CHROMOSOME NUMBERS OF SOME NORTH AMERICAN MIRIDS (HETEROPTERA: MIRIDAE)

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Data are presented on the chromosome numbers ($2n$) of some eighty species of Miridae. The new information is combined with existing data on some Palearctic and Ethiopian species and discussed. From it, it is suggested that continued reference to $2n = 32A + X + Y$ as basic mirid karyotype should be avoided and that contrary to earlier suggestions, agmatoploidy rather than polyploidy is a more probable mechanism of numerical chromosomal change.

Introduction

Leston (1957) and Southwood and Leston (1959) gave an account of the available information on chromosome numbers in the Miridae. These works provided the first indication that the subfamilies may show some modalities that might be useful in phylogenetic analysis in the family. Kumar (1971) also gave an account of the karyotype in some six West African cocoa bryocorines. In the present paper, data will be provided on 80 North American mirids, raising to about 131, the number of mirids for which the chromosome numbers are known.

Materials and Methods

Adult males were collected during the summer of 1970-1972 in Wisconsin and dissected soon after in 0.6% saline solution. The dissected testes were preserved in 3 parts isopropanol: 1 part glacial acetic acid and stored in a referigerator until ready for squashing. Testis squashes were made using Belling's iron-acetocarmine technique as reviewed by Smith (1943) and slides were ringed with either Bennett's zut or Sanford's rubber cement.

Preliminary chromosome counts and other observations were made on a Leitz binocular phase compound microscope equipped with 10× oculars, 40× and 100× (oil) objectives. Photomicrographs of various stages of the meiotic cycle were taken on a Zeiss Universal phase microscope with a Leica 35 mm camera attachment using Kodak high contrast copy film. To prevent too much loss in the depth of field, most photographs were taken under the 40× (dry) objective and 1.25× or 2× optovar magnifications. The films were developed and stored for information retrieval through the aid of a microfilm reader. Results presented are from at least five testis squashes of each species collected over two seasons, in which the stages of division were observed as far as telophase I.

Results and Discussion

Table I presents the list of species examined along with their diploid chromosome numbers. Throughout the table no attempt has been made to indicate the type of sex mechanism (i.e. whether XY: XX, XX: XO or a multiple X system).

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TABLE I

Chromosome numbers in the Miridae of Wisconsin

Species	Chromosome No. (2n)
MIRINAE	
**Capsus ater* (Linnaeus)	34
Lygus vanduzeei Knight	34
L. lineolaris (Palisot de Beavois)	34
Lygocoris pabulinus (Linnaeus)	34
L. tinctus (Knight)	34
L. communis (Knight)	34
L. canadensis (Knight)	34
L. quercalbae (Knight)	34
L. omnivagus (Knight)	34
Orthops campestris (Linnaeus)	34
Dichrooscytus viridicans Knight	34
Tropidosteptes amoenus Reuter	34
Horcias dislocatus (Say)	34
**Adelphocoris lineolatus* (Goeze)	32
***A. rapidus* (Say)	28
**Poecilocapsus lineatus* (Fabricius)	34
**Stenotus binotatus* (Fabricius)	32–34
Phytocoris lasiomerus Reuter	34
P. conspurcatus Knight	34
P. depictus Knight	34
P. penipecten Knight	34
Neurocolpus rubidus Knight	34
N. jessiae Knight	34
N. tiliae Knight	34
Taedia scrupeus (Say)	34
Polymerus venaticus (Uhler)	34
P. proximus Knight	34
Garganus fusiformis (Say)	34
**Leptopterna dolabrata* (Linnaeus)	34
Collaria meilleurii Provancher	14
Litomiris debilis (Uhler)	34
Trigonotylus ruficornis (Geoffroy)	34
PHYLINAE	
Plagiognathus delicatus (Uhler)	30
**P. chrysanthemi* (Wolff)	30
P. politus Uhler	34
P. dispar Knight	32
Microphylellus longirostris Knight	34
Psallus morrisoni Knight	32
P. bakeri (Bergroth)	32
Chlamydatus associatus (Uhler)	32
**Amblytylus nasutus* (Kirschbaum)	32
Lepidopsallus rostratus Knight	32
Criocoris saliens (Reuter)	32
Campylomma verbasci (Meyer)	32
Orectoderus obliquus Uhler	34
ORTHOTYLINAE	
Ceratocapsus incisus Knight	20
C. modestus (Uhler)	24
C. pilosulus Knight	24
C. nigellus Knight	24
Parthenicus nigrellus Knight	24
Slaterocoris breviatus (Knight)	26
S. stygicus (Say)	26
S. attritibialis (Knight)	26
Halticus bracteatus (Say)	30
Labops brooksi Slater	40
Pilophorus walshii Uhler	30
P. perplexus Douglas & Scott	30
P. juniperi Knight	30
Pseudoxenetus scutellatus Uhler	30

TABLE I (contd.)

