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THE IMPORTANCE OF BEES TO KAYAPÓ INDIANS OF THE BRAZILIAN AMAZON

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ABSTRACT

A total of 56 folk species of *Apidae* are discussed in the classification system of the Kayapó Indians of the Brazilian Amazon; 54 of these are stingless Meliponidae. These folk species correspond to 66 scientifically recognized species, reflecting an 86-percent correlation between scientific and folk taxonomic systems. A highly specialized indigenous knowledge about bee behavior (folk ethology) exists that allows for the semi-domestication of 9 folk species. Folk ethology is a field little appreciated by Western science, yet Kayapó knowledge of bees is evidence that significant information about nature and human-environmental relationships can be gained from analysis of folk taxonomic systems.

RESUMEN

En el sistema de clasificación de los Indígenas Kayapó de la Amazonía Brasilera se disciernen un total de 56 especies típicas de Apidae; 54 de los cuales son Meliponidae. Estas especies típicas corresponden a 66 especies científicamente reconocidas, reflejando un 86 porciento de correlación entre los sistemas taxonómicos científicos y típicos. Un conocimiento indígena altamente especializado con relación al comportamiento de las abejas ("folk ethology") existe que permite la semi-domesticación de 9 especies típicas. La etnología típica es un área muy poco apreciada por la ciencia occidental, aún así, el conocimiento Kayapó de las abejas es evidencia de que una gran cantidad de información puede ser aprovechada con relación a la naturaleza y a las relaciones humanas en el medio ambiente a través del análisis de los sistemas típicos taxonómicos.

Previously I have pointed out the general significance of insects to indigenous groups of the American tropics (Posey 1978b, 1980). This paper deals specifically with indigenous knowledge of behavior and classification (folk ethology) of stingless bees (Meliponidae) by the Kayapó Indians of the Brazilian Amazon.

There are approximately 2,500 Gê-speaking Indians in the Kayapó nation, which is divided into 9 widely dispersed villages in a two-million hectare reserva indígena in the Brazilian states of Pará and Mato Grosso. The data used in this paper were collected at Gorotire (7°48′S, 54°46′W), the largest village (population ca. 600), during a 14-month study conducted in 1977-78.

The author was initially attracted to the role of bees in the Kayapó culture by the elaborate ethnosemantic taxonomy and mythological corpus collected about social insects (Posey 1981, in press, a). Social communities of Hymenoptera are thought to mirror Kayapó communities; indeed, it is believed that Indians learned how to live as social beings from an ancestral wise man ("wayanga") who gained his knowledge from the study of bee, wasp, and ant behavior (Posey 1978a, 1981). This belief serves as a social charter to the Kayapó to continue their observations of nature in general and of Hymenoptera in particular and accounts for their reputation as keen ethnologists (Posey 1979, 1981).

The Kayapó have various ways of classifying bees. As is frequently discovered in folk biological studies, several taxonomic systems seem to be superimposed and a particular classification paradigm is brought to play depending on functional context (Garner 1976). One "functional" classification system is based on the aggressive behavior of the bee when disturbed. There are 4 major divisions in this system: (1) docile, (2) stinging, (3) biting, and (4) blister-causing. There are only 2 "stinging" bees, the European and the hybrid Brazilian bee (both *Apis mellifera*); the rest of the "folk species" are stingless Apidae.

It is interesting to note that the hybrid "Brazilian bee" is carefully studied by the Kayapó. The Indians claim it arrived in Gorotire during the period of the full moon in February 1966. The Indians admire the aggressiveness of the bee and its high productivity of thick honey, but they insist it invades the nests of native bees. They claim that the availability of native, stingless bee honey has been greatly reduced because of the colonizing success of the hybrid, stinging bee over native stingless species.

Another functional taxonomic system is based on the qualities of the honey: its taste, acidity, quantity found in one nest, time of the year that the nest can be raided, etc. (Posey, in press, b).

A morphological taxonomic system also exists, but the ability of the Indians to identify bees out of their ecological niche is generally unreliable. Out of a village population of ca. 600, I found only 2 male bee "experts" who are reasonably consistent in identifying folk species from morphological characteristics alone. Since the collection of honey and wax rests within the male cultural domain, women know little about bees.

The most elaborate system of bee classification is based on nest structure and location of the nest. The Kayapó recognize 8 ecological zones and associate certain species of bees with each zone (Posey, in press, b). Nests are grouped by: (1) nest site (in a tree, in the earth, in vines, in abandoned termite hills, etc.); (2) the height of the nest from the ground; (3) the shape and size of the entrance tube (length, shape, markings, size, etc.); and (4) nest size (based on gross size, relative amount of honey per nest, etc.). These criteria correlate with Willie and Michener's (1973) descriptive classification.

