

Science for Environment Policy

Insect-eating bats save global maize farmers €0.91 billion a year from crop damage

Insect-eating bats are estimated to be worth US\$ 1 billion (€0.91 billion) a year to maize farmers around the world, a new study has revealed. Not only do bats reduce crop damage by eating adult corn earworm crop pests, they also suppress fungal infections in maize ears. Bats and their habitats need to be better protected for their ecological and economic contributions, say the study's authors.

Maize (known as corn in the United States) is one of the most widely planted row-crops in the world. Pests, such as the larvae of the corn earworm (*Helicoverpa zea*), cause substantial damage to the plants by eating maize ears (the part of the plant that contains the kernels) and leaves. This reduces [crop yields](#) and quality, and potentially affects food supply in some areas.

Insect-eating bats, such as the North American eastern red bat (*Lasiurus borealis*), commonly forage on adult moths of crop pests, including the corn earworm. Now researchers have performed the first experimental study of the impact of bats on pest suppression in row crops.

The researchers built six 20m x 20m x 7m enclosures over sections of maize fields in the Midwestern United States, and used removable netting to exclude bats from foraging for corn earworm moths at night. Over two growing seasons, the researchers compared pest damage in maize grown under the enclosures with damage to maize grown in identically sized neighbouring sections of the maize field. To ensure that any difference in crop damage was due only to the bats, the enclosures were opened during the day to allow birds, which also feed on crop pests, access to the entire field. The maize in the study was not genetically modified and had received only herbicide treatment previously.

The researchers discovered 59% more corn earworm larvae per ear of maize in sections of the maize field excluded from the bats compared with the control sections. This, they say, indicates that the bats can consume enough adult moth pests at night to directly reduce the number of corn earworm larvae that cause the maize damage. The researchers further speculate that the bats also indirectly reduce larvae numbers by creating a 'landscape of fear' for the moths. Corn earworm moths can detect echolocation calls by bats and previous studies have shown egg-laying is suppressed in moths with similar echolocation detection abilities.

Maize excluded from foraging bats had 56% more damaged kernels per ear and more leaf damage when compared with maize ears in the control sections. By comparing the difference in undamaged kernels between the two types of section, the researchers calculated that the bats effectively increased maize yields by 1.4%.

The bats also had another, previously unknown, positive impact on crop protection — a reduction in fungal infections, which are introduced by corn earworm larvae damage. The researchers found 20% of the maize ears in enclosures were infected with fungi compared with 12% of the control ears. The main fungus was *Fusarium graminearum*, which produces fumonisin, a toxin which is harmful to livestock. Although fumonisin levels in these experiments were within safe levels for livestock, the researchers say this shows bats can play an important role in limiting fungal infections, which decrease the value of livestock crops.

Some countries have adopted corn genetically modified with insecticidal properties from *Bacillus thuringiensis* (*Bt*), to resist pests like the corn earworm larvae. However, non-*Bt* corn is still the dominant global type, and comprised 68% of corn planted globally in 2011. Based on their study, the researchers estimate the value of bats to non-*Bt* corn farmers is 7.88 US\$ (€7.42)/ha, which represents a direct value of US\$ 851 million (€801 million) to the 108 million ha of non-*Bt* corn grown globally. Further ecological models suggest bats can provide 38% of this value to *Bt* crops. This would comprise a contribution of US\$ 150 million (€141 million) for *Bt* corn.

Continued on next page.



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Overall, the researchers say bats could boost the value of global maize crops by US\$ 1 billion (€ 0.91 billion) a year, based on the increased maize yields. This value could be higher if the benefits of suppressing fungal growth and reducing pesticide use are also included.

As nocturnal flying insectivores, bats around the world occupy unique [ecological](#) niches. Bat species in both North America and Europe fill a similar trophic level, and can be predators of economically relevant crop pest species in many agroecosystems. However, they also face increasing threats from disease, mortality caused by increased numbers of wind turbines, and increasing agricultural intensification, which often results in the removal of natural habitat. This research highlights not only the ecological but the economic importance of bats in agriculture, and the need to protect bats from disease threats and the destruction of habitats.

