Chromosomes of South American Bufonidae (*Amphibia anura*)

The family Bufonidae is classified among the amphibia anura because of its degree of evolution, since it is one of the most representative groups of the order Salientia.

Some years ago we began to study several species of the genus *Bufo* using the squash technique. SAEZ, ROJAS and DE ROBERTIS[1–4] described the meiotic process in male *B. arenarum* and indicated that this species has $2n = 22$ chromosomes, SAEZ and BRUM[5], BIANCHI and LAGUENS[6], MORESCALCHI[7–9], ULLERICH[10], BOGART[11], BRUM-ZORRILLA[12] and BEÇAK[13] also found $2n = 22$ chromosomes in different species of this genus, with the exception of those belonging to the regularis group from Africa in which MORESCALCHI[9] found $2n = 20$ chromosomes. The specimens examined and their source of origin are shown in Table I.

In every species studied, 22 metacentric and submetacentric chromosomes were found grouped in 6 pairs of long chromosomes and 5 pairs of short chromosomes. The Figure illustrates the idiograms of the different species. The bivalent configurations are similar to those found in all amphibia anura and at diplonema consist of a ring-shaped element having 2 distal chiasmata. At the beginning of metaphase I, the bivalents lose their anular form and become highly condensed compact elements whose structures are difficult to distinguish.

In all individuals of the different species, the meiotic process is similar to that studied and described by SAEZ, ROJAS and DE ROBERTIS[4]. Positive heteropicnotic chromosomes were not found in any stage of the meiotic prophase or in the first meiotic metaphase.

As reported by other authors, in the species studied here, there was generally a morphological uniformity; however MORESCALCHI[8] found heterochromatic regions located in different species of the genus *Bufo*. In male *B. arenarum*, BIANCHI and LAGUENS[6] found secondary constrictions in the short arms of the homologues of the seventh pair and BRUM-ZORRILLA[12] found the same in the females. Table II shows the values of the centromeric index obtained at somatic metaphase in the different species. We were unable to find heteromorphic homologous pairs in any of the species.

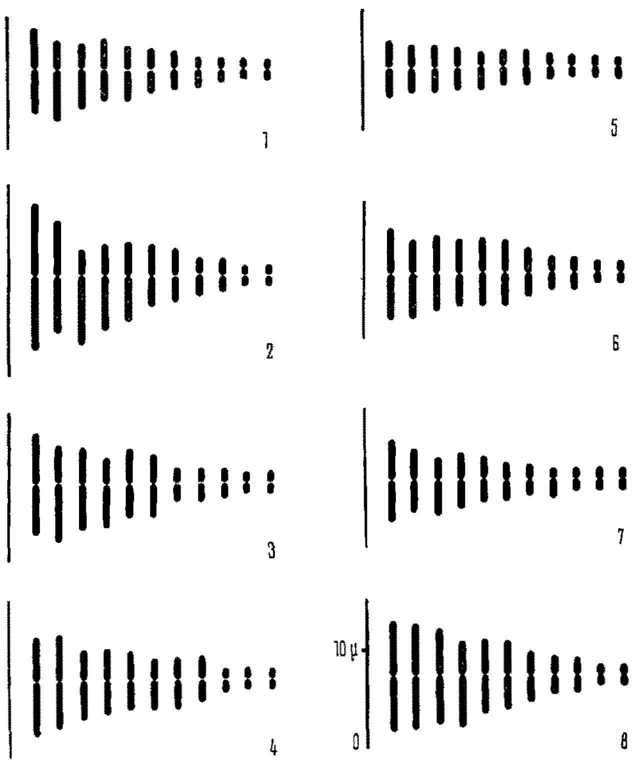
Our investigations on amphibia anura, fundamentally on South American amphibia, started several years ago, but have not demonstrated the presence of cytologically differentiated sex chromosomes in Bufonidae (SAEZ et al.[2–4] and BRUM-ZORRILLA[12]), Ceratophrydae (SAEZ and BRUM[14,15]), Leptodactylidae (BRUM-ZORRILLA and SAEZ[16]) or Hylidae species (BRUM-ZORRILLA and SAEZ[17]).

Similar results were found in other species of anura by GALGANO[18], WICKBOM[19], MAKINO[20], MORESCALCHI[7,8], and BEÇAK[13,21].

However, several authors have found heteromorphic pairs which have been labelled as sex chromosomes.

Table I. Specimens examined and source of origin

Species	Diploid number ($2n$)	Source
B. marinus	22	Paramaribo (Suriname)
B. paracnemis	22	Artigas (Uruguay)
B. ictericus	22	Sao Paulo (Brazil)
B. arenarum ♀	22	Montevideo (Uruguay)
B. arenarum ♂	22	Montevideo (Uruguay)
B. spinulosus spinulosus	22	La Paz (Bolivia)
B.g. fernandezae	22	Corrientes (Argentina)
B.g. d'orbignyi	22	Montevideo (Uruguay)
B. crucifer	22	Sao Paulo (Brazil)



Idiogram of the different species: 1. *Bufo arenarum*; 2. *Bufo ictericus ictericus*; 3. *Bufo paracnemis*; 4. *Bufo marinus*; 5. *Bufo crucifer*; 6. *Bufo granulosus d'orbignyi*; 7. *Bufo granulosus fernandezae*; 8. *Bufo spinulosus spinulosus*.

