CARYOLOGIA Vol. 36, n. 4: 363-371, 1983

KARYOTYPES OF THIRTEEN ANT SPECIES FROM URUGUAY (HYMENOPTERA, FORMICIDAE)

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SUMMARY — The karyotypes of thirteen species of Uruguayan ants belonging to three different subfamilies (Myrmicinae, Dolichoderinae and Formicinae) are reported. Among eight myrmicines studied, the chromosome numbers of four species of *Pheidole* (*P. cornutula, P. fallax, P. spinninodis* and *P. strobeli*) were all $2n=20$ (or $n=10$). A count of $2n=32$ (or $n=16$) was obtained for *Solenopsis saevissima*, while $2n=38$ occurred in three leaf-cutter ants of the genus *Acromyrmex* [*A.* (*Acromyrmex*) *ambiguus, A.* (*A.*) *hispidus* and *A.* (*Moellerius*) *heyeri*]. The one dolichoderinae ant examined, *Conomyrma pyramica*, had $2n=18$ and three species of *Camponotus*, *C. bonariensis, C. punctulatus* and *C. rufipes* (Formicinae), showed a relatively high number $2n=40$ (or $n=20$) compared to that in *C. mus* ($2n=26$).

INTRODUCTION

While more than 300 ant species have been karyotyped (for reviews see CROZIER 1975 and IMAI *et al.* 1977), few species of *Iridomyrmex*, *Dorymyrmex*, *Brachymyrmex* and *Camponotus* have been analysed from the Neotropical region of Peru and Brasil (CROZIER 1970). The present paper is the first report on karyotypes of Uruguayan ants, and deals with the karyological characteristics of thirteen species of the above genera of *Pheidole*, *Solenopsis*, *Acromyrmex*, *Conomyrma* and *Camponotus*.

MATERIALS AND METHODS

The material used was collected from 9 localities listed in Table 1 during 1979-1981. The specimens were identified by the second author and deposited in the collection of the Departamento de Artrópodos, Facultad de Humanidades y Ciencias, Montevideo, República O. del Uruguay.

Somatic chromosome preparations were generally made from cerebral ganglia cells of worker prepupae by using the air-drying technique as improved by IMAI *et al.* (1977). However, pupal testes and the cerebral ganglia of male or queen prepupae were also used in some species. Chromosome morphology was

classified into five categories (M, SM, ST, A, and T) mainly based on the arm ratio criteria of LEVAN *et al.* (1964), though the discrimination of A from ST is more or less intuitive. For describing arm number, we use the term 2AN (diploid arm number) proposed by IMAI and CROZIER (1980) instead of nomble fundamentale (NF) or fundamental number (FN) used by MATTHEY (1945). We also use the term diploid karyotype (2K) introduced by IMAI and CROZIER (1980).

TABLE 1 - *Localities of Uruguayan ants used in this study.*

Code	Locality
A	22.5 Km 33 Rd., Carrasco del Sauce, Canelones.
B	F. D. Roosvelt Pk., Canelones.
C	31.5 Km Interbalnearia Rd., nr. Pando River, Canelones.
D	51 Km Interbalnearia Rd., nr. Solís River, Canelones.
E	Sierra de las Animas, nr. Solís Stat., Maldonado.
F	Los Angeles, Piriápolis, Maldonado.
G	San Rafael, Punta del Este, Maldonado.
H	Lag Merim, Punta Cachimba, nr. Merim Lake, Cerro Largo
I	Artigas City, nr. Cuareim River, Artigas.

RESULTS AND DISCUSSION

Our results are summarized in Table 2, and the detailed descriptions of the karyotypes observed are as follows:

1. *Subfamily Myrmicinae.*

Eight myrmicine species belonging to the genera *Pheidole*, *Solenopsis*, and *Acromyrmex* were studied.

Pheidole is a cosmopolitan genus, and a successful one in Uruguay. IMAI *et al.* (1977) suggested that *Pheidole* is chromosomally conservative. Indeed, of the thirty that have been karyotyped most have the same diploid choromosome number ($2n=20$) and arm number (2AN=40). This proved also to be the case in the Uruguayan *Pheidole* where all four species examined (*P. cornutula, P. fallax, P. spinninodis* and *P. strobeli*) showed $2n=20$ and 2AN=40 (2K=20M or SM). However, the detailed karyotype analysis reveals that they can be divided into at least two karyotypically distinctive groups. As shown in Figs. 1a, b and d, the karyotypes of *P. cornutula, P. fallax* and *P. strobeli* are characterized by two pairs of extremely large submetacentrics of which the first pair is consistently heteromorphic. Note that the distal part of the long arm of one homologue is a little elongated

TABLE 2 - *Chromosome numbers of thirteen ant species from Uruguay, South America.* ♀ = *worker,* ♂ = *male, and* Q = *queen* (= ♀).

