Zootaxa 2315: 39–46 (2009)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Insects found in birds' nests from Argentina: cytogenetic studies in Cimicidae (Hemiptera) and its taxonomical and phylogenetic implications

MARIA G. POGGIO[1], MARIA J. BRESSA[1], ALBA G. PAPESCHI[1], OSVALDO DI IORIO[2] & PAOLA TURIENZO[2]

[1]*Laboratorio de Citogenética y Evolución. Departamento de Ecología, Genética y Evolución. Facultad de Ciencias Exactas y Naturales. 4° Piso, Pabellón II, Ciudad Universitaria C1428EHA, Buenos Aires, Argentina. E-mail: georgininguis@gmail.com*
[2]*Entomología. Departamento de Biodiversidad y Biología Experimental. Facultad de Ciencias Exactas y Naturales. 4° Piso, Pabellón II, Ciudad Universitaria C1428EHA, Buenos Aires, Argentina. E-mail: paolaturienzo@yahoo.com*

Abstract

The Cimicidae (Hemiptera) are known to be blood ectoparasites primarily on birds and bats. Three species of the subfamily Haematosiphoninae are known from Argentina: *Acanthocrios furnarii*, *Ornithocoris toledoi*, and *Psitticimex uritui*; all feed on diverse avian hosts. The chromosome number and male meiosis of *A. furnarii*, and *P. uritui* from new Argentinean samples are analyzed and compared with previous data. The sample of *A. furnarii* described by Ueshima (1966) with 2n = 32 + XY (male), strikingly differs from the present results (2n = 10 + XY, male). The diploid number of *P. uritui* agree with the previously reported by Ueshima (1966), 2n = 28 + X_1X_2Y (male). Taxonomical implications about the identity of *A. furnarii* are discussed and the mechanisms of the karyotype evolution of species belonging to Haematosiphoninae are proposed.

Key words: *Acanthocrios*, *Psitticimex*, Hemiptera, Cimicidae, birds' nests, achiasmatic meiosis, karyotype evolution

Introduction

The Cimicidae (Hemiptera) are known to be blood ectoparasites primarily on birds and bats, with man as a secondary host (Usinger 1966). Five of the seven genera in the subfamily Haematosiphoninae are monotypic, an unusual feature in the Cimicidae: four genera are distributed in North America [*Haematosiphon* Champion, 1900; *Cimexopsis* List, 1925; *Synxenoderus* List, 1925; *Hesperocimex* List, 1925], and three genera in South America [*Ornithocoris* Pinto, 1927; *Acanthocrios* Del Ponte & Riesel, 1945 (= *Caminicimex* Usinger, 1966: Di Iorio & Turienzo 2008); *Psitticimex* Usinger, 1966] (Usinger 1966). Later, *Alayocimex* Hernandez Triana & De la Cruz, 1994, also monotypic, was described from Cuba. Three species of Haematosiphoninae are known from Argentina: *Acanthocrios furnarii* (Cordero & Vogelsang, 1928), *Ornithocoris toledoi* Pinto, 1927, and *Psitticimex uritui* (Lent & Abalos, 1946). They all feed on diverse avian hosts in their nests (Usinger 1966, Turienzo & Di Iorio 2007, Carpintero & Aramburú 2007, Di Iorio *et al.* 2008, Di Iorio & Turienzo 2009, Santillán *et al.* 2009a, 2009b).

Cytogenetic studies in Cimicidae

Forty-five species in this family show a diploid chromosome number that ranges from 10 to 42 with a peak at 31. Cimicid bugs have simple (XY/XX, male/female) and multiple sex chromosome systems, and some species possess supernumerary Xs and Ys (Ueshima 1979; Manna 1984; Grozeva & Nokkala 2002).

Accepted by C. Schaefer: 25 Nov. 2009; published: 21 Dec. 2009

Within the subfamily Haematosiphoninae, only nine species of six genera have been cytogenetically analyzed. According to their morphological and cytogenetic characteristics, they were divided into three groups (Ueshima 1966, Ueshima 1979). The genus *Ornithocoris*, with the least specialized spermaledge, has a male diploid number of 10 (8 + XY), and it is the only genus in the first group. The second group, which has a more specialized spermaledge, and includes the genera *Haematosiphon*, *Acanthocrios*, *Psitticimex*, and *Synxenoderus*, has 2n = 31 (28 + X_1X_2Y, male) and 2n = 34 (32 + XY, male). The third group, which has a peculiar latero-ventral spermaledge and contains only the genus *Hesperocimex*, carries a high chromosome number (2n = 40 – 42), with simple and multiple sex chromosome systems (Table 1).

