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# BEE PLANTS AND RELATIVE ABUNDANCE OF CORBICULATE APIDAE SPECIES IN A BRAZILIAN CAATINGA AREA.

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## RESUMO

***Plantas melíferas e abundância relativa de espécies de Apidae corbiculadas em uma área de caatinga no Brasil.*** O objetivo deste trabalho foi verificar a utilização floral por parte de espécies de Apidae corbiculados na caatinga nos Cariris Velhos, no estado da Paraíba, Brasil. A área apresenta uma pluviosidade total anual em torno de 300 mm. As abelhas foram capturadas principalmente em flores, num intervalo de duas semanas durante um período de 12 meses. Foram coletados 1154 indivíduos de 15 espécies de abelhas em flores de 48 espécies de plantas pertencentes a 34 famílias. *Trigona spinipes* foi a espécie de abelha mais abundante, seguida de *Scaptotrigona* aff. *depilis*, *Apis mellifera*, *Scaptotrigona* aff. *tubiba*, *Frieseomelitta varia dispar*, e *Trigonisca pediculana*. Convolvulaceae (21.7% das visitas), Caesalpiniaceae (18.8%) e Papilionaceae (17.0%) foram as famílias botânicas mais visitadas. As abelhas demonstraram alguma preferência por certas espécies de plantas. *Apis mellifera* e abelhas sem ferrão apresentaram uma baixa sobreposição no uso dos recursos. Maiores sobreposições foram observadas entre abelhas sem ferrão do mesmo gênero. *Trigona spinipes* foi a espécie mais abundante e menos especializada observada. *A. mellifera* apresentou uma baixa abundância na área. Supõe-se que as condições áridas dos Cariris Velhos sejam mais adversas para *Apis mellifera* do que para abelhas da subtribo, Meliponina.

**Palavras-chave:** Apidae, utilização de recursos, Caatinga, Meliponina, abelhas africanizadas.

## ABSTRACT

***Bee plants and relative abundance of corbiculate Apidae species in a brazilian caatinga area.*** The aim of this study was to investigate the floral utilization by corbiculate Apidae species in a caatinga (arid thorn scrub or forest) near Cariris Velhos in the state of Paraíba, Brazil. The area has an annual rainfall of around 300 mm. Bees were netted mainly on flowers and samples were obtained every two weeks over a 12 months period. A total of 1154 individuals of 15 bee species were collected on flowers of 48 plant species

in 34 families. *Trigona spinipes* was the most abundant bee species, followed by *Scaptotrigona* aff. *depilis*, *Apis mellifera*, *Scaptotrigona* aff. *tubiba*, *Frieseomelitta varia dispar*, and *Trigonisca pediculana*. Convolvulaceae (21.7% of visits), Caesalpiniaceae (18.8%) and Papilionaceae (17.0%) were the most frequently visited plant families. Bees showed some preferences for certain plant species. Africanized *Apis mellifera* and stingless bees showed a low overlap in resource use. Higher overlap in resource use was observed between stingless bees of the same genus. *Trigona spinipes* was the most abundant and least specialized species while *A. mellifera* had a low abundance in the area. It is proposed that the arid environmental conditions of the Cariris Velhos caatinga are more adverse to *Apis mellifera* than to Meliponina bees.

**Key words**: Apidae, Resource utilization, Caatinga, Meliponina, Africanized honey bees

## INTRODUCTION

The Caatinga Biome occupies an area of 750.000 $km^2$ in Northeastern Brazil (AB'SABER, 1980). Its vegetation may be arboreal or shrubby, with many spiny species and Cactaceae. ANDRADE-LIMA (1981) classified the Caatinga vegetation in at least 12 vegetation types based on species composition and height. Nowadays the Caatinga is under a very strong antropogenic influence, resulting in pronounced floristic and physiognomic alterations. This situation is alarming, since we do not have an extensive knowledge of the plant and animal communities and their interactions in this ecosystem. To date, the biopotential of the Caatinga is almost unknown. Moreover, the dearth of more information about bee guilds in Caatinga area precludes interpretations about the ecology and the structure of the bee communities, as well as pollination potential.