Species	Chromosome No. (2n)
Reuteria irrorata (Say)	26
Ilnacora malina Uhler	26
I. stalii Reuter	26
Lopidea marginalis (Reuter)	80
L. incurva Knight	80
L. robiniae (Uhler)	80
L. lathyri Knight	80
****Melanotrichus flavosparsus* (Sahlberg)	28
Orthotylus ornatus Van Duzee	28
DERAEOCORINAE	
Deraeocoris fasciolus Knight	34
D. madisonensis Akingbohungbe	34
D. albigulus Knight	34
D. borealis (Van Duzee)	34
D. nitenatus Knight	34
D. nebulosus (Uhler)	34
D. aphidiphagus Knight	34
D. quercicola Knight	34
Hyaliodes vitripennis (Say)	34
H. brevis Knight	36
BRYOCORINAE	
Monalocoris americanus Wagner & Slater	34

This is because there seems to be some confusion in the designation of the sex chromosomes in the Miridae. This will be dealt with in detail in a subsequent paper. Systematic arrangements adopted follows that of Carvalho (1955). The table includes nine species that have previously been investigated by other authors. The numbers for seven of these have been confirmed in this study and they are referred to in the table by a single asterisk. The numbers for two species (referred to by a double asterisk) do not agree, however, with earlier reports.

Leston (1957) gave the diploid number of *A. rapidus* as 28A+xx+Y but remarked that this was questionable. In this study, at metaphase I (polar view), 14 chromosomes, including two m-chromosomes and one very big bivalent, were observed. In side view, when the chromosomes are arranged in a chain on the metaphase plate, 13 pairs were observed, suggestive of distributive pairing of the m-chromosomes, but subsequent stages of division tend to suggest a splitting of the big bivalent (which stays distinct as a single bivalent at diakinesis and metaphase I) into two to give a haploid count of 14 at telophase I. Thus the behaviour of the big bivalent and the m-chromosomes might have accounted for the variation in chromosome number of this species. Leston (op. cit.) also reported a $2n = 24$ A + X + Y for *M. flavosparsus* but a $2n = 28$ was observed in this study. This might have been due to an overlapping or capture of the two m-chromosomes in the squashes examined by Leston rather than to geographic variation.

The species investigated showed a variation from a $2n = 14$ in *C. meilleurii* (the lowest recorded so far in the family) to a $2n = 80$ in *Lopidea spp.* (the highest recorded so far in the family). In general the numbers tend to show modalities at the subfamily level for the Deraeocorinae (34), Mirinae (34) and Phylinae (32). Deviations usually involve addition or loss of one or two chromosomes, as observed by earlier investigators. However, a very anomalous situation was observed in the