The Kayapó utilization of bees raises the question of semi-domestication, or at least species manipulation.

The Kayapó recognize 6 species (see Table 1) whose nests can be raided for honey and wax. If the queen and part of the brood chamber are returned to the nest by the Indians, enough of the dispersed bees will return to re-establish the colony. Thus by manipulating the bees, the Kayapó can seasonally exploit the hive for honey without permanently disrupting the colony. Trees with such hives are known by, and in a sense owned by, certain Kayapó men who systematically raid them for honey and wax.

The Kayapó also "keep" 3 species in or nearby their houses. Nests of

TABLE 1. SEMI-DOMESTICATED (MANIPULATED) SPECIES OF APIDAE UTILIZED BY THE KAYAPÓ.

Kayapó Name	Scientific Name
Ngài-pêrê-y[1]	*Apis millifera*
Ngài-ñy-tyi-ti[1,2]	*Melipona seminigra cf. pernigra* (Moure and Kerr)
Ngài-kumrenx[1,2] (mehn-krak-krak-ti)	*Melipona rufiventris flavolineata* (Friese)
Ngài-re[1]	*Melipona compressipes cf. fasciculata* (sm.) or *afinis* Moure Ms.
mykrwàt[1]	*Frieseomelitta* sp.
udjy[1,2]	*Trigona amalthea* (Olivier)
kukraire[1,2]	*Trigona dallatorreana* Friese
menhôrã-kamrek[3]	*Trigona cilipes pellucida* (Ckll.)
mehnôrã-tyk[3]	*Scaura longula* (Lep.)

[1]These species are systematically raided in subsequent seasons.
[2]Those species whose nests are taken to the village.
[3]Those species that are encouraged to build nests in dry posts in the houses.

certain *Trigona* (*T. dallatorreana* and other unidentified species) are found in the forest and brought back to the village on their attached limbs; complete nests are erected from eaves of the houses. Other species (probably *T. amalthea* and *M. rufiventris*) are brought with nests intact in hollow logs and placed at the margin of the forest near the village or a field clearing. Other species (*T. cilipes* and *S. longula*) tend to prefer building sites in exposed rafters of houses and are allowed to co-exist with the household residents. The nests of all these "kept" species are raided at prescribed times when the honey cache is known to be optimal.

The Kayapó also encourage the establishment of bee nests in their fields. To do this, they sometimes dig large holes, or, more usually, utilize existing armadillo holes. Into these holes are placed dry logs. Several undetermined *Trigona* species (including *T. fuscipennis* Friese) and *Trigona fulviventris guianae* Ckll. are attacted to the logs and build their nests directly in the earthen walls of the hole. The presence of bees is associated with crop success, although there is no clear notion of pollination per se.

In a collection of bees made in Gorotire, 56 folk species were discerned by the Kayapó. There were 66 scientifically recognized species found, of which 11 were unknown or as yet not described (3 of *Megachile*, 2 each of *Partamona* and *Centris* and one species each of *Friescomelitta*, *Tetragona*, *Mesoplia* and *Tetrapedia*).

In a normative comparison between folk and scientific species, there is approximately an 86-percent correlation. Such high correlative quotients are not uncommon (Berlin 1973, Hunn 1975). The complete species list is found in Table 2.

These data point to the importance of bees to the Kayapó Indians of Brazil and other indigenous peoples. It can be concluded that Indians are keen observers of nature, often with high correlations between folk and scientific taxonomic systems. Folk ethology is a field that is little explored by Western science; significant and insightful information about principles of human taxonomic and ecological systems, as well as practical information about man-environment relationships, however, can be gained from folk taxonomic studies.

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TABLE 2. SPECIES OF APIDAE FOUND IN THE GOROTIRE (KAYAPÓ) COLLECTION.[1]

