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The chromosome numbers of Georgian earthworms (Oligochaeta: Lumbricidae)

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Abstract. The data on chromosome numbers (somatic and basic) characteristic to species and subspecies of earthworms (Lumbricidae) of Georgia (Caucasus region) are summarized. Four values of basic chromosome number (11, 15, 17, 18) while 6 values of somatic number (22, 30, 34, 36, 72, 108) are registered in 19 species and subspecies studied. The diploid karyotypes dominate over polyploid karyotypes. It is supposed that the modal numbers, somatic 2n=36 and basic n=18, are evolutionarily initial on the basis of which the formation of the main part of species and subspecies of earthworms have proceeded in Georgia. Polyploidy did not represent the main evolutionary mechanism of the origin of species in Georgia (and the whole Caucasus).

Key words: chromosome number, polyploidy, earthworms, Georgia.

Introduction

According to long-term faunistic researches, the biodiversity of earthworms (Lumbricidae) of Georgia is found to be presently represented by 62 species and subspecies belonging to 11 genera (Kvavadze, 1999). In studies of the earthworms of the Caucasus, and of Georgia among them, the researchers have paid attention primarily to the taxonomy, faunistics, zoogeography, ecology and phylogeny (see Kvavadze, 1999). Until our investigation the Georgian (and Caucasian) earthworms had not been studied karyologically. It is well known however that karyological data give useful information on the taxonomy and evolution of this group (Viktorov, 1993, 1996). Some results of the karyological investigation of lumbricids of Georgia were published by our research group (Bakhtadze et al., 2000, 2003a, b, 2004, 2005a, b; Kvavadze et al., 2007).

This communication summarizes chromosome numbers of the Georgian earthworms.

Material and methods

A total of 265 individuals referred to 19 species and subspecies of the genera *Lumbricus* Linnaeus, 1758, *Dendrobaena* Eisen, 1874, *Dendrodriloides* Kvavadze, 1999, *Octodrilus* Omodeo, 1956, *Eisenia* Malm, 1877, and *Omodeoia* Kvavadze, 1993 (see Table) were collected from different localities of Georgia: Gori, Mtskheta, Lagodekhi, Dusheti, Tianeti districts, the environs of Tbilisi city (east Georgia); Baghdati, Khoni, Samtredia, Abasha, Chkhorotsku, Chokhatauri districts, the environs of Chiatura, Tkibuli, Tskaltubo, Kutaisi towns (west Georgia); Tsageri district (north-west Georgia); Khulo, Kobuleti, Khelvachauri districts (south- west Georgia); Kazbegi district (north Georgia); Gardabani, Tetri Tskaro, Borjomi districts (south Georgia) (Bakhtadze et al., 2000, 2003a, b, 2004; Zhgenti et al., 2006; Kvavadze et al., 2007).

Collecting sites included populated and unpopulated areas, fields, stream banks, brooks,

lakes and a variety of woodland and forest types. Among the species and subspecies studied, 3 are cosmopolitan, 2 Holarctic, 5 belong to earthworms of mesoporeute group, and 9 are endemic to Georgia (Table).

For chromosome preparations the methods described by Russian scientists (Graphodatsky et al., 1982; Bulatova et al., 1987) were used, with certain amendments (Bakhtadze et al., 2003b).

Based on 1130 chromosome preparations with 2745 mitotic metaphases and meiotic prophases (diplotene and diakinesis), chromosome numbers (basic, somatic) and level of ploidy were established.

Results and Discussion

The known chromosome numbers and level of ploidy of the species and subspecies from Georgia are presented in Table. It is evident from this table that the somatic numbers vary over a wide range as they do in the whole family Lumbricidae (Casellato, 1987; Viktorov, 1993). Four values of basic chromosome number (11, 15, 17, and 18) are registered in the studied species and subspecies. For the whole family these numbers are as follows: 11, 15-19 (Casellato, 1987; Viktorov, 1993).