The bee community of Northeastern Brazil has only recently been described. MARTINS (1990, 1994) studied the relations of melittophilous plants and bee species in the state of Bahia and MARTINS & AGUILAR (1992) observed the foraging pattern of social bees at artificial baits in the same state. Regarding the Caatinga in the state of Paraíba, IWAMA (1978) listed the melittophilous plants and more recently AGUIAR & MARTINS (1994), AGUIAR ET AL. (1995) and AGUIAR & MARTINS (1997) studied the communities of bees and bee plants of the region.

In this study we examine the Apidae and their floral resources in a Caatinga area as well as a possible preference for some plant species. We also discuss the overlap of plant species used as food sources by stingless bees and honeybees.

## MATERIAL AND METHODS

### Study Site

The study was conducted at Sitio Bravo, Cabaceiras, located at Cariris Velhos, Paraíba, Brazil (7º22'S, 36º15'W). Granitic outcrops called "lajedos" or "lajeiros" are common in the area. The vegetation is shrubby-arboreous predominated by *Aspidosperma pyrifolium* (Apocynaceae), *Croton sonderianus* (Euphorbiaceae), *Croton moritibensis* (Euphorbiaceae), *Pilosocereus* sp (Cactaceae), *Caesalpinia pyramidalis* (Caesalpiniaceae) and *Mimosa* spp (Mimosaceae). Close to the "lajedos", the microclimate is more mesic than that of surrounding areas. The more mesic conditions are due to the presence of deep crevices and holes that accumulate water, forming small pools in same places. In such area the vegetation is composed predominantly of arboreal species: *Anadenanthera colubrina* (Mimosaceae), *Erythrina velutina* (Papilionaceae), *Ceiba glaziovii* (Bombacaceae), *Hymenaea courbaril* (Caesalpiniaceae) and *Caesalpinia ferrea* (Caesalpiniaceae). The study area was approximately 100 ha and included both the mesic and dry areas.

The climate of Caatinga is strongly seasonal and severe droughts are relatively frequent. In our study area the climate is tropical subdesertic warm with annual mean precipitation of 300 mm (LIMA & HECKENDORFF, 1985). Rainfall is more intensive in February, March and April. Occasional rain occurs in June and July, whereas the dry season extends from August to January.

### Sample Methods

Samples were obtained fortnightly, over the course of one year, from February 1992 to January 1993. Bees were collected mainly during their visits to the flowers using an entomological net in the morning and afternoon along a transect (SAKAGAMI ET AL. 1967). Vouchers specimens were deposited in the Entomological Collection of the Federal University of Paraíba. Plant specimens were identified and deposited in the Herbário Lauro Pires Xavier (JPB) of the Federal University of Paraíba. Only the corbiculate Apidae and their relations to plants are treated here.

### Data Analysis

Trophic niche overlap was analysed by constructing a matrix of similarities using Czekanowski or Sœrensen coeficient (LEGENDRE & LEGENDRE, 1984):

$$C_{ih} = 2a_{ih}/(2a_{ih} + b_i + c_h)$$

where *i* and *h* represent the bee species being compared, **a** is the number of common plant species visited by bee species *i* and *h*, and **b** and **c** are the number of exclusive plant species visited by bee species *i* and *h* respectively. For these calculations, only plant species visited for more than 2% of visits were considered. We chose this value as a threshold because it represented plant species predominantly visited (the inverse of the number of plant species visited times 100).

This similarity matrix was used in a cluster analysis using UPGMA (unweighted pair group of media arithmetic) method.

## RESULTS

A total of 1154 individuals of 15 species of corbiculate Apidae were collected visiting the flowers of 48 plant species from 34 families (Table 1 and 2). *Trigona spinipes* was the most frequently captured bee species, followed by *Scaptotrigona aff. depilis*, *Apis mellifera*, *Scaptotrigona aff. tubiba*, *Frieseomelitta varia dispar*, and *Trigonisca pediculana* (Table 1).

Convolvulaceae, Caesalpiniaceae and Papilionaceae were the most visited plant families by Apidae (Figure 1). It is noteworthy that just two plant species *Jaquemontia densiflora* and *Caesalpinia pyramidalis* showed the great diversity of floral visitors with a total of 11 and 10 bee species visiting their flowers. These species also attracted a great number of bees. For instance, *J. densiflora* was the most visited plant species with more than 200 individuals netted on its flowers. *Erythrina velutina* and *C. pyramidalis* also attracted many individuals to their flowers, with more than 170 and 100 bees respectively being netted (Table 3).