Family, Genus, Species	Collection code number
ANTHOPHORIDAE	
Xylocopa (*Schoenherria*) *dimidiata* Latr.	540-2
X. (*Schoenherria*) *lucida* Smith	112-1
X. (*Schoenherria*) *anthophoroides* Smith	507-1
X. (*Megaxylocopa*) *frontalis* (Oliver)	540-1
Centris (*Centris*) *inermis* Friese	442, 479-6
C. (*Centris*) *flavifrons* (Fab.)	sem no—1
C. (*Centris*) *aenia* Lep.	sem no—1
C. (*Centris*) *spilopoda* Moure	117-1
C. (*Paremisia*) *similis* (Fab.)	442-2
C. (*Paremisia*) *dentata* Smith	442-3
C. (*Trachina*) *longimana* (Fab.)	540-2
C. (*Heterocentris*) *bicornuta* Mocs.	103, 104-2
C. (*Centris*) sp. 1	113, 114-2
C. (*Centris*) sp. 2	111-1
C. (*Paremisia*) sp.	35-1
C. (*Hemisiella*) sp.	105-1
C. (*Melanocentris*) sp.	119, 120, 118-3
Mesoplia sp. (parasite)	278-1
Mesonychium asteria (Smith) (parasite)	603-1
Tetrapedia sp.	222-1
HALICTIDAE	
Halictus hesperus (Smith)	88-2
Neocorynura sp.	280-1
Augochloropsis sp.	451-1
MEGACHILIDAE	
Megachile brasiliensis Dallatorre	99-1
M. (*Austromegachile*) sp.	98-1
M. (*Crysosaurus*) sp.	107-1
M. giraffa Schrottky	97-1
Megachile sp. 1	532-1
Megachile sp. 2	101-1
Megachile sp. 3	331-1
APIDAE	
Bombinae	
Euglossini	
Eulaema (*Eulaema*) *meriana* (Olivier)	540-2
Apinae	218, 109, 106
Apis mellifera (L.)	110, 108, 340
Meliponinae	
Meliponini	
Melipona rufiventris flavolineata (Friese)	547-2
M. tumupasae Schwarz	331, 541, 332, 325-4
M. seminigra (*pernigra*) Moure + Kerr	340-1
M. compressipes (*fasciculata*) or (*afinis* Moure Ms.)	542-1

TABLE 2. CONTINUED

Family, Genus, Species	Collection code number
Trigononi	
Paratrigona (*Paratrigona*) (*peltata Spinola*)	554-1
Oxytrigona tataira (*flaveola* Friese)	555, 553-4
Plebeia (*Plebeia*) *minima* (Gribodo)	520-1
Scaura (*Scaura*) *longula* (Lep.)	sem no—1
Cephalotrigona capitata femorata (Smith)	509-1
Trigona (*Trigona*) *spinipes* (Fab.)	328-6
T. (*Trigona*) *fuscipennis* Friese	557, 89, 71-6
T. (*Trigona*) *amalthea* (Olivier)	343, 504, 475, 94, 334-7
T. (*Trigona*) *fulviventris guianae* Ckll.	466-1
T. (*Trigona*) *chanchamayoensis* Schwarz	44-1
T. (*Trigona*) *pallida pallens* (Latr.)	515-1
T. (*Trigona*) *cilipes pellucida* (Ckll.)	sem no—1
T. (*Trigona*) *dallatorreana* Friese	546, 473-3
T. (*Trigona*) *branneri* Ckll.	516-2
Partamona (*Partamona*) *pseudomusarum* Camargo	512-7
P. (*Partamona*) *cupira* (Smith)	96-1
P. (*Partamona*) sp. 1	334, 356?-2
P. (*Partamona*) sp. 2	581-1
Nannotrigona (*Scaptotrigona*) *nigrohirta* Moure	339, 550-5
N. (*Scaptotrigona*) *polysticta* Moure	342-3
Tetragona (*Tetragona*) *quadrangula* (Lep.)	432- 512-3
T. (*Tetragona*) *goettei* Friese 1900	436, 437, 435-9
T. (*Tetragona*) *clavipes* (Fab.)	522, 338-4
T. (*Tetragona*) *dorsalis* (Sm.)	536, 327, 506-11
T. (*Tetragona*) sp.	86-1
T. (*Ptilotrigona*) *lurida* (Sm.)	604-1
T. (*Tetragonisca*) *angustula fiebrigi* (Schwarz)	508-2
Frieseomelitta varia (Lep.)	519, 513-3
Frieseomelitta sp.	85-1
Frieseomelitta modesta Moure	558-5

[1]The Collection code numbers refer to specimens from the Gorotire collection that are now in the possession of J. M. F. Camargo, Depto. de Biologia, Universidade Federal do Maranhao, 65.000 Sao Luís, Maranhao (Brazil).