The frequency of the somatic and basic chromosome numbers in the studied species and subspecies from Georgia is given in Fig. 1. It follows from the latter that somatic and basic numbers 36 and 18 respectively are the modal numbers since they occur in the majority of species and subspecies. These numbers likewise are prevailing in the higher taxa being recorded in 4 (*Lumbricus*, *Dendrobaena*, *Dendrodriloides*, and *Eisenia*) of 6 investigated genera. It is also significant that these numbers are found in those species and subspecies which are endemic to Caucasus. It can be inferred from these data that 2n=36 (n=18) are characteristic somatic (and basic) numbers for Caucasian lumbricids, the Georgian ones included. They are probably evolutionarily the initial chromosome numbers on the basis of which the formation of the main part of species and subspecies of earthworms has proceeded in Georgia. The basic number 18 is also present in the majority of the karyologically investigated species and subspecies of the family Lumbricidae of the world (44 of 58 cases) (Bakhtadze, 2004). Thus, n=18 can be considered both as modal and initial basic chromosome number of the earthworms.

All the other basic numbers can be considered derivative. The number 17 is recorded for *Omodeoia byblica* (Rosa, 1893) and *O. arsianica* Kvavadze, 1985, the latter being endemic to Georgia. The numbers 15 and 11 are found in *Octodrilus transpadanus* (Rosa, 1884) and *Eisenia fetida* (Savigny, 1826), which are widely distributed and not connected with the Caucasus by genesis.

Of the species and subspecies studied, 17 are clearly diploids whereas 2 are polyploids and have high numbers of chromosomes, 72 in *Dendrobaena tellermanica* Perel, 1967 and 108 in *Dendrodriloides grandis perelae* Kvavadze, 1973. The relationship between polyploids and diploids in the lumbricofauna of Georgia is thus approximately 1:8 (2 and 17 respectively), whereas this relation is approximately 1:1 (43 and 50) with reference to the world lumbricofauna (Viktorov, 1996, 1997). Such a low number of polyploids in the Georgian fauna can be explained, from one hand, by the insufficient number of karyologically investigated species (30.6 % of general number), and by the high endemism of the Georgian (and Caucasian) lumbricofauna, from the other hand. The conditions of the development of the Caucasus and the long-term isolation of the fauna of this region from the fauna of other mountain systems were the factors resulting in the high level of endemism of the Georgian

Table. Somatic and basic chromosome numbers and level of ploidy of earthworm species and subspecies from Georgia.

Species	Distribution	Somatic (2n) chromosome number	Basic (n) chromsome number	Level of ploidy	References
Lumbricus rubellus Hoffmeister, 1843	cosmopolite	36	18	2n	Present study
Dendrobaena veneta (Rosa, 1886)	holarctic	36	18	2n	Bakhtadze et al., 2004, 2005b
D. nassonovi nassonovi Kulagin, 1889	mesoporeute	36	18	2n	Bakhtadze et al., 2004, 2005b
D. hortensis (Michaelsen, 1890)	holarctic	36	18	2n	Bakhtadze et al., 2004, 2005b
D. pentheri (Rosa, 1905)	mesoporeute	36	18	2n	Bakhtadze et al., 2000, 2005b
D. surbiensis (Michaelsen, 1910)	endemic of Caucasus	36	18	2n	Bakhtadze et al., 2004, 2005b
D. nassonovi adjarica Kvavadze, 1973	endemic of Caucasus	36	18	2n	Bakhtadze et al., 2004, 2005b
D. jaloniensis Kvavadze, 1985	endemic of Caucasus	36	18	2n	Bakhtadze et al., 2004, 2005b
D. marinae Kvavadze, 1985	endemic of Caucasus	36	18	2n	Bakhtadze et al., 2003a, 2005b
D. tellermanica Perel, 1967	mesoporeute	72	18	4n	Bakhtadze et al., 2004, 2005b
Dendrodriloides grandis perelae Kvavadze, 1973	mesoporeute	108	18	6n	Bakhtadze et al., 2005a
Ddl. hydrophilica Kvavadze, 1973	endemic of Caucasus	36	18	2n	Bakhtadze et al., 2005a; Zhgenti et al., 2006
Ddl. polysegmentica Kvavadze, 1973	endemic of Caucasus	36	18	2n	Bakhtadze et al., 2003b, 2005a
Ddl. thamarae Kvavadze, 1983	endemic of Caucasus	36	18	2n	Bakhtadze et al., 2005a
Octodrilus transpadanus (Rosa, 1884)	cosmopolite	30	15	2n	Present study
Eisenia fetida (Savigny, 1826)	cosmopolite	22	11	2n	Present study
E. iverica (Kvavadze, 1973)	endemic of Caucasus	36	18	2n	Present study
Omodeoia byblica (Rosa, 1893)	mesoporeute	34	17	2n	Kvavadze et al., 2007
O. arsianica Kvavadze, 1985	endemic of Caucasus	34	17	2n	Kvavadze et al., 2007