**Table 1-** Corbiculate Apidae species collected foraging between February 1992 to January 1993 in the caatinga of Cabaceiras, Cariris Velhos, Paraíba

| Species | Code | Number of individuals |
|---|---|---|
| *Apis mellifera* | Am | 99 |
| *Bombus brevivillus* | Bv | 4 |
| *Euglossa melanotricha* | Em | 9 |
| *Eulaema nigrita* | En | 1 |
| *Frieseomelitta doederleini* | Fd | 32 |
| *Frieseomelitta varia dispar* | Fv | 47 |
| *Melipona asilvae* | Ma | 1 |
| *Partamona seridoensis* | Ps | 3 |
| *Plebeia flavocincta* | Pf | 29 |
| *Plebeia sp* | Pa | 11 |
| *Scaptotrigona aff. depilis* | Sd | 134 |
| *Scaptotrigona aff. tubiba* | St | 98 |
| *Trigona spinipes* | Ts | 628 |
| *Trigonisca pediculana* | Tp | 41 |
| *Trigonisca sp* | Ta | 17 |

Most bees appeared to have preferences for specific plant flowers. For instance, most captures of *Scaptotrigona aff. tubiba* (73.5%; N= 98) were on the flowers of *J. densiflora* as were most captures of *Scaptotrigona aff. depilis* (59.7%; N=134). *Trigona spinipes* (27.7%; N=628) and *Frieseomelitta varia* (31.9%; N= 47), visited the flowers of *E. velutina* more frequently (see also Table 3).

**Table 2**- Families and plant species visited by corbiculate Apidae species. R=resources, P=pollen, N=nectar, HB=habit, H=herbaceous, S=shrub, A=arboreous, Sc=scandent

| Family | Plant species | R | HB | Bee species |
|---|---|---|---|---|
| Alismataceae (ALI) | *Echinodorus* cf *grandiflorus* Mitch. | N/P | H | Ts, Fd |
| Anacardiaceae (ANA) | *Spondias tuberosa* Arr. Cam. | N/P | A | Ts |
| Apiaceae (API) | *Eryngium* sp | N/P? | H | Ts, Fd |
| Asteraceae (AST) | *Wedelia villosa* Gardner | N/P | H | Ts, Fv |
| Bignoniaceae (BIG) | *Tabebuia impetiginosa* (Mart. ex DC.) Standl. | N/P | A | Ts, Am, Fv |
| | *Arrabidea* sp | N | Sc | Ts, Ta |
| Bixaceae (BIX) | *Cochlospermum insigne* St Hil. | P | A | Ts |
| Bombaceae (BOM) | *Ceiba glaziovii* (Kuntze) K. Schum. | N/P | A | Ts |
| Cactaceae (CAC) | *Opuntia palmadora* Br. et Rose | N/P | H | Ts |
| | *Pilosocereus gounellei* (Weber) Byl. et Rowl | N/P | S | Ts |
| Caesalpiniaceae(CAE) | *Caesalpinia ferrea* var. *glabrescens* Benth. | N/P | A | Ts, Sd, Fv, Fd |
| | *Caesalpinia pyramidalis* Tul. | N/P | S | Ts, Sd, Ps, St, Fv, Fd, Pf, Pa, Tp, Ta |
| | *Hymenaea courbaril* L. | N/P | A | Ts, Fv, Fd |
| | *Senna macranthera* var. *pudibunda* (Benth.) Irwin & Barneby | P | A | Ts, Pf, Pa |
| | *Senna spectabilis* Irwin & Barneby | P | A | Ts, Bv, En |
| | *Tamarindus indica* L. | P | A | Ts |
| Capparaceae (CAP) | *Cleome spinosa* L. | N | H | Ts, Fv, Pf |
| Celastraceae (CEL) | *Maytenus rigida* Mart. | | A | Ts, Fd |
| Commelinaceae (COM) | *Commelina* sp | P | H | Ts |
| Convolvulaceae (CON) | *Ipomoea martii* Meissn. | N/P | Sc | Ts, Em |
| | *Jaquemontia densiflora* Meissn. Halleir | N/P | Sc | Ts, Am, Sd, Ps, St, Ma, Fv, Fd, Pf, Tp, Ta |
| Cucurbitaceae (CUR) | *Cucumbita moschata* Duch. | N | Sc | Ts |
| | *Luffa* cf *acutangula* (L.) Roseb. | N | Sc | Ts |
| Erythroxylaceae (ERY) | *Erythroxylum pauferrense* Plowman | N/P | A | Ts, Am, Sd, St |
| Euphorbiaceae (EUP) | *Croton moritibensis* Baill. | N/P | S | Ts, Am, Fv, Fd, Pf, Pa |
| | *Croton sonderianus* Spreng. | N/P | S | Ts, Am, Ps, Fv |
| | *Manihot glaziovii* Muell. Arg. | N | S | Ts, Am |

