

Vulture Bees: Nature's Carrion Connoisseurs

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ABSTRACT

Vulture bees, belonging to the *Trigona* genus, exclusively feasting on carrion or dead animal proteins rather than gathering pollen or nectar. Adapted to various climates, they exhibit a preference for raw, fresh meat and have been observed foraging from a wide array of animal species. With distinctive reddish-brown hairs and large, pointed teeth, vulture bees efficiently dismantle carcasses with their mandibles. Unlike their pollen-collecting counterparts, vulture bees produce a unique honey rich in protein, derived from their specialized diet. These stingless bees, found primarily in neotropical regions, exhibit complex social structures and nest-building behaviours, often utilizing abandoned termite nests for colonization. While their role in pollination remains unclear, vulture bees play a crucial ecological role as carrion consumers, contributing to nutrient cycling and ecosystem health. Despite limited scientific inquiry, their evolutionary adaptation to a carnivorous lifestyle marks them as a remarkable example of nature's diversity. This review synthesizes current knowledge on vulture bee biology, behaviour, and ecological significance, shedding light on these intriguing insects and highlighting avenues for future research.

INTRODUCTION

“Busy as a bee” is an actual saying. Bees excel at multitasking activities. The *Trigona* genus of vulture bees is known by that name and is

categorised differently from other bees because of their peculiar diet and consumption of carrion or dead animal proteins. Even though they are still classified as foragers,

vulture bees do not only depend on the more popular nectar that other bees choose to consume. Depending on where they live, vulture bees will consume different types of carrion. For example, in tropical climates like jungles or rainforests, they frequently eat dead lizards and snakes. It was discovered that the vulture bees did eat the raw meat, indicating that they are not against a varied diet and also noticed that they appeared to prefer the raw, fresh meat to recently decayed or somewhat rotted meat.

The vulture bee, belonging to the *Trigona* genus, has a reddish-brown colour and a size range of 8-22 mm. In contrast to other bees, vulture bees prefer to eat carrion or dead animal proteins rather than gather pollen, purpose fully pollinate other plants, or consume plant nectar. When vulture bees are feeding, they usually enter the carcass through the eyes and break down the meat with their mandibles. It has been observed that vulture bees have foraged from 75 different species of animals. Rather than producing the sweet nectar honey that most bees produce, vulture bees make their own special honey from the protein-rich secretions of their hypopharyngeal glands derived from their diet. In contrast to bees that gather pollen to produce honey, vulture bees have few short, pale hairs on their thorax, or middle body. The wings of vulture bees are translucent yet fusiform, tinged with brown. Each of the vulture bee workers' mandibles has five large pointed teeth. The queen vulture bee has thirteen ovaries, compared to four for the female vulture bees (Nalini and Gaikwad, 2022).

HISTORY

The earliest known records of vulture bees, which are stingless bees, go back only to 1758. But entomologist Davi Roubik Ph.D., an entomologist at the Smithsonian Tropical Research Institute discovered their carnivorous diet of dead animals on 1982. Since bees have

long been known to be vegetarians, this was a very revolutionary discovery. By altering both their hive culture and anatomy, vulture bees adjusted to this new food source as they developed. There is still a lot to learn about this unusual flier's species because so few scientific studies have been done on it.

VULTURE BEE CLASSIFICATION

There are three species of carrion-feeding bees in the world: *Trigona hypogea*, *Trigona necrophaga*, and *Trigona crassipes* (Camargo *et al.*, 1991). Some species of stingless bees are omnivores because they can obtain nutrients from both pollen and carrion.

Warmer neotropical climates, such as those found in South America jungles and rainforests (including those in Mexico, Brazil, and Argentina), are ideal for the growth of vulture bee colonies. One peculiar contradiction among vulture bees is that, although they live in tropical, moist environments, they don't seem to cross large bodies of water.

Despite of their ominous nature, vulture bees are social insects that reside in colonies with the standard bee hierarchy of a queen, worker, drone and larva. In addition to digging underground or in tree hollows, vulture bees have also been known to take over abandoned termite nests. Vulture bees have been observed to build their nests high up in trees and on the branches themselves, in addition to cavities. To protect the colony, stingless bees and vulture bees typically use solid bitumen plates in their nests. Bitumen is a hardened wax substance that seals the nest cavity (Roubik, 2020).



Fig. 1 Nest of Vulture bees

Typically, vulture bee nest structures are constructed from a combination of wax, resins, mud, soil, decomposing plant particles and bee excrement. Direct access to the area where the brood is being raised is provided by the nest entrance. An involucre sheath, composed of wax and resin, is a protective layer that is occasionally built around the vulture bee brood chamber and honey storage pots. Brood cells of vulture bees can be grouped together or arranged in combs, which are typically placed in a horizontal plane (Dorian and Bonoan, 2021).

BEES ADAPTED TO MEAT

Vulture bees slice flesh from dead animals like lizards, snakes, birds and even fish before bringing the carrion to their nests. How they store it is unknown, though! Two opposing scenarios have been presented by scientists: In the early stages, vulture bees directly deposit and mix carrion in wax pots. After 14 days, the mixture transforms into a nutrient-rich paste that is fed to the colony members. The second theory states that immature vulture bee workers eat the carrion in order to secrete a substance through a particular gland. To make the nutrient paste, workers then store the secretion in wax pots. Whatever method vulture bees use to eat the meat they harvest, one thing is for sure: they have regained the vegetarian bee's taste for decaying flesh!