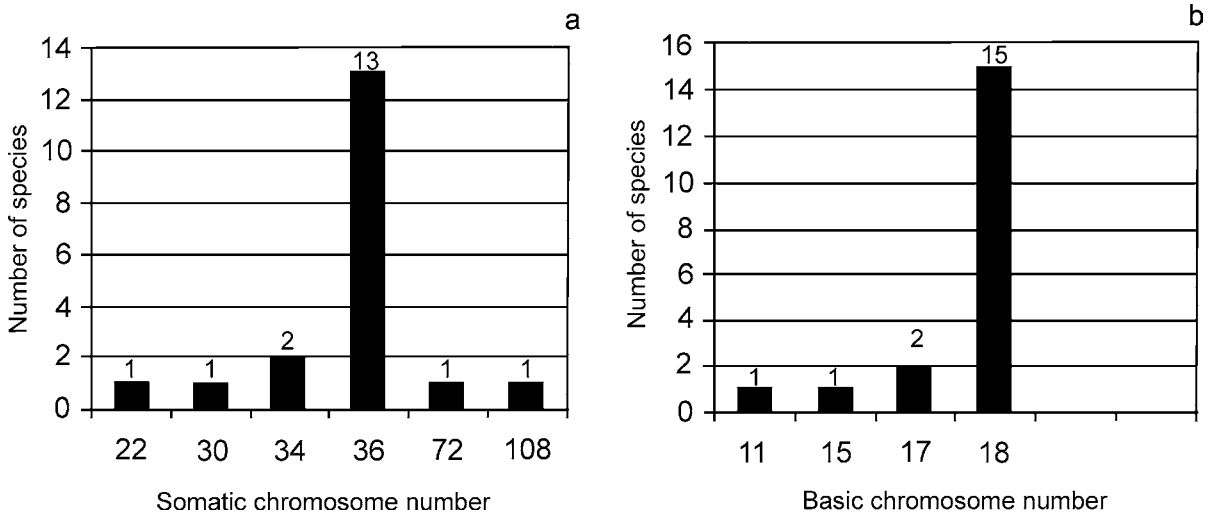

Fig. 1. The frequencies of somatic (**a**) and basic (**b**) chromosome numbers in the earthworm species and subspecies from Georgia.

(and Caucasian) lumbricofauna. As many as 46 species and subspecies of earthworms registered in Georgia (51.68% of lumbricids of the Caucasus) are known to be endemic to the Caucasus (Kvavadze, 1999). As a rule, polyploidy is typical of the widespread, cosmopolitan species (Muldal, 1952). This is supported by the fact that in our studies no species and subspecies endemic to Georgia appeared to be polyploids.

Summarizing, we conclude that although the polyploidy played a part in speciation, it did not represent the important evolutionary pathway of the origin of species in the Georgian (and Caucasian) lumbricofauna.

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