TABLE 1. Species of Haematosiphoninae (Hemiptera: Cimicidae) cytogenetically analyzed.

Species	2n ♂	2n ♀	n ♂	References
Neotropical region				
Acanthocrios furnarii (Cordero & Vogelsang, 1928)	34	-	16+XY	Ueshima, 1966
	12	12	5+XY	Present work
Ornithocoris toledoi Pinto, 1927	-	-	4+XY	Ueshima, 1966
O. pallidus Usinger, 1959	10	-	4+XY	Ueshima, 1966
Psitticimex uritui (Lent & Abalos, 1946)	31	-	14+X_1X_2Y	Ueshima, 1966
	31	-	14+X_1X_2Y	Present work
Nearctic region				
Haematosiphon inodorus (Duges, 1892)	31	32	14+X_1X_2Y	Ueshima, 1966
Hesperocimex coloradensis List, 1925	42	44	19+$X_1X_2X_3Y$	Ryckman & Ueshima 1964
H. cochimiensis Ryckman & Ueshima 1963	40	40	19+XY	Ryckman & Ueshima 1964
H. sonorensis Ryckman, 1958	42	42	20+XY	Ryckman & Ueshima 1964
Synxenoderus comosus List 1925	31	32	14+X_1X_2Y	Ueshima, 1966

Specimens of *A. furnarii* analyzed by Ueshima (1966) came "from a laboratory culture first collected near Tucumán, Argentina, in August, 1957 (R.L. Usinger and P. Wygodzinsky)" (Usinger 1966: 469), and were found in nests of *Furnarius rufus* (Gmelin, 1788) [Aves: Furnariidae]. *Psitticimex uritui* was redescribed from a male and a female collected in nests of *Myiopsitta monachus cotorra* (Vieillot, 1817) [Aves: Psittacidae], "near Tucumán, Argentina, in August, 1957 (R.L. Usinger and P. Wygodzinsky)" (Usinger 1966: 472), although a laboratory culture was not mentioned.

In the present contribution, the chromosome number and male meiosis of these two species from new Argentinean population samples are analyzed, and some striking differences with respect to those presented by Ueshima (1966) are encountered.

Materials and methods

The total number of specimens collected, and dissected specimens for cytogenetic studies between parentheses, came from the following localities and birds' nests:

Acanthocrios furnarii
Furnarius rufus rufus (Gmelin, 1788) [Aves: Furnariidae]

ARGENTINA: Buenos Aires: Río Luján, F.C.G.B.M., Turienzo & Di Iorio leg., 21-IV-2009, 91 exx., 26-VI-2009, 18 exx, 23-VII-2009, 104 exx. (12 males, 5 females), all nests were later inhabited by *Sicalis flaveola pelzelni* Sclater, 1872 [Aves: Emberizidae]; Córdoba: Ea. El Sauce, 6 km W La Falda, 26-VIII-2009, Di Iorio

leg., 108 exx. (1 male), in a nest later inhabited by *Sicalis flaveola pelzelni*.

Psitticimex uritui
Myiopsitta monachus catita (Jardine & Selby, 1830) [Aves: Psittacidae]

ARGENTINA: Córdoba: Ea. El Sauce, 6 km W La Falda, 13-VI-2009, Di Iorio leg., 538 exx. (27 males, 2 females); La Pampa: Toay, 23-IV-2009, Turienzo & Di Iorio leg., 8 exx. (2 males, 4 females), in an old nest of *Pseudoseisura lophotes argentina* Parker, 1960 [Aves: Furnariidae], remodelled and inhabited by a breeding pair of *M. m. catita.*

Myiopsitta monachus monachus (Boddaert, 1783) [Aves: Psittacidae]

ARGENTINA: Buenos Aires: Chascomús, 13-IX-2009, Di Iorio leg., 1216 exx. (8 males).

