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Scarites buparius, a caraboid beetle with an X_1X_2Y sex-chromosomes system[1]

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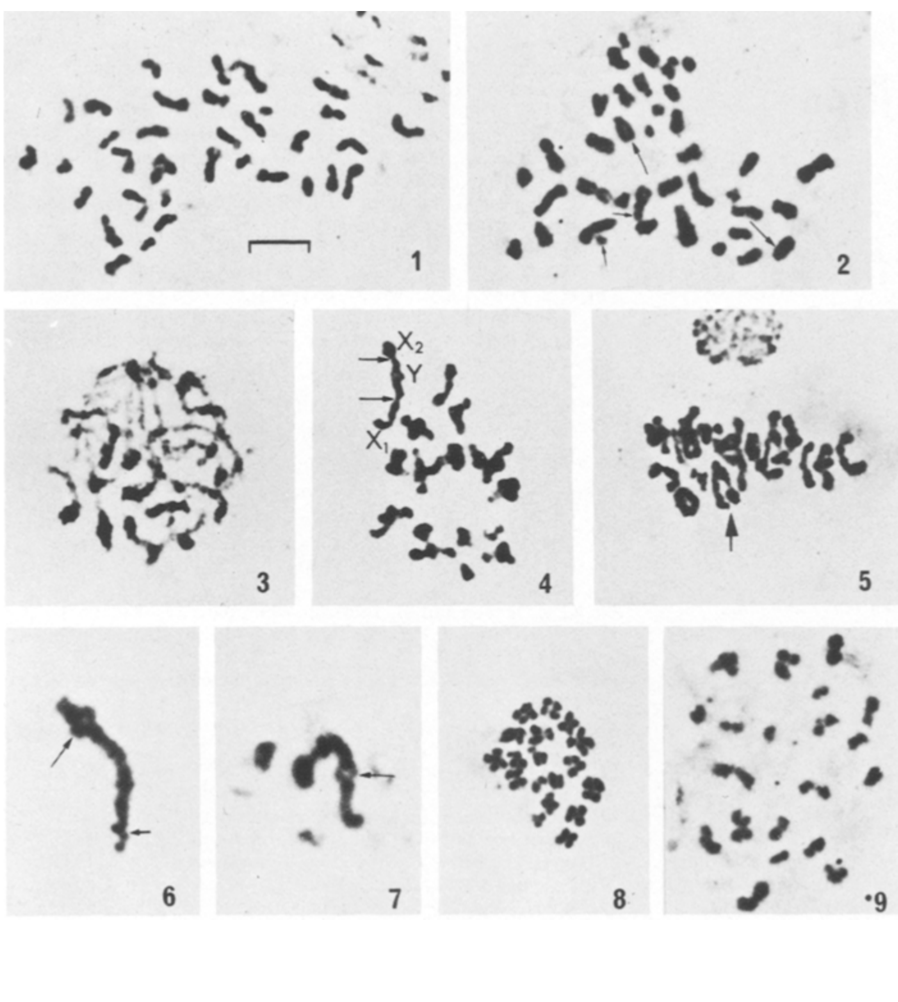
Summary. Scarites buparius has 2n=37 and n=17+X_1X_2Y. This multiple sex-chromosomes system seems to be the result of a reciprocal translocation between the primitive X-chromosome and an autosome. This is the first caraboid beetle, excepting *Cicindela* spp., that has multiple sex-chromosomes.

Multiple sex-chromosomes systems are only known among caraboid beetles, in species of the genus *Cicindela*[2-7]. The mechanism by which these systems have come into being is at present unknown, but it seems that reciprocal translocations among primitive sex-chromosomes and autosomes have not led to the progressive increase in the number of Xs that are found in *Cicindela* spp.[7]. However, such a translocation seems to have occurred in *Scarites buparius*, a caraboid beetle of the tribe Scaritini, not closely related to the tribe Cicindelini.

Materials and methods. 5 males of *Scarites buparius* Forster, 1771, have been analyzed, 4 collected in Torremolinos (Málaga) and 1 in Torrevieja (Alicante). Gonads were dissected out in the laboratory and hypotonized with Ohnuki's modified hypotonic solution[8], fixed with ethanolacetic acid (3:1), stained with lacto-propionic orcein and squashed.

Results. Preparations from the 4 specimens from Torremolinos have 2n=37 and n=17+X_1X_2Y, whereas the 1 specimen from Torrevieja has 2n=39 and n=18+X_1X_2Y. We have identified in the karyotype of this individual 2 pairs of chromosomes, 1 subtelocentric, of about 2.3 μm, and the smallest of all the chromosomes (figure 2, arrows) that are absent from the karyotypes of 37 chromosomes (figure 1). Several chromosomes show at gonial metaphase an arm partially or totally heterochromatic (figures 1 and 2) and at pachytene about 12 bivalents show polarized heterochromatic segments distally located (figure 3). 1st metaphase cells have 17 bivalents (specimens from Torremolinos) or 18 bivalents (specimen from Torrevieja) and in both cases 1 trivalent. We have denominated 'X_1' to the largest chromosome at one extreme of the trivalent (figure 4); it is metacentric and has a secondary constriction in the arm where chiasmata do not occur (figure 6). The chromosome in the center is the 'Y chromosome', somewhat more disymmetrical than the X_1-chromosome. The small chromosome at the other extreme of the bivalent is the 'X_2-chromosome' (figure 4). About 8 or 9 bivalents usually show interstitial chiasmata, an observation not very frequent among caraboid beetles, perhaps owing to the existence of heterochromatic segments distally located. The sex-chromosomes are associated by 2 terminal chiasmata, although subterminal chiasmata are found sometimes (figures 6 and 7).