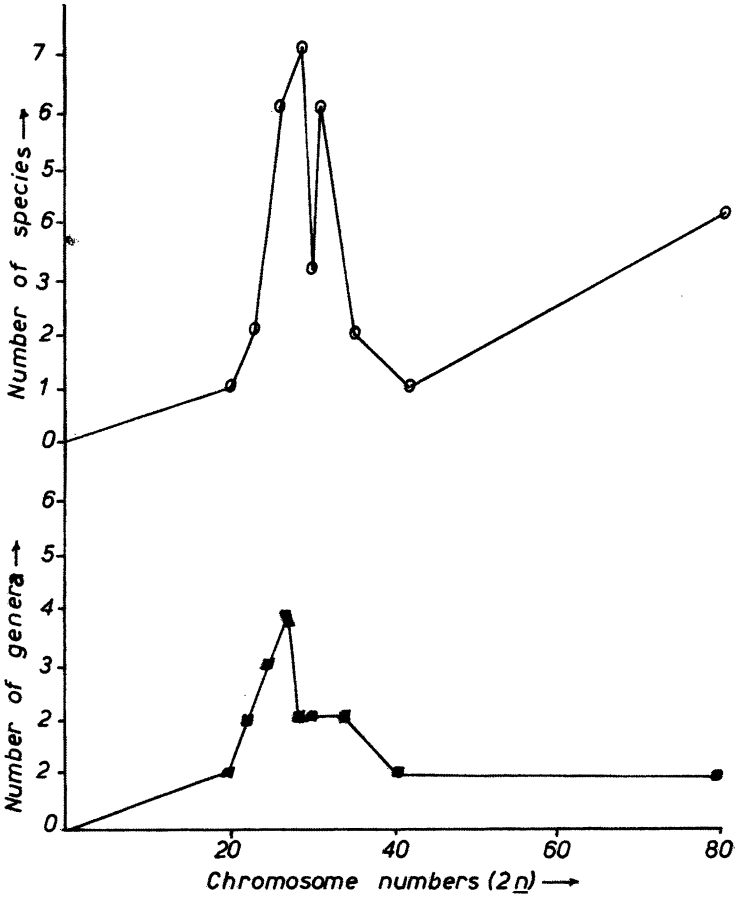

Fig. 1. Distribution of chromosome numbers in Orthotylinae.

mirine *C. meilleurii* with an apparent loss of 20 autosomes. At diakinesis seven well stained bivalents and some other lightly stained aggregate of chromatin material were observed in this species. Metaphase I showed six bivalents and two smaller chromosomes which were cooriented and occupied a central position on the metaphase plate (probably the X and Y). Two types of anaphase I were observed with one having 14 chromosomes and the other 24 chromosomes. At metaphase II, 14 chromosomes were observed while at telophase II, a haploid count of 7 was usual but counts of 6 and 9 were also observed. Thus, this species shows a very anomalous behaviour which is difficult to explain in lieu of any intensive cytogenetic analysis involving both the male and the female.

Leston (1957) postulated $2n = 32A+X+Y$ as the basic mirid karyotype even though earlier in the same paper he observed that it was only in the Mirinae that there was sufficient coverage for a type number to be elucidated with confidence. Manna (1962) and Kumar (1971) followed Leston without any question even though the former was a bit cautious in substituting modal number for basic karyotype. The findings in the present study seem to suggest that any postulates as to a

basic midid karyotype at the present stage of our karyological knowledge of the family is purely conjectural. This is further strengthened by the apparent paucity of data on which the postulate was based. For example, previously available data on the Mirinae were for 26 species involving 14 genera drawn from two of the seven tribes recognized in the subfamily by Carvalho (1955). Also, in the Bryocorinae the karyotype for seven species are known and though the species distribution cover the three tribes recognized in the subfamily, the variation in chromosome numbers seems startling (see Kumar, 1971). A more interesting variation is observed in the Orthotylinae, with a range of $2n = 20$-80 in the 33 species examined so far. As represented graphically, (Fig. 1) the distribution of the chromosome numbers is multimodal.

In postulating a basic karyotype for any group it is suggested that such a karyotype should or ought to recur in the different components of the group with a reasonable degree of stability and frequency. The preceding discussion on known chromosome numbers of the Miridae can hardly be reconciled with this suggestion and thus any further reference to $2n = 32A+X+Y$, as the basic mirid karyotype, ought to be avoided till more extensive data is available.

Leston (1957, 1961) in attempting to explain the mechanism for the evolution of the mirid karyotype from the presumed ancestral cimicoid karyotype of $2n = 18$, suggested polyploidy as a probable mechanism. Polyploidy can be defined as the possession of three or more genomes or chromosome sets instead of two, as is characteristic of a diploid condition (Rieger *et al.*, 1968; Jackson, 1971). The difficulty in invoking polyploidy as a mechanism of numerical chromosomal evolution in the Miridae is apparent from the above definition. Coupled with this, is the apparent rarity of natural polyploidy among bisexually reproducing animals, a problem which Muller (1925) discussed in great detail. Even though some of the Muller speculations on this problem have been shown to be surmountable (Astaurov, 1969) it is noteworthy that an indirect origin of natural polyploidy via parthenogenesis was suggested. From these considerations and in light of the diffuse centromere system of mirid chromosomes it is suggested that a more plausible mechanism is agmatoploidy and/or chromosomal fission coupled with fusion or re-association of fragmented chromosomes. This does not exclude the possibility of polyploidy in closely related taxa but its demonstration in the Miridae has not been reported.

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