All specimens of *A. furnarii* from each population sample collected during autumn and winter were included in the meiotic analysis, because male meiotic cells were found in the testes. However, only the specimens of *P. uritui* from a sample collected in autumn (June) were cytogenetically analysed, because other samples that were collected in winter (August) and late winter (September), only had spermatozoa in testes. Gonads were dissected out in a saline solution, fixed for 15 min in freshly prepared Carnoy fixative (ethanol: chloroform: acetic acid, 6:3:1), and kept at 4ºC in 70 % ethanol. Slides were done by the squash method and the chromosomes were stained in 2 % iron acetic haematoxylin following conventional procedures. Chromosome preparations were observed in a Leica DMLB microscope. Black-and-white images of chromosomes were recorded with a CCD camera (Leica DFC350 FX, Leica IM50 Version 4.0, Leica Microsystems Imaging Solutions Ltd. Cambridge, UK).

Acanthocrios furnarii and *P. uritui* were identified by O.R. Di Iorio following the key and descriptions of Usinger (1966). Voucher specimens were deposited in the collection ODI. This work is part of the research project “Insects found in birds’ nests from Argentina”, and part of the doctoral thesis of P. Turienzo (both under direction of O.R. Di Iorio).

Results

Acanthocrios furnarii

As is characteristic of Hemiptera, chromosomes are holokinetic, i.e. without a localized centromere. In all *A. furnarii* population samples, the diploid chromosome number of males and females is 2n = 12 (10 + XY/XX). In oogonial prometaphases, two chromosomes are much smaller than the others, and correspond to the smallest autosomal pair (Fig. 1a); in spermatogonial prometaphases three smaller chromosomes are detected: two corresponding to the smallest autosomal pair and the other one to the Y chromosome (Fig. 1b).

During male meiosis chromosomes condense from leptotene to pachytene, but no diplotene or diakinesis stages are observed, i.e., meiosis is achiasmatic. At metaphase I, the five autosomal bivalents are completely condensed; homologues are connected with each other through the medial region, but the telomeric regions are separated (Fig. 1c). At this stage both the autosomal bivalents and the sex univalents dispose at the equatorial plate with their long axes perpendicular to the spindle pole. At anaphase I, the sex chromosomes X and Y segregate sister chromatids (equational division) whereas autosomal bivalents segregate homologous chromosomes (reductional division). Both the sex chromatids and the homologous autosomes migrate parallel to the equatorial plane. At metaphase II, the sex chromatids associate forming an XY pseudobivalent, which lies at the centre of the ring formed by the autosomes (Fig. 1d). At anaphase II, the autosomes segregate equationally and the X and Y chromatids divide reductionally. At this stage the chromosomes segregate also with their long axes parallel to the equator. Telophase II nuclei have 6 chromosomes (5A + X or 5A + Y).

Psitticimex uritui

This species possesses 2n = 31 / 32 = 28 + X_1X_2Y / 28 + $X_1X_1X_2X_2$ (male/female), with all the chromosomes of similar size (Fig. 2a). The course of meiosis is similar to that described for *A. furnarii*. During early male prophase I the three sex chromosomes are positively heteropycnotic. Autosomes gradually condense during leptotene, zygotene, and pachytene, but no diplotene or diakinesis is observed, i.e., meiosis is achiasmatic. At metaphase I, homologous chromosomes lie side by side and are connected with each other through their medial region by non-chiasmatic associations. The 14 autosomal bivalents and the three sex univalents are arranged with their long axes perpendicular to the spindle pole (Fig. 2b). At anaphase I, autosomes segregate reductionally whereas the sex chromosomes segregate chromatids (equational division). At metaphase II, autosomes dispose in a ring configuration and the X_1, X_2, and Y chromatids form a pseudotrivalent (Fig. 2c). At anaphase II, autosomes segregate sister chromatids; and the X_1 and X_2 chromatids segregate from the Y. Telophase II nuclei have 16 (14 + X_1X_2) or 15 (14 + Y) chromosomes.