**Table 2-** (cont.). Families and plant species visited by corbiculate Apidae species. R=resources, P=pollen, N=nectar, HB=habit, H=herbaceous, S=shrub, A=arboreous, Sc=scandent

| Family | Plant species | R | HB | Bee species |
|---|---|---|---|---|
| | *Sapium* sp | N | A | Ts |
| Lamiaceae (LAM) | *Ocimum basilicum* L. | N/P | H | Fv, Em |
| | *Plectranthus amboinicus* (Lour) Spreng | N/P | H | Ts, Fv, Pf, Ta |
| Limnocharitaceae (LIM) | *Hydrocleys nymphoides* (Willd.) Buchenau | N/P | H | Ts, Fd, Tp |
| Loasaceae (LOA) | *Loasa rupestris* Gadner | N/P | H | Pf |
| Loranthaceae (LOR) | *Struhtanthus syringifolius* Mart. | N? | H | Am |
| Malphighiaceae (MAP) | *Ptilochaeta tahiensis* Turcz. | P | A | Ts |
| | *Galphimia* sp | P | Sc | Ts |
| Malvaceae (MAL) | *Sida galheirensis* Ulbr | N/P | H | Am |
| | *Sidastrum paniculatum* (L.) P.A. Fryxell | N/P | H | Ts, Am |
| Menyanthaceae (MEN) | *Nymphoides humboldtianum* O.Ktze | N/P | H | Ts, Pf |
| Nyctaginaceae (NYC) | *Boerhavia diffusa* L. | | H | Ts |
| Papilionaceae (PAP) | *Erythrina velutina* Willd. | N | A | Ts, Fv. Fd, Tp, Ta |
| | *Dioclea grandiflora* Mart. | N/P? | Sc | Ts, Am |
| Plumbaginaceae (PLU) | *Limonium* sp | N | H | Ts |
| Polygonaceae (POL) | *Polygonum hispidum* H.B.K. | N? | H | Fd |
| Pontederiaceae (PON) | *Eichhornia paniculata* Solms-Laub. | N/P | H | Ts, Fd |
| Sapindaceae (SAP) | *Serjania glabrata* Kunth. | N/P | Sc | Ts, Am, Sd, Fv, Fd, Tp, Ta |
| Solanaceae (SOL) | *Nicotiana glauca* Graham | N | S | Ts, Fd, Fv, Pa |
| Sterculiaceae (STE) | *Melochia tomentosa* L. | N/P | S. | Ts, Am, St, Fv |
| Turneraceae (TUR) | *Turnera* sp | N/P | H | Ts |
| Verbenaceae (VER) | *Lippia gracilis* Schauer | N | S | Ts, Am |
| Vitaceae (VIT) | *Cissus quinquefolia* Solander et Sims | P | Sc | Am, Sd, Fv, Pf, Pa, Tp |