Fig.2 Vulture bees feeding on meat

The only bees in the world that are known to have evolved to sustain a diet devoid of plant-based food are vulture bees. Because they have

developed an additional tooth on each mandible, vulture bees are able to cut the meat from carcasses while they are foraging and store it in their crop. Because of their acidic gut biome, which helps them break down these complex proteins, vulture bees are able to produce a carrion-decomposing microbe that releases harmful compounds. The entomologists conducting the experiment in Costa Rica surmised that this was probably done to lessen the competition from other local vertebrate scavengers. Unlike common honey bees, vulture bees have evolved much smaller leg baskets because they do not require them for pollen collection.

Vulture bees gather extrafloral nectar from native plants and fruits, as well as decayed or recently deceased flesh. A vulture bee will typically enter a carrion carcass through its eyes and begin to root around inside. They will cut and chew the flesh off with their highly toothed mandible, covering it with their saliva that is high in acid before eating it. The chewed carrion will be carried by the bee back to the colony, where it will be regurgitated into wax pots as opposed to honey pots. Here, the meat will be combined with honey and allowed to develop for a full week. It will turn into a paste-like substance that is high in sugars and free amino acids during this curing period. Their younger ones are fed this paste because they require it to grow. A guide bee can direct a large number of other bees to the food source and will send out recruiting signals in order to enlist new foraging nestmates. The guide appears to indicate the direction by flying in a brief zig-zag pattern and leaving sporadic pheromone deposits in its path.

Research carried out at observation hives built in Panama showed that a guide vulture bee attracted hundreds of foragers to two freshly dead lizard and toad carcasses in just two hours. Within eight hours, a recently killed lizard that was placed 15 metres away from the

hive at that same location was found. In groups of sixty to eighty vulture bees, they worked the carcass over the next two days until only the skeleton remained. Entomologists believe the ability to recruit a large number of bees quickly enables the vulture bees to beat their foraging competition. Vulture bees have also been observed to possess a propensity to rob and attack competitors for food and nest sites. They have even been known to consume toad eggs or abandoned larvae. It has also been observed that vulture bees tend to avoid other small foraging animals like ants.

Their stomach was found to be full of acid-loving bacteria that helps protect the bees from pathogens found in their rotting meat diet. They coat the flesh before eating it by using the bacteria in their saliva. Sourdough and other fermented foods contain *Lactobacillus*, one of the bacteria types. Scavengers such as vultures, hyenas, and vulture bees have evolved this biome to break down the bacteria while still getting the nutrients they need from their food source (Foster F, 2020).

VULTURE BEE REPRODUCTION AND LIFECYCLE

The stages that vulture bees go through are egg, larval, pupal and adult, just like any other insect that goes through metamorphosis. The single queen bee does not go foraging. It is only to fertilise their eggs. If the queen of a certain species of vulture bee mates with more than one bee, the workers will kill it. Only one partner may a vulture bee queen mate with, presumably to maintain the superiority of their colony's genetic makeup. Certain species of stingless bees will fuse an emergency queen cell that is empty with a brood cell that holds a larger larva when the queen's pheromones fade. After eating everything inside the cell, the larva will grow into a new queen. Vulture bees have been observed to be extremely protective of their feeding grounds, using their

teeth and bites of acidic bacteria to ward off competitors.

VULTURE BEE – POLLINATION

It is unknown that vulture bees take part in pollination. They have not been seen visiting flowers in search of nectar and they neither gather nor require pollen in any manner. It was found that any pollen found in their hives was only unintentionally introduced. Their only source of protein is foraged carrion, which is broken down in their particular acidic gut biome, as opposed to the more popular nectar (Bridgeford and Kolberg, 2013).

VULTURE BEE – HONEY

Indeed, vulture bees produce honey in a manner similar to that of regular honey bees. The worker bees will search for carbohydrates from fruits and extrafloral nectaries, as well as protein in this case, carrion. In contrast to other social bees, receptor bees are not involved in the foragers' direct deposit of crop contents into the pots. After that, the sweet paste-like material is kept for 14 days in honey pots apart from the protein pots to cure. The vulture bee's acidic gut biome facilitates this preservation process. Aside from the source of protein, there are two main production differences between vulture bees and common honey bees. One is that instead of using a comb to store honey, vulture bees store it in individual honey cells. The second is that vulture bees employ mass provisioning, which is not the case for common honey bees. Every larva is given all the nutrients it needs to develop fully into an adult, not just during the larval stage (Figuroa *et al.*2021).

Vulture bee honey on early stages looks like thick and is defined as a paste or substance resembling honey that is formed of bacteria and carrion. When fully grown, it has a uniform, honey-like appearance and is yellow in colour.

The honey that vulture bees produce is sweet-smelling and has a pleasing taste similar to honey. But since it contains meat protein, it would not be appropriate for a vegetarian diet. It is not guaranteed not to be toxic to humans because there is no hard proof that it is. The flavour of vulture bee honey is unknown, and bees do not produce enough of it to be ethically harvested.



Fig.3 Honey pots of Vulture bees

CONCLUSION

This was quite the groundbreaking revelation as bees have long since been firmly established as vegetarians. As vulture bees evolved, they adapted to this new food force through changes in anatomy as well as in their hive culture. Only a few scientific studies have been conducted on this unique flier, so there is still a great deal to be learned about their species. Unlike pollenating bees, vulture bees have lactic and acetic acid bacteria in their microbiome, which they use to break down carrion. These unique bees are the only known bee species to eat carrion exclusively making them an evolutionary wonder.

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