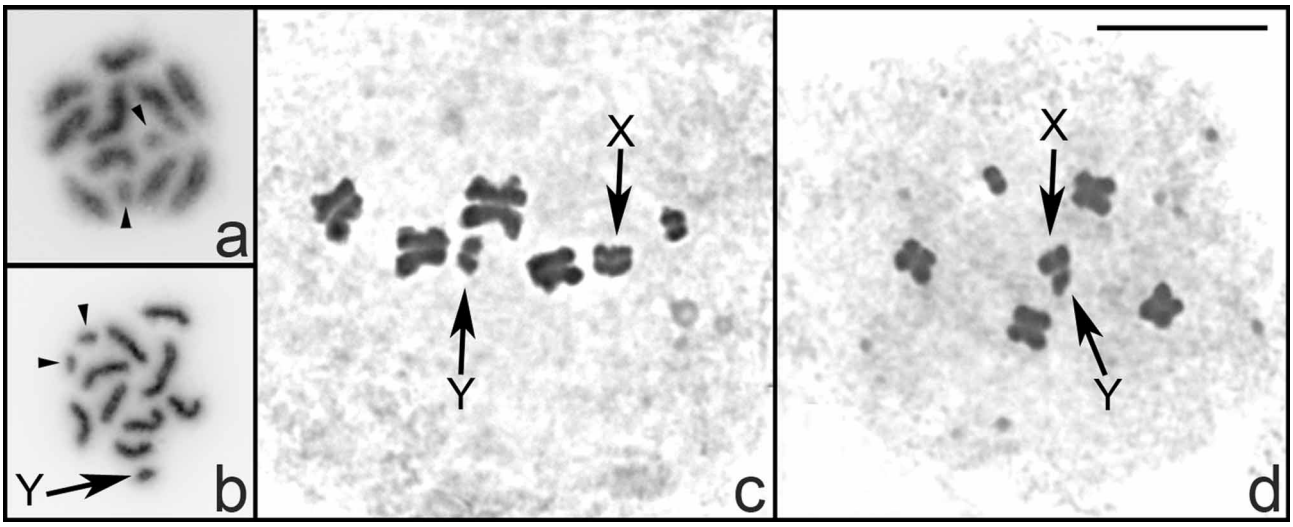

FIGURE 1. Mitotic and meiotic chromosomes of *Acanthocrios furnarii*: a, oogonial prometaphase; b, spermatogonial prometaphase; c, metaphase I; d, metaphase II. Arrows: sex chromosomes. Arrowheads: smallest autosomal pair. Chromosomes are stained with 2 % iron acetic haematoxylin. Bar = 10 µm.

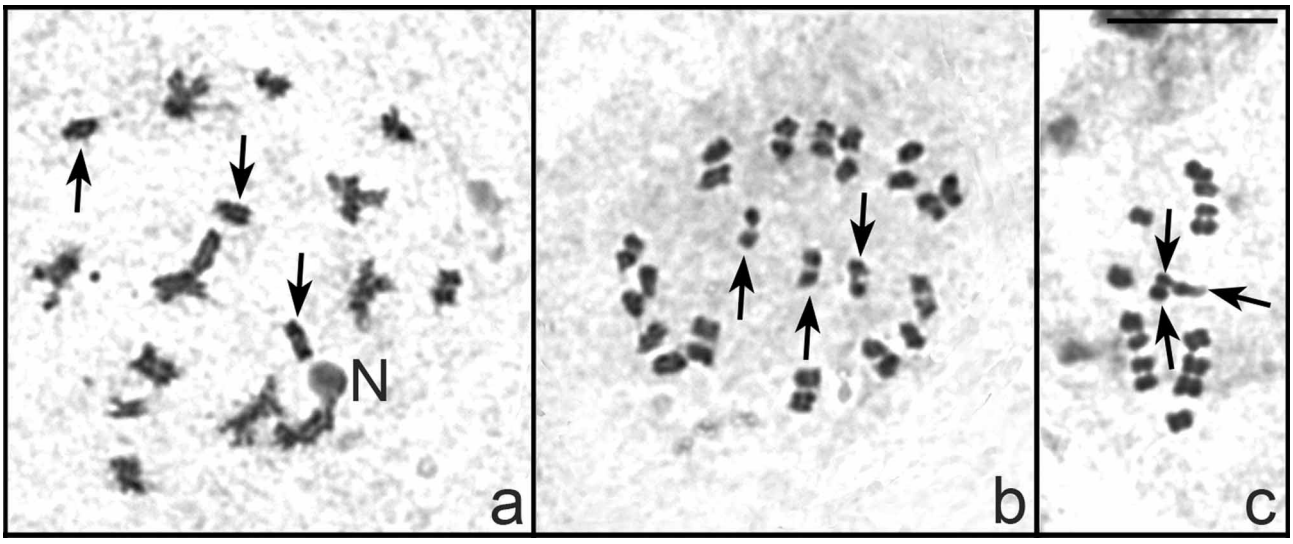

FIGURE 2. Male meiotic chromosomes of *Psiticimex uritui*: a, prometaphase I; b, metaphase I; c, metaphase II. Arrows: sex chromosomes. N: nucleolus. Chromosomes are stained with 2 % iron acetic haematoxylin. Bar = 10 µm.