**Table 3**- Plant species most frequently visited by species of corbiculate Apidae.

| Bee species | Plant species | Number of individuals |
|---|---|---|
| *Trigona spinipes* | *Erythrina velutina* | 174 |
| | *Serjania glabrata* | 65 |
| | *Caesalpinia pyramidalis* | 59 |
| *Apis mellifera* | *Jacquemontia densiflora* | 34 |
| | *Croton sonderianus* | 20 |
| | *Cissus quinquefolia* | 14 |
| *Scaptotrigona aff. depilis* | *Jacquemontia densiflora* | 80 |
| | *Serjania glabrata* | 34 |
| | *Caesalpinia pyramidalis* | 10 |
| *Scaptotrigona aff. tubiba* | *Jaquemontia densiflora* | 72 |
| | *Erythroxylum pauferrense* | 23 |
| *Frieseomelitta varia dispar* | *Erythrina velutina* | 15 |
| | *Caesalpinia pyramidalis* | 9 |
| | *Jacquemontia densiflora* | 5 |
| *Frieseomelitta doederleini* | *Hydrocleys nymphoides* | 10 |
| | *Jacquemontia densiflora* | 6 |
| *Plebeia flavocincta* | *Cissus quinquefolia* | 10 |
| | *Loasa rupestris* | 6 |
| *Plebeia sp* | *Cissus quinquefolia* | 6 |
| *Trigonisca pediculana* | *Caesalpinia pyramidalis.* | 23 |
| | *Jacquemontia densiflora.* | 10 |
| *Trigonisca sp* | *Jacquemontia densiflora* | 6 |

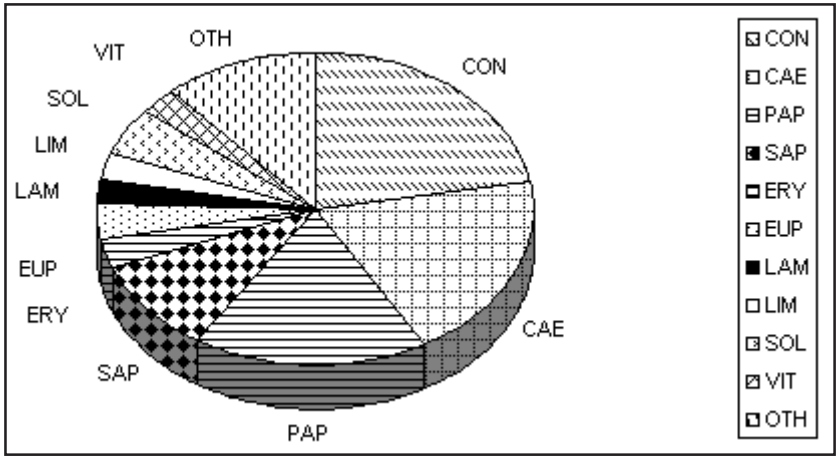


**Figure 1-** Relative number of bee visits to each plant family in the caatinga of Cabaceiras, region of Cariris Velhos. Symbols as in Table 2, OTH = others.

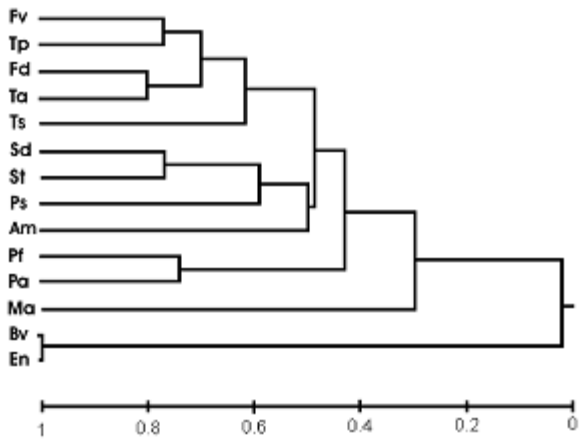


**Figure 2**- Dendrogram showing the trophic niche relationship between bee species, measured as similarity of plant species visited. Symbols as in Table 1.

The cluster analysis showed a low overlap in resource use between honeybees and other Apidae species (Figure 2). However, high similarity values (above 70%) were observed between *Scaptotrigona aff. depilis* and *Scaptotrigona aff. tubiba*; *Plebeia flavocincta* and *Plebeia* sp; *Frieseomelitta varia* and *Trigonisca pediculana*; and *Frieseomelitta doederleini* and *Trigonisca* sp. High values of overlap were observed between bees of the same genus. Interestingly, although *Frieseomelitta* and *Trigonisca* showed high overlap even being different genus, the bee species of these two genus formed a larger cluster with still high overlap.

The overlap between *Bombus brevivillus* and *Eulaema nigrita* probably was spurious because both species visited the same plant species extensively (*Senna spectabilis*).

