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KARYOTYPE OF TEN SPECIES OF SOCIAL WASPS (HYMENOPTERA, POLISTINAE, POLYBIINI)

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ABSTRACT

The present study reports the karyotypes of the following species of social wasps of the tribe Polybiini: *Mischocyttarus* (*Monocyttarus*) *cassununga* (n = 32); *Mischocyttarus* sp (n = 34); *Metapolybia* sp (n = 19); *Polybia* sp1 (n = 16); *Polybia* sp2 (2n = 34); *Polybia* (Myrapetra) *occidentalis* (2n = 34); *Polybia* (*Trichothorax*) *sericea* (n = 27); *Protopolybia pumila* (2n = 42); *Protopolybia e. exigua* (n = 31) and *Parachartergus smithii* (2n = 54). The chromosome numbers of this tribe are discussed in comparison with other social wasps.

INTRODUCTION

Cytogenetic studies on social wasps of the tribe Polybiini have been conducted thus far on 8 species. In an analysis of the karyotype of *Parapolybia indica*, an Old World genus, Hoshiba (1985) found that males have n = 14 chromosomes of meta- and submetacentric morphology. G banding permitted individual differentiation, which cannot be obtained by standard staining due to the similar size and morphology of some chromosomes. Pompolo and Takahashi (1987) described cytogenetically 7 Polybiini species with haploid numbers ranging from 8 to 32 chromosomes, demonstrating the wide chromosomal diversity and heterogeneity of the tribe.

The objective of the present investigation was to continue the cytogenetic study of the tribe Polybiini by determining chromosome numbers and classifying the

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chromosomes according to their morphology. These data may provide information for a future discussion of the tribe within the family Vespidae.

MATERIALS AND METHODS

The following species of the wasp tribe Polybiini were analyzed: *Mischocyttarus (Monocyttarus) cassununga* (R. von Inhering), *Mischocyttarus* sp, *Metapolybia* sp, *Polybia* sp_1, *Polybia* sp_2, *Polybia (Myrapetra) occidentalis* (Olivier), *Polybia (Trichothorax) sericea* (Olivier), *Protopolybia pumila* (R. von Ihering); *Protopolybia exigua exigua* (de Saussure); *Parachartergus smithii* (de Saussure). Colonies of all of these species were collected in Ribeirão Preto (21°10'S, 47°48'W).

Standard chromosome preparations were obtained from gonadal and cerebral ganglion cells of larvae and prepupae by the technique of Pompolo and Takahashi (1986).

An average of eight individuals (males and females) per colony and 10 metaphases per individual were analyzed.

Karyotypes were mounted by arranging the chromosomes in decreasing order of size, according to Hoshiba *et al.* (1989).

RESULTS

Among social wasps, the genus *Mischocyttarus* has the largest number of recorded species, about 189 (Richards, 1978). In the present study, 2 species of this genus were analyzed cytogenetically, i.e., *M. (M.) cassununga* (n = 32, 32 SM-M, Figure 1a) and *Mischocyttarus* sp (n = 34, 32 SM-M + 2A, Figure 1b). Analysis of the chromosome sets seems to indicate that these two species are similar with respect to chromosomes of meta- and submetacentric morphology, but differ in the presence of 2 acrocentrics in *Mischocyttarus* sp. *Mischocyttarus* sp has the largest haploid number detected thus far in the Vespidae.

Cytogenetic analysis of male *Metapolybia* sp cells indicated n = 19 chromosomes, with a karyotype consisting of 14 sub- and metacentric chromosomes and five acrocentrics (Figure 2). The karyotype of this species is characterized by the presence of a chromosome of submetacentric morphology, larger in size than all the others, and deeply stained in all metaphases.

Four species of the genus *Polybia* were studied in the present investigation. *Polybia* sp1 males presented n = 16 chromosomes, 15 sub- and metacentrics and one acrocentric. The karyotype (Figure 3a) shows that some chromosomes, such as the three largest submetacentrics have strongly staining regions on the long arms; in other chromosomes, such as the smaller submetacentrics, the most deeply staining region is located on the short arm; two small metacentrics are more strongly stained on one arm.

