this regard in the southwestern United States, Mexico, and northern South America (Fig. 4). The bat-pollinated *A. tequilana* is the source of commercial tequila, a multimillion dollar industry in Mexico; other species of Agave are used locally to produce similar alcoholic beverages such as pulque, mescal, and bacanora. Agaves are also important sources of sisal fiber in many tropical localities. Although bats are not the exclusive pollinators of most species of Agave, they are critically important pollinators in tropical latitudes in the New World. This is also true of bats pollinating columnar cacti.

Examples of economic and ecological damage caused by insect pests consumed by bats

June beetles. Adults are herbivorous and have the potential to defoliate trees in large numbers; their larvae, white grubworms, attack the roots of grasses and various crops such as corn, wheat, oats, barley, sugarbeets, soybeans, and potatoes.

Wireworms/Click beetles. Wireworms, click beetle larvae, cause several million dollars worth of damage annually, and no crop is known to be entirely immune.

Leafhoppers and planthoppers. These true bugs are vectors of plant pathogens such as the rice dwarf and the maize mosaic viruses, as well as phytoplasmas and bacteria. The brown planthopper has resulted in cumulative losses of rice estimated in the hundreds of millions of dollars, and other species act as serious agricultural pests to potatoes, grapes, almonds, citrus, and row crops.

Spotted cucumber beetles (*Diabrotica undecimpunctata*). Serious pests of corn, spinach, and various cucurbit vines. In their larval stages,

Diabrotica spp. (referred to as corn rootworms) decimate corn crops, costing farmers in the United States an estimated \$1 billion annually in crop yields and costs of pesticide applications. ***The United States Department of Agriculture (www.usda.gov) reports that more hectares of cropland are treated with insecticide to control corn rootworm than any other pest in the United States.***

Stinkbugs. Serious pests of various crops including apples, pecans, soybeans, cotton, field corn, grain sorghum, peaches, and vegetables.²⁵² Stinkbugs pierce plant tissues with their mandibular and maxillary stylets to extract plant fluids, which results in staining of the seed, deformation and abortion of the seed and fruiting structures, delayed plant maturation, and the predisposition to colonization by pathogenic organisms.

Gypsy moths. Serious pests of several hundred species of trees, bushes, and shrubs, both hardwood and conifer, and can lead to the complete defoliation when in high enough densities.²⁵³ Introduced into North America in the late 1800s, their range has continually expanded westward and now threatens temperate forested ecosystems throughout the northeast.

Tent caterpillars. Have irruptive population dynamics, generally advancing to pest status every year in some regions of the United States and causing considerable defoliation of trees over extensive areas.

Coneworms. Larvae feed within cones on cone scales and seeds of various species of firs and western pines, and can cause significant damage to fertilized conifer plantations and loblolly pine seed orchards.

Cutworms. Destructive garden pests, causing fatal damage to nearly any type of vegetable, fruit, or flower.

Tortrix moths. Many moths of the genus *Cydia* are economically important due to the damage they inflict on fruit and nut crops, and include notable pests such as the codling moth, pear moth, alfalfa moth, and hickory shuckworm moth.

Snout moths. Members of the genus *Acrobasis* feed on a wide variety of shoots, nuts, and fruits including alders, birches, hickories, pecans, and cranberries.

Corn earworm and tobacco budworm moths. Rank among the top pests in the United States in damage caused to crops and number of insecticides

applied to crops to control them.²⁶⁰ In Texas, corn earworms are present in an estimated 98% of corn- fields. Each female corn earworm moth potentially lays over 1,000 eggs in her lifetime,²⁶¹ which then develop into larvae that infest corn, cotton, or other crops.