Chromosomes of *S. buparius.* Fig.1. Spermatogonial metaphase, 2n=37. Fig.2. Spermatogonial metaphase 2n=39; short and long arrows show the 2 pairs of chromosomes absent in the individuals with 2n=37. Fig.3. Pachytene. Fig.4. Metaphase I; arrows show the chiasmata formed in the trivalent. Fig.5. Full metaphase; arrow show the coorientation of the trivalent. Fig.6. Subterminal chiasma between the Y-chromosome and the X_2-chromosome (long arrow), short arrow shows the secondary constriction of the X_1-chromosome. Fig.7. Subterminal chiasma between the Y-chromosome and the X_1-chromosome (arrow). Fig.8. Metaphase II cell with 18 chromosomes. Fig.9. Metaphase II cell with 20 chromosomes. The bar represents 5 μm in figures 1–5 and 8–9, and 3.3 μm in figures 6 and 7.

Co-orientation of the trivalent is very regular, assuring that the Y-chromosome moves to 1 pole an both X_1- and X_2-chromosomes to the other (figure 5). 2nd metaphase cells have 18 (figure 8) or 19 chromosomes (specimens from Torremolinos), or 19 or 20 chromosomes (specimen from Torrevieja, figure 9).

Discussion. The specimens from Torremolinos have the supposedly ancestral chromosome number of Caraboidea, 2n=37[7]. Thus, the karyotype of 39 chromosomes has probably originated through a dissociation that gave rise to 1 pair of medium sized subtelocentric chromosomes plus a very small pair of undetermined morphology.

The 3 other species of *Scarites* studied have the primitive XO sex-chromosomes system of the Caraboidea[7,9,10]. For this reason the X_1X_2Y sex-chromosomes system of *S. buparius* appear to be a derived one. As both X_1- and X_2-chromosomes are partially homologous with the Y-chromosome, we conclude that there has been a reciprocal translocation between the primitive X-chromosome and an autosome. This one has become the X_1-chromosome and shows in the arm where chiasmata are not formed a secondary constriction that perhaps denotes the site of the interchange. Its homologue has become the Y-chromosome and the primitive X is now the X_2-chromosome.

The fact that subterminal chiasmata are formed between the Y-chromosome and the 2 Xs suggests to us on the one hand that segments interchanged in the translocation are of some magnitude, and on the other hand that this restructuring is probably of relatively recent origin, so that heterochromatinisation has not yet restricted the formation of chiasmata among the sexual chromosomes to terminal regions, as it is found in other caraboid beetles.

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Karyotype of South American pampas fox *Pseudalopex gymnocercus* (Carnivora, Canidae)

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Summary. The karyotype of the pampas fox has 2n=74 and a NF=76. Except for *Chrysocyon brachyurus,* 2n=74 is a common diploid number for the South American Canidae. This number is higher than in the *Vulpes* group and lower than in the group of the typical *Canis.* No 'marker chromosomes' are present in the South American Canidae.

Pseudalopex gymnocercus is 1 of the 4 species recognized at present in the genus *Pseudalopex.* The separation of *P. gymnocercus* from *P. culpaeus* is clear-cut. However, the relationships between *P. gymnocercus* and the 2 other species of this genus, *P. griseus* and *P. sechurae,* are not so clear and need further research. A study based on specimens from the contact zones between the areas of geographic distribution of each species would clarify their taxonomic relationships. The genus *Pseudalopex* has been considered a synonym of *Dusicyon* by Cabrera[1], a subgenus of *Dusicyon* by Langguth[2] and a subgenus of *Canis* by Langguth[3] and by Van Gelder[4]. New information is needed to arrive at a stable classification of the Canidae. Species of *Pseudalopex* still retain many ancestral characters and show very few derived ones. Among the New World Canidae they show the closest morphological resemblance to the genus *Vulpes.*

The chromosomes of the Canidae have been recently reviewed by Chiarelli[5]. Wurster-Hill[6] and Gallardo and Formas[7] published additional information on *Cerdocyon thous* and *Pseudalopex griseus* respectively.

The present paper reports the karyotype of *Pseudalopex gymnocercus.* One adult male from Itapebí, Depto. Salto, Uruguay was employed in this study. The specimen, Nr. 1349, is kept in the mammal collection of the Depto. Zoología Vertebrados, Facultad Humanidades y Ciencias, Montevideo. Karyological studies were performed on C-metaphases obtained from bonemarrow cells, following the technique used by Fernandez[8]. The slides were stained with a buffered Giemsa solution pH 6.8.

In all the metaphases studied we found an identical chromosome complement with a diploid number of 2n=74, NF (female)=76 (figure). All autosomes are acrocentric or essentially so. Since autosomes are similar in morphology pairing is subjective. Identification of sex-chromosomes is however unequivocal. The X is the only biarmed element (submetacentric) and the Y is the smallest chromosome.

Knowing now the karyotype of *Pseudalopex gymnocercus* we have an almost complete picture of the karyotypic diversity in the South American canids. The following table gives the karyological information on the different species

Species	2n	NF (♀)	Autosomes M+SM	A+SA	Micro	Sex X	Y
Pseudalopex gymnocercus	74	76	0	72	0	SM	A
Pseudalopex griseus	74	76	0	72	0	SM	A
Atelocynus microtis	74–76	76	0	72	2	SM	?
Speothos venaticus	74	76	0	72	0	SM	A
Cerdocyon thous	74	110	34	38	0	?	?
Lycalopex vetulus	74	76	0	72	0	SM	?
Chrysocyon brachyurus	76	78	0	74	0	SM	A