

How Amazon Deforestation Can Banish Our Neotropical Stingless Bees and Other Neotropical Bees?

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Amazon rainforest deforestation can follow a perverse logic of immediate as well as chronic damage on bees. The regions of illegal exploitation of Amazonian resources begin with the extraction of native woods, burning huge areas of regions of native vegetation. Following the removal of trees for illegal timber trade, these sites may give rise to large areas of intensive cattle pasture, which subsequently give rise to intensive agriculture. Illegal deforestation also occurs in large areas of illegal gold mining and other minerals.

How can these threatens affect the bees?

First, native stingless bee queens are not able to fly, so they do not escape from burning areas and the workers stay with her, and consequently hundreds of nests die in these areas. Regions of large areas of pasture do not allow the repopulation of native bee species through remnant forest fragments, as many bees from the Amazon region co-evolved with native plant species, thus not obtaining food (pollen and nectar) efficiently in the large pasture regions. On the other hand, intensive farming regions offer some food resources to generalist bees. This fact is the cruelest in our view.

There are several negative aspects of intensive farming that can seriously affect bees, the the exposure of bees to it is the most worrying, since most of them are proven toxic to bees. Unfortunately, in 2019 more than 300 pesticides, many banned in Europe, were released for use in agricultural by the Brazilian government. These pesticides contaminate the bees in various ways: by direct contact of workers with contaminated vegetation, through the collection of contaminated nectar and pollen that workers take to the nest to be processed and stocked to feed the brood. This creates a chronic exposure condition for larva and adult bees. Even trace or sublethal, trace or sublethal concentrations of pesticides can contaminate the colony. Studies for larva and adult bees have shown that trace concentrations of pesticides can affect the larval development of bees, producing severe deformities in larvae, decreasing adult fitness, decreasing fitness or even exterminating the colony in the long-term. Another serious problem associated with intensive agriculture is that they are monocultures. According to several authors the smaller the pollen variety, the more susceptible to opportunistic diseases the unhealth bee become. Pollen is not only a source of protein, but also of vitamins and flavonoids important to the immune system of bees. Contaminated bees that consume pollen with little plant variety become more susceptible to fungi such as *Nosema*. Already weakened by the *Nosema*, the bee organism can not resist the trace or sublethal amount of pesticides. That is, the process of extermination of bees is a snowball that is growing continuously.

Another major problem our bees face is heavy metal contamination in the gold extraction regions. Large amounts of mercury are released into the rivers and soils of these regions. There is no environmental control, as they are illegal miners in regions that are often difficult to access. Trace metals such as mercury and cadmium, even at trace concentrations, are lethal to bees. Studies with our native bumblebee (*Bombus morio* and *Bombus atratus*) show that trace amounts of mercury (0.2 ppb) and cadmium (1 ppb) are lethal to these

bees, such trace metal concentrations are considered environmental safe for all types of water by the Brazilian National Environment Council (CONAMA). The life cycle of these bee colonies is extremely delicate, as it begins with a single fertilized queen. In theory, if the fertilized queen dies, the whole future colony dies.

Therefore, Brazilian neotropical bees face a great threat of mass extinction, not only in the Amazon region, but also in other regions of the country, like Cerrado. Despite their undeniable importance in polination service and consequently maintenance of the variety of the native forest plant species, little consideration has been given to the risk factors for native bees by our, without mentioning the huge variety of solitary species that are equally affected for this situation.

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