Taxa	Locality code of colony (see Table 1)	Chrom. number (*n*) 2*n*	Diploid Arm Number	Individual number observed	Modal cell no. observed	Fig.
Subfamily Myrmicinae						
Tribe Pheidolini						
Pheidole						
cornutula	I	20	40	1♀	1	
	I	20	40	5♀	6	1a
fallax	A	20	40	1Q	5	
	D	20	40	4Q, 2♀	4, 2	1b
	H	(10) 20	40	1♂, 1Q	3, 1	
spinninodis	D	20	40	2♀	5	1c
strobeli	G	20	40	1♀	2	1d
Tribe Solenopsidini						
Solenopsis						
saevissima	A	32	62	3♀	4	
	B	(16) 32	62	2♂, 1Q	4, 1	
	G	32	62	4♀	5	
	H	32	62	3♀	5	1e
Tribe Attini						
Acromyrmex (Acromyrmex)						
ambiguus	B	38	62	4♀	10	
	B	38	62	3♀	4	
	F	38	62	3♀	4	2a
hispidus	E	38	62	1♀	6	2b
	E	38	62	2♀	4	
Acromyrmex (Moellerius)						
heyeri	E	38	62	4♀	10	2c

Taxa	Locality code of colony (see Table 1)	Chrom. number (n) $2n$	Diploid Arm Number	Individual number observed	Modal cell no. observed	Fig.
Subfamily Dolichoderinae						
Tribe Tapinomini						
Conomyrma						
pyramica	C	18	34	5 ♀	12	1f
Subfamily Formicinae						
Tribe Camponotini						
Camponotus						
bonariensis	E	40	48	3 ♀	7	3b
mus	D	26	42	3 ♀	9	3a
punctulatus	D	40	44	2 ♀	4	3c
rufipes	F	40	44	2 ♀	9	3d
	G	40	44	1♀, 2 ♀	3, 3	
	G	(20) 40	44	1 ♂, 2♀, 1 ♀	5, 3, 1	
	G	(20) 40	44	5 ♂, 3 ♀	7, 5	
	G	(20) 40	44	2 ♂, 1 ♀	3, 2	

and is sometimes stained faintly suggesting an increase of arm size by tandem growth of constitutive heterochromatin, a phenomenon that is often observed in ants. On the other hand, the karyotype of *P. spinninodis* (Fig. 1c) is obviously different from others in two points; it has three pairs of large submetancentrics, and the first chromosome pair, which is probably homologous to the heteromorphic pair in the previous species, is here homomorphic.

A single species of the genus *Solenopsis* (*S. saevissima*) was studied. Ten workers collected at locality codes A, G and H (Table 1), and 2 males and a queen of the locality code B were examined. Fifteen cells of cerebral ganglia showed $2n=32$, and 4 haploid cells had $n=16$. The diploid karyotype involves ten pairs of meta- or submetacentrics with a continuous range in size, five pairs of subtelocentrics, and one pair of acrocentrics, i.e., 2K=

20M or SM+10ST+2A, and 2AN=62 (Fig. 1e). Seven species of *Solenopsis* have been studied cytologically (CROZIER 1970; GLANCY *et al.* 1976; IMAI and KUBOTA 1981), and these can be divided into two chromosomal groups having $n=11$ and $n=16$ respectively. The present observations show that

Fig. 1. — Karyotypes of myrmicine ants (I) (a-e) and a dolichoderine ant species (f). (a) *Pheidole cornutula* ($2n = 20$), (b) *P. fallax* ($2n = 20$), (c) *P. spinninodis* ($2n = 20$), (d) *P. strobeli* ($2n = 20$), (e) *Solenopsis saevissima* ($2n = 32$) and (f) *Conomyrma pyramica* ($2n = 18$).

the fire ant *S. saevissima* belongs to the second group in terms of chromosome number, and its karyological characteristics, with a predominance of meta- or submeta-centrics, suggests a close relationship to *S. aurea* (CROZIER 1970) or *S. invicta* (GLANCEY *et al.* 1976).

Acromyrmex is a representative genus in the Neotropical ant fauna. It belongs to the tribu Attini (fungus-growing ants) and, together with the genus *Atta*, better known as the leaf-cutting ants, has been studied mainly

inconnection with its economic impact on agriculture (WEBER 1972). Three common Uruguayan species, *A.* (*A.*) *ambiguus, A.* (*A.*) *hispidus* and *A.* (*Moellerius*) *heyeri*, were investigated. This is the first karyological report on this group. The material used were collected in sandy ground from Southern localities of Uruguay. A total of 14 cells from 10 workers taken from 3 colonies (locality codes B and F, Table 1) were used for the karyotype analysis of *A.* (*A.*) *ambiguus*. In *A.* (*A.*) *hispidus*, 10 cells obtained from

Fig. 2a-c. — Karyotypes of myrmicine ants (II), the leaf-cutters. (a) *Acromyrmex (Acromyrmex) ambiguus* ($2n = 38$), *A.* (*A.*) *hispidus* ($2n = 38$) and (c) *A. (Moellerius) heyeri* ($2n = 38$).