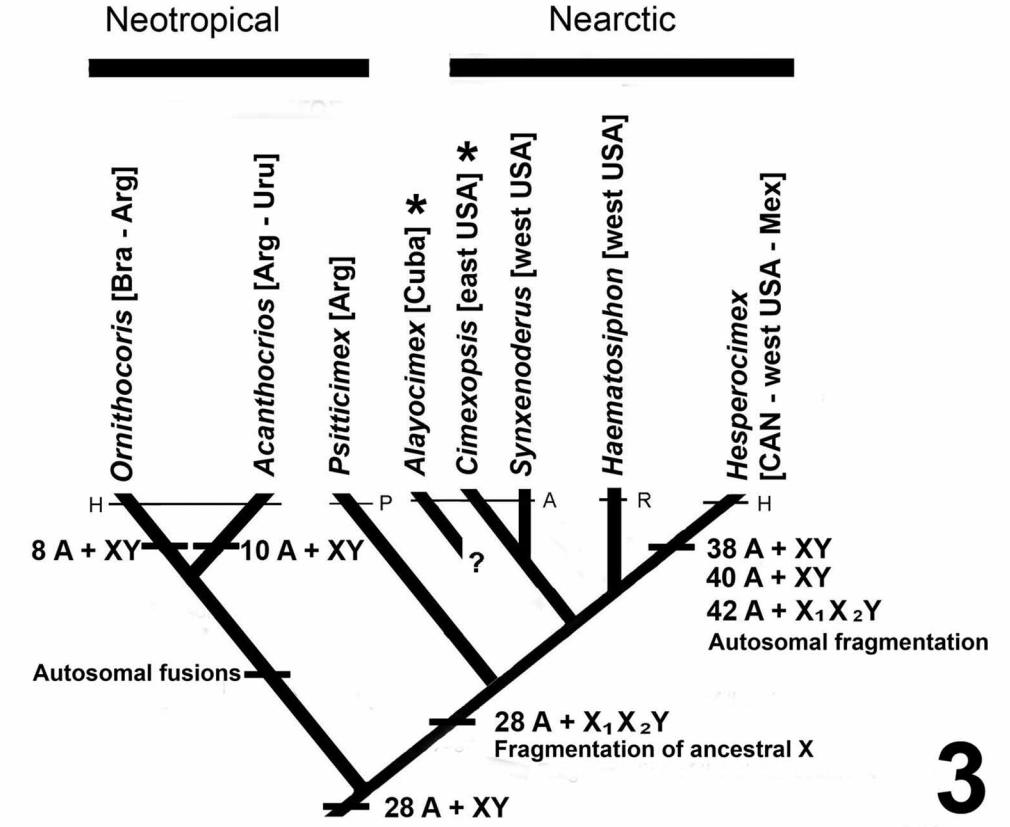

FIGURE 3. Phylogeny on the origin and evolution of the species of the subfamily Haematosiphoninae (modified from Usinger 1966, and Di Iorio & Turienzo 2009) based on their morphological and cytogenetic characteristics, and habitats (diploid autosomal number, sex chromosome system, chromosomal rearrangements, bird's hosts). Primary birds' hosts: Apodidae (A), Hirundinidae (H), Psittacidae (P), and raptor birds (R). Asterisks: taxa with unknown chromosome numbers.

Discussion

Cytogenetic studies in the family Cimicidae are relatively scarce, and most of them refer to the genera *Cimex* and *Paracimex*, representing 44 % of the 45 species cytogenetically analyzed (Ueshima 1979, Manna 1984, Nokkala & Grozeva 2000, Grozeva & Nokkala 2002). Furthermore, although the karyotype has been extensively examined in different aspects, there is only little information on the pattern of male meiosis. The present results in *A. furnarii* and *P. uritui* clearly show that male meiosis is achiasmatic. In the infraorder Cimicomorpha, achiasmatic meiosis has been so far described in a few species belonging to the four phylogenetically closed families (Schuh & Štys 1991, Tian *et al.* 2008, Schuh *et al.* 2009): Nabidae (Nokkala & Nokkala 1984, Kuznetsova & Maryanska-Nadachowska 2000, Kuznetsova *et al.* 2004, Kuznetsova *et al.* 2007, Kuznetsova & Grozeva 2008), Miridae (Nokkala & Nokkala 1986a, Grozeva 2003, Grozeva *et al.* 2006, Grozeva *et al.* 2007), Anthocoridae (Nokkala & Nokkala 1986b), and Microphysidae (Nokkala & Grozeva 2000). According also to previous results, achiasmatic meiosis should be extended to all members of Cimicidae (Grozeva & Nokkala 2002). The absence of recombination, at least in the heterogametic sex, brings about a reduction in the generation of variability, and then the maintenance of linkage groups with coadapted allelic variants (Ituarte & Papeschi 2004). Nevertheless, the presence of achiasmatic meiosis could not be related to an adaptive strategy in the species here analyzed.