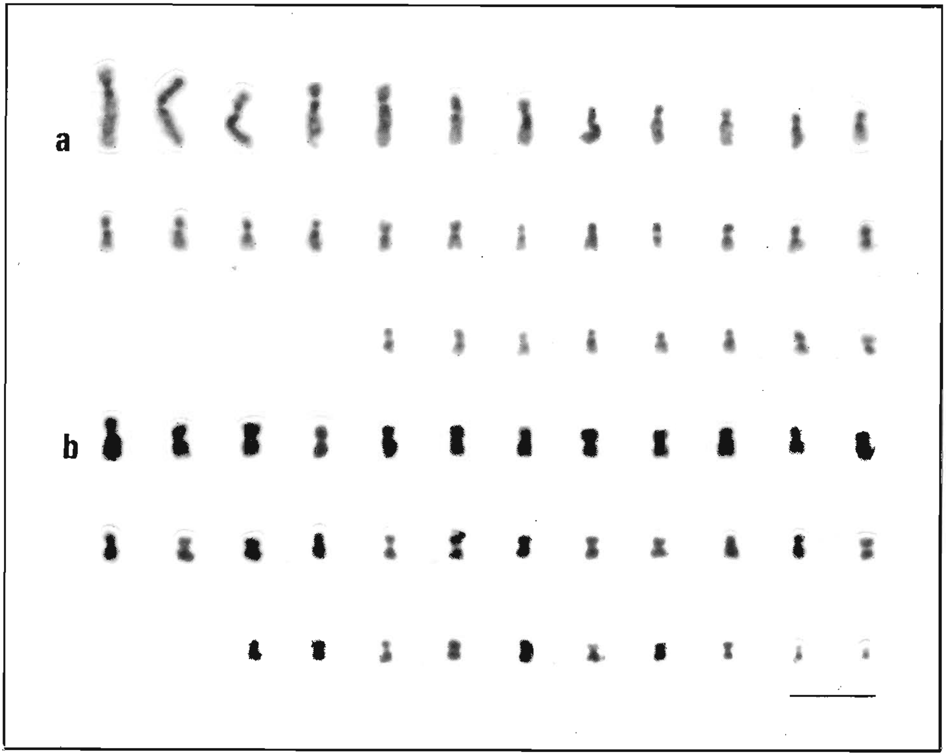

Figure 1 - *Mischocyttarus (Monocyttarus) cassununga*, male karyotype with n = 32 chromosomes, standard staining (a). *Mischocyttarus* sp, male karyotype with n = 34 chromosomes (b). Bar = 5 μm.

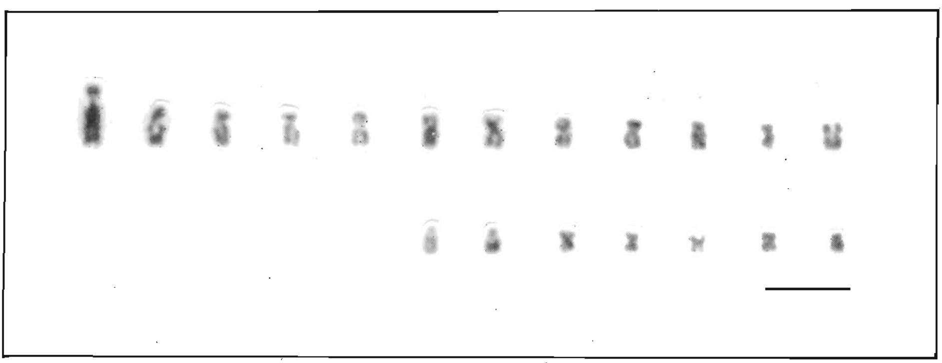

Figure 2 - *Metapolybia* sp., male karyotype with n = 19 chromosomes, standard staining. Bar = 5 μm.

Figure 3b shows the karyotype of *Polybia* sp2 females, with 2n = 34 sub- and metacentric chromosomes. Some chromosomes present more deeply staining regions, with a weakly staining centromeric region in most of them.

Polybia (*Myrapetra*) *occidentalis* had the same chromosome number, i.e., 2n = 34, with a karyotype consisting of 32 sub- and metacentric chromosomes and two acrocentrics (Figure 3c). Pompolo and Takahashi (1987) examined the karyotypes of two species of the subgenus *Myrapetra*, i.e., *P.* (*M.*) *scutellaris* (2n = 34) and *P.* (*M.*) *paulista* (2n = 34). Despite their similarity in chromosome number, these species differ in morphological constitution. The other species of this subgenus ex-