3 workers including 2 colonies (locality code E, Table 1) were examined. On the other hand, chromosome observations of *A.* (*M.*) *heyeri* were made using 4 workers collected at the locality code E (Table 1). The diploid chromosome number of these three species of *Acromyrmex* was $2n=38$. These *Acromyrmex* species have very similar karyotype (see Figs. 2a-c), i.e., one pair of large metacentrics, three pairs of medium sized submetacentrics, eight pairs of subtelocentrics of which two are markedly larger than the rest, and seven pairs of acro- or telocentrics ranging from medium to small in size ($2K=2M+6SM+16ST+14A$ or T and $2AN=62$). Although there is some inter-species variation in the short arm size of subtelocentrics, which could be interpreted as reflecting the tandem growth of constitutive heterochromatin, their karyological similarity suggest that these two subgenera may be more closely related than has formerly been considered.

2. *Subfamily Dolichoderinae.*

One species, *Conomyrma pyramica* collected in the South coast of Uruguay (locality code C, Table 1) was examined. *C. pyramica*, a member of the tribe Tapinomini, is a common species in South America, confined to moist soil along rivers. Twelve cells obtained from 5 workers showed $2n=18$. The diploid karyotype (Fig. 1f) consists of seven pairs of large or medium sized metacentrics, one pair of large submetacentrics and a pair of small acrocentrics (2K=14M+2SM+2A). Thus, the diploid arm number is 2AN=34. According to CROZIER (1975) and IMAI *et al.* (1977), members of the subfamily Dolichoderinae are characterized by medium to low chromosome numbers in the range $2n=10$-28 (the modal number is $2n=18$). *Conomyrma pyramica*, the first of this genus reported from the neotropics, has, therefore, a typical chromosome number for the subfamily.

3. *Subfamily Formicinae.*

Four species of *Camponotus* (*C. bonariensis*, *C. mus*, *C. punctulatus* and *C. rufipes*) were examined. The genus is one of the most successful ant groups, distributed from the tropics to high latitudes and comprising more than one thousand species. This genus is also predominant in Uruguay and some members (e.g., *C. punctulatus* and *C. mus*) show great ecological adaptability.

The material used included several colonies collected in South and Southeastern localities of Uruguay, generally near the coast. One colony of *C. mus* nesting in rotten wood (locality code D, Table 1) was examined. Chromosome counts from 9 cells of 3 workers revealed $2n=26$. The diploid karyotype formula is 2K=16M or SM+10A (Fig. 3a), and 2AN=42. In contrast to this, the other three species showed the very high chromosome number of $2n=40$, and detailed karyotype analysis of *C. bonariensis, C. punctulatus* and *C. rufipes* revealed that their karyotypes are slightly different in arm number. Seven good metaphases obtained from 3 workers of the colony in locality code E (Table 1) of *C. bonariensis* showed 2K=8SM+32A or T (Fig. 3b) and 2AN=48. In *C. punctulatus*, the analysis of the four metaphases taken from 2 workers (locality code D, Table 1) revealed 2K=2SM+2ST+36A or T (Fig. 3c) and 2AN=44. Five colonies of *C. rufipes* collected at the locality codes F and G (Table 1) were studied. A total of 9 workers and 3 queens had $2n=40$, while $n=20$ in 8 males (Table 2). The karyotypes of *C. rufipes* and *C. punctulatus* are almost identical excepting one point, i.e., both of them have $2n=40$, 2AN=44 and 2K=2SM+2ST+36A but the first submetacentric pair of the former species is obviously larger than that of the latter (compare Figs. 3c and 3d).