The cytogenetic observations in *P. uritui* agree with the diploid number previously reported by Ueshima (1966), 2n = 28 + X_1X_2Y (male). However, the sample of *A. furnarii* described by Ueshima (1966) (2n = 32 + XY) strikingly differs from the present results (2n = 10 + XY). This marked difference in the diploid number

could not be explained as a polytypism because many chromosome rearrangements in a very short evolutionary time should have to be proposed, and all population samples examined here have shown not only a similar morphology but also the same karyotype. Taking into account that all specimens here analyzed were determined as belonging to *A. furnarii* by the characters given in the generic description of *Caminicimex* (synonymized to *Acanthocrios*), and following the keys of Usinger (1966), it can be suggested that two different taxonomic entities are involved. The morphological comparison of the material analyzed by Ueshima and ours would shed light on this subject.

In most discussions of the karyotype evolution of bugs, it is generally accepted that the modal chromosome number of a particular taxonomic group, i.e., the commonest number present in a family, a subfamily, a tribe, or a genus, is considered the ancestral one for the group under study (Ueshima 1979). When analyzing karyotype evolution at the family level, some karyotypes are highly homogeneous, but others show intensive processes of karyotype alterations. Cimicidae shows a very heterogenous chromosome constitution, with a diploid chromosome number between 10 and 42, and simple and multiple sex chromosome systems. However, the modal diploid chromosome number of 28 + XY / XX has been suggested as the ancestral one (Ueshima 1979, Manna 1984).

Among the principal mechanisms of karyotype evolution in Hemiptera, autosomal fusions and both autosomal and sex chromosome fragmentations can be included (Ueshima 1979, Manna 1984, Thomas 1987, Papeschi 1994, 1996, Papeschi & Bressa 2006). If the chromosome size and number of *P. uritui* (2n = 31 = 28 + X_1X_2Y) and *A. furnarii* (2n = 10 + XY) are compared, it can be seen that the high chromosome number of *P. uritui* is associated with a small chromosome size, and that the low chromosome number of *A. furnarii* is correlated with chromosomes of large size. For this reason, it is probable that the karyotype of *A. furnarii* originated through a series of multiple autosomal fusions from the ancestral karyotype, whereas the karyotype of *P. uritui* arose by a fragmentation of the original X chromosome, causing a derived multiple sex chromosome system (Fig. 3).

Considering the most common mechanisms of karyotype evolution in Hemiptera, the ancestral diploid number proposed for the family Cimicidae (28 + XY / XX) (Ueshima 1979, Manna 1984), and the results here obtained, the following scenario for karyotype evolution in the nine species of Haematosiphoninae could be suggested (Fig. 3):

- autosomal fusions brought about a reduction in the modal autosomal number (Neotropical Region: *Ornithocoris toledoi*, *O. pallidus*, and *Acanthocrios furnarii*);
- fragmentation of the ancestral X chromosome originated a derived multiple sex chromosome system X_1X_2Y (Neotropical Region: *Psitticimex uritui*, and Nearctic Region: *Synxenoderus comosus* and *Haematosiphon inodorus*);
- autosomal fragmentation resulted in an increase in the number of autosomes (Nearctic Region: *Hesperocimex cochimiensis* and *H. sonorensis*), and also the fragmentation of the X chromosome originated a derived multiple sex chromosome system (Nearctic Region: *H. coloradensis*).

According to the three groups of species within the subfamily Haematosiphoninae proposed by Ueshima (1966), based on morphological and cytological characteristics, *A. furnarii* and *P. uritui* belong to the same group. However, considering our results, it is suggested that *A. furnarii* should belong to the first group which includes the species of the genus *Ornithocoris*, because both genera possess a low autosomal number and the ancestral simple system of sex chromosomes (Fig. 3).