## DISCUSSION

*A. mellifera* and *T. spinipes* are the two most frequently captured bee species in many different ecosystems of the Neotropics. At the Caatinga of Casa Nova, Bahia, *A. mellifera* was the most dominant bee species followed by *T. spinipes* (MARTINS, 1994), while in São João do Cariri, Cariris Velhos region, Paraíba (AGUIAR & MARTINS, 1997) and in this study *T. spinipes* was dominant. In São João do Cariri *A. mellifera* was the fifth most abundant species of Apoidea (AGUIAR & MARTINS, 1997) and in Cabaceiras the seventh most frequent Apoidea (C.F. Martins unpubl.). The low numbers of Africanized honeybees on flowers in the Cariris Velhos region, could be related to the long dry season of this region. We have seen some honey bee colonies with almost no honey or

pollen reserves during the dry season suggesting a high absconding rate.

The list of plants visited by bees in our study is similar to that of IWAMA (1978), who recorded 41 species from 18 families. Nevertheless, we observed a higher diversity of floral resources. Some studies have shown that a low number of plant families predominate in the preferences of the bees, e.g. Leguminosae, Sterculiaceae, Malvaceae and Asteraceae (ROUBIK, 1989; Imperatriz-Fonseca et al., 1993). At Cabaceiras, Convolvulaceae, Caesalpiniaceae and Papilionaceae were the most frequently visited families by Apidae. Flowers of Bromeliaceae, Caesalpiniaceae and Combretaceae were most frequently visited by corbiculate bees in the Caatinga of São João do Cariri (AGUIAR ET AL., 1995) and those of Anacardiaceae, Caesalpiniaceae and Euphorbiaceae in the caatinga of Casa Nova (MARTINS, 1990). As reported earlier (RAMALHO et al., 1990) plant families with the greatest diversity in neotropical regions were the families with the largest number of important species for honey bees and stingless bees. However, the absence of visits to the very abundant Mimosaceae family was remarkable. Mimosaceae is a family that commonly offers pollen and nectar (RAMALHO ET AL., 1989) and the first author (unpubl. data) has seen bees like *Melipona scutellaris* and *M. subnitida* visiting Mimosaceae flowers in other regions of Paraíba state. It is possible that spatio-temporal variation in plant species composition and abundance, and resources availability, accounted for these differences in plant family preference (ROUBIK, 1989).

The results showed high overlap between bees of the same genus as observed by IMPERATRIZ-FONSECA ET AL. (1989) in *Plebeia*. Although the qualitative method used here tends to overestimate overlap, our results show the overall picture of resource sharing during all the year in the most visited plant species independent of resource type and number of individuals foraging.

Regarding the overlap of plant species used as food sources by stingless bees and honeybees, PEDRO & CAMARGO (1991) also observed that Meliponina overlapped with *A. mellifera* on only a few plant species. In the Caatinga of Casa Nova, MARTINS (1990) observed that although *A. mellifera* and *T. spinipes* showed high overlap in resource use, plants commonly visited by one species had few bees of the other species and *vice versa*, suggesting some partitioning in resource use. WILMS ET AL (1996) observed that the trophic niche of Africanized honeybees was positioned between those of Meliponini and Trigonini (*sensu* MOURE 1951), and WILMS & WIECHERS (1997) found indirect evidence of competition for food between Africanized honeybees and *Melipona.*

In our area, the niche overlap between *A. mellifera* and the native bee population was low suggesting that honeybees have a lower impact on native bee populations. This could be a consequence of the lower numbers of Africanized honeybees suggesting that environmental conditions were more adverse to *A. mellifera* than to Meliponina. Bee surveys of others open tropical/ subtropical areas of Brazil (ROUBIK, 1989) found Meliponina bees present at similar frequencies to those reported here, implying that the stingless bees are

well adapted to the very dry Cariri environment.

However, others factors could also play a role in the low niche overlap and low number of honeybees in the area as well. The differences in abundance and diversity of bee guilds between areas in Caatinga could be explained by "catastrophic" events, such as the extended droughts common in the area leading to local bee guild extinction followed by stochastic re-colonization that could change species abundance (HANSKI, 1982). In this sense, a species with low abundance that survives a drought period would have a greater probability of becoming common following a drought. Nevertheless, long-term studies on bee guilds in Caatinga are still lacking and it would be worthwhile to carry out research about natives' bees and Africanized honeybees related to population dynamic.

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