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SUSCEPTIBILITY OF THE TWO-SPOTTED SPIDER MITE, *TETRANYCHUS URTICAE* KOCH, TO THE FUNGAL PATHOGEN *HIRSUTELLA THOMPSONII* FISHER

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ABSTRACT

Laboratory bioassays determined the susceptibility of the two-spotted spider mite, *Tetranychus urticae* Koch, to *Hirsutella thompsonii thompsonii* Fisher. Direct placement of conidia onto mites which were placed on bean leaf discs floating on distilled water in covered petri dishes yielded a mean mortality of 96.5%. Mortality of mites placed on leaf discs cut from bean plants previously sprayed with a commercial formulation of the bioacaricide (Mycar®, Abbott Laboratories, North Chicago, IL) and placed in the covered dishes ranged from ca. 24 to 99%. No significant response to dose of Mycar occurred at the rates tested (1.2-9.6 g/liter). Under greenhouse conditions (22-30°C; 50-90% RH), the formulated material failed to either sporulate on sprayed foliage or cause mite mortality. Raising humidity levels with intermittent misting of foliage increased sporulation of the fungal inoculum on plant surfaces, but no infections occurred in mites on those plants.

RESUMEN

La susceptibilidad de la arañita roja, *Tetranychus urticae* Koch, a *Hirsutella thompsonii thompsonii* Fisher fué determinada por bioensayos. La colocación directa de conidios sobre los ácaros, los cuales fueron colocados sobre discos cortados de hojas de fríjol flotando sobre agua distilada en cajas de Petri resultó en una mortalidad promedio de 96.5%. La mortalidad de los ácaros colocados sobre los discos de hojas de fríjol rociado previamente con una formulación comercial de bioacaricida (Mycar®) fue de 29 hast 99%. No hubo una relación significativa a diferentes dosises de Mycar entre 1.2 hasta 9.6 g/litro. Debajo condiciones del vivero (22-30°C; 50-90% RH) el hongo ni esporuló en el follaje ni causó la mortalidad de los ácaros. La esporulación del inoculo sobre las superficies del follaje se aumentó cuando periodicamente se echaba agua en forma de una niblina sobre las plantas para aumentar la humedad, pero sin embargo no hubo infecciones de los ácaros en estas plantas.

Hirsutella thompsonii Fisher is an acarine mycopathogen which was originally described from the citrus rust mite, *Phyllocoptruta oleivora* (Ashmead) (Fisher 1950). It primarily attacks eriophyid mites inhabiting citrus and other plants throughout the world and is recognized as the most important natural enemy attacking *P. oleivora* in Florida (Muma 1955, McCoy et al. 1976). Currently it is being commercially formulated by Abbott Laboratories (North Chicago, IL) as Mycar® for use in suppressing *P. oleviora* on citrus in Florida. The carrier in the formulation apparently functions as a substrate for fungal growth and sporulation on plant surfaces. Optimal sporulation and infection occur in the presence of high humidity or free water on treated surfaces (McCoy 1981).

Other mites susceptible to *H. thompsonii* were listed by McCoy (1979). His list included 6 tetranychid species, but the two-spotted spider mite, *Tetranychus urticae* Koch, was not tested. If susceptible, *H. thompsonii* might prove useful as a bioacaricide against *T. urticae*, especially in environments (e.g. greenhouses) where conditions are, or could be modified for, optimal fungal sporulation and host infection. *T. urticae* is an important pest of greenhouse crops with a wide range of susceptible hosts. This study examines the susceptibility of *T. urticae* to *H. thompsonii* and the potential of a commercial formulation of the mycoacaricide in suppressing *T. urticae* on plants grown in greenhouse conditions.

MATERIALS AND METHODS

The culture of *H. thompsonii thompsonii* (strain no. HTF 72; CBS Accession No. 556.77B, Centraal bureau voor Schimmelcultures, Baarn, Netherlands) used in the laboratory bioassays was originally obtained from C. W. McCoy (IFAS, University of Florida, Lake Alfred) and subsequently maintained at room temperature on an artificial medium. The commercial formulation (ABG 6065, 3.6 x 10^8 colony forming units/lb) used in laboratory bioassays and greenhouse screening trials was provided by Abbott Laboratories (North Chicago, IL) and stored at 4°C.

APPLICATION OF CONIDIA. Several leaf discs (11 mm diam.) cut from Irish shamrock, *Oxalis acetosella* L., were infested with *T. urticae* by transferring ca. 30 mites from infested plants to each leaf disc. Individual discs were then randomly assigned to either a treatment or control group. Single conidia were removed with microforceps from an agar plate culture of the fungus and placed on the dorsum of individual mites on the discs in the treatment group. Mites in the control group were touched with clean forceps. Leaf discs were then floated on distilled water in covered petri dishes to prevent mites from crawling off the discs and to maintain high humidity levels. One treatment disc and 1 control disc were placed in individual dishes to represent 1 replicate. Treatments and controls were replicated 4X in a randomized complete block (RCB) experimental design in 3 tests.