Finally, if the hypothesis of two different taxonomic entities is confirmed, the synonymy of *Cimex passerinus* Cordero & Vogelsang, 1928 with *A. furnarii* made by Usinger (1966) needs to be reevaluated (although the single type specimen of *C. passerinus* is lost). Furthermore, the low chromosome number found now in the specimens identified as *A. furnarii* approaches this entity to the genus *Ornithocoris*, where *A. furnarii* was previously located (Carvalho 1939).

Acknowldgements

Research was funded by grants UBACyT X164 of University of Buenos Aires and PICT 2007-00635 of ANPCyT from Argentina. M.G. Poggio, M.J. Bressa, and A.G. Papeschi thank the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET). We also thank Sebastián Zeballos (Ea. El Sauce) for providing facilities and the nests from his property; as well as Viviana Massoni for providing facilities in the collections from Chascomús.

References

Carpintero, D. & Aramburú, R. (2007) Presencia de *Caminicimex furnarii* (Heteroptera: Cimicidae) en nidos de golondrina (Passeriformes: Hirundinidae) en Argentina. *Revista de la Sociedad Entomológica Argentina*, 66(1–2), 153–156.

Carvalho, J.C.M. (1939) Sobre a biologia de *Ornithocoris toledoi* Pinto, 1927, percevejo dos galinheiros em Minas Gerais (Hemiptera, Cimicidae). *Ceres*, 1, 120–140.

Di Iorio, O.R., Bulit, F., Aldatz, F. & Massoni, V. (2008) Insects found in birds' nests from Argentina: *Tachycineta leucorrhoa leucorrhoa* (Vieillot, 1817) [Aves: Hirundinidae], a new host for *Acanthocrios furnarii* (Cordero & Vogelsang, 1928) [Hemiptera: Cimicidae]. *Zootaxa* (edition on-line), 1–24.

Di Iorio, O.R. & Turienzo, P.N. (2008) A nomenclatural note in Cimicidae (Hemiptera) from South America. *Zootaxa* (edition on-line), 65–68.

Di Iorio, O.R. & Turienzo, P.N. (2009) Insects found in birds' nests from the Neotropical Region (except Argentina) and immigrants in the Nearctic Region. *Zootaxa* (edition on-line), (2187), 1–144.

Grozeva, S. & Nokkala, S. (2002) Achiasmatic male meiosis in *Cimex* sp. (Heteroptera, Cimicidae). *Caryologia*, 55, 189–192.

Grozeva, S. (2003) Karyotype of three endemic mediterranean Miridae species (Heteroptera) from Bulgaria. *Acta Zoologica Bulgarica*, 55, 53–59.

Grozeva, S., Nokkala, S. & Simov, N. (2006) First evidence of sex chromosome pre-reduction in male meiosis in the Miridae bugs (Heteroptera). *Folia Biologica*, 54, 9–12.

Grozeva, S., Simov, N. & Josifov, M. (2007) Karyotaxonomy of some European *Macrolophus* species (Heteroptera: Miridae). *Mainzer naturwissenschaftliches Archiv*, 31, 81–87.

Ituarte, S. & Papeschi, A.G. (2004) Achiasmatic male meiosis in *Tenagobia* (*Fuscagobia*) *fuscata* (Heteroptera, Corixoidea, Micronectidae). *Genetica*, 122, 199–206.

Kuznetsova, V., Grozeva, S. & Nokkala, S. (2004) New cytogenetic data on Nabidae (Heteroptera: Cimicomorpha), with a discussion of karyotype variation and meiotic patterns, and their taxonomic significance. *European Journal of Entomology*, 101, 205–210.

Kuznetsova, V., Grozeva, S., Sewlal, J. & Nokkala, S. (2007) Cytogenetic characterization of the Trinidad endemic *Arachnocoris trinitatus* Bergroth: the first data for the tribe Arachnocorini (Heteroptera: Cimicomorpha: Nabidae). *Folia Biologica*, 55, 18–26.

Kuznetsova, V. & Grozeva, S. (2008) Cytogenetic characters of *Arachnocoris trinitatus* Bergroth, 1916 (Insecta: Heteroptera: Nabidae) from nests of the spider *Coryssocnemis simla* Huber, 2000 (Araneae: Pholcidae). *Comparative Cytogenetics*, 2, 139–142.

Kuznetsova, V.G. & Maryanska-Nadachowska, A. (2000) Autosomal polyploidy and male meiotic pattern in the bug family Nabidae. *Journal of Zoological Systematics & Evolutionary Research*, 38, 87–94.