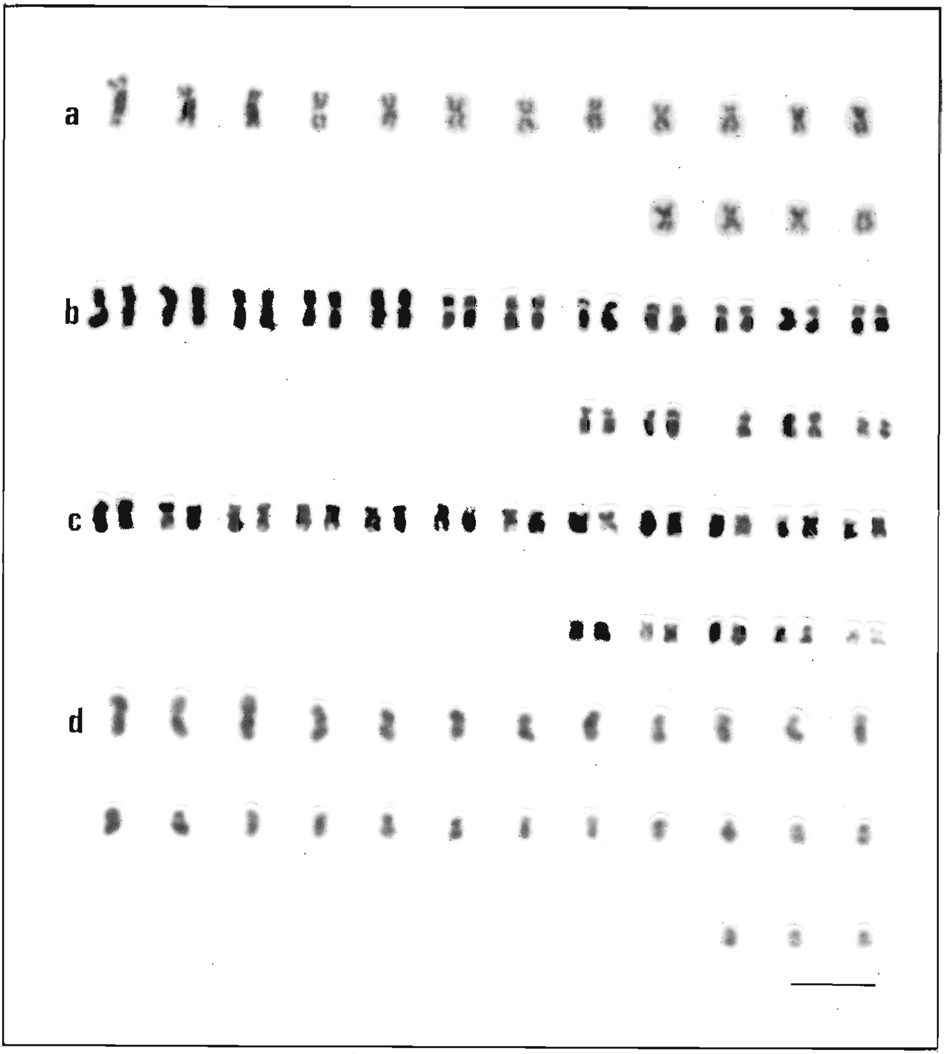

Figure 3 - *Polybia* sp1, male karyotype with n = 16 chromosomes (a). *Polybia* sp2, female karyotype with 2n = 34 chromosomes, standard staining (b). *Polybia* (*Myrapetra*) *occidentalis*, female karyotype with 2n = 34 chromosomes, standard staining (c). *Polybia* (*Trichothorax*) *sericea*, male karyotype with n = 27 chromosomes (d). Bar = 5 μm.

amined in the present study, *P. (M.) occidentalis*, also has 2n = 34 and appears to be similar to *P. (M.) paulista* in chromosome morphology.

The highest chromosome number in the genus *Polybia* was found in *P. (T.) sericea*, with n = 27. A male karyotype, probably consisting of 24 sub- and metacentrics and three acrocentrics is shown in Figure 3d.

Differences were detected in the karyotypes of two species of *Protopolybia*. *P. pumila* had 2n = 42 chromosomes (40 meta- and submetacentrics and two acrocentrics, Figure 4a) while *Protopolybia e. exigua* had n = 31 chromosomes (30 meta- and submetacentrics and one acrocentric, Figure 4b). Differences in the karyotypes of two species, probably as a result of interspecific differentiation, was also reflected in the differences in nest architecture and morphological traits.