Based on the karyological data, the four *Camponotus* species examined here can be divided into two groups: (1) *C. mus* having a low chromosome number ($2n=36$) and many metacentrics or submetacentrics, and (2) *C. bonariensis, C. punctulatus* and *C. rufipes* characterized by a high chromosome number ($2n=40$) and with predominantly acrocentric chromosomes. In

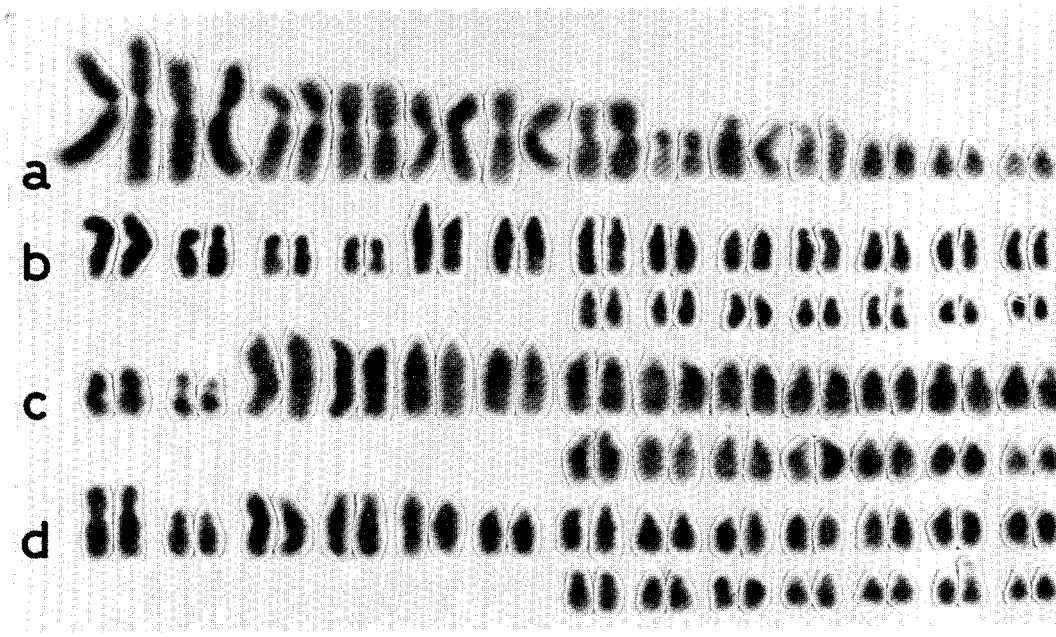

Fig. 3a-d. — Karyotypes of formicine ants. (a) *Camponotus mus* ($2n = 26$), (b) *C. bonariensis* ($2n = 40$), (c) *C. punctulatus* ($2n = 40$) and (d) *C. rufipes* ($2n = 40$).

spite of such a remarkable difference in chromosome number, their arm numbers were fairly conservative (2AN = 42-48), suggesting that Robertsonian rearrangement may have played a significant role in the karyotype differentiation of these two groups. On the other hand, the minor karyological difference found in the second group may be due to pericentric inversions and/or tandem growth of constitutive heterochromatin. Such a phenomenon seems to be a general characteristic of *Camponotus* because, among the thirty seven specie karyotyped, low numbered species ($2n=18$-28) usually have metacentric rich karyotypes, while acrocentrics predominate in high numbered species ($2n=40$-52) (CROZIER 1975; IMAI *et al.* 1977).

Acknowledgements. — We wish to thank Dr. R. H. CROZIER for critical reading of the manuscript and valuable comments and M. KUBOTA for his suggestions on ant taxonomy. This research was partly supported by the Matsumae International Foundation, Japan (1982).

REFERENCES

CROZIER R. H., 1970. — *Karyotypes of twenty-one ant species (Hymenoptera; Formicidae), with reviews of the known ant karyotypes.* Can. J. Genet. Cytol., 12: 109-128.

—, 1975. — *Hymenoptera.* In: *Animal cytogenetics* (B. John, ed.), vol. 3. Insecta 7. Berlin, Stuttgart: Gebrüder Borntrager.

GLANCY B. M., ROMAIN M. K. ST. and CROZIER R. H., 1976. — *Chromosome numbers of the red and the black imported fire ants, Solenopsis invicta and S. richteri.* Ann. Ent. Soc. Am., 69: 469-470.

IMAI H. T. and CROZIER R. H., 1980. — *Quantitative analysis of directionality in mammalian karyotype evolution.* Am. Nat., 116: 537-569.

IMAI H. T. and KUBOTA M., 1981. — *Karyological survey of Indian ants. Some preliminary reports.* Nucleus, 24: 93-96.

IMAI H. T., CROZIER R. H. and TAYLOR R. W., 1977. — *Karyotype evolution in Australian ants.* Chromosoma, 59: 341-393.

LEVAN A., FREDGA K. and SANDBERG A. A., 1964. — *Nomenclature for centromere position on chromosomes.* Hereditas, 52: 201-220.

MATTHEY R., 1945. — *L'évolution de la formule chromosomiale chez les vertébrés.* Experientia, 1: 50-56, 78-86.

WEBER N. A., 1972. — *Gardening ants: the attines.* Amer. Phil. Soc., Philadelphia.

Received 17 November 1982; revision accepted 26 April 1983