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Table II. Centromeric index of 8 species studied

Pair of chromosomes	1	2	3	4	5	6	7	8	9	10	11
B. marinus	0.45	0.50	0.40	0.44	0.50	0.44	0.50	0.50	0.50	0.46	0.40
B. paracnemis	0.40	0.50	0.37	0.34	0.44	0.39	0.50	0.50	0.50	0.50	0.40
B. ictericus	0.50	0.45	0.38	0.33	0.40	0.40	0.44	0.50	0.42	0.50	0.50
B. arenarum ♂	0.48	0.36	0.41	0.48	0.45	0.50	0.47	0.45	0.45	0.45	0.42
B. arenarum ♀ (somatic chromosomes)	0.47	0.39	0.42	0.48	0.44	0.48	0.45	0.44	0.45	0.44	0.43
B. spinulosus spinulosus	0.41	0.45	0.50	0.33	0.40	0.39	0.46	0.44	0.45	0.50	0.48
B.g. d'orbigny	0.47	0.45	0.33	0.45	0.49	0.45	0.45	0.45	0.47	0.50	0.50
B. crucifer	0.46	0.45	0.40	0.45	0.47	0.40	0.48	0.50	0.48	0.48	0.50
B.g. fernandezae	0.46	0.49	0.33	0.46	0.40	0.46	0.45	0.45	0.45	0.50	0.45

YOSIDA[22] described an *XY* pair in the male *Hyla arborea*, WEILER and OHNO[23] found heteromorphism in the female *Xenopus laevis*, MORESCALCHI[8] described them in *Discoglosus pictus*, and MANNA and BHUNYA[24] reported heterogamety in the *B. melanostictus* female. SAEZ et al.[1–4] studied in detail the existence of the sex chromosomes in amphibia anura specially in the *B. arenarum* species. They concluded that the presumed sex chromosomes found in different species of amphibia by other authors were only bivalets that had a different behavior. In this work, it was pointed out that this bivalent element and behavior are only common chromosomes which can have different shapes, sizes and affect different chromosomes of the same individual. Therefore we postulate that there is not yet sufficient data available to prove the existence of the sex chromosomes, inspite of the presence of differences in size of the members in a somatic pair of homologues[25].

Resumen. Se estudiaron los cariotipos de ocho especies de Bufonidae sudamericanos: *B. arenarum, B. ictericus, B. paracnemis, B. marinus, B. crucifer, B. granulosus d'orbignyi, B. granulosus fernandezae* and *B. spinulosus*. En todas las especies se encontraron $2n = 22$ cromosomas. No se encontró en el macho, ningun par heteromórfico, ni bivalente con caracteristicas y comportamiento que indicara la presencia de cromosomas sexuales.

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Inherited Semisterility for Control of Harmful Insects. I. Productions of Semisterility due to Translocation in the Mosquito, *Culex pipiens* L., by X-Rays

Inherited semisterility, i.e. the inviability of approximately half of the gametes of an organism and as a consequence half of the zygotes, was observed for the first time already 65 years ago as a natural phenomenon in different plant species[1]. Cytological investigations on other plant species provided the clue to the cause of semisterility[2]. Semisterile individuals of plants or animals are heterozygotes for reciprocal chromosomal translocations or pericentric inversions.

Soon after the epoch-making discovery of the mutagenic activity of X-rays by MULLER[3], it was recognized that ionizing irradiation produces to a great extent also chromosomal abberrations like translocations and inversions. Several authors have studied the production of translocations in *Drosophila* under quantitative and qualitative aspects[4–6]. A very interresting side line of these investigations on translocations was the artifical composition of a *Drosophila* strain with 2 different translocations, which was reproductively isolated from normal strains[7].

Already in 1940, SEREBROVSKY[8] suggested the release of individuals with translocations into a natural population as a new means for pest control. However his paper remained unknown and has not stimulated any efforts for pest control by the mechanism suggested. Without knowing the paper of SEREBROVSKY, the present author[9] and CURTIS[10] have recently and independently again suggested translocations and the ensuing semisterility as a possibility for control of harmful insects. We were led to this new approach after the first successful eradication of the mosquito species *Culex fatigans* in a Burmese village through the preexisting mechanism of cytoplasmic incompatibility[11]. This is a very rare genetical mechanism, only known from not more than 3 different groups of insects (4 species). Therefore we started to explore the possibility of producing translocations and semisterility in different mosquito species.

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