Manna, G.K. (1984) Chromosomes in evolution in Heteroptera. *In*: Sharma, A.K. & Sharma, A. (Eds.). *Chromosomes in evolution of eukaryotic groups*. CRC Press, Boca Raton Florida USA. p. 189–225.

Nokkala, S. & Nokkala, C. (1984) Achiasmatic male meiosis in the Heteropteran genus *Nabis* (Nabidae, Hemiptera). *Hereditas*, 101, 31–35.

Nokkala, S. & Nokkala, C. (1986a) Achiasmatic male meiosis of collochore type in the heteropteran family Miridae. *Hereditas*, 105, 193–197.

Nokkala, S. & Nokkala, C. (1986b) Achiasmatic male meiosis in *Anthocoris nemorum* (L.) (Anthocoridae, Hemiptera). *Hereditas*, 105, 287–289.

Nokkala, S. & Grozeva, S. (2000) Achiasmatic male meiosis in *Myrmedobia coleoptrata* (Fn.) (Heteroptera, Microphysydae). *Caryologia*, 53, 5–8.

Papeschi, A.G. (1994) Chromosome rearrangements in *Belostoma plebejum* (Belostomatidae, Heteroptera). *Caryologia*, 47, 223–230.

Papeschi, A.G. (1996) Sex chromosome polymorphism in species of *Belostoma* (Belostomatidae, Heteroptera).

Hereditas, 124, 269–274.
Papeschi, A.G. & Bressa, M.J. (2006) Evolutionary cytogenetics in Heteroptera. *Journal of Biological Research*, 5, 3–21.
Ryckman, R.E. & Ueshima, N. (1964) Biosystematics of the *Hesperocimex* complex (Hemiptera: Cimicidae) and avian hosts (Piciformes: Picidae; Passeriformes: Hirundinidae). *Annals of the Entomological Society of America*, 57(5), 624–638.
Santillán, M.A., Carpintero, D.L., Galmes, M.A. & Sarasola, J.H. (2009a) Presencia de *Psitticimex uritui* (Hemiptera: Cimicidae) en pichones de águila coronada (*Harpyhaliaetus coronatus*) en la provincia de La Pampa. In: *XIII Reunión Argentina de Ornitología*. Tucumán, Tafí del Valle, 3 al 6 de Junio de 2009. p. 110.
Santillán, M.A., Carpintero, D.L., Galmes, M.A. & Sarasola, J.H. (2009b) Presence of cimicid bugs (Hemiptera: Cimicidae) on a Crowned Eagle (*Harpyhaliaetus coronatus*) nestling. *Journal of Raptor Research*, 43(3), in press.
Schuh, R.T. & Štys, P. (1991) Phylogenetic analysis of Cimicomorphan family relationships (Heteroptera). *Journal of the New York Entomological Society*, 99, 298–350.
Schuh, R.T., Weirauch, C. & Wheeler, W.C. (2009) Phylogenetic relationships within the Cimicomorpha (Hemiptera: Heteroptera): a total-evidence analysis. *Systematic Entomology*, 34, 15–48.
Thomas, D.B.J. (1987) Chromosome evolution in the Heteroptera (Hemiptera): agmatoploidy versus aneuploidy. *Annals of the Entomological Society of America*, 80, 720–730.
Tian, Y., Zhu, W., Li, M., Xie, Q. & Bu, W. (2008) Influence of data conflict and molecular phylogeny of major clades in Cimicomorphan true bugs (Insecta: Hemiptera: Heteroptera). *Molecular Phylogenetics and Evolution*, 47, 581–597.
Turienzo, P.N. & Di Iorio, O.R. (2007) Insects found in birds' nests from Argentina. Part I: a bibliographical review, with taxonomical corrections, comments, and a hypothetical mechanism of transmission of cimicid bugs. *Zootaxa* (edition on-line), 1–52.
Ueshima, N. (1966) Cytology and cytogenetics. *In*: Usinger, R.L. (Ed.). *Monograph of Cimicidae* (*Hemiptera - Heteroptera*). Thomas Say Foundation. p. 183–237.
Ueshima, N. (1979) Hemiptera II: Heteroptera. *In*: John, B. (Ed.). *Animal Cytogenetics*. Gebrüder Borntraeger, Berlin-Stuttgart. p. v + 1–117.
Usinger, R.L. (1966) *Monograph of Cimicidae* (*Hemiptera - Heteroptera*). The Thomas Say Foundation, 7, xi + 1–585.