A diploid number of 54 chromosomes was detected in cells of *Paracharter-gus smithii* females. The karyotype of this species consisted of sub-, meta- and acrocentric chromosomes (Figure 5), the last type being more numerous.

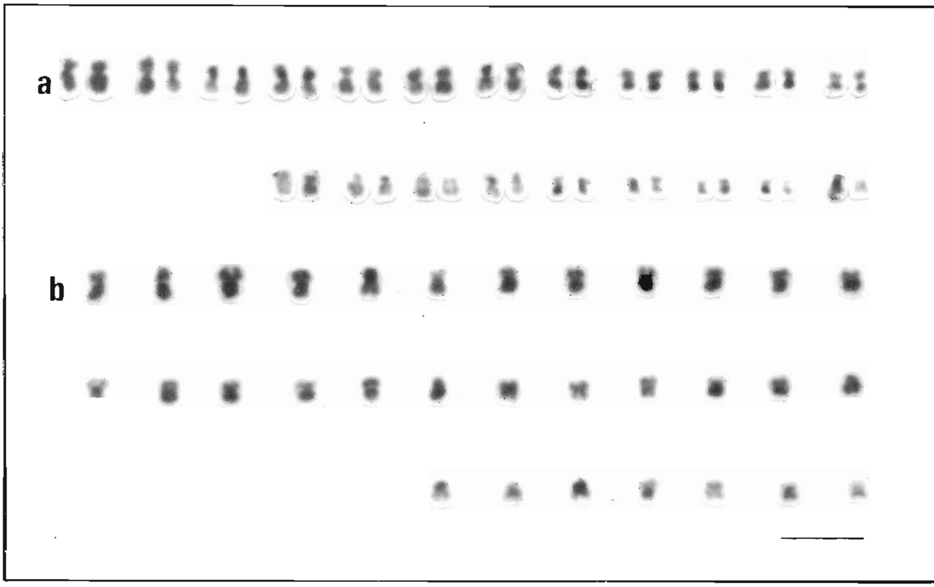

Figure 4 - *Protopolybia pumila*, female karyotype with 2n = 42 chromosomes, standard staining (a). *Protopolybia exigua exigua*, male karyotype with n = 31 chromosomes (b). Bar = 5 μm.

DISCUSSION

In the present study we examined the karyotypes of 10 species belonging to five genera of the Polybiini. The haploid numbers ranged from n = 16 to n = 34 chromosomes.

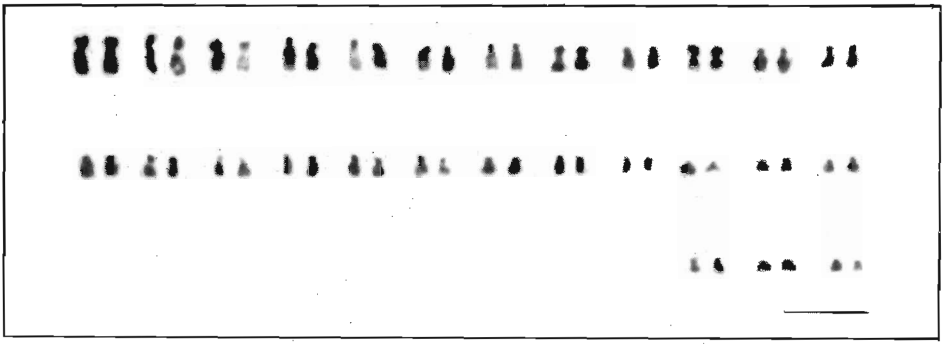

Figure 5 - *Parachartergus smithii*, female karyotype with 2n = 54 chromosomes, standard staining. Bar = 5 μm.

Analysis of standard chromosome preparation showed the presence of more deeply staining regions. These regions, as shown by the C-banding technique, correspond to heterochromatin. Imai *et al.* (1977, 1988) pointed out that the technique they used for the preparation of ant chromosomes (similar to that used in the present study) showed deeply staining regions, which they called C bands, with no need for later treatment.

Imai *et al.* (1988) proposed a cycle of morphological changes in ant chromosomes, from metacentric to telocentric to acrocentric (M → T → A), during the course of karyotype evolution in ants. Heterochromatin may have a role in the recovery of centromeric instability soon after centric fission, converting telocentric chromosomes to acrocentrics.

The Vespidae are divided into three subfamilies: Stenogastrinae, Vespinae and Polistinae. In the latter two a total of 49 species have been studied cytogenetically (Pompolo and Takahashi, 1987; Hoshiba *et al.*, 1989 and present study).

For a general overview of the cytogenetic work performed thus far on the tribe Polybiini, Table I lists studies on 10 genera and 18 species (Hoshiba, 1985; Pompolo and Takahashi, 1987, present study). This is a very low number when we consider the number of species existing in Latin America. The chromosome numbers are distributed almost uniformly within the range of n = 8, 14, 16, 17, 19, 21, 25, 27, 28, 29, 31, 32, 34, the lowest having been detected in *Pseudopolybia* v. m. *testacea* and the highest in *Mischocyttarus* sp.

In addition to the studies carried out in Brazil, the karyotype of a Japanese species (*Parapolybia indica*) was analyzed by Hoshiba (1985). According to Richards (1971, 1978), the genus *Parapolybia*, which originated in the Indo-Malaysia region, is morphologically similar to the genus *Stelopolybia* which occurs on the American continent. Differences in chromosome number were detected cytogenetically. Pompolo and Takahashi (1987) detected 2n = 64 for 2 species of the genus *Stelopolybia*, as opposed to n = 14 for *Parapolybia*.

Table I - Chromosome numbers in the tribe Polybiini.

Species	Chromosome n		References
	n	2n	
Pseudopolybia vespiceps morph *testacea*	8		(a)
Polybia (Myrapetra) paulista	17	34	(a)
Polybia (Myrapetra) scutellaris		34	(a)
Polybia (Myrapetra) occidentalis		34	(c)
Polybia sp1	16		(c)
Polybia sp2		34	(c)
Polybia (Trichothorax) sericea	27		(c)
Mischocyttarus (Monocyttarus) cassununga	32		(c)
Mischocyttarus sp	34		(c)
Metapolybia sp	19		(c)
Protopolybia pumila		42	(c)
Protopolybia exigua exigua	31		(c)
Parachartergus smithii		54	(c)
Brachygastra lecheguana		56	(a)
Protonectarina sylveirae		58	(a)
Parapolybia indica	14		(b)
Stelopolybia pallipes pallipes	32	64	(a)
Stelopolybia multipicta		64	(a)

(a) Pompolo and Takahashi (1987), (b) Hoshiba (1985), (c) present study.

Recently, Hoshiba *et al.* (1989) investigated karyotype evolution in social wasps (Polistinae, in the genus *Polistes* in particular, and in the Vespinae). The variation detected among 32 species was n = 9 to 34 chromosomes ($\bar{n}$ = 25.3). The presence of high numbers may be explained by the hypothesis of minimum interaction (Imai *et al.*, 1986), whereby fission seems to have been responsible for the increase in chromosome number, this would reduce the genetic consequences of mutations of the translocation type. The two subfamilies Polistinae and Vespinae evolved independently from their ancestors, which had low numbers ($\bar{n} \leq 12$).

Wasps of the tribe Polybiini (belonging to the subfamily Polistinae) showed a variation in haploid number from 8 to 34 chromosomes (with a mean value of $\bar{n}$ = 23.5) in 10 genera and 18 species investigated mostly in Brazil. It can be seen that each species presents a characteristic karyotype both in terms of chromosome number and morphology. Variability is observed at the genus level, mainly observed in

Protopolybia and *Polybia*. The variation in chromosome is very wide in the genus *Polistes* (tribe Polistini) even at the subgenus level, a fact that led Hoshiba *et al*. (1989) to suggest that each genus presented an independent or parallel evolution of the karyotype from an ancestor having a haploid chromosome number of 9 to 14. A more detailed analysis of karyotype evolution in social wasps, and those occurring in Brazil in particular, will be possible only after additional cytologic data are obtained for other species.

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RESUMO

O presente trabalho relata os cariótipos das seguintes espécies de vespas sociais da tribo Polybiini: *Mischocyttarus* (*Monocyttarus*) *cassununga* (n = 32); *Mischocyttarus* sp (n = 34), *Metapolybia* sp (n = 19); *Polybia* sp1 (n = 16); *Polybia* sp2 (2n = 34); *Polybia* (*Myrapetra*) *occidentalis* (2n = 34); *Polybia* (*Trichothorax*) *sericea* (n = 27); *Protopolybia pumila* (2n = 42); *Protopolybia e. exigua* (n = 31) e *Parachartergus smithii* (2n = 54). Os números cromossômicos desta tribo são discutidos com outras espécies de vespas sociais.

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